



Egis Insights | Thought Leadership

Intersection between the Atom and Modern-day Computing —

Why nuclear energy and the pocket-sized revolution of Small Modular Reactors maybe the unsuspecting saviour of modern-day computing.



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1 Ever-Increasing Demand for Energy, the “Age of Electrification”, and Now Data Centres

We have always anticipated an increase in global energy demand, driven primarily by population growth, rapid industrialization, and the expanding electrification of our economies. Energy does more than just providing a comfortable life; it powers healthcare, communications, water and wastewater treatment, financial services and banking to name a few and to include many other necessities that we take for granted. Energy abundance is not only crucial for a country's security, but also deeply tied to a nation's economic growth and stability.

The rise in our energy demand has led us to an “Age of Electrification” because in our pursuit of going emission-free and eco-friendly, we have shifted key utilities such as Electrical Vehicles (EVs) and electrical buses for public transport, electrical cooktops, electrical furnaces in heavy industries and boilers to our existing power grids.

With us entering the Age of Electrification, we have already saturated our existing power grids, and one might foresee that the final nail in coffin might be modern-day computing, or neural network computing, or artificial intelligence, which come in the form of power-hungry data centres.

This brings us to a few critical questions: Is our existing power grid ready for increasing modern-day computing demands? What happens if we continue adding data centres to our existing grid without new reliable baseload sources? The answers to these questions are quite simple but grim — Our existing grids are not ready for power-hungry data centres used for modern-day computing and they have a fair chance of collapsing due to excess energy demand.

Our existing power grids are not ready for the power-hungry data centres of modern-day computing — and they have a fair chance of collapsing due to excess energy demand.

The Grim Answer

Data centres are inevitable and we will require more of them. So, intuitively, the solution is clear: to prevent our grids from collapsing, we need more energy, or a source that provides high baseload power that we can turn on and off at will.

Conventional thermal power plants burning coal and natural gas are reliable, but they come with a major catch: CO₂ emissions that worsen the greenhouse effect, drive global warming, and cause severe air pollution. Conversely, renewables like wind and solar can support the grid, but they are intermittent and cannot deliver high, consistent baseload energy. This leaves us with a clear objective: we need a high baseload energy source that produces immense power without releasing harmful emissions into the environment.



2 Nuclear Energy: The Unsuspecting Saviour of Modern-Day Computing

Nuclear energy is not new. In the conventional sense, it has been around since the 1960's and has gained sufficient operational experience (approximately 60 years) and technological maturity. Nuclear energy, obtained by splitting the nucleus of an atom (specifically Uranium-235), has a very high energy density and does not release any greenhouse gas emissions in doing so. Unlike solar and wind energy, it is not dependent on the weather and provides continuous energy on demand.

Nuclear at a Glance

60 Years

Operational
Experience

~400

Plants Operating
Worldwide

1

Football Field Holds
All Spent Fuel Ever

0 g CO₂e/kWh

Operational
Emissions

Now, the answer's clear — we have a source of energy that can power our grid without polluting the environment. However, it does come with its own challenges. First, is the obvious radioactive spent fuel that is generated after the operation of a nuclear power plant. However, the volume of radioactive waste produced by nuclear plants is significantly lower than the volume of pollutants released by thermal power plants. In fact, studies show the total spent nuclear fuel generated globally since the dawn of commercial nuclear power, powering millions of homes and entire cities for decades, could fit onto a single football field. Ergo, considering the massive amount of energy generated by roughly 400 nuclear power plants worldwide, that is a remarkably small footprint. So, this is a bargain where the merits of operating nuclear power plants far outweigh its demerits. Then, the next obvious question is, is it safe?



3 Nuclear: The Ultimate Green and Safe Source of Energy

Because nuclear power produces no operational emissions, it is truly clean energy. The real-world consequences of abandoning it were made clear when Germany shut down its operating nuclear power plants. The resulting grid shock forced a reliance on fossil fuels, leading to air pollution which led to hundreds of premature deaths. This reality positions nuclear power as the ultimate "green flex" of the modern era.

Another thing we should address is the bad rep that nuclear has received due to accidents such as Fukushima, Three-Mile Island, and Chernobyl. Albeit these were catastrophic events, they have shaped the entire nuclear industry and has birthed something that is unique to the nuclear field — "The Nuclear Safety Culture".

The philosophy of nuclear safety culture at its core is simple — everyone working for a nuclear power plant is responsible for safety, and personnel are free (and encouraged) to question any practices that they feel compromises nuclear safety.

The Nuclear Safety Culture

Additionally, nuclear power plants go through a lot of scrutiny by nuclear regulators (each country has one), who act as watchdogs and scrutinize everything, ensuring nuclear operators maintain the highest possible safety standards.

Now, we have addressed three main concerns with nuclear energy — radioactive waste, safety, and technological maturity — then why are we not making new power plants to power our data centres?

Radioactive waste

A football-field footprint

Safety

Safety culture + regulators

Technological maturity

~60 years of operation

The catch

Time & space to build

The answer is simple: it takes a lot of time and a fair amount of space to build a nuclear power plant. So how do we get around this?

4 SMRs: The Pocket-Sized Revolution of Nuclear Energy

Conventional large-scale nuclear power plants take 10 to 15 years to build and are notoriously known for high capital costs, budget overruns, and construction delays. Hence, the solution lies in standardization and modularization: introducing Small Modular Reactors (SMRs).

The SMR approach shifts nuclear construction away from bespoke, complex mega-projects toward simple, repeatable installations. Where traditional nuclear projects demand massive upfront investments (often exceeding €10 billion per reactor) SMRs are projected to require significantly less capital, making them far easier to finance.

Conventional Reactor

10–15 yrs
to build

often > €10B
per reactor

Small Modular Reactor

~50 acres
footprint

factory-built
& scalable

SMR components are planned to be factory-manufactured and shipped directly to the site for assembly. This ensures that SMRs will be faster and cheaper to build, significantly reducing upfront costs. Also, owing to their compact footprint (around 50 acres), SMRs can be installed in locations unable to support large reactors, powering smaller electrical grids, isolated areas, or sites with limited water access. They also have the potential to be highly scalable, allowing capacity to be added as demand grows.

This is where the intersection with modern computing becomes “critical”. Data centres are facing an urgent energy crunch: AI-focused facilities now require up to 80 MW of power, i.e., more than double the 32 MW consumed by standard data centres. In the U.S. alone, data centre power demand is projected to jump from 17 GW in 2022 to 35 GW by 2030, all while grid interconnection delays stretch up to a decade. These bottlenecks have driven major tech companies such as Google, Amazon, Meta, NVIDIA to turn to SMRs for reliable, 24/7 carbon-free power.

The Data Centre Energy Crunch

80 MW

AI facility need
(vs 32 MW standard)

17 → 35 GW

U.S. demand
2022 → 2030

~10 yrs

Grid interconnection
delays, up to

300 MW

Uninterrupted
power per SMR unit

Turning to SMRs for 24/7 Carbon-free Power

Google

Hyperscale AI

Amazon

Cloud & AI

Meta

AI Infrastructure

NVIDIA

Compute Demand

Producing up to 300 MW of uninterrupted power per unit, SMRs offer reliable, off-grid energy needed for high-performance computing. But despite this promise, one final hurdle remains: the readiness of supply chain for SMR deployment.

5 Is the Nuclear Supply Chain Ready for Expansion Fuelled by Modern-Day Computing?

SMRs operate on the same principle of nuclear fission as conventional large-scale reactors, however, shrinking their size brings in its own challenges. In addition to complex reactor physics and regulatory barriers, the main question that must be asked is: "Does the global market have the materials required to initially launch SMRs before we can scale up the production?"

A major challenge we must address here is lack of technical maturity of SMR markets. In contrast to conventional light- and heavy-water reactors, there are hundreds of SMR designs currently in development, each of them using different reactor configurations and cooling methods. This highlights a critical absence of standardization for which our current supply chain is unprepared for. Not to mention that with numerous SMR designs in development, licensing has become a nightmare because regulators are unfamiliar with new reactor types. Hence, a lack of regulatory acceptance discourages current market players to invest in materials that they are unsure about.

To provide a comparison here, recent studies have shown that procurement issues, design immaturity, and licensing delays caused severe cost overruns in First-Of-A-Kind (FOAK) Gen-III reactors, even for technologies that had been proven and operated for over 50 years. Without a well-developed, fully coordinated supply chain to reduce direct EPC costs and lower uncertainty, SMRs risk falling into the same financial traps as their predecessors.

Supply-chain Bottlenecks to Overcome

- 01 **Specialized forging presses.** A global scarcity of the heavy forging presses required to manufacture reactor pressure vessels.
- 02 **HALEU fuel availability.** Critical vulnerabilities in the supply of High-Assay Low-Enriched Uranium (HALEU) fuel required for SMRs.
- 03 **Specialized talent pool.** A global shortage of nuclear personnel — nuclear engineers, certified welders, and quality inspectors.

The nuclear industry already faces heavy manufacturing constraints due to a global scarcity of specialized forging presses required for reactor pressure vessels, alongside critical vulnerabilities in the availability of High-Assay Low-Enriched Uranium (HALEU) fuel required for SMRs. Compounding to these issues, there is a global shortage of specialized nuclear personnel such as nuclear engineers, certified welders, and quality inspectors.

Therefore, although SMRs are envisioned to shorten construction timelines through factory-based manufacturing and using the concept of modularization, scaling them up requires overcoming severe supply chain bottlenecks and specialized talent pool.



SMRs have the potential to deliver clean and reliable power to data centres without straining the existing infrastructure, ensuring grid stability. Yet, to sustain this revolution and realize its promise, we must standardize SMR designs and establish robust regulatory frameworks, which will in turn foster a resilient and confident global supply chain, furthering modern-day computing.

Act: Standardize SMR designs

Converge the hundreds of competing configurations and cooling methods toward repeatable, standardized designs.

Act: Robust regulatory frameworks

Regulatory acceptance and licensing pathways built for new reactor types, so the market can invest with confidence.

Result: A resilient global supply chain

Which these two foster in turn — resilient and confident — furthering modern-day computing.

The atom has the potential to power data centres and advance modern-day computing, while data, in its pursuit of survival, is fuelling an atomic revolution.

The Poetic Symbiosis

The Bottom Line

SMRs have the potential to deliver clean, reliable power to the data centres driving modern computing without straining the existing infrastructure, ensuring grid stability.

To sustain the revolution, we must standardize SMR designs and establish robust regulatory frameworks, which will in turn foster a resilient and confident global supply chain, furthering modern-day computing.



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