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Can nuclear energy play a role in global decarbonisation?

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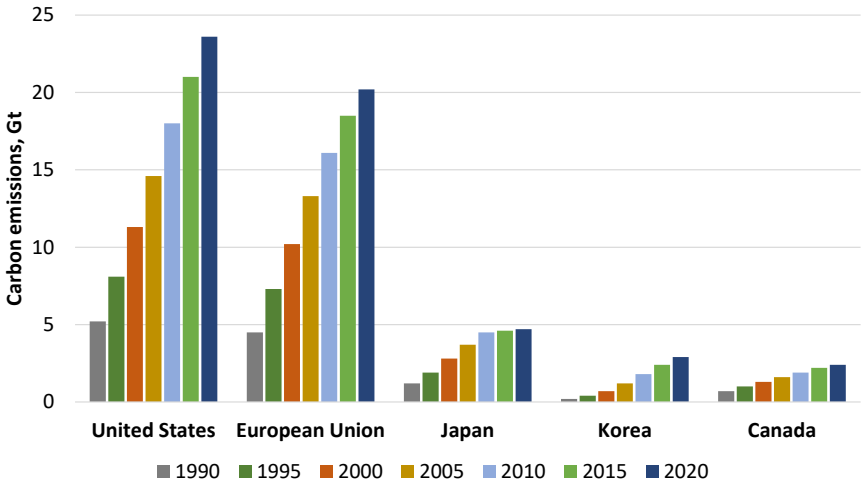
Nuclear energy is a low-emission electricity source that currently provides about 10% of global electricity production. In addition to electricity, nuclear power is also capable of producing heat and hydrogen. Over the past 50 years, nuclear power has enabled the avoidance of a significant amount of global carbon emissions (Figure 1).

According to the International Energy Agency (IEA), annual nuclear energy capacity additions need to be doubled to be on track with the IEA's net-zero scenario and would play an important role in a global clean energy transition if its challenges are addressed.

Figure 1: Avoided carbon emissions for key markets between 1990 – 2020



Source: IEA, OCBC

With technological advancements in nuclear energy, its deployment has the potential to be safer with lower risk of nuclear accidents. This has increased countries' confidence in considering nuclear energy as a clean energy source. For example, Singapore previously assessed nuclear energy to be unsuitable for deployment a decade ago given the risks nuclear energy deployment posed to a small city-state. This has now changed, and Singapore is keen to keep its energy options open while monitoring the developments in nuclear energy. The feasibility of nuclear energy deployment would depend on extensive efforts in feasibility studies to ensure the economic, regulatory, social and environmental aspects of a nuclear energy project have been considered. This can enable authorities to make informed decisions and to mobilise investments in this space.

Growing interest and acceptance of nuclear energy

Amid countries' race to net-zero alongside increasing energy security concerns and soaring fuel prices, there has been increasing interest in harnessing nuclear energy to tackle climate change for some countries:

- Belgium has extended the lifespan of two of its nuclear reactors by another decade, beyond the original shutdown date of 2025, coupled with accelerating its renewable energy transition.

- Germany intends to keep two nuclear power stations on standby, beyond its year-end deadline, to bolster the country's energy security for fear of energy shortages this winter amid rising gas prices.

- Japan also revealed a plan to bring idle reactors back into service and invest in developing next-generation reactors. This signifies a major policy shift on nuclear energy a decade after the 2011 nuclear accident at the Fukushima Daiichi Nuclear Power Plant.

- China has been ramping up efforts on nuclear power station projects with plans for construction of two new nuclear power plants, to bolster the country's energy security and support its climate goals.

- According to the Energy 2050 Committee Report commissioned by the Singapore government, nuclear energy was identified as a potential low-carbon power source for the country alongside hydrogen and geothermal energy. The Centre for Strategic Energy and Resources, a Singapore-based think tank, will be carrying out a study on potential benefits of nuclear technology (e.g. floating nuclear power plants) in South-east Asia.

Public perception of nuclear energy continues to be mixed, but more people are expressing more neutral or positive sentiment compared to the past.

Harnessing nuclear energy requires robust policies and investments in innovative technologies

To realise the decarbonisation potential of nuclear energy, comprehensive government regulations and continued technology developments are required to ensure the safe and long-term operation of nuclear plants. In the race towards net-zero, there has been increased government support for small modular reactors (SMRs) that refer to advanced nuclear fission[1]

[1] Nuclear fission involves the release of energy when atoms are split apart. Most nuclear reactors use uranium atoms and energy is released in the form of heat and radiation when a neutron collides with a uranium atom and splits it, leading to a nuclear chain reaction.

reactors with enhanced safety systems. These are smaller than conventional nuclear power reactors, and can come in the form of prefabricated units that are easily transported to other locations for installation. The US and Canada are markets that have launched government initiatives to boost SMR development, spurring the momentum of private investments in this space. For example, Canada has an SMR Action Plan in place to develop and deploy SMRs for various applications in Canada and abroad.

Apart from nuclear fission, there has also been significant interest and advancements in nuclear fusion technologies. Unlike nuclear fission, nuclear fusion involves the fusion of atoms, while releasing high amounts of energy, that does not create a nuclear chain reaction. In Asia, the Chinese government has approved the construction of a pulsed-power plant and aims to generate nuclear fusion energy by 2028. Singapore-headquartered investment company Temasek also joined other firms in contributing to raise US$1.8bil to help construct a net energy nuclear fusion machine in the US.

Nuclear energy risks should be addressed for safe implementation

Implementing nuclear energy technologies comes with challenges and risks such as:

- Management of radioactive nuclear waste: Based on research from Stanford and the University of Columbia, SMRs may produce higher volumes of nuclear waste for management and disposal compared to conventional power plants.

- Supply chain capabilities: The lack of nuclear construction in recent years has led to limited global expertise in the nuclear industry. Strengthening the global supply chain to ensure strategic partnerships and appropriate knowledge-sharing (e.g. to create a skilled workforce and develop R&D infrastructure) would be necessary to accelerate the safe deployment of nuclear energy.

- Public perception: There is still opposition to nuclear energy due to public fears shaped by historical nuclear accidents e.g. Chernobyl and Fukushima nuclear disasters. It will be crucial to implement more robust safety regulations and waste management safeguards for these technologies, with the appropriate public engagement and education efforts.

Investors' role in enabling nuclear energy

Alongside robust public policies, the private sector also has a crucial role to play in reducing the risks that come with nuclear energy and accelerating its implementation. This can be done through avenues such as the following:

- Support development and deployment of nuclear technologies: For example, investors interested in decarbonisation efforts may see SMRs as attractive investments due to lower capital cost, shorter payback periods and reduced project risk compared to conventional nuclear reactors. Providing investment support for pilot projects and developing supply chains can support safe technology deployment.

- Strengthen supply chains and manage risks: Investors can leverage existing supply chains and strengthen them by contributing to technology risk management (e.g. waste management), to address the risks that new technologies may still hold.

Summary

With greater momentum for nuclear energy amid energy security concerns, there is a need for the public and private sector to develop the nuclear industry in a way that is safe and effective in tackling climate change. Greater efforts in supporting nuclear power innovation, implementation and risk management can expand the range of mitigation measures towards a net-zero future.

The successful long-term deployment of new nuclear fission and nuclear fusion technologies depends on strong government support, safety and regulatory frameworks, as well as the mobilisation of investments through the private sector. Investors can accelerate decarbonisation via nuclear energy through investments that support the development and deployment of new technologies, strengthening supply chains and managing the risks that come with such technologies.

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