

Small Modular Nuclear Reactors



Last modified: 5th August 2016

Contents

What are SMRs?

Small

Modular

Advantages of SMRs

Disadvantages of SMRs

Would SMRs benefit the UK?

What are other countries doing?

In recent years, a number of companies have begun research and development work on small modular nuclear reactors (SMR), in the hope that they could prove cheaper and more flexible than conventional large units. However, critics say there is no demonstrable demand for SMRs, that they are likely to prove more rather than less expensive, and still produce nuclear waste for which there is no proven solution.

In the March 2016 budget, the government announced a £250 million competition to identify an SMR to be built in the UK, with a delivery roadmap to be published later this year.



Small reactors have been used for more than 50 years on military submarines and ships. Image: Defence Images, Creative Commons License

Small

The 'S' in 'SMR' refers to the generation capacity. There is no fixed definition of an SMR, but the general consensus suggests that they will be under 300 MW. This is the roughly the capacity of [Thanet Wind Farm](#), which has 100 offshore wind turbines.

Modular

The 'M' refers to the fact that the individual parts of the SMR can be factory produced, and then shipped to the end location and assembled there, in the same way as a prefabricated house. This also means that not every part has to be produced in the same factory. Advantages of modularity include the standardisation of components and designs and the potential for mass production.

'Modular' could also refer to the fact that multiple reactors can be installed sequentially at the same site. This is potentially appealing to developers, as it means a site can start generating an income before it is fully developed, and capacity can be increased over time to match demand.

Advantages of SMRs

SMRs have the following potential advantages when compared with large nuclear stations:

- Lower absolute capital cost, potentially easing the path for investors
- Reduced construction risk via off-site factory production and standardisation of components and systems
- Shorter construction and installation times
- Lower cooling requirements, potentially allowing installation on inland sites
- Reduced investment in the transmission network (as they could be deployed in a more dispersed pattern)
- Easier to decommission
- Design of safety features made easier by smaller reactors, since less heat would need to be dissipated in the case of emergency
- Reduced refuelling needs, with some plants anticipated to operate for 30

years without replenishment of uranium

- In addition to generating electricity, the size of SMRs makes them attractive to more bespoke applications such as water desalination.

Some SMR designs potentially offer significant safety advantages in that they are literally 'fail-safe'; if all safety processes failed, the reactors would turn themselves off with no potential for release of radioactive substances. However, other designs are close cousins of existing large reactors such as Pressurised Water Reactors (PWRs), and do not have this 'fail-safe' characteristic.

Disadvantages of SMRs

The obvious disadvantage of the SMR concept is simply that they do not exist as reactors for power generation. Nor is there obviously a market; former government advisor Professor Gordon MacKerron [has described them](#) as 'a classic case of supply-push technology development – no potential user of SMRs, mostly electric utilities, has expressed any serious interest in them'.

Nuclear reactors grew bigger because manufacturers and operators gained commercial advantages from increasing size and output. Logically, therefore, SMR economics should overall be worse than those of large reactors. In addition, establishing a fleet of smaller, dispersed nuclear installations would presumably provoke more problems with public acceptance and incur a greater cost for security.

Would SMRs benefit the UK?

Not even the most optimistic observers expect that any SMRs could be in operation in the UK before 2025 at the very earliest. By then, the electricity system is likely to look very different; increasingly based on ever-cheaper wind generation, with storage, electric cars, [demand-side measures](#), interconnection and other flexible technologies. It is not clear where SMRs would fit into this picture – although arguably, in purely technical terms, they would fit into a decentralised electricity system better than existing large reactors.

In December 2014, an Energy and Climate Change Committee [report](#) found that SMRs are a potentially complementary technology to the current nuclear new build programme and could offer significant skills, supply chain, and trade and export opportunities. And [according to the National Nuclear Laboratory](#), the global market in SMRs could be worth £250-£400 billion in 2035, provided the technology proves competitive.

NNL concluded that UK companies would need government support to build an SMR industry. And there is some interest. [Westinghouse](#) has proposed 'a shared design and development model', under which it, the Government and UK industry

would jointly own a new company to build, license and deploy the new SMR reactors. NuScale has set out a [similar scheme](#). Finally, [Rolls Royce](#) said it had submitted a [detailed design to the Government for a 220 MW SMR](#).

What are other countries doing?

Alongside the UK, 9 countries - Argentina, China, France, India, Japan, South Korea, South Africa, Russia and the US - are investing time and money into SMR research and development.

In a similar style competition to the UK competition, the US Department of Energy allocated \$452m to support the development of an SMR, based on light water technology.



Could SMRs herald a move away from large nuclear power plants? Image: Mike Boeing Photography, Creative Commons License