

The future of nuclear energy

One step back, two steps forward

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Introduction

Once on the cusp of a renaissance, the nuclear industry now risks being banished to the Dark Ages. This is the impression that emerges from much of the commentary in the months since the crisis at the Fukushima Daiichi nuclear power plant in Japan. Before the devastating earthquake and tsunami on March 11th, atomic power enjoyed a return to prominence among planners. Now, a commonly held view is that the nuclear industry will see a slowdown in growth, if not an outright decline.

For certain countries, the effect of Fukushima on popular and political support for nuclear power is significant. Burgeoning support for the abandonment of nuclear recently swung elections in Germany, which now plans to phase out atomic power altogether. Japan, still reeling from its traumas, said it will not build any new reactors, whereas before the natural disaster it envisioned a new fleet.

Where appropriate, the Economist Intelligence Unit has revised down its forecasts for nuclear capacity. In doing so, however, it became clear that Germany and Japan represent exceptions to the rule. Much of the nuclear scepticism that other governments have signalled does not represent an erosion of enthusiasm for atomic power. Rather, it has more to do with showing tact in front of a jittery public. This is, crucially, the case in the world's keenest builder of nuclear plants: China.

Nuclear energy is a response to long-term trends, and hence not easily abandoned or replaced. The need for new sources of electricity to power economic growth persists, and the promise of nuclear in bolstering energy security and reducing carbon emissions makes it an appealing option. Indeed, a review of our forecasts for the ten largest nuclear power producers—accounting for some 85% of global capacity—shows that, despite Japan's crisis, the overriding global trend over the next decade will be growth.

Today, the top ten countries have around 320 gigawatts (gw) of nuclear infrastructure between them; by 2020, this capacity will swell to 405 gw. But this is only part of the picture, as countries from eastern Europe to Africa are also showing an interest in going nuclear. Taken together, it looks like something of a renaissance.



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Atomic decade: Top ten nuclear countries

	Net nuclear capacity, gw			Change in capacity, 2020 v 2010	
	2010	2015	2020	%	gw
United States	101.1	103.4	109.0	8	7.9
France	63.3	64.8	66.4	5	3.2
Japan	46.8	45.0	44.7	-5	-2.1
Russia	22.7	29.7	41.0	81	18.3
Germany	20.5	11.7	9.0	-56	-11.5
South Korea	18.7	24.2	28.1	50	9.4
Ukraine	13.1	13.1	16.2	23	3.1
Canada	12.6	12.6	15.0	19	2.4
United Kingdom	11.0	9.6	12.7	16	1.7
China	10.1	37.1	63.1	527	53.0
Total	319.8	351.2	405.2	27	85.3

Source: Economist Intelligence Unit.



United States of America

Even before Japan's nuclear emergency, prospects for a vaunted "nuclear renaissance" in the US were receding due to the uncertain political will to subsidise it. Fukushima will not help. In the coming decade, the incident's impact in the US is likely to be felt most keenly through the debate it has triggered on "uprating", whereby more power is squeezed out of existing reactors. A safety review continues, but the Economist Intelligence Unit expects that greater suspicion of this practice will feed into slower capacity expansion and we have reduced our forecasts accordingly.

Yet it would be easy to overstate the impact of a far-flung crisis: by 2020, we still expect the US to have 109 gw of nuclear capacity, compared with 101 gw today. Nuclear's future in the US—the world's biggest atomic generator—actually looks a little brighter than its present. The US needs energy from somewhere and, thanks to climate change and energy security concerns, nuclear power attracts support from both Democrats and Republicans. Construction or pre-construction work is under way at the sites of five new reactors, and there are few signs that these will be blocked.

Thus, despite all the fuss, by 2020 a total of 8 gw of nuclear capacity will be added. This does not match the ambitious additions in a fast-growing economy like China. But neither is it exactly a bleak picture for America's nuclear industry.

Net nuclear capacity (gw)

2010	2015	2020
101.1	103.4	109.0



France

Among major economies, France is the most reliant on nuclear energy, which provides around three-quarters of its electricity. Given France's dearth of other resources, nuclear has enjoyed long-standing support not just from the ruling centre-right Union pour un mouvement populaire (UMP), but also from the opposition Parti socialiste (PS). When push comes to shove, this will survive the impact of distant events.

Admittedly, nuclear politics has become more complicated of late. The PS's allies, the Greens, stepped up their criticism of nuclear power in the wake of the Fukushima disaster, and have called for a referendum on nuclear power's future. Indulging their friends, the socialists have called for an audit of nuclear power stations and will endeavour to appear more willing to debate the future of nuclear. Yet even they fail to see the necessity for a referendum. This has, in any case, been rejected out of hand by the president, Nicolas Sarkozy, who opted for a lower-key safety review instead.

It would not be surprising to see opposition parties trumpeting renewable energy, but France is too committed to atomic power to turn away from it during the next decade. Indeed, two new reactors will come online within this period (in 2013 and in 2017). The Economist Intelligence Unit forecasts that France's nuclear capacity will rise by 5% between 2010 and 2020, although its share of generation will fall to 71% by 2020, from 76% in 2010, as renewables gain.

Net nuclear capacity (gw)

2010	2015	2020
63.3	64.8	66.4



Japan

To curtail carbon emissions and ease reliance on imported fossil fuels, Japan was expected to expand its nuclear capacity from 46 gw in 2010 to around 60 gw by 2020. This was the outlook for Japan's nuclear sector before the earthquake and tsunami of March 11th. These natural disasters have significantly altered Japan's nuclear equation. Besides taking at least 2.7 gw of nuclear power capacity out of commission permanently (damaged reactors at the Fukushima plant will be scrapped), Japan's nuclear emergency and the lasting unease that it created have undermined popular and political support for atomic energy.

Unsurprisingly, plans for two new reactors at the devastated Fukushima facility were quickly discarded. Largely for political reasons, the prime minister, Naoto Kan, announced in May that Japan will not build any more nuclear plants. Yet the underlying rationale behind Japan's adoption of nuclear energy remains intact. The Economist Intelligence Unit's preliminary forecast is that fewer new reactors will be built this decade than previously expected, while several older ones will be decommissioned. Moreover, efforts to improve safety and inspection standards could lead to further delays. Stagnation will therefore be the trend. We now expect one less reactor to be in service in 2020 than this year, and capacity will decrease by two gigawatts from today, to around 45 gw.

Japan will thus remain one of the biggest users of atomic power, but the global nuclear industry will benefit from markedly less growth in Japan than it previously expected. There are also clouds hanging over the overseas prospects for Japan's nuclear equipment makers—the likes of Toshiba and Hitachi, which along with GE supplied units for the Fukushima facility—or Tokyo Electric Power Company, the utility that owns the stricken plant. Fairly or not, the stigma of association with the world's second-worst nuclear accident, and the poor safety record that it has highlighted, will prove bad for business.

Net nuclear capacity (gw)

2010	2015	2020
46.8	45.0	44.7



Russia

Russia has largely shrugged off the Fukushima crisis. Although a nuclear review was quickly ordered, the president, Dmitry Medvedev, boldly reaffirmed government support for nuclear power.

As elsewhere in former Soviet countries, safety concerns are less pronounced than in the West. Moreover, atomic power is a crucial factor in Russia's energy calculus. Using nuclear energy to generate electricity at home frees up more of the country's vast hydrocarbon resources—most notably its gas reserves, the world's largest—for sale abroad at a higher profit. Russia's authorities have suggested that more than 50 reactors could be built in the next two decades; only China is busier building plants at the moment.

The Economist Intelligence Unit's forecast, little changed by recent events, projects Russia's nuclear capacity to surge from around 23 gw today to 41 gw in 2020. Furthermore, not only does Russia's frenetic construction programme remain largely on track, but it has also lost none of its mercantile enthusiasm for assisting others with theirs.

Since Fukushima, Russia has signed a new deal with Belarus and reaffirmed plans to build Turkey's first reactor. Iran's controversial first reactor, built by the Russian state-owned Atomstroyexport, has reportedly gone into operation. A deal with Bangladesh is also reported to be in the offing later this year. At home and abroad, Russia is anything but bearish on nuclear energy.

Net nuclear capacity (gw)

2010	2015	2020
22.7	29.7	41.0



Germany

Antipathy towards nuclear power in Germany is historically strong, but before the Fukushima incident the future of atomic energy looked brighter. Since Japan's crisis, however, a virulent anti-nuclear lobby has pounced on the accident as an illustration of the dangers of atomic energy, and Germany's governing parties have reversed their support for it. Despite the temporary shutdown of seven reactors for a three-month moratorium, the Christian Democratic Union, the main party in the centre-right coalition government, was punished in state elections in late March and May, while the anti-nuclear Green Party made hay. The outlook for nuclear capacity in Germany is dim.

That nuclear power will be phased out entirely looks almost certain, but politicians disagree over the timeline. The Greens want to see the last nuclear plant switched off in 2017; the main opposition Social Democratic Party in 2020; and the ruling coalition on May 30th committed to a complete shutdown by 2022. This, however, may face legal challenges from power companies. How to pay for a dramatic shift away from nuclear, and what to replace it with, are crucial questions—especially given the central importance of Europe's largest economy to hopes of hitting EU carbon emissions targets. Satisfactory answers are not apparent.

Against such a backdrop, the Economist Intelligence Unit expects that 9 gw of nuclear capacity will remain in service by 2020, a plunge of more than 50% from 2010 levels, but not much longer. This is in comparison to the outlook before Fukushima, when we expected 18.5 gw to be in operation at the end of the decade. Instead, Germany is set to see the sharpest dwindling of nuclear power among all major economies.

Net nuclear capacity (gw)

2010	2015	2020
20.5	11.7	9.0



South Korea

South Korea, like neighbouring Japan, has been driven towards nuclear energy by the impetus to wean itself off imported hydrocarbons. The Economist Intelligence Unit forecasts that electricity demand growth will exceed 4% almost every year this decade, a fair tick for a developed economy. To slake this thirst, South Korea has turned to nuclear energy with enthusiasm.

There is another incentive to build new plants. South Korea wants to export 80 reactors by 2030, and local companies have started nipping at the heels of established global players. Korea Electric Power, Samsung and Hyundai won orders from the United Arab Emirates in 2009, and a South Korean consortium was successful in a bid to build a reactor in Jordan last year. Maintaining a strong domestic market for South Korean equipment will generate revenue to support these efforts.

Events in Japan, however, threaten to damage sentiment towards atomic power, and have prompted calls for a reassessment of South Korea's plans. Reflecting undermined support for nuclear energy, we have lowered our 2020 forecast from 33 reactors to 29. (We assume that the situation in Fukushima will drag on, but that risks posed by radiation leakage are limited outside of the immediate vicinity of the ruined plant; otherwise the effect could be greater.)

Nevertheless, nuclear power will have a substantially larger role by 2020 than it does today. The prime minister, Kim Hwang-sik, has stressed that South Korea cannot afford to abandon nuclear power if it is to secure economic growth. South Korea's current fleet of 21 reactors has a combined capacity of around 19 gw; we forecast that this level will rise by 50%, to 28 gw, by 2020, which looks like good news for the country's nascent nuclear industry.

Net nuclear capacity (gw)

2010	2015	2020
18.7	24.2	28.1



Ukraine

Unlike some other devotees of nuclear energy, such as France and Japan, Ukraine is well endowed with natural resources. Its coal reserves are the second-largest in Europe, and natural gas is plentiful. And yet nuclear energy provides one-half of Ukraine's electricity needs, and official plans envisage its share expanding significantly. Why is it so keen on nuclear power?

Reserves aside, thanks to a dismal business environment Ukraine's energy production remains limited. Its industry is also energy-guzzling, so the country is in fact a net importer of energy. Electricity demand will post healthy growth this decade, but Ukraine's energy policy is made in the shadow of its primary gas provider and former master, Russia. Prices of gas imports from its major supplier have escalated in recent years, while in negotiations Moscow has demonstrated few qualms about switching off supplies to strengthen its hand. An April 2010 agreement linked to basing rights for Russia's Black Sea fleet has ensured Ukraine a hefty gas price discount for the rest of the decade. Still, it understandably wants to diversify away from gas.

Following Fukushima, Ukraine's prime minister, Mykola Azarov, said that his country would rethink its energy strategy. But the Economist Intelligence Unit does not expect Ukraine to abandon support for nuclear power—surprising, perhaps, given that the country suffered the world's worst nuclear accident, at Chernobyl. Nevertheless, as is typical in much of the former Soviet bloc, nuclear safety fears are less pronounced than in the West. Given the cost of new plants and demands of decommissioning old reactors, though, Ukraine's addition to its nuclear capacity may undershoot current plans.

Nuclear capacity in Ukraine is expected to begin its ascent in the latter half of the decade, rising from 13.1 gw in 2015 to 16.2 gw in 2020. Whether Ukraine's continued bullishness on nuclear will enhance its energy security, however, will depend on its success in finding substitutes for Russian nuclear fuel and equipment, on which it relies heavily. It has taken some steps in this direction but remains deeply dependent on its demonstrative neighbour.

Net nuclear capacity (gw)

2010	2015	2020
13.1	13.1	16.2



Canada

Nuclear capacity in Canada is smaller today than it was in the mid-1990s. Since 2005 it has stagnated at around 12.5 gw, generating about 14% of the country's power. There have been signs of life: Ontario, the centre of nuclear power production in Canada, funded refurbishments of some nuclear plants. But there have also been notable recent reversals. Last year, for instance, the provincial government announced that it would not build mooted new reactors at the Darlington power station, blaming soaring costs.

Yet interest in nuclear energy is being stirred by Canada's obligation to cut carbon emissions under the Kyoto Protocol, in addition to a target of cutting emissions by 20% from 2006 levels by 2020. Atomic power could make sense for other reasons, too; Canada has plenty of available fuel, churning out almost one-fifth of the world's uranium, which makes it the world's second-largest producer (behind Kazakhstan).

Events in Fukushima appear unlikely to have much effect on the debate in Canada. There is no serious suggestion that approval of plans for a new 4.8-gw plant at Darlington, again under review, should be linked to an assessment of the Japan crisis (although only two of the four reactors planned are expected to be built by 2020). Indeed, operators have been left to make their own safety reviews following Fukushima. The Economist Intelligence Unit expects that new nuclear capacity will be added late this decade, as its attributes of being low-emission and low-cost (after the steep initial capital outlay) outweigh objections. Canada's capacity will rise from 12.6 gw today to 15 gw by 2020.

Net nuclear capacity (gw)

2010	2015	2020
12.6	12.6	15.0



United Kingdom

The UK’s nuclear infrastructure is ageing: 14 of the current fleet of 19 reactors will have to close this decade. But energy plans call for a “significant proportion” of the 25 gw of new generating capacity (ex-renewables) required before 2025 to come from nuclear. Yet after Fukushima the UK government ordered a safety review, and there are signs of divisions within the Conservative-Liberal Democrat coalition on the future of the country’s nuclear infrastructure.

Ministers have nonetheless said that nuclear will play an important role in the UK’s future energy mix. Indeed, if the UK does not follow through on its nuclear plans, it could face severe energy shortages: by the Economist Intelligence Unit’s calculations, without adding new reactors, by 2020 electricity demand will exceed supply by around 5%, a gap that would need to be met by other sources. The interim conclusions of the government’s safety review supported existing plans for new reactors and downplayed the threat of natural disasters to the country’s nuclear infrastructure.

Of greater concern than official indecision could be the ability to attract sufficient funds, which may be a problem after Fukushima. The UK should be especially vulnerable to suspicion of nuclear as subsidies are officially off the table, so construction will rely on private sources of cash.

The Economist Intelligence Unit’s forecast nevertheless assumes that the UK will solicit the needed funds. Shakiness in investor sentiment should tail off as the Fukushima incident drifts down the headlines and many countries continue to pursue nuclear programmes.

Although nuclear capacity in the UK will dip this decade as old reactors are retired, there will be a spurt in 2020 as new reactors come into service. Capacity will rise from almost 11 gw currently to 12.7 gw by 2020. This still leaves a lot of work to do if nuclear is to make up a big chunk of the non-renewable capacity that the government thinks will be needed by 2025.

Net nuclear capacity (gw)		
2010	2015	2020
11.0	9.6	12.7



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China

China's move to suspend new nuclear construction and launch a reassessment of the phenomenal 27 reactors under construction, made less than a week after the crisis at Fukushima began, went against the grain. After all, the country's leadership is hardly known for squeamishness in the face of engineering challenges. Besides, neither China's existing nor planned nuclear plants cluster in seismic hotspots or coastal regions prone to tsunamis. Moreover, as China, which derived around 66% of its energy from coal last year, seeks to tap cleaner sources of energy, it wants to pursue all available options.

Partly, Beijing's decision to reassess its atomic plans was a public relations exercise designed to reassure a jittery public: demand for iodine, taken to ward off the effects of radiation, spiked in Beijing as Japan's nuclear unease deepened. Pausing the nuclear roll-out could also give planners a premise for scaling down their ambitious 2020 capacity target of 70 gw, compared with around 10 gw in 2010, which the Economist Intelligence Unit believes is out of reach. It is doubtful whether global uranium mining capacity can keep pace, if skilled nuclear staff can be trained quickly enough, or whether even China can manage to build so many new plants so rapidly.

Our revised forecasts take this into account, as well as delays owing to enhanced safety concerns following Fukushima. The current suspension could drag on until the end of the year. Accordingly, we have slightly lowered our projections, expecting fewer reactors by 2020 than we did previously. Yet China's position as the number-one market for nuclear equipment is assured: although 7 gw less than the country's official target, we expect capacity to expand to 63 gw by 2020, a sixfold increase from 2010. Fukushima? Where's that?

Net nuclear capacity (gw)

2010	2015	2020
10.1	37.1	63.1



Other noteworthy nuclear countries



Brazil

The immediate public policy aftershocks from Fukushima have barely touched Brazil, although longer-term plans to boost nuclear energy could be affected. Given a lack of seismic activity in the Latin American giant, so far nuclear safety issues have not generated much concern: the government has restated its intention to carry on with a plant at Angra, in Rio de Janeiro state. The country is also keen to capitalise on its uranium reserves, which account for around 5% of the world total. By 2020, we expect over 3 gw of nuclear capacity to be online, up from just under 2 gw in 2010. Plans call for 8 gw of nuclear capacity by 2030. One-third of the new plants are slated for Brazil's densely populated south-east, however, where residents are better-educated and more environmentally aware than in other parts of the country. These will meet popular resistance.



India

India has the fourth-largest nuclear capacity currently under construction (3.8 gw) and boasts a credibility-stretching target of adding 470 gw by a conveniently far-off 2050. Building more nuclear capacity is a major plank of the country's effort to overcome severe power shortages. True, radiation leaks in Japan have emboldened nuclear's sceptics, triggering violent protests near nuclear sites; the coastal areas where India wants to put its reactors are prone to earthquakes and flooding. Yet India's government, which staked much on a controversial nuclear deal signed with the US in 2008, does not look prone to a major wobble when it comes to its nuclear ambitions. There is likely to be only a small slowdown in construction as a result of Fukushima.



Pakistan

Pakistan's nuclear programme is not significant by global standards: there are three reactors in commercial operation, and two more are expected to come on stream by 2020. What chiefly makes it notable is the military dimension: Pakistan's nuclear rivalry with India elicits a hunger for fissile material. For those who worry about safety, too, Pakistan's nuclear ambitions tend to generate sleepless nights. Despite being prone to epic earthquakes, Pakistan's determination to expand its nuclear capacity is unshaken by recent events in Japan. Our forecast is for 1.4 gw of capacity by 2020, around double the amount today.



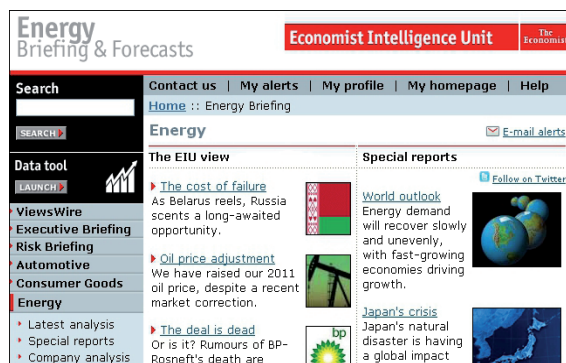
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