SQUIRE PATTON BOGGS

Fueling the Future with Nuclear Power

Opportunities and Challenges

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As depicted in a recent Hollywood blockbuster film, nuclear energy was first harnessed in 1945 as both an awe-inspiring and fear-inducing achievement of humankind.

Since then, nuclear energy has developed into an efficient but controversial source of power. More than 70 years later, the benefits of nuclear power as an alternative to fossil fuels are well-known, but so too are its risks. A handful of disasters, such the Fukushima incident in 2011, have shown that the risks can be catastrophic, and have a chilling effect on global acceptance of nuclear energy. Following the Fukushima disaster, Germany and Switzerland pledged to phase out their nuclear programs, and Italy passed a public referendum to cancel all of their plans for new nuclear reactors. The "chilling effect" was felt well beyond Europe. Between 2008 and 2010, construction began on 38 reactors globally, yet in the two years following Fukushima, only four reactors moved forward with construction.

Despite this recent history, interest in nuclear power has reignited, driven by the global push for greener energy. The surge in electricity demand due to the burgeoning power demands of artificial intelligence (AI) and data centers have driven the nuclear renaissance. As of July 2025, more than 440 traditional large-scale nuclear reactors are in operation in civilian power plants across 31 countries, a 10% increase over two years.[1] Nuclear power now accounts for 9% of the world's energy, marking a 125% rise from just two years ago.[2]

More recently, on 19 November 2025, the US and the Kingdom of Saudi Arabia (the Kingdom) signed the "Joint Declaration on the Completion of Negotiations on Civil Nuclear Cooperation," a milestone that signals both countries' intention to move toward a formal "123 Agreement," under which the US may share nuclear technologies with the Kingdom. The Kingdom has long been interested in establishing a civilian nuclear power program, and this marks the most concrete progress to date, and arrives at a critical moment in the Kingdom's progress with its unprecedented slate of giga-projects under Vision 2030. The Kingdom's ambitions will require vast amounts of energy, at a time where it seeks to diversify away from traditional fossil fuels and position itself as a leader in clean energy.

The industry is poised for another year of growth in 2026 and beyond, and the ambitious endeavors by the Kingdom, as well as many other modernizing countries, to pursue nuclear power plant (NPP) programs will inevitably give rise to challenges of comparable scale. In this article, we identify the opportunities and challenges facing the nuclear industry in the year ahead, and provide practical insight into how states, developers, vendors and contractors can overcome the legal and regulatory challenges to developing NPP projects.

Renewed Interest in Nuclear Power and Its Next Generation Technologies

The renewed demand for nuclear power has not only brought new NPPs online and into development, but it has also paved the way for the research and development of next-generation technologies that could reshape how nuclear power is developed, deployed and integrated into energy systems. Among them are Small Modular Reactors (SMRs): compact, factory-built reactors that offer the promise of lower upfront costs, enhanced safety and greater flexibility in deployment. Several governments and private developers are targeting commercial deployment of SMRs within the next decade, with data center operators and off-grid industries showing particular interest.[3]

Also emerging are Generation IV reactors; a family of advanced designs focused on improving fuel efficiency, reducing long-lived radioactive waste and enhancing safety. A coalition known as the Generation IV International Forum has brought together 13 countries to research and develop Generation IV reactors.[4] US and Chinese companies have also been developing and building such reactors, and are aiming for commercial operation by the early 2030s.[5]

Further ahead, nuclear fusion power remains the industry's holy grail. Unlike traditional nuclear fission, fusion produces no long-lived radioactive waste and carries minimal safety risks, offering the potential for near-limitless clean energy. Fusion could, theoretically, generate four times more energy per unit of fuel than fission, and nearly four million times more energy than burning dirty fossil fuels.[6]

1 World Nuclear Association, Nuclear Power in the World Today (17 July 2025), p. 534.

2 Ibid.

3 Microreactor builders eye share of growing nuclear market," Reuters, 27 March 2025 (Neil Ford); 2025 Global Data Center Outlook," JLL (2025).

4 World Nuclear Association, "Generation IV Nuclear Reactors," *World Nuclear Association Information Library* (2025).The 13 countries are Argentina, Australia, Brazil, Canada, China, France, Japan, Korea, Russia, South Africa, Switzerland, the United Kingdom, the United States and, through the Euratom research and training programme, the European Union.

5 *TerraPower begins construction at 345-MW advanced reactor site in Wyoming,"* Utility Dive, 14 November 2023; and "*China Begins Commercial Operation of 1st HTGR,"* Neutron Bytes, 10 December 2023.

6 International Atomic Energy Agency, *What is Nuclear Fusion*, 3 August 2023.

While commercialized fusion appears to be at least a decade away, both government and privately funded projects are said to be making significant strides toward controlled fusion technology. The fusion outlook is sufficiently promising for Google to have recently agreed to purchase electricity from a planned nuclear fusion plant that is expected to begin commercial operation in the early 2030s.[7]

State of Play: Global Leaders, New Entrants and Opportunities

While new nuclear energy technologies are rapidly developing, traditional large-scale reactors remain the focus of development and operation today. The expansion of new and existing nuclear programs presents a wide range of opportunities for states, vendors and contractors.

As of now, the US operates more nuclear reactors than any other country, with 94 in operation.[8] China has taken the lead in global nuclear development, however, with 59 reactors currently in operation, 31 under construction and approximately 150 more planned over the next 15 years.[9] France is in third place, operating 57 reactors. There are currently 69 reactors under construction in the world, and 80% of those are in Asia or Eastern Europe.[10]

There have recently been several new entrants into the nuclear power market, including the United Arab Emirates(UAE), which commissioned the first reactor in its four-reactor Barakah NPP in 2020. All four reactors were in operation by 2024. Several other countries are in the process of developing their first NPPs, including Bangladesh, Egypt and Turkey.

While the US and China have the most domestic NPPs, Russia (with 36 domestic NPPs in operation now) is the leading global exporter of nuclear reactors, with 19 NPPs under construction across seven countries in Eastern Europe, the Middle East and Asia.[11]

In respect of "Western" suppliers, Westinghouse Electric Company (a US company but now owned by Brookfield, the Canadian firm) effectively withdrew from the one plant it was building domestically (Vogtle, Georgia), after filing for bankruptcy and paying compensation to the owners to be released from its contractual obligations. Westinghouse is currently vying for its reactor designs in planned projects in Bulgaria and Ukraine. The French Électricité *de France* (EDF) is the only other "Western" player in the global market, but their only current export project is for an NPP in the UK.

South Korea, which is seen as aligned with the "West", has emerged as an up-and-coming global NPP supplier in this race. South Korean NPP developer KEPCO[12] and its subsidiary KHNP[13] successfully built the UAE's Barakah NPP relatively within budget and time. Building on that success, South Korea has aggressively sought new NPP projects globally, particularly in Eastern Europe, the Middle East and Southeast Asia. The Czech Republic recently awarded KHNP a US$18 billion contract to build up to four new nuclear reactors. KHNP beat out EDF for the Czech project after Westinghouse was excluded, purportedly for refusing to accept delay damages liability.[14]

The Challenges to Successfully Delivering NPP Projects

South Korea's reputation for building NPPs without significant cost overruns and delays is unique in the market. Historically, the NPP industry has been plagued with enormous cost overruns and delays, such as those Westinghouse faced in building the Vogtle NPP, and Areva in constructing the Olkiluoto 3 reactor in Finland. While most NPP projects aim for a design and construction duration of five-years or less, actual durations are often far longer. For the 18 reactors that came online globally in 2022, the average time to project completion was nine years, suggesting an average of four years of delay.[15] On the Vogtle NPP, Westinghouse and its construction partner Shaw Group faced more than seven years of delay and ballooning costs, which materially contributed to Westinghouse filing for bankruptcy in 2017. Most of the 58 ongoing NPP construction projects around the world are facing delays, with at least 24 projects in significant delay.[16]

While complex construction projects are always susceptible to cost overruns and delays, NPP projects are even more vulnerable due to a myriad of issues that are not present in most other construction projects. The very nature of nuclear power requires navigating difficult challenges in development of NPP projects, including: (1) a highly regulated environment with an often-changing regulatory framework, (2) a necessarily intense focus on nuclear safety, (3) frequent challenges from anti-nuclear interest groups, (4) the need for complex and proprietary technologies, (5) multilateral geopolitical and non-proliferation concerns and (6) the high costs of NPP projects. All of these challenges, taken together, drive development costs much higher than those of other means of electric power generation and bring significant risk of delay.

7 *Financial Times*, "Google agrees deal to buy power from planned nuclear fusion plant," 22 May 2024.

8 World Nuclear Power Reactors 1951-2025, as of 19 May 2025.

9 Ibid; "China's Nuclear Power Program: A Blueprint for Global Competitiveness," *Nuclear Business Platform* (2024); "There's a Race to Power the Future. China Is Pulling Away," *The New York Times*, 30 June 2025.

10 World Nuclear Association, Nuclear Power in the World Today (updated mid-2025), p. 24.

11 WNISR 2023, p. 27; "Russian nuclear ambition powers on at home and abroad," *Reuters*, 26 August 2016 (Nina Chestney).

12 Korea Electric Power Corporation.

13 Korea Hydro & Nuclear Power.

14 S&P Global, *Czech Government Excludes Westinghouse from ongoing Nuclear Plant Tender*, dated 31 January 2024.

15 WNISR 2023, p. 63.

16 WNISR 2023, p. 20.

1. Stringent and Often Changing Regulations

Developing NPPs internationally involves navigating multiple countries' regulatory regimes, including export controls. A nation's export control regime is generally designed to preclude unauthorized states or entities from acquiring its nuclear technology. Although the United Nation's International Atomic Energy Agency (IAEA) provides an overall framework for international trade involving nuclear technology,[17] national export authorities ultimately control nuclear trade. These regimes, however, can be disparate and unevenly applied, leaving gaps that give rise to uncertainty and, often, potential risks.[18] Navigating these ever-evolving regimes, whether to source necessary materials or obtain safety-related information, may cause delays in various phases of NPP projects.

1. Focus on Nuclear Safety and Nuclear Waste Management

NPP projects involve radioactive fuel and waste, which pose significant environmental, health and safety risks requiring careful management. Most nuclear power host countries have developed stringent regulations specifically for NPPs. With recent advances in nuclear technology, however, new NPPs are frequently "first-of-a-kind" projects without tried-and-true avenues for mitigating the risks of delay and cost increases caused by regulatory unknowns.

These regulatory regimes can also vary widely from jurisdiction to jurisdiction and often include strict licensing requirements that can make or break a project, including those for design certification, site approval, construction and operation; though states with more experience in NPP construction may have more developed processes for these approvals. For example, the Nuclear Regulatory Commission in the US has created a front-loaded licensing and approval framework that combines construction and operating approvals into a single process, streamlining early-stage compliance.[19]Such strategies attempt to front-load a lengthy regulatory process to avoid problems down the line.

2. Overcoming Anti-nuclear Resistance

Opposition from anti-nuclear stakeholders remains one of the most significant challenges to the global expansion of nuclear power. Environmental non-governmental organizations (NGOs) have long campaigned against nuclear power, citing concerns over radioactive waste, the risk of catastrophic accidents and potential links to nuclear weapons development. These groups have shaped public opinion and influenced national policy in many countries.

For example, Germany's phase out of its NPPs was driven not only by Fukushima, but also by sustained pressure from environmental groups and aligned political parties. The results have been mixed. Once an electricity exporter, Germany now relies heavily on imports, including from France's grid, which is largely powered by NPPs. In 2024, German officials acknowledged they were considering restarting several phased-out NPPs due to energy security concerns and rising prices. France, by contrast, offers a model of sustained public trust, with a fleet of 56 reactors that supply roughly 68% of the nation's electricity (and some of Germany's). France's success is attributed to sustained government backing; clear communication with communities; rigorous safety oversight and tangible local benefits (e.g., jobs, improved infrastructure and lower energy costs).

Looking ahead, the viability of the next-generation technologies mentioned above will depend first on engineering and cost efficiency, but ultimately on public trust. Although the next-generation technology promises enhanced safety and reduced waste, they will nonetheless face public skepticism over the nuclear industry, generally. As with traditional NPPs, securing political backing in the face of opposition from environmental groups will be essential to their success.

3. The Technical Complexity of NPP Projects

The technical complexity of NPP projects amplifies the concerns usually associated with delays and cost overruns on construction projects. The highly technical nature of NPP projects and the intense regulatory environment in which they are developed makes them particularly vulnerable to changes that can cause delays and cost overruns. For example, Westinghouse's Vogtle project was plagued by significant delays and cost overruns, some the result of federally mandated design changes following the Fukushima disaster. The US government amended the design certification for the reactor after engineering contracts were struck, the design was completed and manufacturing of long-lead-time components had begun.[20] The amendment mandated that designs ensure safe operation against seismic activity, as well as other safety risks and the requisite changes halted construction and caused significant delays.

4. The Impact of Multilateral Geopolitics and Nuclear Non-proliferation Concerns

NPP projects also require careful consideration of intricate political and public policy landscapes. Almost all ongoing NPP construction projects are implemented through public companies or involve public finance, and around 45% of the world's nuclear capacity is fully state-owned.[21] NPP projects often involve taxpayer subsidies and face intense public scrutiny over safety and environmental concerns.

17 See, e.g., International Atomic Energy Agency's Guidance on the Import and Export of Radioactive Sources, 2012 edition.

18 World Nuclear Association Report on An Effective Export Control Regime for a Global Industry, dated April 2018, p. 18.

19 World Nuclear Association Repot on Structuring Nuclear Projects for Success: An Analytic Framework, dated September 2012 (hereinafter referred to "WNA Report 2012"), p. 8.

20 Nuclear Newswire, *Root Cause of Vogtle and VC Summer Delays*, dated 13 November 2014.

21 WNISR 2023, p. 21.

Further, the construction of NPPs can have geopolitical implications and influence economic dynamics, requiring parties not only to navigate both public and private law, but also ever-shifting international relations. For example, KHNP lost out to Westinghouse on a NPP in Poland, even though KHNP's proposed price was several billion dollars lower than Westinghouse's price.[22] It appears that the choice of Westinghouse was, at least in part, a political choice meant to strengthen ties between Poland and the US, as made clear by then US Vice President Harris's tweet: "US partnership on this project is advantageous for us all: we can address the climate crisis, strengthen European energy security, and deepen the US-Poland strategic relationship."[23]

With so many cross currents at work, it is imperative to consider all possible stakeholders prior to, and throughout the development and construction of NPPs. Stakeholders can include associated utility companies, affected communities, local governments, national governments, contractors and vendors, safety authorities/regulatory bodies, international organizations and many others, depending on the specifics of the project.

5. The Costs of NPP projects

All of these challenges mean that NPP projects are among the most challenging and most costly construction projects in the world, averaging more than US$30 billion in development and delivery costs. To put that into context, the capital cost per kilowatt of electricity generated by nuclear, coal and combined-cycle power plants are as follows:[24]

	Nuclear	Coal	Combined-Cycle
Capital costs of generating 1 kW of electricity	US$ 6,695	US$ 4,074	US$1,062 – US$2,845

Furthermore, NPPs require the commitment of a significantly high portion of capital investment before any revenue is generated, unlike gas or coal power plants, which incur more of their costs during operations. This presents a steep financial risk, considering that 11.5% of NPP projects have ultimately been abandoned.[25] Thus, the World Nuclear Association recommends allocating project risks appropriately, including by carefully determining which party is most capable of controlling the risks associated with the significant upfront investment, in an effort to lower uncertainty to acceptable levels.[26] Given the high costs of developing NPPs, lowering their cost has been studied heavily[27] and case studies repeatedly note the importance of effective planning from the outset. For example, the Energy Technologies Institute's report on nuclear costs drivers noted that the UAE Barakah Project's success "is tied directly to the way the RfP was structured and carried out."[28] It further noted, "[t]he bidding process was intentionally designed to avoid as many of the past mistakes as possible. The KEPCO consortium [the project's vendor] shows the value of clear responsibility and authority under the prime contractor."[29]

Overcoming Legal and Regulatory Challenges

As outlined above, NPP projects are prone to significant delays and substantial cost overruns because of the legal, regulatory, technical and geopolitical issues that make them susceptible to significant delays and substantial cost overruns. Developers, vendors or contractors thus must proactively manage the following challenges and considerations:

- Navigating complex and potentially under-developed nuclear regulatory frameworks in the host state
- Assessing the relevant experience and technical expertise of the lead vendor, which can have a substantial impact on the likelihood of project success
- Negotiating reasonable contract terms with clearly delineated responsibilities to reduce the risk of delays and cost overruns
- Implementing disciplined contract administration, effective recording keeping and timely communication protocols to mitigate and manage unavoidable delays and contract variations

1. Navigating the Nuclear Regulatory Frameworks

For states seeking to establish or expand their civilian nuclear power programs, proactive planning is essential. They must identify and establish comprehensive regulatory frameworks well before issuing tenders. This includes implementing a coherent statutory regime that covers, among many others, licensing across project phases; safety and environmental standards; radioactive waste management protocols; export controls and international safeguards. Strong frameworks help host states ensure their nuclear programs meet international safety and non-proliferation standards.

For developers, these frameworks provide predictability around licensing, approvals and project oversight. They also provide legal certainty to vendors and contractors, allowing all parties to coordinate project timelines, processes and sequences with confidence. Where needed, developers and vendors should work closely with the state to establish or modernize its regulatory framework.

22 WNISR 2023, p. 150.

23 Nuclear Engineering International News, *Westinghouse and KHNP may both build NPPs in Poland*, dated 3 November 2022.

24 Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2022, Table 1.

25 WNISR 2023, p. 67.

26 WNA Report 2012, p.12.

27 The ETI Nuclear Cost Drivers Project: Full Technical Report, dated September 2020 (hereinafter referred to as "ETI Nuclear Cost Drivers Project").

28 ETI Nuclear Cost Drivers Project, p. 36.

29 Ibid.

The UAE offers a leading example. In preparation for the Bakarah NPP, the UAE government implemented a national nuclear development policy in 2008, based on the highest standards of safety, transparency and security. Subsequently in 2009, the Federal Authority for Nuclear Regulation (FANR) was established as an independent regulator to ensure that all national nuclear activities align with the IAEA's best practices. FANR oversaw the development of the statutory regime mentioned above, which was drafted in consultation with the IAEA and other international technical experts. Under FANR's oversight, the Emirates Nuclear Energy Corporation (ENEC) managed the development, finance and procurement of the Bakarah NPP. This expert-informed and governance-led approach has positioned the UAE as a benchmark for emerging civil nuclear states seeking to execute NPPs.

Knowledgeable legal counsel can play a critical role in supporting host states to design regulatory frameworks aligned with international standards. For developers and vendors, legal advisers provide essential guidance on navigating the host state's licensing regimes, export control requirements and regulatory compliance throughout the project lifecycle.

2. Assessing the Experience, Expertise and Reliability of Nuclear Vendors

To state the obvious, selecting the lead vendor is one of the most important decisions in an NPP project. In addition to the offered price and completion schedule, host states and project developers must assess the vendor's technology, delivery track record, familiarity with the (or similar) regulatory framework and capacity to manage the particular project. Key global vendors include KEPCO/KHNP (South Korea), Westinghouse (US/Canada), EDF (France), Rosatom (Russia) and CNNC and CGN (China).

While one of these vendors will likely emerge as the best choice for any given project, they are not always equally suited to every project. Beyond a developer's potential preference for the technology offered by a potential vendor, developers must also consider the vendors' relative capabilities and experience delivering projects in the nation or region, the likelihood that they and their delivery partners (including suppliers and subcontractors) can operate successfully in the relevant business culture, their likelihood of effectively managing labor in the relevant market and more.

As geopolitics will also often play a role in a host state's choice of vendor, host states and developers must consider political risks, in addition to the quality, time and cost considerations expected on major development projects. Legal counsel, in association with public policy advisors with broad multinational experience, can support host states and developers conducting vendor due diligence by evaluating licensing histories, export control exposures and intellectual property risks. Legal counsel can also identify and assist in managing the geopolitical policy implications inherent in choosing a vendor.

3. Careful Contracting is Key, Even More Than With Other Development Projects

In launching their tender process and particularly after selecting a preferred vendor, developers must navigate a complex matrix of relevant contracts, including financing documents, offtake agreements, fuel supply agreements and, of course, Engineering, Procurement and Construction (EPC) contracts and related documents. NPP projects typically involve tens or even hundreds of separate work packages, delivered through multi-tiered supply chains, with highly specialized subcontractors supplying critical components. While modular contracting offers flexibility and access to specialist suppliers, it also increases the risk of coordination failures, interface gaps or inconsistent obligations. Legal advisers assist developers in structuring, aligning and negotiating these contracts through cohesive risk allocation and mitigation strategies that feature clear deliverables, consistent back-to-back terms and strategic milestone-linked payments. A carefully structured contractual framework is essential to managing complexity, limiting disputes and holding parties accountable to their obligations.

Furthermore, NPP projects require complex, long-term contractual relationships that go well beyond the four corners of the contracts. In addition to standard considerations such as variation mechanisms and termination rights, NPP contracts must address multifaceted interfaces among project participants with unique and stringent regulatory obligations including nuclear safety codes, export control laws and radiation protection standards among dozens of others. The contract suite must reflect these requirements and allocate compliance obligations. Failing to map these issues clearly into the contract documents may expose project participants to substantial delays and costs.

4. Mitigating and Managing Delays and Cost Overruns Requires Discipline and Vigilance

Despite the efforts of experienced vendors and contractors, delays and cost overruns are virtually guaranteed on NPP projects. However, developers and vendors can significantly mitigate their impact through proactive project management systems, disciplined contract administration, diligent record keeping and ready communication. Vendors and contractors should implement procedures for maintaining complete, accurate and objective project documentation throughout the project lifecycle. Reliable project documentation and timely written correspondence can help parties narrow issues and avoid formal disputes.

Given the high-value, long-duration and technically intensive nature of NPP projects, parties should also consider adding standing dispute adjudication boards (DAB) in their contract relationships. A DAB comprises independent, technically qualified experts empowered to review issues in real time, make recommendations and even issue binding interim determinations on disputes before they escalate into arbitration or litigation. Standing DABs are particularly useful in large-scale, long-term projects, as they help preserve cooperative relationships, manage uncertainty and keep the project on track despite disruptive events.

Closing Thoughts: The Value of Early Advice

As Confucius is often quoted as saying, "A fool despises good counsel, but a wise man takes it to heart." Ben Franklin is credited with the observation that "An ounce of prevention is worth a pound of cure."

Participants in NPP projects, more than almost any other infrastructure undertaking, benefit from regular, high-quality, specialist advice from the outset of a project through to completion. 2026 and beyond would be no different, as NPP project participants will need to carefully consider all the factors discussed above in order to succeed. NPP projects feature a vast web of interrelated risks and obligations, ranging from financing risks and regulatory and licensing requirements (including export controls, proper authorizations, technological classifications and supply chain approvals), to geopolitical and public policy considerations. With the myriad and interrelated risks faced by dozens of project participants, it is critical that major participants are constantly well advised on the legal, contractual, regulatory, technical, financial and geopolitical landscape they are traversing.

NPP participants should invest in thoughtful, effective counsel from the start of each project and select advisers who know their industry and the environment that they are operating in. The up-front costs of good advice will be recovered many times over through the execution of a successful project: one that is completed in a safe, timely and cost-effective manner, and will generate greener energy for decades to come.

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