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# Tech deployment delays crank up pressure on Asia's nuclear momentum

China seeks to raise total nuclear capacity to 58GW by 2020, but whether this capacity target will be a hit or miss affair relies on the pace of equipment upgrades and capacity oversupply, with delays traced back to an existing industry slowdown.

China's nuclear power behemoth is pushing for the indigenous development of power plant technology in order to raise its operational capacity from 48.6GW in September 2019 to 58GW by 2020. Whether this target will be hit on time remains in suspense, however, as developers are faced with delayed technology deployment and capacity oversupply.

**Gloria Lu**, senior director for corporate & infrastructure ratings at S&P Global Ratings, argued that China may slightly miss its 58GW goal and 30GW in construction by 2020, as it has not approved any new builds during 2016-2018. "After the Fukushima nuclear accident, China requires third-generation (3G) or more advanced reactors for new builds," Lu said.

Three first-of-its-kind (AP1000 and EPR) 3G reactors of foreign design have been completed and started commercial operation in the second half of 2018, but they incurred significant delays and cost overruns. This made policymakers very prudent in approving new builds.

**China still appears committed to its nuclear programme and has made more progress behind-the-scenes than might first seem.**



"The AP1000 pressurised water reactors Sanmen-1 (designed by now bankrupt US Westinghouse) was delayed by four years and incurred 70% cost overruns, whilst the European pressurised reactor Taishan (EPR designed by EDF's Framatome) was delayed by three years, with an estimated 30% cost overrun," S&P's Lu added.

These delays can be traced back to an existing industry slowdown. **David Fishman**, consultant at The Lantau Group, noted that after a multi-year run of rapid and successful power project development from 2008 to 2013, the years since 2014 have seen China struggle with missed targets for capacity installation, and an expanding and already three-year gap since the last commercial power reactor broke ground (2016-present).

### Missed chances

China's nuclear power targets for 2020 had been rising until Japan's Fukushima incident. The new 58GWe target was issued only in 2014 and had been repeated by industry players until the China Electricity Council (CEC) formally

acknowledged in 2019 that a 53GWe capacity by 2020 is a more realistic figure. "The final tally will thus miss the mark, but not by far, with a shortfall of less than 10%," Fishman said.

Missing this target was surely an industry setback, but it is also easy to read too much into it, Fishman said. "There was no associated weakness or failure of Chinese construction capabilities or a loss of policy support for nuclear in general. Meeting the 2020 goal would have required a significantly higher number of new reactors to pour concrete back in 2014-2016, but this didn't happen."

Instead, Fishman cited that the shortfall was caused by two specific industry initiatives working in tandem. "Firstly, China's post-Fukushima nuclear plan designated safer 3G technology to be preferred over 2G or 2G+ units, and that no further 2G+ units would be approved (several 2G+ units began construction in 2015, but they were grandfathered in from approval prior to 2013)."

The Chinese industry also follows a "demonstration plant first, mass deployment second" development model.

## Nuclear power plants in China

Status	Number of Units	Gross Capacity (GWe)
Operational	47	49
Under Construction	12	12
Approved (including inland)	44	50
Planned (including inland)	60+	-65*
Total	163+	-176

Source: The Lantau Group

**China's post-Fukushima nuclear plan designated safer 3G technology to be preferred over 2G or 2G+ units.**



In this model, all under-construction first-of-a-kind (FOAK) plants are required to prove successful commercial operation before they could proceed with what the industry calls “Nth of a kind” (NOAK) construction.

Taken together, this meant that China's already under-construction 3G units needed to be completed before any new builds could be approved. “Unfortunately, the FOAK 3G reactors under construction at the time in China met with numerous schedule overruns, supply chain hiccups, and technological hurdles—hardly atypical for FOAK technology. FOAK reactors have greater risk of taking longer and costing more to build than NOAK reactors, and particularly in this case, where the underlying technology shift is major (e.g., from 2G to 3G),” Fishman said.

When the Chinese-designed 3G reactor HPR1000 had its design finalised and approved in 2015, it was allowed to swiftly begin construction of demonstration sites. The result was that from 2013 to 2019, the entirety of China's under-construction fleet consisted of either grandfathered 2G+ reactors that would be the last of their kind, or demonstration plants for 3G designs that were the first of their kind.

“With no proven 3G technologies available for batch deployment, it was inevitable that China would miss its 2020 deployment goals, but without any kind of policy shift or change of leadership commitment to nuclear energy,” Fishman explained to *Asian Power*.

Another factor that could slow down the industry and threaten the profitability of Chinese nuclear power operators is the increasing volume of generation traded on a competitive market basis, according to S&P Global Ratings' Lu.

“The volume not under market trade (still about three-quarters of the total) is protected by the preset on-grid tariffs. In 2018, China General Nuclear Power Corp. (CGNPC) had 23.8% nuclear

power generation traded on market, the ratio was 27.0% for China National Nuclear Corp. (CNNC). Against the backdrop of increasing competition in the power market, prices of market-traded volumes generally have to be discounted, tending to weaken the profitability of operators,” she said.

Whilst Fishman acknowledged the slowdown of development in recent years, an uptick in nuclear sector activity could be more likely looking ahead. “China still appears committed to its nuclear programme and has made more progress behind-the-scenes managing technology shifts and deployment plans than might first seem,” he said.

In Q3 2019, China's nuclear power industry comprised 47 operational power reactors, for a gross installed total of roughly 49GW of electricity. Three different companies are responsible for nuclear power plant development, with the majority of the fleet split between China General Nuclear (CGN) and China National Nuclear Company (CNNC) and the third company—the State Power Investment Company (SPIC)—just starting out with its first reactor sites.

### Government support

As a source of clean energy and base load electricity, nuclear power is well supported by the government in generation dispatch to grids with priority before coal power, noted Lu. Much of China's progress in nuclear development from the past decade resulted in an increased cost-competitiveness compared with costs of other fuel types.

“The regulator also sets the province-based minimum utilisation hours policy to ensure reasonable consumption of nuclear power for maintaining relatively high operational efficiency,” Lu said.

“In 2018, the average utilisation of nuclear power was 80%, compared with 50% for thermal power, 24% for wind, and 13% for solar.”

She also cited Datang Power-backed

research that said the levelised cost of energy (LCOE) of nuclear power is ranked the second lowest in China, only higher than hydropower. “The current regulatory regime essentially places nuclear power as cost-competitive as coal power as it defines the on-grid tariffs of nuclear power as the lower of RMB0.43/kWh and local benchmark coal power tariffs,” she said.

Construction costs of recently completed Generation II reactors were between RMB14,000-15,000 per kW (equivalent to roughly \$2,000/kW, well below new build costs in developed markets), whilst new Generation III reactors are budgeted at RMB17,000-18,000 (about \$2,500-\$2,600). This compares to construction costs of RMB6,000-7,000 per kW for wind and RMB4,000-5,000 per kilowatt for solar in China at present.

### Projects still on track

In contrast, the construction of China's own 3G HPR1000 reactors are on track with scheduled commission as early as in 2020. In 2019, three units of new reactors (totalling 3.4GW) were approved for construction, in which two are HPR1000 reactors (developed from G-II PWR or pressurised water reactor long used in China) and another is the CAP1400, the enlarged version of AP1000 with Chinese intellectual property rights.

“In our view, the prolonged trade tension between the US and China and the expected long-term technology confrontation of two nations may reshape China's choice of nuclear power technology. We gauge China may prioritise the reactors of HPR1000 and CAP1400 for new builds,” Lu said.

The Lantau Group also noted that amongst the approved and planned reactors are at least 36 units located in inland regions where development has been frozen since the Fukushima accident in 2011. This includes approved inland sites that were just months away from pouring concrete in 2011 but will now have to wait until the next 14th FYP period begins in 2021 to start construction. All currently under-construction and future PWR reactors will be at the gigawatt level or larger.

Aside from under-construction units, 45 units have already secured site approval and are in various stages of pre-construction standby, including several that have already completed all necessary preparations to begin pouring concrete and are simply waiting for issuance of their construction license. “Beyond this, the long-term pipeline includes at least 60 more reactor units proposed by provincial governments or local municipalities currently making their way through the

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regulatory requirements for site approval (seismic safety reports, environmental impact evaluations etc),” Fishman said.

### Japan falls short

With China on track to revive its nuclear power industry, things aren't looking up for its neighbour Japan. Nearly a decade after the Fukushima nuclear plant accident, Japan is still struggling to restart its idle nuclear reactors. The government has even cut back on its objective of raising the share of nuclear power back to about 20% by 2030 from the current 5%.

Whilst analysts are severely bearish about the country hitting its nuclear targets, S&P Global Platts' Lu projects that nuclear generation will only represent a 9% share by 2030, whilst Fitch Solutions is forecasting 8.4% by 2029. The noose around new nuclear projects is tightening not only because of public opposition but also because of toughening regulatory demands and rising restart costs.

The Nuclear Regulation Authority's (NRA's) tough stance on counterterrorism measures will weigh on generation from operational nuclear power plants in the near term, according to Fitch Solutions. In mid-2019, the NRA rejected applications to extend deadlines for the installation of additional security measures at a number of the country's nuclear power plants and approved new rules that would allow the suspension of operations at facilities whose back-up control centres were not completed by their individually-specified deadlines.

As a result, both Kansai Electric Power and Kyushu Electric Power recently announced that they had powered-down their respective nuclear reactors with the expectation that they would miss their NRA deadlines. Kyushu Electric Power has announced a halt on Sendai No. 1 and No.2 for 8 months from March and May 2020 respectively, whilst KEPCO will suspend operations at Takahama No. 3 from 2 August to 22 December 2020, and Takahama No. 4 from 7 October 2020 to 10 February 2021.

According to S&P Global Platts, hitting the 20% target will enlist 30 nuclear reactor restarts, but such an effort will require additional huge costs, which will weaken their profitability and operating cash flow over the years to come. “The necessary capex and expenses for Japan's nuclear operators to meet the regulators' additional safety standards to protect against potential severe natural disasters or terrorist attacks are estimated at around \$44b (JPY4.8t) in total, three times the 2013 level,” Lu said.

The pressure on Japanese utilities could only be somewhat mitigated by the Japanese government's supportive pricing scheme for decommissioning.

“The regulator recently allowed the nuclear reactor operators to pass decommissioning costs through to tariffs over the long term. As a result, in our view government support could somewhat mitigate the additional cost burden for the nuclear reactor operators,” Lu added.

### ASEAN's nuclear question

As the approach to nuclear power transforms in East Asia, regulators in the nearby Southeast region are still in a deadlock over how to inject the resource into their respective power mixes. One of the Southeast Asian nations with suspended development plans is Vietnam. Previously, its National Assembly in 2009 approved the investment policies for a project that comprised two nuclear power plants in southern central Vietnam, Ninh Thuan 1 and Ninh Thuan 2, each with 2GW installed capacity. It eventually issued a resolution to suspend this project in November 2016.

Whilst Vietnam has no ongoing nuclear power project, Baker McKenzie's partner **Dang Chi Lieu** said that in the long term, the resource will not be completely out of question as the cost efficiency of other resources for baseload power is being scrutinised.

“In the Vietnam Energy Forum held by the Ministry of Industry and Trade (MOIT) back in August, there have been proposals that due to high energy demand, further imports of LNG and coal is inevitable, which may not be cost efficient as well as create environmental risks, especially with coal. Additionally, although renewable energy poses high potential, its instability due to being weather-dependent would be an issue,” Dang said.

Vietnam also previously laid out in its Power Development Plan (PDP) VII that the first nuclear power generator may commence operation in 2028. By 2030, nuclear power sources should reach the capacity of 4,600MW and produce

**According to Vietnam's Power Development Plan VIII, nuclear power will take up to 5.7% of total power production by 2030.**



about 32.5 billion kWh. Accordingly, in 2030, nuclear power would take up to 5.7% of total power production. Dang noted, however, that this is relatively low compared to coal-fired thermal power (53.2%), gas power—including LNG (16.8%), hydropower (12.4%) and other renewable sources (10.7%).

The targets and the possible resumption of nuclear power development would still be subject to national policies, which is to be regulated by the new PDP VIII for the period of 2021-2030, with a vision towards 2045. The MOIT is expected to complete this plan in 2021, Dang said.

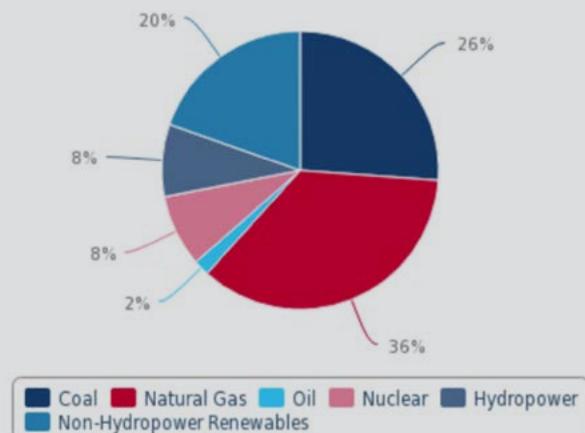
Another nuclear programme is also in the works further east in the Philippines. Its energy minister has proposed a formal executive order to the President's Office to include nuclear power in the country's energy mix, as the country deals with surging power demand over the coming years. Congress is allegedly considering the establishment of an independent regulatory body and has drafted legislation to address nuclear safety and security issues.

“These developments were however criticised for not being more transparent in the Senate, which is set to begin an inquiry into the DoE's nuclear power agenda,” Fitch Solutions said.

To support the Philippines' nuclear potential, foreign suppliers of equipment from the US, Japan, Russia, France and South Korea have already expressed interest in recent years to invest in its nuclear power sector. The country's Department of Energy (DoE) also signed a memorandum of understanding with Russia's state-owned Rosatom for a pre-feasibility study on the construction of nuclear power plants in the country.

“As such, should the government decide to progress with its nuclear plans, with adequate resources given, they do have the capacity to ramp up the sector relatively quickly,” Fitch Solutions added.

Share of power generation in Japan by source



Source: Fitch Solutions