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CLIENT ALERT

Financing Nuclear Projects in the U.S. – Considerations in the Current Market Environment

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For previous alerts in this series on nuclear energy, please see: Another Nuclear Renaissance and Nuclear Energy – Growth and Transactional Opportunities.

As we have noted in previous client alerts, the expansion of energy-intensive economic activity in the U.S., including the rapidly increasing number of data centers hosting artificial intelligence services, has renewed the focus on developing nuclear energy as an option to address future U.S. power needs.

According to estimates from Bloomberg, $21 trillion in incremental power grid investment will be required to reach a global net-zero carbon emissions goal.[1] Despite its potential to play a prominent role in the transition to a low-carbon energy market, investments in nuclear energy remain a largely overlooked option when compared to wind, solar and other alternative energy generation sources. In 2023, the total value of private equity-backed energy transition deals was $25.9 billion, but only $1.7 billion of that amount consisted of investment in nuclear energy.[2] In the first quarter of 2024, there were six M&A deals in nuclear energy totaling $519.8 million.[3] The magnitude of nuclear investment appears likely to increase in the near future. At the United Nations COP28 summit in December 2023, the U.S. and more than twenty other countries

1 https://about.bnef.com/blog/global-net-zero-will-require-21-trillion-investment-in-power-grids/

2 https://weaver.com/resources/will-private-equity-be-driving-force-behind-energy-transition/

3 https://www.power-technology.com/data-insights/ma-activity-nuclear-power-industry/

pledged to triple nuclear energy capacity by 2050.[4] In September 2024, a report from the Department of Energy ("DOE") estimated that expansion at existing nuclear power plants could provide more than 60 gigawatts of new nuclear capacity.[5] Significant public and private investment in the nuclear energy industry will be required to meet these ambitious goals.

Given the recent attention to the development of nuclear power capacity, this alert provides a brief summary of considerations applicable to nuclear project financing in the current market environment.

Traditional Approach

Full-size nuclear plants, typically generating at least 1,000 megawatts of electricity per reactor, have been the mainstay of the U.S. nuclear industry for decades. With an average footprint of over one square mile, and refueling every one and a half to two years, full-size nuclear plants require a high up-front investment during the construction stage, but require comparatively low incremental maintenance investment thereafter. The high expense of construction is partly due to the need for specialized materials, like nuclear-grade steel, and the fact that many key reactor components must be fabricated on location because they are too large to ship from an off-site factory. As a result, cost-overruns and timeline delays have been a constant feature of full-size nuclear plant construction. From 1966 to 1977, when full-size reactor construction in the U.S. peaked, the DOE estimated that nuclear construction costs exceeded estimated budgets by an average of 207%.[6]

The high start-up costs of nuclear projects and the potential for cost-overruns have long been a daunting obstacle to the private financing of nuclear power plant construction. During the 1970s and 1980s, most nuclear plants were constructed in regulated energy markets with government-owned utilities which could utilize public funds to finance construction costs.[7] The regulated nature of energy markets ensured that construction costs could be recouped via deliberate and predictable energy pricing. Since that time, many energy markets have been deregulated, resulting in lower wholesale energy prices and greater price volatility, and challenging the traditional nuclear financing model.

Certain markets provide a contrasting example to the public finance approach noted above. In Finland's *Mankala* model, which has been used in Finland to finance the construction of almost all large power plants since the 1970s, local power companies cooperate to establish a limited liability company, pursuant to which construction, operation, and maintenance costs are shared among the participants, with each participant receiving a share of the produced power at cost.[8] France's *Exceltium* consortium utilizes a similar structure, with investors contracting with Électricité de France (France's state-owned utility) to assist with financing new power plants in exchange for lower-cost power, which can be utilized by the investors

4 https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key

5 https://www.energy.gov/ne/articles/doe-report-finds-more-60-gigawatts-new-nuclear-capacity-could-be-built-existing-nuclear

6 https://ieefa.org/wp-content/uploads/2022/01/Southern-Companys-Troubled-Vogtle-Nuclear-Project_January-2022.pdf

7 https://world-nuclear.org/information-library/economic-aspects/financing-nuclear-energy

8 Id.

themselves or sold on the open market. In Japan, the Kyushu Electric Power Co. recently accessed capital markets to issue Japan's first environmental bond for the purpose of financing Kyushu's nuclear projects.[9]

In other jurisdictions, governments have instituted creative structures to ensure a predictable return on investment that would otherwise be unavailable in a deregulated energy market. In England, the UK government utilized a "contract for difference" mechanism to support the construction of the Hinkley Point C nuclear plant. While investors retained responsibility for construction costs (including cost overruns), the "contract for difference" established a mechanism to bridge gaps between the variable market price of electricity and the price at which the investors would recoup project costs plus an agreed margin. The result is a contractual structure that is functionally similar to a long term energy price hedge.

In the U.S., federal and state governments have played a prominent role in supporting construction of nuclear power plants and mitigating risks associated with nuclear projects by way of loan guarantees, statutory liability pooling, and tax credits.

By providing guarantees of construction loans, the U.S. government mitigates financing risk by assuring lenders a full or partial recovery of their investment. Recently, the Loan Programs Office at the DOE granted $12 billion in conditional guarantees for the Vogtle Units 3 and 4 that came online in 2023 and 2024, the first new reactors constructed in the U.S. in three decades.[10] The DOE increased the initial guarantee amount of $8.3 billion by an additional $3.7 billion to address cost overruns in the construction process of the two reactors.

The U.S. government has also passed legislation to mitigate operational risk in the nuclear sector. In March 2024, President Biden signed into law a forty-year extension of the Price-Anderson Act ("PAA"), first passed in 1957. The PAA requires each nuclear reactor with at least 100 megawatts of electric generating capacity (which includes all current U.S. commercial reactors) to maintain the maximum level of liability insurance commercially available ($500 million in 2024).[11] A secondary layer of industry self-insurance requires each individual reactor in the U.S. to contribute up to $158 million in additional damage payments, plus a potential 5% surcharge ($7.9 million per reactor) in the event a severe radioactive release results in damages in excess of the $500 million in insurance maintained by the reactor where the incident occurred. According to the Nuclear Regulatory Commission, 94 reactors are currently subject to the requirements of the PAA, resulting in aggregate available compensation of $16.1 billion in the event of a nuclear incident. Under the PAA, the nuclear industry's liability for any incident is capped at such amount. With respect to small modular reactors, the PAA specifies that a plant consisting of multiple small reactors may participate in the PAA as a single reactor, subject to specified limits on individual and aggregate reactor output.

9 https://www.bloomberg.com/news/articles/2024-05-28/kyushu-electric-raises-30-billion-from-nuclear-transition-bond

10 https://www.energy.gov/lpo/articles/how-loan-programs-office-and-plant-vogtle-are-shaping-energy-transition-through

11 https://crsreports.congress.gov/product/pdf/IF/IF10821

Lessons for the Future and New Reactor Design Opportunities

The average age of nuclear plants in the U.S. is more than 40 years old, and the regulatory landscape of the U.S. energy market has changed significantly in that time.[12] However, the lessons of the past provide helpful guidance for possible approaches to the financing of nuclear power plant construction in the future. As noted above, several key challenges remain relevant in today's market: (i) mitigating investor exposure due to high up-front construction costs, (ii) increasing predictability and certainty of recoupment of investment and (iii) providing a regulatory framework to manage operational liability, particularly in a catastrophic failure scenario.

Cost overruns remain a persistent problem in today's market. The decades-long absence of new nuclear construction has reduced the scope of the domestic nuclear supply chain and workforce experience needed for the construction process.[13] The Vogtle project faced delays and cost increases as a result, with the cost of the reactors exceeding estimates by 114%.[14] Due to the joint ownership of the Vogtle reactors by Georgia Power Company, Oglethorpe Power, Municipal Electric Authority of Georgia, and Dalton Utilities, individual investor exposure, although significant, was mitigated.[15] In addition, by way of an agreement with Georgia's regulators and other interested community groups, $7.6 billion of the project's costs will be borne by electric customers through a surcharge added to their utility bills.[16]

Small modular reactors are receiving increasing attention as a lower-cost alternative to traditional full-scale plants. Instead of the large geographic footprint required by full-scale reactors, small modular reactor projects are anticipated to require as little as two acres of land and may be housed in normal-sized buildings. Traditionally, at full-scale reactor sites, labor, excavation, and heat sink construction represented over 60% of a nuclear plant's cost.[17] Small modular reactor designs are anticipated to significantly mitigate these expenses. Additionally, rather than being fabricated on site as is the case with larger plants, newer technologies may allow for factory fabrication and shipping.[18] The result is expected to be a significant decrease in project expense and funding requirements.[19] But investors are right to remain cautious in the near term; for the time being, small modular reactor construction possesses many of the risks inherent to its larger sibling. In November 2023, America's first small modular reactor project was abandoned because its costs increased from $55 per megawatt-hour to

12 https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php

13 https://nap.nationalacademies.org/read/26630/chapter/6#67

14 https://ieefa.org/wp-content/uploads/2022/01/Southern-Companys-Troubled-Vogtle-Nuclear-Project_January-2022.pdf

15 https://www.georgiapower.com/company/plant-vogtle.html

16 https://georgiarecorder.com/2023/08/31/georgia-power-state-regulators-agree-to-division-of-vogtle-nuclear-plant-costs/

17 https://energy.mit.edu/wp-content/uploads/2018/09/The-Future-of-Nuclear-Energy-in-a-Carbon-Constrained-World.pdf

18 https://sgp.fas.org/crs/nuke/R45706.pdf

19 https://oklo.com/files/doc_presentation/Oklo-Investor-Presentation-July-2023_vFinal.pdf

$89 per megawatt-hour and local utilities that had subscribed to the project were not willing to pass the additional expense along to consumers.[20]

Despite construction cost concerns with respect to both full-scale and small modular reactors, the DOE has signaled its intent to provide strong support for additional nuclear reactor construction by way of more than $62 billion of loan guarantee authority under the Innovative Clean Energy Loan Guarantee Program and up to $250 billion in loan authority under the Energy Infrastructure Reinvestment Program.[21]

Although energy market deregulation has resulted in additional volatility in energy prices compared to the regulated markets of prior decades, once a nuclear project is operational, contractual arrangements such as power purchase agreements and energy price hedges provide energy producers with pathways to achieve a more secure and predictable revenue stream. Through the use of such price-stabilizing agreements, nuclear reactor owners can provide increased comfort to financing providers with respect to certainty of repayment, as well as generate increased visibility as to expected returns to equity holders. Power purchase agreements and energy price hedges are a common tool utilized by power companies with non-nuclear generation assets, and will be an important feature of any financial model for a nuclear power plant in a deregulated energy market as well.

To facilitate a nuclear renaissance in the U.S., it will be critical to adapt the lessons of past decades to the current deregulated market environment. For now, many of the defining features of traditional nuclear project development – high startup costs and susceptibility to cost overruns - remain applicable. Government support, in the form of loans, loan guarantees, and tax credits, remains a critical component of nuclear reactor construction financing. Once operations commence at a nuclear plant, appropriate use of power purchase agreements and hedging arrangements will be crucial to ensuring a predictable and sufficient revenue stream. As with any nascent industry, once nuclear reactor construction regains momentum, processes will become smoother and more efficient, components will become commoditized and cheaper, and skilled industry expertise more readily available. Likewise, despite a challenging start, small modular reactors may break the traditional capital-intensive nuclear model and make nuclear energy a viable mid-scale alternative to other energy generation options. Both these trends present an opportunity to bring nuclear energy into the traditional project finance arena, and produce a deeper, more developed market for the financing of nuclear power plant construction.

[20] https://www.eenews.net/articles/nuscale-cancels-first-of-a-kind-nuclear-project-as-costs-surge/

[21] https://www.energy.gov/lpo/advanced-nuclear-energy-projects.

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