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Tariffs Mean Nuclear Energy is COOKED, aff can't surpassthe burden

Pomper 25 [Miles A. Pomper, Yanliang Pan, 3-10-2025, Miles Pomper is a **Senior Fellow** in the Washington DC office of CNS. His work focuses on nuclear energy, nuclear nonproliferation, nuclear security, and nuclear arms control. He holds a master's degree in international affairs from Columbia University and a master's degree in journalism from Northwestern University. Before joining CNS he served as Editor-in-Chief of *Arms Control Today* from 2003-2009. Previously, he was the lead foreign policy reporter for *CQ Weekly* and *Legi-Slate News Service*, where he covered the full range of national security issues before Congress, and a Foreign Service Officer with the US Information Agency. "Trump's Tariffs on Canada Could Kill the U.S. Nuclear Energy Revival", World Politics Review, https://www.worldpoliticsreview.com/us-nuclear-energy-tariffs/]//dshah

Hopes for a U.S. nuclear energy revival may be **jeopardized by the tariffs that President Donald Trump continues to threaten to impose** on Canada, as well as his plans to similarly target the European Union moving forward.

That's because the **nuclear industry depends on a global supply chain** that can take uranium concentrate from Kazakhstani mines, for instance, convert it to uranium hexafluoride in Canada and enrich the product in France, before finally delivering it to a U.S. fuel fabricator. **Trump's tariffs will make that exceedingly complicated, costly and precarious, to the great detriment of the U.S. nuclear sector.**

Flexible global market mechanisms have allowed the U.S.—a country with negligible uranium mining activities and limited downstream conversion and enrichment capacity—to secure enough fuel to operate the largest fleet of nuclear reactors worldwide, producing some 20 percent of the country's electricity. All that will change if the Trump administration follows through on its threatened 10 percent tariff on uranium imports from Canada, among other products—which were imposed on March 4 but subsequently removed—amid threats of broadening the trade war to the EU. Trump left in place an additional 10 percent tariff he announced on March 4 on Chinese uranium imports, which were already under a 17.5 percent tariff as of Feb. 4.

As of 2023, more than **95 percent of** the **uranium purchased by U.S. utilities was of foreign origin.** Canada accounted for the largest share at just over 25 percent. Further downstream along the supply chain, only around one-third of the uranium conversion and enrichment capacity needed to keep U.S. reactors running are domestically located, with the rest sourced from the EU, Canada, Russia and China. For the U.S. nuclear industry, the tariffs would be all harm and no benefit, not least because U.S. nuclear fuel buyers will have to swallow much of the costs. Ever since the first Trump administration contemplated tariffs on uranium products in 2019, the Canadian uranium supplier Cameco has included provisions in its fuel contracts to ensure that any future U.S. tariffs would be passed on to the buyer. Nor will the impact on prices be confined to Canada and the EU, for **once tariffs kick in, all suppliers will have an incentive to raise their asking price**. And the **U.S. utilities will have** to pay given their inelastic demand and—in some cases—**limited inventories.**

To make matters worse, the same **uranium material may have to leave the U.S. for conversion,** enrichment and fuel fabrication before re-entering the country, thereby **triggering the tariff a second and even third time**, quickly compounding domestic fuel costs. Fuel prices have already spiked in recent years due to geopolitical turbulence as well as expectations that rising demand for low-carbon fuel sources and electricity—needed to power data centers and electric cars—will spark a nuclear renaissance. Recurring tariffs may further **erode utilities' thin operating margins,** further burdening an industry that is just beginning to recover from its post-Fukushima decline as well as competition with cheap natural gas from fracking.

Will U.S. domestic fuel producers benefit from these tariffs? The answer, for the most part, is no. Mining, conversion and enrichment are capital-intensive industries, and companies wait for long-term price signals when deciding whether to undertake the cumbersome and time-consuming process of restarting or expanding operations. For those companies previously on the verge of such a decision, skyrocketing uranium prices in recent years have already provided the necessary demand signal, and a tariff would make little difference. In conversion and enrichment, meanwhile, **domestic producers** would **lose** foreign **customers** reluctant to pay a tariff on any uranium feed material they ship to U.S. facilities for further processing. And if **reactors** do **shut down** due to higher fuel and operating costs, demand on uranium products and services will fall, thus threatening recent commitments to capacity expansion by U.S.-based fuel producers, which have given the domestic supply chain its first hopes of recovery in more than a decade.

In no small part due to the protests of U.S. utilities and foreign nuclear fuel suppliers alike, the first Trump administration in 2019 decided not to impose trade restrictions on uranium imports following a lengthy investigation into whether they threatened national security. Even the domestic uranium producers that petitioned for trade protection in the first place eventually applauded the "no action" decision as it ended 19 months of market uncertainty.

From a market perspective, the only thing worse than tariffs is arguably the uncertainty over future **tariffs.** Unfortunately, Trump's flip-flopping on the import duties threatened for Canada, combined with those expected for the EU, will likely represent only the **begin**ning of **an uncertain period.** There are still questions, for instance, over how long tariffs on various products that may be imposed will remain in place, given the administration's signals of sector-specific exemptions. Logistically, great uncertainty also remains over how tariffs would apply to book transfers and swaps that are common in the nuclear industry, as well as over how U.S.-origin material stored at foreign warehouses would count versus foreign-origin material at U.S. facilities.

The expectation of tariffs leading into the March 4 announcement had already led to a price premium on uranium held within the United States. Any further tariffs would now risk bifurcating the market between U.S.- and foreign-origin uranium products, with the potential to disrupt supply chains. Uranium traders have not tracked the physical origins of traded material for decades. For an industry accustomed to a globally interconnected open market, a return to the practice of tracking uranium origins all the way through the supply chain could impose unforeseen logistical burdens and supply disruptions, if it can even be done.

Still, the greatest open question is over the retaliatory export restrictions that major nuclear fuel suppliers might impose on the U.S. in response. **The Canadian government has been contemplating retaliatory controls** and taxes on major export commodities bound for the U.S., **including uranium.** If **Canada wants to retaliate in the civil nuclear sector**, it can. **Beyond uranium, the leading U.S.-based vendor of reactor technology, Westinghouse Electric Company, is now Canadian-owned. And U.S.-based companies marketing small modular reactors, from NuScale to GE-Hitachi, have received their first crucial orders from European and Canadian customers. Without these demonstration projects, their reactor designs will remain confined to paper. To complicate matters further, U.S. companies, lacking heavy nuclear manufacturing capacity of their own, must rely on foreign suppliers of large reactor components** for future construction. North America's largest manufacturing facility for commercial reactor equipment, for instance, is the BWXT factory in Ontario, where the pressure vessel for GE-Hitachi's BWRX-300 reactor is supposed to be fabricated—that is, if the BWRX project is not canceled due to Trump's tariffs and the ensuing retaliatory turmoil.

In 2020, during the first Trump administration, the Department of Energy published a strategy paper titled, "Restoring America's Competitive Nuclear Energy Advantage," highlighting the importance of the industry for national security. Energy assurance is arguably an even bigger priority for Trump during his second term, and judging from his Jan. 20 executive order urging the return of uranium to the critical minerals list, the current White House clearly recognizes the importance of uranium as a strategic resource.

Yet imposing **tariffs** on major uranium-supplying allies is a poor way of guaranteeing the United States' uranium access, as it **risks undermining** the open market and the United States' position within it. Nor is alienating critical reactor development and deployment partners like Canada a winning strategy for restoring the U.S. civil nuclear industry, which already lacks both committed demand and supply capacity, and has for decades struggled to compete with vertically integrated Russian and Chinese state-owned enterprises. Unless the administration begins paying attention to the dangerous effects of its trade policy on the **nuclear industry, the U.S. will keep**

losing in that competition.

On subs

On the uq

On the uq

The US is far ahead and still going --- investment is inevitable regardless of the aff.

Dibb 24

[Paul Dibb and Richard Brabin-Smith, both former deputy secretaries of defence. 4-26-2024, "Why the US will stay dominant in undersea warfare", Strategist, https://www.aspistrategist.org.au/why-the-us-will-stay-dominant-in-undersea-warfare/] //JC

A number of commentators in Australia have lately made rash pronouncements about the demise of US submarines, alleging that innovative technologies will make the vessels vulnerable. Others have been arguing that US nuclear-powered submarines are now noisier than their Chinese counterparts and will be easily detectable by China. The fact is that **the United States** has been **so far ahead in submarine technology** and **secure underwater operations** over the past 50-plus years that its submarines are virtually **undetectable** by either China or Russia. In the Cold War, US attack submarines (SSNs) tailed Soviet ballistic–missile firing submarines (SSBNs) at close quarters without being detected. There is every reason to believe that the same applies these days to China's SSBNs. It is our view that China's SSBNs are so easily tracked by US SSNs that China's allegedly survivable second-strike nuclear capability is at high risk (as was that of the USSR in the Cold War). In brief, the quietness of US submarines and the sophistication of their operations are legendary. The reason for this is that for more than half a century the United States has **persistently poured vast amounts** of **research and development in**to **superior underwater warfare technology.** Naturally, these capabilities are among the United States' most highly guarded secrets, so little information about them is in the public domain. However, we recommend two books: Blind Man's Bluff by Sherry Sontag and Christopher Drew (1998) and The Silent Deep: The Royal Navy Submarine Service since 1945 by Peter Hennessy and James Jinks (2016). The former is about highly classified US submarine operations involving the CIA tapping into the USSR's seabed communications in the sea of Okhotsk for the Soviet Pacific submarine fleet in Kamchatka. US submarines made repeated visits and were not detected. The Silent Deep covers close–quarter submarine operations against Soviet SSBNs and SSNs by British nuclear submarines, whose reputation is similar to US submarines'. To our knowledge, there is no equivalent book available about operations against China's submarines yet (but the subject is touched on by Michael McDevitt's China as a Twenty First Century Naval Power, 2020). Those who talk about **superior Chinese submarine operations** being able **easily to detect US submarines do not know what they are talking about**. The fact is that until recently **China** has **depended very much on Russian technology for** its SSBNs and SSNs. That includes **even such relatively** straightforward techniques as isolating the noise of engines and other machinery from the hull. We need to remember that in the Cold War Soviet ballistic–missile firing submarines were known as **boomers** because their loud noises were **detectable over very considerable distances**. As for China dealing with US submarines, the Pentagon stated in 2023 that **China** '**continues to lack a robust deep-water anti-submarine warfare capability**.' It is true, of course, that both Russia and China are making progress towards quieter submarine operations. But do we believe that the United States is sitting on its hands and making no technological advances? **Of course not**. The **US** Navy **continues to invest huge amounts** in **ensuring** that its submarines remain **at the absolute forefront** of hard-to-detect operations under the world's oceans. So, when we take delivery of our three Virginia–class SSNs from the US, we can be confident that they will be both highly effective and difficult to counter. This is why China is so angry about the prospect of our acquiring them. China already has a bad case of SLOC anxiety (worrying about its sea lines of communication). It fears loss of critical supplies, such as oil, that come through the confined waters of Southeast Asia.

Prolly kills case

Their ev says turbine development is what causes it is. Not why atomic

SSBN delays from alt causes like cost. Honrada 25

Honrada 25, Asia Times, "Sinking ship: US undersea nuclear deterrent's plunging credibility", 3-21-2025, https://asiatimes.com/2025/03/sinking-ship-us-undersea-nuclear-deterrents-plunging-credibility/#/ Lexmas

Delays and cost overruns in the US Columbia-class **SSBN** program threaten the credibility of its undersea nuclear deterrent and ability to match China's naval expansion."

The US Navy's plan to replace its aging undersea nuclear deterrent faces costly delays, raising concerns about the credibility of its posture and future ability to keep pace with China's naval expansion.

This month, the US Congressional Research Service (CRS) released a report mentioning that the US Navy faces an estimated 12 to 16-month delay in the delivery of its first Columbia-class ballistic missile submarine (SSBN), threatening the timely replacement of aging Ohio-class SSBNs.

The **delay, attributed to** shipyard **workforce shortages, supply chain disruptions and** component **delivery setbacks**—particularly Northrop Grumman's late turbine generators and Huntington Ingalls Industries' bow section—raises concerns about the impact on subsequent submarines.

The **US Navy** is **consider**ing **extending** the **service life** of up **to** five Ohio-class boats to **mitigate risks, but** this **strategy involves additional costs** and logistical hurdles.

Meanwhile, the simultaneous construction of Columbia-class SSBNs and Virginia-class attack submarines (SSNs) presents industrial-base challenges as shipyards and suppliers struggle to scale production. The US Navy and industry aim to increase Virginia-class production to two boats annually by 2028, yet the current output remains at 1.1-1.2 submarines per year.

Rising costs compound the issue, with the Columbia-class program's procurement budget growing 12.1% in the past year alone. **Further overruns could siphon funding from other** US **Navy** shipbuilding **programs**, placing additional **strain** on the US Department of Defense's (DOD) **long-term naval strategy.**

Amid ballooning costs and delays, the US may need to ramp up submarine production more urgently than ever. In an article this month for We Are The Mighty, Logan Nye mentions that, at present, China relies on anti-ship ballistic missiles (ASBM) such as the DF-21D and DF-26B to keep US carrier battlegroups at bay from Taiwan.

No warrant why investing in domestic nuke energy why it goes to the submarine fleet, prolly goes

IL. Deterrence fails---Adversaries are defensive.

ICG 23 [Shoring Up, 10-27-2023, "Preventing War in the Taiwan Strait" International Crisis Group, https://www.crisisgroup.org/asia/north-east-asia/taiwan-strait-china/333-preventing-war-taiwan-strait, accessed: 10-27-2024] OA

As noted above, the status quo has traditionally comprised different elements for each of the principal actors in the Taiwan Strait. For China, it is critical that Taiwan **not pursue** de jure **independence**, which would **obstruct unification**, its ultimate goal. For Taiwan, the key is to maintain de facto sovereignty, thus keeping a say in determining its own status. As for the U.S., it seeks an equilibrium in which China **does not pursue forceful unification** and Taiwan **does not declare formal independence**. Within this matrix, all the parties constantly try to improve their respective positions without going so far that the others walk away from the framework altogether, potentially leading to conflict. Yet this game is dangerous: the more any party feels it is **losing the ground** it most cares about, the more the **conflict risk rises**. For purposes of assessing whether this risk is still growing, a key consideration will be how a militarily more capable China responds to a shifting environment in which the barriers to peaceful unification have got higher thanks to a stronger sense of Taiwanese identity and Washington's efforts to strengthen Taiwan's de facto sovereignty. On one hand, despite the challenges, **peaceful unification** remains Beijing's stated **preference**. China appears to remain confident that, with time and a cross-strait power balance that continues to shift overwhelmingly in its **favour**, Taiwanese "compatriots" will **come around** to seeing unification as an "**inevitable historical trend".**111 In 2021, Xi remarked that "time and momentum are always on our side".112 Similarly, Xi's report to the 20th Party Congress and 2019 speech on the 40th anniversary of the "Letter to Taiwan Compatriots", and the 2022 White Paper on Taiwan all convey the belief that reunification is **inexorably approaching**.113 On the other hand, China's war-fighting capacity has increased. Moreover, Beijing has long believed that the **threat of force** – replete with clearly escalatory shows of military might – is important for deterring Taiwan from moving toward **formal independence** and inducing caution in how Washington engages with Taipei. This mindset may increase the **risk of conflict** due to **misjudgement** or **miscalculation**. It is also not certain how long China's current preferences will hold. Its decision-making about whether and how to apply force to compel unification will be both fundamentally political and also contextual – in that it will take into account various factors above and beyond the advancement of its military capabilities, including the domestic and international situation that the country faces.114 Beijing will not necessarily attack Taiwan simply because it has the **military ability** to do so. Nor, however, is it likely to hold back from launching an assault, regardless of its capacities at the time, if it feels Taiwan has **crossed its red line**, namely declaring de jure independence.115

On Heg

On the uq

1. **NU/T - Rosatom is declining, but Western development allows them to compete.**

Bellona 24 [Bellona; News Organization; March 13; "Rosatom's output **dropped** over the last year. We look at three reasons why," https://bellona.org/news/nuclear-issues/2024-03-rosatoms-output-dropped-over-the-last-year-we-look-at-three-reasons-why; DOA: 3-27-2025] tristan

A decrease in output from Russian nuclear power plants is an expected and natural stage in the development of the country's nuclear energy industry, which is experiencing a period of **aging** of a certain part of its nuclear fleet. In recent decades, Rosatom has taken a leading position in the construction of nuclear power plants abroad, but has delayed the construction phase of replacement capacities within the country. Over the next 5 years, there will be a gradual **reorientation** of Rosatom's activities from foreign nuclear power plant construction projects to domestic ones. At the same time, the quality of Russian turbine equipment still leads to periodic technical problems and is mainly used on domestic Russian projects. It is unlikely that the situation will change quickly in the coming years, therefore, in many cases of competitive selection of projects, the success of Rosatom's new export proposals for the construction of nuclear power plants will **depend on** effective cooperation with foreign, primarily Western, partners. And in the future, perhaps even Chinese.

And, China's exports will slow.

Willis 24 [Matthew; News Reporter @ NSB; May 16; New Security Beat; "Don't Panic US: China's Nuclear Power Ascendancy Has Its Limits," https://www.newsecuritybeat.org/2024/05/dont-panic-us-chinas-nuclear-power-ascendancy-has-its-limits/; DOA: 3-27-2025] tristan

Nonetheless, nuclear projects have encountered hurdles in developing countries where substantial financial support, technical oversight, and design adaptations to local conditions are often required. Moreover, China has **rarely** mobilized its vast financial resources to support nuclear abroad.

Even ignoring prospective stagnation at home and the unlikeliness of that leading to major exports, China's nuclear sector will be preoccupied with **domestic** commitments for some time.

These constraints, paired with the Belt and Road Initiative's focus on **other** energy projects and the **failure of past** bilateral nuclear agreements, make it unlikely China will build 30 or more reactors overseas by 2030. Beijing will finance only so many projects abroad, especially with current high debt levels and other economic headwinds.

Competition with China Should Not Drive US Nuclear Power Policy

American policymakers should resist the drumbeat of some advocates pushing a boost of the US nuclear industry to "keep up" with China's nuclear construction. China's domestic nuclear constraints and lack of overseas expansion means increased US nuclear support for competitive reasons is not warranted.

1. China and Russia are way too far ahead there's literally no reason why investing solves and if tech is too ahead obviously no country reverses decisions

U.S. Nuclear laws DECK solvency

Freeman '18 [Madison Freeman, research associate @ Council on Foreign Relations. 7-12-2018, "How Russia, China Use Nuclear Reactors To Win Global Influence", Defense One, https://www.defenseone.com/ideas/2018/07/china-and-russia-look-dominate-global-nuclear-power/149642/, doa 3-9-2025] //ALuo

In addition, U.S. nuclear exports are **severely limited by restrictive export laws and** an **inefficient and complicated export control process.** While maintaining nonproliferation standards is critical to safeguarding global peace, the **stringent conditions** of these agreements and export controls make U.S. technology **far less appealing** to other countries than technology from Russia or China, which comes with **fewer strings attached.** Creating hurdles for U.S. exports will not prevent the adoption of nuclear technology by interested countries, but it will **remove the United States** from a role in which it can help **guide the development** of nuclear power and monitor for proliferation concerns.

On the IL

Pursuit causes short-termism---extinction.

Pampinella '19 [Stephenis Pampinella; Assistant Professor of Political Science and International Relations at the State University of New York; 01-23-2019; "The Internationalist Disposition and US Grand Strategy"; The Disorder of Things; https://thedisorderofthings.com/2019/01/23/the-internationalist-disposition-and-us-grand-strategy/; accessed 01-18-2025] leon

Finally, **attempts** to revive **US hegemony** will doom **transnational efforts to deal** with **existential** non-state **threats**. **Hegemonists** like Thomas Wright **argue** that **Russia** and **China** are the **greatest threat** to the **United States**, and that **Washington** should **never** make **concessions** to either power as a means of ensuring cooperation on issues of global governance. However, "**ring**-**fencing**" **global capitalism** and **climate change** as **separate issues** will **fail** to **achieve** the **necessary level** of **cooperation** to **cope** with these **threats**. **National security** policymakers **cannot recognize** that the **greatest dangers** faced by **US citizens** are non-state **economic** and **ecological** global **processes** that shape **domestic politics** from the **inside-out**, and not rival sovereigns. Economic destitution to the point of embracing fascist dictators coupled with environmental collapse are near-certain non-state threats which transcend our boundaries – in fact, as a global power, the United States has been complicit in creating them.

The **internationalist disposition** would **suggest** that the **priorities** of US **foreign policy** must **change**. Regulating global processes should be the primary objective, and it requires that the United States pursue intense macro-levels of cooperation with all other states, including its rivals, to achieve them. **Yet** it will be **unlikely** to do so if it **remains wedded** to **liberal hegemony** and **consumed** by **g**reat **p**ower **c**ompetition. **Short**-**term** incentives to **accumulate** **resources** and **power** will **override** the **long-term** need for **global governance**. The **result** will be a **world** whose **people** live in **precarity**, **ravaged** by **climate change**, and **constantly** on the **verge** of **g**reat **p**ower **war**.

1. Literally no warrant why the nuclear race is key to the heg race or why US heg is down rn it is a one liner in their piece of evidence and their IL ev points out alt cuases . DON'T let Eli blow it up in rebuttal it's way too late AND kills rebuttal clash.

On AI

Fears are overblown and companies solve --- their ev excludes new tech and domestic investments

Ramachandran '24 [Vijaya; Director for Energy & Development @ the Breakthrough Institute, Board Member of the Energy for Growth Hub, PhD in Business Economics from Harvard University; July 9; Breakthrough Institute; "Unmasking the Fear of AI's Energy Demand," https://thebreakthrough.org/journal/no-20-spring-2024/unmasking-the-fear-of-ais-energy-demand; DOA: 3-24-2025] tristan

In a detailed thread on X, MIT Innovation Fellow and former National Economic Council director Brian Deese argues that forecasters consistently overestimate electricity demand, in part because they emphasize static load growth over efficiency gains. Deese points out that in the early 2000s, analysts predicted surging electricity demand.

Instead, U.S. electricity demand has stayed flat for two decades. And although data center energy use is increasing, energy intensity (energy use per computation) has decreased by 20% every year since 2010. Nvidia—one of the largest companies designing graphics processing units (GPUs) for gaming, professional visualization, data centers, and automotive markets—is continuously improving the energy efficiency of its GPUs. Its new AI-training chip, Blackwell, for example, will use 25 times less energy than its predecessor, Hopper. Deese points out that analysts may be double-counting energy use by data centers because technology companies initiate multiple queries in different utility jurisdictions to get the best rates.

A (carbon-heavy) query to ChatGPT suggests AI and data service providers have considerable room to improve the energy efficiency of data center infrastructure using various measures:

Virtualization and Consolidation: Virtualization technology can be used to consolidate servers and reduce the number of physical machines running. This can lead to significant energy savings by optimizing server utilization rates.

Efficient Cooling Systems: Cooling accounts for a substantial portion of a data center's energy consumption. Implementing efficient cooling techniques such as hot/cold aisle containment, using free cooling when ambient temperatures allow, and employing modern cooling technologies like liquid cooling can reduce energy usage.

Energy-Efficient Hardware: Energy-efficient servers, storage devices, and networking equipment can be a priority, as can the use of products with high energy efficiency ratings (such as ENERGY STAR certified devices), with use configurations optimized for lower power consumption.

Power Management Software: Power management tools and software can monitor and adjust power usage based on demand. This includes dynamically adjusting server power levels during periods of low activity (e.g., using power capping techniques).

Optimized Data Center Layout: Data center layouts can be designed to minimize energy waste and optimize airflow. This includes proper rack layout, efficient cable management, and ensuring equipment is placed to minimize cooling requirements.

Energy-Efficient Data Storage: Efficient data storage technologies and practices, such as data de-duplication and compression, can be used to reduce the overall storage footprint and associated energy requirements. Continuous monitoring and optimization will also help.

Electricity demand from electric vehicles (EVs) may prove to be comparable or even higher than that of AI. The Princeton REPEAT model estimates the demand for electricity in the United States at 391 TWh for EV transportation (light-duty vehicles and other electric transport) in 2030, which is similar to BCG's 2030 estimates for data centers (320 - 390 TWh). Rystad Energy predicts EV usage will grow from 18.3 TWh to 131 TWh for the same period. Despite the additional energy demand, policymakers strongly encourage the purchase of EVs and the construction of charging infrastructure, while commentators seem relatively unconcerned about EV charging needs. This may be because EVs are seen to be filling an existing societal need for transportation, as well as a solution to the problem of climate change. Even though AI has potential to raise productivity and improve lives, it is a new and energy-intensive technology whose value runs counter to the priorities of the environmental community.

No matter the level of future AI use, AI's energy demand will make it more difficult—if not impossible—to dismiss the intermittency challenges associated with powering commercial and industrial loads with wind and solar energy. Data centers' real-time power demand requires continuous, dispatchable power which cannot be provided solely by renewables without significant excess generation capacity and large amounts of cheap storage.

Technology companies like Microsoft and Google are taking steps to meet their data center energy needs. Microsoft recently inked an agreement with Constellation Energy to supply its data center with nuclear-produced power. Other firm clean energy sources may also play crucial roles in decarbonizing AI energy consumption. Last year, Google partnered with Fervo Energy to power its Nevada-based data center with geothermal power. At least one hydropower developer—Rye Development—is planning to develop hydroelectric facilities to match data center electricity use.

The bottom line is that we do not need to fear AI's challenge to the energy grid. Utilities and tech companies will meet increased demand by using a mix of energy sources, including clean and firm electricity supplies like nuclear energy, geothermal power, and even hydropower. AI is not the first—and nor will it be the last—game changer in society's energy consumption. The discourse on AI's energy footprint must therefore shift from apprehension to proactive problem-solving, focused on energy efficiency gains and diversification of clean energy sources, driven by the notion that a high-energy planet is essential for human progress.

1. **Solar is key to the tech race prefer our ev does the comparison. And remember you cut solar that's 1NC CAN**

John **Atkinson**, 1-23-20**25**, "Solar Microgrids – or "Hypergrids" – Are America's Best Bet to Win the AI Race," John has over 15 years of marketing and policy communications experience in the clean energy industry, with expertise in technologies including solar, energy efficiency, batteries, electric vehicles, and hydrogen. As a marketing writer, he has crafted impactful long-form, short-form, and social media content for industry-leading companies such as Google X, Amazon Web Services, Mosaic, Chargepoint, Nextracker, LONGi, Black & Veatch, and JLL, along with ongoing work for the sponsored content division of Canary Media (and formerly GTM). As a policy consultant, he has guided successful federal regulatory and legislative initiatives, secured millions of dollars in state grants, and produced numerous reports on clean energy policy and technology issues for Foreign Policy Analytics.,https://www.scalemicrogrids.com/blog/solar-microgrids---or-hypergrids---are-americas-best-bet-to-win-the-ai-race , accessed 3-30-2025, /Lexmas

Skyrocketing energy demand for AI data centers is an inescapable topic. Continued leadership in **AI is** critical to America's economic growth and its national security, but its voracious appetite for energy is **straining** the **capacity of** our aging electricity **grids** – and potentially increasing electricity costs and emissions in the process, especially if this new demand is met primarily by reactivating nuclear plants or going all-in on natural gas.

Scale's Duncan Campbell recently worked with collaborators from Stripe and Paces to investigate the potential of off-grid microgrids powered by solar, battery storage, and natural gas for backup **to meet** AI's energy **needs**, and what they found has been making headlines: 90% **solar-powered microgrids** in the U.S. southwest **offer a fast**er **and** more **scalable solution than** existing **nuclear** or natural gas-only **options, with** comparable costs and **lower risk**.

In short, **the surest path for America to win the AI race will harness our world-class solar resources and technology leadership.**

Importantly, thanks to the combination of Scale's modeling expertise and Paces' siting expertise, we know that this opportunity isn't just hypothetical – an incredible 1,200 gigawatts of these primarily solar-powered AI datacenters could be built in the U.S. southwest, enough to meet all projected US datacenter growth through 2030 several times over.

Read on for a summary of their key findings, dig into the team's white paper for an in-depth look into this important research, and reach out to us if you're interested in discussing how to make off-grid solar microgrids for AI data centers a reality.

Why Speed, Scale, and Certainty are Key – And Why Solar Wins

For individual companies and entire countries, the AI race has existential stakes: those who first develop the best models, powered by the biggest "**hyperscale" data centers, could lock in long-term dominance over one of the most strategically important and profitable industries in history.** The urgency of securing this first-mover advantage has led companies to leave aside their usual concerns about power costs or sustainability and instead prioritize the speed of accessing data center power supplies, in tandem with the scale of power that can be accessed – and, relatedly, the certainty that the power will be built at the expected speed and scale.

After 20 years of essentially flat demand, the U.S. utility grid isn't ready to accommodate the speed or scale of this load growth in the timeframe required, leading hyperscalers to either adopt desperate-sounding gambits like Microsoft restarting Three Mile Island (more on that below) or give up on utility power entirely and take matters into their own hands with off-grid solutions, most often with natural gas turbines. But, while gas turbines offer a familiar, tired-and-true approach, it's not the fastest or the most scalable approach in 2025, and it faces supply chain, cost, and permitting risks that create significant uncertainty over its viability.

Here's what we found when we modeled different pathways for the development of a 500 MW data center:

Solar+Storage is Faster to Build: Due primarily to faster procurement times, off-grid **solar**-plus-storage **microgrids** (with gas engines for backup) **can be built sooner than a**n equivalent amount of off-grid gas turbine capacity. Typical deployment times are 2-4 years for solar microgrids, compared to 3-5 years for gas turbines – and innovative construction practices and design choices could accelerate solar's timeline further. For example, AI training data centers with lower uptime requirements could begin operations on solar and storage alone, ahead of the installation of backup gas engines.

Huge Solar Resource and Ample Supply Chain: Paces found vast areas of the U.S. southwest that would be feasible sites for a 500 MW data center cluster, with criteria including proximity to airports and highways to facilitate construction and access to gas pipelines for backup power generators. With over 1,200 GW of suitable sites, this region could easily host enough solar-powered data centers to meet projected U.S. AI demand of 30-300 GW by 2030. Solar and storage supply chains are also already scaling up rapidly, and both have spare capacity well in excess of current demand.

Turbines Face Supply Chain and Permitting Risks: Only a handful of companies around the world (GE, Siemens, Mitsubishi) manufacture utility-scale gas turbines, and booming demand is already beginning to strain their limited manufacturing capacity. Turbine lead times of 3+ years today are thus likely to increase. Moreover, gas-only projects may face air quality permitting issues in some areas, potentially further slowing down timelines and/or limiting their scale of deployment.

Limited Opportunities for Nuclear Restarts: As noted above, Microsoft made headlines with their plans to restart the Three Mile Island nuclear facility, closed in 2019, to power data center operations. This represents a much faster option than **the decade-plus timeline for developing new nuclear power plants in the U.S.**, but it will still take four years (until 2028) to begin operations, **and there are** relatively **few** similar opportunities for recently-decommissioned **plants that can be quickly and cost-effectively restarted.**

We expect that the massive demand pull of AI data centers will help drive the **commercialization of emerging energy technologies such as** enhanced geothermal, **small modular nuclear reactors, and even nuclear fusion**, and recent news announcements underscore this potential. However, timelines for deploying these pre-commercial technologies **tend to start at 2028 at the most optimistic**, **and delays** for first-of-a-kind (FOAK) facilities **are** highly **likely**, **making them too speculative as a first choice for AI companies seeking to secure competitive advantages today.**

Comparing Cost (and Sustainability) of Different Options

Given the absolute importance of securing hyperscale energy supplies ASAP, the cost of power is relatively much less important for AI data centers than for traditional commercial and industrial customers. That said, costs are never irrelevant, and most solutions being given serious consideration have been in the neighborhood of $100 per MWh. For reference, the average price for grid-connected industrial users in the U.S. is a bit over $80 per MWh, and rates are going up in most places due to the growing costs of maintaining our aging utility grids.

To estimate costs, the Scale team worked with viable sites identified by Paces and ran 20-year powerflow models for thousands of microgrid configurations supporting data center load 24/7, and ran these through Lazard's industry-standard Levelized Cost of Energy (LCOE) model. What we found was surprising, even to us – even including the cost of full backup, solar is quite competitive with natural gas-only solutions at about 50% solar, and remains within an acceptable range (and significantly lower than Three Mile Island-type restarts) at 90% solar.

Natural gas is still cheapest, but with downside risk: We estimate a cost for off-grid natural gas turbine-based solutions as $86 per MWh, which is higher than average industrial rates but is likely the cheapest off-grid option today. However, it's important to note that natural gas generation prices are largely determined by fuel costs, which can go through periods of volatility – most recently following Russia's invasion of Ukraine in 2022. As the U.S. ramps up exports of LNG and becomes increasingly integrated in the higher-priced international market for gas, it is projected to lead to further upward pressure on domestic prices as well.

Solar is cost-competitive, with room to improve: Our model found that **microgrids integrating solar**, battery storage, and natural gas backup **have very competitive costs** with significant upside. For standard designs, this ranges from $93 per MWh for a 44% solar configuration to $109 per MWh to meet 90% of energy needs with solar. These already-competitive costs can be improved further by adopting cost optimizations such as fixed-tilt systems and DC-coupled storage, **which could drop costs to $87 per MWh** for 44% solar – essentially the same price as gas-only – to $97 for 90% solar.

Nuclear remains expensive, even in a restart scenario: Nuclear power has seen its share of the electricity mix fall over the past decade due to its inability to compete with gas and renewables on cost, and the onrush of AI energy demand doesn't change that fact. Even in a case like Three Mile Island with a recently-decommissioned plant, the costs of restarting the plant plus delivering power over the utility grid results in an estimated LCOE of $130 per MWh. And, according to Lazard, the cost of building a new nuclear plant in the U.S. has an estimated LCOE of $190 per MWh.

2. It takes too long to build nuclear
1.

Both inks rely On SMRs

1. **<u>Zero</u> examples of SMR success – <u>costs</u>, low <u>output</u>, <u>delays</u>**

Jim Green, 1-17-2024, [Dr. Jim Green is the national nuclear campaigner with Friends of the Earth Australia, a member of the Nuclear Consulting Group, and is former editor of the World Information Service on Energy's Nuclear Monitor newsletter. He is author of a detailed SMR briefing paper released in June 2023. Jim has a degree in Public Health and a Doctorate in Science and Technology Studies], "Small modular nuclear reactors: a history of failure," Climate and Capital Media, https://www.climateandcapitalmedia.com/small-modular-nuclear-reactors-a-history-of-failure/, accessed 3-13-2025 //cy

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<u>Global hype around small reactor designs to replace fossil fuels is on the rise everywhere but few, if any, are likely to ever be built.</u> <u>Small modular reactors (SMRs) have been the subject of endless hype in recent years but in fact,</u> **<u>no SMRs have ever been built</u>**<u>, none are being built now and in all</u> **<u>likelihood none will ever be built</u>** <u>because of the prohibitive costs.</u> SMRs are defined as reactors with a capacity of 300 megawatts (MW) or less with serial factory production of reactor components (or 'modules'). No SMRs have been built, but dozens of small (<300 MW) power reactors have been built in numerous countries, without factory production of reactor components. Before looking at the troubled history of small reactors, it's important to note the context for the explosion in SMR hype. The hype for new types of reactors is largely a result of the stunning failure of conventional reactor construction projects. <u>In the U.S., the only current reactor construction project is the Vogtle project in Georgia (two AP1000 reactors). The latest cost estimate of</u> **<u>$34 billion</u>** <u>is more than</u> **<u>double the estimate</u>** <u>when construction began – $14-15.5 billion.</u> The V.C. Summer project in South Carolina (two AP1000 reactors) was abandoned in 2017 after the expenditure of around $9 billion. U.S. nuclear giant Westinghouse filed for bankruptcy shortly after the abandonment of the South Carolina project, and its parent company Toshiba only survived by selling off its most profitable assets. In 2006, Westinghouse said it could build an AP1000 reactor for as little as $1.4 billion, 12 times lower than the current estimate for Vogtle. Add a zero to industry estimates and your estimate will be far closer to the mark than theirs In the late 2000s, the estimated construction cost for one EPR reactor in the U.K. was £2 billion (US$2.52 billion). The current cost estimate for two EPR reactors under construction at Hinkley Point – the only reactor construction project in the UK – is £32.7 billion (US$41.3 billion). Thus the current cost estimate is eight times greater than the initial estimate of £2 billion per reactor. The only current reactor construction project in France is one EPR reactor under construction at Flamanville. The current cost estimate of €19.1 billion (US$20.8 billion) is nearly six times greater than the original estimate of €3.3 billion (US$3.58). (Lower figures cited by EDF and others typically exclude finance costs.) The costs of reactors in the U.S., the U.K. and France range from $17 billion to $20.8 billion per reactor. The ballooning cost estimates have increased 12-fold, 8-fold and 6-fold, respectively. It seems the golden rule of nuclear economics is to add a zero to industry estimates and your estimate will be far closer to the mark than theirs. <u>Globally,</u> **<u>nuclear power generation has been stagnant</u>** <u>for 30 years. Nuclear power's share of global electricity generation</u> **<u>has nearly halved from 17.5% in 1996 to 9.2% now</u>**<u>. Renewables have climbed to 30% and the International Energy Agency (IEA) expects "turbocharged" growth to reach 38% by 2027.</u> The global nuclear power renaissance never happened, partly because of the international fallout of the Fukushima disaster and partly because of the catastrophic cost overruns with conventional reactor projects. It is in this context that the industry has pivoted to promoting SMRs. However, history suggests it is false hope. SMRs so far? Shut down <u>The history of small reactors is a</u> **<u>history of failure</u>**<u>. The U.S. Army built and operated eight small reactors beginning in the 1950s, but they proved unreliable and expensive and the program was shut down in 1977. In addition, 17 small civilian reactors were built in the US in the 1950s and 1960s, but all have since shut down.</u> Twenty-six small Magnox reactors were built in the U.K. but all have shut down and no more will be built. The only operating Magnox is a mini-Magnox in North Korea: the design was made public at an Atoms for Peace conference and North Korea uses its 5 MW Magnox to produce plutonium for nuclear weapons. India operates 14 small pressurized heavy water reactors, each with a capacity of about 200 MW. <u>Professor</u>

M.V. Ramana noted in his 2012 book, "The Power of Promise: Examining Nuclear Energy in India," that despite a standardized approach to designing, constructing and operating these reactors, many suffered cost overruns and lengthy delays. There are no plans to build more of these small reactors in India. Nuclear power's share of global electricity generation has nearly halved from 17.5% in 1996 to 9.2% now Elsewhere, the history of small reactors is just as underwhelming. This includes three small reactors in Canada (all shut down), six in France (all shut down) and four in Japan (**all shut down**). Ramana concludes his history of small reactors with this downbeat assessment: "**Without exception,** small reactors **cost too much for the little electricity** they produce, the result of both their **low output and their poor performance."** Just two SMR plants are said to be operating – neither meeting the "modular" definition of serial factory production of reactor components. These so-called SMRs exhibit familiar problems of massive **cost blowouts and multi-year delays.**

1. No, structural issues still means it takes too long to build
2.