Could Small Modular Reactors Power Data Centers in the UK?

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As digital services such as artificial intelligence continue to grow, so will the demand for data processing and storage. The number of data centers, the backbone of this digital world, is growing rapidly across the globe and the United Kingdom is no exception. However, with this increase in demand comes an associated rise in energy consumption. Traditionally, data centers rely on power from the national grid, which in the UK is largely powered by fossil fuels, contributing to both environmental concerns and rising energy costs. To meet future energy demands while reducing carbon emissions, a potential solution is emerging: Small Modular Reactors (SMRs).

SMRs represent a new and innovative approach to nuclear energy. Unlike traditional nuclear reactors, which are large and complex, SMRs are smaller, scalable and potentially safer. Their ability to provide stable, low-carbon energy could play a vital role in transforming the energy landscape of the UK, especially when it comes to powering energy-intensive facilities like data centers.

This article explores how SMRs could be utilized to power data centers in the UK, examining the potential benefits, challenges and the broader impact on energy sustainability and security.

Understanding SMRs

SMRs are a new generation of nuclear reactors that have a significantly smaller output capacity than traditional nuclear reactors. Typically, SMRs have the capacity to produce less than 500 megawatts (MW) of electricity, which is a fraction of the output of traditional reactors. The UK's most modern nuclear power plant, Hinckley Point C, will have a capacity of 3,200 MW. What sets SMRs apart is their modular nature—these reactors are designed to be manufactured in factories and then assembled onsite. This modular approach makes them potentially more cost-effective, more flexible and quicker to deploy than conventional nuclear power plants.

SMRs have several key advantages over traditional nuclear reactors, including:

Safety: Many SMR designs incorporate passive safety features that require no active human intervention to shut down in the event of a malfunction or emergency. This significantly reduces the risk of accidents.
Scalability: Because SMRs are modular, they can be deployed in stages. If demand increases, additional modules can be added to increase energy production.
Flexibility: SMRs can be placed in a variety of locations, including remote or off-grid areas, making them ideal for applications that require a reliable and consistent energy supply.
Reduced Waste: SMRs tend to produce less nuclear waste compared to larger reactors and some designs even propose using spent nuclear fuel from older reactors.
Low Carbon Emissions: Like traditional nuclear power, SMRs generate energy without emitting greenhouse gases, making them a strong option for countries like the UK that are aiming for net-zero emissions by 2050.

These advantages make SMRs a promising solution for providing a reliable, low-carbon energy source to power critical infrastructure such as data centers.

The Growing Demand for Data Centers in the UK

The UK is home to a rapidly growing data center industry, driven by the increasing consumption of digital services, cloud computing, artificial intelligence and data-driven technologies. According to recent reports, the global data center industry is projected to continue expanding at a rapid pace and the UK is expected to see its energy demand from data centers increase significantly over the next decade.

Data centers consume substantial amounts of electricity to run and cool the servers and systems that store and process data. The UK, like many countries, relies on a grid that is powered by a mix of fossil fuels, nuclear and renewable energy sources. However, as the demand for data center services grows, the strain on the grid increases, leading to higher electricity costs and greater environmental concerns.

Moreover, data centers are often located in regions where the energy supply might not be sufficient to meet their needs. The decentralization of data centers can put additional pressure on local power grids, making energy reliability a concern. This is where the use of SMRs could come into play.

The Potential of SMRs to Power Data Centers

SMRs offer a potential opportunity to meet the rising energy demands of data centers in the UK. Their ability to provide a stable, continuous and low-carbon energy supply could significantly reduce the carbon footprint of data centers, helping the UK meet its climate goals.

1. Reliability and Stability

Data centers require a constant and uninterrupted supply of energy to ensure the smooth functioning of their operations. Any disruption in power can lead to significant losses in terms of data processing, security and operational downtime. Traditional energy sources such as wind or solar power, though important for a sustainable energy mix, may not always provide the continuous power needed due to intermittency issues.

SMRs, on the other hand, can operate continuously without the fluctuations seen in renewable sources. This makes them a reliable and stable source of power for data centers, providing the necessary consistency to ensure uninterrupted service. Their ability to operate at full capacity, even during extreme weather conditions or grid disruptions, makes them particularly valuable in the context of energy-intensive industries like data processing.

2. Carbon Emissions Reduction

One of the most compelling reasons to consider SMRs for powering data centers is their potential to dramatically reduce carbon emissions. As the UK transitions towards a low-carbon economy, data centers will need to move away from fossil-fuel-powered electricity. By using nuclear power, specifically SMRs, data centers can significantly reduce their carbon footprint.

SMRs are seen as a potential solution for industries that require high, consistent energy demand but are also committed to reducing greenhouse gas emissions. The UK government has committed to net-zero carbon emissions by 2050 and SMRs could help meet this target by providing an emissions-free energy source for sectors like data storage and processing, which currently rely heavily on fossil fuels.

3. Energy Security
The use of SMRs for data centers could also help improve the UK's energy security. With energy security being a growing concern, especially in light of global geopolitical tensions and energy supply disruptions, having a local, reliable and secure energy source is crucial. SMRs offer a resilient and sustainable solution to this problem. They can be deployed close to data centers, reducing dependence on external power sources and improving energy resilience in the face of supply chain disruptions or other challenges.

4. Economic Benefits
SMRs have the potential to drive significant economic benefits in the UK. By investing in nuclear energy infrastructure, particularly the development of SMRs, the country could create jobs in manufacturing, construction and operation of nuclear facilities. Additionally, SMRs could become a key export commodity, positioning the UK as a global leader in nuclear technology and innovation.

As data centers continue to proliferate in the UK, their energy costs will be a significant factor in their operational economics. SMRs, once operational, could provide a more stable and predictable pricing model for energy, which would help data center operators better plan for long-term costs and ensure profitability.

Challenges and Considerations

While the potential of SMRs to power data centers in the UK is promising, there are several challenges and considerations that must be addressed.

1. Regulatory and Licensing Issues
Nuclear energy, even in the form of SMRs, is heavily regulated due to safety and security concerns and integrating SMRs into the national energy mix will require careful planning, permitting, and licensing. The UK government is currently in the process of consulting on a new National Policy Statement for nuclear generation (EN-7). This is part of an effort by the UK government to encourage the development of nuclear power plants across England and Wales as highlighted in a press release from the Prime Minister’s office published on 6 February 2025 titled “Government rips up rules to fire-up nuclear power”.

2. High Initial Costs
The construction of SMRs requires significant upfront investment. While SMRs are cheaper to build and maintain than traditional nuclear reactors, they still represent a substantial financial commitment. For data center operators, the high initial cost of building an SMR facility may pose a barrier, although the long-term benefits in terms of stable and affordable energy could offset these costs over time.

3. Waste Management
Although SMRs produce less nuclear waste than traditional reactors, the disposal and management of radioactive waste remain a key issue. The UK has yet to fully address long-term nuclear waste storage solutions and this issue would need to be resolved before SMRs could be widely deployed.

4. Technological development
Although SMRs are a promising technology, they are still in development. Most SMR designs are still being tested and refined and it will take time before they are commercially viable on a large scale. However, the UK government’s expert nuclear delivery body, Great British Nuclear (GBN), is currently considering designs for SMRs put forward by GE Hitachi, Holtec, Rolls Royce SMR and Westinghouse for regulatory approval.

Where are we now?

SMRs represent a promising solution to the growing energy needs of data centers in the UK. Their ability to provide stable, low-carbon and reliable energy could significantly reduce the environmental impact of the data center industry, while also enhancing energy security and providing economic benefits. In the UK it is expected that GBN will soon conclude its review and select those SMR technologies that are best placed to be operational by the mid-2030s. Successful bidders' technologies will be allocated sites and incorporated into projects, and bidders will receive funding to develop their technology.

With the UK's commitment to achieving net-zero emissions by 2050, SMRs could become an essential component of the nation's energy strategy, helping to power the digital economy in a sustainable way. As the technology matures and the regulatory environment adapts, SMRs could play a pivotal role in shaping the future of energy for the UK, particularly in industries that rely on high and constant energy demand such as data centers.