

China is building half of the world's new nuclear power despite inland plants pause

China has expanded its nuclear power capacity at the fastest rate of any country in the 21st century, according to new data from Global Energy Monitor. Despite a moratorium on inland nuclear plants imposed after the Fukushima disaster, China is building enough capacity to overtake France within the next few years and hold the world's second-largest nuclear fleet. Nearly half of the world's nuclear power under construction is located in China. Its government has promoted nuclear power to shore up baseload capacity in the electricity sector and to help achieve its targets for carbon peaking before 2030 and carbon neutrality by 2060. But not all of the proposed buildout may come to fruition. Less than one-third of China's planned nuclear capacity has begun construction, and China already has more cancelled nuclear capacity than any other country as a result of its pivot away from inland nuclear plants. By contrast, China has about two-thirds of the world's utility-scale solar and wind power under construction, which, along with promising advancements in utility-scale battery technology, may reduce the need for continued additions of nuclear power.

China is approaching France in operational nuclear power capacity

China is emerging as a world leader in nuclear power, according to research from GEM's Global Nuclear Power Tracker, which includes over 1,405 gigawatts (GW) of nuclear capacity from over 1,540 units worldwide. China's total operational capacity of

58.1 GW is a close third behind France's at 64.0 GW. Those two countries, plus the United States with its 102.5 GW in operation, account for well over half of the world's operational nuclear capacity.

China surpasses France by count of operational nuclear power units, with 58 to France's 56. (However, the difference may be negligible as two of the 58 units in China are very small power-generating reactors whose purpose is primarily experimental.) China has consistently ranked above France in annual electricity generation from nuclear sources for four consecutive years.

Comparing the nuclear power fleets of China, France, and the United States — the top three countries by nuclear generation in 2023 — helps illustrate the different roles that nuclear plays in these countries' energy profiles. The United States generated 775 terawatt hours (TWh) from nuclear, accounting for just over 18% of its 4,249 TWh total [power generation](#). France's 336 TWh of generation from nuclear made up 65%, or just under two-thirds, of its 514 TWh total generation. But China's 435 TWh of nuclear generation [made up only 5%](#) of its 9,462 TWh of total generation. (The global average is 9% of electricity from nuclear power.)

China is the largest generator of electricity in the world by far, with more than double the generation of the second-ranked country, the United States. So despite nuclear's growth within China, its percentage share of generation is still much smaller than the corresponding global average, in large part because the "denominator" in the equation, total Chinese electricity demand, is so substantial. In addition, coal-fired power still accounts for well over half of all Chinese power generation.

Nuclear power generation by country

Country	Nuclear generation, 2023 (TWh)	Total generation, 2023 (TWh)	Nuclear % of total generation
United States	775	4,249	18.3%
China	435	9,462	4.6%
France	336	514	65.3%
World total	2,678	29,479	9.1%

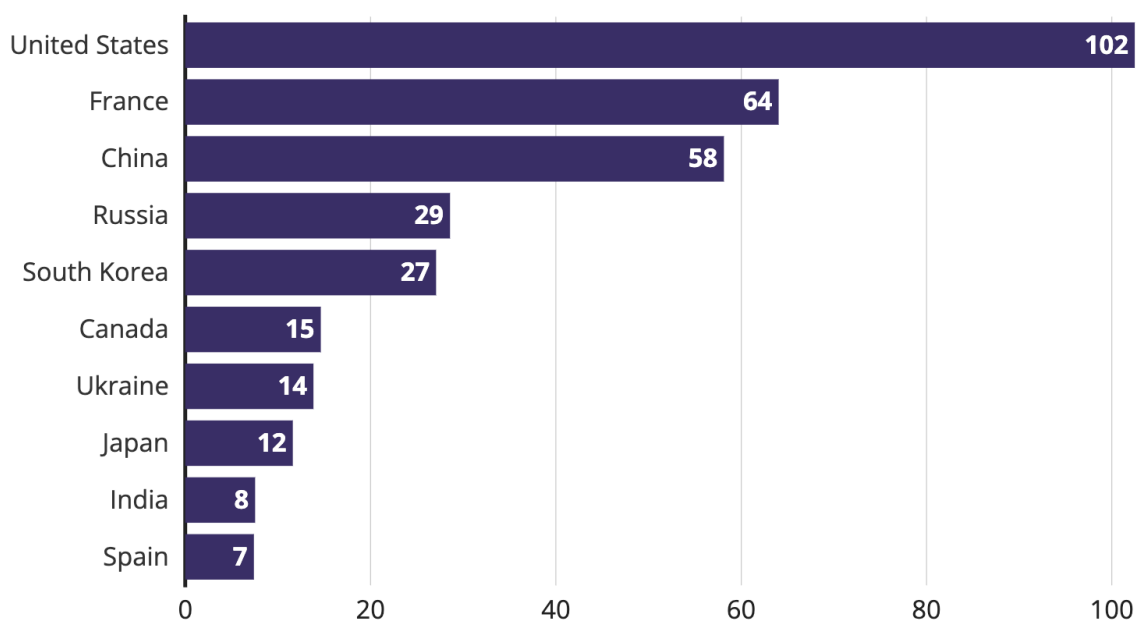
Source: Global Nuclear Power Tracker



The United States still leads the world by a sizable margin in terms of total operating nuclear capacity. While China's nuclear power growth is perhaps the most notable among the world leaders in nuclear power, it is not alone in expanding capacity in recent decades. Several of the other top ten countries by operating nuclear power have added capacity in the last ten to fifteen years, including Russia, South Korea, and India.

United States, France, and China lead the world in operating nuclear power

Operating nuclear power capacity by country, in gigawatts (GW)



Source: Global Nuclear Power Tracker, July 2024, Global Energy Monitor

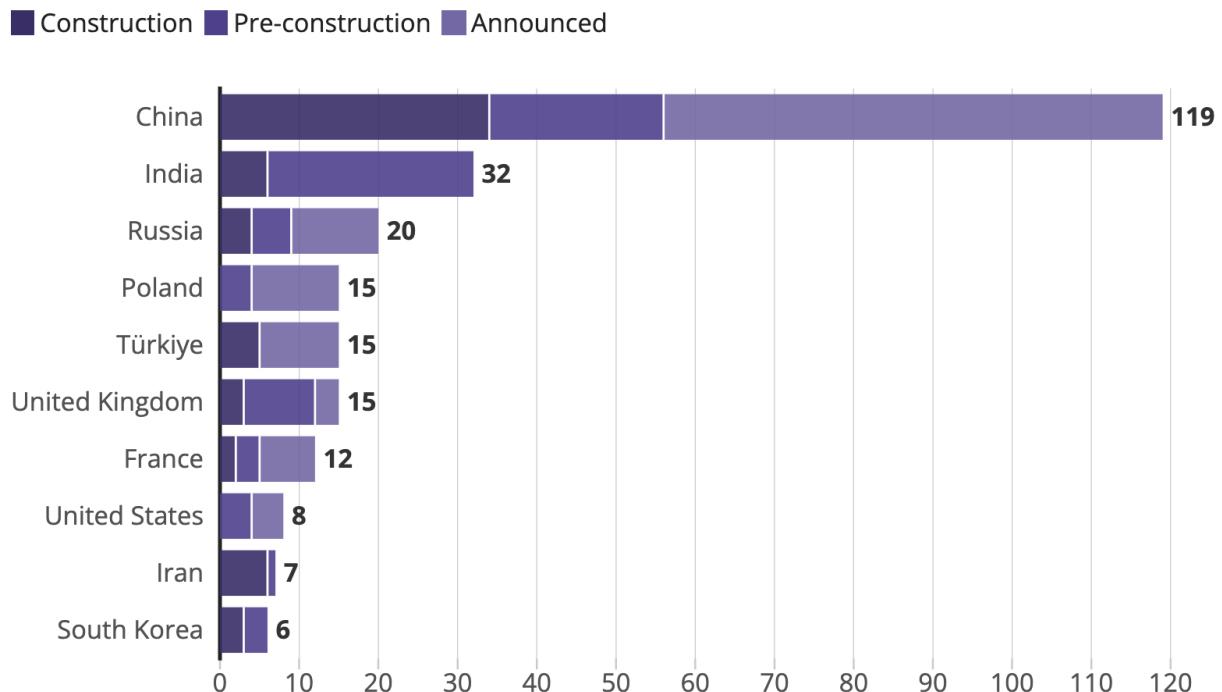


China's prospective nuclear capacity ambitions

GEM data on prospective facilities — that is, announced, pre-construction, and under construction — indicate which countries intend to continue expanding nuclear power in the coming years. Although the United States currently leads all countries with 94 operational nuclear power units and a total capacity of 102 GW, China's ongoing construction progress is positioning it to shrink the U.S.-China difference over the next decade. China has 118 GW of prospective capacity, which puts the country not only first worldwide for this metric, but also surpasses the second through eighth place countries combined. India, the country with the second-largest prospective nuclear capacity, has a substantial 31.7 GW of prospective nuclear power, but China's current plans call for additions of over four times that amount.

China plans for ambitious nuclear energy expansion

Prospective nuclear power capacity by country, in gigawatts (GW)



Source: Global Nuclear Power Tracker, July 2024, Global Energy Monitor

This growth reflects a targeted effort by the Chinese government to rapidly expand nuclear capacity. The 14th Five-Year Plan (2021-2025) aims to increase the size of the country's total operational fleet to 70 GW by 2025. In each of the first three completed years of this plan, there have been between four and six nuclear units starting construction, and two to three units entering commercial operation. China had 50 GW of active capacity at the beginning of 2021, meaning that additions of 20 GW would be needed in five years' time. Currently, it is a little under half of the way there, with 58.1 GW as of early Q3 2024.

China may fall just short of its goal. Currently, the expected start date data would translate to China having 63 GW online by the end of 2025. But 2026 would then see a further 8 GW added, putting China at 71 GW — not only above the 70 GW mark from the 14th Five Year Plan, but also overtaking France's 66 GW for the second-largest nation by operating nuclear capacity.

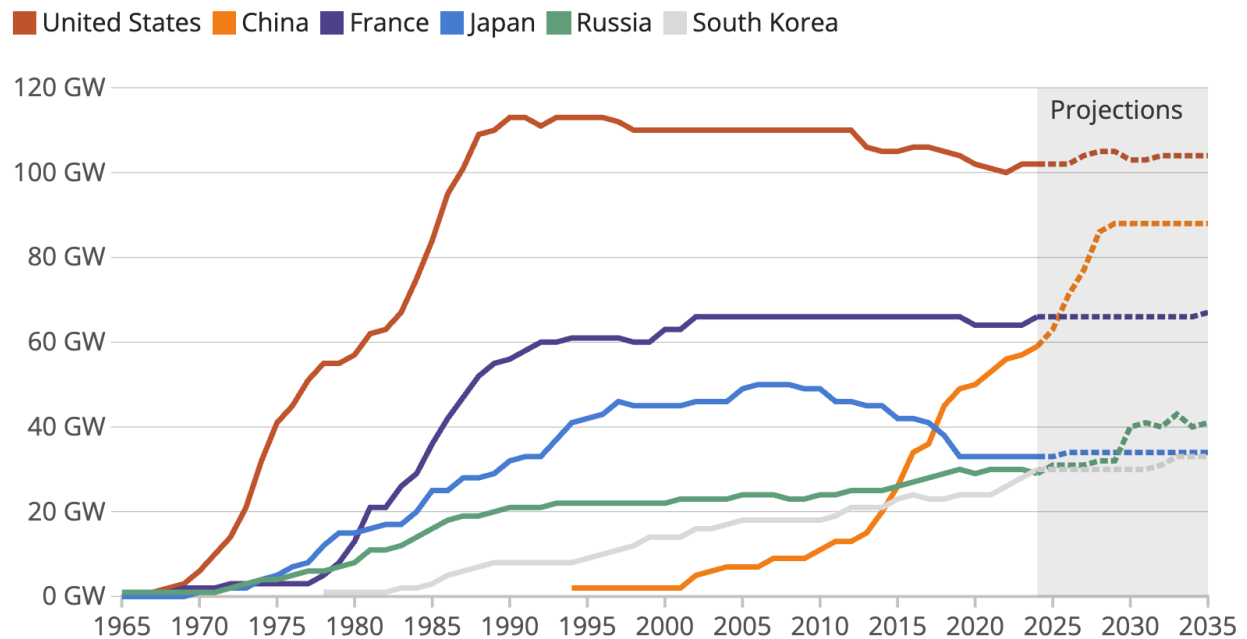
China would need more than 100 GW of operational capacity to surpass the U.S. as the country with the largest nuclear power fleet. Some predictions have this happening as early as [the end of the decade](#), but GEM data at the project level do not currently show this rapid of a change. GEM data only show start years for Chinese nuclear units through 2029, meaning that projections for 2030 or beyond are still indistinct. Only about 25% of China's 118 GW of prospective capacity has a target start year, which would bring the country to a total of 88 GW in operation. Most of the rest of this prospective capacity represents facilities that are not yet under construction, having only been announced or entering pre-construction stages.

In a scenario where all prospective capacity enters operation, and assuming no retirements before that point, China would easily surpass the United States for the world's largest operational nuclear fleet, 177 GW to 110 GW. Of course, not all prospective facilities will actualize, and real-world scenarios may include retirements or other temporary but prolonged shutdowns. But at face value, current GEM start year

data would also suggest that no further additions to the Chinese nuclear fleet will occur after 2029, which should not be expected either.

China could soon overtake France on nuclear power capacity, with projects expected to come online in next few years

Annual operating nuclear power capacity, grey shaded area are projections based on expected start years from capacity in development, in gigawatts (GW)



Source: Global Nuclear Power Tracker, July 2024, Global Energy Monitor



Drivers for these changes include the Chinese government's goals of meeting continued increases in energy demand while also decreasing reliance on coal, a key contributor to emissions and air pollution. The "[Action Plan for Carbon Dioxide Peaking Before 2030](#)," a pivotal policy document, discusses these objectives and the overarching strategy to ensure that the country reaches peak carbon emissions before 2030 and achieves carbon neutrality by 2060. Nuclear is not the only power sector undergoing a Chinese buildout. As detailed in [a recent GEM briefing](#), China is home to almost two-thirds of the world's utility-scale solar and wind power under construction.

Although Chinese provincial governments are involved in site selection and local approvals, the central government ultimately plays a critical role in the strategic direction of China's nuclear power program. It has had the effect of both promoting and restraining nuclear power development across different parts of the country. As discussed further below, the central government slowed the pace of overall Chinese nuclear capacity additions with a moratorium on new projects and tighter safety regulations that deprioritized new inland nuclear plants.

China's nuclear buildout shows a shift to new generations and technological advancements

China is playing a significant role in the development and deployment of new technologies in nuclear power, specifically Generation III and Generation IV reactors. There are four generations of nuclear power plants, categorizations determined by the time of their development and by specific groupings of technological design. Generation II plants account for the majority of operational capacity worldwide. The nuclear fleets of the United States and France fit this pattern, with most of their reactors classified as Generation II. In addition, some Generation III reactors are operational in these and other countries. [Generation III reactors generally have modifications on Generation II reactors](#), including additional safety design elements that are intended to reduce the need for active controls or operational intervention to prevent accidents in the event of a malfunction.

Like that of the United States and France, China's operational nuclear fleet is still majority Generation II in terms of total capacities, but this balance is shifting as more Generation III reactors come online. In 2006, China initially announced plans for the AP1000 to serve a foundational role in its fleet — a Generation III reactor designed by the U.S.-based company Westinghouse. The AP1000 has since entered operation at four Chinese nuclear units, the first of which was Unit 1 of the [Sanmen nuclear power plant](#) in September 2018. However, China has since also designed and implemented its

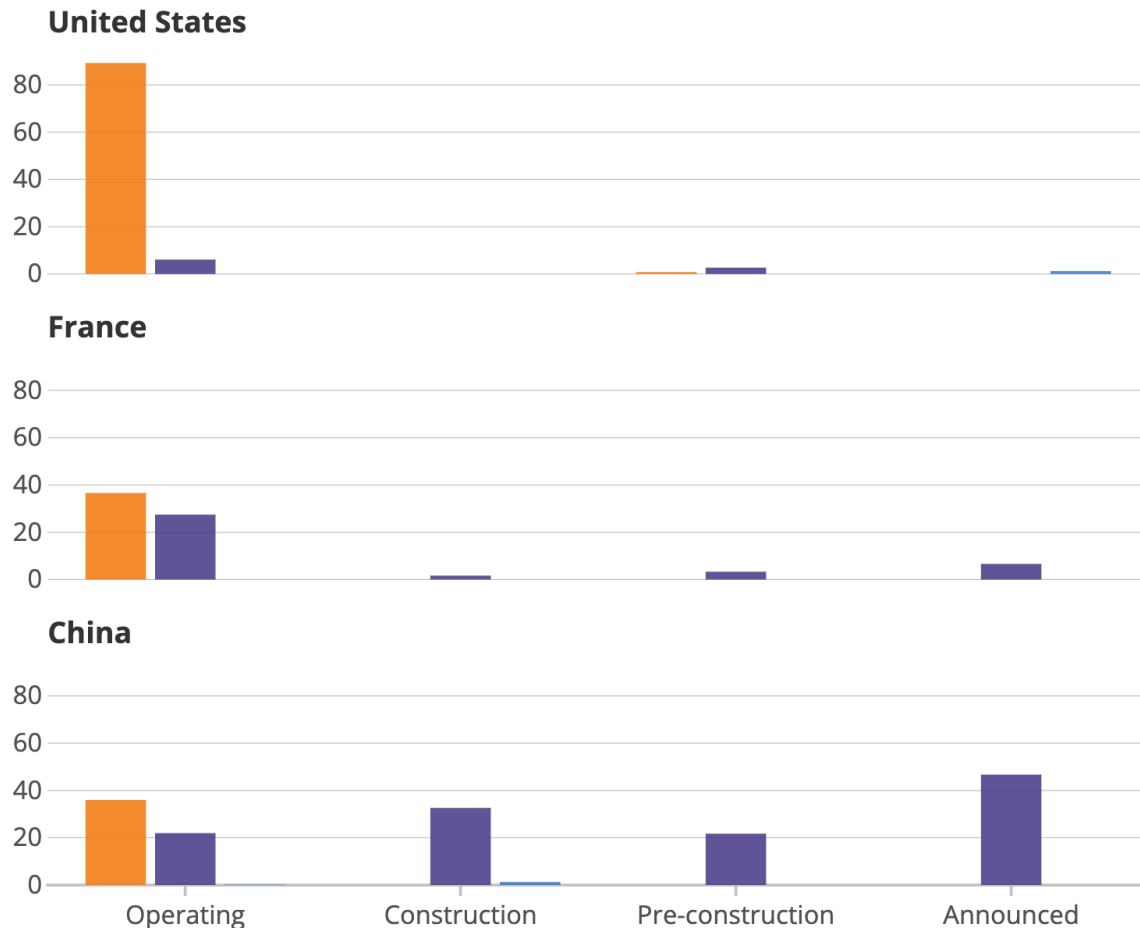
own Generation III reactors: One notable example is the HPR1000, also named the Hualong One. This design is operational at four Chinese nuclear units and under construction at an additional thirteen, with its increasing use promoted in the [14th Five-Year Plan](#). China is also deploying the Hualong One internationally, with two operational units in [Pakistan](#) and a prospective unit in [Argentina](#). With this reactor design and others, China is not only aiming to meet more of its domestic nuclear energy needs with its own technology, but is also seeking to establish itself as a technological leader and supplier for the international nuclear power market.

China is also involved in advancing nuclear technology with Generation IV designs, the next evolutionary stage in reactor design. In December 2023, the world's first Generation IV nuclear unit officially [entered commercial operation](#) at the [Huaneng Shandong Shidao Bay nuclear power plant](#). Called the [HTR-PM](#) (High-Temperature Reactor Pebble-bed Module), it relies on two small reactors that drive one steam turbine with an overall output capacity of 211 MW. This capacity is less than one-fifth of the average capacity of currently operational Generation III reactors in China, which is around 1150 MW according to GEM data. As an example of a small modular reactor (SMR) — a classification often discussed as part of the future of the nuclear power industry — this reactor is designed with intentions of more flexible deployment and quicker construction. China has also [proposed](#) a scaled-up version of this design which would yield a larger nameplate capacity of 650 MW.

Most operating nuclear power uses second generation technology, while almost all planned capacity is third generation

Nuclear power capacity by reactor generator technology and status, in gigawatts (GW)

Technology: ■ 2nd generation ■ 3rd generation ■ 4th generation



Source: Global Nuclear Power Tracker, July 2024, July 2024, Global Energy Monitor



Frosty outlook: China's inland plant ice persists

As ambitious as China's nuclear buildout has been and may continue to be, capacities would have been even higher if not for the indefinite suspension of all plans for inland nuclear power plant construction following the Fukushima nuclear accident in 2011. After Fukushima, the Chinese government imposed a moratorium on the approval

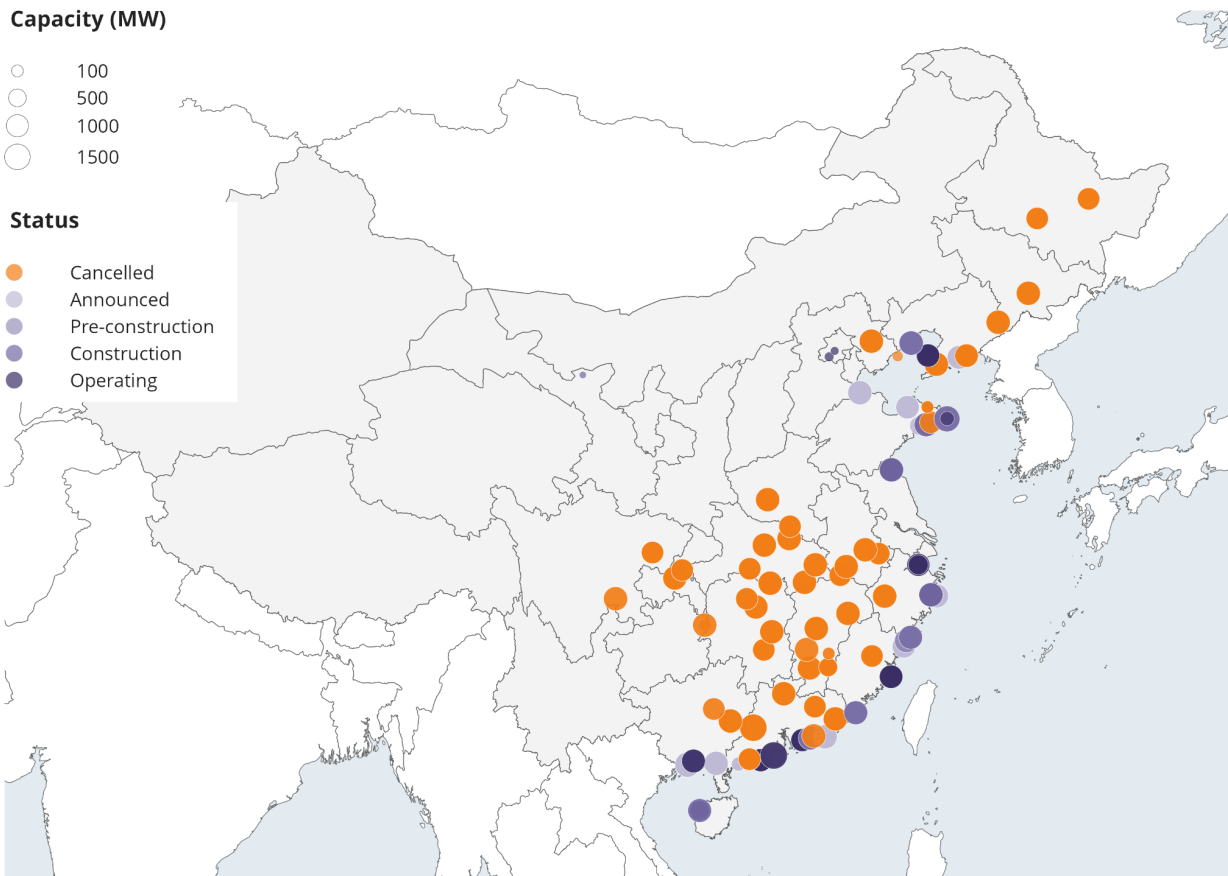
process for inland nuclear power plants, and development has continued to stagnate for over a decade, prompted by concerns about safety and environmental impacts. Nuclear power plants need sufficient water sources for cooling purposes, and they discharge trace amounts of radioactive wastewater. Coastal nuclear power plants benefit from access to seawater for cooling, facilitating absorption of trace amounts of pollution by the ocean. But inland nuclear plants [must rely on nearby rivers or lakes for cooling water](#), a fact which, alongside general safety reviews, has been cited as a central concern leading to the moratorium.

China's 14th Five-Year Plan, covering the years 2021 to 2025, omitted any mention of inland nuclear power, instead emphasizing the deployment of nuclear facilities in coastal regions. GEM data corroborate the lack of construction or pre-construction activities at any inland Chinese nuclear power plants. The Global Nuclear Power Tracker reveals that China had 185 inland nuclear units cancelled. With a combined capacity of 201 GW, this cohort of cancelled Chinese units is larger than either the currently operational U.S. fleet (102 GW) or the total amount of nuclear capacity ever cancelled in the United States (172 GW). The Chinese units affected by the moratorium are shown with a GEM-assigned status of "cancelled - inferred 4 y" as consistent with GEM's [Methodology](#), because after their initial announcement, they fell out of more recent planning documents, and no progress has been observed for over four years.

However, the classification of "cancelled" for these plants carries some nuance. In the abstract, any of these facilities could re-enter official plans and progress forward to completion. While it appears extremely unlikely that all of them will do so, the idea of lifting the moratorium has been a subject of discussion in light of China's ambitious goals of carbon peaking by 2030 and carbon neutrality by 2060. For example, the topic of initiating construction on inland nuclear power plants [was proposed](#) during the 14th Chinese People's Political Consultative Conference (CPPCC) National Committee First Session in spring 2023.

Planned inland nuclear power in China has been **cancelled**, while **operating** and prospective projects are in coastal areas

Locations of nuclear plants in China by status, circles sized by megawatt (MW) capacity



Note: Cancelled projects are those where no progress has been observed for at least four years.

Source: Global Nuclear Power Tracker, July 2024, Global Energy Monitor



Among the projects affected by the moratorium, some may be more likely candidates to eventually move forward than others. The following three projects may have a relatively smoother pathway toward eventual construction and operation: the [Taohuajiang nuclear power plant](#) in Hunan province, the [Xianning Dafan nuclear power plant](#) in Hubei Province, and the [Jiangxi Pengze nuclear power plant](#) in Jiangxi province. These three [had already commenced](#) pre-construction preparations with initial investments.

Owners of cancelled inland nuclear projects were encouraged to preserve the site for energy generation purposes. For instance, Jiangxi Nuclear Power CO LTD, the owner of the Jiangxi Pengze facility, has used the site for developing wind and solar renewable energy projects. This approach has resulted in the commissioning of a [solar farm](#) in 2020 and a [wind farm](#) in 2021.

This situation also highlights some central questions regarding nuclear's place in the energy transition, including how it compares to wind and solar in terms of nameplate capacity and risks for delays or cancellations. While the original project plans called for a total nuclear capacity of 4000 MW, less than 5% of that capacity is now operational via wind and solar facilities on the same site. But country-wide, the relationship is essentially inverted, as China has added significantly more [wind](#) and [large utility-scale solar](#) capacity than nuclear capacity. China's currently operational nuclear capacity is only about 14% that of its wind capacity and 16% of its large utility-scale solar capacity, according to GEM data.

Nuclear has historically performed differently than wind and solar within the generation stack, serving a baseload role with a much higher capacity factor while wind and solar are intermittent. However, the roles of wind and solar are expected to shift with continued advancements in [utility-scale battery technology](#). China's once-envisioned inland nuclear fleet also underscores risks for nuclear power which are not nearly as prevalent for wind and solar: postponements and cancellations. GEM data show that China's total cancelled nuclear capacity of 201 GW is more than 30 times that of its cancelled wind facilities, and more than 40 times that of its cancelled large-scale utility solar facilities. With China's ambitious nuclear buildout ongoing, it will be important to continue to monitor the rate of cancellations compared to additions.

About the Global Nuclear Power Tracker

The Global Nuclear Power Tracker (GNPT) is a worldwide dataset of nuclear power facilities. The GNPT catalogs every nuclear power plant unit of any capacity and of any status, including operating, announced, pre-construction, under construction, shelved, cancelled, mothballed, or retired.

About Global Energy Monitor

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MEDIA CONTACTS

Joe Bernardi

Project Manager, Global Nuclear Power Tracker

joe.bernardi@globalenergymonitor.org

Ye Huang

China Researcher

ye.huang@globalenergymonitor.org