RSiS S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES
Nanyang Technological University, Singapore

Science, Technology and Security

May 2026

Published by the Future Issues and Technology (FIT) Research Cluster, RSIS. This Bulletin comes as a series of articles on science and technology from the angle of national security.

Powering the AI Era: Nuclear Power in the Age of Artificial Intelligence | Ysa Marie Cayabyab, Benjamin Ang, and Karryl Kim Sagun Trajano

Artificial Intelligence (AI) is rapidly transforming the global energy system, acting as a catalyst that exponentially accelerates the scale of electricity consumption. Data centres lie at the heart of this transformation, accounting for around 1.5% of global electricity consumption in 2024, with demand growing at an annual rate of approximately 12% over the past five years. The shift in the global energy landscape is prompting a fundamental reassessment of energy security, one that intersects digital innovation with infrastructure capacity, grid resilience, and the pursuit of sustainable, stable electricity supply.

This issue of Science, Technology, and Security brings together perspectives on the nexus of AI and nuclear energy. Contributors examine nuclear power's renewed relevance as a stable, low-carbon solution capable of meeting the immense energy demands of AI-driven computing. They also explore the strategic, regulatory, and geopolitical implications of integrating advanced AI systems with nuclear infrastructure, including questions of governance, safety, and public trust.

First, Professor Hwang Yongsoo and Mr Dongkeun Lee identify nuclear energy as a reliable long-term solution to rising electricity demand, driven largely by data centres. He suggests the fastest path to sustainability is expanding existing nuclear capacity through plant life extensions, uprates, and restarts. A key challenge, however, is the regional concentration of demand, especially in the US and China. While China is rapidly increasing power capacity, the US faces ongoing infrastructure and transmission constraints. These pressures may extend to Southeast Asia, Japan, and South Korea as AI-driven demand grows, highlighting the need for stronger industrial capacity and greater international coordination.

Ms Elen Conjares, meanwhile, discusses the Philippines' ambition to become a regional AI hub under its National AI Strategy Roadmap 2.0, driving rapid data centre growth. However, high electricity costs and reliance on coal constrain expansion and deter investors, underscoring the need for cleaner, more reliable energy such as nuclear power. Of note is the government's revival of its nuclear programme through policy updates and regulatory reforms, with the Bataan Nuclear Power Plant seen as the fastest expansion pathway despite technical and financial hurdles. As AI-driven

electricity demand surges globally, nuclear energy is gaining importance as a stable, low-carbon solution, aligning the Philippines with broader global trends.

Finally, Professor Zhang Hongzhou examines the Mekong region's dual dilemma, as reliance on fossil fuels drives price volatility and energy insecurity, while hydropower, though renewable, remains contested for its environmental, social, and geopolitical impacts. These challenges are intensifying with the expansion of AI data centres and the rapid growth of electric vehicles, which are sharply increasing demand for clean electricity and straining already fragile energy systems. With energy demand projected to grow among the fastest in Asia, there is a need for greater investment in clean energy, especially better-designed hydropower, alongside more coordinated and socially conscious energy development.

A common theme across the contributions is the emergence of electricity as a strategic constraint in the AI era. Energy is no longer merely an input to economic growth but a limiting factor that dictates the geography of digital expansion. The rapid rise of AI workloads, cloud computing, and data-intensive services is driving electricity demand growth that, in some regions, is beginning to outpace the development of grid capacity and generation infrastructure. This shift effectively places energy systems at the centre of digital competitiveness, where access to reliable and affordable power increasingly determines the attractiveness of locations for data centres, advanced manufacturing, and emerging AI ecosystems.

This reconfiguration elevates nuclear energy into a geopolitical and industrial priority. Unlike intermittent renewables, nuclear power offers stable baseload generation that can support continuous high-demand operations. As a result, it is regaining attention in national energy strategies, particularly among economies seeking to balance decarbonisation goals with surging electricity needs. However, nuclear deployment is also shaped by complex constraints, including regulatory approval processes, financing challenges, public acceptance, and long lead times for construction. These factors mean that its expansion is as much an institutional and political undertaking as it is an engineering one.

At the same time, this energy shift highlights the unevenness of global readiness. Some regions, particularly those with established nuclear infrastructure or strong grid capacity, are better positioned to scale. Others face structural bottlenecks, including ageing grids, fossil fuel dependence, or limited investment capacity, which constrain their ability to respond to rising demand. These disparities risk widening existing gaps in digital and economic development, as AI-driven growth becomes increasingly tied to energy availability.

Addressing these challenges will therefore require more than capital investment alone. It will demand deeper institutional coordination across government agencies, utilities, and private technology firms, as well as sustained workforce development to support both nuclear and broader energy transitions. Long-term policy alignment will also be critical, ensuring that energy planning, industrial strategy, and digital development are integrated rather than pursued in isolation.

This STS issue examines the complex challenges of transitioning to nuclear energy in the context of rising electricity demand and the AI-driven expansion of digital

infrastructure. It highlights the need to align technological innovation with regulatory frameworks, industrial capacity, and international coordination, particularly as energy systems become a defining constraint in the digital economy. Collectively, the articles underscore that securing a digital future depends on a more integrated approach to energy governance, where the development of nuclear infrastructure is embedded within broader efforts to modernise grids, strengthen institutions, and build workforce capabilities. In this framing, energy reliability, sustainability, and governance must advance alongside technological progress to ensure that the benefits of the AI era are both scalable and equitably distributed.

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