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PERSPECTIVES

Impact of the Clean Energy Transition on Asset Retirement Obligations and Environmental Cleanup Costs

Our perspectives feature the viewpoints of our subject matter experts on current topics and emerging trends.

INTRODUCTION: HIDDEN CHALLENGES OF ENERGY TRANSITION

The evolution of energy transition in the United States has been driven, historically, by advances in new technology, fuel availability, fuel pricing, and, probably most importantly, societal benefits. In response to these pressures, the US is currently attempting to convert most of its electrical energy resources 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 as well as shareholder commitments. The increasing pressure to convert resources is creating a significant cost to the 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 itself, including significant environmental clean-up outlays.

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

> *Accelerated decommissioning polices 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]

In the author's 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 value provided in the Fitch example, a 1,000 MW coal-fired generation facility should anticipate an environmental clean-up cost of approximately $117 million; however, the estimate of potential environmental clean-up costs provided in the Fitch example is most likely inadequate.

The rate at which decommissioning cost outpaces ARO has driven facilities owners to explore other potential avenues to fund clean-up costs, including historic insurance coverages that may go back decades or more. Old liability policies are almost always written on an "occurrence" basis, covering losses that happen during the time the policy is held, 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 is to reduce carbon dioxide (CO2) emissions.

[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)

One of the unintended consequences is the 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 clean-up expenditures.

Depending on the age of a facility and when a particular event occurred over the life of that facility, certain exclusions may or may not apply. Insurance policies predating the establishment of the US Environmental Protection Agency (EPA) generally did not have pollution exclusion clauses. Beginning approximately in 1973, pollution exclusion clauses began to appear in policy language, and, starting in the 1980s, more restrictive exclusion clauses began to be 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. As an example, in 2012, the coal-fired generation capacity that was announced for retirement during 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 for the remaining US coal-fired plants declined nearly 65% to 665 terawatt-hours (TWh) while the actual 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 actual energy output reductions.[7]

SHIFTING TO NON-CARBON ENERGY SOURCES

Energy transition in general is not a new policy or process. What is new is the accelerated conversion from carbon-based fuels to non-carbon-based forms of energy generation. Decarbonizing the grid, or generating energy from renewable sources instead of fossil fuels, is central to the current 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] The current US electrical grid started with humble beginnings in 1882 at Thomas Edison's Pearl Street Station in New York City, the first permanent central power station for supplying incandescent lighting driven by reciprocating steam engines supplied by four coal-fired boilers.[9] That means the current national, integrated grid has been evolving and developing for more than 140 years. The current schedule demands that the US be completely carbon free in terms of its electrical generation mix in the next 11 years.

A July 2020 Washington Post article describes the proposed transition schedule for the US as laid out by the current administration.[10] Figure 1 from this article shows the portion

[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 U.S. 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-U.S..pdf)
[6] Celebi, M, et al., A Review of Coal-Fired Electricity Generation in the U.S. 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-U.S..pdf)
[7] Celebi, M, et al., A Review of Coal-Fired Electricity Generation in the U.S. 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-U.S..pdf)
[8] McBride, J. et al. How Does the U.S. Power Grid Work? Council on Foreign Relations. 7/5/22 (https://www.cfr.org/backgrounder/how-does-us-power-grid-work)
[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/

of all non-carbon generation, including nuclear generation, achieved through 2019 and proposed through 2035.

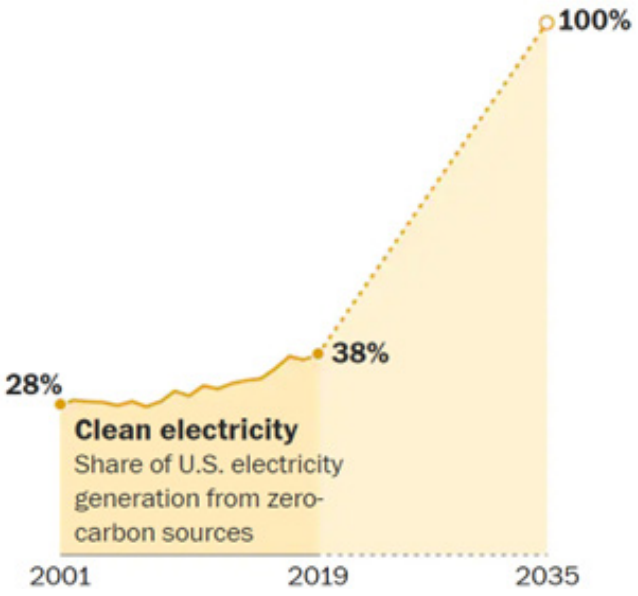


***Figure 1** - Proposed schedule of transition of US electricity generation from zero-carbon sources.*[11]

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

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

These data suggest approximately 60% of the US total electrical energy output will need to be converted to some form of non-carbon-based generation in the next 11 years. Potential non-carbon generation alternatives include nuclear, hydrogen, and wind & solar generation.

- **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 either by developers or the financial market to undertake a new nuclear facility.

- **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.

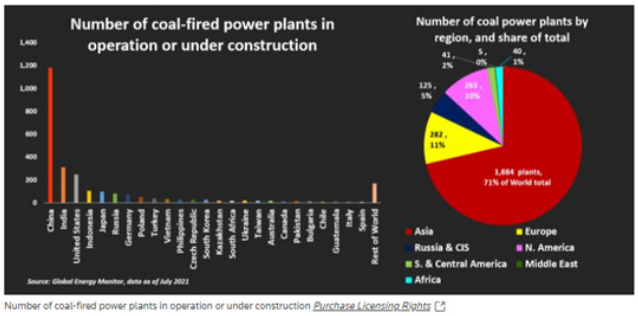
- **Wind and Solar** - Both wind and solar have had phenomenal growth in the past 15 years but even with the aggressive growth spurred by substantial subsidies, wind only represents 10.2% (425 billion kilowatt-hours (kWhs)) of the total electrical energy produced in the US, and solar represents 3.9%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

As mentioned earlier, a full 60% of the US electrical energy is generated from fossil fuels. The only other option for achieving a low- to no-carbon fleet is geologic carbon capture and sequestration/storage (CCS) of existing or new fossil fuel facilities. Geologic carbon sequestration is a method of securing CO2 in deep geologic formations to prevent its release to the atmosphere and contribution to global warming as a greenhouse gas.[15]

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,[16] an almost unnoticeable reduction.

[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/)
[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 U.S. electricity generation by energy source? (U.S. utility-scale electricity generation by source, amount, and share of total in 2023) U.S. Energy Information Administration. 2/2024 (https://www.eia.gov/tools/faqs/faq.php?id=427)
[15] USGS. The Concept of Geologic Carbon Sequestration, March 2011 (https://www.usgs.gov/media/images/concept-geologic-carbon-sequestration)
[16] Nasi, M (Jackson Walker, LLP). True Costs of Financing Decarbonization. PowerGen International, 5/24/22, Slide 15.

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.[17] Realistically, the needle has not moved much at the global level, and nations like China and India continue to add to their global coal-fired fleet. Figure 3 shows the number of coal-fired power plants by country. China represents more than 70% of the current coal-fired plants in operation today.



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[18]*

NEW EPA EMISSIONS STANDARDS & THEIR IMPLICATIONS

On May 11, 2023, the EPA proposed Clean Air Act emission limits and guidelines for CO_2 from fossil fuel-fired power plants based on cost-effective and available control technologies. The proposals would set limits for new gas-fired combustion turbines, existing coal, oil, and gas-fired steam generating units, and certain existing gas-fired combustion turbines.[19] The basis for the proposed rule (Rule) is Sections 111(b) and (d) of the Clean Air Act. Under Section 111(b) of the Clean Air Act, the EPA sets New Source Performance Standards (NSPS) for greenhouse gas (GHG) emissions from new, modified, and reconstructed fossil fuel-fired power plants.[20] Under section 111(d) of the Clean Air Act, states must submit plans to the EPA that provide for the establishment, implementation, and enforcement of standards of performance for existing sources.[21]

The proposed standards are based on technologies such as carbon capture and sequestration/storage (CCS), low-GHG hydrogen co-firing, and natural gas co-firing, which can be applied directly to power plants that use fossil fuels to generate electricity. Notably, the proposed rule would exempt peaking power plants (so-called "peakers"), which consist of combustion turbines with an imposed limited capacity factor of 20% or less that only run for short periods of high demand each year.[22]

- **CCS** is a promising technology for GHG management but is limited by location and geology. A notable challenge for CCS is the development of pipeline infrastructure to manage potential transportation of CO_2 to appropriate points of terminus. This is predominately in a conceptual stage of development and would require significant time to develop most likely beyond the regulatory dates currently proposed in the Rule and the schedule for a carbon free generation system in the US as envisioned by the current administration.

- **Co-firing of low-GHG hydrogen** is a priority development technology but the ability to utilize "green hydrogen" is challenging due to slow development of hydrogen infrastructure and the significant cost associated with making green hydrogen. Green hydrogen[23] is created when energy is used to power electrolysis that comes from renewable sources like

[17] 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/

[18] 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/)

[19] US EPA. Risk and Technology Review of the National Emissions Standards for Hazardous Air Pollutants. 4/11/24. (https://www.epa.gov/stationary-sources-air-pollution/risk-and-technology-review-national-emissions-standards-hazardous)

[20] US EPA. NSPS for GHG Emissions from New, Modified, and Reconstructed Electric Utility Generating Units. 4/25/24. (https://www.epa.gov/stationary-sources-air-pollution/nsps-ghg-emissions-new-modified-and-reconstructed-electric-utility)

[21] US EPA. Greenhouse Gas Standards and Guidelines for Fossil Fuel-Fired Power Plants. Fact Sheet: Carbon Pollution Standards for Fossil Fuel-Fired Power Plants Final Rule. State Plans. (https://www.epa.gov/stationary-sources-air-pollution/greenhouse-gas-standards-and-guidelines-fossil-fuel-fired-power); CLEAN AIR ACT SECTION 111 REGULATION OF GREENHOUSE GAS EMISSIONS FROM FOSSIL FUEL-FIRED ELECTRIC GENERATING UNITS, EPA Presentation.

[22] Kirkland & Ellis. EPA's Proposed New Emission Limits are Latest Development in Conflicting Visions to Regulate Power Plants. Kirkland Alert. 5/17/23 (https://www.kirkland.com/publications/kirkland-alert/2023/05/epas-proposed-new-emission-limits-to-regulate-power-plants)

[23] IEA. The Future of Hydrogen. International Energy Agency. 6/2019 (https://www.iea.org/reports/the-future-of-hydrogen)

wind, water, or solar. As a comparison, "blue hydrogen" is hydrogen produced from natural gas through a process of steam methane reforming, where natural gas is mixed with steam and a catalyst and produces hydrogen. Steam reforming represents more than 95% of the hydrogen produced in the world today.[24]

Given the challenges of producing significant quantities of electricity with current non-carbon fuel technology and the difficulties associated with sequestering significant amounts of CO_2 due to both technology and infrastructure, the current regulatory options may constrain alternatives for utilities, developers, and system operators to limited capacity, natural gas fueled combustion turbines. This approach will meet the regulatory requirements but will not satisfy the administration's desire for a carbon-free electrical generation fleet. It will also require significant investment in natural gas pipeline infrastructure, require significantly more capital outlay than other more efficient forms of natural gas generation technology, and, more importantly, most likely produce more CO_2 emissions.

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.

CONCLUSION

Risk managers who either insure or have previously insured any carbon-based generation facilities should take note and consider enlisting the help of energy transition consultants. Based on the current rate of energy transition, it should be anticipated that every single coal-fired generation facility in the US will be closed within the next decade and that every one of them 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."

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[24] Ahmed, U, Zahid, U. Techno-economic assessment of future generation IGCC processes with control on greenhouse gas emissions. Computer Aided Chemical Engineering, 2019, 46:529-534.