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Nuclear Hype Ignores High Cost, Long Timelines

Nuclear Options Are Years Away While Solar, Wind, Storage and Geothermal Are Clean, Cost-Effective Options Ready Now

- *Nuclear power is being touted as a solution to meeting growing electricity demand spurred by demand from artificial intelligence and data centers.*
- *Plans to build small modular reactors (SMRs) may bear fruit after 2030 but will be of no use in meeting current demand growth.*
- *Announcements of new SMR plans have one thing in common: They've been very short on details.*
- *Solar and geothermal plants are being built for less money and in much less time than even the most optimistic SMR designs.*

Nuclear hype has been omnipresent since September. First, Constellation and Microsoft announced a deal that could lead to the restart of Unit 1 at the Three Mile Island (TMI) nuclear plant in Pennsylvania that came online in 1974 but was closed in 2019. Then within days of each other, Google and Amazon came forward with plans to support development efforts of two small modular reactor (SMR) companies. In between, the Department of Energy said it would soon release an additional $900 million to fund SMR commercialization plans.

It is time to stop and take a deep breath. Restarting a limited number of recently closed conventional reactors is entirely different than building unproven and unlicensed SMRs. These announcements may, at some point, lead to the construction of a small number of megawatts of new nuclear capacity after 2030, but nothing like the amount of power—or on the short-term timeline—that is being sought today.

Aside from the hype, what is most striking now is the paucity of detail in the SMR announcements.

Kairos and Google

In their announcement, for example, Kairos Power and Google said they had signed a master plant development agreement that would lead to the building of a "fleet" of reactors generating a total of 500 megawatts (MW) of capacity by 2035, with the first unit planned for a 2030 startup.

Beyond that, details from Kairos and Google were slim—in fact, almost nonexistent. The Kairos website says its SMR will offer 75MW of capacity, and be sold as a two-unit, 150MW plant. For comparison, Microsoft's deal at TMI is for 835 MW of capacity, with a planned startup date in 2028.

Whose Reactor?

The companies said Kairos would "develop, construct and operate" the reactors, selling the output to Google. Founded in 2016, Kairos has no nuclear construction or operational experience and a miniscule balance sheet. How the company will afford to finance and build its reactors, even with help from Google and the government, is an open question, in part because there are numerous SMR startup companies all vying for similar funding.

What Technology and Fuel?

The technology being developed by Kairos would use molten salt as the coolant instead of the light water used in existing conventional boiling and pressurized water reactors in the U.S. The company's reactor technology has not yet been fully licensed by the Nuclear Regulatory Commission (NRC), and there is no certainty when and even if that will happen. The reactor will also require high-assay low enriched uranium (HALEU) fuel. This fuel, enriched to roughly 19% (much higher than the 4%-5% enriched fuel used in existing U.S. reactors), is in extremely short supply in the U.S. Indeed, supply concerns have already prompted another company, the Bill Gates-backed TerraPower, to delay the expected commercialization of its Natrium SMR in Wyoming by two years, to at least 2030.

Where?

The companies said the plants "will be sited in relevant service territories to supply clean electricity to Google data centers."[1] That may be good for Google, but the statement ignores the many issues faced in the different power markets and grid systems around the country when building new generation resources.

Will the reactors be sited in an organized market, such as PJM, home to a major concentration of data centers in Virginia and other rapidly growing areas where Google has interests? If so, how long do the two companies expect it to take to get through the interconnection queue process? PJM's interconnection system has been overwhelmed with developer requests to build new capacity and is effectively closed while officials look to clear the queue. In other words, Kairos and Google cannot even get in line at the moment.

If not located in an organized wholesale power market like PJM, the plants Kairos and Google plan to build will need utility sign-on and, by extension, state regulatory approval. That is a time-consuming process that cannot be avoided. It also would force Google and Kairos to address growing concerns about the broader benefits of the surge in AI and data center demand: Will the costs of the new infrastructure benefit all utility customers? That is a question regulators increasingly will want answered.

A third option would be to go it alone, off the grid or behind the meter, but that would entail essentially becoming a utility, something that Google likely is not interested in and with which Kairos has no experience. These co-location deals also suffered a recent setback when the Federal Energy Regulatory Commission (FERC) denied a plan by Talen and Amazon to effectively take some of the capacity of the 2,494MW Susquehanna nuclear plant off the grid to power a nearby data center.

Amazon, Energy Northwest and X-energy

The details in the Amazon, Energy Northwest and X-energy announcement were equally sparse. The topline takeaway was Amazon's pledge to bring five gigawatts (GW) of X-energy's SMR technology online by 2039—15 years from now—with the focus initially on developing one 320MW plant in Energy Northwest's Washington service territory.

Whose Reactor?

The partners said "the reactors will be constructed, owned and operated by Energy Northwest."[2] Energy Northwest is a joint operating agency of the state of Washington. Its membership includes 24 public utility districts and five municipalities; its primary asset is the Columbia nuclear power station, a 1,151 MW boiling water facility that began commercial service in 1984.

Energy Northwest was formerly the Washington Public Power Supply System, which defaulted on billions of dollars in bonds in the early 1980s in a previous nuclear power expansion program.[3] It is a small company with about 1,000 employees and no recent nuclear plant construction experience.

How Energy Northwest will finance and build the planned reactor was not addressed in the parties' press release. If the construction is to be underwritten by Amazon, what contract protections will it require to protect its bottom line?

What Technology and Fuel?

The technology at the heart of the deal is X-energy's proposed 80MW high temperature gas reactor (HTGR), which the company says will commonly be sold as a four-pack, bringing it to the planned 320MW unit to be built by Energy Northwest.

As with Kairos, X-energy is still in the licensing process at NRC with no certainty as to when or if that effort will be resolved satisfactorily. The X-energy reactor also requires the same hard-to-secure HALEU fuel needed by Kairos.

The HTGR technology touted by X-energy has a mixed history. The only commercial-scale HTGR built in the U.S. was the 330MW Fort St. Vrain facility in Colorado. It operated from 1979-89 and never posted an annual capacity factor of more than 30%.[4] Equally problematic, its availability factor, the amount of time the unit was available to generate electricity, only exceeded 50% twice during its 11 years of operation.[5]

The newest HTGR, located in China, also appears to be having operational problems. The Chinese design links two reactors each with 100MW of capacity to a single turbine, but the facility's generation capacity was derated in 2023 to just 150MW total.[6] In addition, the reported generation only totaled 112 gigawatt-hours (GWh), which amounts to an annual capacity factor (assuming 90% operation during the year) of just 9.5%.

Where?

The first four-unit plant will be built on Energy Northwest property within the Hanford Nuclear Reservation in central Washington state. The companies' announcement also says Energy Northwest has the option to add another 640MW of capacity (two more of the X-energy four packs) at the site.

Where the remaining 4GW of capacity would be located was left unanswered, raising the same questions as with the Kairos deal about siting.

The announcement also is unclear about the costs and benefits for Energy Northwest's members. Energy Northwest will build, own and operate the reactors, but Amazon has "the right to purchase electricity from the first project." And if expanded, the additional power would be offered to Amazon and other utilities—placing all the risks on Energy Northwest, while the benefits would flow largely to Amazon. The municipal and public utility members of Energy Northwest should be asking hard questions about this deal now, before the dollars begin to flow out the door.

Back to Reality

Missing in these two announcements is any acknowledgement of the enormous timing mismatch.

The rush for electricity to power rising AI and data center demand is a "now" issue. In a summer analysis, for example, S&P estimated that demand from the sector could require roughly 50,000 MWs of capacity by 2028. These SMR deals, if they happen at all, are a next-decade resource, at the earliest.

This point, a key rationale in IEEFA's past research questioning SMRs, has been underscored recently by others in the electric utility sector.[7]

Most telling is the critique offered by John Ketchum, the CEO of NextEra Energy, parent of Florida Power & Light, the largest U.S. utility as well as a major renewable energy developer. In the company's third quarter earnings call in October, Ketchum told analysts that "alternatives such as new utility scale nuclear and SMRs are unproven, expensive and again, not expected to be commercially viable at scale **until the latter part of the next decade (emphasis added)**."

Responding to a subsequent analyst question, Ketchum added a point regarding the financial viability of the SMR developers currently pushing forward with design proposals: “A lot of them are very strained financially. [There] are only a handful that really have capitalization that could actually carry them through the next several years.”

Ketchum is not the only cautionary voice. In a recent interview with the Financial Times, Andres Gluski, CEO of AES (like NextEra, both a utility holding company and large renewable power developer) said: “The euphoria is a little bit overblown.”

Not even all the big tech types are convinced. Speaking at a Wall Street Journal event, Matt Garman, CEO of Amazon’s cloud computing unit, stressed the key point: SMRs are “not going to solve anything in the 2020s.”

> **“SMRs are ‘not going to solve anything in the 2020s.”’**
>
> **— Matt Garman, CEO, Amazon cloud computing unit**

The Solutions Are Already Here

That underscores the real point. Options to build significant new clean energy capacity are available now, and that needs to be the focus.

In October, SB Energy Global said it had begun commercial operation at an 875MW solar project in Texas—less than two years after the project was announced. The biggest customer for the project is Google, which has agreed to purchase 75% of the output. Financing for the project was secured in November 2023, meaning getting the steel in the ground and the plant into commercial operation took just 11 months.

Enbridge announced a similar large-scale project on Nov. 1, saying it would build an 815MW solar farm west of Dallas that it expects will be fully online in 2026. The main customer for the project is AT&T.

In Arizona, another hot spot for both solar and data center demand growth, Ørsted launched commercial operation at the hybrid Eleven Mile Solar and battery storage project in November—just 21 months after beginning construction. The project includes 300MW of solar generation capacity plus a 300MW, four-hour battery unit. The project’s principal offtaker is Meta Platforms, the parent company of Facebook and Instagram.

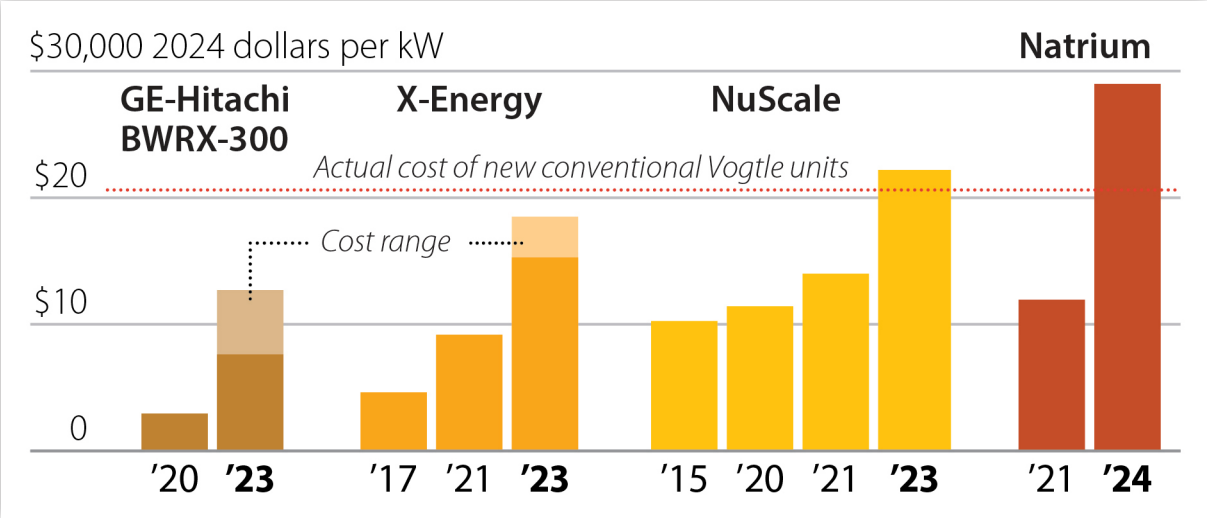
When it secured financing, Ørsted pointed to the tax transferability provisions in the Inflation Reduction Act as a key component in getting the deal finalized. That “opens the doors for a lot more corporates and companies with tax liability in the United States to come in and help support clean energy projects,” according to Melissa Peterson,[8] head of onshore and origination at Ørsted. “It’s really a unique structure that we hope to replicate over and over again.”

Another clean, near-term option is geothermal energy. Long geographically limited, developers are now pushing forward with projects that clear this limitation through the adaptation of fracking technologies used in the oil and gas sector.

One of the sector's leading companies is Houston-based Fervo. It recently secured approval for a 400MW project in Utah that it expects to have online by 2028, with the first 90MW slated for commercial operation in 2026.

Beyond the speed of development, the project's estimated cost is noteworthy. S&P says Fervo's Cape project will cost roughly $1.3 billion, putting its construction cost at $3,200 per kilowatt. Costs for SMR projects being tracked by IEEFA are well over $10,000/kW, even though none have been fully licensed or begun construction.

SMR Construction Costs Are Already High, and Rising



Source: IEEFA calculations based on public data

Importantly, this is an apples-to-apples comparison, since geothermal will provide the same 24/7 power production that AI and data center companies say they must have. In filings with the Public Utilities Commission of Nevada for a project it is developing for Nevada Power and Google, Fervo estimated that the facility's annual capacity factor would be 86%.

In short, there are clean, cost-effective power options available today both for big tech and everyone else. Utilities, developers and large power users need to focus there and stop hyperventilating over expensive, unproven nuclear technologies that will not generate meaningful amounts of power until well into the 2030s, if then.

Endnotes

1 Kairos Power. Google and Kairos Power Partner to Deploy 500 MW of Clean Electricity Generation. October 14, 2024.

2 Amazon. Amazon signs agreements for innovative nuclear energy projects to address growing energy demands. October 16, 2024.

3 Energy Central. Energy Northwest goes for X-energy HTGR SMRs. August 16, 2024.

4 Capacity factor measures the amount of electricity produced during a given period compared to the maximum amount that could have been produced.

5 World Nuclear Association. Fort St. Vrain. Last visited November 12, 2024.

6 Mycle Schneider. The World Nuclear Industry Status Report 2024. September 2024.

7 IEEFA. Small Modular Reactors: Still too expensive, too slow and too risky. May 29, 2024.

8 CNBC. Denmark's Orsted wins $680 million JPMorgan backing for U.S. solar and battery projects. May 23, 2024.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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