UK energy

The big challenge facing small nuclear reactors

Making them cost competitive requires a new approach to constructing plants

Contractors work on construction of Hinkley Point nuclear power station in Somerset. The two giant French-designed plants have a rating of 1,630MW each © Bloomberg

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When Britain unveiled its first commercial nuclear reactor back in 1956, Calder Hall in Cumbria had the ability to generate 50 megawatts of electricity. Fast-forward four decades to the last reactor the UK completed, at Sizewell in Suffolk. Still functioning, it has a capacity of 1,200MW.

Spot the theme? Yup, ever bigger reactors. Size has steadily increased because of simple nuclear economics. Sizewell B may be able to generate 24 times as much power as a 50MW reactor. But it doesn't need 24 times the material inputs and staffing to generate that extra power.

That's why the latest generation of reactors are even more gargantuan. The two French-designed plants being installed at Hinkley Point in south west England have a rating of 1,630MW each.

Which all makes it seem faintly counter-intuitive that Britain is considering downsizing and spending money on a fleet of so-called small modular reactors.

The government is considering plans to put up to £2bn into developing the technology. A number of companies, including Britain's Rolls-Royce and GE Hitachi, are pitching to sell their products.

The aim is to fund prototypes with a view to kick-starting a new SMR industry. This would build perhaps dozens of mini-reactors to help the UK meet its net zero emissions target while also keeping the lights on, as well as exporting this technically advanced kit.

Large nuclear hasn't exactly a spotless record when it comes to cost containment. So why make it harder by forgoing those scale advantages? Research by a team led by Tony Roulstone at Cambridge university looked at the relative costs of building a "first of a series" SMR against a comparable large reactor.

It concluded that if you used the same project techniques as for conventional plants, the SMR would cost (once the interest costs incurred in construction were taken into account) roughly 70 per cent more per kilowatt (kW) to build than the larger one.

Squeezing that cost back down requires a wholly different approach to construction. Instead of building everything in the open on a massive building site, as with large reactors, it means making as much as possible in factories before shipment to site. The same Cambridge team estimated that with ever more prefabrication and standardisation of parts, you could ultimately squeeze the cost down roughly to parity with the larger reactor.

Then there's the fact that building a small prefabricated reactor is much faster than a big one; say 3-5 years as opposed to 7-8 years. That reduces the amount of debt taken on before the reactor starts producing, and hence the amount of rolled up interest that later needs to be repaid. And last, there is the putative benefit of further "learning by doing" as the production line churns out ever more SMRs.

In the longer run, the Cambridge team estimated, these factors could cut total costs to around $4,000/kW. That's roughly equivalent to the costs achieved in Korea's conventional reactor programme, which is the best-of-kind among developed economies.

It's all quite an effort simply to get back roughly to where you might already be with conventional reactors. But the lack of a compelling cost advantage isn't a reason for shunning SMRs. These could in theory perform roles that large reactors cannot. For instance, their compact scale could permit them to be sited closer to users than giant coastal reactors, allowing the heat they throw off to be used for industrial purposes.

SMRs do have one inestimable advantage over large reactors. Their total cost - perhaps $2bn - is much more easily financed by the private sector than the $10bn-odd a large reactor requires. That makes it more credible to claim that you could build up the sort of pipeline that could encourage the investment needed to build low cost SMRs.

The UK has plenty of form in pursuing hubristic nuclear projects that become money swamps. A glance at the history of overruns and delays that plagued the Advanced Gas-cooled Reactor project in the 1960s should suffice as a reminder. For SMRs to avoid a similar miserable fate, the government must pick a single commercial technology which can bring in sufficient private sector investment and attract export orders. This cannot be some "made in Britain" industrial exercise. If that's what's in prospect, then, honestly, big is probably best.

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