PATRIZIA

SMALL MODULAR REACTORS:

What role can they play in the energy transition?

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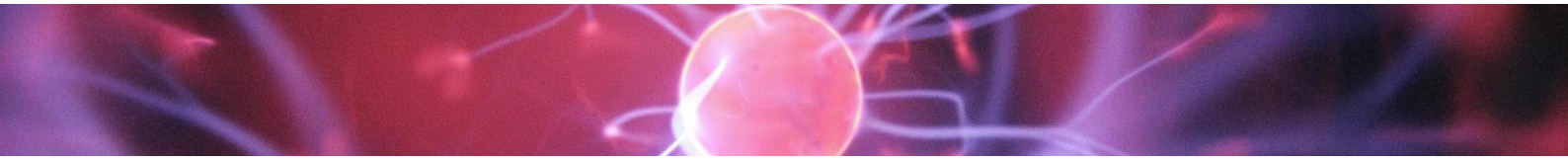
Small modular reactors provide synchronous baseload supply in an energy grid increasingly dependent on intermittent renewables. Unlike traditional reactors, they are scalable and portable, and are expected to have significantly lower capital costs. But deployment is in the early stages, and risks, including public perception, remain.



The role that nuclear energy plays in the world's current and future energy mix has been a divisive topic for debate for decades. Many proponents of nuclear energy, including the International Energy Agency (IEA), argue that for the world to meet its Net Zero by 2050 targets, nuclear energy must form part of the solution. Currently, nuclear is the second largest source of low-carbon electricity globally (trailing just hydropower) and accounts for a third of the globe's low-carbon energy supply. Nuclear reactors play an important role in stabilising electricity grids (which is increasingly important in a world more reliant on renewables) as they can provide synchronous baseload supply. Furthermore, as substitutes for Russian energy were urgently sought in the wake of the invasion of Ukraine, nuclear energy's appeal rose.

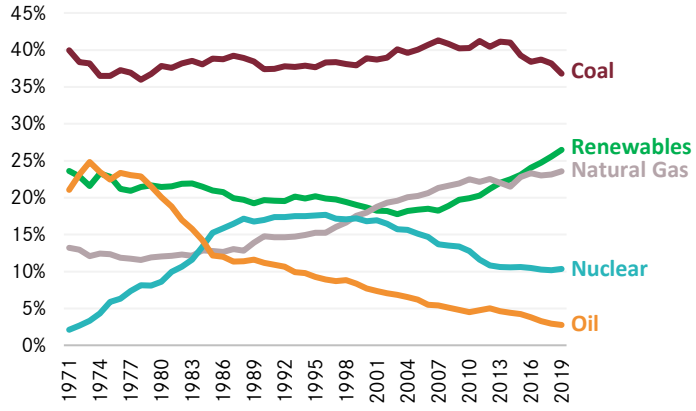
But there have long been environmental and safety concerns related to nuclear energy; the implications of the 2011 Fukushima and 1986 Chernobyl disasters cannot be ignored. Nuclear energy's share of global electricity supply has declined from its mid-1990s high of 17% to approximately 10% today, as shown in Chart 1. In the wake of the Fukushima disaster, some governments moved to phase out nuclear energy entirely (Germany, for example). The upfront capital costs and lengthy construction timeframes (circa 10 years) involved in building traditional nuclear reactors has discouraged private investment into new reactors. The Plant Vogtle project in the United States is one such example. The project to build two nuclear reactors in Georgia is seven years late and US$17 billion over budget. Finally, the fleet of nuclear reactors in use today is ageing, and amid a period of low wholesale electricity prices affecting the margins of nuclear reactors, many are being closed. The IEA estimates that 25% of the current fleet will be closed by 2025.[1]

In the absence of any additional investment in extending the lifetime of existing reactors or building new reactors, nuclear capacity operating in advanced economies would fall substantially – by two-thirds by 2040 per the IEA's estimates.[2] Importantly, in this scenario, a sharp increase in investment in other forms of power generation would be required if the Net Zero by 2050 scenario is to be achieved.

The future share of nuclear energy in the global energy mix remains unclear, but a shift away from the traditional, centralised, large reactors in use today is looking increasing probable. Global interest in small modular reactors (SMRs), commonly defined as reactors that produce electricity of up to 300 MW(e) per module (compared to 1,600 MW(e) for traditional reactors), is rising. SMRs are exactly as the name suggests. They are a fraction of the size of a traditional reactor (small). They can be deployed either as single- or multi-module plants and are designed to be built in factories and ultimately shipped to their final destination (modular). Finally, they harness nuclear fission to generate heat to produce energy (reactors). While interest in them is on the rise, SMRs have been used since the 1950s on military ships and submarines that require long periods between refueling.

SMRs have been touted as a solution to some of the biggest hurdles traditional nuclear reactors face. Many aspects of the construction of SMRs are expected to be standardised, which should lead to lower upfront capital costs and construction times than traditional nuclear plants, and to a lower levelized cost of electricity relative to current traditional reactors and other sources of electricity as shown in Chart 2 overleaf.

CHART 1: WORLD ELECTRICITY GENERATION MIX BY FUEL, 1971 - 2019



Source: PATRIZIA, International Energy Agency

[1]International Energy Agency, *Nuclear Power in a Clean Energy System*, May 2019
[2]Ibid

The modular nature of SMRs provides flexibility and scalability benefits, enabling them to be used in areas where larger nuclear plants are not required. Their portable nature means they can be used in both remote locations where access to power is both difficult and cost-prohibitive, or on existing energy generation sites, such as retired coal power plant sites, where they can make use of electricity infrastructure already implemented on site.

The role they can play in grid decentralisation is clear – they can be placed in locations where the energy is demanded and can serve as reliable counterparts to renewables. They also have a relatively small physical footprint, an equivalent solar-only or wind-only solution would require expansive solar and wind warms that would have a significant impact on the natural environment. An interesting application of SMRs could be as an energy source for data centres that are trying to achieve their stated carbon-free energy goals. Data centres are required to operate to very high levels of availability, which makes some renewable energy sources on their own, such as wind and solar, inappropriate for the provision of clean energy to data centres.

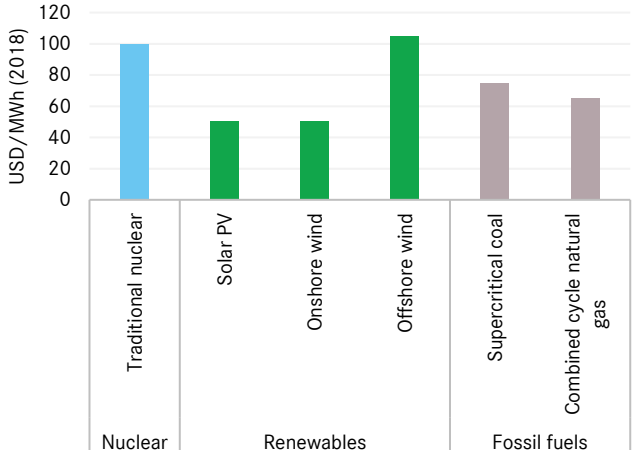
While the potential benefits are clear, the investment case and economic competitiveness of SMRs relative to other sources of clean energy have been entirely untested. It is difficult to have confidence in production times, as well as costs and benefits relative to traditional nuclear reactors. Public acceptance and safety measures are also hurdles to overcome, especially in relation to the distributed nature of the reactors.

But SMRs have been gaining political traction – President Biden has allocated US$21 billion of the 2023 fiscal budget to nuclear and hydrogen programs. UK Prime Minister Rishi Sunak pledged '*ambitious cooperation on nuclear with France*' at COP27. But it is Canada that is leading the charge on this front, it has released an SMR Action Plan and four of its provinces are involved in a joint strategic plan to expedite the deployment of SMRs.

Given the development and deployment of SMRs remains in a reasonably preliminary stage, it is unsurprising that there is, so far, very little private investment. However, the 2022 inclusion of nuclear energy in the EU green taxonomy and the UK government's decision in March 2023 to include nuclear in its Green Investing Rulebook are encouraging signs that governments are trying to attract sustainability-minded investors into the nuclear space. If the deployment of SMRs gathers pace and the expectation that they can be deployed more quickly and cost effectively than traditional nuclear reactors is realised, it may be an emerging asset class to keep a close eye on for prospective infrastructure investment.

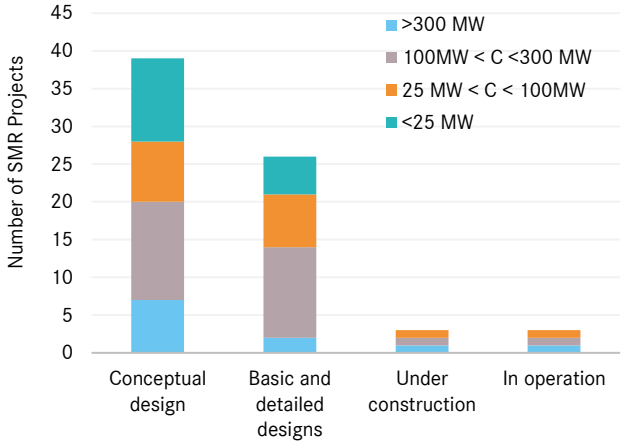
Ultimately, nuclear energy's role in the energy transition remains somewhat unclear. What looks more certain is that the way nuclear energy is produced could be on the precipice of a shakeup. But, while momentum behind SMRs is gathering pace, a lot of unknowns remain, not least of which is the public perception and investor sentiment towards nuclear energy. For this asset class, its own reputation may be the biggest hurdle to overcome.

CHART 2: LEVELISED COST OF ELECTRICITY IN THE US, 2040



Source: PATRIZIA, International Energy Agency

CHART 2: GLOBAL NUMBER OF SMRS BY STATUS OF DEVELOPMENT



Source: PATRIZIA, International Energy Agency

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