

ESG

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The future of nuclear energy in Singapore

Summary

- Ambitions to achieve countries' net-zero targets have encouraged innovation in nuclear technologies such as Small Modular Reactors, which are emerging as viable solutions to sustainably meet rising energy demands. Singapore, for instance, could potentially fulfil around 10% of its energy needs by 2050 through advanced technologies like nuclear power and geothermal energy.
- While advanced nuclear technologies offer enhanced safety and suitability for urban environments, public concerns regarding safety and waste management remain as significant barriers. Effective community engagement and education are essential to change perceptions and foster greater acceptance of nuclear energy.
- International initiatives and collaboration in nuclear energy are increasing, which are essential for facilitating knowledge sharing and technology transfer related to nuclear energy.

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Nuclear energy potential in Singapore

Global demand for reliable and clean energy is rising, driven by factors like increasing energy consumption, electrification of transport and adoption of artificial intelligence. Countries are increasingly transitioning away from fossil fuels and intensifying their efforts to adopt clean and renewable energy solutions. A notable example of this shift is the growing interest in nuclear energy, which produces almost no greenhouse gas emissions to generate energy, as a means to meet rising energy demands. This interest reflects a broader trend towards exploring diverse energy sources to ensure enhanced energy resilience.

Singapore could potentially meet around 10% of its energy needs by 2050 through next-generation geothermal energy or nuclear energy, according to the Energy Market Authority's (EMA) Energy 2050 Committee Report. A government pre-feasibility study on nuclear energy concluded in 2012 that the technologies available then were not yet suitable for deployment in Singapore. Given recent advancements in nuclear technologies and the global pursuit of net-zero goals, there is a growing optimism about reconsidering nuclear energy in Singapore's energy mix. It was announced at Singapore Budget 2025 in February that Singapore will study the potential deployment of nuclear power in Singapore, with plans to develop related capabilities, including nuclear safety. Small modular reactors (SMRs) were cited as one advanced nuclear technology that has better safety features than conventional nuclear power plants.

As Singapore is alternative energy disadvantaged, pursuing safe and advanced nuclear energy technologies can contribute to diversifying Singapore's energy mix and bolstering greater energy resilience. This can contribute to its recently enhanced climate targets for 2035, which aims to further reduce its emissions to

between 45 – 50 MtCO₂e in 2035, down from the previous goal of 60 MtCO₂e by 2030.

What are Small Modular Reactors (SMRs)?

SMRs and other advanced nuclear technologies are among the solutions that can provide a reliable and clean source of power. SMRs, in particular, are advanced nuclear fission reactors that generate heat which can be used directly or to generate electricity. They are thought to be suitable for Singapore, as they are compact systems that can be factory-assembled and deployed in populated urban areas because of their smaller footprint. The EMA has also highlighted that they are looking at SMRs to power AI data centres by big tech companies.

SMRs can be sited within the footprint of existing coal plants, or co-located with refineries and chemical facilities, allowing them to directly substitute fossil fuels by providing the necessary power to maintain the continued operation of existing assets. There is also potential for SMRs to be situated underground, according to the S. Rajaratnam School of International Studies, making SMRs suitable for countries like Singapore with land constraints. In addition to providing greater safety and security protection, locating SMRs underground can also be more economical compared to those built on ground level. Due to advances in construction technology and engineering design, large rock caverns to site SMRs can be created more cost-effectively than the construction of most underground train stations and tunnels. However, public acceptance of living near nuclear plants continues to remain an obstacle for some countries.

Changing public perceptions of nuclear energy

While nuclear power accounts for around 10% of the world's electricity from a fleet of nearly 420 active nuclear reactors globally, concerns about the potential of nuclear accidents have eroded public trust in nuclear technologies. This stems from the fear of radiation leaks from nuclear reactors and improper nuclear waste disposal practices. Although it is feasible to locate SMRs in densely populated areas in Singapore, the not-in-my-backyard mindset can be an obstacle for implementing nuclear technologies in the country.

In addition to advanced technological capabilities and effective governance, changing public perceptions of nuclear energy is crucial to the successful integration of nuclear power into Singapore's energy landscape. This can be achieved through community engagement aimed at alleviating fears associated with radiation by demonstrating the enhanced safety features of advanced nuclear technologies, thereby promoting nuclear energy as a viable component of Singapore's energy mix.

Opportunities for global and regional nuclear energy collaboration

Recognising the potential of nuclear energy in limiting the increase in global temperature to the 1.5-degree threshold, global initiatives in nuclear energy have been surging. Over 20 countries, including the US, UK and Japan signed a joint declaration at COP28 in 2023 to triple nuclear energy capacity by 2050 from 2020's baseline. More countries joined the declaration at COP29 in 2024, bringing the total number of countries that endorsed the declaration to 31.

Tripling nuclear energy capacity by 2050 is an ambitious goal, particularly given the challenges related to regulatory and governance frameworks, public perceptions and politicised nuclear issues, among others. International cooperation is essential for navigating these complexities and sharing best practices to ensure the safe and effective deployment of technologies. For example, Singapore and the US have signed a civil nuclear cooperation agreement, known as the '123 Agreement' which entered into force in December 2024, to facilitate Singapore's capability building journey to further evaluate the potential of advanced nuclear technologies in meeting the country's energy needs.

The Trump administration, despite halting support for many clean energy initiatives, has shown support for geothermal and nuclear energy. This can facilitate new opportunities for US–Southeast Asia partnerships on nuclear technology transfer and capacity building, especially with stronger interest and renewed optimism in nuclear energy from Southeast Asia. With this positive momentum, Singapore also plans to deepen cooperation with other countries in this space, potentially including Malaysia and Indonesia that have operated research reactors for decades. One such research reactor is Malaysia's TRIGA PUSPATI reactor, which has been in operation since 1982.

China has been a key player in the global nuclear energy landscape, with an annual nuclear fusion budget of approximately US\$1.5bn, which is nearly double the amount allocated by the US for research in 2024. It is expected to surpass France and the US to become the world's leading nuclear power generator by 2030, according to BloombergNEF. Furthermore, China's engagement in international partnerships, as demonstrated by initiatives like the Belt and Road Initiative, can facilitate related knowledge and technology transfer to Southeast Asia and beyond. Singapore and China have announced plans to explore opportunities to cooperate in green development, biomedical sciences and digital economy at the Suzhou Industrial Park, along with initiatives to strengthen Tianjin Eco-City as a testbed for green enterprises to trial new ideas. This collaborative framework may also pave the way for enhanced nuclear collaboration, leveraging existing initiatives to promote safe and sustainable nuclear technologies.

Moving forward

A new era for nuclear energy will require significant investments. Between 2016 and 2022, investments in nuclear averaged over US\$40 bn annually. Investment in nuclear power needs to triple by 2030 from recent levels and scale up in many markets, according to the International Energy Agency.

As Singapore continues to monitor investment trends and technology developments, various challenges like managing radioactive waste and public perceptions would also need to be overcome for nuclear to play a role in the country's future energy landscape. Collaborating with international organisations and other countries that have successfully implemented nuclear power can provide valuable insights and best practices, enabling Singapore to develop robust regulatory frameworks and tailor its nuclear strategy to local conditions.

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