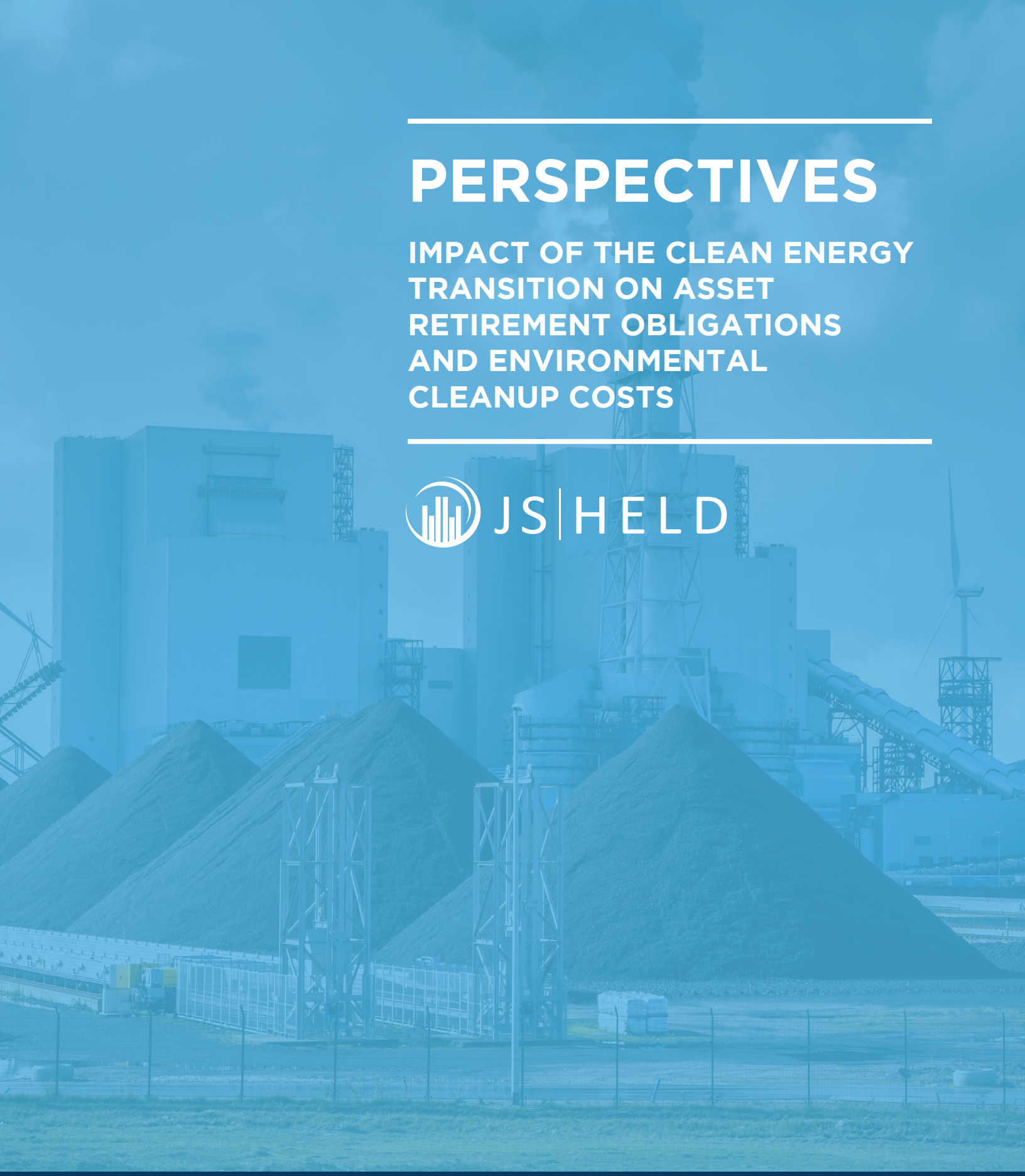

# PERSPECTIVES

## IMPACT OF THE CLEAN ENERGY TRANSITION ON ASSET RETIREMENT OBLIGATIONS AND ENVIRONMENTAL CLEANUP COSTS

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Utilities, insurers, and system operators navigating the energy transition should read this article to learn more about:

- Why to expect power generation facility retirement costs to far exceed reserves.
- Why insurance recovery is becoming strategic.
- Why closure pace outstrips replacement capability.
- How regulatory volatility complicates energy transition planning.
- The extent to which reliability and emissions goals are misaligned.
- Why proactive risk management is critical.

## Executive Summary

Accelerated retirement of US coal fired power plants—driven by regulatory pressure, stakeholder expectations, and shifting energy policy—has created significant unintended financial and operational consequences. Chief among them are substantial asset retirement obligations and environmental cleanup costs that often far exceed existing reserves, particularly for coal ash remediation. The pace of closures has outstripped projections, raising grid reliability concerns as dispatchable baseload capacity declines faster than viable non carbon alternatives can replace it. Evolving EPA standards and shifting federal policies add uncertainty, increasing reliance on historic insurance coverage and heightening risk for utilities, insurers, and system operators navigating the energy transition.

## EXPERT VOICES

### John Dulude, PE, MBA

John brings decades of senior leadership in the power sector to the paper's examination of forced coal retirements, applying deep experience in generation planning, system reliability, and decommissioning. He clarifies how accelerated policy timelines expose structural gaps between asset retirement assumptions and the true scope of environmental and financial obligations.

### Kim Logue Ortega

Kim applies her environmental law and regulatory advisory background to interpret how shifting EPA rules and legacy compliance decisions reshape today's cleanup and claims landscape. She connects historical permitting, pollution exclusions, and regulatory timing to the practical challenges owners face in funding environmental obligations after early plant closures.

## Introduction: Hidden Challenges of Energy Transition

The evolution of the energy transition in the United States has been historically driven by advances in technology, fuel availability and pricing, and, probably most importantly, societal benefits. In response to these pressures, the US is currently seeking to convert most of its electricity generation from carbon-based fuels to non-carbon sources such as solar and wind. This conversion of electrical energy resources requires both the construction of new infrastructure and the retirement of coal-fired generation facilities. We have all heard of "unintended consequences," unforeseen effects of planned actions. The unexpected costs of retiring carbon-based energy sources—including "early" retirement of fully functional, dispatchable baseload electrical generation

capacity—represent an unintended consequence of the current US energy transition policy.

The pressure to convert to non-carbon energy sources began primarily with government intervention and regulation; however, the demand has evolved to include both stakeholder and shareholder commitments. The increasing pressure to convert resources is imposing a high cost on owners, shareholders, and, ultimately, customers of carbon-based facilities, beyond the obvious expenses required to develop alternative forms of generation to replace carbon-based resources being retired. With the closure of these facilities comes the cost of that closure, including significant environmental cleanup costs.

A recent article prepared by Sustainable Fitch highlighted the current challenge:

> *Accelerated decommissioning policies pose financial risks to utility companies by bringing forward their asset retirement obligations (AROs)—the financial liabilities associated with the dismantling of plants. According to a recent World Bank study, decommissioning costs can range from an average of USD58,000/megawatt (MW) in India to* ***USD117,000/MW in the US*** *[emphasis added], implying multi-billion-dollar liabilities falling due in the coming years. In addition to plant closures, utility companies face costs associated with removal of hazardous waste and environmental remediation. Management of coal ash—the material left over from the burning of thermal coal—presents particular difficulties, typically involving complex and costly clean-up operations, and in cases of inadequate remediation, exposing companies to further risks to their financial profiles including fines, reputational damage, and litigation. The scale of investment required to meet emissions reduction targets is focusing attention on potential financing solutions.*[1]

Based on industry experience with decommissioning of carbon-based generation facilities, the typical ARO for a generation facility is woefully inadequate to cover all the significant environmental clean-up costs associated with the actual decommissioning of a facility. Assuming the estimated cleanup cost provided in the Fitch example, a 1,000 MW coal-fired generation facility should anticipate an environmental cleanup cost of approximately $117 million; however, this estimate is most likely inadequate.

The rate at which decommissioning costs outpace ARO has driven facility owners to explore other avenues to fund cleanup costs, including historic insurance coverage that may date back decades. Old liability policies are almost always written on an "occurrence" basis, covering losses that occur during the policy period, regardless of when a claim is filed. That policy structure is designed to protect against long-tail events—incidents that could cause injury or damage years after they occur.[2] It also means that even though a policy period has expired, there may be coverage under those policies for a new claim if a triggering event occurred during the old policy period.[3]

The intended consequence of a significant and accelerated conversion from carbon-based generation to non-carbon-based generation is to reduce carbon dioxide (CO2) emissions. One unintended consequence is an increase in claims on historic insurance coverages and insurance companies, as facilities owners try to bridge the financial cost gap associated with mandated retirements of carbon-based generating plants and AROs that did not anticipate the significant increase in environmental cleanup expenditures.

[1] Sustainable Fitch. Coal Power Phase-Out Will Front-Load Credit Impact of Asset Retirement Obligations. 6/27/22 (https://www.sustainablefitch.com/corporate-finance/coal-power-phase-out-will-front-load-credit-impact-of-asset-retirement-obligations-27-06-2022 )
[2] Insureon. Occurrence-based insurance policy (https://www.insureon.com/insurance-glossary/occurrence-based-policy)
[3] Yetka, C. Old Insurance Policies Could be Worth Their Weight in Gold, Part 1. Fortnightly Magazine, September 2021 (https://www.fortnightly.com/fortnightly/2021/09/old-insurance-policies-could-be-worth-their-weight-gold-part-1)

Depending on a facility's age and when a particular event occurs during its life, certain exclusions may or may not apply. Insurance policies issued before the establishment of the US Environmental Protection Agency (EPA) generally lacked pollution exclusion clauses. Beginning approximately in 1973, pollution exclusion clauses began to appear in policy language, and, starting in the 1980s, increasingly restrictive exclusion clauses were incorporated into policies.[4]

## Accelerated Reduction of the Coal-Fired Power Generation

Over the last 15 years, closures and retirements of the US coal-fired generation fleet have outpaced original estimates. From 2005 to 2022, the fleet capacity dropped from 321 gigawatts (GW) to 219 GW, and an additional 68 GW are scheduled for retirement by the end of the decade. The reduction in coal-fired generation has been steeper than estimated. For example, in 2012, the coal-fired generation capacity announced for retirement over the 10-year period from 2013 to 2022 was projected to be approximately 33 GW; however, the actual retirements during that period totaled approximately 100 GW (about 70 GW more than the 2012 estimate).[5]

The reduction in the remaining coal-fired generation energy output has also decreased at an even faster rate than the reduction in coal-fired generating units. Over the 2005 to 2022 period, annual energy output from the remaining US coal-fired plants declined by nearly 65% to 665 terawatt-hours (TWh), while the number of coal-fired generating units declined by 29%. This pattern indicates that the remaining coal-fired generating plants are used less frequently. The fleet-wide coal-fired capacity factor (a measure of how often generating plants operate at full capacity) has decreased from 67% to 35% over the same period as the coal-fired unit reductions.[6] If historical trends are any indication, the announced coal plant retirements are likely to underestimate the actual reductions in energy output.[7]

## Shifting to Non-Carbon Energy Sources

In general, energy transition is not a new policy or process. What is new is the accelerated transition from carbon-based fuels to non-carbon-based energy sources. Decarbonizing the grid, or generating energy from renewable sources instead of fossil fuels, was central to the Biden administration's climate goals, particularly pledges to halve US emissions from its 2005 level by 2030 and to achieve a carbon-free power sector by 2035,[8] while the Trump administration has moved in a different direction with a greater focus on promoting coal as a reliable fuel.

The current US electrical grid began in 1882 at Thomas Edison's Pearl Street Station in New York City, the first permanent central power station for supplying incandescent

[4] Yetka, C. Old Insurance Policies Could be Worth Their Weight in Gold, Part 1. Fortnightly Magazine, September 2021 (https://www.fortnightly.com/fortnightly/2021/09/old-insurance-policies-could-be-worth-their-weight-gold-part-1)
[5] Celebi, M, et al., A Review of Coal-Fired Electricity Generation in the US The Brattle Group/Prepared for The Center for Applied Environmental Law and Policy). 4/27/23, P.6. (https://www.brattle.com/wp-content/uploads/2023/04/A-Review-of-Coal-Fired-Electricity-Generation-in-the-US.pdf)
[6] Celebi, M, et al., A Review of Coal-Fired Electricity Generation in the US The Brattle Group/Prepared for The Center for Applied Environmental Law and Policy). 4/27/23, P.4. (https://www.brattle.com/wp-content/uploads/2023/04/A-Review-of-Coal-Fired-Electricity-Generation-in-the-US.pdf)
[7] Celebi, M, et al., A Review of Coal-Fired Electricity Generation in the US The Brattle Group/Prepared for The Center for Applied Environmental Law and Policy). 4/27/23, P.6. (https://www.brattle.com/wp-content/uploads/2023/04/A-Review-of-Coal-Fired-Electricity-Generation-in-the-US.pdf)
[8] McBride, J. et al. How Does the US Power Grid Work? Council on Foreign Relations. 7/5/22 (https://www.cfr.org/backgrounder/how-does-us-power-grid-work).

lighting, driven by reciprocating steam engines powered by four coal-fired boilers.[9] That means the current national, integrated grid has been evolving and developing for more than 140 years. The Biden decarbonization schedule required, in comparison, the US to be completely carbon-free in its electricity generation mix within about a decade.

A July 2020 *Washington Post* article describes the proposed transition schedule for the US as laid out by the Biden administration.[10] Figure 1 from this article shows the portion of all non-carbon generation, including nuclear generation, achieved through 2019 and proposed through 2035.

Figure 2 from the same *Washington Post* story provides additional details on the relatively recent mix of electrical generation fuels. In 2019, the US depended on carbon-based fuels for more than 60% of its overall electrical generation.

These data suggest that approximately 60% of the US total electrical energy output will need to be converted to non-carbon-based generation over the next decade. Potential non-carbon generation alternatives include nuclear, hydrogen, and wind & solar generation:

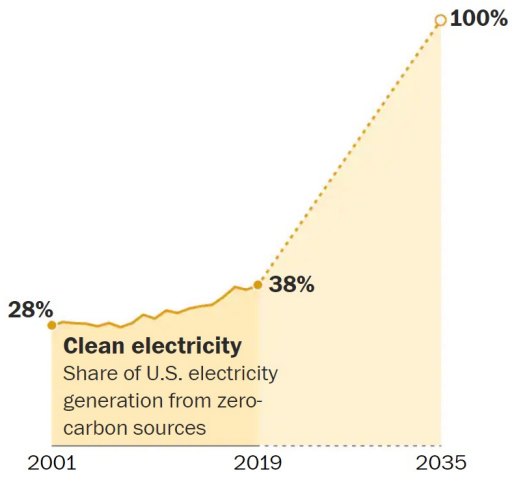



***Figure 1*** *- Proposed schedule of transition of US electricity generation from zero-carbon sources.*[11]

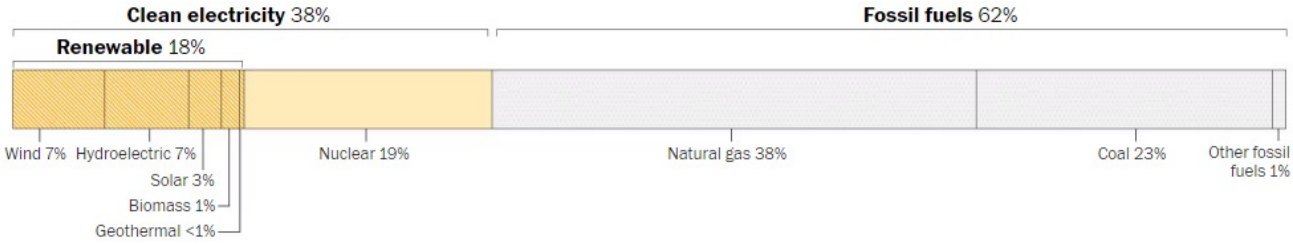



***Figure 2*** *- US electricity generation by fuel source in 2019.*[12]

[9] ETHW. Milestones:Pearl Street Station, 1882. Engineering and Technology History Wiki. 6/14/22. (https://ethw.org/Milestones:Pearl_Street_Station,_1882)
[10] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)
[11] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)
[12] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)

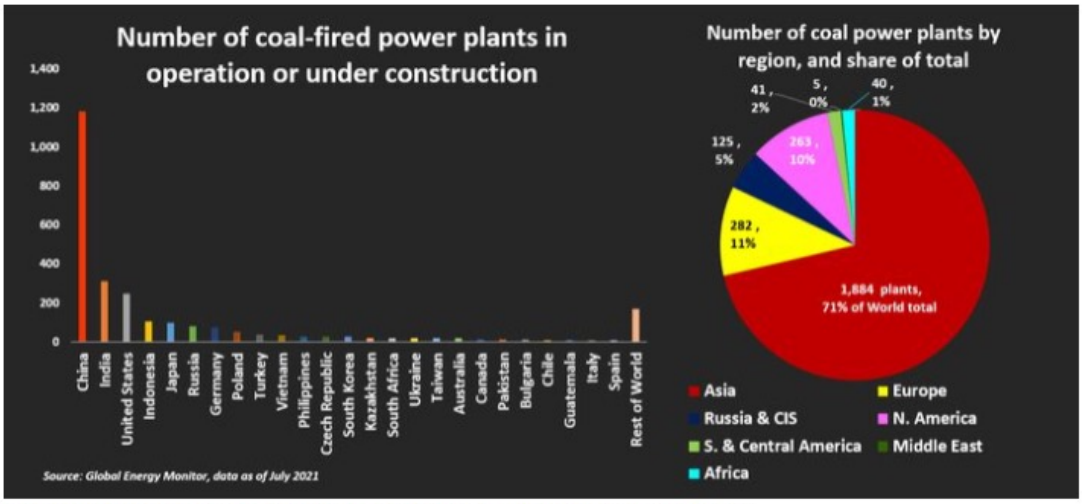
» ***Nuclear*** - Under ideal conditions, it takes more than a decade to realistically license a new nuclear plant or to expand an existing one. The current conversion schedule provides no credible way to take advantage of new nuclear generation.[13] Given the more recent struggles and cost overruns at Plant Vogtle, as well as the cancellation of additional units at Summer Nuclear Plant, there appears to be little appetite from developers or the financial markets to undertake a new nuclear facility. There is a strong interest in small modular reactors, but none are currently operating in the United States.

» ***Hydrogen*** - Hydrogen is an intriguing opportunity; however, grid-scale, green hydrogen plants are still in the pilot stage of development. That leaves inverter-based resources (IBRs) such as wind and solar.

» ***Wind and Solar*** - Both wind and solar have had phenomenal growth in the past 15 years, but even with the aggressive growth spurred by substantial subsidies, wind only represents 10.2% (425 billion kilowatt-hours (kWhs) of the total electrical energy produced in the US, and solar represents 3.9% (165 billion kWhs).[14] The Energy Information Administration noted that there are approximately 73.62 billion kWh of "small" solar (defined as facilities of less than 1 MW and not connected to the grid).

Achieving a complete decarbonization of the US electrical fleet by 2050 has been projected to reduce CO2 concentrations by 3.3 parts per million (ppm), meaning a change in the "business as usual" level of 480.3 ppm to an improved level of 477 ppm,[15] which is an almost unnoticeable reduction.

Correspondingly, global electricity production in 1985 (capacity) sourced from coal, natural gas, and oil was 63.57% of the total global electrical capacity. In 2022, global capacity from those same three sources represented 61.26%. This represents approximately a 3% drop over 37 years.[16] Realistically, the needle has not moved much globally, and nations like China and India continue to add coal-fired power plants. Figure 3 shows the number of coal-fired power plants by country. China accounts for more than 70% of the world's operational coal-fired plants.




Number of coal-fired power plants in operation or under construction *Purchase Licensing Rights*

***Figure 3*** *- Number of coal-fired power plants in operation or under construction by country.*[17]

[13] Duke Energy. NRC New Nuclear Licensing Process. Duke Energy. 1/17/12 (https://nuclear.duke-energy.com/2012/01/17/nrc-new-nuclear-licensing-process)
[14] Energy Information Administration. What is US electricity generation by energy source? (US utility-scale electricity generation by source, amount, and share of total in 2023) US Energy Information Administration. 2/2024 (https://www.eia.gov/tools/faqs/faq.php?id=427)
[15] Nasi, M (Jackson Walker, LLP). True Costs of Financing Decarbonization. PowerGen International, 5/24/22, Slide 15.
[16] Ritchie, H, and Rosado P. Electricity Mix. Our World in Data. 7/2020 (revised 1/2024) (https://ourworldindata.org/electricity-mix)
[16] Varadhan, S, Sheldrick, A. COP26 aims to banish coal. Asia is building hundreds of power plants to burn it. Reuters. 10/31/21 (https://www.reuters.com/business/energy/cop26-aims-banish-coal-asia-is-building-hundreds-power-plants-burn-it-2021-10-29/)

## The Future of Closures & How It Impacts Insurance Coverages

While the debate of non-carbon versus natural gas options will continue, the drumbeat of retirements and closures of the existing coal-fired fleet will also continue unabated. Owners of the remaining coal fleet in the US recognize that, despite significant and legitimate concerns over the impact on reliability associated with these accelerated closures, they retain interest in an ever-increasing liability. They also recognize that as the fleet contracts, their share of liability grows. Simply put, there is a proverbial game of "musical chairs" being played with the coal fleet in the energy sector today, and no one wants to be the last player left standing.

The cross-current resistance to these early retirements is being voiced by system operators such as the Midcontinent Independent System Operator (MISO), or the Pennsylvania-New Jersey-Maryland (PJM), which are expressing compelling concerns for potential shortages of capacity and energy during extreme weather events. These concerns are both significant and real, as played out in states like Texas during the 2021 winter storm.

The reliability of electrical service in the US as we know it is at an inflection point. An electrical energy grid that relies primarily on non-dispatchable, intermittent capacity and energy that is dependent on weather for its operation will be substantially strained during extreme weather events. As discussed before, there are also contravening regulations, such as Sections 111(b) and (d) of the Clean Air Act, that do not necessarily incentivize or support overall national policy edicts for an eventual carbon-free electrical generation fleet.

## Recent Regulatory Updates & Impacts

Since the original publication of this article in 2024, the change in administration has implemented numerous policy changes that shift near-term compliance timing, retirement economics, and the sequencing of closure-related environmental obligations. This ever-evolving regulatory climate adds significant uncertainty for utilities, developers, and system operators, as shifting policies and compliance requirements make long-term planning increasingly challenging. This ongoing volatility further underscores the need for flexible strategies to adapt to future regulatory changes. Recent regulatory developments have manifested in three primary ways: (1) presidential instruments (e.g., proclamations and executive orders) that provide targeted, short-term regulatory relief or direct agencies to prioritize permitting speed; (2) administrative actions and notice-and-comment rulemakings that propose revising or repealing standards and compliance deadlines; and (3) implementation risk from ongoing rulemaking, judicial review, and state/federal program interactions. As the examples below demonstrate, many of these changes are proposals or interim relief actions and may change as rulemakings and litigation proceed:

[9] ETHW. Milestones:Pearl Street Station, 1882. Engineering and Technology History Wiki. 6/14/22. (https://ethw.org/Milestones:Pearl_Street_Station,_1882)
[10] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)
[11] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)
[12] Muyskens, J and Eilperin J. Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go. Washington Post. 7/30/20 (https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go/)

» **Mercury and Air Toxics Standards (MATS):** *exemptions and/or delayed compliance for certain fossil-fuel-fired power plants.*

On April 8, 2025, the current administration issued a proclamation providing two years of relief from a more stringent Biden-era MATS update for certain coal-fired plants, citing grid and national security concerns.[18] EPA Administrator Lee Zeldin also announced on March 12, 2025, that EPA would reconsider the Biden-Harris administration's MATS update for fossil-fuel-fired plants and was considering a two-year compliance exemption under Clean Air Act section 112(i)(4) while EPA undertakes rulemaking.[19]

» **Power-plant greenhouse gas standards (Clean Air Act §111):** *EPA proposal to repeal sector-wide greenhouse gas (GHG) standards.*

On June 11, 2025, EPA announced a proposal to repeal "greenhouse gas" emissions standards for the power sector under Clean Air Act section 111, including the 2024 carbon pollution standards framework.[20] The proposal was published in the Federal Register on June 17, 2025, as "Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units," which proposes, among other approaches, repealing all GHG standards for fossil fuel-fired EGUs.[21] EPA officially repealed the 2009 Endangerment Finding in February 2026, which had previously served as the legal foundation for regulating greenhouse gases under the Clean Air Act.[22]

» **Coal combustion residuals (CCR/coal ash):** *deadline relief for CCR management unit requirements.*

On July 17, 2025, EPA announced a direct final rule and companion proposal extending compliance deadlines tied to coal combustion residual (CCR) management unit requirements, including allowing submission of facility evaluation reports by February 8, 2027, and extending groundwater monitoring requirements (with related downstream deadlines extended as well).[23]

» **Permitting/NEPA process reforms affecting coal plant projects (e.g., life-extension retrofits, repowering, and supporting infrastructure).**

Following the current administration's January 20, 2025, Executive Order 14154 ("Unleashing American Energy"), the National Environmental Policy Act (NEPA) implementation guidance was issued, directing agencies to revise or establish NEPA procedures to expedite reviews and streamline environmental reviews for infrastructure, including energy projects.[24]

» **Presidential coal plant construction and permitting initiative.**

On February 11, 2026, the current administration issued an executive order announcing a new national initiative to increase the construction and permitting of coal-fired power plants across the United States. The administration cited energy independence and grid reliability as primary motivations, directing the Department of Energy to fast-track approvals for new coal facilities and to provide incentives for utilities investing in advanced coal technologies.[25]

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[18] Presidential Proclamation, "Regulatory Relief for Certain Stationary Sources to Promote American Energy" (April 8, 2025).
[19] EPA Press Release, "Trump EPA to Reconsider Biden-Harris MATS Regulation That Targeted Coal-Fired Power Plants to be Shut Down" (March 12, 2025).
[20] EPA Press Release, "EPA Propose Repeal of Biden-Harris EPA Regulations for Power Plants, Which, If Finalized, Would Safe Americans More than a Billion Dollars a Year" (June 11, 2025).
[21] Federal Register, Vol. 90, No. 115 (June 17, 2025).
[22] Federal Register, Vol. 91, No. 32 (Feb. 18, 2026).
[23] Federal Register, Vol. 90, No. 138 (July 22, 2025).
[24] Council on Environmental Quality, Memorandum for Heads of Federal Departments and Agencies, "Implementation of the National Environmental Policy Act" (Sept. 29, 2025).
[25] Executive Order 14386, "Strengthening United States National Defense with America's Beautifum Clean Coal Power Generation Fleet" (Feb. 11, 2026).

# Conclusion

Risk managers who insure, or have previously insured, any carbon-based generation facilities should take note and consider enlisting the help of energy transition consultants. Based on current energy transition rates, it is anticipated that many coal-fired power plants in the US will be closed within the next decade, and each will incur significant environmental cleanup costs. Regardless of when these coverages occurred, risk managers should adopt the position, *"Praemonitus, praemunitus,"* or, as translated, "Forewarned is forearmed."

# Acknowledgments

We would like to thank our colleagues John Dulude, PE, MBA, Kim Logue Ortega, JD, and Jennifer Hobden for providing insights and expertise that greatly assisted this research.

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