

NUCLEAR POWER 2023 END OF YEAR UPDATES

Nuclear Reactor Construction Starts Drop Again in the World

China and Russia Remain Global Leaders

The nuclear niche market remains dominated by China and Russia. The first hosting the most construction sites, the second implementing the most projects globally. For the past four years, not a single construction start has been registered in the world that was not located in China or implemented by the Russian industry.

Developments Over the Year 2023

At the beginning of 2023, nine reactors were scheduled to start up during the year in the world but only five, totaling 5 GW (gigawatts) of capacity, finally generated first electricity, one each in Belarus, China, Slovakia, South Korea, and the United States. The commissioning of the other four was delayed at least into 2024. At the same time, five units totaling 6 GW were closed of which the last three in Germany and one each in Belgium and Taiwan. Thus, the startup/closure balance was negative by 1 GW.

As five reactors—two each in Canada and Japan, and one in France—were reconnected to the grid after Long Term Outages (LTO)¹, and only three entered the LTO category—one each in China, France, and South Korea—the total number of operating reactors in the world increased by two from 411 at the beginning of 2023 to 413 or 370.9 GW as of 1 January 2024.

IAEA Matches WNISR Dataset

After the International Atomic Energy Agency (IAEA) kept revising its statistics of operational reactors downwards (see [IAEA Unexpectedly and Quietly Revises Operating Reactor Data](#) in WNISR2023 for details), at the beginning of 2024, for the first time, the number of operating reactors in the WNISR and IAEA datasets was identical. The largest difference between the two datasets was for 2012, the year following the Fukushima events, when the IAEA considered 29 more units as “in operation” than WNISR.

1 - In the WNISR statistics, a nuclear reactor is considered in Long-Term Outage or LTO if it has not generated any electricity in the previous calendar year and in the first half of the current calendar year. It is withdrawn from operational status retroactively from the day it has been disconnected from the grid.

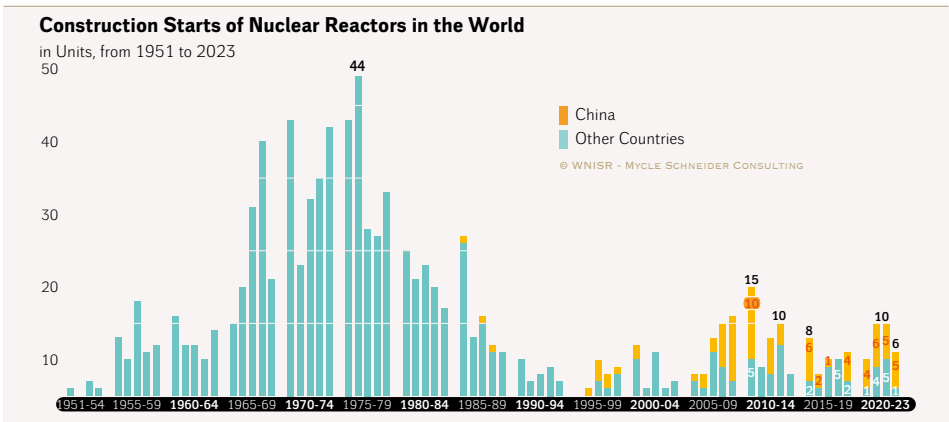
As of early 2024, the IAEA now has 25 reactors in a new category called “Suspended Operation”, similar to WNISR’s LTO category. This is a remarkable development, as for a decade WNISR has called for a revision of the IAEA’s practice allowing for numerous stranded reactors that had not generated any power for many years to be included in the “operational” category. In July 2022, the IAEA had yet the historic maximum at 449 operating units in 2018, while according to WNISR data, the number peaked at 438 as early as 2002. The revised IAEA data now put the historic peak at 440 units in 2005, that is 6.5 percent more than 18 years later.

As of 1 January 2024, a total of 26 units remain in the WNISR’s LTO category—remarkably close to the IAEA’s 25 in “Suspended Operation”—21 in Japan, three in India, and one each in China and South Korea.

Reactor Construction Starts Decline

Construction started on six reactors, of which five in China, a notable drop compared to ten official building starts per year in 2021 and 2022. Since the official construction start at the second unit of Hinkley Point C in 2019 and until the end of 2023, all 31 construction starts happened either in China (20) or were implemented by the Russian nuclear industry in various countries (11). Russia also started four of the 20 latest building sites in China and has thus turned into the leading global nuclear vendor with 24 active construction projects in eight countries (including Russia) versus 22 for China (all in China).

Figure 1 • Construction start in the World/China, 1951–2023



Source: WNISR, with IAEA-PRIS, 2024

As of the beginning of 2024, a total of 60 reactors or 60.5 GW were listed as under construction in 16 countries—of which 26 or 43 percent in China alone. Nine in ten reactors under construction are located in Nuclear Weapon States, or were designed and are implemented by companies controlled by Nuclear Weapon States in other countries.

Outpaced by Battery Investment, Nuclear Irrelevant in the Power Market

With an unprecedented surge in renewable energy deployment, nuclear power is further falling behind. While the 2023 nuclear capacity startup/closure balance was negative, solar power grew by an estimated record 440 GW², with China alone adding 217 GW... and one 1-GW nuclear reactor.

For the first time, with global annual deployment tripling in 2023 over 2022, more money was invested into stationary (grid connected) batteries than in nuclear power. In addition, the residential storage market took off in a big way, with about 500,000 battery systems installed during the year in Germany alone.³

Pledge to Triple Nuclear Capacity by 2050 Impossible to Implement

During the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2023 in Dubai, 25 countries—including France, the United Kingdom, and the United States, but also non-nuclear countries like Albania, Ghana, and Moldavia—pledged to triple the global installed nuclear capacity by 2050. China and Russia, the only drivers of current reactor building, are not part of the signatories.

WNISR2023 has calculated a scenario showing that if all currently licensed lifetime extensions are carried through to their end (no reactor has yet operated for 60, leave alone 80 years) and all current constructions are completed (historically one in nine is abandoned before generating any power), in the remaining 27 years, simply to *maintain the current number of operating reactors*, 270 additional reactors would need to be planned, built, and commissioned. Such a building rate of ten startups per year—beginning in 2024—would double the average rate we have seen over the past 20 years, with no change in the past

2 - Han Feizi, “Bright, shining promise of China’s solar revolution”, *Asia Times*, 5 February 2024, see <http://asiatimes.com/2024/02/bright-shining-promise-of-chinas-solar-revolution/>, accessed 13 February 2024.

3 - Unless otherwise noted, the information in this paragraph is based on data compiled in Nat Bullard, “Decarbonization: Stocks and flows, abundance and scarcity, net zero”, 31 January 2024, see <https://www.nathanielbullard.com/presentations>, accessed 18 February 2024.

few years, on the contrary (see above). That is a very challenging and rather unrealistic goal. The idea to plan, build, and commission in those 27 years an *additional* 1,000 reactors or so to triple the current operating capacity is simply impossible from an industrial point of view.⁴ This is obviously a surprisingly empty but highly misleading pledge that contributes to the public confusion about the state, the trends, and the prospective of the international nuclear industry.

4 - See also François Diaz-Maurin, “Nuclear expert Mycle Schneider on the COP28 pledge to triple nuclear energy production: ‘Trumpism enters energy policy’”, *Bulletin of the Atomic Scientists*, 18 December 2023, see <https://thebulletin.org/2023/12/nuclear-expert-mycle-schneider-on-the-cop28-pledge-to-triple-nuclear-energy-production-trumpism-enters-energy-policy/>, accessed 18 February 2024.