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# Britain should leap-frog Hinkley and lead 21st Century nuclear revolution

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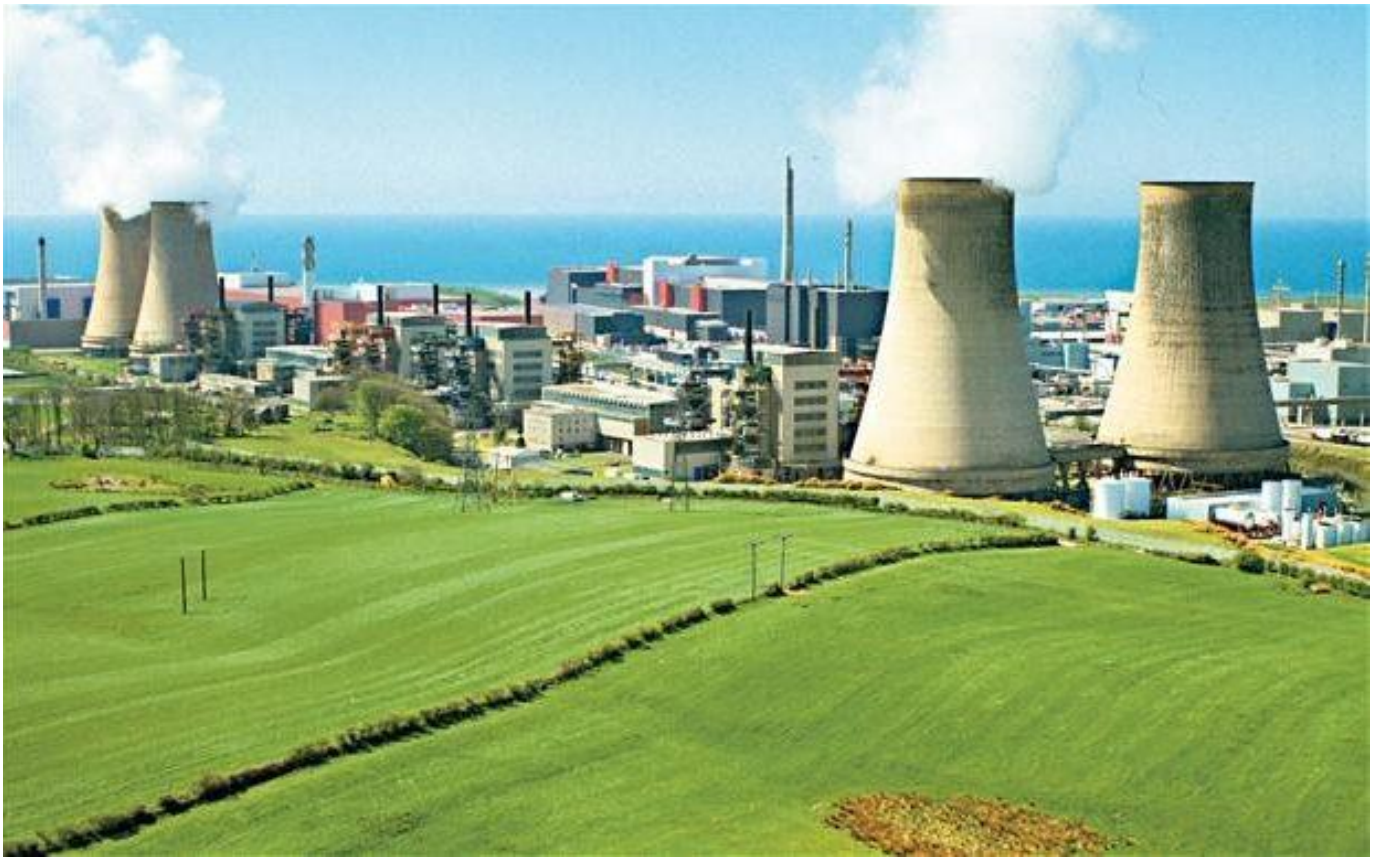

Calder Hall in Cumbria was the world's first nuclear power plant, opened by the Queen in 1956

It is hard to imagine now, but Britain once led the nuclear revolution.

Ernest Rutherford first broke the nuclei of atoms at Manchester University in 1917. Our Queen opened the world's first nuclear power plant in 1956 at Calder Hall.

Such were the halcyon days of British atomic confidence, before defeatism took hold and free market ideology was pushed to pedantic extremes.

Most of Britain's ageing reactors will be phased out over the next decade, leaving a gaping hole in electricity supply. By historic irony the country has drifted into a position where it now depends on an ailing state-owned French company to build its two reactors at Hinkley Point, with help from the Chinese Communist Party.

The horrors Hinkley are by now well-known. The European Pressurized Reactor (EPR) is not yet working anywhere. The Olkiluoto plant in Finland is nine years late and three times over budget. EDF's Flamanville project is not faring much better.

What is clear is that the costs of 'old nuclear' have spun out of control everywhere in the developed world. It is too expensive to keep trying to refine an inherently dangerous technology dating back sixty years in a Sisyphean attempt to make it less threatening after Chernobyl and Fukushima.

The capital cost of new nuclear plants in Europe and the US has risen from $1,000 per kilowatt in the 1970s to around $5,500 today in real terms. Hinkley will be nearer $8,000. Hence the lapidary term 'negative learning' coined by Yale scientist Arnulf Grubler.

The standard light water reactors were solid workhorses in their day - and averted huge releases of CO2 from fossil fuels - but they operate at 100 times atmospheric pressure. They need costly containment structures  to prevent an explosive release of deadly radioactive gases across hundreds of miles.

Ernest Rutherford first 'split the atom' at Manchester University in 1917

This nuclear cost spiral has been happening just as solar and wind costs plummet, and the verdict is in. The nuclear share of global power has dropped to 10.7pc from 17.6pc in 1996. Ten new reactors were built last year, but eight were in China. In Europe they are shutting down.

There is an alternative. Research into a radical new wave of safer, cleaner, and cheaper reactors is suddenly reaching critical mass, some are entirely compatible with the intermittency of wind and solar.

This is what Theresa May should be looking at as she launches her industrialisation drive and fashions an energy policy fit for the 21st Century.

The Washington think tank Third Way has identified fifty advanced reactor projects in North America, including eight based on molten salt fuel, ten on liquid-metal, and some based on fusion designs.

The US Energy Department has thrown its huge research power behind this push for a "meltdown-free" reactor cheap enough for mass production. It even explored micro modular variants for large jet aircraft at a forum in March, and Boeing has filed a patent to do exactly that with a laser-powered fusion-fission engine.

One of the US-backed projects is a "waste annihilating molten salt reactor", which uses up spent nuclear fuel and lethal plutonium residue. As it happens, Britain's start-up company Moltex Energy is working on similar lines, and this country needs the technology even more urgently than the US.

"We have the largest plutonium stockpile in the world and we don't know what to do with it," said Stephen Tindale from the Alvin Weinberg Foundation.

Moltex founder Ian Scott estimates that his molten salt design can cut costs to almost a quarter of the Hinkley tariff. "We think we can come in at a levelized £29 per megawatt hour," he said.

"That is radically cheaper than gas or coal in Europe. It could have a massive impact on the UK economy and it would be a terrible shame if we lose it," he said.

Molten salt reactors were built by the US physicist Alvin Weinberg at the Oak Ridge Laboratories in the 1960s, but were never pursued because the Pentagon wanted the plutonium residue from light water reactors to build nuclear warheads.

They dissolve the nuclear fuel in molten salts rather than using dry pellets of uranium. Advocates say a melt-down is impossible, and there can be no chain-reaction along the lines of Fukushima. If the reactor gets too hot, a freeze plug melts and the salts drain off. They cool down and turn solid. The fission process stops automatically.

"It is inherently stable. You could break every containment barrier and still not get a leak of cesium or iodine outside the reactor," said Dr Scott. The plants operate at atmospheric pressure so they are much smaller and safer.

Bags of radioactive contaminated soil piled up along the coast near the Fukushima nuclear plant

The Moltex reactor can run off existing spent nuclear fuel, cleaning up the legacy headaches of old nuclear plants. "We can process nuclear waste very cheaply instead of burying it at enormous cost in steel tanks for 200,000 years underground," he said. The plan is switch to thorium as a "greener" source of fuel once Britain's stockpile of nuclear waste has been consumed.

The Moltex design slashes costs by using a convection process that avoids pumping molten salt around the system. This reduces corrosion, the metallurgy barrier has bedevilled molten salt projects.

Dr Scott is the former chief scientist of Unilever and his technical advisory board includes Derek Fray at Cambridge, Paul Madden at Oxford, and Tim Abram at Manchester. The design is one of several projects being examined by the UK government in its competition for the best small modular reactor.

"We have done everything entirely without government so far, and frankly we have had much more interest in Canada where we were welcomed with open arms by the regulators," said Dr Scott.

Canada is now the crucible for molten salt reactors. Terrestrial Energy in Toronto is the most advanced such project in the world with an integral molten salt reactor, and is already pre-licensed. "We can bring our reactor to the commercial market in the 2020s," said the chief executive Simon Irish.

"Once we put a shovel to the ground we can build it in three to four years. The parts can be manufactured on a mass scale.  We believe we can produce power for 40-50 US dollars per megawatt hour," he said.

That is £31 to £38, a third of Hinkley. The reactor core - relatively cheap to make - is simply removed and replaced after seven years.

Molten reactors have a double advantage. They operate at 700 degrees centrigade, much hotter than light water reactors. This dry 'high quality heat' is itself valuable. It can drive steam electrolysis, make ammonia fertilizers or polymers,  and can even be turned into methanol for synthetic transport fuels.

Mr Irish said his 190 MW design is ideal for a new energy order dominated by renewables. "We can deploy extra power at peak times and pull it back into the troughs, and we can do it within minutes like a natural gas turbine. We tick all the boxes," he said. Old workhorse reactors cannot be switched on and off at will.

I do not wish to neglect a flurry of other designs that may have equal promise, nor can I vouch for the technical and cost claims. Specialist readers will delve further, and make their own judgment. What is clear is that nuclear technology is in ferment.

In a sense we have rare chance to go back to the drawing board. Britain still has a superb stable of nuclear scientists and talent but no longer faces a fortress of vested interests with horrendous sunk costs. It could leap frog the field.

The British state can borrow for twenty years at 1.2pc and it should do so with zest to break out of the austerity cage, launching a blast of fiscal stimulus to carry the country through the post-Brexit adjustment while at the same time giving our engineering industries a shot of adrenaline.

A gamble on the untested technology of advanced reactors might prove a costly flop but it is hard to see how it could be worse than a blank cheque for an obsolete nuclear model that will bleed us into the 2060s. At least we can take back our energy destiny.