



The Olkiluoto 3 nuclear plant in Finland is four years behind schedule and some €2 billion over budget.

The nuclear landscape

The accident at Fukushima has convinced many nations to phase out nuclear power. Economics will be the deciding force, says **Peter Bradford**.

A year after the nuclear meltdowns at the Fukushima Daiichi plant in Japan, tens of thousands of people from the area still cannot return to their homes. Many will not be able to do so during their lifetimes. Only two of Japan's 54 reactors are operating, and there is uncertainty over whether the others will return to service. Once-robust Japanese plans for new nuclear construction have been abandoned, with the government's energy white paper in October 2011 calling for a reduction in reliance on nuclear power.

The disaster has triggered other countries to rethink their nuclear-energy policies. Germany, Belgium and Switzerland have announced plans to close all of their existing reactors (although phase-out plans have been reversed before). They will not build new reactors. Neither will Italy, which closed its reactors after the 1986 Chernobyl accident in what is now Ukraine. In June 2011, some 94% of the Italian electorate voted against any resumption. The Czech Republic has cancelled all but two of its planned plants. Poland has deferred reactor construction for several years. Even France, long a nuclear-power stalwart, may close some reactors early depending on the outcome of elections later this year.

Other nations have made less drastic changes, such as bringing in enhanced safety measures or 'stress tests' for reactors. In countries including the United Kingdom, the United States, China, Russia, India and South Korea, plant closures and cancellations attributed to Fukushima are less likely, but planned expansions will struggle to stay on course.

Before Fukushima, the number of new nuclear plants built in the past 20 years roughly equalled the number retired. The latest re-evaluations suggest at least a short-term downturn for nuclear power's share of global energy production.

Yet the most implacable enemy of nuclear power in the past 30 years has been the risk not to public health, but to investors' wallets. No new nuclear-power project has ever bid successfully in a competitive energy market anywhere in the world.

Fukushima is not the only recent challenge to nuclear power: long-term natural-gas prices and price forecasts have more than

halved in the United States, and globally, electricity demand has dropped on average owing to the economic slowdown. But these events have merely worsened the odds for new nuclear reactors: private capital was no more available before these events than it is now. Accidents at nuclear plants and economic changes have occurred before, within the living memory of global financial communities. The knowledge that any of these events — or new future threats — might happen has long discouraged investors.

Buffeted by economic forces, new nuclear capacity cannot be expected to contribute significantly to global energy supplies or to climate-policy solutions in the decades ahead. Most of the world's reactors are more than 20 years old, so plant completions will be largely offset by retirements. Wise economic and environmental policy will have to allow nuclear energy whatever place it can earn among other energy sources, and not burden it with unnecessary hopes and fears.

THE SECOND COMING

In the United States, where no new reactor has received a construction permit since 1978, a 'second coming' of nuclear construction has been anticipated with as much ballyhoo (and accuracy) as its religious counterpart. In 2009, 31 applications for new reactor projects had been filed or announced. Three years later, only four projects remain on course for construction by 2021. Only on 9 February this year did the US Nuclear Regulatory Commission issue its first licence to build a new reactor in 34 years.

Many people have accepted a version of history in which US nuclear construction wound down because of excessive regulation, environmental alarmism and public fearfulness after the 1979 accident at Three Mile Island in Pennsylvania. For them, the new reactor licence for a site in Georgia proves that US regulators and the public have regained their resolve. But this view rests on a fallacy. Three Mile Island happened at about the same time that competitive market forces were unleashed on the process of power-plant selection. This is the true reason for the decline in reactor construction: some 50 US reactor orders had already been cancelled before the accident.

Chicago-based firm Exelon, the largest US nuclear operator, predicts that electricity from new nuclear plants will cost 12 cents per kilowatt hour (kWh). In comparison, other low-carbon alternatives — combining natural gas with energy efficiency, expansion of existing nuclear plants and wind — will cost 3–11 cents per kWh. Trying to sell new reactors into US power markets that do not value low carbon, and that are predicted to pay no more than 6 cents per kWh for many years,



A YEAR AFTER THE TSUNAMI

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is a certain route to bankruptcy.

This economic impracticality has been felt globally since the early 1990s. Although the number of nuclear plants in operation jumped from a handful in 1960 to 424 in 1989, they then levelled off, peaking at 444 reactors in 2002 (see 'Not going up'). After Chernobyl, at least a dozen plants of the same design were taken out of action. Older, smaller plants were decommissioned. But the determining factor was the drop in construction in the United States and western Europe — a result of the cost of building new plants and the refusal of investors to bear the risks of cancellations, cost overruns and the emergence of cheaper alternatives.

At the time of the Fukushima disaster, only four countries (China, Russia, India and South Korea) were building more than two reactors. In these four nations, citizens pay for the new reactors the government chooses to build through direct subsidies or energy price hikes. In a few cases, such as the Olkiluoto 3 reactor under construction in Finland, the company providing the reactor promises a fixed price or looks to its own government for finance. Olkiluoto is being built by Areva, an entity largely owned by the French government, which was gambling that the project would jump-start demand for its newest reactor design. As Olkiluoto is four years behind schedule and more than €2 billion (US\$2.7 billion) over budget, that gamble has fallen flat.

The only nations for which building high-cost nuclear plants has any prospect of becoming competitive are those that combine very limited access to natural gas with high growth (Japan once among them). Even then, there is no reason to pay over the odds for nuclear. Instead, all greenhouse-gas mitigating measures and alternative-energy sources should have to compete with each other in the marketplace.

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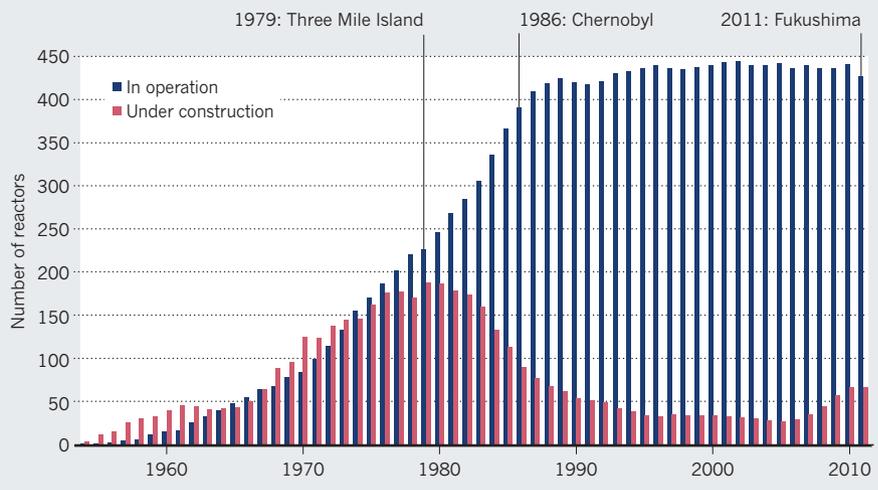
POLITICAL BALANCE

On top of the ongoing dire economic situation, Fukushima has shifted the political equation. The Chernobyl disaster was widely seen as a product of the lax Soviet safety culture, in which an unsafe design was combined with reckless operation. But Japan was considered to be in the technological and regulatory front rank. Champions of nuclear power in the US Congress (and even President Barack Obama on one occasion) had held up Japan as a nuclear success story that US regulators and energy policy-makers should strive to emulate.

After Chernobyl, Italy and Germany

NOT GOING UP

Building of new nuclear reactors declined after the 1979 Three Mile Island accident, as economic realities hit home. The number in operation has levelled out since the late 1980s.



SOURCE: IAEA-PRIS, MSC, 2011

decided to phase out nuclear energy, as Sweden had done after Three Mile Island. All three later reconsidered as concerns over climate change and years without a conspicuous reactor accident shifted the political balance back towards nuclear energy. The unfavourable economics did not change, but the willingness of governments to override economics with subsidies and mandated purchases did.

In the United States, this change has produced a paradox. The right-wing legislators who swept into state and federal office in 2010 have conflicting tendencies towards nuclear energy: they are largely pro-nuclear, pro-market, climate-change sceptics, yet they disparage governmental backing of particular technologies with taxpayers' money. Before Fukushima, the net effect seemed to be towards state and federal measures that were favourable for new nuclear capacity, such as increases in taxpayer-backed loan guarantees or laws that made energy customers responsible for runaway costs or cancelled plants. After Fukushima, those measures quietly died.

In the United Kingdom, too, a conservative government pledged to produce new nuclear power without government subsidies. It is now having to torture the language of new policies to subsidize new reactors without this being recognized as such.

It is impossible to say what will happen next for nuclear energy. The indications from emerging carbon markets are that they will not produce a high enough price to support new nuclear. These markets are not providing enough emissions avoidance either, so the price for carbon could go higher. If Exelon's predictions are correct, and if gas prices remain low, carbon prices would have to more than triple to make new nuclear look economical. At that level,

many other alternatives could be built on a large scale more quickly.

The hopes of the US nuclear industry now rest on the new reactor in Georgia — one of the few states with a law assuring that energy customers will pay all reactor costs regardless of price. Energy secretary Steven Chu, visiting the site last month, intoned: "If this project goes forward and is built on-budget, on-time and on-schedule, that would be a very good thing. A lot of other companies will say, 'OK. We now know we can do this and it would be a good investment.'" But companies will say no such thing unless they can also produce energy at a competitive price. Instead, they will join Exelon in saying 'we can do this and go broke'.

Many countries state the unknowable or the implausible with great certainty. Germany has declared that existing nuclear capacity is too dangerous and can be phased out at little cost. The Middle East and the Czech Republic assert that new nuclear is a vital low-carbon energy source. Others, including the United Kingdom, have said that there will soon be new nuclear without subsidies.

It would be ideal if Fukushima could steer us away from these prophecies and towards a sensible assessment of market economics, climate science and nuclear risks. Then nuclear power would serve the public, not the other way around. I don't know how many reactors we would get, but we would get the number that we need. ■

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