Google Goes Nuclear: The Unlikely Mineral Powering Kairos’s Hermes 2 and Its 24/7 Carbon-Free Data Center Energy

written by Tracy Hughes | August 19, 2025

Google’s pursuit of carbon-free energy for its power-hungry data centers has led the tech giant into an unexpected partnership at the frontier of nuclear innovation. In a first-of-its-kind agreement, Google will source “reliable, 24/7” electricity from Kairos Power’s Hermes 2 reactor – an advanced, small-scale nuclear unit – to help run Google’s Tennessee and Alabama data centers. This power purchase agreement, struck with the Tennessee Valley Authority (TVA), marks the first time a US utility has agreed to buy power from a next-generation “Gen IV” reactor. Initially, the Hermes 2 demonstration unit will deliver up to 50 MW of always-on carbon-free power to TVA’s grid for Google’s use. It’s a pilot project with outsized ambitions: under a broader Kairos–Google deal, this launch is intended to pave the way for 500 MW of new advanced nuclear capacity by 2035 to support Google’s growth.

Why would an internet company stake its clean energy strategy on an unproven nuclear design? Because Google, like its Big Tech peers, faces a herculean challenge: powering energy-intensive AI and cloud computing operations around the clock without fossil fuels. Solar panels and wind turbines alone can’t guarantee uptime when an algorithm demands power at 3 AM. Google needs firm, 24/7 carbon-free power, and it needs it at scale. “To power the future, we need to grow the availability of smart, firm energy sources,” notes Google’s head of data center energy, framing the Kairos partnership as a way to "bring firm carbon-free energy" to its digital infrastructure and support a *growing digital economy*. In other words, advanced nuclear reactors – long dismissed by some as too slow or costly to matter for climate change – are suddenly on the table as a pragmatic solution for the AI era's energy appetite. If Hermes 2 proves successful, it could help drive down costs and "improve the economics of clean firm power" for the region and beyond.

The Kairos–Google project is moving forward on an aggressive timeline. Hermes 2, a power-generating demonstration reactor to be built at Oak Ridge, Tennessee, received its construction permits in late 2024. It consists of two 35 MWt (thermal) molten-salt-cooled reactor modules sharing a single turbine-generator system. Initially designed for about 28 MWe (electric) output, Kairos decided to uprate Hermes 2 to 50 MWe "generated by a single reactor" to deliver meaningful power to Google faster. The target is to have Hermes 2 operational by 2030 – not coincidentally, aligning with Google's goal to run on carbon-free energy around the clock by that year. TVA, for its part, will transmit the reactor's output via its grid to Google's facilities, integrating this novel power source into normal operations. For TVA, which was born as a New Deal-era utility, the collaboration is a chance to show how even a federally chartered power company can innovate: the utility says it's proactively adding "firm" clean energy sources like advanced nuclear to support economic growth in its region.

Beyond the immediate benefits to Google, there is a broader strategic impulse behind this experiment. As TVA's CEO Don Moul put it, "electricity is the strategic commodity that is the building block for AI and our nation's economic prosperity." In his view, this first-of-a-kind deal is less about one reactor and more about "developing a technology, a supply chain, and a delivery model" for a new industry – one that can "unleash

American energy” and “help America win the AI race”. In short, Hermes 2 is more than a power plant; it’s a bet that advanced reactors can be scaled up as a strategic infrastructure for the United States in a data-driven future. And at the core of that bet lies a decidedly unglamorous yet indispensable material: **beryllium**.

Inside the Reactor: FLiBe and the Beryllium Difference

The Kairos Hermes 2 reactor doesn’t look or work like a traditional nuclear plant. Instead of water cooling the reactor core, Hermes 2 is an experimental fluoride salt-cooled design. Its coolant is a high-tech cocktail called FLiBe – a molten mixture of lithium fluoride and beryllium fluoride salts. This liquid salt circulates through the reactor, carrying heat from the nuclear fuel to a power-generating turbine. The choice of FLiBe is key to Kairos’s technology: the salt remains chemically stable at the reactor’s operating temperatures and, unlike water, can do its job at atmospheric pressure. In practical terms, a FLiBe-cooled reactor can run much hotter than a water-cooled reactor without needing an immense pressurized vessel – enabling higher thermal efficiency and a simpler, compact design. This innovation is part of what makes small reactors like Kairos’s concept feasible as modular units that could someday be factory-produced.

But FLiBe’s advantages don’t come from lithium alone. The **beryllium** in this molten salt plays an outsized role in making the reactor viable. Beryllium has unique nuclear properties: it can function as a neutron moderator and reflector, taming the speed of neutrons and reflecting them back into the core to sustain the chain reaction. In fact, beryllium’s light atoms can even multiply neutrons under certain conditions, a handy trick for keeping a reactor fueled and efficient. These traits make beryllium an invaluable ingredient in some advanced reactor designs – and in FLiBe, they help ensure the reactor has the right neutronic environment to operate safely and efficiently. In short, **without beryllium, FLiBe wouldn't be FLiBe**. The metal also contributes to FLiBe's favorable chemistry: when combined with lithium fluoride, beryllium fluoride helps lower the melting point and provides the coolant's remarkable thermal stability. Kairos's reactor design depends on this special salt to reach the high temperatures and passive safety characteristics that set it apart. As one analysis notes, several next-generation reactor concepts (especially molten salt designs) **"require significant beryllium"** in their cores – whether in the coolant, moderator, or reflector – to achieve their performance goals. Beryllium, in effect, is the quiet enabler inside the reactor, making possible what would otherwise be out of reach for a small, low-pressure nuclear system.

This reliance on an exotic material is a reminder that building breakthrough energy technology isn't just about clever engineering – it's also about materials science and supply chains. By selecting FLiBe coolant, Kairos Power essentially signed up for a new supply chain challenge: **securing a steady stream of nuclear-grade lithium fluoride and beryllium fluoride**. Lithium (in various compounds) is commercially abundant, thanks to the battery industry. Beryllium, on the other hand, is a different story – a story that has now become central to Kairos's mission.

Securing a Critical Mineral Supply Chain

Kairos Power's Molten Salt Purification Plant, built in partnership with Materion, produces high-purity FLiBe coolant –

a mixture of lithium fluoride and beryllium fluoride – for the company's experimental reactors. This first-of-its-kind facility, located at Materion's campus in Ohio, is the largest FLiBe production site ever built and can output the salt in commercial quantities. Its commissioning was hailed as a "critical milestone" in Kairos's drive to vertically integrate and secure the essential coolant supply for its Hermes demonstrations.

Long before Google ever signed on, Kairos Power realized that if it didn't solve the FLiBe supply problem, its reactor would remain a paper design. So in 2022, Kairos and Materion Corporation (NYSE: MTRN) – a name better known in the aerospace and defense realms – quietly flipped the switch on a new Molten Salt Purification Plant (MSPP) in Elmore, Ohio. Materion was a natural ally for this venture: it is an industry leader in beryllium materials, operating the United States' only active beryllium mine and refining facilities. By locating the FLiBe production plant at Materion's site, the two companies cemented a strategic partnership linking nuclear energy with a specialized mining and chemical supply chain. The plant takes raw beryllium hydroxide (from Materion's mine in Utah) and lithium fluoride, and produces high-purity beryllium fluoride – which is then blended into the FLiBe salt. For the first time in history, a facility now exists to manufacture commercial quantities of FLiBe coolant. This was a necessary step if Kairos hopes to move beyond one-off lab experiments to a fleet of reactors. Ed Blandford, Kairos's chief technology officer, called MSPP a *"cornerstone"* of their Materion collaboration – an investment in supply chain certainty that gives Kairos control over producing its own coolant to exacting nuclear specifications. In essence, Kairos had to become part chemical company to ensure its reactor dreams can be realized. It's an unusual case of vertical integration in the energy industry, born of necessity. After all, there is no commodity market for FLiBe salt – they had to create one.

The need to lock down beryllium supply goes beyond one startup's ambitions – it touches national strategic interests. Beryllium is officially recognized by the U.S. government as a critical mineral, essential for economic and national security. Materion's Utah mine at Spor Mountain is, remarkably, the only domestic source of beryllium ore and one of the few sources in the world. (The metal is so specialized that the U.S. actually dominates global production, yet consumes most of it internally.) The Department of Defense has even designated beryllium as both "critical" and "strategic," the only material with that dual distinction, given its importance in everything from fighter jet sensors to nuclear weapons components. For decades, the federal government has taken steps to shore up this supply – even partnering with Materion to build a dedicated beryllium metal factory to guarantee military needs. In short, beryllium has long been treated as a material where supply security = national security.

What's counter-intuitive is that America's beryllium supply security challenge isn't about import dependence (as it is for minerals like rare earths or cobalt) – it's about having all our eggs in one basket at home. Virtually all U.S. beryllium comes from a single mine-and-processor: **Materion**. Analysts have pointed out that this domestic monopoly brings its own risks. A single-point failure at that mine – whether a technical mishap, a labor issue, or any disruption – could choke off the flow of a metal that a host of vital industries rely on. Moreover, with only one major producer, there's limited competitive pressure to increase output or innovate in extraction techniques. As new demands emerge (like Kairos's reactors), the question isn't just *"Can we get beryllium?"* but *"Can we get enough, at reasonable cost, without derailing other uses?"*

Those demand pressures are no longer hypothetical. **Beryllium has re-emerged as one of America's most critical strategic metals,** and its supply chain is feeling the strain. Traditional defense and aerospace needs already consume a large share of production (think missile guidance systems, satellite optics, precision instruments). Now, clean energy is joining the queue. Advanced nuclear developers are effectively new customers for beryllium, and potentially big ones – a standard Kairos power plant in the future could require many tons of FLiBe coolant, translating to significant beryllium demand. Industry observers note that molten-salt reactors and other next-gen designs will drive "intensifying demand" for beryllium, further straining the single-source supply model. If multiple companies begin building such reactors in the 2030s, Materion's current production capacity could be tested as never before.

This shifting landscape has not gone unnoticed. There's talk of needing supply diversification – essentially developing new beryllium sources or producers to bolster resilience. In Utah, a handful of exploration firms are now trying to do just that, drilling in the desert for the next Spor Mountain. It's a long game – opening a new mine can take years, if not decades – but the very fact that junior miners are on the hunt for beryllium speaks to a new reality. When a material becomes critical to both missile systems *and* clean energy infrastructure, both Pentagon officials and clean energy planners have a stake in ensuring it doesn't run out. We could soon see beryllium elevated alongside lithium, nickel, and others in the pantheon of energy-transition minerals that merit government attention and investment.

Niche Minerals in the New Energy

Landscape

There is a larger lesson in beryllium's story. The transition to a cleaner and more digital economy is not just about deploying solar farms and SMRs and EVs – it's about the hidden threads of materials and minerals that make those technologies possible. In the past, energy discussions rarely mentioned beryllium. Why would they? Beryllium was a niche metal for fighter jets and satellite mirrors, a material most often encountered by scientists and defense contractors. Yet here we are: a deal to power cutting-edge data centers with advanced nuclear reactors hinges in part on a stable supply of BeF_2 salts. It's a vivid example of how niche industrial materials are becoming linchpins of 21st-century infrastructure. We've seen this pattern before: wind turbines turned dysprosium (a rare earth element) into a strategic resource; battery factories did the same for lithium and cobalt. Now, as AI drives new electricity demand and nuclear engineers resurrect designs from the 1960s (the molten salt reactor) to meet modern needs, even obscure elements like beryllium are getting pulled into the spotlight.

For policy makers and business leaders, the message is to broaden the field of vision. Ensuring a robust clean energy future isn't just about building reactors or grids – it means securing the raw materials supply chains those projects rely on. In the case of Kairos and Google, that meant literally building a chemical supply chain alongside the reactor, in the form of the MSPP fluoride salt plant. Nationally, it may mean rethinking how we classify and support critical materials. Beryllium may be produced on U.S. soil, but its availability could become a choke point if demand spikes. Proactive steps, from strategic stockpiles to R&D on alternative materials, might be warranted to avoid bottlenecks. The Department of Energy, for instance, has explicitly tied advanced reactors to the nation's technology leadership, with Energy Secretary Chris Wright emphasizing that deploying such reactors is *“essential to US AI dominance and energy leadership”*. If that’s the case, then safeguarding the ingredients of those reactors is part and parcel of maintaining that leadership. It’s telling that in the same breath, TVA’s CEO highlighted building not just reactors but also a “supply chain” and “industry” around them. We’re witnessing energy policy, industrial policy, and even digital economy policy converging – and materials like beryllium sit at the intersection.

Beryllium’s new-found role in clean power for the AI era is a twist no one predicted decades ago. It underscores how innovation can suddenly transform the fortunes of a material: from a defense-oriented specialty to a cornerstone of carbon-free electricity. As we look ahead, we should expect more surprises of this kind. The coming decades might elevate other unsung elements – today sitting quietly in chemical catalogs – to starring roles in our energy system. Policymakers would do well to heed these harbingers. Crafting a resilient, secure clean energy economy will require investing not just in bytes and watts, but in the rocks and metals that undergird them. The story of Kairos and Google’s reactor deal is ultimately a story about the fusion of high tech and heavy industry. It took Silicon Valley’s urgency for 24/7 power and married it to a metallurgical marvel invented in mid-century America (fluoride salt reactors), and in doing so, it shone a light on an old mine in Utah producing a metal most people can’t name. If the experiment succeeds, it will confirm something profound: sometimes the future – of energy, of AI, of industry – hinges on mastering very old, very elemental things. And sometimes the next big leap is enabled by a substance sitting humbly on the periodic table, waiting for its moment to matter.

Sources

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