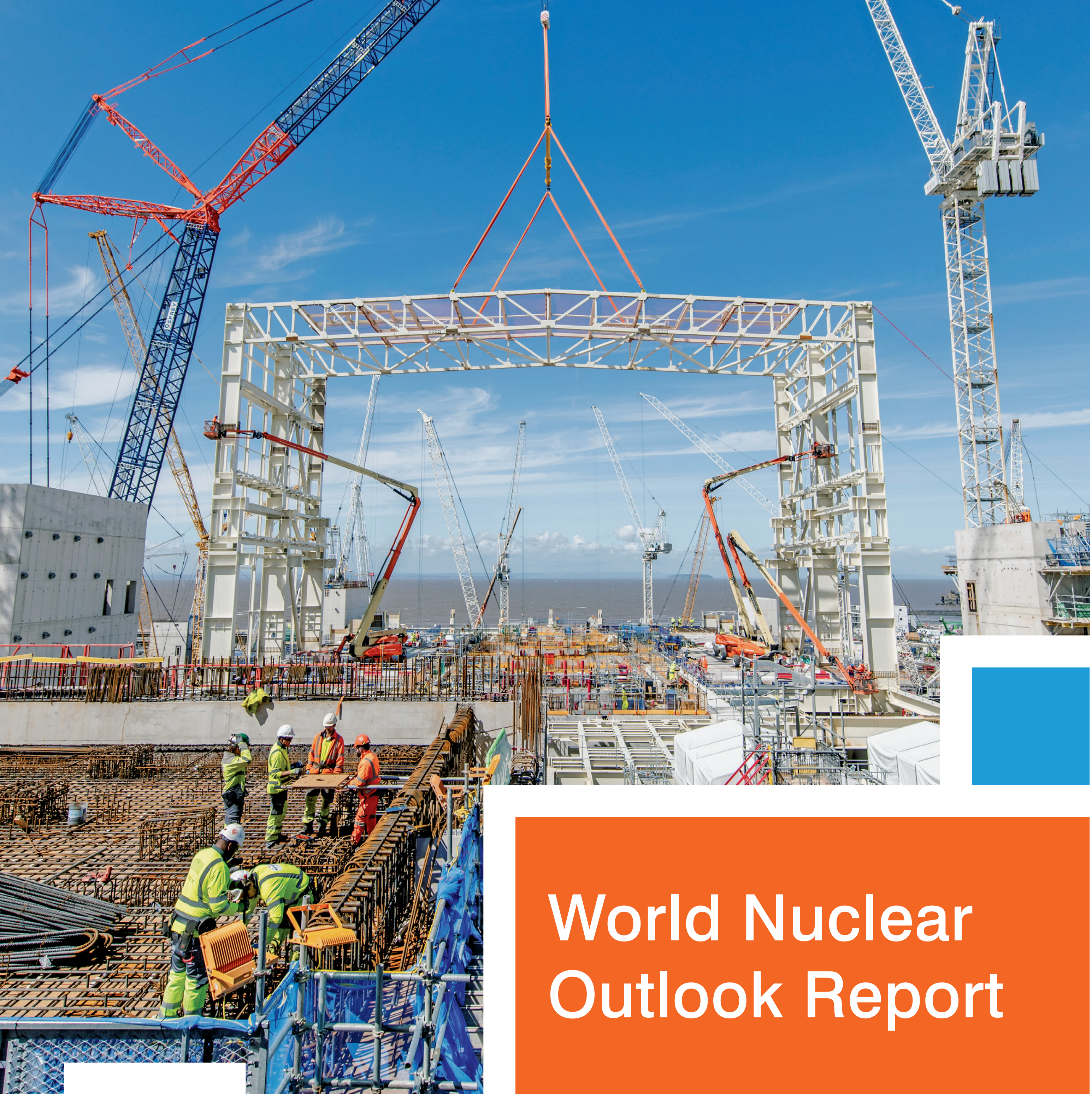

World Nuclear Outlook Report

WORLD NUCLEAR ASSOCIATION

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Contents

Executive summary

Global nuclear capacity would expand significantly to 2050 if the continued operation of existing reactors and the deployment of new nuclear build meet targets set by governments for national nuclear capacity. When all operable, under construction, planned, proposed, and potential reactors[a] are combined with government targets, the total global capacity could reach 1446 GWe[b] by 2050, surpassing the approximately 1200 GWe target established under the *Declaration to Triple Nuclear Energy*, which was launched at the COP28 meeting in Dubai in 2023. This indicates strong international support for nuclear energy as a core component of climate and energy security strategies.

Key Findings

1. Global nuclear capacity outlook

- Total capacity in 2050 could reach 1446 GWe by 2050, surpassing the approximately 1200 GWe target established under the *Declaration to Triple Nuclear Energy*.
- Most growth to 2030 stems from reactors currently under construction; planned projects drive expansion to 2035; and proposed, potential, and government-driven programmes account for the increase in capacity after 2035.
- Five countries — China, France, India, Russia, and the USA — would represent nearly 980 GWe of total global nuclear capacity in 2050.
- Newcomer nuclear nations have ambitions for nuclear capacity to reach 157 GWe by 2050, highlighting rising interest beyond traditional nuclear operators.

2. Reactor long-term operation could contribute more than one-quarter of 2050 capacity

- Of the global reactor fleet operable in 2025, 189 GWe would have operated for up to 60 years by 2050; up to an additional 213 GWe could continue to operate if operating lifetimes were extended up to 80 years.
- Historical performance data show no age-related decline in reactor capacity factors, and the average age of permanently shut-down reactors has increased, reaching 48 years in 2024, with no indication of an upper limit on the duration of reactor operation.
- Operating lifetime extension remains one of the most cost-effective ways to secure additional low-carbon electricity.

3. Build rates would need to increase significantly

- Achieving the projected 2050 capacity requires scaling annual grid connections from 14.4 GWe/yr (2026–2030), 22.3 GWe/yr (2031-2035), 49.2 GWe/yr (2036–2040), 51.6 GWe/yr (2041-2045) and 65.3 GWe/yr (2046-2050).
- The required 65.3 GWe/yr during 2046–2050 is roughly double the historic peak build rate seen in the 1980s.

4. Government targets are ambitious but not fully backed by plans

- The 542 GWe of additional capacity associated with government targets beyond projects assessed as planned, proposed or potential is not yet supported by identified projects, and the level of commitment through policy or other governmental measures varies significantly from country to country.
- Several national targets (*e.g.*, the USA's 400 GWe by 2050) rely heavily on an expansion of nuclear capacity where there is currently little or no ongoing construction, or identified reactors planned or proposed for deployment.
- Targets are predominately aspirational, and not all planned or proposed reactors will inevitably proceed to construction.

5. Energy demand trends reinforce the need for nuclear expansion

Five major global trends will significantly influence electricity and energy demand by 2050:

- Expanding supply to the 750 million people who lack access to electricity.
- Meeting, in an equitable manner, the energy needs of the rising global population, projected to reach 9.8 billion by 2050.
- Accelerating electrification, in all sectors of the economy, as countries shift from fossil fuels to low-carbon electricity.
- Growing consumption from new technologies, including digital infrastructure and data-intensive processes.
- Decarbonising hard to abate sectors of the economy through alternative sources of low-carbon heat.

[a] These categories are defined in Chapter 3, section 3.2

[b] Capacities stated in this report are gross capacities, the total electrical power produced, as opposed to net capacities, the deliverable power after subtracting internal consumption.

Recommendations for governments, industry, and stakeholders

For governments

- Recognize that nuclear energy is a central pillar in meeting global climate goals, especially given the expected increase in electricity and energy demand.
- Integrate nuclear energy into long-term decarbonization and energy security planning, alongside renewables and other low-carbon technologies.
- Set durable, actionable nuclear policies and industrial strategies to enable long-term investment and to maintain industrial capabilities, workforce and supply chains.
- Support operating lifetime extension programmes to 60-80 years where technically feasible, avoiding premature closures.
- Reform electricity markets to ensure equitable treatment of nuclear energy alongside other low-carbon sources.
- Support the acceleration of licensing, siting, and financing mechanisms to facilitate an increase in construction rates.

For financial institutions

- Implement technology-neutral lending and ESG policies to ensure nuclear and other low-carbon sources are evaluated using equivalent criteria.
- Support nuclear deployment in emerging economies through financing frameworks, guarantees, and multilateral partnerships.

For the nuclear industry

- Expand manufacturing and supply chain capacity, including fuel cycle infrastructure.
- Optimize series build to reduce costs and shorten build times.
- Develop large-scale deployment strategies to meet post-2035 demand, including for non-grid applications utilizing novel reactor technologies.

Conclusion

National nuclear capacity goals to 2050 exceed the global tripling target and reflect strong alignment between national objectives and global decarbonization needs. Achieving these ambitions will require unprecedented construction rates, strategic lifetime extension of existing reactors, and significant policy and market reforms. If nations deliver on their commitments, nuclear power would play a critical role in ensuring secure, affordable, and net-zero-compatible energy for a rapidly expanding and electrified global economy.

1 Review of nuclear energy

- In 2024, nuclear reactors supplied a record high of 2667 TWh, surpassing the previous peak of 2661 TWh in 2006.
- Nuclear accounts for 9% of global electricity, down from 17% in the mid-1990s, due to faster growth in overall electricity demand.
- Since 2012, nuclear output has risen, driven by growth in Asia (especially China, India, Pakistan, UAE, and reactor restarts in Japan).
- Most reactors currently operating and under construction are PWR reactors, with an average capacity of around 1 GWe.
- 78 GWe[1] of new nuclear capacity is under construction globally, with China leading with 38 GWe; other major builds are in Egypt, India, Russia and Turkey.
- Recent construction has focused on reactors with capacities of 1 GWe or above, but some smaller reactors are under construction.
- Nuclear energy is primarily used for grid electricity, but also supports district heating, which is provided by ~15% of reactors, and desalination, which has been used more rarely, but has been carried out in India, Japan, Kazakhstan, Pakistan and Russia.
- The International Energy Agency's Net Zero Emissions by 2050 Scenario projects nuclear capacity to reach over 1000 GWe by 2050. This is around 80% of the goal endorsed in the Declaration to Triple Nuclear Energy, which was launched at COP28 in Dubai in 2023.

1.1 How has nuclear generation developed in different regions?

In 2024 nuclear reactors supplied 2667 TWh of electricity – a new record for annual global electricity supply, surpassing the previous peak of 2661 TWh in 2006.[1]

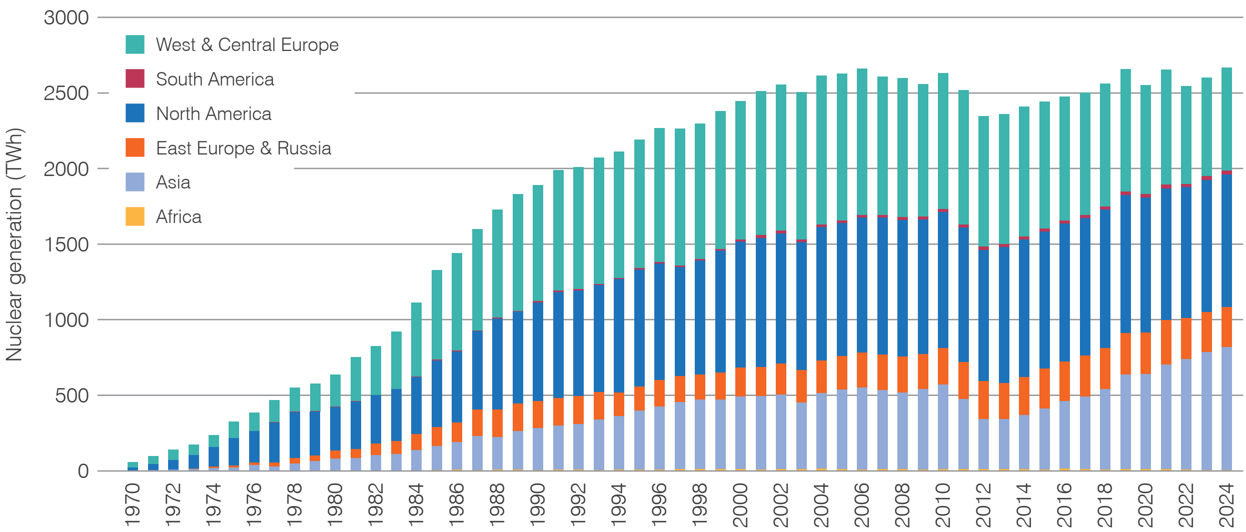
Nuclear generation was first used for electricity generation in the mid-1950s. However, it did not make a significant contribution to global electricity supply until a period of rapid growth in the 1970s and 1980s, followed by slower growth through to 2006, at which point annual nuclear generation remained broadly the same for five years.

There was a decline in global nuclear generation in 2011 and 2012, following the March 2011 accident at Japan's Fukushima Daiichi nuclear plant. Germany made the political decision to accelerate the shutdown of its reactors, shutting down eight reactors in 2011, with the remaining nine shutting progressively between 2012 and 2023.

In Japan, most reactors continued operating after the Fukushima Daiichi accident, but once they went offline for refuelling or other planned outages, they required a long process of authorization to restart under new regulatory conditions. As of September 2025, 14 reactors have restarted, with 11 reactors in the process of restart approval.

Despite the loss of output from Germany and Japan, since 2012 global nuclear output has again trended upwards, with particularly strong growth in Asia, where output has more than doubled. This has been led by the rapid growth of nuclear generation in China, as well as new reactor starts in India, Pakistan and United Arab Emirates.

Figure 1.1 Global nuclear generation by region



Source: World Nuclear Performance Report 2025

Output has also risen steadily since 2012 in East Europe & Russia, with new reactor starts in Belarus and Russia. Generation declined slightly in North America, with the start-up of three reactors in the USA against the closure of 13 reactors in the USA and three in Canada. In South America and Africa, generation has remained broadly constant.

In West & Central Europe output from nuclear power plants has declined. In addition to the 17 reactor closures in Germany, 12 reactors have closed in Belgium, Sweden, Switzerland and the UK compared to the start-up of just three, in Finland, France and Slovakia. However, that decline has been halted in the last two years, with output increasing, resulting in part from the return to service of reactors in France, which had had outages for repairs in 2022-23.

1.2 What contribution is nuclear making to energy supply?

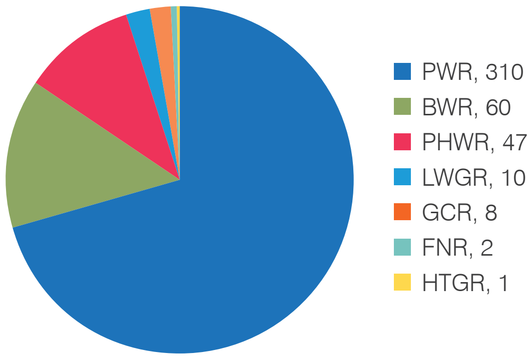
Nuclear generation in 2024 supplied 9% of the world's electricity. While generation in absolute terms is at an all-time high, the share of nuclear in the electricity generation mix has declined from around 17% in the mid-1990s, as overall electricity demand has increased more rapidly than the increase in nuclear generation.[2]

1.3 What reactors make up the current global nuclear fleet?

The current fleet of nuclear power reactors is dominated by large capacity units. As of 1 October 2025, there are 438 operable reactors, with a total capacity of 397 GWe.

More than 70% of operable reactors are pressurized water reactors (PWRs). Boiling water reactors (BWRs) account for 14%, pressurized heavy water reactors (PHWRs) for 11%, light water graphite moderated reactors (LWGRs) 2%, gas-cooled reactors (GCRs) 2%, and there are just two operable fast neutron reactors (FNRs) and one high-temperature gas-cooled reactor (HTGR).

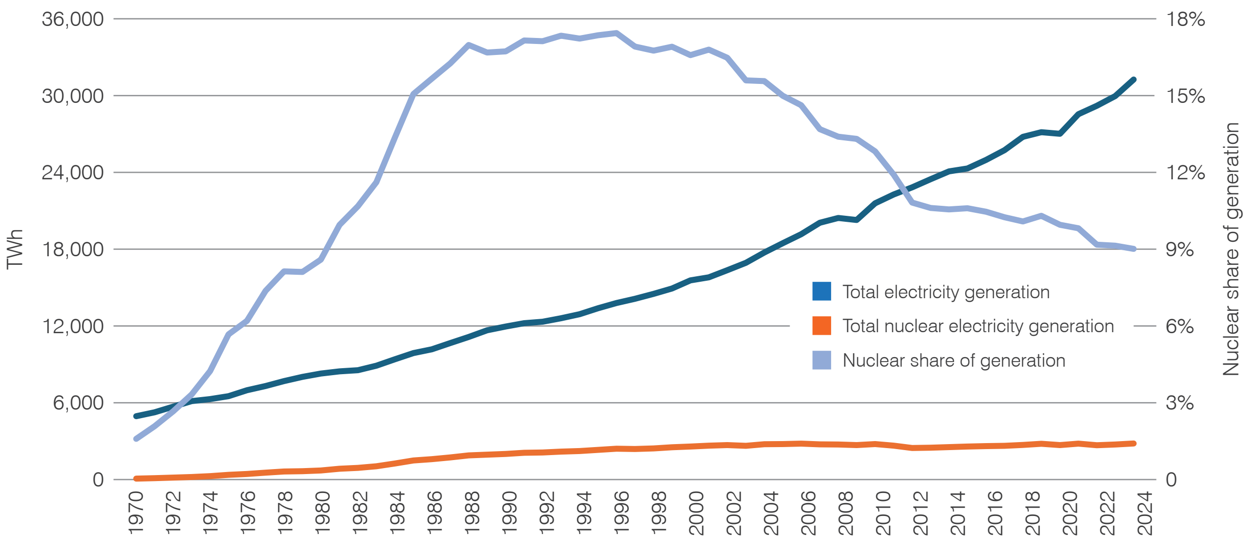
Figure 1.3 Operable reactors by process type (number of reactors)



Source: World Nuclear Assocation Reactor Database

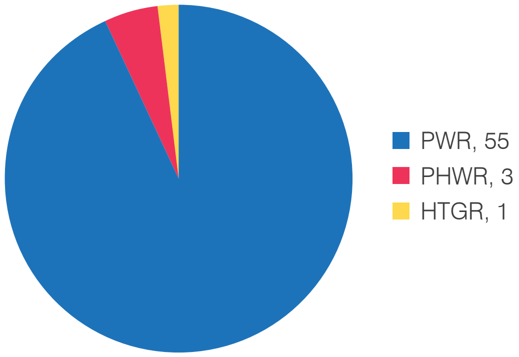
In recent years the PWR design has been even more dominant, with 55 of the 59 reactors to enter service in the last ten years being PWRs

Figure 1.2 Global electricity generation and nuclear share of generation mix



Source: Energy Institute Statistical Review of World Energy 2025

Figure 1.4 Operable reactors grid connected since 2016 by process type (number of reactors)



Source: World Nuclear Association Reactor Database

1.4 What reactor sizes have been built?

There has been a trend towards larger reactor capacities, as reactor designs were developed during the 1970s, with larger reactors offering the potential of greater economies of scale. The mean average gross capacity for reactors entering their first year of operation reached 1000 MWe in the mid-1980s and has remained broadly at this level to the present day.

While less prevalent, smaller capacity reactors have continued to enter service, with recent examples being the two 35 MWe (gross) reactors of the *Akademik Lomonosov* floating nuclear power plant and the 211 MWe (gross) Shidaowan HTGR unit. Significant future small modular reactor (SMR) deployment would see a resurgence in the number of new smaller capacity reactors, but larger reactors will likely continue to make up the majority of the overall capacity added.

1.5 What additional nuclear capacity is likely in the short term?

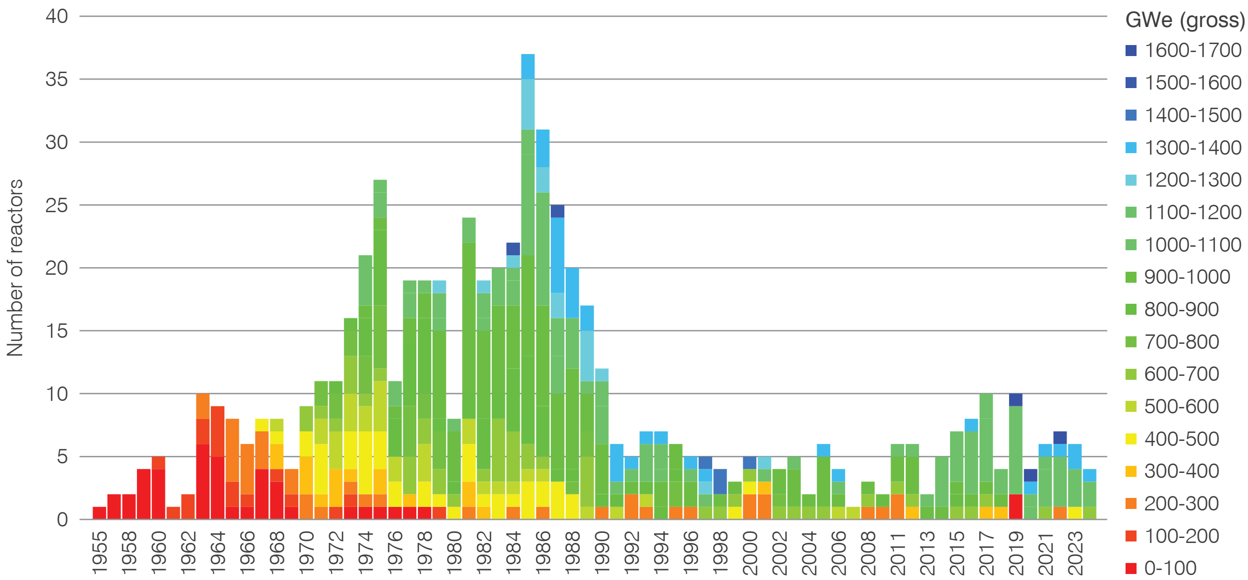
With average construction times of around 6-7 years, from first concrete to grid connection, additions to nuclear capacity by 2030 will be largely defined by reactors already under construction.

A total of 70 reactors, with a combined capacity of 78 GWe (gross) is currently under construction globally, with almost half, 38 GWe, located in China.

Egypt, India, Russia and Turkey each have around 5 GWe of nuclear capacity under construction, with other reactors under construction in Bangladesh, Brazil, Pakistan, Iran, Slovakia, South Korea and the UK. Reactors are also formally under construction in Argentina, Japan and Ukraine and Argentina, but these reactors are not currently being worked on.

In addition, three reactors in the USA currently shutdown are being prepared for restart: Holtec's Palisades reactor in Michigan; Constellation's Three Mile Island 1, which now forms part of the Crane Clean Energy Center; and NextEra's Duane Arnold in Iowa. A small number of other recently closed reactors could feasibly restart before 2030, if supported by policymakers and market conditions.

Figure 1.5 Number of reactors by capacity in first year of commercial operation



Source: World Nuclear Association Reactor Database

Table 1.1 Reactors under construction as of 1 October 2025

Reactor	Location	Construction Start	Gross Capacity (MWe)	Reactor Type
Carem25	Argentina	08/02/2014	29	PWR
Rooppur 1	Bangladesh	30/11/2017	1200	PWR
Rooppur 2	Bangladesh	14/07/2018	1200	PWR
*Angra 3**	*Brazil*	*30/05/2010*	*1405*	*PWR*
Changjiang SMR 1	China	13/07/2021	125	PWR
Changjiang 3	China	31/03/2021	1200	PWR
Changjiang 4	China	28/12/2021	1200	PWR
Haiyang 3	China	07/07/2022	1253	PWR
Haiyang 4	China	22/04/2023	1253	PWR
Jinqimen 1	China	10/08/2025	1200	PWR
Lianjiang 1	China	27/09/2023	1250	PWR
Lianjiang 2	China	26/04/2024	1250	PWR
Lufeng 1	China	24/02/2025	1200	PWR
Lufeng 5	China	08/09/2022	1200	PWR
Lufeng 6	China	26/08/2023	1200	PWR
Ningde 5	China	28/07/2024	1200	PWR
San'ao 1	China	31/12/2020	1210	PWR
San'ao 2	China	31/12/2021	1210	PWR
Sanmen 3	China	28/06/2022	1251	PWR
Sanmen 4	China	22/03/2023	1251	PWR
Shidaowan 1	China	28/07/2024	1225	PWR
Shidaowan 2	China	08/05/2025	1225	PWR
Shidaowan Guohe One 2	China	21/04/2020	1500	PWR
Taipingling 1	China	26/12/2019	1202	PWR
Taipingling 2	China	15/10/2020	1202	PWR
Taipingling 3	China	10/06/2025	1202	PWR
Tianwan 7	China	19/05/2021	1200	PWR
Tianwan 8	China	25/02/2022	1200	PWR
Xiapu 1	China	29/12/2017	600	FBR
Xiapu 2	China	27/12/2020	600	FBR
Xudabao 1	China	03/11/2023	1290	PWR
Xudabao 2	China	17/07/2024	1290	PWR
Xudabao 3	China	28/07/2021	1274	PWR
Xudabao 4	China	19/05/2022	1274	PWR
Zhangzhou 2	China	04/09/2020	1212	PWR
Zhangzhou 3	China	22/02/2024	1212	PWR
Zhangzhou 4	China	27/09/2024	1214	PWR
El Dabaa 1	Egypt	20/07/2022	1200	PWR
El Dabaa 2	Egypt	20/11/2022	1200	PWR
El Dabaa 3	Egypt	03/05/2023	1200	PWR
El Dabaa 4	Egypt	23/01/2024	1200	PWR
Kudankulam 3	India	29/06/2017	1000	PWR
Kudankulam 4	India	23/10/2017	1000	PWR
Kudankulam 5	India	29/06/2021	1000	PWR
Kudankulam 6	India	20/12/2021	1000	PWR
PFBR	India	23/10/2004	500	FBR
Rajasthan 8	India	30/09/2011	700	PHWR
Bushehr 2	Iran	10/11/2019	1057	PWR
*Ohma**	*Japan*	*07/05/2010*	*1383*	*BWR*
*Shimane 3**	*Japan*	*24/10/2006*	*1373*	*BWR*
Chashma 5	Pakistan	31/12/2024	1200	PWR
Cape Nagloynyn 2	Russia	31/08/2022	57	PWR
Cape Nagloynyn 1	Russia	31/08/2022	57	PWR
Kursk II-1	Russia	28/04/2018	1255	PWR
Kursk II-2	Russia	15/04/2019	1188	PWR
Leningrad II-4	Russia	20/03/2025	1188	PWR
Leningrad II-3	Russia	14/03/2024	1188	PWR
Seversk BREST-OD-300	Russia	08/06/2021	300	FBR
Mochovce 4	Slovakia	27/01/1987	471	PWR
Saeul 3	South Korea	01/04/2017	1400	PWR
Saeul 4	South Korea	20/09/2018	1400	PWR
Shin Hanul 3	South Korea	20/05/2025	1400	PWR
Akkuyu 1	Turkey	03/04/2018	1200	PWR
Akkuyu 2	Turkey	08/04/2020	1200	PWR
Akkuyu 3	Turkey	10/03/2021	1200	PWR
Akkuyu 4	Turkey	21/07/2022	1200	PWR
*Khmelnitski 3**	*Ukraine*	*01/03/1986*	*1089*	*PWR*
*Khmelnitski 4**	*Ukraine*	*01/02/1987*	*1089*	*PWR*
Hinkley Point C1	United Kingdom	11/12/2018	1720	PWR
Hinkley Point C2	United Kingdom	12/12/2019	1720	PWR

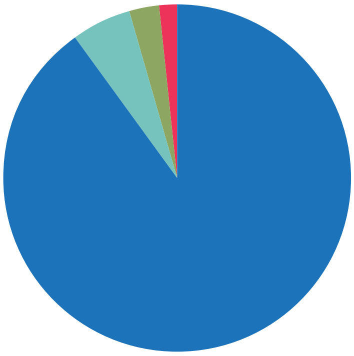
*Construction suspended

Source: World Nuclear Association Reactor Database (1 October 2025)

Most reactors currently under construction are large reactors, with capacities over 1000 MWe. As with recent startups, there are a small number of SMRs under construction, including first-of-a-kind units at Changjiang (ACP100, 125 MWe) in China and at Cape Nagloynyn (RITM-200S, 57 MWe) in Russia.

Most reactors under construction are PWRs. The only two BWRs listed as under construction are in Japan, where construction on both has been suspended since 2011.

Figure 1.6 Processes used in reactors under construction



Source: World Nuclear Association Reactor Database

1.6 What are the drivers for current and future use of nuclear technology?

1.6.1 Reducing greenhouse gas emissions

Fossil fuels became the predominant source of primary energy at the start of 20th century, displacing traditional biomass.[3] Currently, approximately three-quarters of global greenhouse emissions come from the burning of fossil fuels for energy,[4] releasing enormous quantities of greenhouse gas into the atmosphere. Nuclear energy is an effective alternative source of low-carbon electricity and heat, with very low greenhouse gas emissions across the full life cycle.

The United Nation's Intergovernmental Panel on Climate Change (IPCC) have concluded that human activities, principally through emissions of greenhouse gases, have 'unequivocally' caused global warming, with global temperatures between 2011-2020 being 1.1°C higher than the average temperature between 1850-1900.

The IPCC's sixth assessment report concluded that:

> "Continued greenhouse gas emissions will lead to increasing global warming, with the best estimate of reaching 1.5°C in the near term in considered scenarios and modelled pathways. Every increment of global warming will intensify multiple and concurrent hazards (high confidence). Deep, rapid, and sustained reductions in greenhouse gas emissions would lead to a discernible slowdown in global warming within around two decades"

Through the United Nations Framework Convention on Climate Change, governments have made commitments to address global warming, pledging in the Paris Agreement to "limit global temperature increase to well below 2 degrees Celsius above pre-industrial levels, while pursuing efforts to limit the increase to 1.5 degrees Celsius". A total of 194 countries ratified the Paris Agreement, with only Libya, Yemen and Iran failing to do so. The United States withdrew during the first Trump presidency, but rejoined in 2021, before President Trump issued an executive order in 2024 for the United States to withdraw again at the start of his second term.

Climate models have projected many emissions paths that would be consistent with meeting the temperature goals of the Paris Agreement. In general, those consistent with keeping global temperatures rises below 2 degrees Celsius require greenhouse gas emissions to reach net zero[c] by around 2075, with peak emissions before 2025, and those limiting temperature rises to 1.5 degrees Celsius require emissions to reach net zero by around 2050, with peak emissions before 2030.

In reality, greenhouse gas emissions have increased dramatically over the last 125 years, with carbon dioxide emissions rising from 2 billion tonnes CO_2 in 1900 to 38 billion tonnes in 2024.

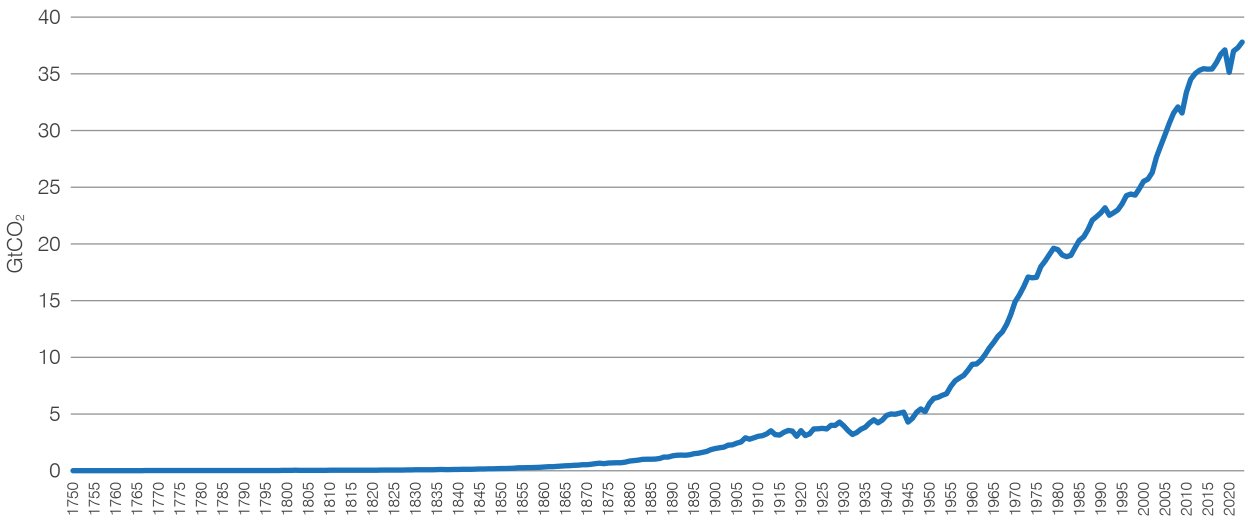
A major contributory factor to the increase in global greenhouse gas emissions has been the increase in demand for energy, met predominantly by fossil fuels.

A reduction in global emissions on the scale required to meet the objectives of the Paris Agreement is unachievable without a rapid switch from unabated fossil fuels to sources with low greenhouse gas emissions.

All forms of power generation have some greenhouse gas emissions associated with activities in their life cycle, but life cycle emissions analysis from the United Nations

[c] Net-zero emissions means any remaining emissions would be matched by withdrawals of carbon dioxide from the atmosphere, for example through direct air capture of carbon dioxide.

Figure 1.7 Annual global carbon dioxide emissions



Source: Global Carbon Budget (2024)[5]

Economic Commission for Europe shows that emissions from nuclear are among the very lowest in comparison to other forms of generation, and two orders of magnitude lower than emissions from fossil fuels.[6] Nuclear power plants also offer a large power output from a relatively small area. A large nuclear power plant occupies around 3 km^2, much less than that required for wind and solar.

In combination, these benefits make it clear that nuclear energy has an important role to play in meeting global greenhouse gas emissions goals. This was recognized in the Global Stocktake agreement, unanimously endorsed at the United Nations COP28 climate change conference in Dubai in 2023. That agreement recognized nuclear energy as a means to achieve 'deep, rapid and sustained reductions in greenhouse gas emissions'.[7]

As discussed in section 1.6.2, efforts to reduce greenhouse gas emissions include greater electrification of the energy sector. Electricity is being applied to sectors such as transport, heating and industrial processes because of policy pressure to decarbonize, improving economics of technologies such as EVs and heat pumps, corporate and consumer demand and energy security needs. This will only be effective if the additional electricity demand is met from low carbon sources, such as nuclear.

The increasing adoption of electric vehicles is being met through additional electricity demand, reducing demand on petroleum products. According to the IEA, 18% of new car sales globally in 2023 were electric, with more than half being in China. This meant around 40 million electric cars were on the roads in total. IEA expects this to reach between 500-800 million electric cars by 2035.[8] Zero emissions vehicle mandates, and policies to phase out new petrol or diesel car sales in some countries are driving this change.

Other uses of electricity are also drivers for increased nuclear generation. For heating and cooling in buildings, there is increasing adoption of heat pumps, driven by greater efficiencies and policy incentives.[9] Fossil fuelled boilers and furnaces are being replaces with electric alternatives for industries such as food processing, chemicals, and textiles. Electric arc furnaces can replace blast furnaces for industries such as steel production.

Nuclear plants also offer the potential for greenhouse gas emissions mitigation through direct use of nuclear heat, rather than via the subsequent generation of electricity.

Nuclear technologies can be used to provide industrial process heat. In some cases, the outlet heat produced by conventional light water reactors is suitable. But for industrial processes requiring higher temperatures reactors such as high temperature gas cooled reactors will provide a suitable heat source.

For some transport sectors direct electrification is not a simple alternative to the use of fossil fuels. For examples, in aviation, although some advances have been made for short haul flights, the power density of batteries makes them unsuitable for aviation.

Synthetic fuels may be made through the combination of hydrogen and carbon dioxide through Fischer-Tropsch synthesis, where the two gases are chemically combined under high temperature and pressure. The hydrocarbons produced are then refined to produce the jet fuel.

In such cases, production of synthetic fuels may offer a carbon-neutral alternative to conventional fossil fuels, with nuclear process heat being used as a low-carbon energy source to drive the process.

1.6.2 Meeting growing electricity demand

Economic growth, industrial development and higher standards of living require affordable and reliable energy supplies. Population growth and urbanization also drive increased demand for energy.

While some advanced economies have reduced their energy demand in recent years, with increasing pursuit of energy efficiency and the transfer of more energy intensive industry to emerging economy countries, global demand for energy has continued to rise.

In the 20th century primary energy consumption grew ten-fold, and has continued to grow in the 21st century. This growth in energy consumption is expected to slow, and under some scenarios decline.

According to the International Energy Agency, under its Stated Policies Scenario, final energy consumption would increase from 445 EJ in 2023 to 533 EJ in 2050. Under its Announced Policies scenario, consumption would fall slightly to 434 EJ and under its Net Zero Scenario consumption would fall more sharply to 344 EJ.

However, under all three scenarios electricity consumption increases, from 29,863 TWh in 2023, to 58,352 TWh, 70,542 TWh and 80,194 TWh in 2050 under the Stated Policies, Announced Policies and Net Zero Scenarios, respectively.[10] The increase in the share of energy supply met by electricity is largely due to the use of electrification as a method of emissions reduction, as direct use of fossil fuels is replaced by electricity generated from low-carbon sources. Nuclear generation, as one such source, is predicted to see supply rise, to 4460 TWh, 6055 TWh and 6969 TWh under the three IEA scenarios. This pattern of increasing nuclear output to 2050 is reflected in many other scenarios and projections, this is described in more detail in Chapter 7.

1.6.3 Ensuring reliability of supply

The assurance of secure and reliable supplies of energy is essential in modern economies. As noted in Section 1.7.1, nuclear energy can help reduce overall system costs, for example by minimizing the need for large-scale energy storage and backup capacity. In systems with high shares of renewables, additional costs arise from the need to reinforce grids, invest in energy storage, and enhance system flexibility to manage intermittent generation. Nuclear provides continuous, dispatchable generation that complements intermittent renewables like solar and wind.

Nuclear power plants contribute to grid inertia, which supports overall power system stability. Inertia is the kinetic energy stored in the rotating mass of large synchronous generators—such as those in coal, gas, hydro, and nuclear plants. When a sudden disturbance occurs (for example, the loss of a large generator), this stored energy resists rapid changes in frequency, slowing the rate of decline and giving grid operators time to take corrective action. By providing rotational inertia, nuclear plants help dampen frequency fluctuations and reduce the risk of cascading failures or blackouts. Because nuclear units typically operate continuously at high output, they offer a steady source of inertia. In contrast, systems dominated by inverter-based renewables such as solar and wind have lower inherent inertia and are more susceptible to rapid frequency deviations.

1.6.4 Strengthening security of supply

The inherent nature of different generation forms, in terms of carbon emissions or reliability of output, are key factors when assessing their merits. However, the impact of external factors on the ability to secure supplies of fuel, and the impact of supply issues on the price of electricity, are also important factors.

Geopolitics, sanctions and wars have all constrained supply and resulted in significant price volatility. The 1973 Yom Kippur War resulted in OPEC members cutting oil exports to the USA and allies supporting Israel. Oil prices quadrupled, sparking a global energy crisis. The 1979 Iranian Revolution and subsequent Iran-Iraq War and the 1990 Gulf War both led to oil prices doubling.

Recently, Russia's invasion of Ukraine led to record-high gas and electricity prices in Europe. In addition to supply constraints, such as the transit of Russian gas through Ukraine, many European countries have sought to reduce their dependence on Russian gas supplies.

Oil and gas rely on pipelines, LNG terminals and shipping routes, all of which are potential vulnerabilities for supply chains. Oil can be stockpiled, but storage for natural gas is limited, which can restrict long-term resilience.

In comparison, nuclear fuel is extremely energy-dense, and each fuel assembly typically remains in the reactor for several years. Reactor operators usually acquire new fuel assemblies well ahead of refuelling and may also hold inventories of fresh fuel onsite, reducing the risk of short-term supply shocks.

Uranium is mined globally in countries such as Australia Canada, Kazakhstan and Namibia, and no equivalent of OPEC dominates supply, although some fuel cycle services, such as enrichment, do have a small number of major suppliers. Significantly, uranium fuel costs make up only a small share of nuclear electricity costs. Therefore, overall generation costs are not so strongly affected by changes in nuclear fuel prices.

1.7 The Declaration to Triple Nuclear Energy

In December 2023, at the United Nation's COP28 climate change conference in Dubai, 25 governments signed the Declaration to Triple Nuclear Energy, committing themselves to supporting a global goal of tripling nuclear capacity by 2050.[11] An additional six governments joined the declaration at COP29 in Baku, Azerbaijan, and two more joined at COP30 in Belem, Brazil. The signatories to the declaration are: Armenia, Bulgaria, Canada, Croatia, Czech Republic, El Salvador, Finland, France, Ghana, Hungary, Jamaica, Japan, Kazakhstan, Kenya, Republic of Korea, Kosovo, Moldova, Mongolia, Morocco, Netherlands, Nigeria, Poland, Romania, Rwanda, Senegal, Slovakia, Slovenia, Sweden, Turkey, Ukraine, United Arab Emirates, UK, and the USA.

The declaration recognized the key role of nuclear energy in achieving global net-zero greenhouse gas emissions by 2050, which would be needed to keep the goal of limiting global temperature increases to 1.5 °C within reach. The declaration also recognized nuclear energy's role in supplying clean dispatchable baseload power, thereby strengthening energy security.

Also at COP28, 130 nuclear companies signed a pledge to support the tripling nuclear goal. Then at New York Climate Week 2024, 14 financial institutions declared their support and discussed how the finance sector could contribute to nuclear achieving the tripling goal. Later, at CERAWeek 2025 in Houston, Texas in March 2025, 14 companies representing large energy users also expressed their support for a tripling of nuclear capacity by 2050.

The target set in the governmental Declaration to Triple Nuclear Energy is based on a baseline of nuclear capacity in 2020, when operable nuclear capacity was 393 GWe. A tripling of this capacity would require operable capacity to reach nearly 1200 GWe by 2050. In the following chapters we review the technologies that will be used to meet these capacity goals. We will also review current nuclear capacity targets set by governments and examine whether, at a national level, there is sufficient ambition to meet the global tripling goal.

2 Nuclear power technology development

- Most reactors in use today are based around pressurized water reactor (PWR) or boiling water reactor (BWR) designs, with capacities more than 1000 MWe. They use water cooling and operate at around 300 °C,
- However, there is increasing interest in a wider range of reactor sizes and designs to meet a more diverse range of applications and provide more options for deployment.
- New reactor designs are being developed for a range of different capacities, from below 1 MWe to more than 1700 MWe, allowing nuclear technologies to be applied to a wide range of applications.
- Designs in development will use gases, molten salts and liquid metals for cooling, which will enable reactors to operate at higher temperatures, and be used for new applications.
- Most nuclear reactors currently planned and proposed are intended to be used primarily for electricity generation. However, the use of nuclear technologies for marine propulsion, direct to end user power, district heating, provision of high temperature process heat, desalination, energy storage, hydrogen production and sustainable aviation fuel production is likely to increase in the coming decades, particularly if political commitments to clean energy are pursued and strengthened.
- This chapter illustrates how reactors can be categorized by size and coolant used and then illustrates some of the new uses to which new reactor technology is being applied.

2.1 How are reactors categorized by size?

2.1.1 Large reactors

Since the start of nuclear generation in the 1950s the average size of nuclear reactors has tended to increase, as reactor designers sought to improve economies of scale. Some early reactors had relatively small capacities, of similar capacities to those designs classed as small modular reactors today. Most large reactors designs available for construction now have a capacity of 1000 MWe or higher.

Large reactors make up most reactors in use today, and almost all those reactors are water-cooled. A small number of liquid metal-cooled fast reactors have also been constructed. The UK also deployed two types of gas-cooled reactors, the Magnox and AGR series. All Magnox reactors are shutdown, and the last of the AGRs are expected to close by 2030.

While most large reactors in use today are used for grid electricity production, around 15% also provide district heating.

2.1.2 Small modular reactors

Small modular reactors (SMRs) are nuclear reactors designed for smaller scale power generation. In addition to their size, they are characterized by their modular design, which allows for factory fabrication. According to the International Atomic Energy Agency, SMR designs are typically up to 300 MWe, although larger designs, such as the 470 MWe Rolls-Royce SMR also may have a highly modular design.

Some SMR designs are also based on water-cooled systems, with SMR variants of PWR, BWR and PHWR designs. However, other designs are based on gas, liquid metal, or molten salt systems, and have the potential to provide additional services, such as the provision of high temperature process heat.

2.1.3 Microreactors

Microreactors are compact nuclear reactors, designed to be produced in factories and small enough to be transported by lorry to their deployment site, making them suitable for remote locations. They have much lower power outputs than conventional large reactors or SMRs. This lower power output means that the reactors can rely on fully passive cooling systems.

2.2 How are reactors categorized based on coolant used?

2.2.1 Water-cooled reactors

Water-cooled reactors use water as a primary coolant as well as a moderator. There are three main types – pressurized water reactors, boiling water reactors and pressurized heavy water reactors.

With output heat of around 300 °C these reactors can be used for electricity generation, district heating and low temperature process heat applications. While most water-cooled reactors are large, smaller designs are being developed.

Advanced large water-cooled reactors are evolutions of previous designs, incorporating new technologies. Modular construction approaches are also favoured to reduce building times.

Many water-cooled SMRs are scaled down versions of widely deployed gigawatt-scale light water reactor plants, with an emphasis placed upon modularization, scalability and factory manufacture. Several light water small modular reactor designs feature integral reactor modules for which the key components such as steam generators, the pressurizer and the reactor core are contained within the same single module.

2.2.2 Gas-cooled reactors

High-temperature gas-cooled reactors (HTGRs) operate at significantly higher temperatures than traditional water-cooled reactors, with outlet temperatures from 500 °C to 950 °C. They typically use helium as the coolant, as it does not react with other materials in the core.

The high-temperature heat produced by these reactors will enable nuclear technology to decarbonize hard-to-abate industries such as steel, chemical and concrete production, which currently rely on fossil fuels for process heat. An eventual development of such technology would be the very high temperature reactor (VHTR), able to operate at temperatures exceeding 1000 °C, for high temperature applications above those targeted by HTGRs.

These advanced reactors are being developed at capacities suited for SMRs and microreactors.

2.2.3 Liquid metal-cooled reactors

Fast neutron reactors cooled with liquid metal, usually sodium or lead, are reactors without moderators that use high energy neutrons to split atoms rather than slower thermal neutrons used in most commercial power plants.

Liquid metal-cooled fast reactors also have efficiency benefits as their use of fast neutrons increases the amount of energy that can be extracted from their nuclear fuel and reduces the amount of long-lived waste generated.

2.2.4 Molten salt reactors

Molten salt reactors use a mixture of molten salts as their primary circuit coolant; fuel can either be dissolved within the coolant or contained within pins. The use of molten salt enables the reactors to operate at lower pressures to traditional commercial nuclear plants. The higher temperatures found within their cores also enable decarbonization solutions, similarly to high temperature reactors. Some molten salt reactors are designed to operate as fast neutron reactors, so have the potential to reduce waste outputs.

Table 2.1 Characteristics of reactor designs based on coolant type and capacity

Coolant	Water			Gas		Liquid Metal (Sodium or Lead)	Molten Salt	
Process	PWR	BWR	PHWR	HTGR	Gas Fast Reactor	Fast Reactor	Fluoride HTR	Chloride Fast Reactor
Fuel Enrichment	LEU, LEU+	LEU, LEU+	Natural U or VLEU	HALEU	HALEU	HALEU	HALEU	HALEU
Outlet Temperature	~300C	~285 C	~300 C	~750 C	~550 C	~550 C	~750 C	~750 C
Large Reactor designs	AP1000 EPR/ EPR2 APR1400 VVER-1000/ 1200/TOI Hualong One/ HPR1000 SRZ-1200	ABWR ESBWR	Monark PHWR-700			BN-1200 CFR-600 PFBR		
Small Modular Reactor designs	Holtec SMR-300 NuScale Power Module AP300 Rolls-Royce SMR ACP100 RITM-200N/S Nuward	BWRX-300	BSMR-200	Xe-100 HTR-PM (China)	EM² (850C)	Terrapower-Natrium ARC-100 (510C) BREST-300 SSR-W	Kairos Power FHR (650 C) Terrestrial IMSR (700 C)	Terrapower MCFR
Micro Modular Reactors	KLT-40S			BANR Jimmy Radiant-Kaleidos eVinci (Heatpipe)		Oklo Newcleo-LFR-AS-30		

2.3 Applications of nuclear technology – grid electricity supply

Nuclear reactors have been supplying electricity to grids for more than 70 years. The 5 MWe AM-1 (Atom Mirny, 'Peaceful Atom') reactor at Obninsk first supplied electricity to the Moscow grid in June 1954, with reactors in France, the UK, and the USA following soon after.

As discussed in Chapter 1, growth in nuclear generation accelerated during the 1970s and 1980s, with the global share of electricity supplied by nuclear generation reaching 17% in the mid-1980s.

While growth in nuclear generation has slowed, global generation in 2024 achieved a new high, with 2667 TWh of electricity supply. There has been particularly strong growth in Asia over the last decade, with nuclear electricity generation more than doubling, from 402 TWh in 2015 to 811 TWh in 2024.

While the use of nuclear technology for non-electric applications is expected to grow, grid electricity supply is expected to remain the predominant use of nuclear technology.

2.4 Applications of nuclear technology – non-electric nuclear applications

Nuclear technology has been used in several power applications besides grid electricity supply for more than 70 years. The first nuclear-powered submarine – the USS Nautilus (SSN-571) – was launched in 1954. Calder Hall, the UK's first nuclear power plant, which started up in 1956, supplied steam to the Windscale (later Sellafield) site, as well as generating electricity for grid supply. More than 40 reactors worldwide have supplied district heating systems.

With growing demand for decarbonization, new applications for nuclear reactors are being developed.

2.4.1 Marine propulsion

Nuclear powered marine propulsion has historically been mostly limited to naval vessels and icebreakers. A new interest in nuclear power is arising from the commercial shipping sector following the International Maritime Organization's 2023 Greenhouse Gas Strategy, which demands a reduction across international shipping in carbon emissions of at least 40% by 2030 (compared to 2008 levels) and to reach net-zero emissions by 2050.

Advanced nuclear reactors to power emissions-free shipping freighters are being developed, such as Core Power's Molten Chloride Fast Reactor, which is designed to improve on insurability and emergency preparedness

The Sibir, a nuclear-powered icebreaker (Image: Rosatom)

zones, compared to the PWRs that have so far been used to power naval vessels. There is currently no precedent for insuring a mobile commercial nuclear power plant, or liability regime for moving a reactor from one jurisdiction to another.

2.4.2 Direct to end user power

Small modular reactors and microreactors can provide remote facilities with a direct supply of electricity, without connecting to the grid. This enables remote industrial operations such as mining facilities to decarbonize their operations without installing an expensive link to the grid. Data centre owners have also started looking to small reactors and microreactors to support their operations as they require large amounts of constant power which corporate sustainability policies require to be as low carbon as possible. With larger data centres larger capacity reactors may be preferred. With the significant growth of this sector, which currently accounts for 1-1.5% of global electricity use, forecast over coming years, there is a need to ensure it is supplied with decarbonized, reliable power.

Nuclear power is also being considered for extra-terrestrial applications, with companies such as Rolls-Royce and BWXT developing reactors for lunar and Martian deployment.

Increased demand from data centres

The rapid emergence of AI over recent years has highlighted how digitization and technological growth is leading to increased electricity demand from data centres. Companies such as Meta, Amazon Google and Microsoft are all looking to nuclear energy to help supply their growing demand for electricity from low-carbon sources.

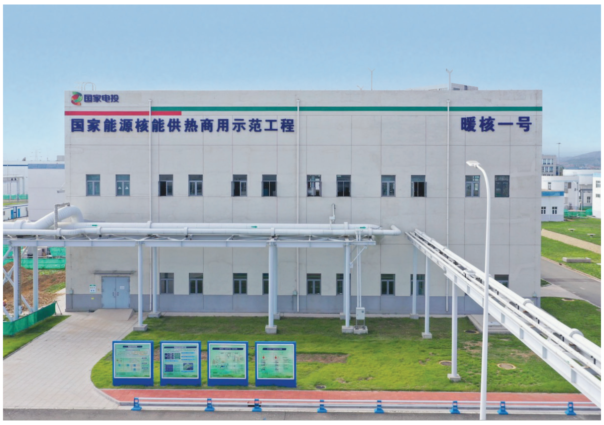
The global electricity demand from data centres is expected to increase rapidly over the next 5-10 years. The IEA projects that global electricity demand will more than double, from 415 TWh in 2024 to 945 TWh in 2030 and 1300 TWh in 2035, according to their base case scenario. Of this around 220 TWh is projected to be supplied by nuclear power.[12]

Nuclear is well suited to supplying power to data centres, providing firm, clean power with high reliability. With some data centres requiring gigawatts of power, nuclear is also scalable to meet these needs.

A number of technology companies have already invested in nuclear technology to meet their future energy needs. While the IEA expect new nuclear capacity to be focused on meeting additional demand post-2030, another option is to secure the output of existing nuclear capacity, including plants that have recently shut down, some examples of such agreements are summarized below.

- Microsoft have agreed a 20-year power purchase agreement with Constellation to enable the restart of the 880 MWe (gross) TMI 1, now named the Crane Clean Energy Center.[13]
- Amazon (AWS) have a long-term power purchase agreement with Talen Energy for nuclear power to support the AWS data centre near Susquehanna nuclear plant. The delivery is initially 960 MW for AWS, with a ramp schedule of 840–1,200 MW by 2029; 1,680–1,920 MW by 2032; and then full capacity through to 2042, with options to extend the duration of the agreement.[14]
- Amazon is investing, with off-take rights, to support the development of X-Energy's Xe-100 SMR at Energy Northwest's Columbia site. Initially there will be four Xe-100 modules, with a capacity of ~320 MW, with the option to expand this up to twelve modules.[15]
- Amazon has also signed an MOU with Dominion Energy to explore SMR development at the North Anna site.[16]
- Meta has signed a 20-year power purchase agreement with Constellation for 1,121 MW from the Climate Clean Energy Centre in Illinois.[17]
- Google is collaborating with Kairos Power and TVA for the supply of power from Kairos's Hermes demonstration plant.[18] In October 2024 Google signed an agreement with Kairos Power to purchase energy from small modular reactors, which will support the deployment of Kairos Power's molten salt-cooled reactor using ceramic pebble-type fuel by 2030 and a fleet totalling 500 MWe of capacity by 2035 .
- TerraPower and US data centre developer Sabey Data Centers have signed a memorandum of understanding to explore the deployment of Natrium power plants at current and future data centres.[19]
- Equinix, a data centre operator, has signed agreements with Oklo and Radiant in the US, as well as ULC-Energy and Stellaria in Europe.[20]
- Holtec, EDF and Tritax plan to develop advanced data centres power by SMRs at the former Cottam coal-fired power plant in the UK. This was announced as part of the Atlantic Partnership for Advanced Nuclear Energy announced by the UK and US governments in September 2025.[21]

2.4.3 District heating



District heating project at Haiyang nuclear power plant (Image: SPIC)

Nuclear district heating involves using heat generated by a nuclear power plant to provide warmth to residential, commercial, or industrial areas. The heat is collected via the condenser used to cool the steam leaving the turbine and fed into the district heating system rather than into cooling towers or bodies of water. Using nuclear power to heat buildings in this way reduces the need for fossil fuel powered boilers, reducing emissions and improving air quality in urban areas. Additionally, hot water can be piped over long distances from the plants to where it is needed, with low heat loss.

District heating has been provided by conventional nuclear power plants in Russia and Switzerland for several decades. More recently, the Haiyang nuclear power plant in Shandong province, China, supplies steam from its two AP1000 units, which is then fed through an onsite heat exchanger. This heat is then fed to an offsite heat exchange station belonging to Fengyuan Thermal Power, from where heated water flows through municipal heating pipes to consumers over an area of 13 million square metres.

2.4.4 High-temperature process heat

Some advanced nuclear power reactors designs are intended to provide heat above 700 °C. This would enable them to supply industrial facilities with the heat they require for processes such as the manufacture of concrete, steel, paper, chemicals and glass that are currently provided by fossil fuels or other unsustainable means. Interest in high temperature reactors to decarbonize these processes has grown substantially.

In China, the world's first modular high temperature gas-cooled reactor nuclear power plant entered commercial operation in 2023. The High Temperature Gas-Cooled Reactor – Pebble-bed Module (HTR-PM) in Shidaowan, in Shandong province, features two small reactors (each 250 MWt) that drive a single 210 MWe steam turbine. It uses helium as coolant and graphite as moderator. Each reactor is loaded with more than 400,000 spherical fuel elements ('pebbles'), each 60 mm in diameter and containing 7 g of fuel enriched to 8.5%. The HTR-PM is expected to be followed by the HTR-PM600 , with one turbine rated at 650 MWe driven by three twin-reactor units.

In the USA, Dow Chemical is working with X-energy to deploy HTGRs at its Seadrift site in Texas, and in northeast UK, X-energy is seeking to develop its reactors to support an industrial site. In France, Jimmy is looking to build its high-temperature microreactor to supply a distillery with process heat.

High Temperature Gas Cooled Reactor-Pebble-bed Module, Shidaowan (Image: CNNC)

2.4.5 Desalination

There are more than 20,000 desalination plants in operation globally, the majority of which are powered by fossil fuels.[22] Two methods of desalination can be facilitated by nuclear power: distillation and reverse osmosis. For distillation, heat from a nuclear reactor is used to boil seawater, which is then condensed, separating the salts and impurities from the water. For reverse osmosis, electric power produced by a reactor is used to pump seawater at very high pressure through a semi-permeable membrane which allows water molecules to pass through while blocking the passage of salts and other impurities. The widespread use of nuclear power in desalination would decarbonize this energy-intensive process.

Nuclear powered desalination has been used in India, Japan, Kazakhstan and Pakistan and new projects have been proposed in Saudi Arabia, South Africa and the USA.[23] Some of the output from the reactors under construction at El Dabaa in Egypt is planned to be used to power desalination plants.

Nuclear reactors powering navy vessels have been used to produce clean water for use on the vessels, and have been used to provide water to areas affected by natural disasters.[24, 25]

2.4.6 Energy storage

Some advanced nuclear reactors have been designed specifically for energy storage. Reactors such as the MoltexFLEX reactor in the UK and TerraPower's Natrium plant in the USA have thermal storage tanks that can deliver power when required. The reactor can therefore either deliver power to the grid or to its storage tanks depending on demand.

2.4.7 Hydrogen production

Hydrogen is considered to be a key component of future energy systems due to its ability to be used as a fuel, in the production of fuels and as a replacement for high-carbon compounds in industrial processes such as coke in steelmaking.

Nuclear reactors can be used to produce hydrogen through electrolysis. For example, the Bay Hydrogen Hub project aims to use a small amount of heat from the Heysham II nuclear plant to a solid oxide electrolyzer cell (SOEC) to produce hydrogen.[26]

Advanced high temperature nuclear technologies would be able to produce hydrogen through thermochemical reactions by providing the high temperature heat required.

2.4.8 Sustainable aviation fuel

Sustainable aviation fuel (SAF) has the potential of reducing carbon emissions from aircraft by up to 80% compared to traditional jet fuel and therefore provides a solution to one of the hardest sectors to decarbonize. Advanced nuclear power could supply the high temperature heat required for the synthesis of SAF.

2.4.9 Floating nuclear power plants

While a floating nuclear power plant is a type of nuclear energy installation, rather than an application, such a plant can deployed in situations where it may not be preferable to build a land-based plant.

A floating nuclear power plant consists of a nuclear reactor installed onto a barge that would then be towed to its deployment location, where it could be connected to provide power, heat or other services, such as supply of potable water through desalination.

Floating nuclear power plants have the potential to benefit from the scaling and series production offered by shipyard construction. They should also require less infrastructure to be established at their eventual deployment location.

Floating nuclear power plant Akademik Lomonosov (Image: Rosatom)

It may be possible to deploy floating nuclear power plants more rapidly than siting an equivalent reactor on land, as fewer site-specific constraints would be involved.

The only floating nuclear power plant currently in operation is Rosatom's *Akademik Lomonosov*, which is located at the Russian port of Pevek, in northeast Russia, where its two KLT-40S reactors provide power and heat to the region.

Four RITM-200S floating nuclear power reactors are under construction, with the reactors to supply power to the Baimskaya mine in northeast Russia. The reactors are being manufactured in Russia, with the vessels being built at a shipyard in China.[27]

Several companies are currently developing their own floating nuclear power plant offerings with a variety of technologies, including light water reactors and molten salt reactors. These include Core Power, KEPCO E&C's BANDI, Saltfoss Energys' CMSR power barge and Prodigy Clean Energy's nuclear barge, which is designed to accommodate SMRs from other vendors.

3 Global and national nuclear energy developments

- The UNFCCC global stocktake (COP28, 2023) was the first UNFCCC process to formally endorse nuclear energy as a valid option for emissions reduction. It urged countries to accelerate zero- and low-emissions technologies, including renewables, nuclear, CCUS, and low-carbon hydrogen production.
- The Declaration to Triple Nuclear Capacity, launched at COP28, in 2023 has now been signed by 31 countries, who pledge support to tripling global nuclear capacity by 2050 (compared with 2020 capacity) and mobilize investment and encourage financial institutions to support nuclear.
- At the G7 meeting in Turin in 2024, all G7 nations except Germany expressed support for nuclear in those countries that chose to use it. They recognized nuclear as a clean, reliable baseload source that enhances energy security and grid stability.
- The World Bank announced in June 2025 that it would support nuclear projects. It will back operating lifetime extensions and small modular reactors (SMRs) in developing nations.
- In September 2024, 14 global financial organizations (including Bank of America, Barclays, BNP Paribas, Citi, Goldman Sachs, Morgan Stanley) backed nuclear as part of the low-carbon transition.
- In March 2025, 14 major corporations (including Amazon, Dow, Google, Meta) pledged support for tripling nuclear capacity by 2050.
- Many countries have set capacity targets, or have plans for deployment of reactors, that would contribute to achieving the main Declaration to Triple Nuclear Capacity objective.

3.1 Recent international developments

3.1.1 UNFCCC global stocktake

The UN Framework Convention on Climate Change (UNFCCC) first global stocktake in 2023 endorsed nuclear energy as a valid option for reducing greenhouse gas emissions.

The global stocktake process was instigated through the Paris Agreement at COP21 in France. This committed parties that were signatories to the Paris Agreement to review every five years progress towards the collective goal of limiting climate change to 1.5 °C.

At COP28, in 2023, in the *Outcome of the first global stocktake* document[28], governments concluded that insufficient progress towards meeting the 1.5 °C goal had been made, recognized the need to make "deep, rapid and sustained" reductions in greenhouse gas emissions, and called on parties to contribute to global efforts "in a nationally determined manner" through measures including:

> *Accelerating zero- and low-emission technologies, including, inter alia, renewables, nuclear, abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production.*

This was the first time that nuclear energy had been endorsed as a mitigation option within the COP process, reflecting the more positive position of many countries towards nuclear energy.

3.1.2 Support for nuclear energy in the G7

At its 2024 Ministerial Meeting on Climate, Energy and Environment, in Turin, Italy, the Group of Seven (G7) nations[d] committed to support the use of nuclear energy in those countries that opt to use it.

The countries that opt to use nuclear energy or support its use (at the time all G7 nations except Germany) recognized its potential as a clean energy source that can reduce dependence on fossil fuels to address the climate crisis and improve global energy security; they also recognized nuclear as a "source of baseload power, providing grid stability and flexibility, and optimising use of grid capacity."

3.1.3 Declaration to Triple Nuclear Capacity

At COP28 in Dubai, 25 countries signed the *Declaration to Triple Nuclear Energy*. The declaration, authored and agreed by the countries involved, recognized the key role of nuclear energy in achieving global net-zero greenhouse gas emissions. Each signatory government committed to *"work together to advance a global aspirational goal of tripling nuclear energy capacity from 2020 by 2050, recognizing the different domestic circumstances of each Participant."*

When the declaration was launched on 2 December 2023 the following countries signed the declaration: Bulgaria, Canada, Czech Republic, Finland, France, Ghana, Hungary, Jamaica, Japan, Moldova, Mongolia, Morocco, the Netherlands, Poland, Romania, Slovakia, Slovenia, South Korea, Sweden, Ukraine, the UAE, the UK and the USA. Later that week Armenia and Croatia also signed.

[d] *The G7 nations are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States*

Six more countries joined the declaration at COP29 in Azerbaijan: El Salvador, Kazakhstan, Kenya, Kosovo, Nigeria and Turkey, bringing the total number of signatories to 31.

The declaration included pledges to mobilize investments, including innovative financing, to encourage international financial institutions to support nuclear energy, as well as to promote resilient supply chains for nuclear technologies. The declaration also included pledges to support the development of advanced reactors, extend the operating lifetime of existing plants where feasible and welcome complementary commitments from the private sector, NGOs, development banks and the finance sector.

3.1.4 World Bank support for nuclear projects

In June 2025, at a board meeting of the World Bank Group, it was decided that the bank would be open to "supporting efforts to extend the life of existing reactors and accelerate the potential of small modular reactors in developing countries."[29] The World Bank last financed a nuclear project in 1959.

The Declaration to Triple Nuclear Capacity (see above) had called for the World Bank's shareholders to include nuclear in their organization's energy lending policies.

The World Bank Group is a multilateral lending organization whose mission "is to end extreme poverty and boost shared prosperity on a liveable planet." The bank's largest shareholder is the USA at 17%. In 2024 the World Bank Group facilitated $117.5 billion "in loans, grants, equity investments and guarantees to partner countries and private businesses."

3.1.5 Financial organizations back global goal to triple nuclear capacity

In September 2024, during New York Climate Week, 14 financial institutions stated their recognition that global civil nuclear energy projects have an important role to play in the transition to a low-carbon economy. They further expressed support for long-term objectives of growing nuclear power generation and expanding the broader nuclear industry to support the energy transition. The institutions include: Abu Dhabi Commercial Bank, Ares Management, Bank of America, Barclays, BNP Paribas, Brookfield, Citi, Credit Agricole CIB, Goldman Sachs, Guggenheim Securities, Morgan Stanley, Rothschild & Co, Segra Capital Management, and Société Générale.

3.1.6 Major large energy users support tripling of nuclear capacity

In March 2025, on the sidelines of CERAWeek 2025 in Houston, 14 companies, including Amazon, Dow, Google and Meta,[e] signed the *Large Energy Users Pledge*,[30] supporting a goal of at least a tripling of global nuclear capacity by 2050.

The pledge noted that large energy users often depend on the availability of abundant energy and that "a resilient strategy for fostering economic growth should include an increase in the share of electricity provided by nuclear energy."

[e] *Allseas, Amazon, Bureau Veritas, Carbon3Energy, Clean Energy Buyers Association, Core Power, Dow, FEPC, Fly Green Alliance, Google, Lloyd's Reister, Meta, Oxy and OSGE. Siemens Energy issued a statement of support.*

3.2 Countries with operable nuclear reactors

Definitions of capacity categories in country assessments

The following assessments assign nuclear capacity to 2050 in each county for each of the following categories:

60-year operation

The capacity that would be delivered if all operable reactors as of 1 November 2025 operate for up to 60 years. This is assumed for all currently operable reactors except those scheduled to be shut down as part of a phase-out policy (*e.g.* Spain's nuclear reactors) or because of specific technical limitations (*e.g.* the UK's AGR reactors).

80-year operation

The additional capacity that would be delivered if those reactors that would exceed 60 years of operations before 2050 continue to operate for up to 80 years.

Under construction

The capacity that would be delivered by those reactors under construction as of 1 November 2025. Start-up dates are estimated based on latest announcements, where available, or World's Nuclear Association's assessment.

Planned

The capacity that would be delivered by those reactors that, on 1 November 2025, are categorized as planned, according to the World Nuclear Association definition of a reactor with approvals, funding or commitment in place, and mostly expected to be in operation within the next 15 years.

To estimate potential start-up dates, the first planned reactors are considered to become operable no earlier than 2035, with construction of all reactors to have been completed by 2040, in line with the definition's 15-year timeframe. Exceptions include those planned reactors that either already have construction start-up dates or grid-connected dates specified, or for countries with active build programmes, where the first reactors are estimated to start operation in 2030, consistent with construction starting in the coming months and 5–6-year build times being achieved, as is regularly the case in China.

Proposed

The capacity that would be delivered by reactors categorized as proposed by World Nuclear Association, as of 1 November 2025.

The proposed categorization represents those reactors for which there are specific programmes or site proposals, but the timing of construction and operation is very uncertain. For the purposes of this report, the first of these proposed reactors are assumed to start coming online from 2040, and for all proposed reactors to have entered operation by 2050. Exceptions apply if construction starts or grid-connection starts have been specified that indicate grid connection would take place ahead of 2040. Additionally, for countries with active build programmes, the first proposed reactors are estimated to be grid connected from 2036.

Potential

The 'Potential' categorization has not previously used by World Nuclear Association. This represents the capacity that would be delivered by reactors that have been announced, but where those announcements are not sufficiently advanced to be categorized as planned or proposed by World Nuclear Association. For example, the India country assessment includes as potential capacity the series of Bharat Small Reactors announced by its finance minister in the 2024 Budget speech.

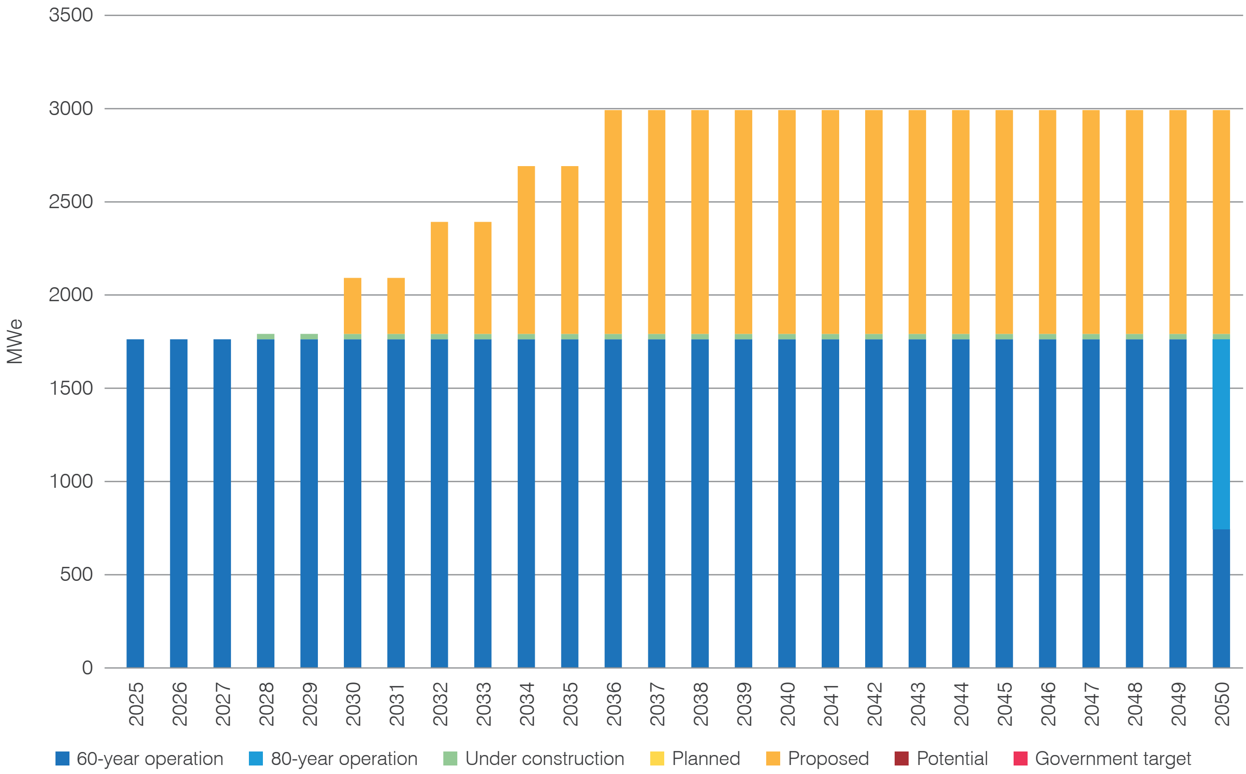
Government target

This represents the capacity that would be delivered if the targets for nuclear capacity in 2050 announced by governments are met. Where government targets are to be met before 2050 that target is assumed to still apply 2050 if no later target has been announced.

Where a government target sets an overall capacity target it is assumed that part of this target capacity will be met by those reactors that would have less than 60 years of operations by 2050, those reactors operating in 2050 if they have not yet reached 80 years of operation, and the additional capacity of those reactors defined, as of 1 November 2025, as under construction, planned, proposed or potential, unless the target has been specified as being additional.

3.2.1 Argentina

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
745	1018	29	0	1200	0	0	2992



Argentina has three operable reactors and one 29 MWe small modular reactor (SMR), called CAREM, under construction. The country has announced plans to construct at least one additional large reactor, although government officials have indicated that four 300 MWe SMRs may be built instead.

Argentina was the first South American country to use nuclear energy for electricity production. Its first reactor, Atucha 1 (originally 319 MWe, uprated to 340 MWe) was connected to the grid in 1974.

In 2009, a law was passed to promote the construction of a new nuclear plant with one or two units in addition to the construction of the CAREM unit, as well as the extension of the operating lifetime of Embalse beyond its design lifetime of about 32 years.[31,32]

Long-term operation

The 608 MWe Embalse reactor, a Candu 6 PHWR, underwent a three-year refurbishment project finishing in early 2019, to enable it to operate for a further 30 years. This Candu design is theoretically capable of achieving a second 30-year operating lifetime extension.

The two units at Atucha are both Siemens PHWRs, unique to Argentina. The first unit commenced operation in 1974. A 30-month refurbishment project, which is expected to allow the unit to operate for a further 20 years, commenced at the end of September 2024.

The larger unit 2 at Atucha (692 MWe) commenced operation in 2014 following a long construction period beset by delays.

New capacity

Large-scale reactors

Nucleoeléctrica Argentina (NA-SA) and China National Nuclear Corporation (CNNC) signed an engineering, procurement and construction (EPC) contract in 2022 for the development of a third large-scale unit at Atucha, with the planned unit to be an HPR1000 with a rated gross power of 1150 MWe. This proposal appears to have replaced earlier plans for the third large-scale unit at Atucha to be an additional Candu/PHWR. In turn, the planned HPR1000 may also have been superseded by the proposed construction of four 300 MWe SMRs at Atucha.

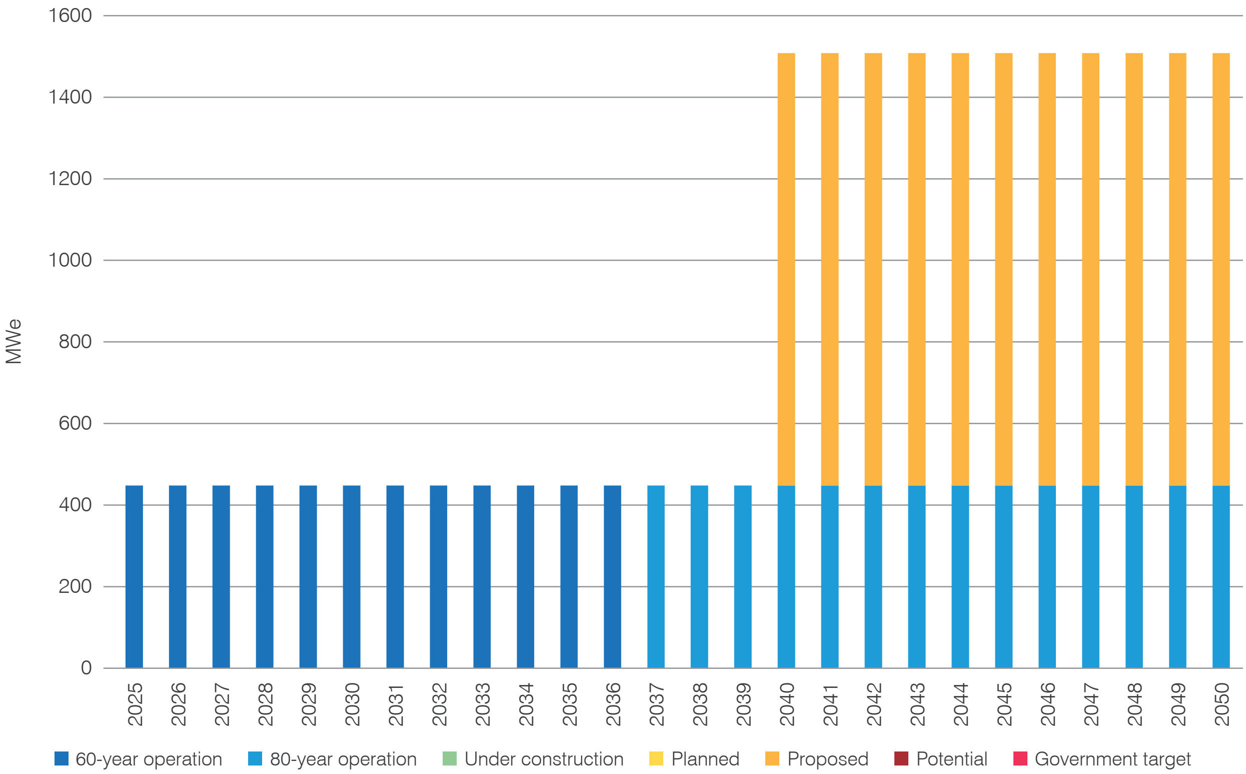
Small-scale reactors

A 29 MWe SMR named CAREM has been under construction at the Atuchu site since 2014, but construction has been suspended on several occasions. The National Atomic Energy Commission (CNEA) envisions that commercial deployment would involve a multi-reactor plant consisting of four scaled-up reactors of around 120 MWe each.[33]

In March 2025, the chairman of the council of advisors of President Javier Milei said that the country would install four ACR-300 small modular reactors, with a combined 1200 MWe capacity, at the Atucha site, with the aim to have the first unit in operation by 2030. The ACR-300 design has been developed by national technical project company Invap.

3.2.2 Armenia

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	448	0	0	1060	0	0	1508



Armenia has one operable reactor and plans for a new reactor. Two units were constructed at Metsamor and were connected to the grid in 1976 and 1980. Following an earthquake in 1988 both units were taken offline. Unit 2 was returned to service in 1995. This single operable reactor generates more than a quarter of the country's electricity.

In March 2023 the government approved a 10-year operating lifetime extension for Metsamor 2. The government stated that the several planned investments, along with the already implemented upgrades, could extend the operating lifetime of the reactor to 2036.[34]

Long-term operation

In 2021, Metsamor 2 was shut for a 140-day outage to allow for a further extension of its operating lifetime, including work to allow operation to 2026 and preparatory work for a further extension to 2036. The unit's power was upgraded from 376 MWe to 416 MWe. Additional work to support the extension of operation to 2036 took place during the unit's maintenance shutdown in 2025.[35]

New capacity

Large-scale reactors

Construction of a new nuclear plant has long been part of Armenia's overall plan, although finance has proved to be an obstacle.[36]

In May 2023 the country's prime minister said that negotiations were underway with "Russia, the USA and third countries" on the construction of a new nuclear plant.

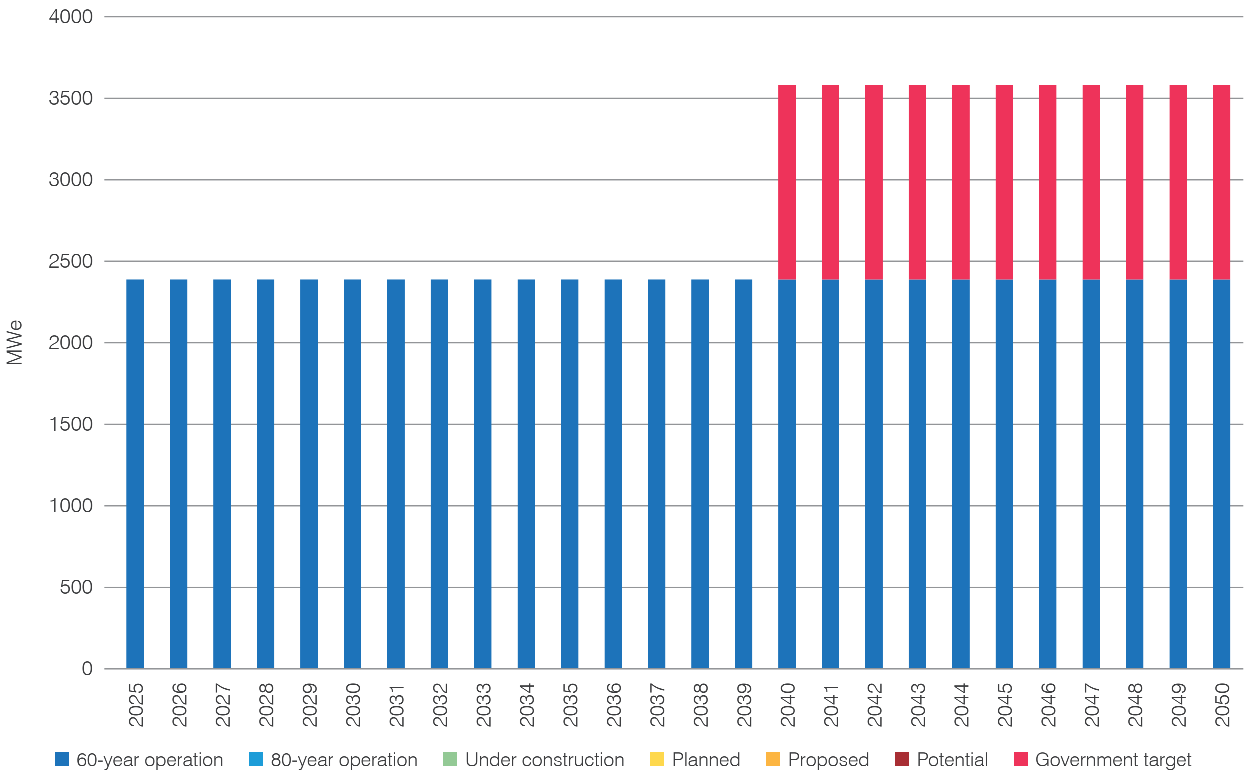
Small-scale reactors

In a January 2024 Armenian Security Council Secretary Armen Grigoryan was reported as stating that discussions with the US regarding SMRs have entered a "substantive phase". Later in 2024, the US State Department confirmed that it had received an application from Armenia to expedite the process.[37]

In October 2024 prime minister Pashinyan said the Armenian government had made "a strategic decision" to build a small modular reactor and was reviewing multiple potential vendors.

3.2.3 Belarus

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
2388	0	0	0	0	0	1194	3582



Belarus's first nuclear power plant, Ostrovets, provides about 40% of the country's electricity needs. The first unit entered into service in 2020, and the second unit in 2023.

Long-term operation

The two units at Ostrovets are expected to operate for a minimum of 60 years, to at least 2080.

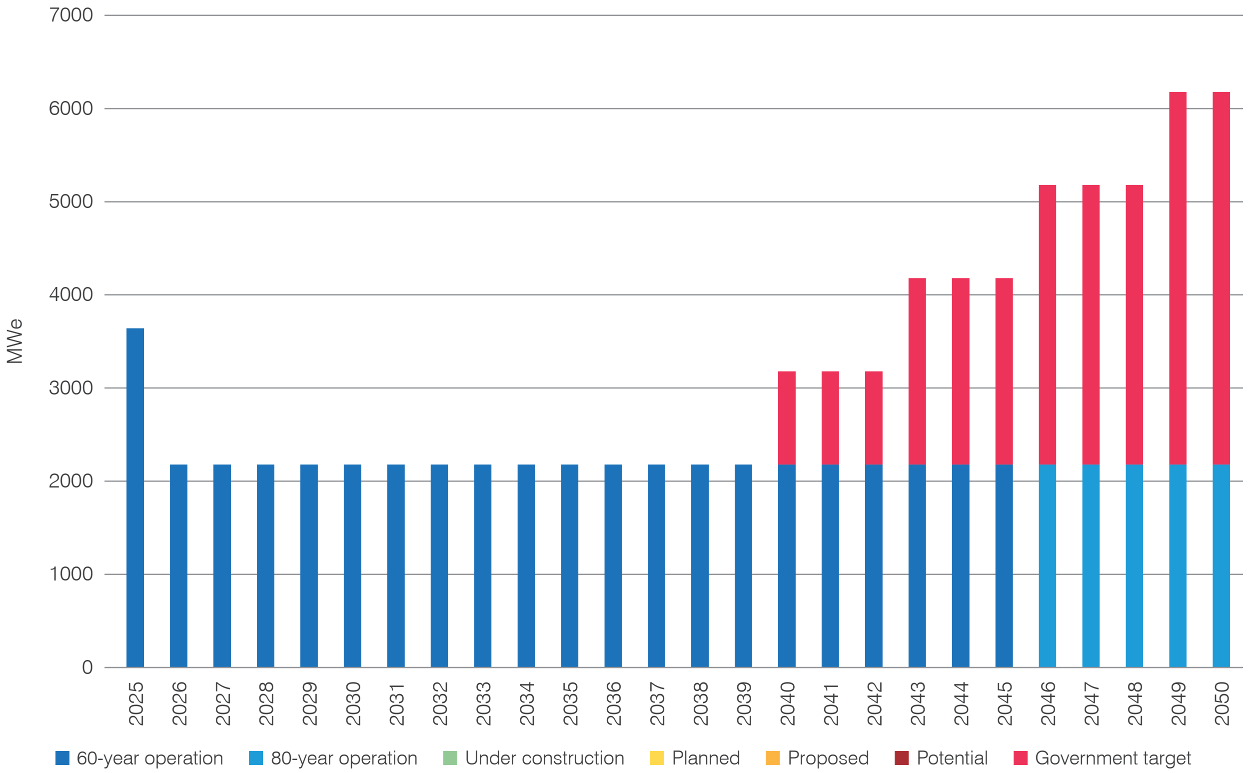
New capacity

Large-scale reactors

In December 2023, the country's energy minister said that Belarus was considering building a second nuclear power plant, or a third unit at Ostrovets.[38] In November 2024 Deputy Energy Minister Denis Moroz said that a report will be drawn up in 2025 on the options of a second nuclear power plant or a third unit at the existing plant.[39]

3.2.4 Belgium

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2179	0	0	0	0	4000	6179



Belgium has three operable nuclear reactors, two at Doel and one at Tihange. Until 2022, it was assumed that all reactors in Belgium would be shut down by 2025. Under a plan announced by Belgium's coalition government in December 2021, Doel 3 was shut down in September 2022, while Tihange 2 shut down at the end of January in 2023.

The newer Doel 4 and Tihange 3 had been planned to be shut down by 2025. However, in March 2022 Belgium delayed its plans to phase out nuclear energy by a decade, with Doel 4 and Tihange 3 operating to 2035, with the prime minster stating that it was to "strengthen our county's independence from fossil fuels in a turbulent geopolitical environment."[40]

In February 2025 the new coalition government announced plans to continue operating Doel 3 and Tihange 4 for an additional 10 years to 2045 – and said it aims to construct new reactors. Energy minister Mathieu Bihet said that in addition to maintaining the current 4 GWe of nuclear generating capacity, the government aimed to construct a further 4 GWe of new nuclear capacity.[41] However, Tihange 1 shut down in October 2025, and Doel 2 is expected to shut down before the end of 2025.[42]

Long-term operation

In December 2023 the government finalized a deal with Engie to implement a ten-year extension of Doel 4 and Tihange 3 beyond their 40-year design operating lifetimes.

The additional 10-year extension proposed by the 2025 coalition government would see those plants operate for 60 years.

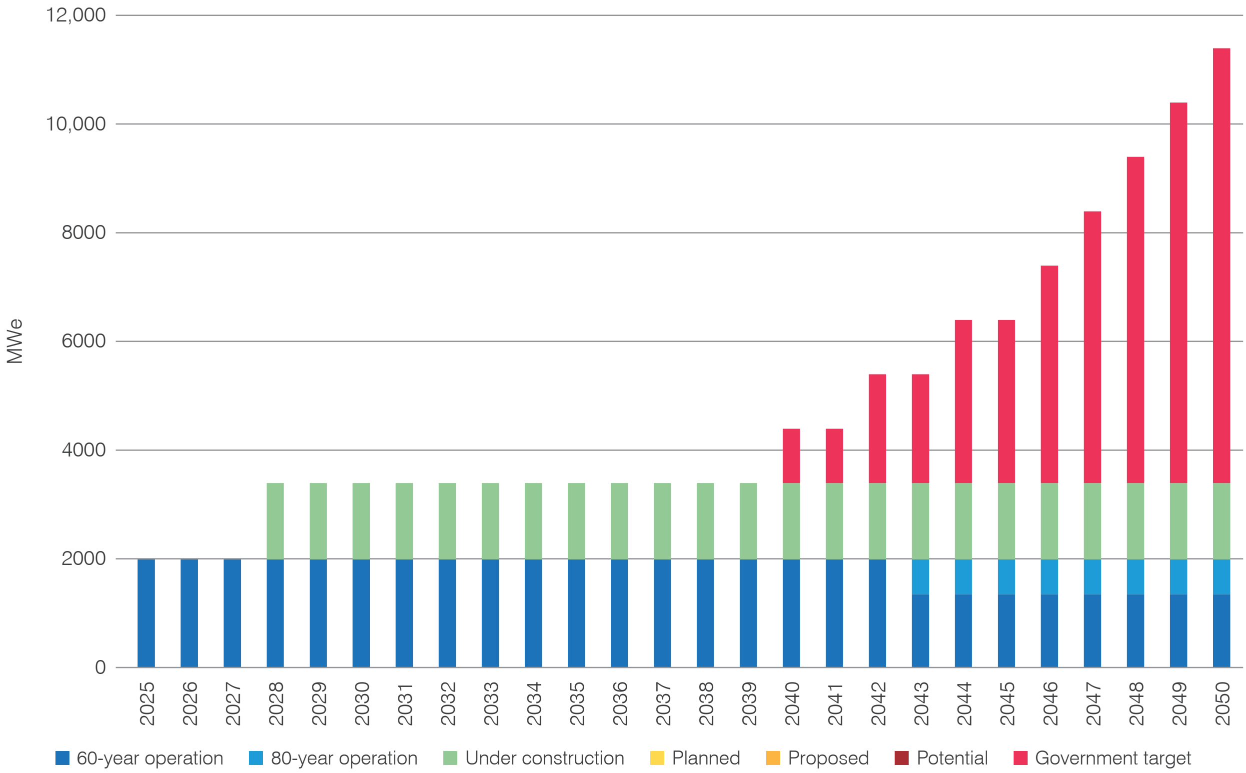
The Federal Agency for Nuclear Control (FANC) has called for clarity on a possible extension of the operation of Doel 4 and Tihange 3 after 2035.

New capacity

In his February 2025 statement, the country's energy minister said that SMRs would not provide sufficient capacity alone to meet the 4000 MWe goal, but which reactor technologies would be used was still to be evaluated.

3.2.5 Brazil

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1350	640	1405	0	0	0	8000	11,395



There are two operable reactors in Brazil, Angra 1&2. A third unit at Angra, with a net capacity of 1340 MWe, is under construction. Pre-construction work began in 1984, but the project has experienced several delays, and construction is currently not expected to be completed until at least 2029.

Long-term operation

Electronuclear applied in 2019 to extend the operating lifetime of Angra 1 from 40 to 60 years. The unit commenced operation in 1982.[43]

New capacity

Large-scale reactors

Brazil's National Energy Plan to 2050, published in 2020, included an aim to add 8-10 GWe of nuclear capacity by 2050. The plan concluded that large PWR reactors would be used for new plant projects that are instigated in the 2020s. After 2030, new projects may be based on large PWRs, SMRs and/or fourth generation reactor technologies, "if the latter reach technological maturity and competitiveness."[44]

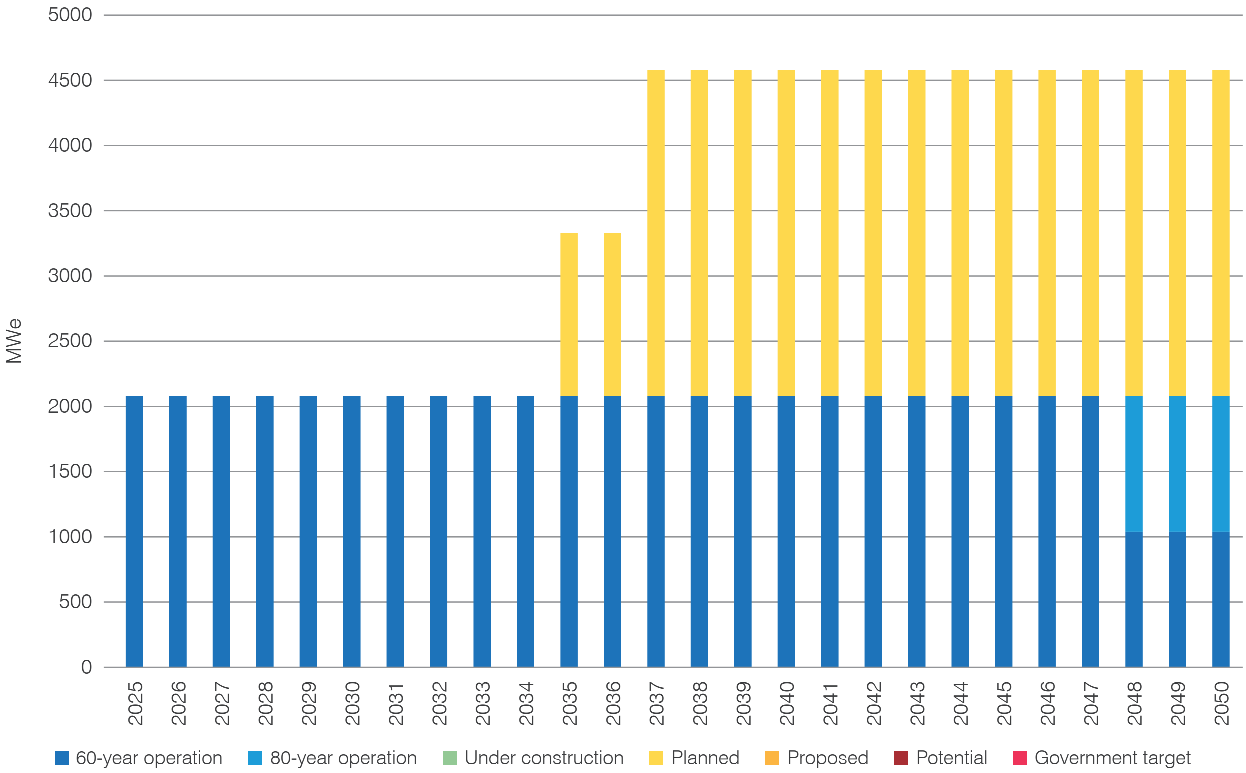
Small-scale reactors

In May 2025 Brazil's Minister of Mines and Energy said that he expected the development of a small modular reactor project with Russia in the near future.[45]

In June 2025 Indústrias Nucleares do Brasil signed a contract with the Ministry of Science, Technology and Innovation and the Financing Agency for Studies and Projects for the development and testing of critical technologies applicable to a planned microreactor. The National Nuclear Energy Commission (CNEN) project aims to demonstrate the feasibility of the development of a Brazilian 3-5 MWe microreactor that would fit within a 40-foot container and be operated remotely for more than 10 years without refuelling.[46]

3.2.6 Bulgaria

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1040	2080	0	2500	0	0	0	4580



Bulgaria has two VVER-1000 reactors currently in operation, Kozloduy 5&6, with a combined net capacity of 2006 MWe. Together, the two units generate around one-third of Bulgaria's electricity.

Since the 1980s additional units have been under consideration, at Kozloduy and at Belene. In January 2023, the then energy minister set out an energy strategy which includes plans for two new reactors at Kozloduy and two at Belene.[47]

In April 2024 the recently-appointed energy minister under a caretaker administration stated that construction of two new units at Kozloduy was among the key priorities in the work of the government, stating that "It is of strategic importance both for Bulgaria's and the region's energy security and for achieving the decarbonization goals".[48] Plans for construction at Belene were cancelled.

Long-term operation

The two VVER-1000 units at Kozloduy began operating in 1987 and 1991. A programme of work was carried out between 2014 and 2019 to allow for 60 years of operation, and to uprate both reactors to 104% of their original capacity, through installation of new stators and upgrades to the turbine generators. This should see operation continue to 2047 and 2051 respectively. The operating licences have initially been extended by ten years, to 2027 and 2029.

New capacity

Large-scale reactors

Discussions with various parties have been ongoing regarding the construction of new units at Kozloduy since the early 2010s[49], with Westinghouse, GE and Russian VVER-1000 units under consideration.

In 2021 the Bulgarian government approved plans for a new unit at Kozloduy, and in 2023 the Bulgarian National Assembly voted in favour of asking ministers to negotiate with the US government for a new AP1000 unit as Kozloduy 7, and to initiate a licensing and environmental impact assessment for a further unit. The government set a target date of 2033 for completion of unit 7, with unit 8 to follow two-to-three years later.

In February 2024 the Bulgarian parliament gave the go-ahead for talks to take place with Hyundai E&C, as the sole shortlisted constructor for engineering, construction, delivery and commissioning of the new units at Kozloduy, and in March 2024 the Bulgarian parliament ratified an agreement with the USA on coordination regarding construction of Westinghouse AP1000s as Kozloduy 7&8. In July 2025 Bulgaria's Ministry of Energy and the USA's Citi agreed a partnership to secure funding for the construction of the two AP1000 units.[50]

Small-scale reactors

In November 2021 Bulgarian Energy Holding (BEH) signed a memorandum of understanding with US engineering firm Fluor to look at the possibility of replacing coal-fired plants with NuScale small nuclear reactors (SMRs).

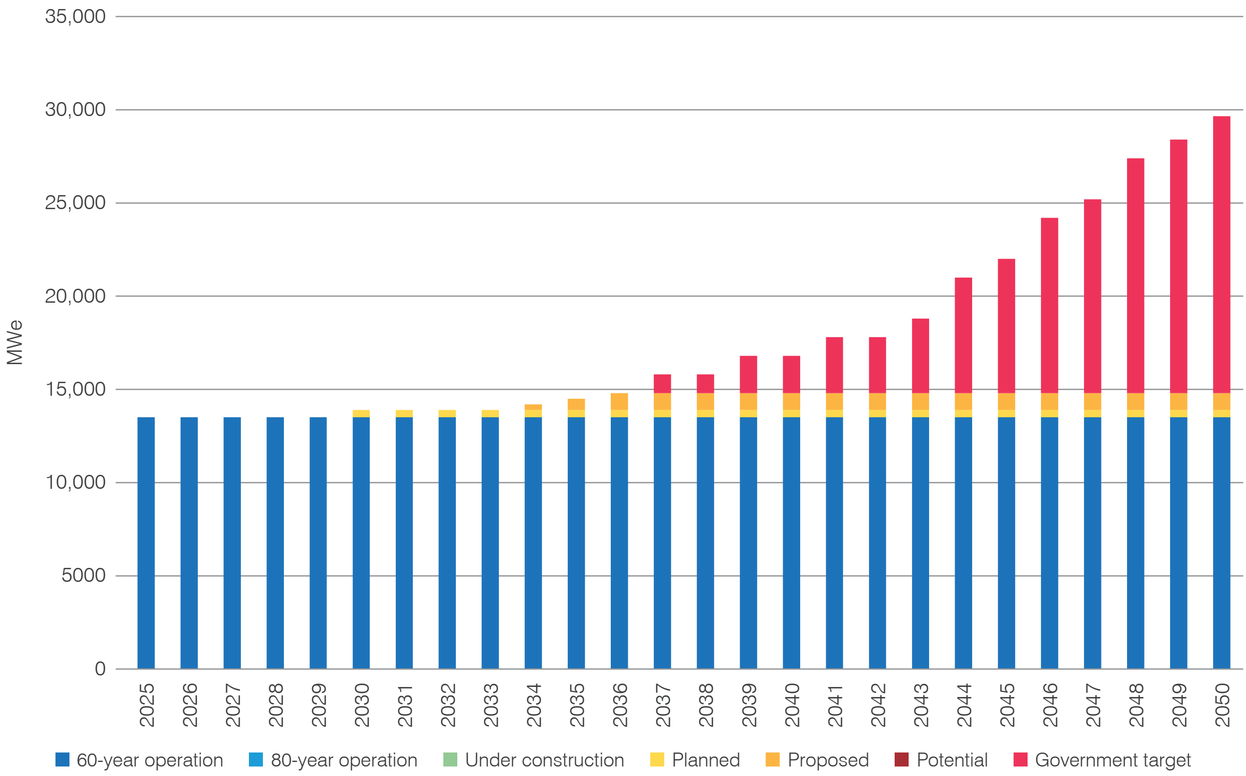
Another memorandum of understanding was signed in February 2021 between NuScale and the Kozloduy nuclear power plant. The two sides said they would work on numerous studies on building SMRs within the existing Kozloduy nuclear power plant.[51,52]

More recently, a separate grant agreement was signed by the US Trade and Development Agency with state-owned Bulgaria Energy Holding (BEH) for a detailed technical analysis of US-sourced small modular reactor (SMR) design options to support Bulgaria's planned deployment of one or more SMR nuclear plants.[53]

In February 2024 Bulgaria and France signed a declaration of intent on analysing potential projects to build large reactors and SMR technologies in Bulgaria.[54]

3.2.7 Canada

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
13,500	0	0	400	900	0	17,800 (requiring an additional 14,896)	31,400



Under the Canadian constitution, electricity generation, transmission, and distribution falls primarily under the jurisdiction of the provinces.[55] Two provinces currently use nuclear power, with 17 reactors with a total capacity of 12.7 GWe operating over three sites in Ontario and one reactor in Point Lepreau in New Brunswick.

In February 2023 the Canadian government launched the ‘Enabling Small Modular Reactors Program’, providing C$29.6 million (about $22 million) in support for the development and deployment of SMRs. Under the programme, applicants can request up to C$5 million for R&D projects, with the programme providing up to 75% of the total project costs, or up to 100% for projects led by Indigenous applicants.

In May 2024, the provincial governments of Alberta and Saskatchewan signed a memorandum of understanding to advance the development of nuclear power generation by 2050.[56]

In June 2025, the Ontario government released its Energy for Generations energy roadmap, which noted that, according to the Independent Electricity System Operator, the province could need up to 17.8 GWe of new nuclear generation to meet rising demand in a high electrification scenario.[57] Achieving the capacity target in this scenario would require building at minimum the equivalent of eight large nuclear units or 8000 MWe (in addition to the four units already planned at Bruce C) and potential operating lifetime extension of Bruce 1&2.

In January 2024 Canada became the first country to include nuclear power finance in green bonds. The government's green bond financing programme – which previously excluded nuclear energy from obtaining financial support – was revised to explicitly permit "the deployment of nuclear energy to generate electricity and/or heat."[58]

Long-term operation

Extensive refurbishment programmes are being carried out to extend the operation of reactors at all four sites (Bruce, Darlington and Pickering in Ontario, and Point Lepreau in New Brunswick).

Refurbishment at the Bruce plant began in 2020 for unit 6. Upon completion, the plant is expected to remain in operation until approximately 2064.[59]

At Darlington the programme to refurbish all four units began in 2016. Refurbishment of units 1-3 has been completed, with refurbishment of unit 4 scheduled to be completed by 2026. The work should extend operation by up to 30 years and involves replacing fuel channels, upgrading ancillary systems and the turbine generators.[60]

Pickering 1&4 were permanently shut down in 2024. Refurbishment of units 5-8 is expected to be completed by the mid-2030s.[61]

Point Lepreau was the first Candu-6 reactor to undergo refurbishment, starting in 2008. The licence for Point Lepreau was renewed in 2022 for an additional 10 years and the unit is expected to continue to run for several decades, with a possible second refurbishment in the early 2040s.[62]

New capacity

Large-scale reactors

In February 2024 the Ontario government committed to providing C$50 million ($37 million) of funding to support pre-development work to study the feasibility of building up to 4800 MWe of new generating capacity at the Bruce site.[63]

Electricity demand from data centres has also raised interest in the Peace River Nuclear Power Project in Alberta that would consist of four Candu Monark reactors capable of supplying up to 4800 MWe.[64]

Small-scale reactors

The Canadian Nuclear Safety Commission (CNSC) has had a pre-licensing vendor design review process since 2018 – for about ten small reactors with a wide range of capacities up to 300 MWe.

In addition, the CNSC and the US Nuclear Regulatory Commission (NRC) have had agreements since 2017 to cooperate in reviewing advanced reactor and small modular reactor technologies.

As part of a memorandum of cooperation between the CNSC and NRC from 2019 the two regulators carried out a joint review of Terrestrial Energy's postulated initiating events analysis and methodology for the Integral Molten Salt Reactor (IMSR). In 2022 the two regulators agreed to cooperate on regulatory and safety issues in the licensing review of the BWRX-300 design.

A March 2022 report prepared by the governments of Ontario, Saskatchewan, New Brunswick and Alberta, A Strategic Plan for the Deployment of Small Modular Reactors[65], proposed a three-stream approach to SMR deployment:

- A grid-scale SMR project of 300 MWe constructed at the Darlington nuclear site in Ontario by 2028. Subsequent units in Saskatchewan would follow, with the first SMR projected to be in service in 2034.
- Two advanced SMRs that would be developed in New Brunswick. ARC Clean Energy was targeting operation at the Point Lepreau nuclear site by 2029, and Moltex Energy would have both its spent fuel recovery system and reactor in operation by the early 2030s, also at the Point Lepreau site.
- A new class of microreactors designed primarily to replace the use of diesel generators in remote communities and mines. A 5 MWe gas-cooled demonstration project is under way at Chalk River, Ontario.

According to ARC it has "completed phase one of the vendor design review with the Canadian Nuclear Safety Commission (CNSC) and is nearing completion of phase two which will be followed by full licensing of the first ARC-100, targeted in the early 2030s."[66]

In August 2024 all environmental assessment and licensing activities for the 5 MWe Chalk River demonstration project were put on hold.[67]

Ontario

In December 2021, OPG announced the selection of GE Hitachi's BWRX-300 for the Darlington SMR project. In July 2023 the Ontario government announced it was working with OPG to begin planning and licensing for three additional

BWRX-300 reactors, for a total of four, at the Darlington plant site.[68] The Canadian Nuclear Safety Commission issued a construction licence for the first BWRX-300 at the Darlington SMR project in April 2025. In July 2025 EDF subsidiary Arabelle Solutions announced it would supply turbine island equipment for the unit. The first of the four planned units is expected to start up by 2030.[69]

New Brunswick

New Brunswick's government has committed to having 600 MWe of new nuclear generation as part of plans to achieve net-zero emissions in its electricity sector by 2035.[70] The province's first SMR is planned to be in operation by 2030 at Point Lepreau.[71] The provincial government is partnering with ARC Clean Energy Canada, which is developing the ARC-100, a 100 MWe advanced sodium-cooled fast reactor.[72,73]

In May 2024 a collaboration agreement was signed between Korea Hydro & Nuclear Power, ARC Clean Technology and New Brunswick Power with the goal of establishing teaming agreements for global small modular reactor fleet deployment.[74]

Saskatchewan

Saskatchewan does not have nuclear power reactors, and around three-quarters of electricity is generated from fossil fuels. Government-owned SaskPower has selected the BWRX-300 for potential deployment, and intends to make a commercial decision by 2029 on whether to build an SMR, for deployment in the mid-2030s.[75]

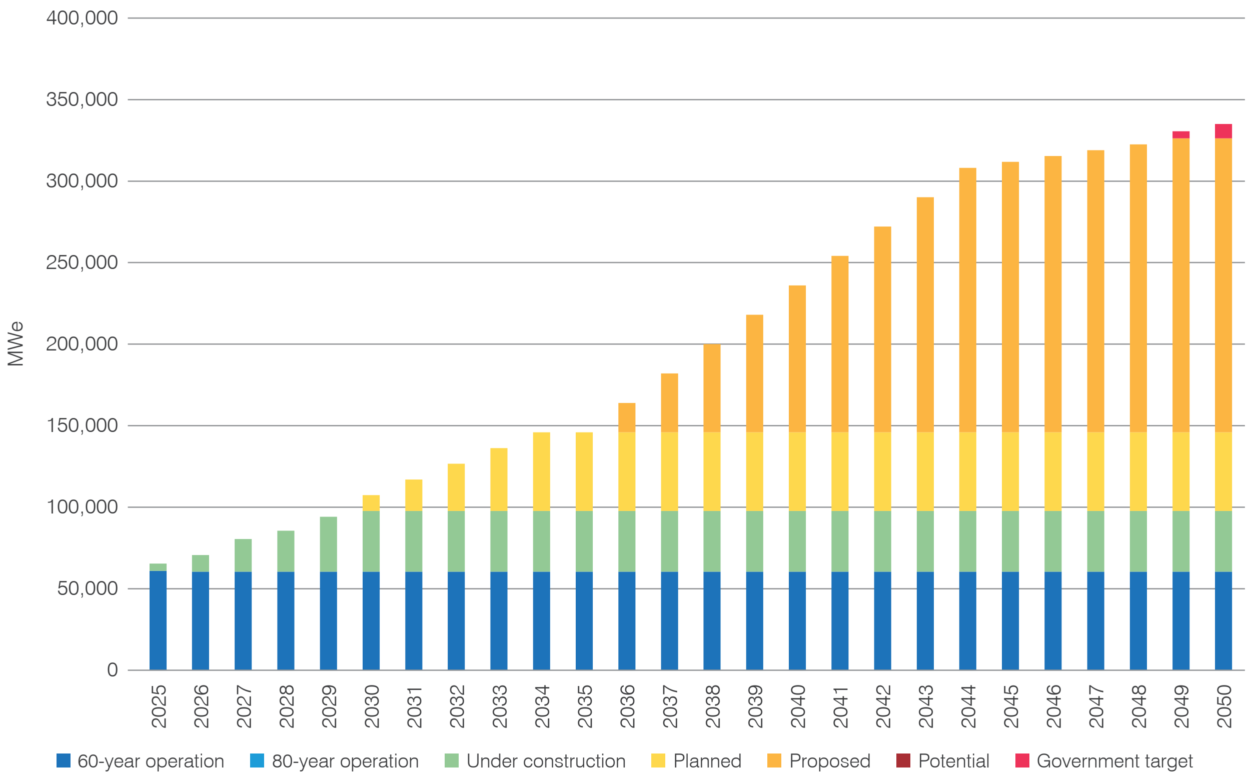
Alberta

For Alberta, SMRs could help reduce emissions from large industrial facilities, which are the largest source of emissions in the province. In July 2025 Premier Danielle Smith announced public consultations on integrating nuclear power into Alberta's energy mix.[76] Small modular reactors could power remote, energy-intensive sites like oil sands operations.

A partnership between OPG and Capital Power, an Alberta-based wholesale power generator, is exploring the regulatory and permitting processes needed to deploy an SMR in Alberta. Capital Power President CEO, Avik Dey, said that the company is looking at deploying a 300 MWe SMR for baseload generation around 2035.[77]

3.2.8 China

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
60,416	0	38,515	48,256	180,250	0	335,000 (requiring additional 7563)	335,000



China has 58 operable reactors, totalling 60 GWe of gross nuclear capacity. There are 33 reactors under construction in China, with a total capacity of 35 GWe[78].

China's 14th Five-Year Plan (2021-2025) stated that China would "actively develop nuclear power in a safe and orderly manner"[79]. With 60 GWe of operable capacity and no more than 4 GWe of reactors under construction scheduled to start up before the end of 2025, actual capacity will fall short of this target.

With the new medium- and long-term development plan for nuclear energy still under development, China Nuclear Energy Association anticipated China's nuclear capacity to reach 110 GWe by 2030 and 150 GWe by 2035[80]. Another study by China Nuclear Power Development Centre, a research institute under the National Energy Administration, said that China's nuclear capacity could reach 335 GWe in 2050[81].

Funds for nuclear power projects are mainly raised by the group companies that control nuclear power projects. Those four group companies, namely CNNC, CGN, SPIC and Huaneng, are all state-owned very large enterprises.[82] The group companies seek finance in multiple ways including bond, equity and leasing, but in general the main finance approach is still national equity capital investment.[83]

While only the four state-owned enterprises mentioned above are licensed to control and operate nuclear power projects, other large state-owned power utility companies in China, including Huadian, Datang and CHN Energy, are also participating in the development of nuclear power by taking minority stakes and providing financing support.

New capacity

Large-scale reactors

Between 2019 and 2024, approval was given for the construction of 46 new reactors in China. In April 2025 China's State Council approved construction of a further ten new reactors at Fangchenggang Phase III, Haiyang Phase III, Sanmen Phase III, Taishan Phase II and Xiapu Phase I.[84]

Small-scale reactors

Development of small modular reactor (SMR) technology and demonstration projects is listed as a key action in China's 14th Five-Year Plan[85] and the National Development and Reform Commission's *Action Plan for Carbon Dioxide Peaking*

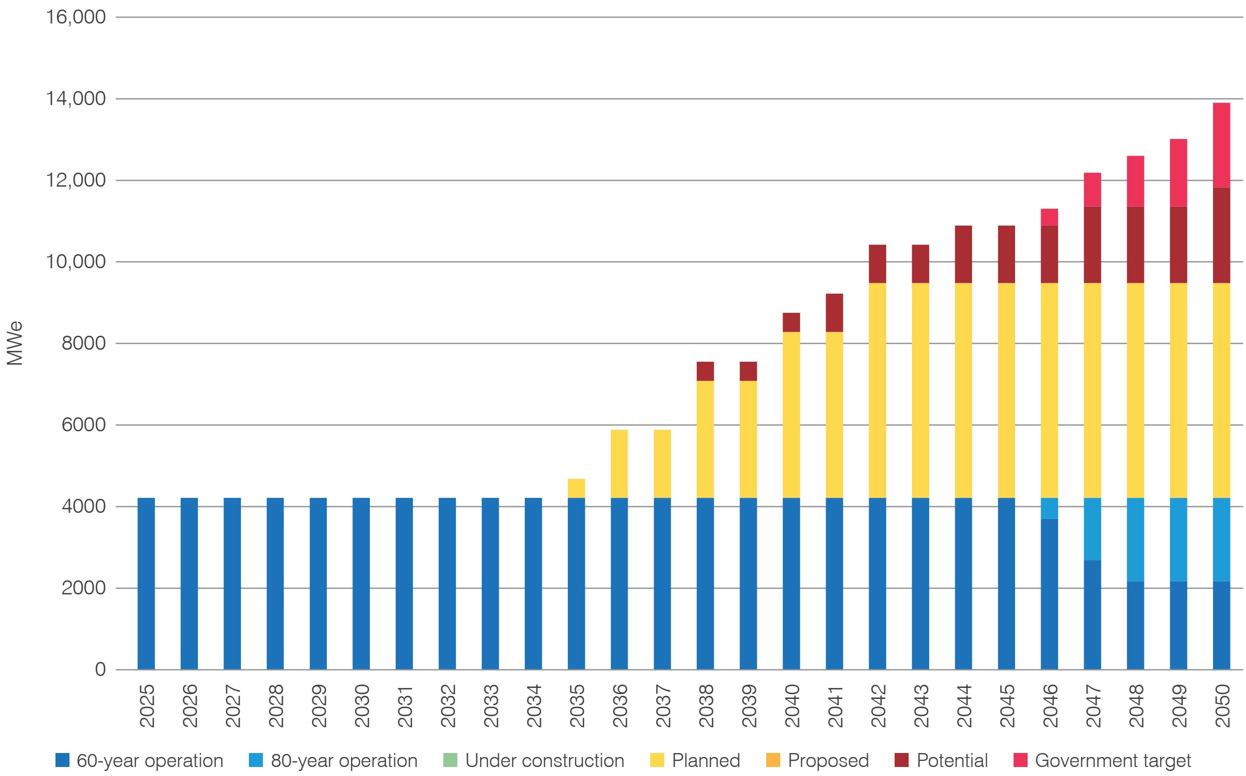
Before 2030, published in 2021[86]. There are a variety of SMR technologies being developed, including the ACPR50S floating nuclear plant, the ACP100, and the High Temperature Gas-Cooled Reactor – Pebble-bed Module (HTR-PM).[87]

A demonstration project for the ACP100 started construction in 2021 in Changjiang, Hainan province. The unit is planned to commence operation in 2026[88].

The 210 MWe HTR-PM demonstration project at Shidaowan, owned by Huaneng, entered commercial operation in December 2023.[89]

3.2.9 Czech Republic

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
2172	2040	0	5270	0	2350	13,900 (requiring additional 2068)	13,900



A 2011 draft national energy policy to 2060 involved a major increase in nuclear power, to 13.9 GWe or – in the case of major adoption of electric vehicles – up to 18.9 GWe. The version adopted in November 2012 assumed at least 50% of the country's power would be provided by nuclear, with two new reactors being built at Temelin and one at Dukovany.

The 2015 national energy policy reiterated most of the plans outlined in 2012, with one new reactor at Dukovany and two at Temelin, but without any state guarantee on electricity prices. In the plan new nuclear capacity of 2500 MWe was to be added by 2035, and more thereafter, making nuclear the main source of electricity production with its share rising from 35% to between 46% and 58% in 2040.

In a speech in December 2019 the Czech prime minister stated that construction on the country's next unit – at Dukovany – was now expected to begin in 2029, with the reactor in operation by 2036, bringing nuclear's share of electricity to 40% by 2040.[90]

Long-term operation

At the beginning of 2009, CEZ commenced its long-term operation (LTO) project, the immediate focus of which was to extend the planned operating lifetimes of the four Dukovany reactors by 10 years. In March 2016 unit 1 was licensed for continued operation indefinitely subject to ongoing reporting, followed by units 2-4 in 2017.

In June 2020 CEZ stated that it expects to invest about $2.3 billion over the next 27 years to extend the operating lifetimes of the four reactors at Dukovany by a further 20 years to a total of 60, which would see the last unit retire in 2047.

New capacity

Large-scale reactors

In mid-2016 CEZ asked the Ministry of the Environment to begin the environmental impact assessment process for two new units at Dukovany. Application for a construction permit is envisaged in 2028. The government's *National Action Plan for the Development of the Nuclear Energy Sector in the Czech Republic* adopted in June 2015 said that Dukovany 5 has priority over Temelin in order to maintain production at the site after the old reactors are retired about 2047.

In March 2020 CEZ announced that it had submitted a licence application for two new PWRs up to 1200 MWe each at Dukovany.

In April 2024, the European Commission (EC) approved a state aid mechanism enabling the funding of the construction and operation of the fifth unit at Dukovany. As part of this mechanism the power plant's owner, ČEZ (which is 70% government-owned), is to receive a loan from the state of up to around €7.74 billion for the construction of the new unit.

The French and South Korean bidders, plus Westinghouse, had submitted binding bids in October 2024 for the new unit at Dukovany and non-binding offers for up to three more units – a sixth at Dukovany and two at Temelin. However, in February 2024, the Czech government announced it was changing the tender to be binding offers for four new units, with Westinghouse's bid ruled out. The Czech government selected KHNP as its preferred bidder in July 2024 for two APR1000 units at Dukovany. According to KHNP they would be eligible to sign additional contracts for the two Dukovany units if the Czech government decides within the next three years to proceed with Temelin units 3&4[91].

In April 2025[92] the Czech Minister for Industry and Trade said a contract between CEZ and reactor vendor Korea Hydro and Nuclear Power for the construction of two reactors at CEZ's Dukovany plant site has been finalized.

In August 2025 a ceremony was held at Dukovany to mark start of a detailed site survey in preparation for the construction of two Korean-supplied APR1000s there.

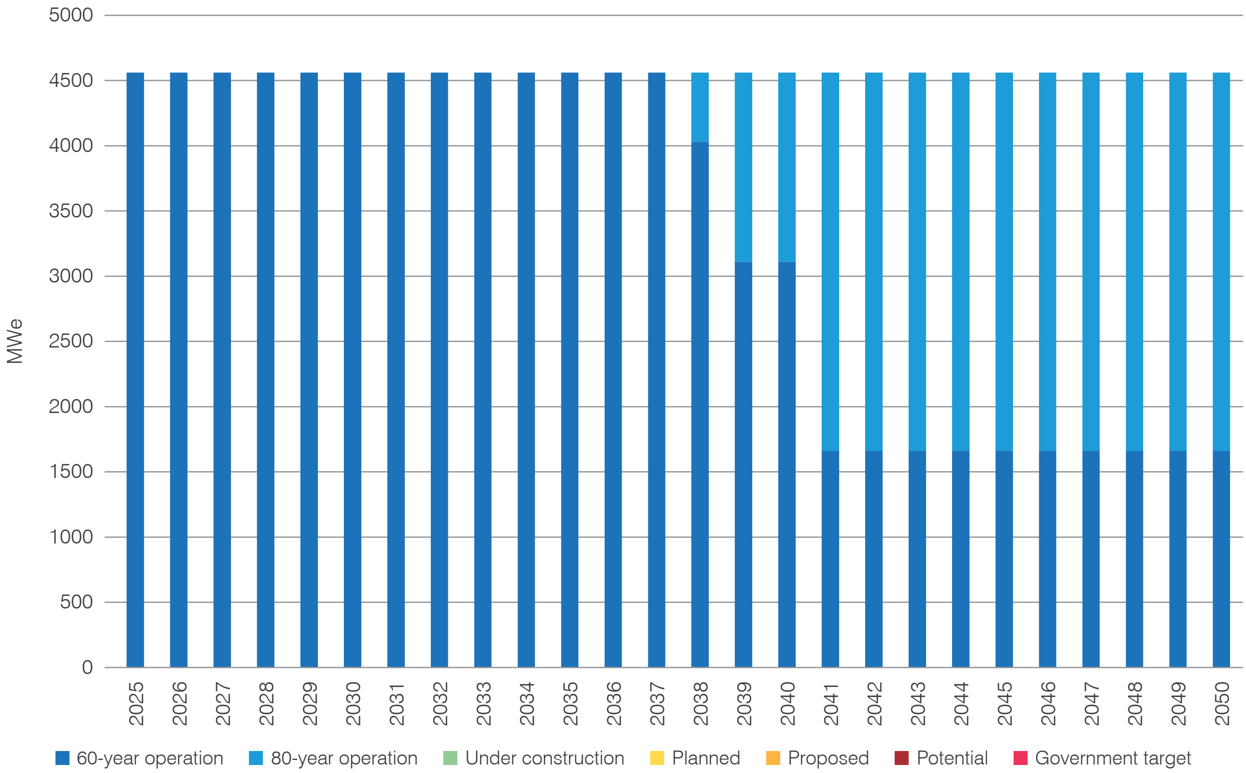
Small-scale reactors

Under a strategic partnership agreed in October 2024, CEZ and the UK's Rolls-Royce SMR would cooperate on developing and building Rolls-Royce SMR's 470 MWe units in the Czech Republic, UK and internationally. Under the agreement, CEZ would acquire a 20% stake in Rolls-Royce SMR.

The first unit is planned to be completed at Temelin by 2035. A further five units would be built in the Czech Republic by 2050.

3.2.10 Finland

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1660	2902	0	0	0	0	0	4562



Finland has five operable nuclear reactors, three at Olkiluoto and two at Loviisa.

In June 2019, the Finnish government announced a new energy policy with the objective of achieving carbon neutrality by 2035. The policy would see the phase-out of coal power by 2029. It also proposed the commissioning of two nuclear power reactors, and was supportive of operating lifetime extensions for existing reactors.[93] However, since this policy was put in place plans for two new reactors, Hanhikivi 1 and Olkiluoto 4, have been cancelled.

Long-term operation

TVO's Olkiluoto 1&2 started up in 1978-80 with a net capacity each of 660 MWe. The units have since been uprated to 880 MWe each and their current planned operating lifetime is 60 years. TVO now proposes progressively to uprate them further to 1000 MWe each. In October 2023 TVO commenced an environmental impact assessment to investigate the possibility of further extending the planned operating lifetimes beyond 60 years by at least 10 years.

Continuation of energy production at the two units at Loviisa is planned until the end of 2050 at the latest, which would require operating lifetimes over 70 years.[94]

New capacity

Large-scale reactors

Plans were advanced for the construction of a Russian VVER-1200 unit at Hanhikivi. However, in May 2022 Fennovoima terminated its contract with Rosatom.

Small-scale reactors

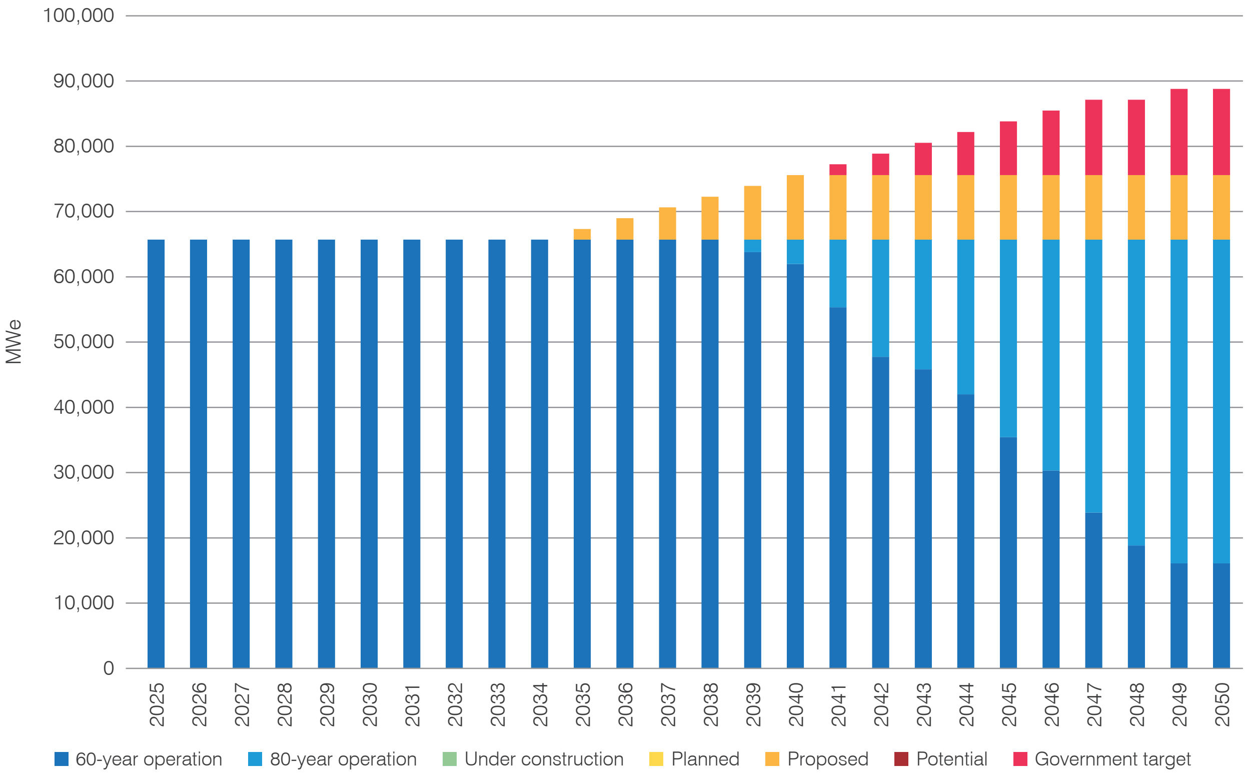
TVO Nuclear Services and the Finnish company Steady Energy have signed an agreement to develop a small modular reactor design for district heating, without electricity generation. The 50 MWt LDR-50 reactor is intended to be online for district heating in Finland by 2030. Construction of a non-nuclear pilot facility at a coal power station in central Helsinki is scheduled to start in late 2025.[95] Construction. The pilot plant will serve as a full-scale, operational model of the LDR-50 reactor design and will use an electric element to produce heat instead of nuclear fuel.

Fortum’s two-year nuclear feasibility study launched in November 2022 is examining the prerequisites for nuclear new build in Finland and Sweden, with both SMRs and conventional large reactors being considered.[96]

In July 2025 GE Vernova Hitachi Nuclear Energy and Fortum signed an agreement on pre-licensing and engineering activities for site adaptation in Finland and Sweden aiming for deployment of BWRX-300 small modular reactors in the 2030s. Similar agreements were signed with EDF and Westinghouse in partnership with Hyundai Engineering & Construction a month earlier.[97]

3.2.11 France

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
16,106	49,584	0	0	9900		13,200	88,790



Long-term operation

French reactors were originally licensed to 30 years, with ten-year reviews to allow their continued operation.

In February 2021, France's nuclear safety regulator set the conditions for the continued operation of EDF's 900 MWe reactors beyond 40 years. In August 2023 the national nuclear regulatory authority approved the extended operation of Tricastin 1, making it the first reactor in the French fleet that can operate beyond 40 years.[98]

In July 2010 EDF said that it was assessing the prospect of 60-year operating lifetimes for all its reactors. This would involve replacement of all steam generators (three in each 900 MWe reactor, four in each 1300 MWe unit) and other refurbishment.

In February 2023 President Macron's office said the feasibility of extending the operating lifetimes of its nuclear reactors beyond 60 years would be explored.

In July 2025 the French Nuclear Safety and Radiation Protection Authority decided that EDF's 1300 MWe reactors could operate beyond 40 years if "necessary upgrades" are carried out.[99]

New capacity

Large-scale reactors

In February 2022 President Macron announced plans to build six new reactors by 2050 as part of the country's National Low Carbon Strategy (*Stratégie Nationale Bas-Carbone*, SNBC), with the first reactor planned to be operational by 2035. A study would also be launched into the possibility of eight additional reactors, supported by the deployment of SMRs. In November 2022 the French Council of Ministers approved draft legislation intended to streamline the bureaucratic processes needed to build the new nuclear reactors near, or within, existing sites.

EDF has proposed building three pairs of EPR2 reactors at Penly, Gravelines and Bugey. Technical studies at a fourth site, Tricastin, will continue with a view to hosting future reactors there and EDF said in February 2023 that it also plans to explore the potential of building new reactors at its Blayais site. Preparatory work was authorized to start at Penly in 2024, with first concrete planned in 2027.[100]

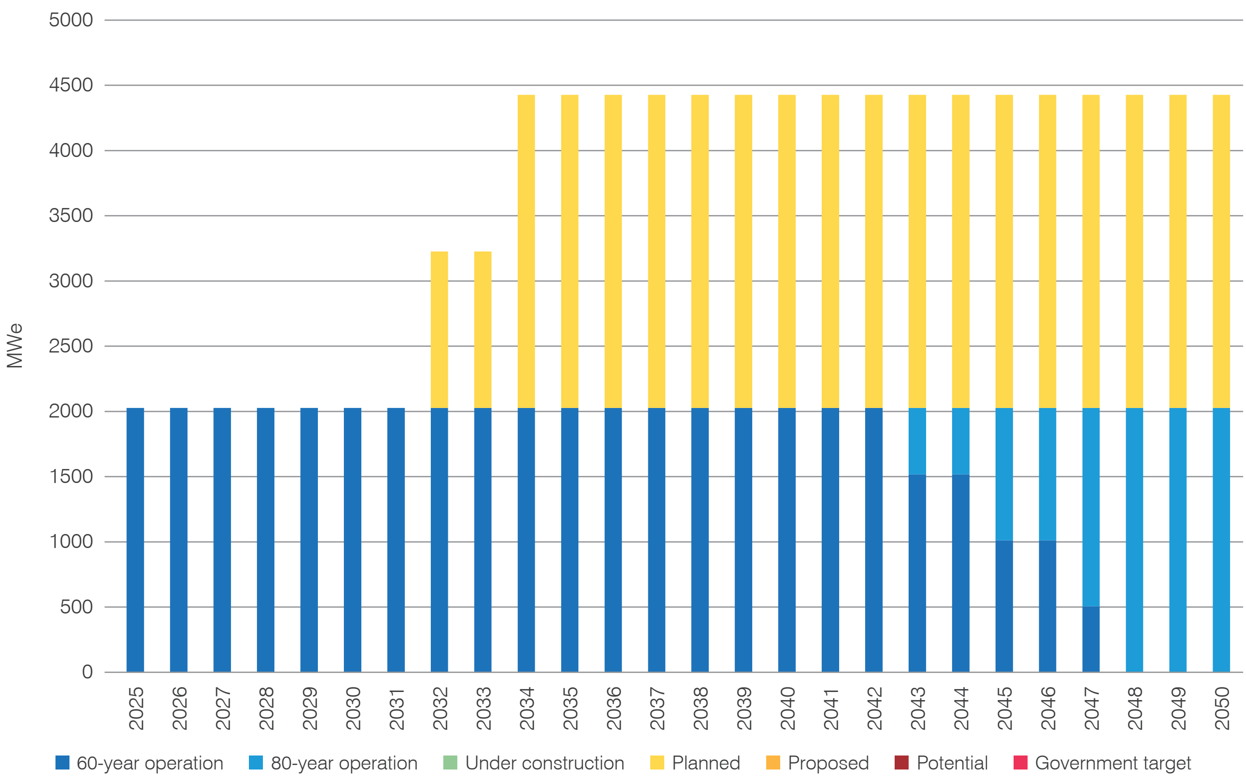
Small-scale reactors

TechnicAtome, Naval Group, EDF and CEA in France have developed the Nuward NP-300 PWR design, with applications for power, heat and desalination. The 340 MWe plant would consist of two 570 MWt/170 MWe reactors. First concrete for a demonstration unit was expected in 2030.[101]

However, in However, in July 2024, EDF said that in response to feedback from potential European customers it planned to optimise the Nuward design, focusing on existing and proven technologies, with the aim to finalise the conceptual design of the reactor by mid-2026 and "market a product for the 2030s."[102]

3.2.12 Hungary

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2027	0	2400	0	0	0	4427



Hungary plans for 60-70% of electricity to be supplied by nuclear power by the beginning of the 2030s.[103]

New capacity

Large-scale reactors

An agreement was signed between the Hungarian government and Russia's Rosatom in 2014 to build two new reactors at Paks. In August 2022 the Hungarian Atomic Energy Authority issued the construction licence for the two VVER-1200 units at Paks II.

In January 2023 the energy minister announced a two-year delay to the construction of Paks II, pushing the completion date to 2032. First concrete is expected in 2025.[104]

In September 2025 the European Court of Justice backed Austria's appeal against Hungary's state aid for the construction of the Paks II nuclear power plant and said the European Commission "should have ascertained" whether the direct award of a contract "complies with EU public procurement rules". Hungary's Foreign Minister responded that the court's decision "does not limit or slow down the progress of the investment in any way."[105]

The Hungarian authorities are also looking into building further units beyond the Paks II project.[106]

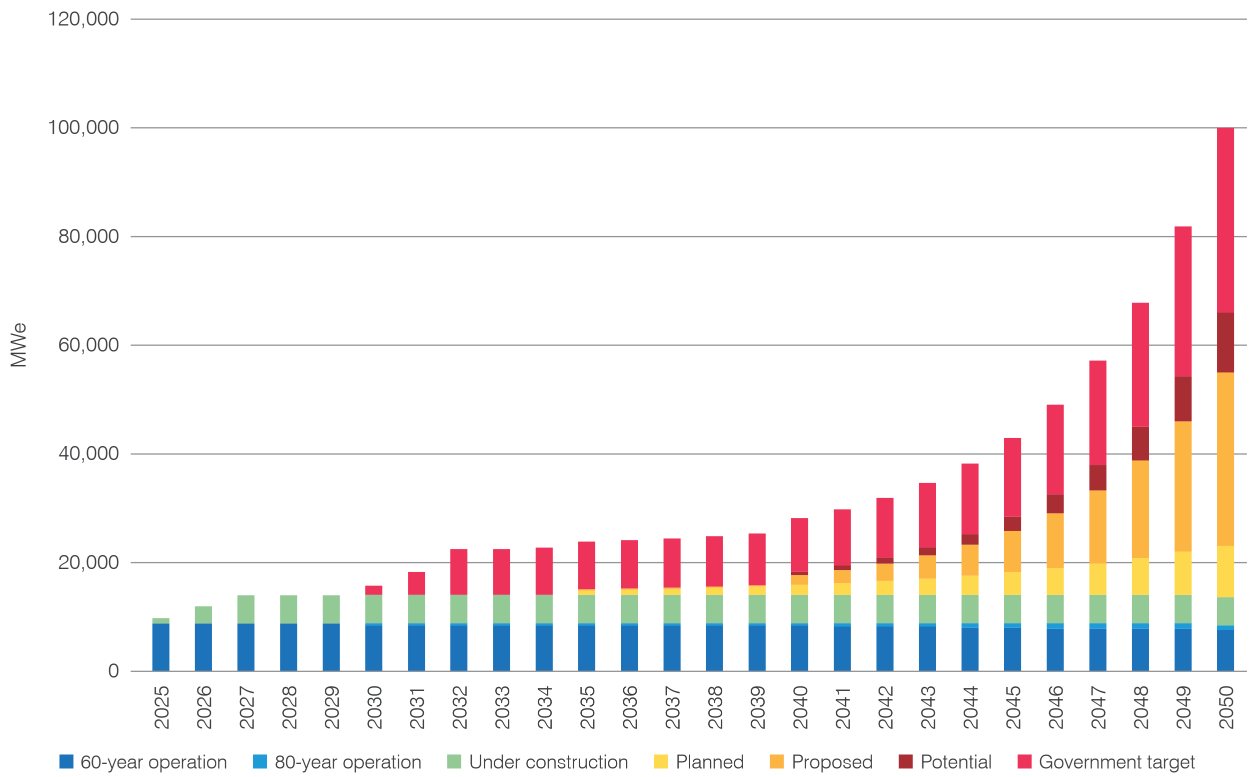
Small-scale reactors

In 2023 Hungary's energy minister said the country could consider buying one or more small modular reactor (SMR) plants, but not earlier than 2029-2030.[107,108]

In May 2024, Hungary and Japan agreed on joint technological development of low-power and small-size nuclear reactors for both countries.[109]

3.2.13 India

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
7600	860	5200	9400	31,948	11,000	100,000 (requiring an additional 33,992)	100,000



India has 24 operable reactors with a total capacity of 7900 MWe. Six reactors, with a capacity of 5200 MWe, are under construction, including a 500 MWe indigenous fast neutron reactor.[110]

India has committed to reaching net-zero emissions by 2070. Contributing to this goal, in early 2025 the *Nuclear Energy Mission for Viksit Bharat* was announced, with the aim to reach 100 GWe of nuclear power capacity in the country by the centenary year of the country's independence (*i.e.* 2047).[111]

In April 2025[112] India's Minister for Power emphasised that hitting the nuclear capacity goal was central to India's goal of reaching net-zero carbon emissions by 2070, as well as strengthening India's long-term energy security.

Actions to be taken for the scaling up of nuclear energy capacity include:

- Amending the 1962 Atomic Energy Act and the 2010 Civil Liability for Nuclear Damage Act to enable broader participation by private and state sectors.
- Strengthening public perception and enhancing awareness about nuclear energy's safety and benefits.
- Facilitating faster land acquisition through brownfield expansions and repurposing retired thermal sites.
- Streamlining regulatory approval processes to reduce project timelines.
- Introducing tax concessions, green power classification, and long-term financing to ensure competitive nuclear tariffs.
- Diversifying technology choices through competitive bidding and promoting indigenous manufacturing under the 'Make in India' initiative.
- Securing diversified uranium fuel sources and expanding the vendor base for specialized nuclear equipment.
- Building skilled workforce capacity by strengthening nuclear education and training infrastructure.

In February 2025 the state-run power company NTPC announced plans to construct 30 GWe of nuclear generation capacity, requiring a $62 billion investment, over the next two decades. Jindal Nuclear Power, a subsidiary of the private company Naveen Jindal Group, has plans to deploy up to 18 GWe of nuclear capacity.[113]

New capacity

Large-scale reactors

In the near term, India expects to triple its nuclear capacity to around 22.5 GWe by 2032.[114,115] In addition to the 5200 MWe of reactors under construction, pre-construction activities are underway on ten units with 7000 GWe capacity.

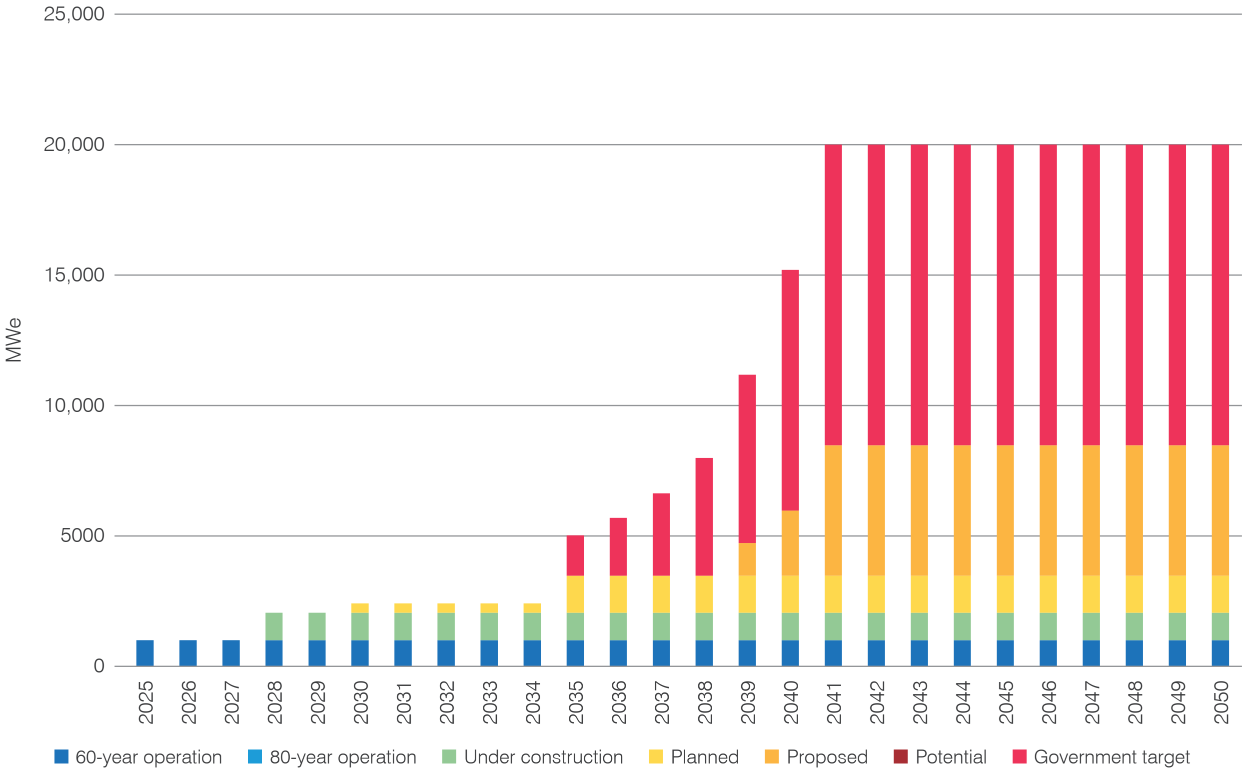
The government has also accorded 'in-principle' approval for an additional 32 GWe of capacity, in cooperation with vendors from France, USA and Russia, as well as further indigenous PHWRs.[116]

Small-scale reactors

In the Budget 2024 speech, India's Finance Minister announced government support to develop SMRs, referred to as Bharat Small Reactors (BSRs), based on indigenous PHWR technology. The *Nuclear Energy Mission* aims for at least five 220 MWe BSRs to be operational by 2033, as well as amendments to Indian legislation to encourage private sector participation. The first two lead units of a 55 MWe variant of the BSR would be built at a Department of Atomic Energy site by 2033.[117] The country's Bhabha Atomic Research Centre is also developing a 5 MWt high temperature gas cooled reactor for hydrogen production.

3.2.14 Iran

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1000	0	1057	1417	5000	0	20,000 (requiring an additional 11,536)	20,000



Iran has one Russian VVER-1000 unit in operation at the Bushehr plant. Russia's Rosatom is building a second VVER-1000 at Bushehr and excavation works on a third unit commenced in January 2021.[118]

The Atomic Energy Organization of Iran (AEOI) in 2007 announced a plan to build a 360 MWe reactor designed by Iran at Darkhovin. The design was completed in 2012 and groundworks commenced in 2022. The AEOI estimated that the project would be finished by 2030.[119]

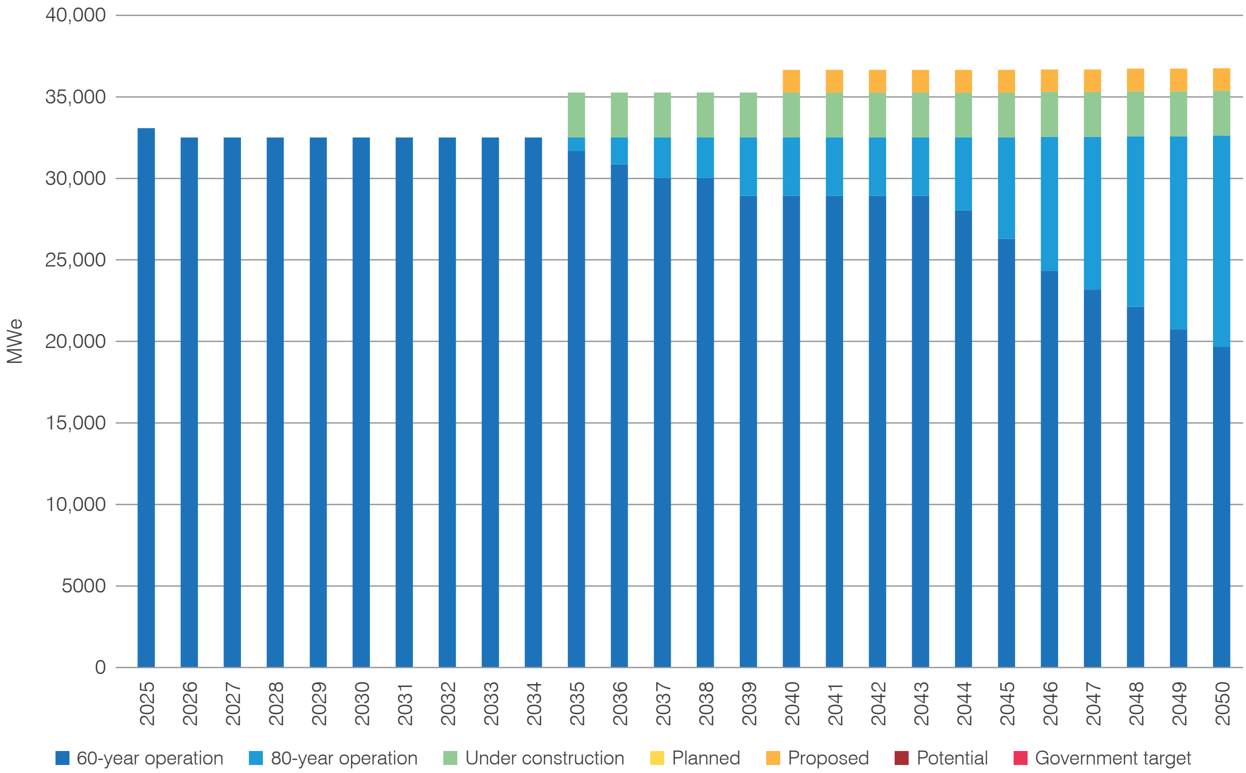
The AEOI announced that work at a new site in Hormozgan province commenced in February 2024. The Iran-Hormoz power plant is planned have four units of 1250 MWe each but no information on the plant design or contractors have been given.

In September 2024 the AEOI said that Bushehr 2 would start up in 2029. First concrete for unit 3 was planned to be poured before the end of 2024,[120] although this has not been confirmed to have taken place.

Iran has set a target of 20 GWe of nuclear capacity by 2042.[121]

3.2.15 Japan

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
19,662	12,961	2756	0	1385	0	0	36,764



Japan depends on imports for approximately 90% of its primary energy demand. Released in 2010 – before the accident at the Fukushima Daiichi nuclear plant in March 2011 – Japan's third energy plan positioned nuclear energy to have a key role in energy security and the low-carbon transition, proposing to build more than 14 reactors and increase the proportion of zero-emissions energy (nuclear and renewables) in the electricity mix to 70% by 2030.[122]

Nuclear plans were scaled back following the Fukushima Daiichi accident. However, in its sixth Strategic Energy Plan published in 2021, and *The Basic Policy for the Realization of GX* (green transformation) in 2023, the government was more positive on extending operation at existing plants, as well as building new reactors.[123,124] That policy set a target of having 20-22% of electricity being supplied by nuclear by 2030, requiring a total nuclear capacity of around 27 GWe.[125] In February 2025 the government's Seventh Strategic Energy Plan set a target of nuclear to supply around 20% of electricity in 2040.[126]

In its *Green Growth Strategy in line with Carbon Neutrality in 2050* published in December 2020, the government said it aimed for approximately 30-40% of power generation in 2050 to be covered by both nuclear power and thermal power generation with carbon dioxide capture. In addition, electricity demand was estimated to increase by about 30-40% due to electrification.[127]

Japan had 55 operable nuclear reactors at the time of the March 2011 accident at Fukushima, all of which were taken offline when the accident occurred or in the months after. Up to October 2025, 14 units have restarted, with 19 operable units still requiring permission to restart, of which 11 units have applied to restart.[128]

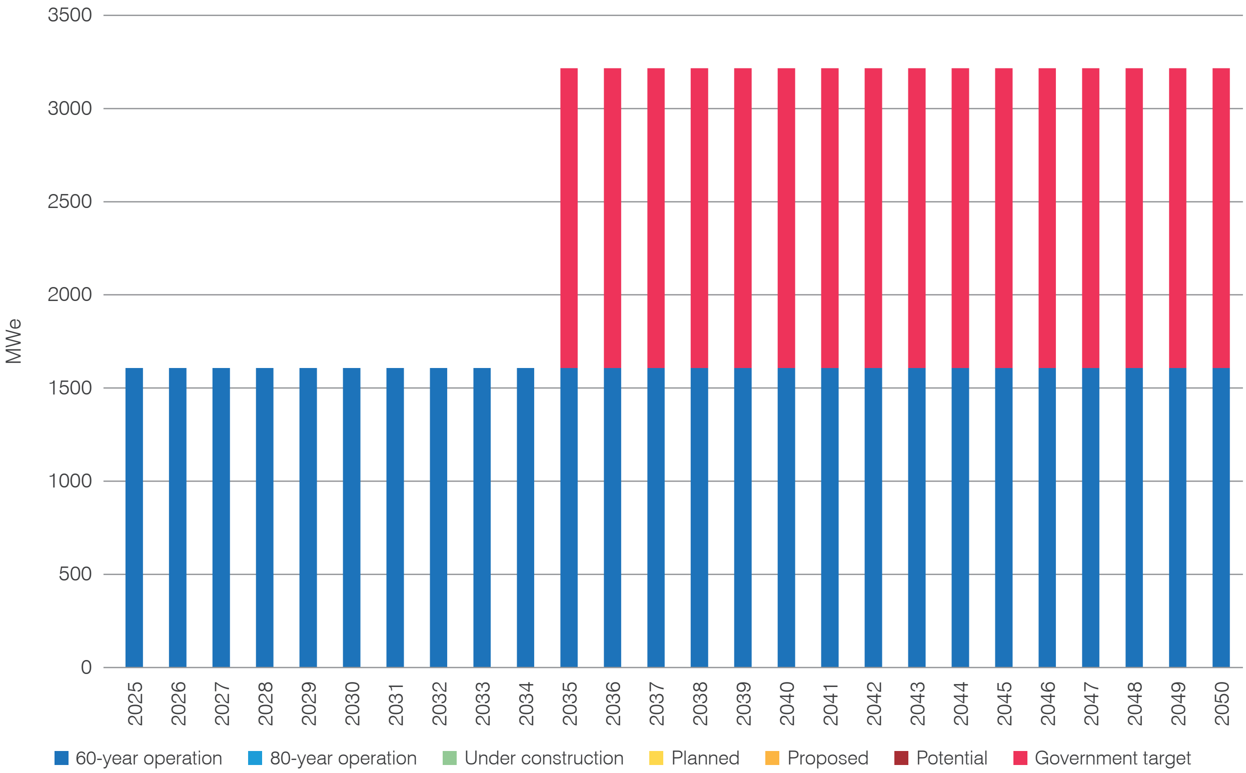
Construction on two reactors, Shimane 3 and Ohma, was suspended following the Fukushima Daiichi accident. Their operating companies are seeking regulatory approval to restart construction.

Long-term operation

In May 2023 parliament approved a new rule allowing reactors to operate beyond 60 years by excluding those years when reactors were offline following the Fukushima Daiichi accident.[129] Other than this exception, nuclear plant operating lifetimes in Japan are limited to 60 years.

3.2.16 Mexico

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1608	0	0	0	0	0	1608	3216

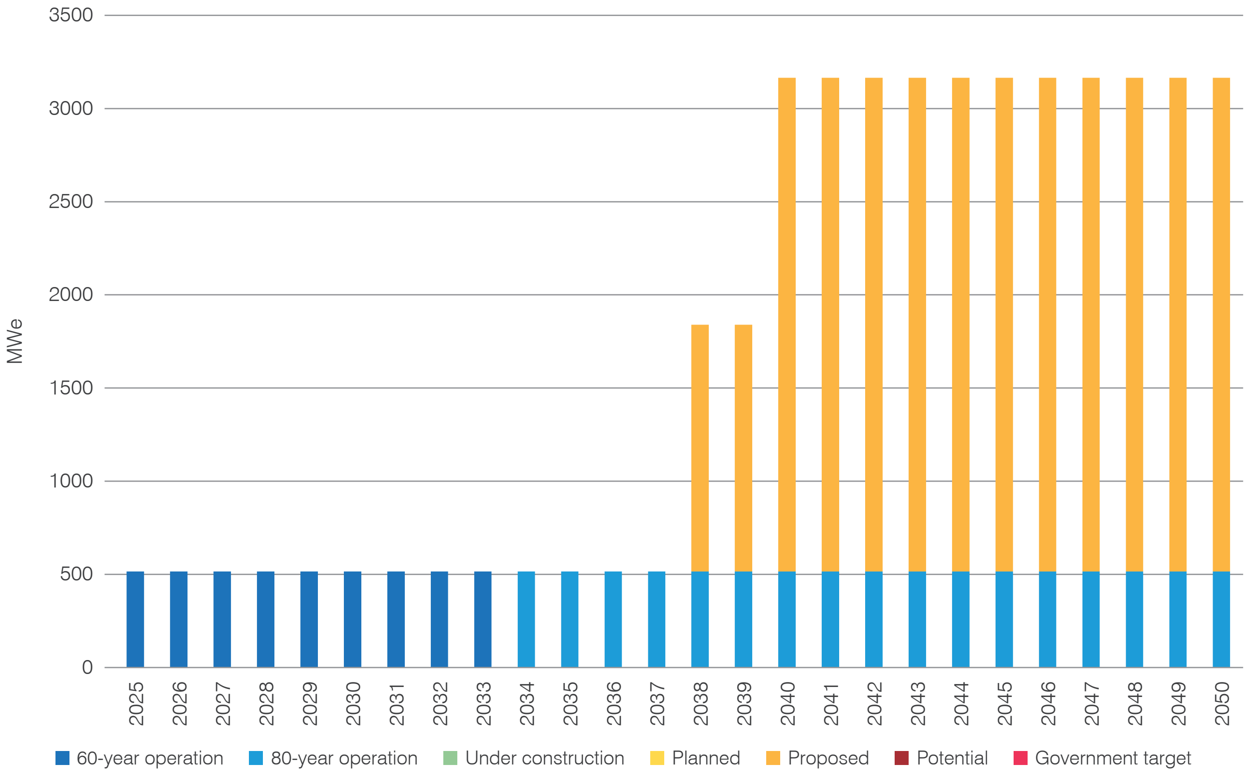


Mexico has two operating reactors at the Laguna Verde plant, with a total net capacity of 1552 MWe. The two BWRs started up in 1989 and 1994 and are licensed to operate to July 2050 (unit 1) and April 2055 (unit 2).

High-level government support exists for an expansion of nuclear energy, primarily to reduce dependence on natural gas, but also to cut carbon emissions.[130] In 2022 Mexico submitted its updated Nationally Determined Contribution (NDC) to increase its mitigation targets to 35% reduction in greenhouse gas emissions. An August 2022 Secretariat of Energy report implied that, to reach the government's clean energy targets, annual electricity production from nuclear energy would need to double by 2035.[131]

3.2.17 Netherlands

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	515	0	0	2650	0	0	3165



The Dutch government aims to meet climate targets by extending the operating lifetime of its existing nuclear power reactor and adding four new reactors by 2040.[132] The single PWR at Borssele will have reached 60 years of operation in 2033.

New capacity

Large-scale reactors

In 2022 the government identified Borssele as the preferred location for constructing two new reactors of between 1000 MWe and 1650 MWe each; the units were expected to be operational by 2035, and would generate about 9-13% of the Netherlands' electricity requirements.[133] Other potential locations were Tweede Maasvlakte, near Rotterdam and Terneuzen in Zeeland. A fourth site, Eemshaven in Groningen was excluded due to local opposition. In March 2024, the government announced plans for the addition of two more units by 2050, with the site and plan yet to be announced for the third and fourth new units.[134]

In March 2025 Eemshaven was added back to the list of sites formally under consideration, with an environmental impact assessment to be carried out for all four sites. However, this delayed the site selection process from being completed by mid-2025, so the start-up of the first two reactors by 2035 is no longer realistic. Around the same time, KHNP withdrew from the technology selection process, leaving Westinghouse and EDF engaged with the Netherlands government.[135]

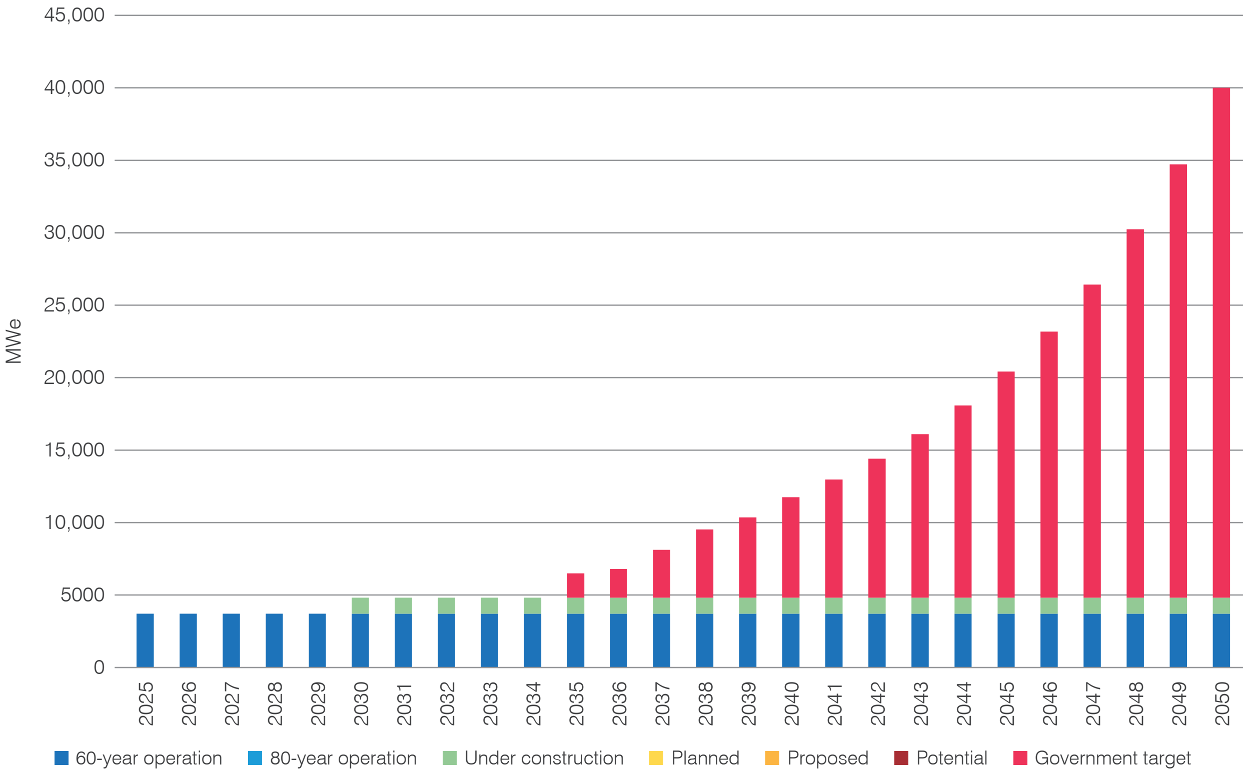
Small-scale reactors

In August 2022 Rolls-Royce SMR signed an exclusive agreement with Dutch nuclear energy development company ULC-Energy to collaborate on the deployment of Rolls-Royce SMR units in the Netherlands.[136] This was followed by a MoU with Rolls-Royce minority shareholder Constellation in September 2022.[137]

A study by NRG-Pallas has identified four regions in the Dutch province of Gelderland as suitable for hosting a small modular reactor. The province aims to designate two locations for an SMR in 2027.[138]

3.2.18 Pakistan

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
3720	0	1100	0	0	0	35,180	40,000



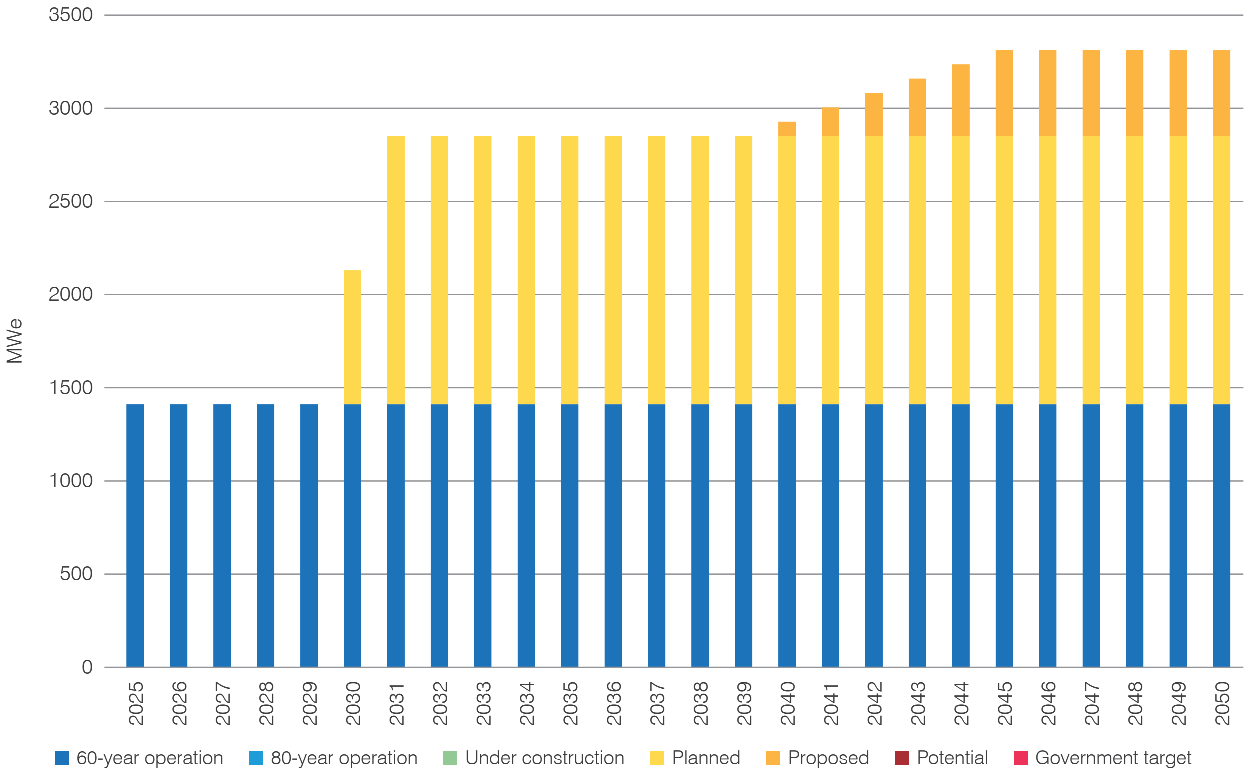
Pakistan has six Chinese-supplied operating reactors at the Chashma and Karachi plants with a total net capacity of 3262 MWe.

Expansion of nuclear power capacity has long been a central element of Pakistan's energy policy to meet the rapidly increasing power demand and achieve emissions reduction targets. Pakistan's *Nuclear Energy Vision 2050*, published in 2022, envisions nuclear generation capacity reaching 40,000 MWe by 2050.[139]

In June 2023, Pakistan agreed a $4.8 billion deal with China to provide an HPR1000 reactor as unit 5 of the Chashma plant. Construction began at the end of 2024.

3.2.19 Romania

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1411	0	0	1440	462	0	0	3313



Long-term operation

Two Candu-6 units at the Cernavoda nuclear plant have been in operation since 1996 and 2007. Unit 1 is undergoing refurbishment, with major work scheduled from 2027 to 2029.[140] The project is expected to extend the reactor's operating lifetime by another 30 years to 2060.

New capacity

Large-scale reactors

Work on Cernavoda 3&4 began in the 1980s but was halted before the end of the decade. There have been long-standing plans to complete the construction of the reactors. In June 2023 a support agreement was signed between the Romanian government and Nuclearelectrica allowing work to complete units 3&4 at Cernavoda to progress. The units are expected to enter commercial operation in 2030 and 2031, respectively.[141]

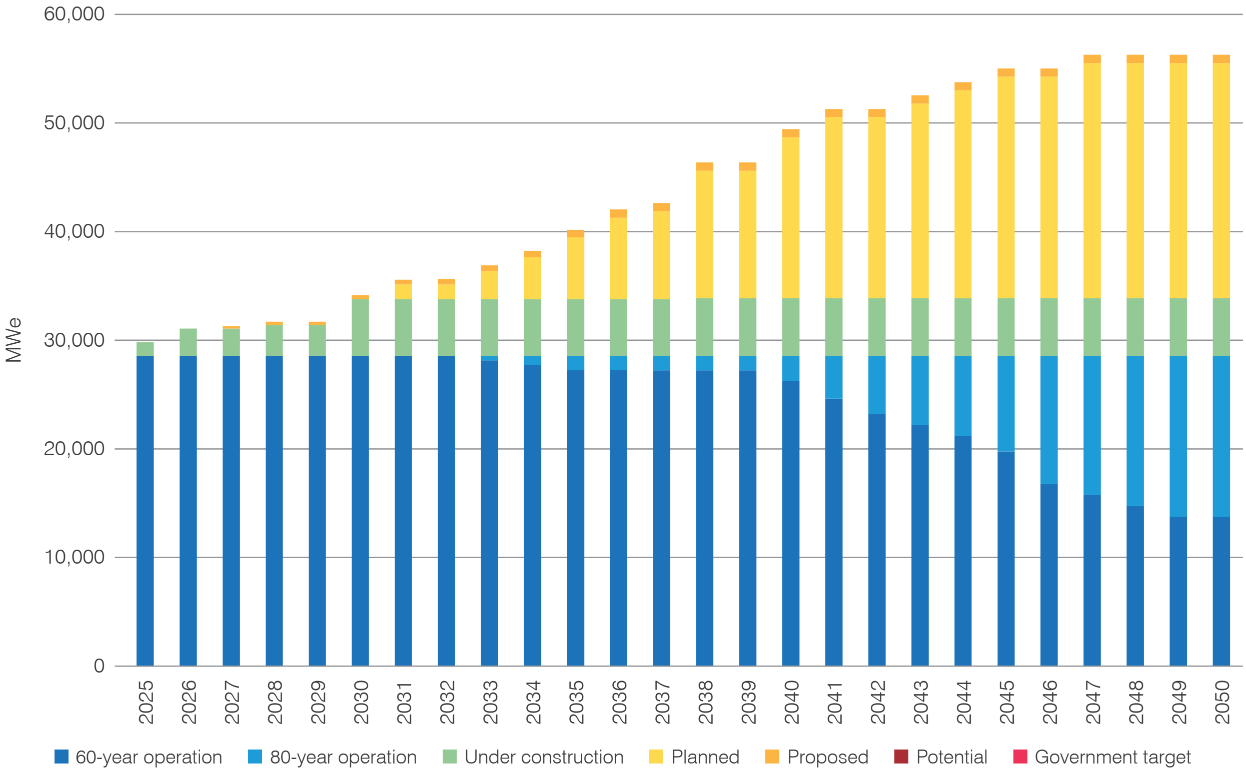
Small-scale reactors

In May 2022 Doicești, in the Muntenia region, was selected as the location for Romania's first SMR. At the end of December 2022 RoPower (a joint venture between Nuclearelectrica and Nova Power & Gas) and NuScale Power signed a contract for the front-end engineering and design work for a VOYGR-6 (6x77 MWe) power plant.

In May 2023 the USA, along with multinational public-private partners from Japan, South Korea and the United Arab Emirates, announced funding of up to $275 million for the deployment of the 462 MWe VOYGR-6 plant.[142] In October 2024 the US Export-Import (Exim) Bank approved a $98 million loan for pre-project services.[143]

3.2.20 Russia

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
13,757	14,813	5299	21,655	754	0	0	56,278



Russia has 36 operable reactors with a total net capacity of 26,802 MWe.[144] Seven reactors with a gross capacity of 5300 MWe are under construction.

Long-term operation[145]

Most of Russia's reactors have been upgraded for long-term operation beyond their initial design lifetimes, mostly with 15-year extensions initially. Design operating lifetimes are around 30 years for most units – which is generally extended by another 30 years – and 60 years for the newer VVER-1200 reactors.

New capacity

In 2022, Russian government aimed at increasing nuclear energy's contribution to the electricity supply to 25% by 2045 (from 19% in 2021). A plan to build 16 reactors by 2035 has been approved. These include both large and small reactors. The new units are:[146]

- Kursk II units 1-4 (VVER-1200)
- Leningrad II units 3&4 (VVER-1200)
- Smolensk II units 1&2 (VVER-1200)
- Baimsky GOK: four floating nuclear units (RITM-200M)
- Yakutia: one SMR (RITM-200N)
- Seversk: BREST-OD-300 fast reactor
- Kola II-1 (VVER-600)
- Beloyarsk 5 (BN-1200 fast reactor)

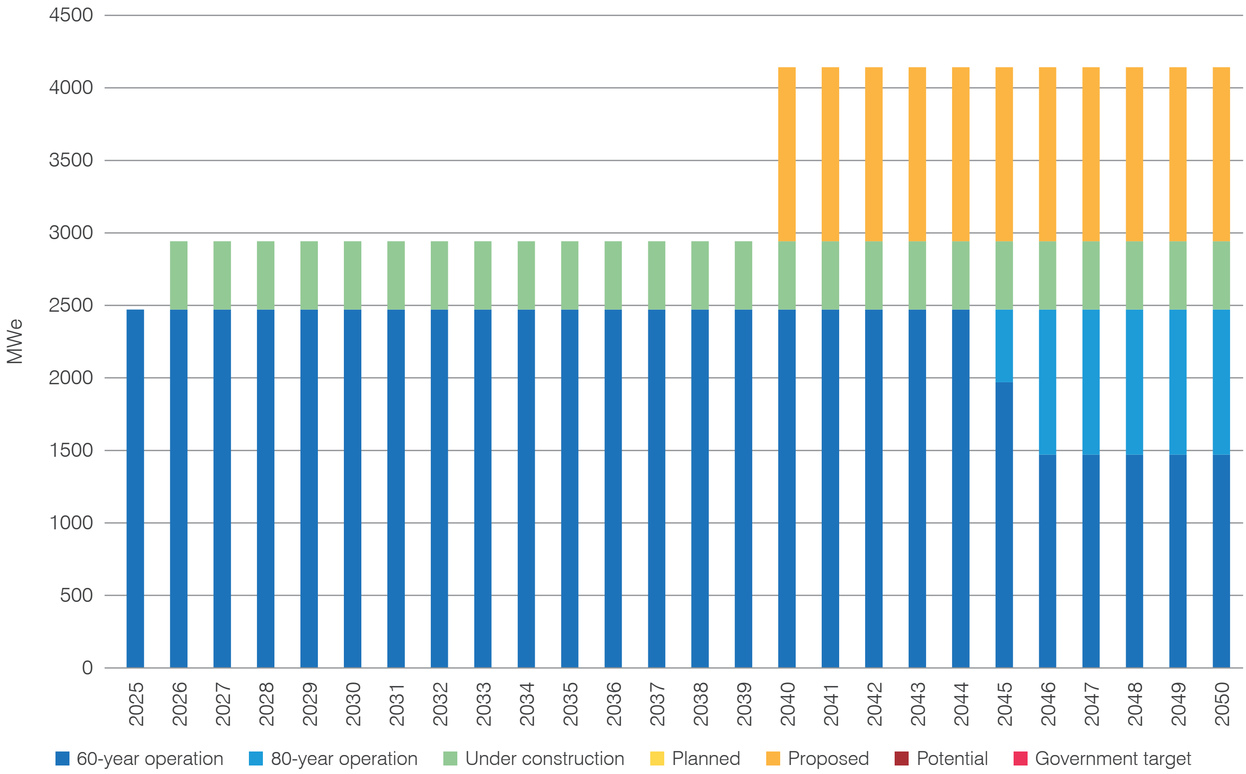
Additionally, units are planned for Kola (2 units), Khabarovsk (2 units), Krasnoyarsk (4 units), Novocherkassk (2 units), Primorsk (2 units), Reftinskaya (one unit) and South Urals (2 units).

Construction commenced on: Kursk II units 1&2 in April 2018 and April 2019, respectively; the BREST-OD-300 in June 2021; two of the RITM-200M floating nuclear reactors in August 2022; and Leningrad II units 3&4 in March 2024 and March 2025, respectively.

In March 2025 Rosatom reported[147] that eight RITM-200 reactor pressure vessels were under construction at its ZIO-Podolsk plant, including vessels intended for floating nuclear power units.

3.2.21 Slovakia

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1471	1000	471	0	1200	0	0	4142



Slovakia's five existing VVER-440/V-213 units at the Bohunice and Mochovce sites are owned by Slovenské elektrárne. A sixth VVER-440 at Mochovce (unit 4) is expected to start operation in 2025.

New capacity

Large-scale reactors

The Slovakian government approved plans for a new 1250 MWe unit, near the Bohunice nuclear power plant, in May 2024.[148] In August 2025 prime minister Robert Fico said the European Commission has positively assessed the content of the draft agreement between the governments of Slovakia and the USA on cooperation in the field of nuclear energy, and that the US government had approved the proposal. Fico said that the agreement was a basic prerequisite for the conclusion of another intergovernmental agreement on the construction of a new 1250 MWe Westinghouse unit in Bohunice.[149]

Small-scale reactors

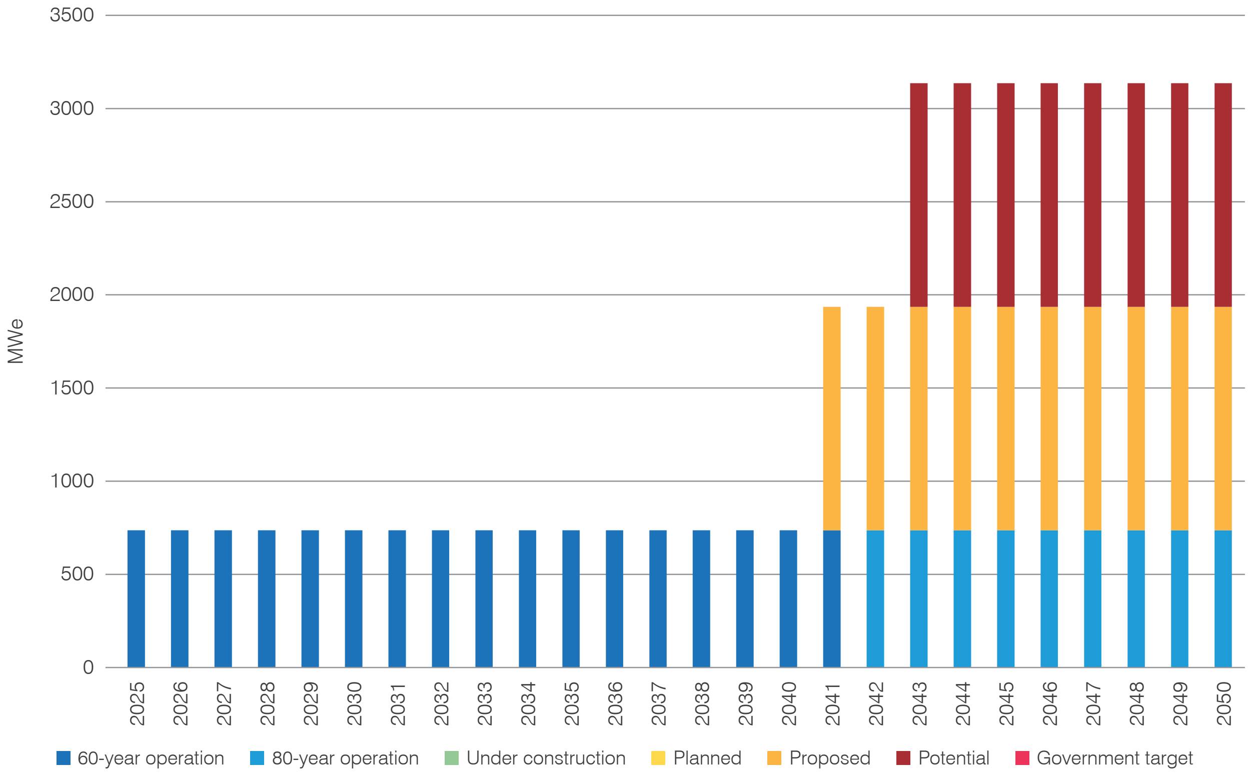
A feasibility study, as part of the US-funded Project Phoenix, is looking into the potential for small modular reactors in Slovakia with an indicative timeline to 2035. The aim is to complete the feasibility study in 2025, with the initial SMR design and licensing process running from 2026 to 2029, procurement of major components from 2030 to 2033 and "implementation project, construction, commissioning" in 2035.[150]

In January 2025 France-based Newcleo signed framework agreements with Slovakian companies JAVYS and VUJE which could lead to up to four of its 200 MWe lead-cooled fast reactors at the Bohunice site.[151]

In August 2025 Slovenské elektrárne and Synthos Green Energy signed a memorandum of understanding to explore the possible deployment of GE Vernova Hitachi's BWRX-300 small modular reactors.[152]

3.2.22 Slovenia

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	736	0	0	1200	1200	0	3136



A cross-party summit held in January 2024 agreed on the necessity of both renewable and nuclear energy for Slovenia's carbon-free future.[153] A referendum on new nuclear power units due to be held in November 2024 was called off in October that year and may now be held in 2028.

Long-term operation

The Krško nuclear power plant, is a 736 MWe Westinghouse PWR operational since 1981. It is co-owned by Croatia's Hrvatska Elektroprivreda (HEP) and Slovenia's GEN Energija and generates about 40% of the country's electricity output.

The unit's operating lifetime was designed to be 40 years, and a 20-year extension has been approved.

New capacity

Large-scale reactors

A second and possibly third unit at Krško – referred to as the JEK 2 project – is planned. A final investment decision expected by 2028, construction starting in 2032, and completion by 2041. A nationwide referendum on the project due to take place in November 2024 was called off by parliament and is now planned to be held in 2028.

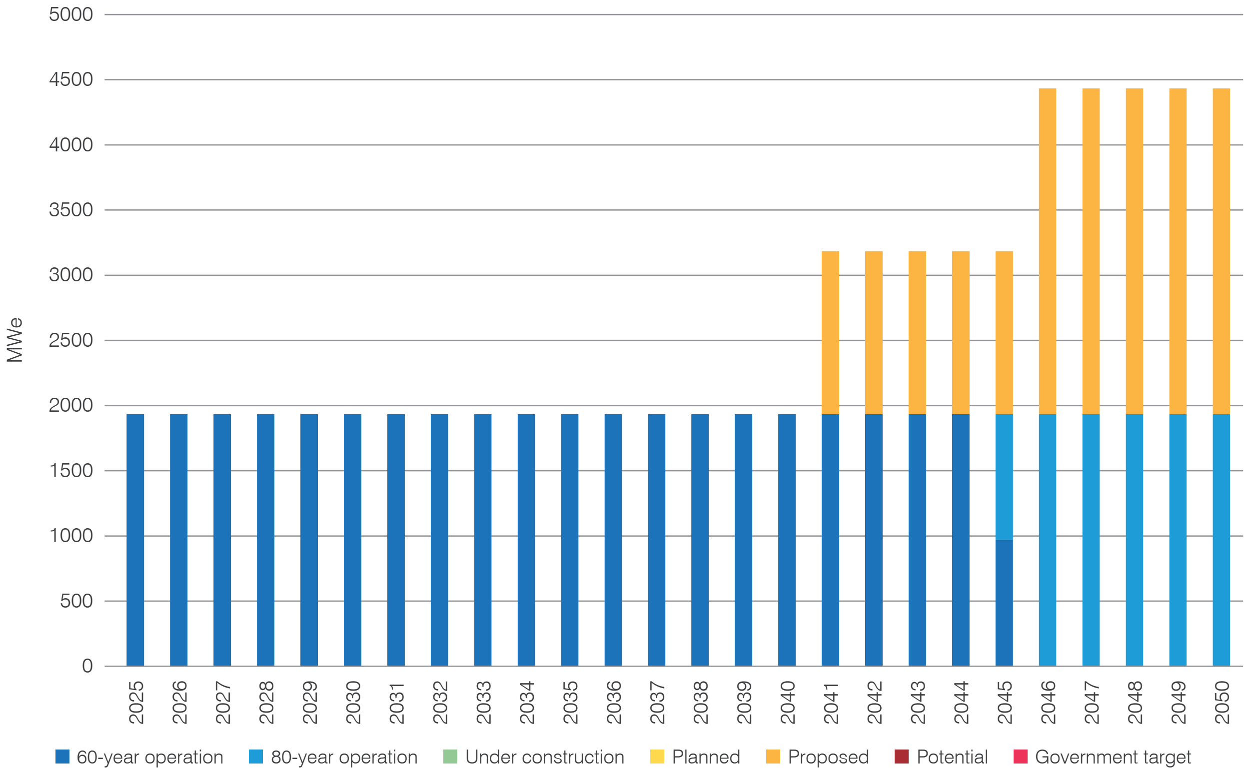
In November 2025 the JEK 2 project company stated that Westinghouse's AP1000 and EDF's EPR and EPR1200 reactors had all been judged to be suitable for the JEK 2 site.

Small-scale reactors

In addition to allowing for the expansion of the Krško plant, the national 'spatial strategy' approved by parliament in mid-2023 paves the way for building small modular reactors (SMRs) in the country.

3.2.23 South Africa

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	1934	0	0	2500	0	0	4434



South Africa has two 900 MWe-class PWRs commissioned in 1984-85, operating at Koeberg, near Cape Town.[154]

Long-term operation

A licence to continue operating Koeberg 1 for another 20 years until July 2044 was approved in July 2024, following extensive maintenance. The regulator is expected to reach a decision on the long-term operation of unit 2, which has undergone similar maintenance, by early November 2025.

New capacity

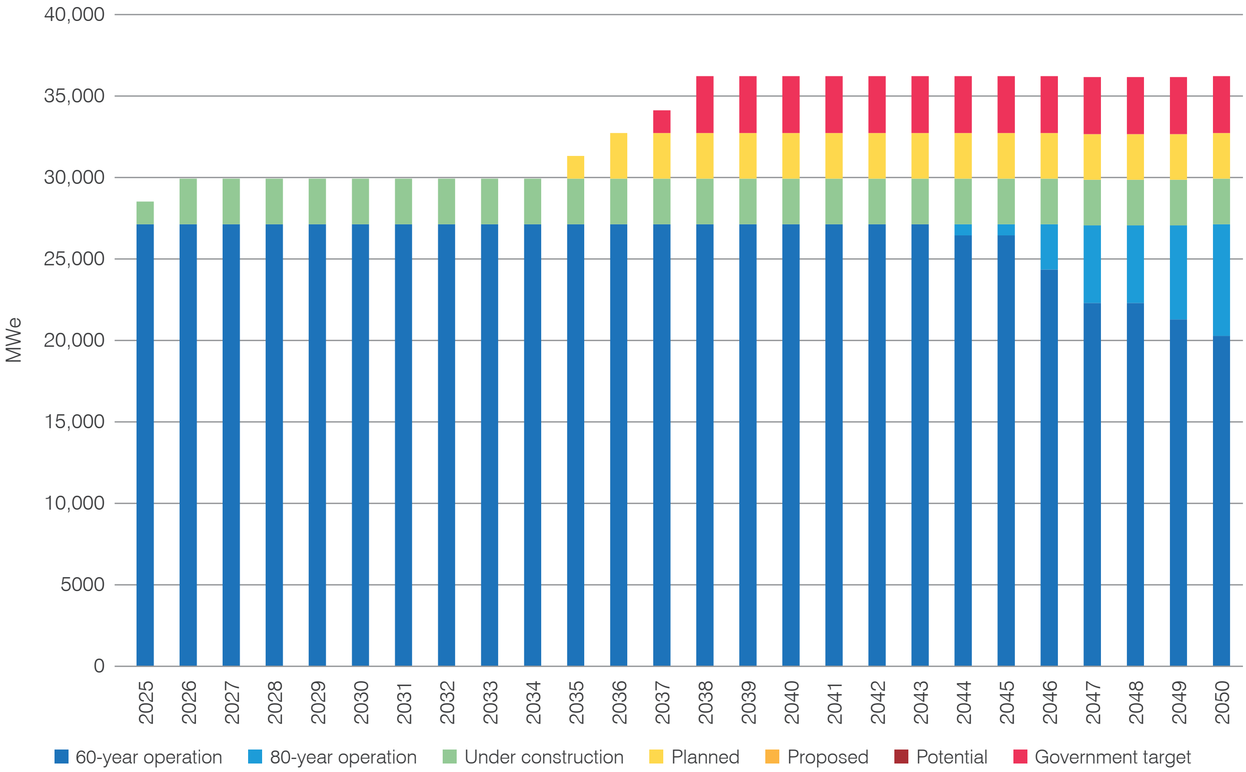
Large-scale reactors

Plans for 9.6 GWe of new nuclear capacity outlined in the country's 2010 Integrated Resource Plan (IRP) have been scaled back.[155] In December 2023 South Africa's Department of Mineral Resources and Energy confirmed that it would go ahead with the procurement of 2500 MWe of new nuclear capacity; however, the Ministerial Determination for the procurement process was withdrawn in August 2024 to allow for public consultation.

In August 2025, South Africa's Minister of Forestry, Fisheries and the Environment upheld a 2017 decision to grant Eskom environmental authorization to construct and operate a new nuclear power station in Duynefontein, near Eskom's existing Koeberg nuclear power plant in the Western Cape.[156]

3.2.24 South Korea

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
20,279	6847	4200	1400	0	0	3500	36,226



South Korea has 26 operable reactors with a total net capacity of 25,825 MWe, two APR1400 reactors under construction at the Saeul nuclear plant, and a APR1400 under construction and another planned at Shin Hanul.

The 11th Basic Plan for Electricity Supply and Demand (2024-2038) issued in February 2025 includes the construction of two additional large reactors (in addition to Saeul 3&4 and Shin Hanul 3&4), as well as 700 MWe of SMR capacity by 2038.[157]

In December 2022 Korea announced a commitment of 400 billion won ($310 million) for the development of the i-SMR.

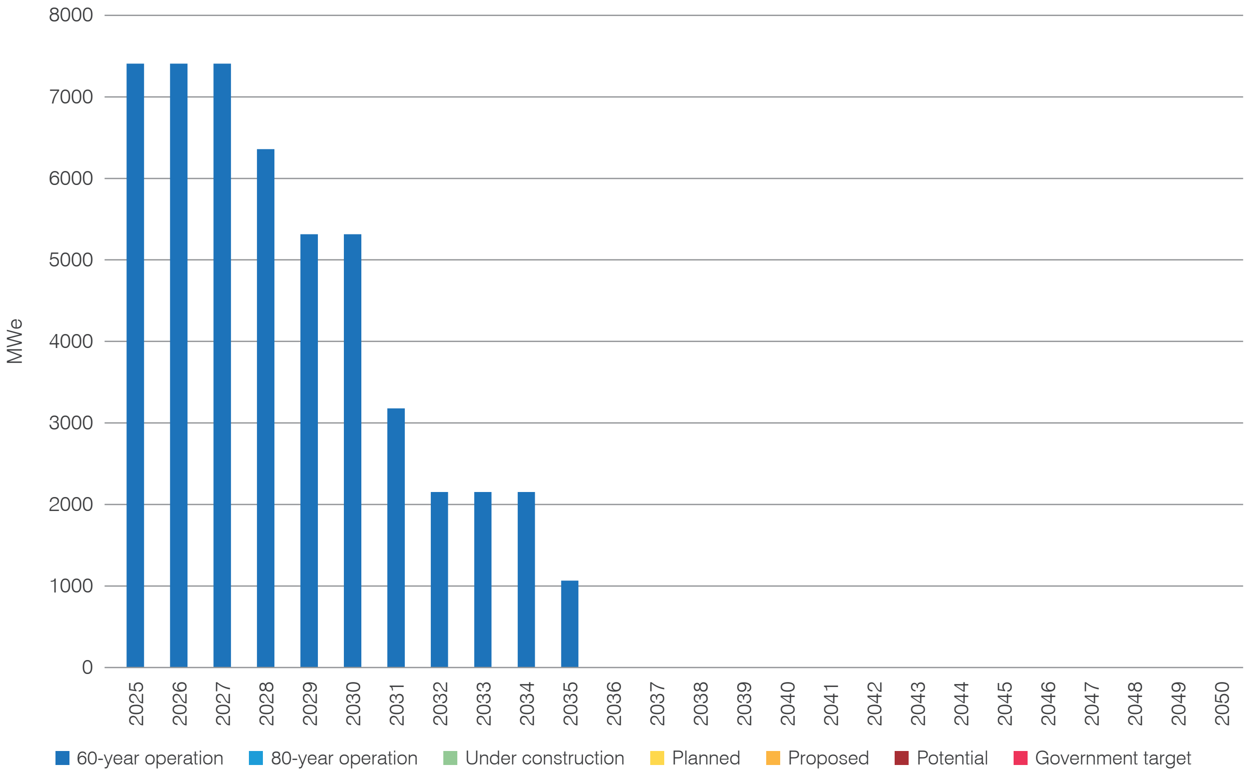
In September 2025 President Lee Jae-myung, who took office in June 2025, reiterated South Korea's long-term direction "must be toward renewable energy", although he stressed that existing and under-construction nuclear projects would continue.[158]

Long-term operation

South Korea has begun the process of extending the operating lifetimes the ten units that were due to end their design lifetimes by 2030 following the expiration of their 30-40-year operating licence periods.

3.2.25 Spain

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	0	0	0	0	0

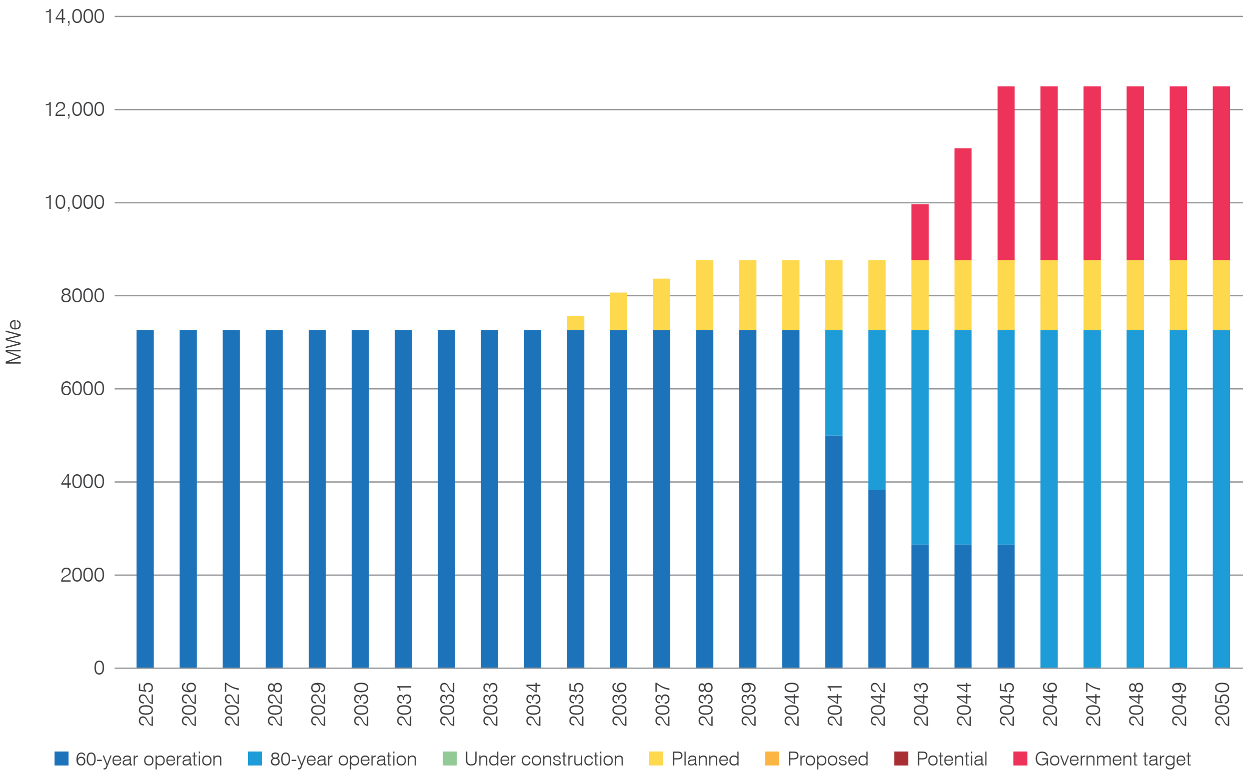


Spain has seven operable nuclear reactors with a total net capacity of 7123 MWe, providing around one-fifth of its electricity. The country has a policy to phase-out nuclear power by 2035, with four reactors closing by the end of 2030.

In February 2025 the Plenary Session of the Congress, the lower house of Spain's legislative branch, voted narrowly in favour of calling on the government to reverse the phase-out decision.[159]

3.2.26 Sweden

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	7267	0	1500	0	0	12,500, (requiring an additional 3733)	12,500



Sweden had nuclear phase-out policy from 1980 that was repealed in 2010. In June 2023 Sweden replaced its energy target of "100% renewable" electricity by 2040 with "100% fossil-free" electricity, allowing the government to push forward with plans for new nuclear plants.

Long-term operation

Preliminary studies are to be undertaken at Oskarshamn and Forsmark to explore measures to extend the operating lifetimes of units from 60 to 80 years.

New capacity

Large-scale reactors

In November 2023 the government announced plans to construct two large-scale reactors by 2035 and the equivalent of 10 new large reactors, including small modular reactors, by 2045.

The government has promised SEK 400 billion ($38.2 billion) in credit guarantees to companies that plan to build new reactors.[160]

Small-scale reactors

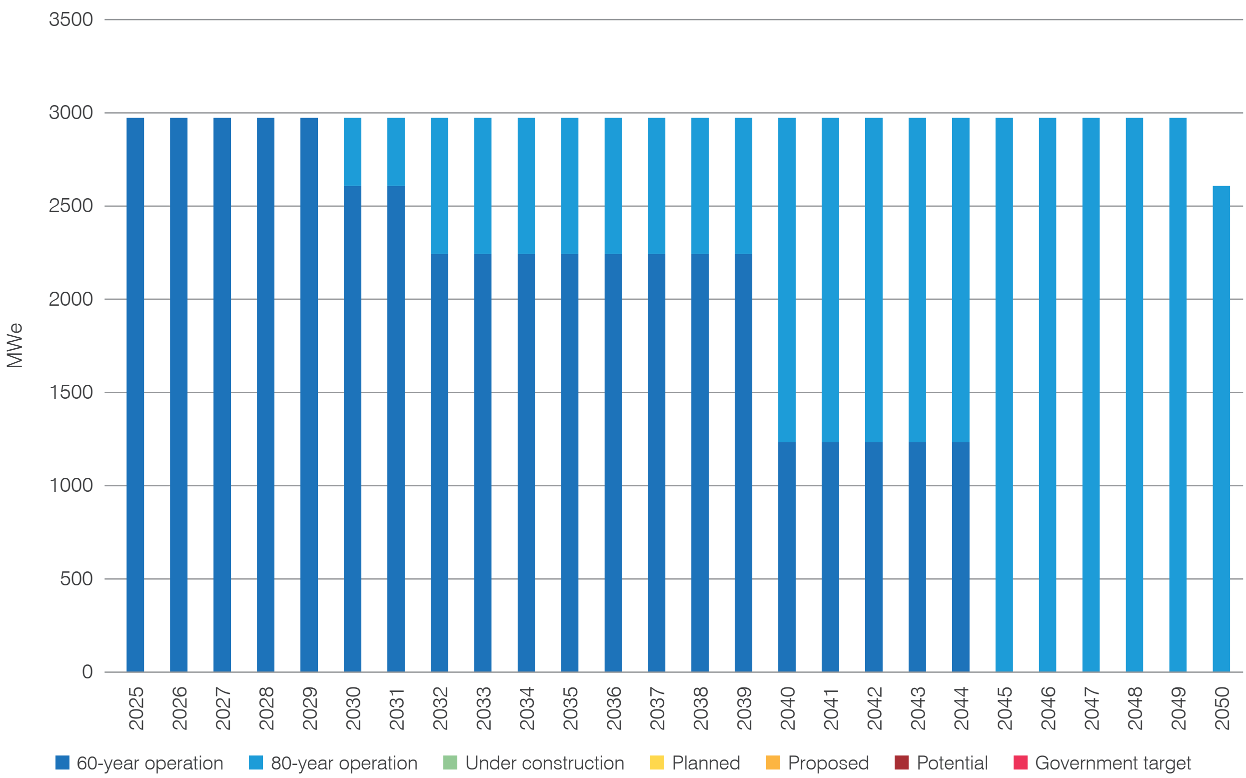
In December 2022 Fortum and Kärnfull announced that they were exploring the development of SMRs.

in November 2023, Vattenfall applied for planning permission to build new nuclear generating capacity on the Värö peninsula to the west of the Ringhals plant. Vattenfall said it aims to deploy new nuclear capacity at the site in the early 2030s.

In mid-2024 Vattenfall announced it had shortlisted Rolls-Royce SMR and GE Hitachi Nuclear Energy as potential SMR suppliers next to the existing Ringhals site. In August 2025 Vattenfall said that it had decided that small modular reactors, rather than large reactors, had been chosen to be the form of new nuclear capacity to be built on the Värö peninsula. The project would be for around 1500 MWe of capacity, either five BWRX-300s or three Rolls-Royce SMRs with start up scheduled for the early 2030s.[161]

3.2.27 Switzerland

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2608	0	0	0	0	0	2608



Switzerland has four operable reactors – Beznau 1&2, Gösgen and Leibstadt, with a combined capacity of 2973 MWe. Both Beznau and Gösgen produce district heating in addition to power. Beznau makes available 80 MW of heat to industry and homes over a 130 km network serving 11 towns – potentially 2.5 PJ/yr.

In May 2011, following the Fukushima Daiichi accident in Japan, the Swiss federal government declared that the country's nuclear power plants would gradually be phased out. In May 2017 a referendum approved the government's *Energy Strategy 2050*, which included the provision for a gradual withdrawal from nuclear power[162].

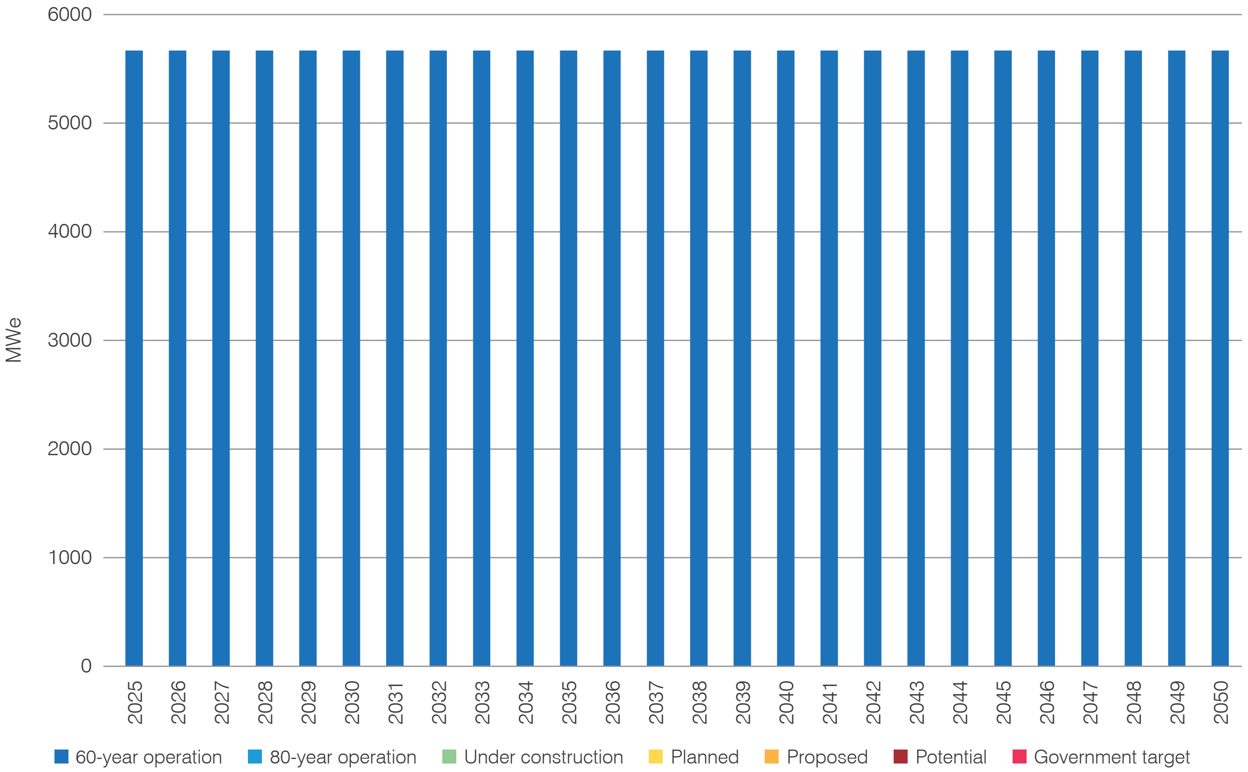
In August 2025 Switzerland's Federal Council presented draft legislation that would remove the country's ban on the construction of new nuclear power.[163]

Long-term operation

All operational Swiss reactors have had power uprates – the Beznau units from 350 MWe to 365 MWe, Gösgen from 920 MWe to 1010 MWe, and Leibstadt from 990 MWe progressively to 1220 MWe.

3.2.28 United Arab Emirates

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
5668	0	0	0	0	0	0	5668



United Arab Emirates has four operable reactors at Barakah. Unit 1 was connected to the grid in August 2020, followed by unit 2 in September 2021, unit 3 in October 2022, and unit 4 in March 2024. Those four operating units add up to a total net capacity of 5348 MWe and supply up to 25% of the UAE's electricity demand.

New capacity

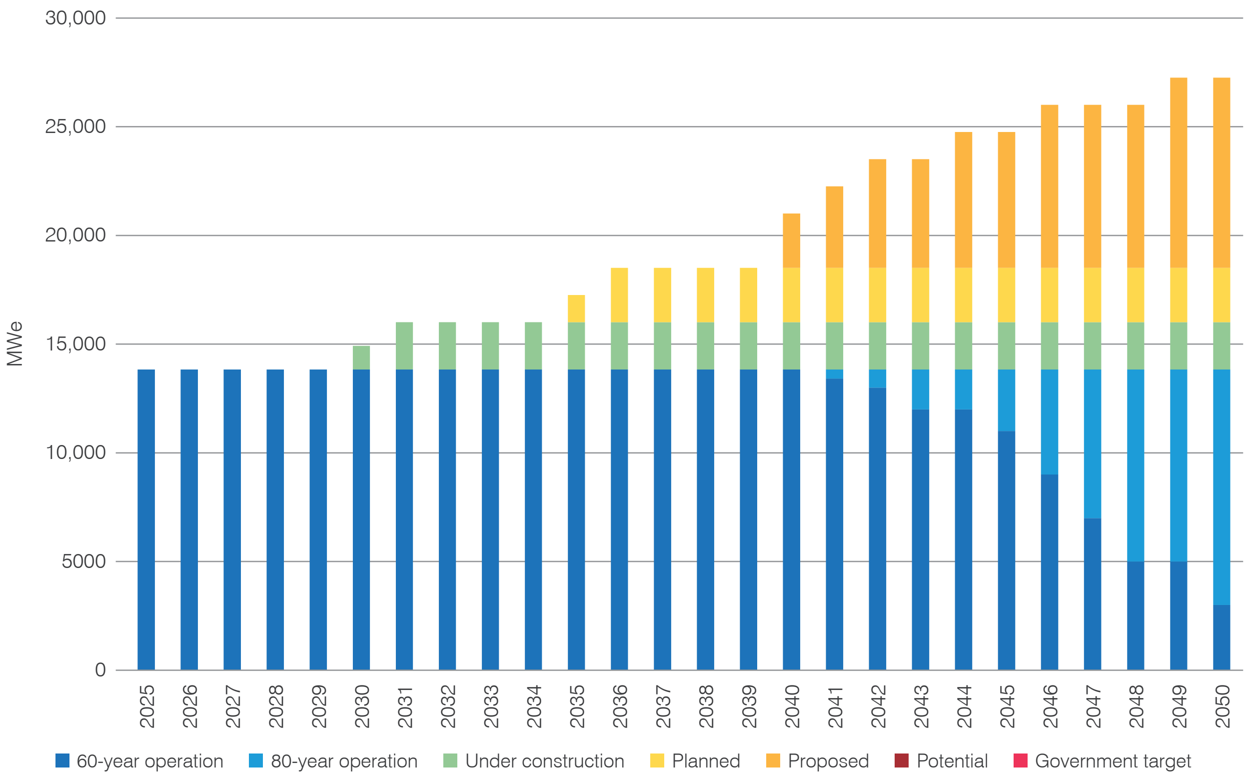
In April 2024 it was reported[164] that the UAE was planning to launch a tender for construction of a new nuclear power plant. However, there has been no official announcement to date.

In November 2024 it was announced that the Emirates Nuclear Energy Corporation and government-owned diversified energy group ADNOC are to evaluate the deployment of advanced nuclear technology such as small modular reactors to support the UAE's energy diversification strategy, and will look into using excess heat from the Barakah nuclear power plant in ADNOC's oil and gas operations.[165]

The *UAE Energy Strategy 2050* aims to have nuclear providing 6% of total energy supply by 2050[166].

3.2.29 Ukraine

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
3000	10,835	2178	2500	8750	0	24,000 (would be achieved by existing plans)	27,263



Ukraine's nuclear power plants are operated by National Nuclear Energy Generating Company (NNEGC) Energoatom, the country's nuclear power utility. All reactors are VVER types, two being upgraded 440 MWe V-312 models and the rest the larger VVER-1000 units[167]. The *Energy Strategy of Ukraine* aims to achieve 24 GWe of nuclear capacity by 2050[168].

The six-unit Zaporizhzhia plant has been under the control of Russian military forces since early March 2022, and all its units are in cold shutdown[169].

New capacity

Large-scale reactors

Construction of Khmelnitski 3&4 began in 1986 and 1987, respectively, but has been suspended since 1990, with unit 3 reportedly around 80% complete and unit 4 about 25% complete.

In March 2025, a law was passed by the Ukrainian parliament backing a plan to procure equipment in storage at the incomplete Bulgarian Belene project to allow for completion of Khmelnitski 3&4.[170]

In June 2022 Energoatom and Westinghouse signed an agreement to construct nine AP1000 units in Ukraine, which would add 11,250 MWe nuclear capacity[171]. These could include two new units at Khmelnitski,[172] one or more units at Chyhyryn on the Tayasmyn river, and two units at the South Ukraine nuclear plant.

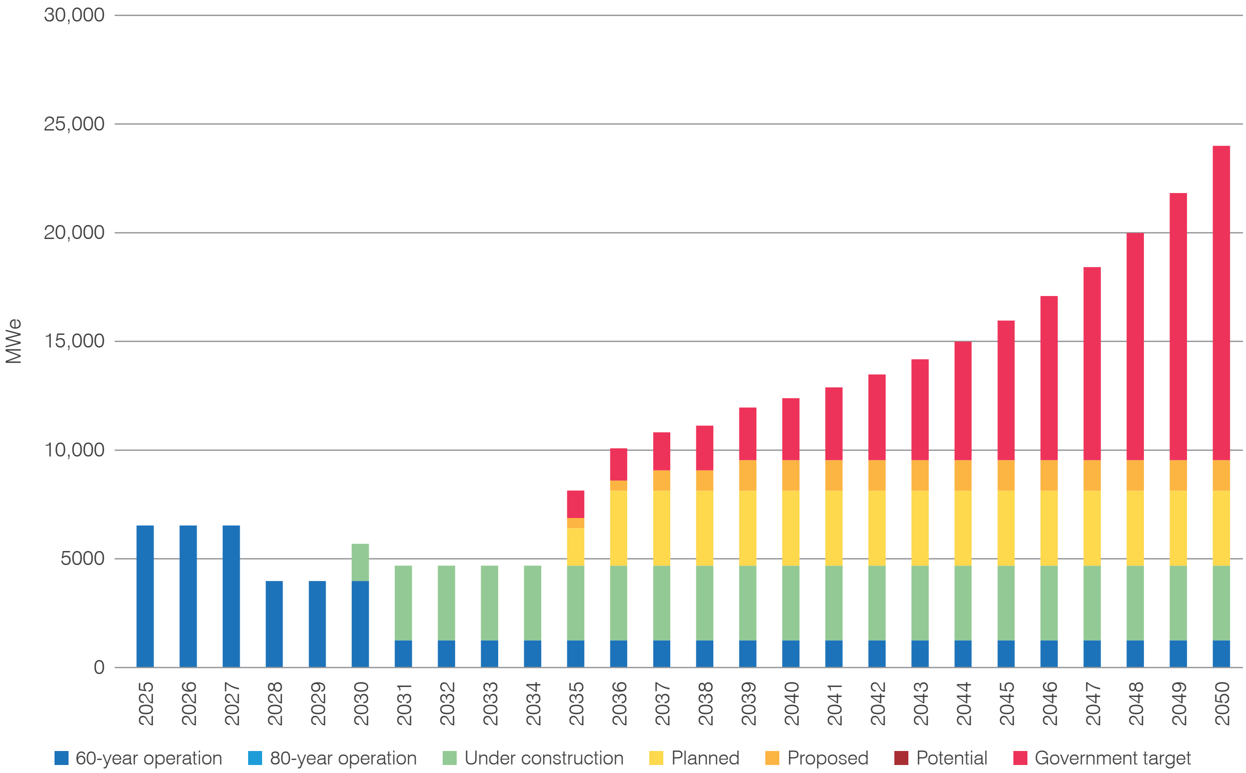
Long-term operation

The original design lifetime of the reactors operating in Ukraine was 30 years. Energoatom initially planned to extend the lifetimes of Rovno 1&2 and South Ukraine 1 by 15 years, and final checking of the pressure vessels (for embrittlement) and the internals of all three units was in 2008-9. In mid-2012 Energoatom announced that the 11 oldest 1000 MWe reactors were to have 20-year operating lifetime extensions by 2030.

In December 2010, national regulatory agency SNRIU approved the lifetime extension of the two 440 MWe power units of the Rivne plant until December 2030 and December 2031, respectively.[173] In July 2018, Rovno 3 was granted a 20-year extension by the SNRIU.

3.2.30 United Kingdom

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
1250	0	3440	3440	1410	0	14,460	24,000



The UK has nine operational nuclear reactors with a total capacity of 5900 MWe at five locations, eight advanced gas-cooled reactors (AGRs) and one pressurized water reactor (PWR).

The country's Labour government (since July 2024) has not indicated any change in the goal set by the previous administration to deliver 24 GWe nuclear capacity by 2050. Great British Nuclear (GBN), a non-departmental public body sponsored by the Department for Energy Security and Net Zero, was set up in 2024 to help deliver the 24 GWe target. It was renamed Great British Energy – Nuclear (GBE-N) in June 2025.

Long-term operation

Operation of the UK's AGR reactors been extended several times. However, the design is susceptible to gradual cracking of graphite bricks comprising the reactors' moderators and limiting their operational lifetimes. Hartlepool 1&2 and Heysham I-1&2 are due to close in 2028, and Heysham II-1&2 and Torness 1&2 are due to close in 2030.

EDF Energy plans to operate the Sizewell B PWR reactor for 60 years, to 2055.[174]

New capacity

Large-scale reactors

Two EPR reactors are under construction at Hinkley Point C, with start-up of the first reactor expected around 2030.

A second set of two EPRs are planned at Sizewell C. Following the 2025 UK Spending Review, in which the UK government announced a £14.2 billion investment in the project,[175,176] a final investment decision is expected later in 2025.

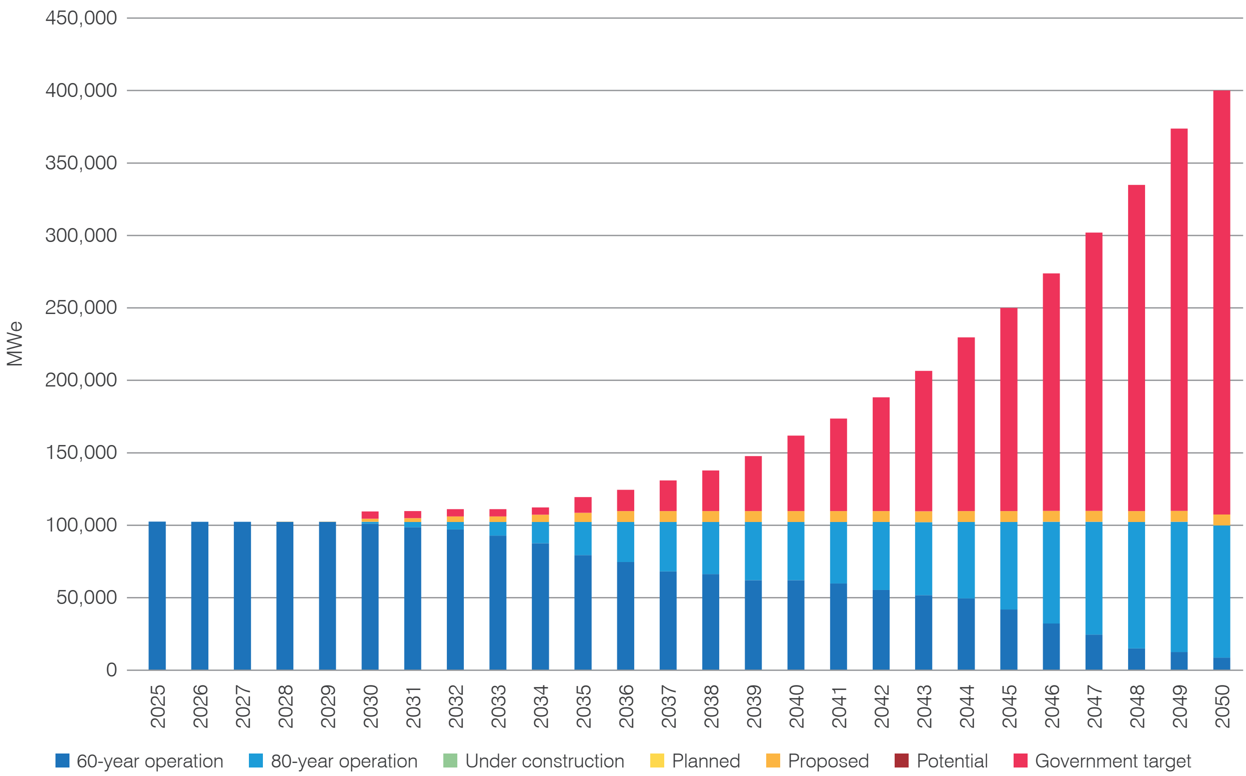
Small-scale reactors

In 2024 the UK government, and GBN began the selection process for which SMR technology to would be supported for deployment to help reach the UK's 24 GWe capacity goal.

In June 2025 the government announced that Rolls-Royce SMR had been selected as the preferred bidder, subject to final government approvals.[177] A site is due to be allocated later in 2025, with first grid connection expected in the mid-2030s. A final investment decision is expected to be taken in 2029.[178]

3.2.31 USA

60-year operation (MWe)	80-year operation (MWe)	Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
8733	91,158	0	0	7540	0	400,000 (requiring an additional 292,569)	400,000



The United States has 96 operable reactors, with total capacity of 102 GWe gross, 97 GWe net. Almost all US reactors were built between 1967 and 1990, except for Watts Bar 2, which first started construction in 1973, but then was suspended, before being completed in 2013, and Vogtle 3&4, where construction started in 2013 and the two units were brought online in 2023 and 2024.

In May 2025 President Trump signed a series of executive orders with the aim of increasing US nuclear energy capacity to 400 GWe by 2050, with 5 GWe of power uprates and 10 large reactors under construction by 2030.

The *Reinvigorating the Nuclear Industrial Base* executive order aims to strengthen the US fuel cycle, develop transport technologies for nuclear fuel, expand conversion and enrichment capacity, use surplus plutonium in fuel and expand the nuclear energy workforce.

The *Reforming Nuclear Reactor Testing at the Department of Energy* executive order aims to expedite the deployment of advanced reactors at the department's facilities and establish a pilot programme for reactor construction outside of national laboratories, with the goal of three reactors reaching criticality by July 2026.

In pursuit of the *Reforming Nuclear Reactor Testing at the Department of Energy* executive order the US Department of Energy (DOE) announced in August 2025 its initial selection of 11 advanced reactor projects for the Nuclear Reactor Pilot Program. The selected companies are: Aalo Atomics; Antares Nuclear; Atomic Alchemy; Deep Fission; Last Energy; Natura Resources; Oklo (selected for two projects); Radiant Industries; Terrestrial Energy; and Valar Atomics.

The Ordering the *Reform of the Nuclear Regulatory Commission* aims to expedite the process of licensing applications and adoption of new technology.

President Trump's goal of 400 GWe of nuclear capacity by 2050 expands upon a goal set by President Biden during the previous administration to triple nuclear capacity by 2050. During the Biden presidency the USA led the 22-country coalition to launch the *Declaration to Triple Nuclear Energy Capacity by 2050* during the COP28 climate change meeting in 2023.[179]

Long-term operation

Almost all reactors in the USA have had their original 40-year operating licences extended to allow operation for 60 years, although several such-licensed have since shut down before reaching 60 years of operation.

The US Nuclear Regulatory Commission (NRC) is considering applications for the extension of operating licences to 80 years, with its subsequent licence renewal (SLR) programme. As of March 2025,[180] nearly 50 reactors have either been approved, are under review, or have declared an intent to seek approval:

- Reactors approved (to 80 years): Turkey Point 3&4, Peach Bottom 2&3, Surry 1&2, North Anna 1&2, Monticello, Virgil C. Summer 1
- Reactors under review: Point Beach 1&2, Oconee 1-3, St. Lucie 1&2, Browns Ferry 1-3, Dresden 2&3.
- Reactors expected to apply: H.B. Robinson 2, Edwin I. Hatch 1&2, Duane Arnold, Palisades, Nine Mile Point 1, Ginna, Cooper, Watts Bar 1, Farley 1&2, Prairie Island 1&2, Hope Creek, Salem 1&2, Donald C. Cook 1&2, Millstone 2&3, Three Mile Island 1, plus seven unnamed units.

Reactor restarts

Several reactors that had shut down are now in the process of restarting. Constellation plans to restart the 880 MWe reactor at the Crane Clean Energy Centre, previously known as Three Mile Island 1, in 2027. The unit, which commenced operation in 1974, was closed in 2019. Plans to restart the reactor were announced in 2024, when Microsoft signed a 20-year power purchase agreement with Constellation.[181]

Holtec is pursuing a restart of Palisades, which ceased operation in 2022, having been first grid connected in 1971. The plant resumed operational status in August 2025, with plans to restart the reactor before the end of the year. Holtec intends to apply for a subsequent licence renewal to permit operation of the plant until 2051.[182]

NextEra Energy has told the NRC that it intends to submit an environmental review document for the proposed restart of the 624 MWe Duane Arnold nuclear power plant in October 2025. The plant, which was first grid connected in 1974, was shut down in 2020.[183]

New capacity

Large-scale reactors

GE Hitachi's ABWR and ESBWR, Korea's APR1400 and Westinghouse's AP1000 have all received US design certification.

In July 2025 Westinghouse announced plans to start the construction of ten new AP1000 reactors in the USA, with construction to start by 2030.[184]

In June 2025 Fermi America submitted the first part of its COL application to build four AP1000 reactors in Carson County, Texas. The second part of the COL application was submitted in August. The company aims to put the first reactor in operation in 2032, followed by the others in 2034, 2035 and 2036.

Small-scale reactors

In addition to restarting the shutdown Palisades reactor, Holtec intends to commission the first two of its SMR-300 units at the Palisades site by 2030. The SMR-300 is a PWR with a net capacity 300 MWe. In February 2025 Holtec signed an expanded construction agreement with South Korea's Hyundai E&C.[185]

In March 2024, TerraPower submitted a construction permit application for a Natrium reactor at Kemmerer in Lincoln County, Wyoming, near PacifiCorp's Naughton coal-fired plant. The Natrium reactor is based on the GE Hitachi (now GE Vernova Hitachi Nuclear Energy) 345 MWe (840 MWt) PRISM sodium-cooled fast reactor coupled with a molten salt-based energy storage system. The Natrium storage technology allows the system's output to be increased to 500 MWe for five-and-a-half hours. A groundbreaking ceremony at the site took place in June 2024 to mark the start of construction of the 'sodium test and fill facility', which will be used to test components for use in the Natrium plant as well as to carry out the initial transfer of sodium to the plant.

Dow (owner of Dow Chemical Company) and reactor company X-energy submitted a construction licence application to the NRC in March 2025 for four 80 MWe Xe-100 high-temperature gas-cooled small modular reactors at the Long Mott Generating Station in Calhoun County, Texas. The plant would provide process heat and electricity to The Dow Chemical Company's Seadrift Operations site.[186] In addition to electricity, the Xe-100 units would also provide high-temperature steam for industrial processes.[187]

The Xe-100 is also intended for deployment at the site of Energy Northwest's Columbia nuclear plant in Washington state. A joint development agreement has been signed between Energy Northwest and X-energy for the deployment of up to 12 Xe-100 units.[188]

Tennessee Valley Authority (TVA) intends to deploy a GE Hitachi BWRX-300 at the Clinch River site at Oak Ridge, Tennessee. The NRC accepted for review the construction permit application in July 2025; the review is expected to be completed within 17 months.[189]

Oklo plans to build its first Aurora unit at Idaho National Laboratory by early 2028. It selected Kiewit Corporation as the lead constructor in July 2025.Oklo had previously submitted an application to the NRC in March 2020 to build and operate an Aurora compact fast reactor at the INL site. However, in January 2022 the regulator said it had insufficient data for the process to move forward. The company resumed pre-licensing activities with the NRC later that year.

Aalo started ground works on the site of its Aalo-X reactor in August 2025. The unit will be a precursor to the company's 50 MWe sodium-cooled Aalo-1 reactor. Aalo aims to reach first criticality with the test unit by July 2026, and to deploy the Aalo-1 reactor by 2029.

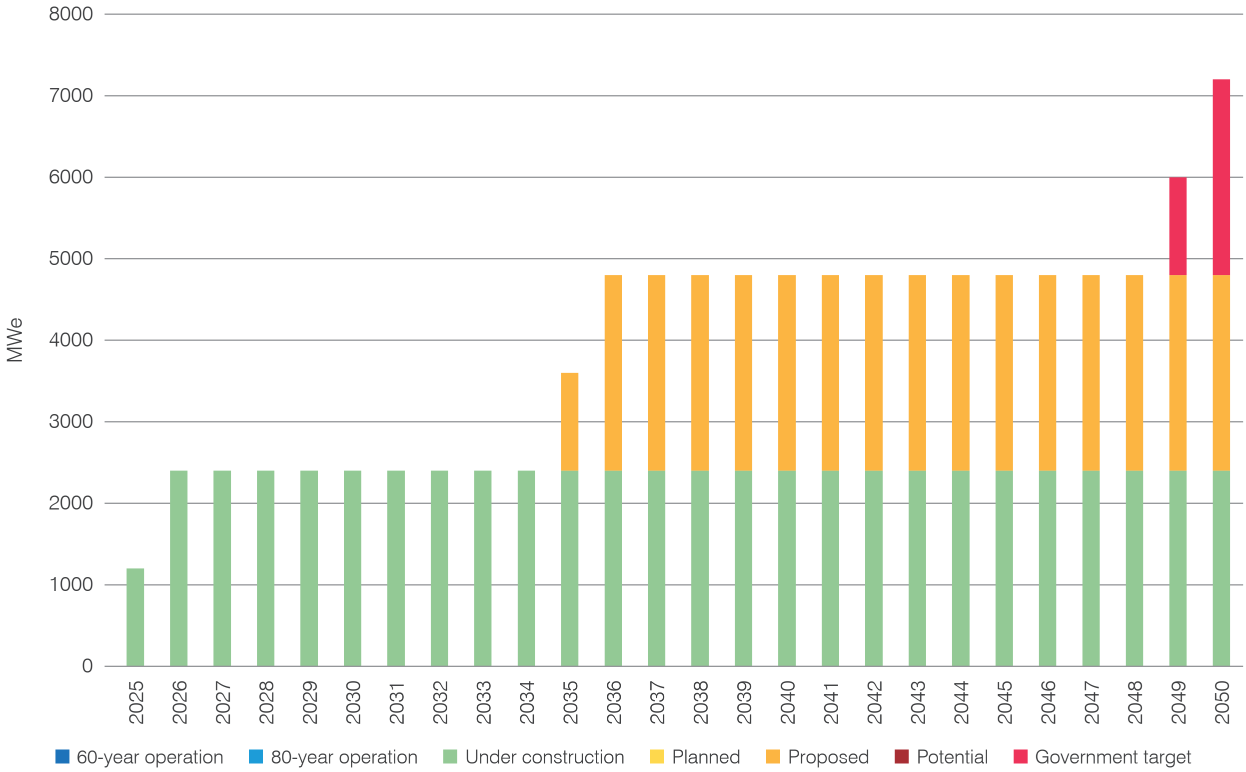
A power purchase agreement between Kairos Power and the Tennessee Valley Authority was signed in August 2025 that would see Kairos Power's Hermes 2 deliver power to the grid for Google's data centres.

ENTRA1 Energy has signed a collaborative agreement with TVA to deploy up to 6 GW of NuScale SMR capacity at sites across TVA's seven-state service region in south-eastern USA.[190]

3.3 Countries with first reactors under construction

3.3.1 Bangladesh

Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
2400	0	2400	0	7200 (requiring additional 2400)	7200



Bangladesh's Integrated Energy and Power Master Plan (IEPMP) 2023 targeted a total nuclear capacity of 2400 MW by 2030, 4800 MW by 2041 and 7200 MW by 2050,[191] noting that "to build a low carbon economy, clean energy supply must expand rapidly, which includes hydro, nuclear, solar PV, wind, modern biomass as well as CCS, ammonia and hydrogen."

New capacity

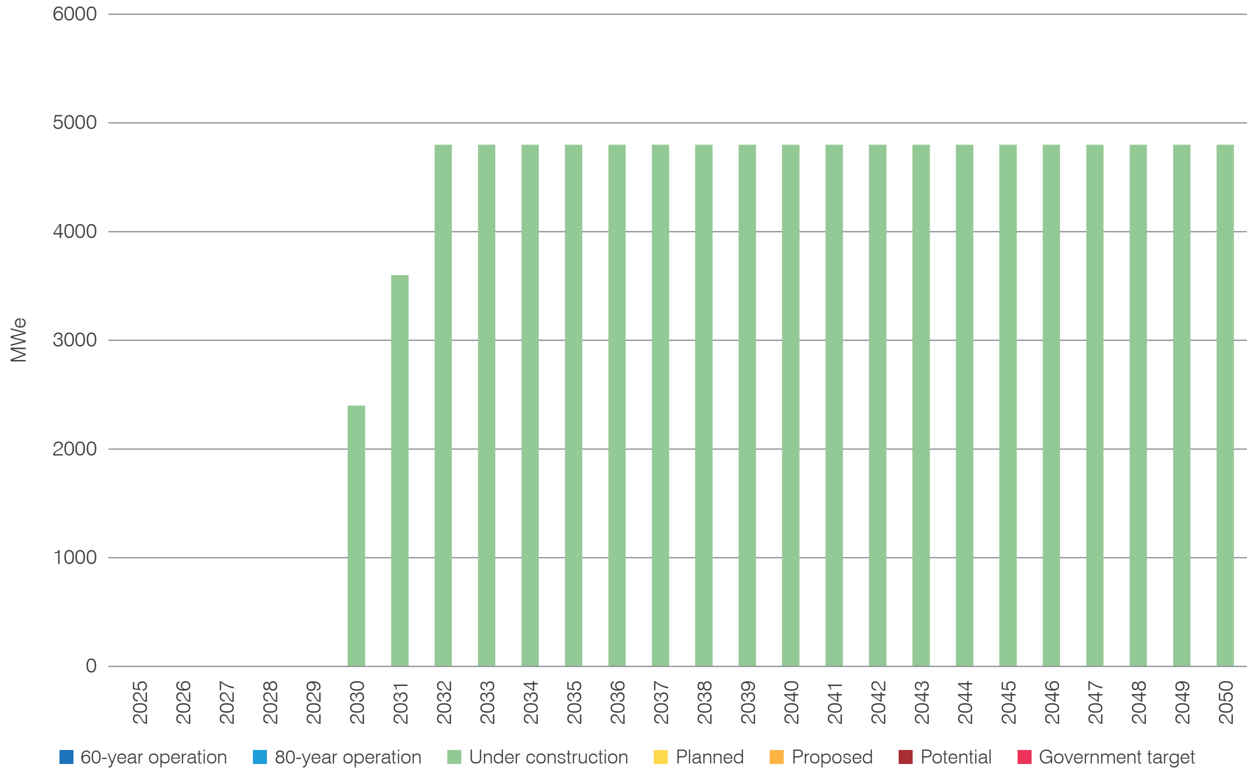
Large-scale reactors

Bangladesh has two Russian VVER-1200 reactors under construction at Rooppur. Construction of Rooppur 1 started in November 2017 and unit 2 in 2018. Hot testing of unit 1 was carried out in July 2025.[192]

Although the interim government has accused former prime minister Sheikh Hasina of misappropriating $5 billion through inflating the cost of the Rooppur deal, the country is still pursuing nuclear energy. Discussions over the last 10 years with both Japan and China have yet to develop significantly.[193]

3.3.2 Egypt

Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
4800	0	0	0	0	4800



Egypt has a strategy to diversify the energy mix, including through the use of renewable and nuclear energies.[194]

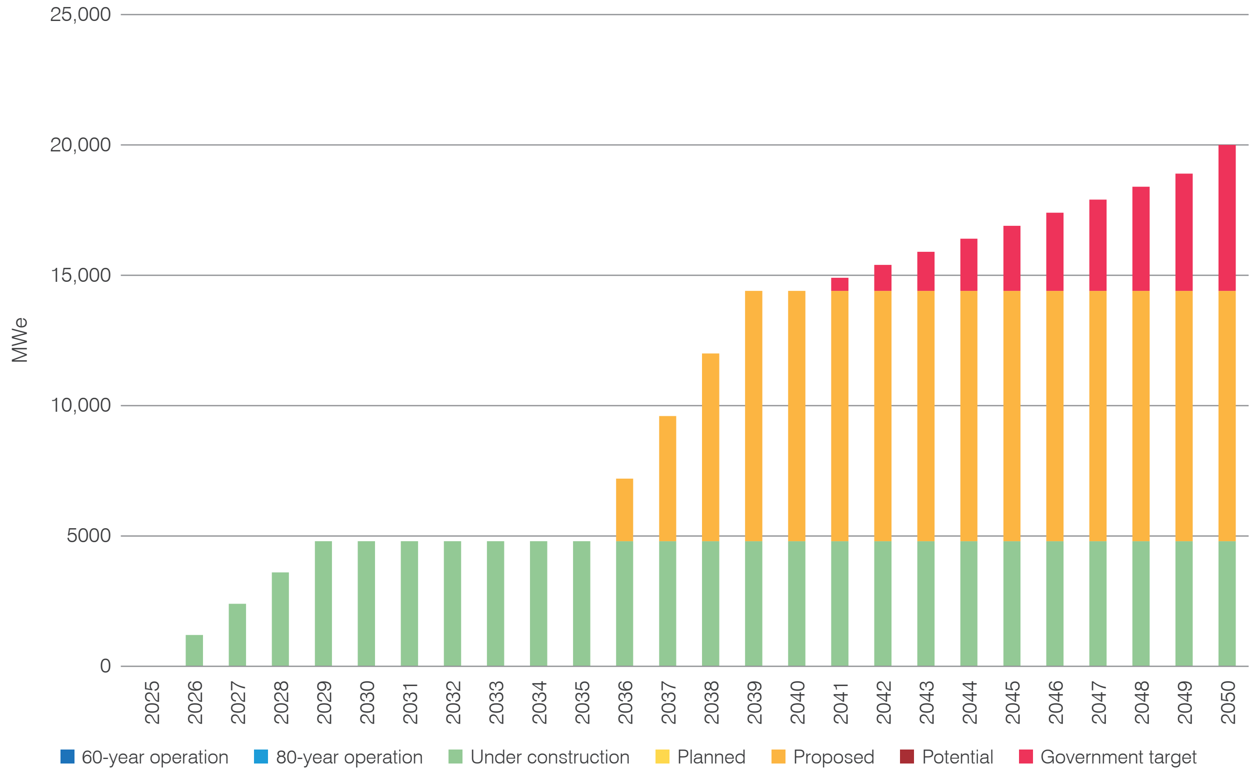
New capacity

Large-scale reactors

Four VVER-1200 reactors are under construction at El-Dabaa, with the first unit planned to be online in 2028.[195] An initial agreement for the project – the first commercial nuclear power plant in the country – was signed in 2015. Construction of unit 1 began in July 2022, unit 2 in November 2022, unit 3 in May 2023 and unit 4 in January 2024. Egypt's aim is for 9% of electricity to be generated by nuclear by 2030, which would be achieved by the commercial operation of the first two units by that time, directly displacing oil and gas.[196]

3.3.3 Turkey

Under Construction (MWe)	Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
4800	0	9600	0	20,000 (Requiring an additional 5600)	20,000



The Turkish government plans that by the 2050s, Turkey would have 20,000 MWe of nuclear capacity installed.[197] In 2024 the energy minister said that the country's energy demand was growing and "our first priority is to ensure the security of supply in a sustainable manner" while also making Turkey carbon-neutral by 2053.

New capacity

Large-scale reactors

The Akkuyu plant comprising four VVER-1200 units is under construction in Mersin province on Turkey's southeastern coast. It is expected to generate around 10% of Turkey's electricity when completed.

A second plant is planned for Sinop, on Turkey's northern coast. There are also plans for a third plant in the Thrace region, in the country's northwest.[198]

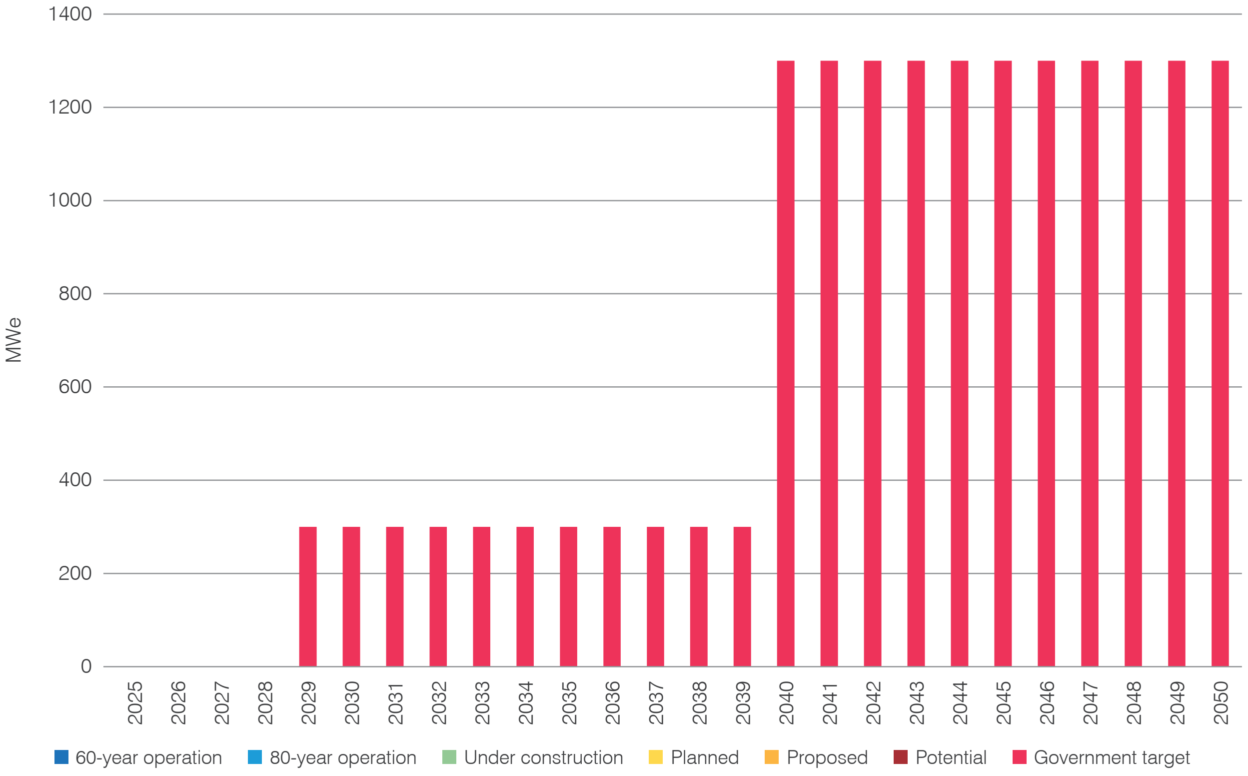
Small-scale reactors

Turkey is developing plans for small modular reactors, with the aim of adding 5 GWe of capacity by 2050. Turkey's state-owned EUAS International ICC signed a Memorandum of Understanding (MoU) with the UK's Rolls-Royce in March 2020 to evaluate the technical, economical and legal applicability of small modular reactors (SMRs).[199]

3.4 Prospective nuclear countries

3.4.1 Ecuador

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	1300	1300

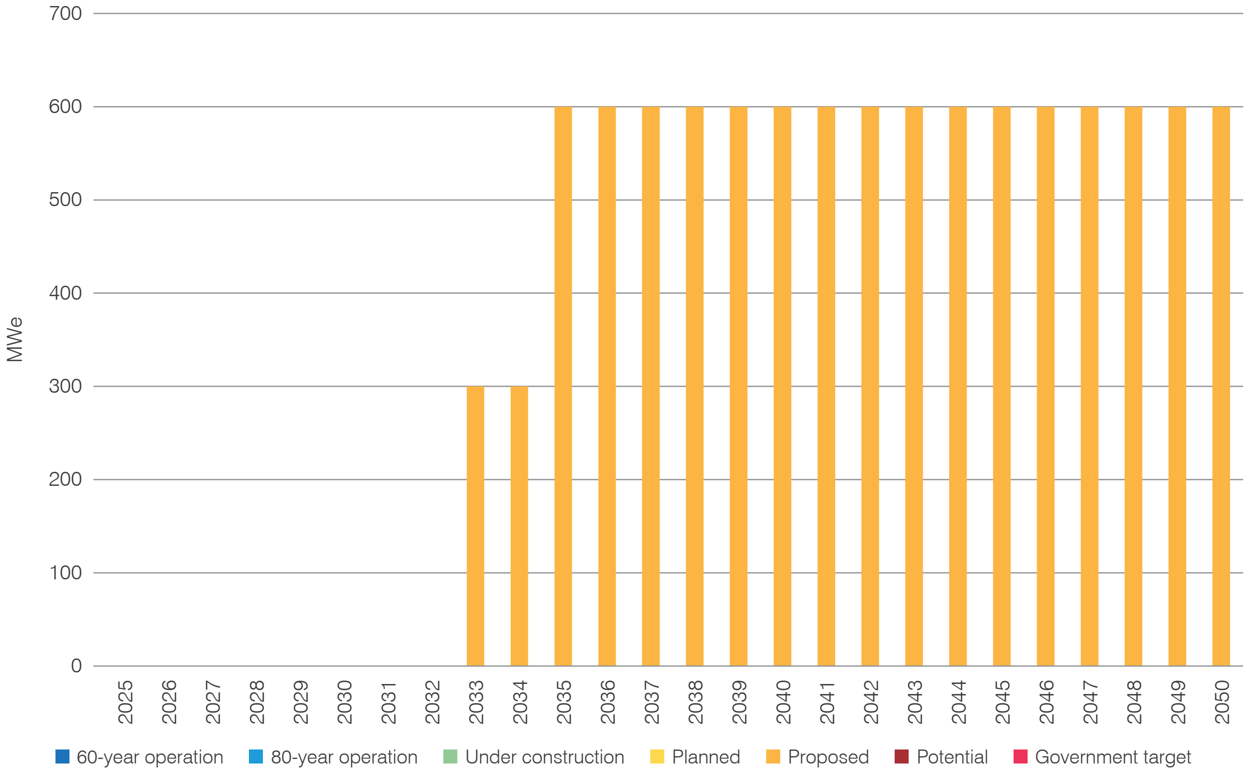


In 2025 the Ecuadorian government published new plans for nuclear power in the country, coming in response to severe energy shortages faced in 2024.[200]

The plan included the development of a 300 MWe small modular reactor in the medium term. In the longer term, the plan envisions constructing a 1000 MWe nuclear plant.

3.4.2 Estonia

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	600	0	0	600



Estonia has relied heavily on oil shale for its electricity production. Eesti Energia, owner of the world's two largest oil shale-fired power plants (Balti, 765 MWe, and Eesti, 1615 MWe), both in Narva in the east of Estonia, plans to end the production of electricity from oil shale by 2030.

In its draft update of Estonia's National Energy and Climate Plan for 2030 (approved in August 2023), the government had set a target of covering 100% of electricity consumption with renewable energy.

In June 2024, the Estonian parliament passed a resolution supporting the adoption of nuclear energy in the country. Estonia is one of the 16 nations that have joined the Nuclear Alliance within the EU to promote the use of nuclear energy.

In late 2020 the government convened the Nuclear Energy Working Group (NEWG) to consider the options for the development of nuclear power in Estonia. The final report of the NEWG issued at the end of 2023 stated that SMRs would be suitable for the country. A sub-working group of the NEWG proposed 16 possible coastal locations for nuclear power plants.[201]

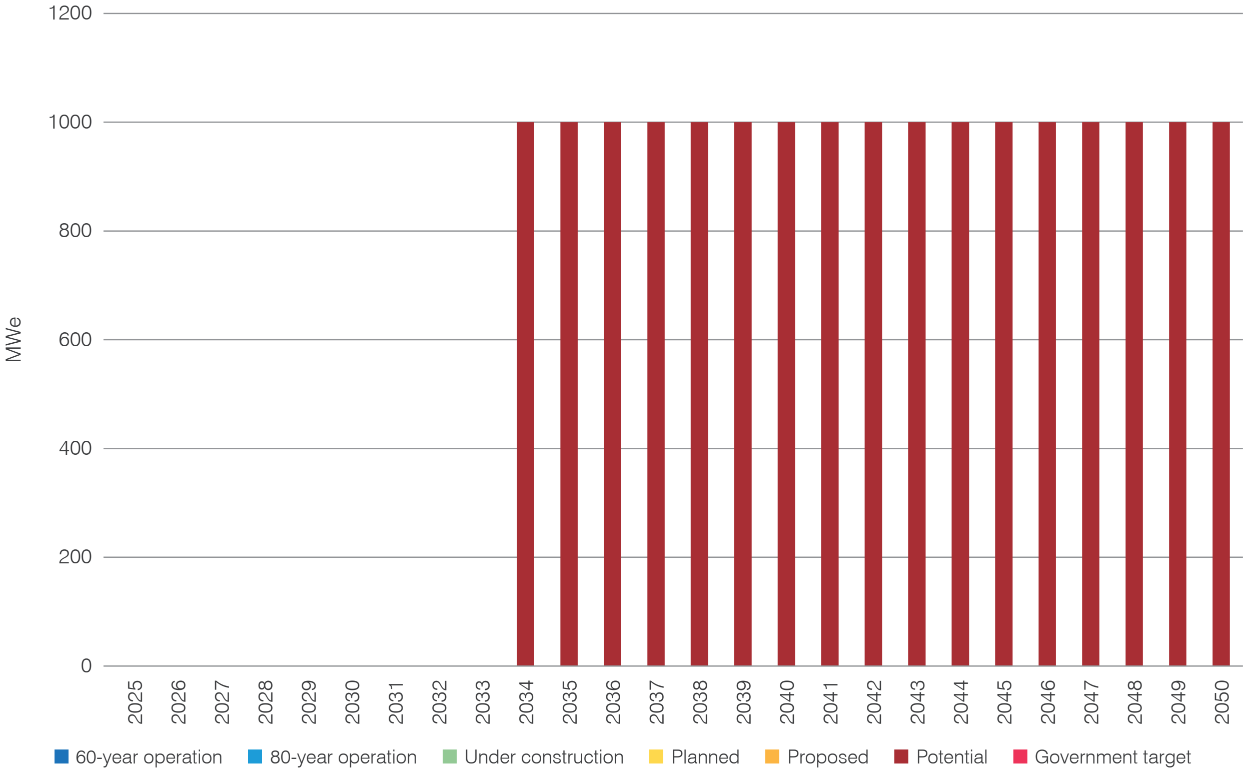
New capacity

Small-scale reactors

Estonia's Fermi Energia has selected GE Hitachi Nuclear Energy's BWRX-300 small modular reactor for a 600 MWe nuclear power plant with two units (2x300 MWe) to be built by the mid-2030s.[202] Fermi Energia has completed geological studies in the Viru-Nigula municipality of northeastern Estonia to assess the suitability of the area for the construction of an SMR plant, the company is also considering a site in the neighbouring Lüganuse municipality.

3.4.3 Ghana

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	1000	0	1000



The Ghanaian government has been considering using nuclear energy for nearly 20 years. In September 2021 Ghana's Minister of Environment, Science, Technology and Innovation said that five vendors – from Canada, Russia, South Korea and the USA – had responded to a request for interest issued to help the country build its first plant, with the expectation being that a contract would be signed for a 1000 MWe plant sometime in 2024/2025.

New capacity

Large-scale reactors

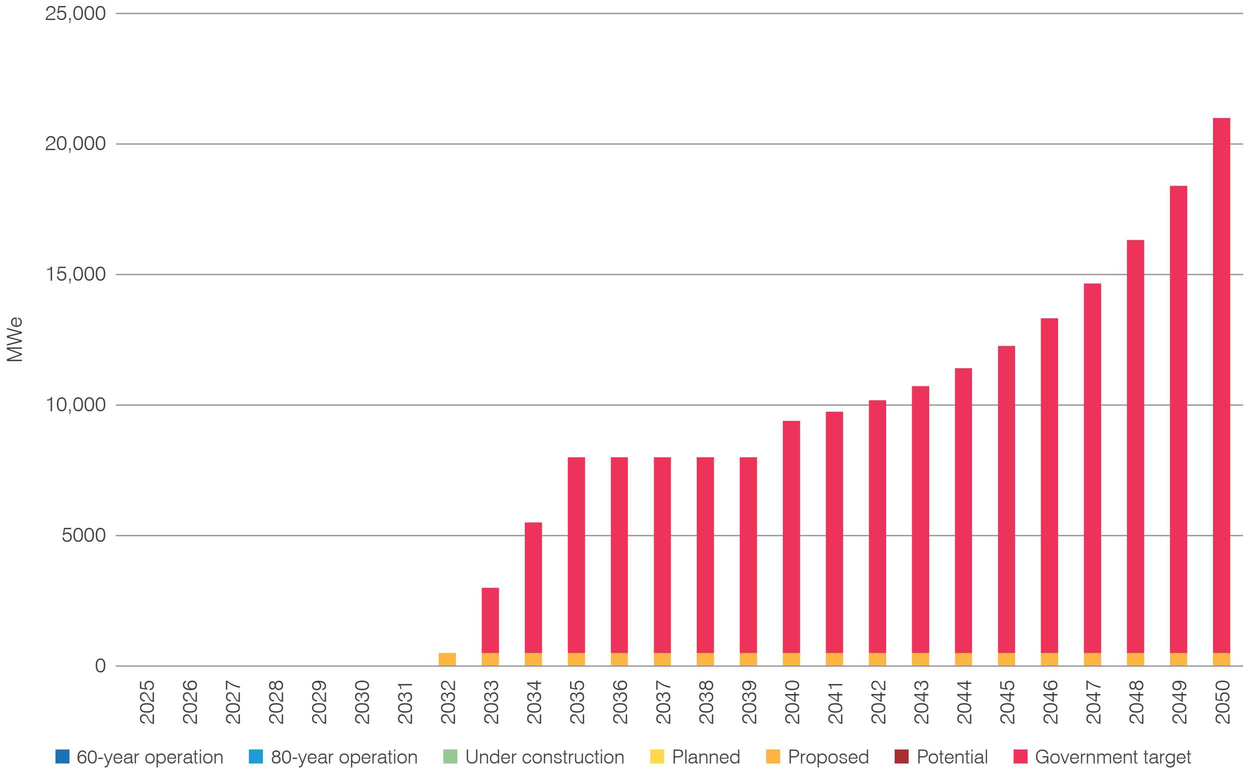
In 2018 Nuclear Power Ghana (NPG) was established to be the owner/operator of Ghana's first nuclear plant. In September 2023, NPG announced that it selected Nsuban in Ghana's Western Region as its preferred nuclear power plant location, with Obotan in the Central Region as a backup site.[203,204] Ghana aims for start-up of a 1000 MWe plant by 2034.[205]

Smale-scale reactors

In August 2024, NPG and Regnum Technology Group signed an agreement to deploy a single NuScale VOYGR-12 multi-module SMR plant.

3.4.4 Indonesia

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	500	0	20,500	21,000



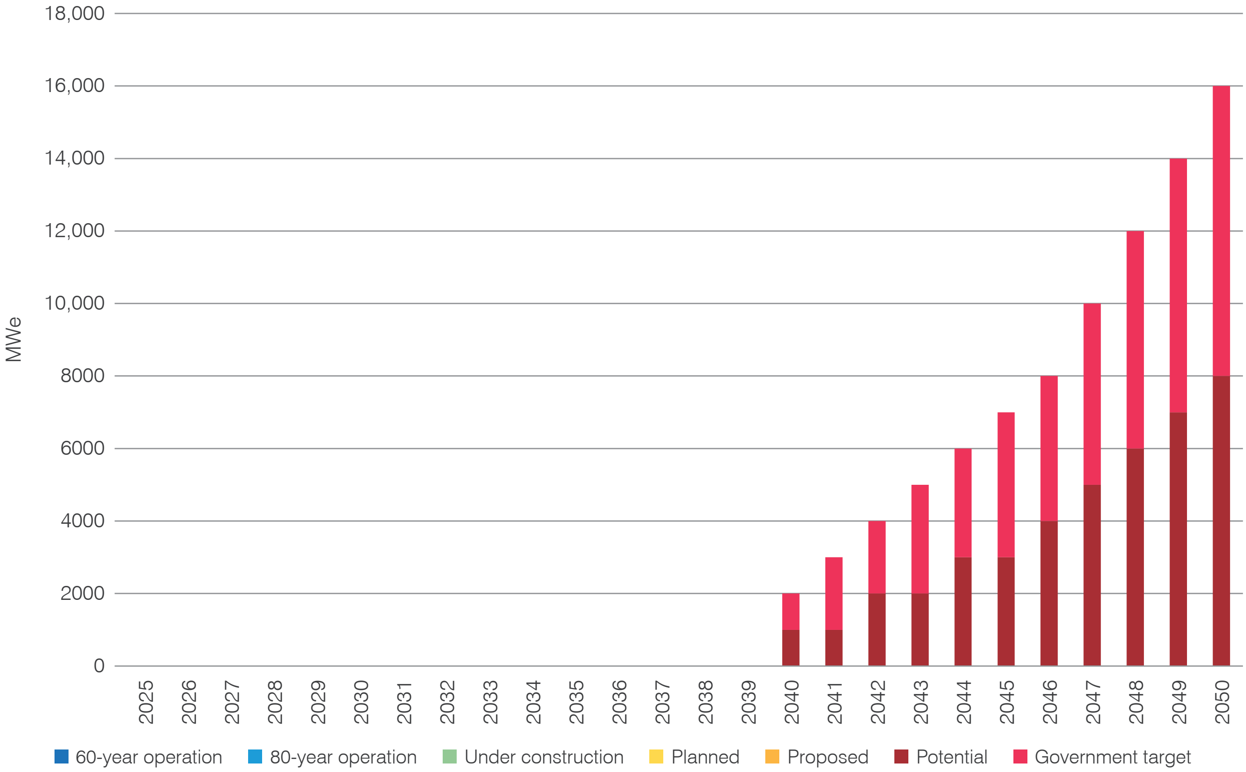
The Indonesian government has committed to implementing an energy transition to reduce climate change and achieve net-zero emissions by encouraging research and development of renewable power generation technologies. The Indonesian National Energy Council targeted 8 GWe of installed capacity to come from nuclear power plants in 2035, increasing to 45-54 GWe in 2060,[206] with an intermediary target of 21 GWe in 2050.[207]

PT Thorcon Power Indonesia has initiated the licensing process for the construction of a power plant based on its advanced molten salt reactor technology. A site at Kelasa Island, located in Central Bangka, is being investigated to host the plant. The two-unit plant would have a capacity of 500 MWe and is planned to start operation by 2032.

In September 2025 President Prabowo Subianto signed the revised National Energy Policy (KEN), setting Indonesia's energy transition pathway to net-zero emissions by 2060. The policy designated nuclear energy as part of the new national energy mix, with targets for nuclear to contribute 0.4-0.5% by 2032, 2.8-3.4% by 2040, 6.8-7.0% by 2050 and 11.7-12.1% by 2060.

3.4.5 Italy

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	8000	8000	16,000



Italy operated a total of four nuclear power plants starting in the early 1960s but decided to phase out nuclear power in a referendum that followed the 1986 Chernobyl accident. It closed its last two operating plants, Caorso and Trino Vercellese, in 1990.

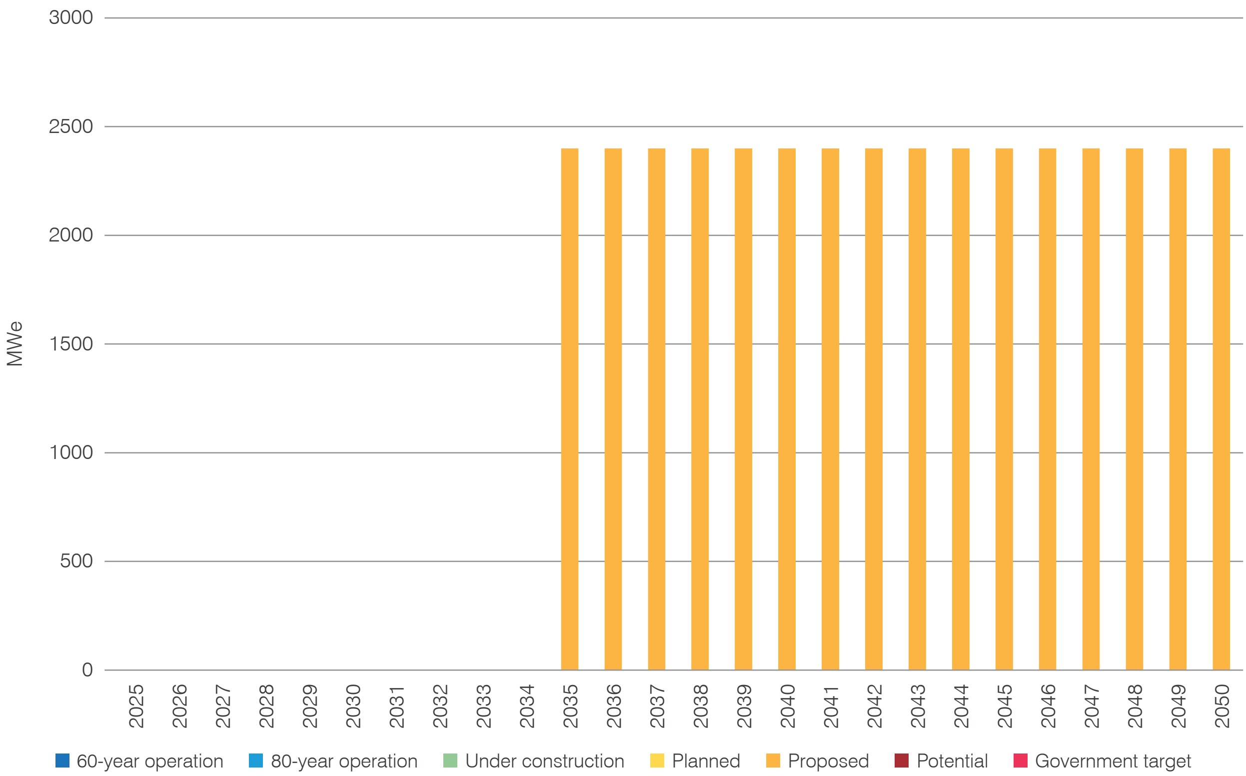
In March 2023, the Italian Chamber of Deputies' Environment Committee decided to conduct a fact-finding study on the role of nuclear energy in guiding Italy through the energy transition, to achieve decarbonization by 2030 and climate neutrality by 2050.[208]

Italy's government included potential new nuclear capacity in its National Integrated Energy and Climate Plan, which was submitted to the European Commission on 1 July 2024. Referring to the Plan, the country's Minister for Environment and Energy Security said: "We expect to be able to reach about 8 GWe from nuclear power by 2050, covering more than 10% of the nation's electricity demand. This percentage may increase to over 20-22% (16 GWe) by fully exploiting the potential of nuclear power in our country."[209]

In October 2025 the Council of Ministers introduced a draft bill delegating responsibility to the government for the reintroduction of nuclear energy.[210]

3.4.6 Kazakhstan

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2400	0	0	2400



Kazakhstan is the world's leading producer of uranium. Although it does not currently use nuclear energy, a Russian-designed BN-350 sodium-cooled fast reactor operated near Aktau for 26 years, until 1999.

In January 2024, the government revealed an action plan aiming for nuclear energy to comprise 5% of the national generation mix by 2035.[211] A public referendum held in October 2024 saw 71% of people support construction of a nuclear power plant.

New capacity

Large-scale reactors

Russia's Rosatom has been selected as the leader of an international consortium to build Kazakhstan's first planned nuclear power.[212] Engineering surveys are being undertaken near Ulken in the Almaty region. Two VVER-1200 units are planned.

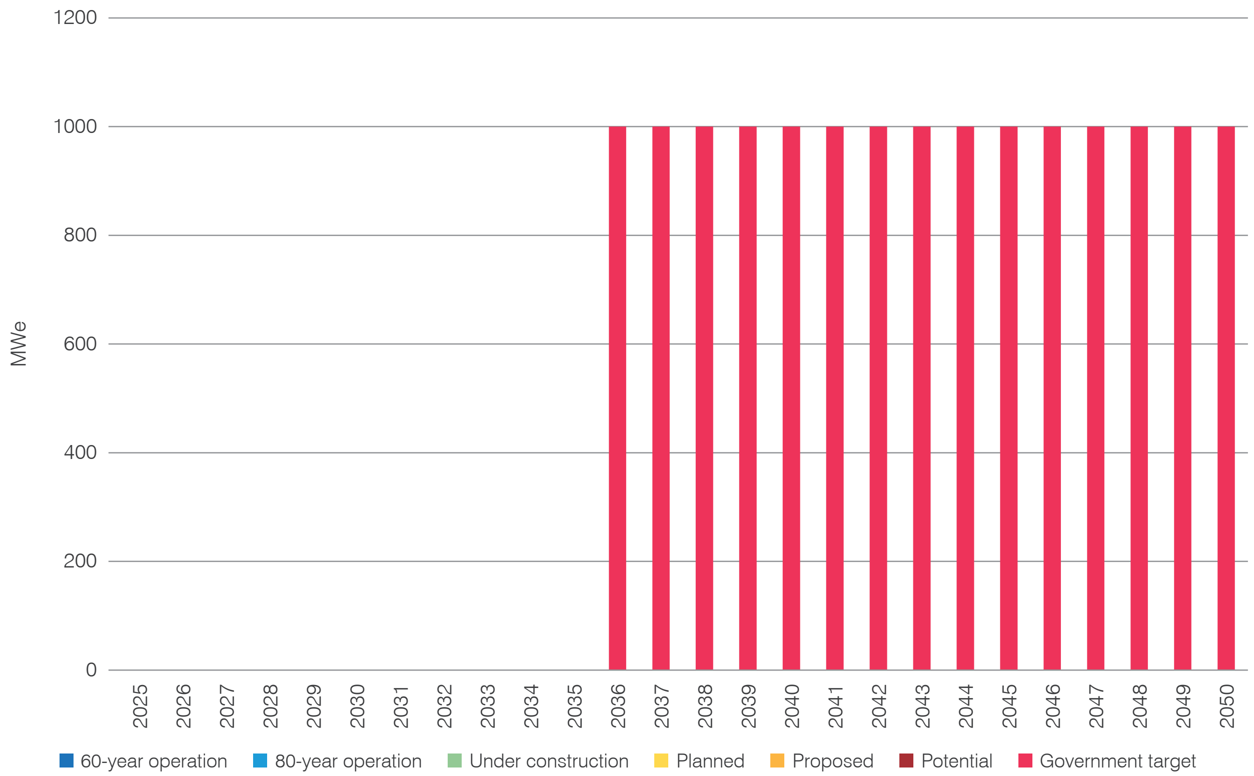
In July 2025 the first deputy prime minister said that CNNC would build the country’s second and third nuclear plants.[213]

Small-scale reactors

Kazakhstan is looking into deploying SMRs. In December 2021 NuScale Power and national nuclear company KNPP signed a memorandum of understanding on exploring the possibility of deploying NuScale VOYGR plants in Kazakhstan[214].

3.4.7 Kenya

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	1000	1000

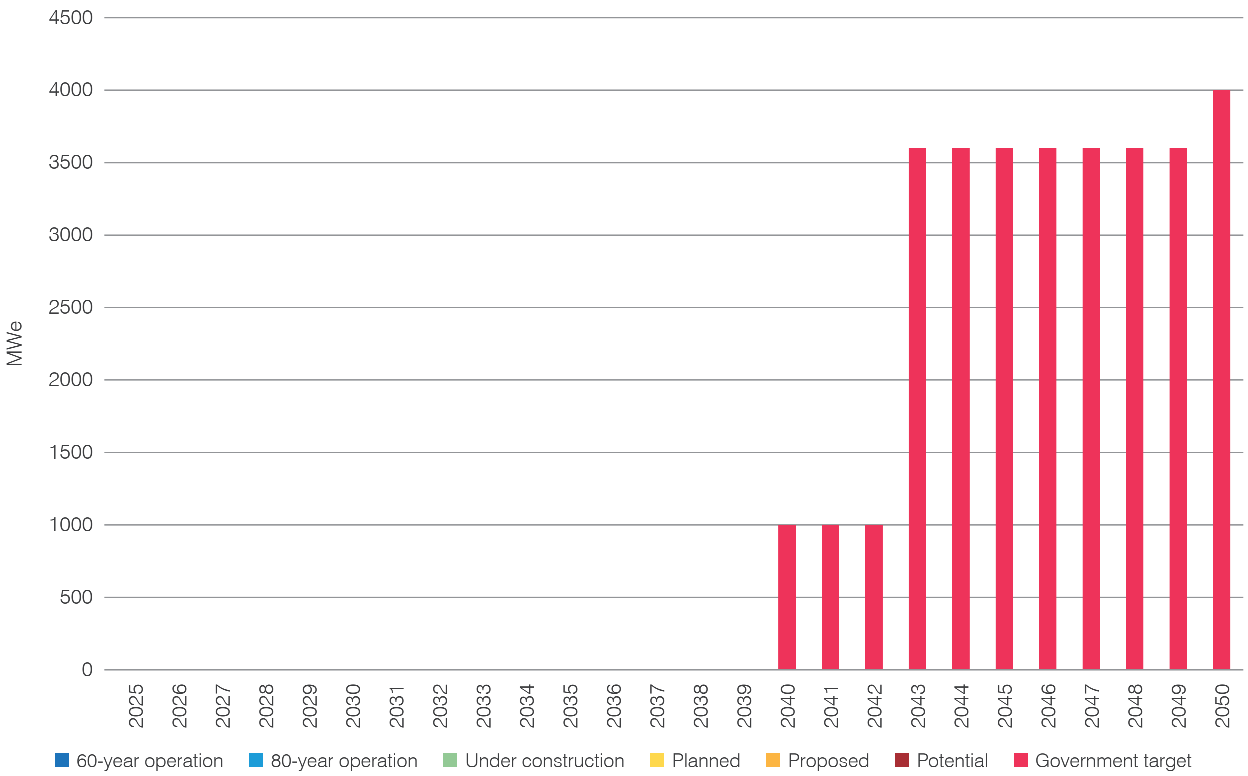


As of mid-2025, Kenya's domestic installed electricity capacity is around 3840 MWe, consisting of hydropower, geothermal, thermal power, wind, solar and biomass facilities.[215]

Kenya's Nuclear Power and Energy Agency's strategic plan, launched in March 2024, envisions the commissioning of its first nuclear power plant by 2035, with construction starting in 2030-31.[216] The organization was planning to launch an international tender process, with a bidding stage between 2026 and 2027 for a 1000 MWe reactor.

3.4.8 Nigeria

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	4000	4000

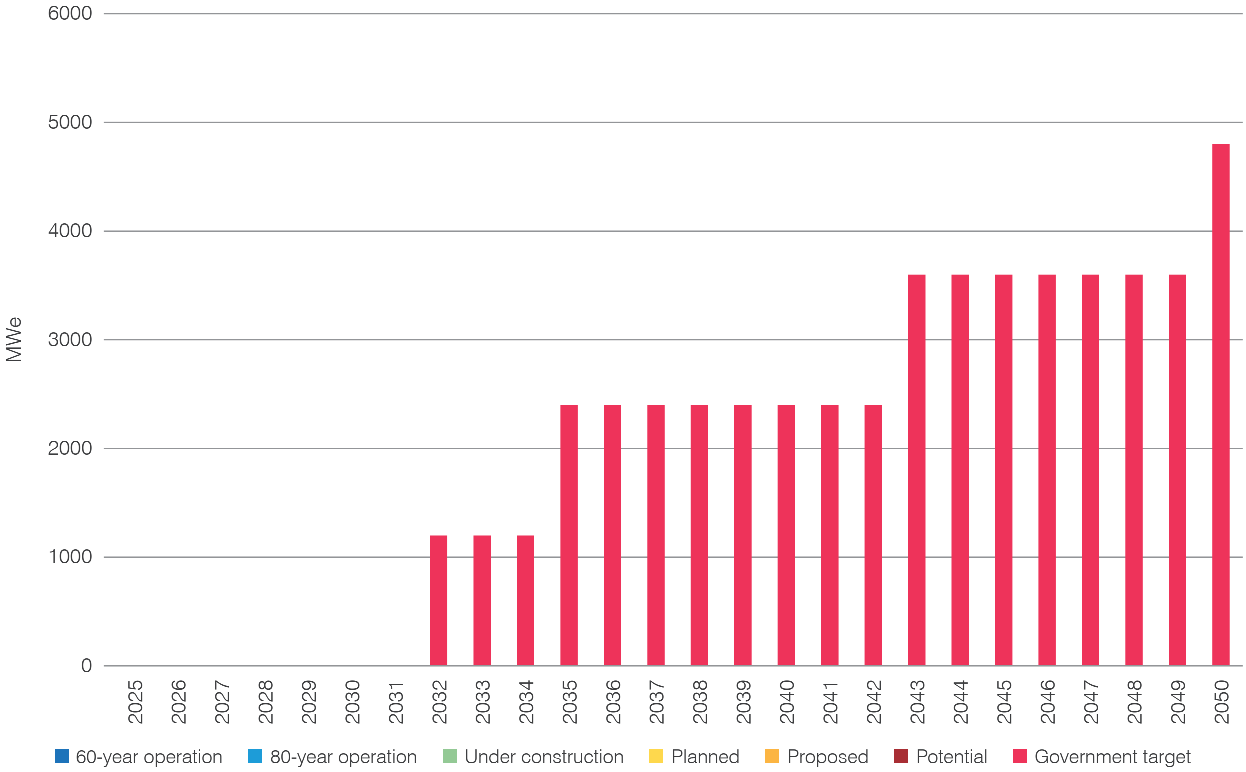


Nigeria plans to build 4000 MWe of nuclear capacity.[217] Agreements relating to the power plant project had been signed with France, India, Russia and South Korea, with the Nigerian Nuclear Regulatory Authority (NNRA) also having agreements on cooperation and training with regulators in Pakistan, Russia, South Korea and the USA.

Two sites for large reactors had been identified by the Nigeria Atomic Energy Commission (NAEC), Geregu in Kogi state and Itu in Akwa Ibom state. However, in May 2025 the country's Minister of Power advised against the proposed construction of four 1200 MWe nuclear units and instead advocated for SMRs.[218]

3.4.9 Philippines

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	4800	4800



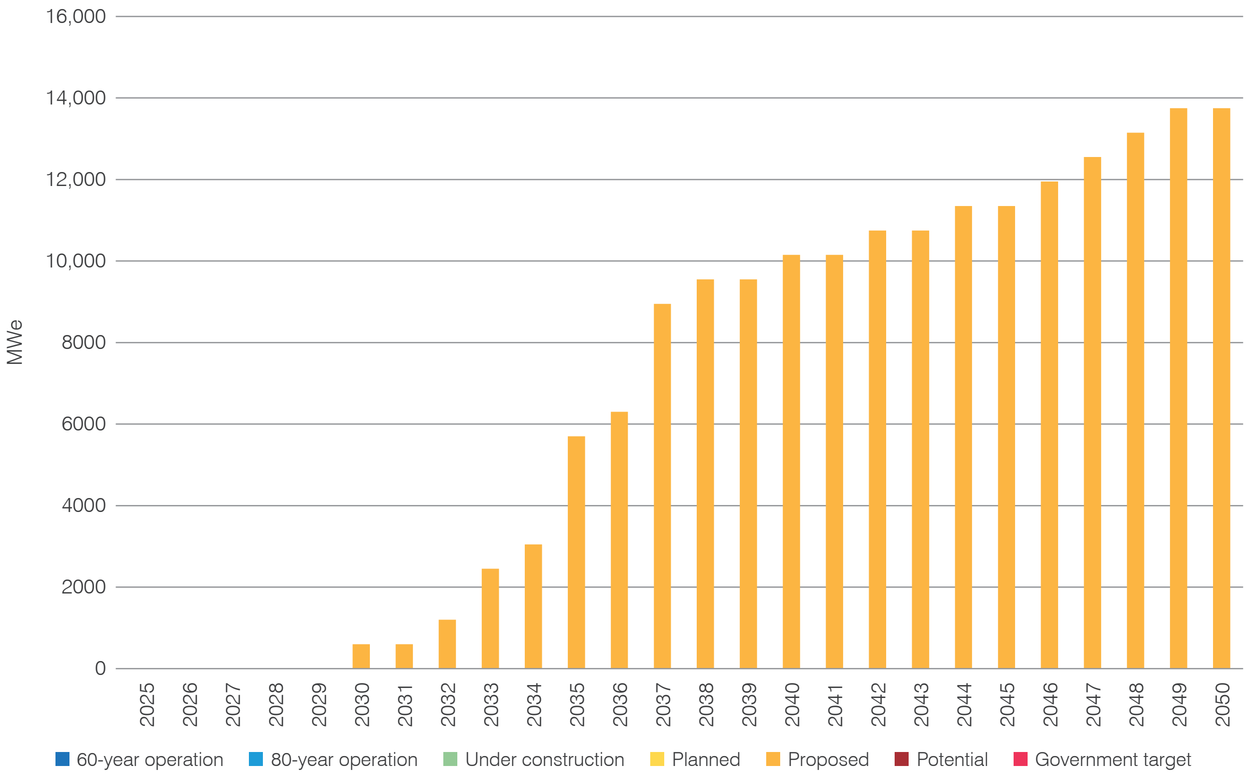
Philippines began construction of a 621 MWe Westinghouse unit at the Bataan nuclear plant in1976, but it was never commissioned. The Philippine government is working with Korea Electric Power Corporation to research on the feasibility of the revival of the Bataan project.[219]

Philippines is also looking at possibilities of building new nuclear power plants, including both large reactors and small modular reactors.

In its Clean Energy scenario, the *Philippine Energy Plan 2023-2050* targets at least 1200 MWe nuclear capacity in 2032, an additional 1200 MWe by 2035 and an additional 2400 MWe by 2050.[220,221]

3.4.10 Poland

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
3750	10,000	0	9000 (met through existing plans and proposals)	13,750



A four-unit VVER-440 plant at Żarnowiec in the north of Poland was under construction in the 1980s, but the project was cancelled in 1990.

In 2009, the Polish government decided to initiate a new nuclear power programme in the country.[222] In *Energy Policy of Poland until 2040 (EPP2040)*, adopted in 2021, Poland planned to bring its first unit online by 2033, and subsequent units every 2-3 years, leading to the construction a total capacity of 6-9 GWe by 2043.[223]

New capacity

Large-scale reactors

At the end of October 2022 the Polish government announced that Westinghouse had been chosen to build the country's first nuclear plant using AP1000 technology with a total capacity of 3750 MWe.[224]

A permit for preparatory works at Lubiatowo-Kopalino was issued in September 2025. Construction is due to begin in 2026, with commissioning of the first unit planned for 2033.[225]

Polish companies ZE PAK and Polska Grupa Energetyczna (PGE), and Korea Hydro & Nuclear Power (KHNP) signed a letter of intent in October 2022 on preparing a plan to build the second nuclear power plant in Pątnów, using Korea's APR1400 technology.[226] A joint venture by PAK and PGE, PGE PAK Energia Jądrowa, submitted an application for the plant to the government in August 2023 and got a decision-in-principle approval in November 2023[227]. However, KHNP withdrew from the project in August 2025.[228]

Small-scale reactors

NuScale VOYGR

In February 2022, Polish copper and silver producer KGHM signed an agreement with NuScale Power to initiate work towards deploying a first NuScale VOYGR SMR power plant in Poland as early as 2029. KGHM lodged an application in April 2023 and received the decision-in-principle from the government in July.

The VOYGR plant, which would have a total capacity of 462 MWe, would consist of six 77 MWe NuScale modules.

BWRX-300

In December 2021, GE Hitachi, BWXT Canada and Synthos Green Energy (SGE) signed a letter of intent to cooperate in deploying BWRX-300 reactors in Poland. In December 2023, Orlen Synthos Green Energy (OSGE) – a joint venture between chemical producers SGE and PKN Orlen – received decisions-in-principle on the construction of SMR plants from the Poland Ministry of Climate and Environment.

The OSGE SMR plan includes 24 BWRX-300 reactors at six different locations – a total capacity of the project 7.2 GWe. The goal of OSGE is to deploy the first SMR in Poland before the end of the 2020s[229].

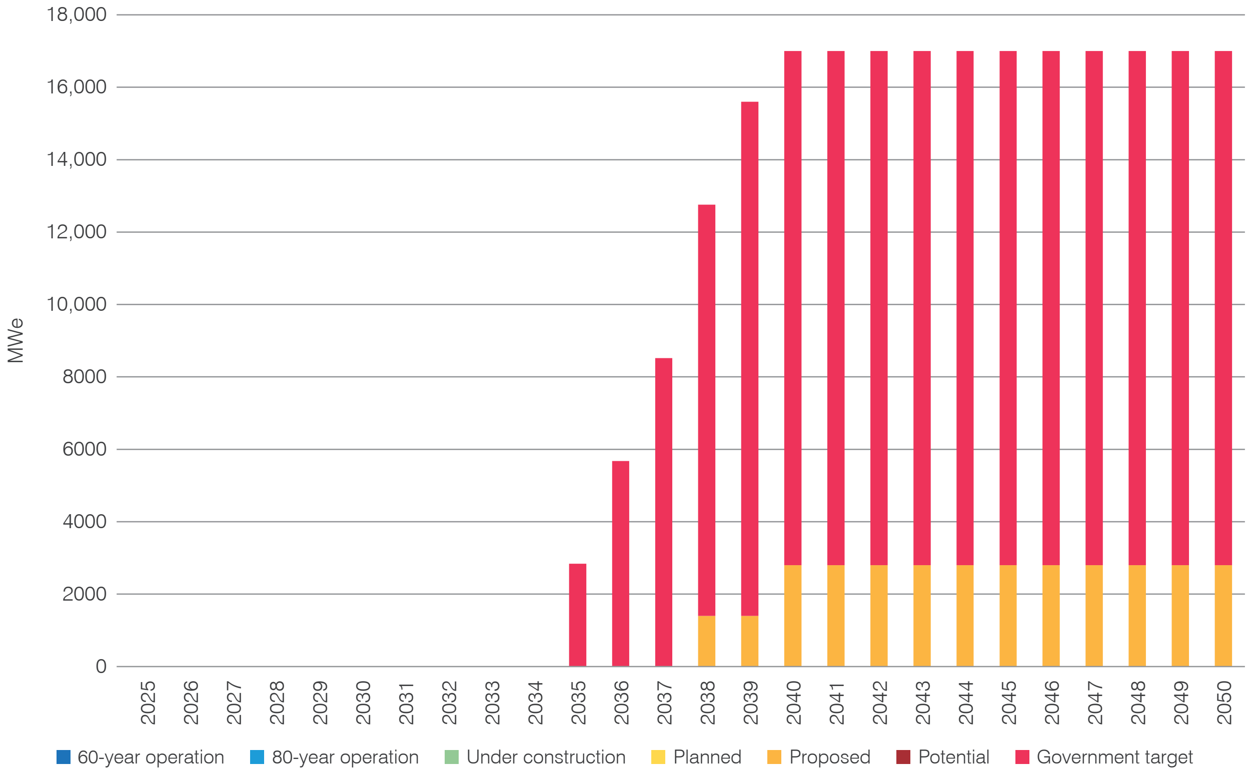
In August 2025 it was announced that the first site would be in Włocławek, in central Poland.[230]

Rolls-Royce SMR

In 2023 Poland state-owned Industria – part of Industrial Development Agency JSC (IDA) – selected Rolls-Royce SMR technology to produce 50,000 tonnes of low-carbon hydrogen every year. The application for a decision-in-principle regarding this Central Hydrogen Cluster project was approved by the Polish Climate and Environment Minister in May 2024.[231]

3.4.11 Saudia Arabia

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2800	0	17,000 (requiring an additional 14,200)	17,000



In April 2013 the King Abdullah City for Atomic and Renewable Energy (KA-CARE) projected 17 GWe of nuclear capacity by 2032.In January 2015 the nuclear target date was moved to 2040.[232]

In September 2016, MEED reported that Saudi Arabia was carrying out technical and economic feasibility studies for the first reactors and was also looking at possible locations for the kingdom's first nuclear project, a 2.8 GW facility.

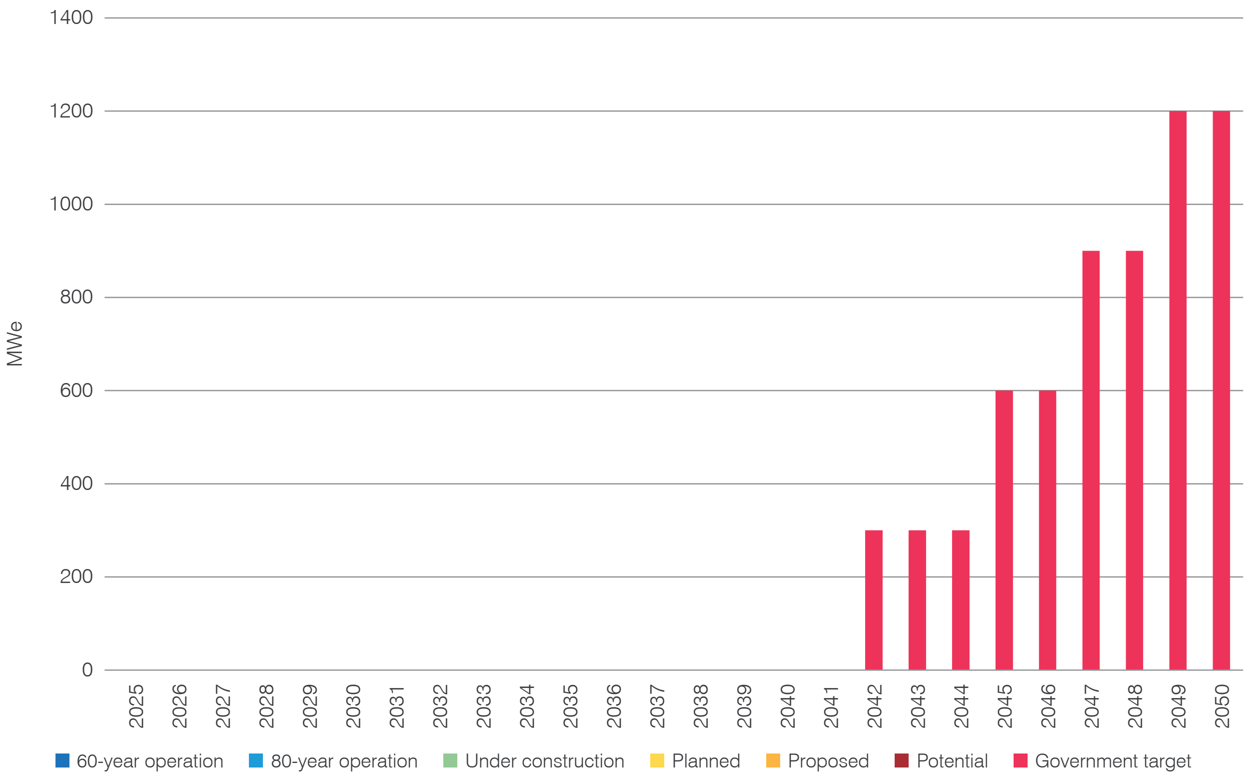
In July 2017, the government approved the establishment of the Saudi National Atomic Energy Project (SNAEP) as part of its 'Vision 2030' plan. There are four core components of the SNAEP:

- Large nuclear power plant – prepare the infrastructure and carry out site characterization out for the first large (1200-1600 MWe) nuclear power plant in Saudi Arabia.
- Small modular reactor – development of SMRs including high-temperature gas-cooled reactors for use in petrochemical industries, thermal applications and water desalination.
- Nuclear fuel cycle – achieve self-sufficiency in nuclear fuel production, including development of indigenous uranium and thorium reserves.
- Regulator – establish a legislative and regulatory framework for the nuclear industry.

A key development of the SNAEP was the establishment in February 2022 of the Saudi Nuclear Energy Holding Company (SNEHC) to act as the developer of the country's national nuclear energy programme.[233]

3.4.12 Serbia

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	1200	1200

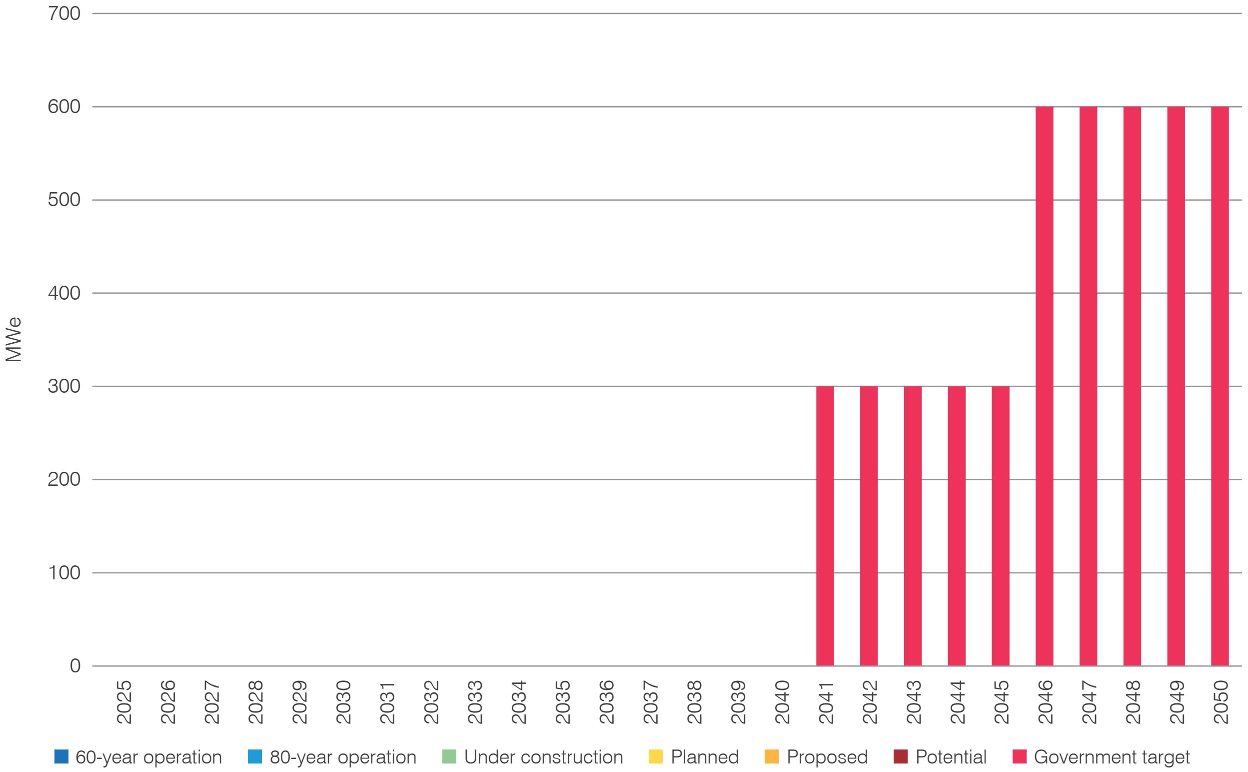


In 2024 Serbia's National Assembly voted through amendments to the energy law which ended the 35-year prohibition on the construction of nuclear power plants. The Serbian *Energy Sector Development Strategy of the Republic of Serbia up to 2040 with Projections up to 2050* includes the potential use of nuclear energy after 2040 as part of climate change commitments.

At the *Nuclear Energy Summit* in March 2024 Serbian president Aleksandar Vučić said Serbia is seeking support from other countries on nuclear know-how and financing towards its goal of establishing 1200 MWe of SMR capacity.

3.4.13 Sri Lanka

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	600	600

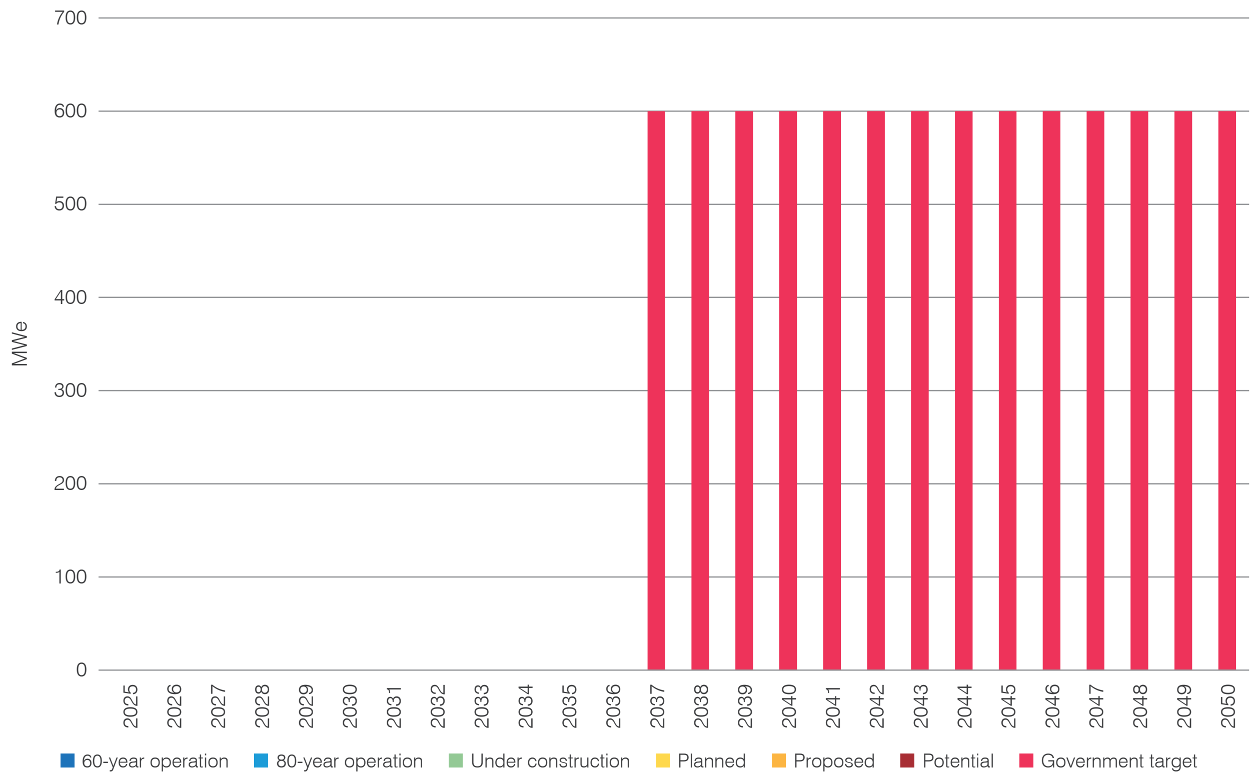


The Sri Lankan government intends to include the use of nuclear energy as a part of long-term generation plans.[234]

The Ceylon Electricity Board's (CEB's) *Long Term Generation Expansion Plan 2023-2042*[235] included a scenario with a 600 MWe nuclear unit starting up after 2040. The report notes that accommodating a single unit above 600 MWe in the Sri Lankan network would be technically challenging for the country's network, based on anticipated demand growth and a generation mix expected to be dominated by intermittent renewables. The report adds that alternative small-scale reactors could be suitable for the country in the future, once these technologies have been proven.

3.4.14 Thailand

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	600	600

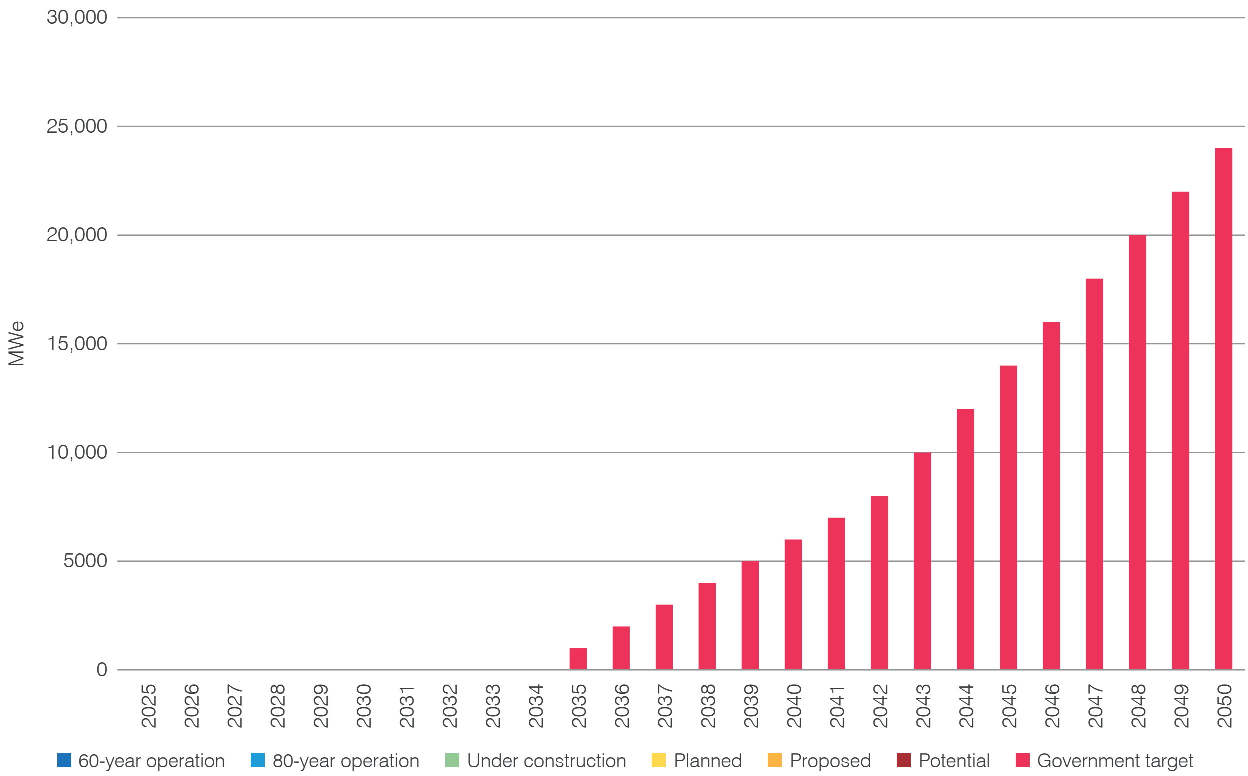


In its draft *Power Development Plan 2024-2037* the Thai Ministry of Energy proposed two 300 MWe SMRs be constructed and operational by 2037, one in the north of the country, and one in the south.[236]

In April 2024, Thai company Global Power Synergy Public Company Limited (GPSC) signed a memorandum of understanding with Denmark's Seaborg Technologies (now Saltfoss Energy) to explore the potential deployment of the Compact Molten Salt Reactor (CMSR) installed on a Saltfoss Power Barge in Thailand[237].

3.4.15 Uganda

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	0	0	24,000	24,000



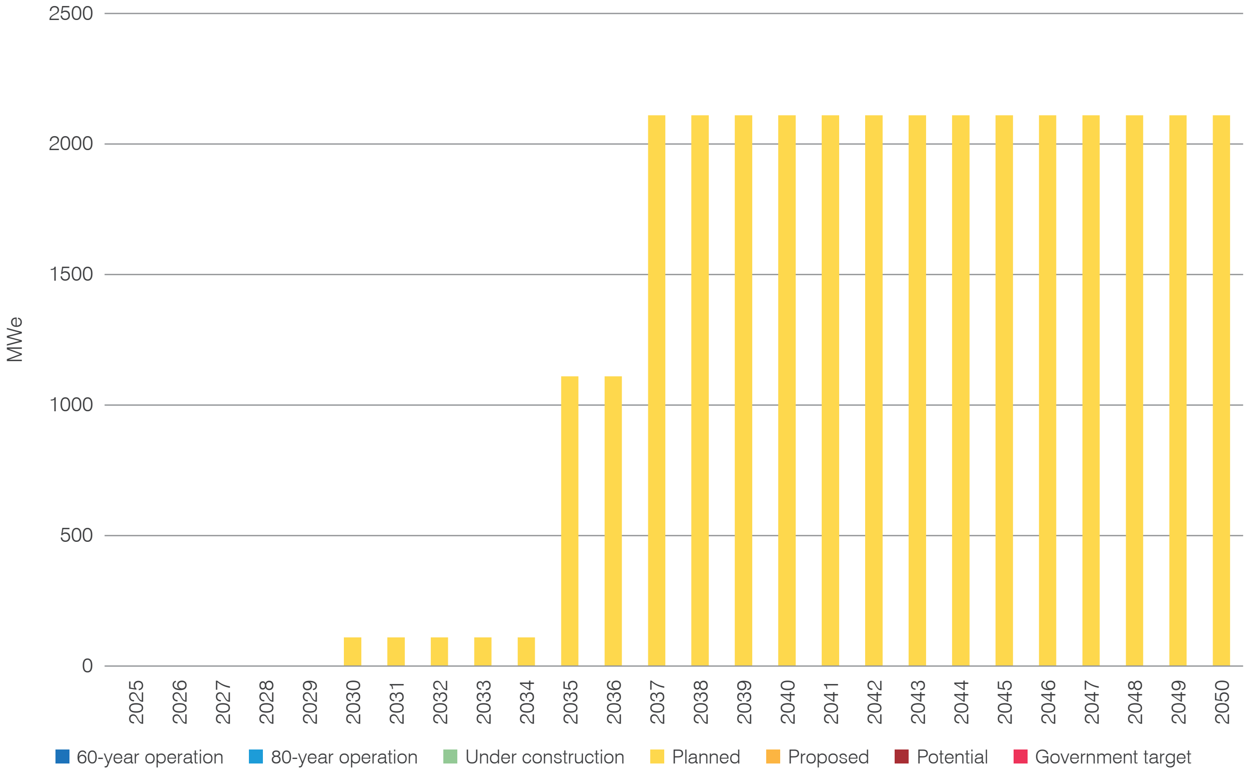
The *Uganda Vision 2040* roadmap[238] launched in April 2013 incorporates the development of significant nuclear capacity as part of the country's future energy mix, with 24 GWe of nuclear capacity by 2040.[239] This ambitious goal was reiterated by the minister of state for energy and mineral development in June 2024.[240]

In May 2022 the country's Minister of State for Energy said the government had acquired land on which to site a nuclear power plant.[241] The base case scenario was for two 1000 MWe units by 2031 with an expected cost of $9 billion.

In August 2023 Ugandan President Yoweri Museveni announced that Russia and South Korea had been selected to build two nuclear power plants with a combined capacity of 15 GWe[242].

3.4.16 Uzbekistan

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	2100	0	0	2400



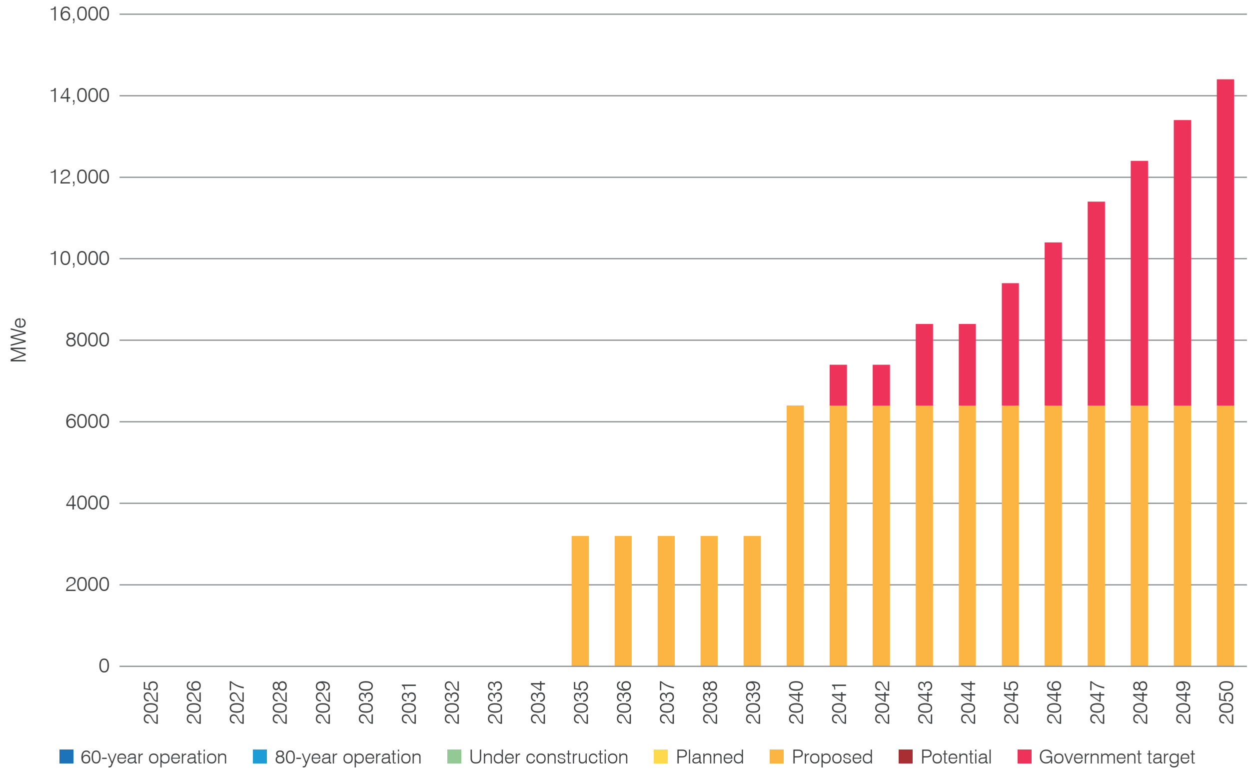
In December 2017 Uzbekistan and Russia signed an intergovernmental agreement on nuclear energy cooperation. In September 2018 a further intergovernmental agreement was signed for construction of two VVER-1200 reactors to be commissioned about 2028.[243]

In 2024 it was announced that the first nuclear development would be a six-unit small modular reactor plant to be built in the Jizzakh region, based on the 55 MWe RITM-200N – the first export order for the Russian design.[244] Pouring of first concrete was scheduled for the spring of 2026.[245,246]

In September 2025 it was announced that the Jizzakh project would now consist of two VVER-1000 units and two RITM-200N units.[247]

3.4.17 Vietnam

Planned (MWe)	Proposed (MWe)	Potential (MWe)	Government target (MWe)	Total for 2050 (MWe)
0	6400	0	8000	14,400



New capacity

Large-scale reactors

The Vietnamese National Assembly agreed a resolution in November 2024 calling for the resumption of the Ninh Thuan nuclear power project – plans had previously been cancelled in 2016. The project consists of two two-unit plants: Ninh Thuan I and Ninh Thuan II, which would each have a capacity of at least 2000 MWe.

In April 2025 Vietnam revised its National Power Development Plan. This indicated each unit of the Ninh Thuan plants could be up to 1600 MWe in capacity. Additionally, the plan identified that a further 8 GWe of capacity would be needed by 2050, with the potential for further increases.[248]

Vietnam aims to complete construction of its first two nuclear plants no later than the end of 2031, according to a February 2025 statement by prime minister Pham Minh Chinh, although concomitant reports indicate that Ninh Thuan I would be completed between 2031 and 2035, while Ninh Thuan II is forecast to be operational in 2036 to 2040.[249]

Vietnam has identified eight potential nuclear power sites across five central provinces, each capable of supporting 4-6 GWe. The designated sites in Ninh Thuan's Phuoc Dinh and Vinh Hai remain the primary focus, but additional locations under review include Quang Ngai, Binh Dinh, Phu Yen, and Ha Tinh provinces.[250]

Smale-scale reactors

In February 2025, the Minister of Industry and Trade said that Vietnam's nuclear energy development would include both centralized nuclear power plants and small modular reactors to diversify the country's energy supply.[251]

3.5 Other prospective nuclear countries

3.5.1 Algeria

In April 2024 a memorandum of understanding was signed between the Algerian Ministry of Energy and Mines and Rosatom on the use of nuclear applications in health and radiotherapy, reactors used in research, nuclear pharmaceutical preparations, and the formation of scientific and technical frameworks, in addition to the development of nuclear technologies and applications for peaceful purposes.[252] Reports at the time did not include details on plans for new nuclear build.

3.5.2 Australia

In 2023, opposition Liberal Party leader Peter Dutton started to advocate for nuclear power, in particular small modular reactors (SMRs), which could be placed at the sites of decommissioned coal-fired power plants.[253] The Liberal-National Coalition has proposed that nuclear power, and specifically SMRs, are needed for Australia to achieve net-zero emissions by 2050.[254,255]

Politically, the ruling Labor party has maintained an anti-nuclear stance since the 1970s. Federal Climate Change and Energy Minister Chris Bowen has dismissed the proposal for nuclear build to be a just a distraction from the need to transition the Australia's energy sector to renewables.[256]

There are several legal hurdles impeding the consideration of nuclear power for Australia. New South Wales has a Uranium Mining and Nuclear Facilities (Prohibition) Act 1986, and Victoria has a Nuclear Activities (Prohibitions) Act 1983. Federally, the Environment Protection and Biodiversity Conservation Act 1999 and Australian Radiation Protection and Nuclear Safety Act 1988 would need to be amended to remove prohibitions against regulation of nuclear power.[257]

3.5.3 Jamaica

In 2023 Jamaica prime minister Andrew Holness expressed the intention of government to introduce nuclear energy, specifically SMRs, to the country.[258] In 2024 Holness signed a memorandum of understanding with Atomic Energy of Canada Limited aiming to deploy SMRs in Jamaica within two decades.

3.5.4 Jordan

Jordan imports almost 96% of its energy needs from outside the country. To meet the growing energy demand, reduce reliance on imported fossil fuels and increase the availability water resources availability through desalination, Jordan has been considering nuclear energy since 2007.[259] In 2008 the Jordon Atomic Energy Commission (JAEC) and the Jordan Nuclear Regulatory Commission (JNRC) were established to facilitate Jordan's nuclear programme.[260]

After several years of assessment and engagement with the potential vendors, Jordan signed an intergovernmental agreement with Russia in 2015 regarding a project for two 1000 MWe reactors. Nevertheless, in 2018 Jordan government announced that the project for large-scale reactors was abandoned and would not be considered in the next 10 years, with SMRs being considered instead. JAEC has signed SMR cooperation agreements with various vendors including CNNC, Rolls-Royce, NuScale, X-energy and Rosatom.[261]

3.5.5 Malaysia

The Malaysian government launched in August 2025 an assessment of the role of nuclear energy in the country's future energy mix.[262] The Ministry of Energy Transition and Water Transformation stated that no decision had yet been made on the implementation, type of technology or capacity of reactor to be developed. The feasibility study will focus on regions where renewable energy deployment faces challenges, such as Peninsular Malaysia and Sabah.

3.5.6 Moldova

In July 2023, Nuclearelectrica and Energocom, two state-owned-enterprises from Romania and Moldova respectively, signed a memorandum of understanding on enhancing the cooperation between the two companies on units 3&4 of Nuclearelectrica's Cernavoda nuclear power plant and explored the possibility of power supply from those units to Moldova.[263]

3.5.7 Myanmar

Myanmar signed an agreement with Rosatom in February 2023 on working together on the use of nuclear energy. The agreement includes cooperation on the training of a workforce for building and operating a small modular reactor.[264]

3.5.8 Norway

Norway relies on hydropower for almost 90% of its electricity production, but has recently been considering the use of nuclear power. In April 2025 the government appointed the Norwegian Radiation and Nuclear Safety Authority, the Norwegian Water Resources and Energy Directorate and the Norwegian Directorate for Civil Protection to develop a plan for an environmental impact assessment programme for a proposed commercial nuclear power project.

The municipality of Vardø in Finnmark proposed nearby Svartnes as a possible site for a 600 MWe nuclear power plant to Norsk Kjernekraft. This would equate to an annual output of up to 5 TWh – "enough to triple the power supply in Finnmark."

Norsk Kjernekraft has also submitted a proposal to the Ministry of Energy for an assessment into the construction of an SMR based in the municipalities of Aure and Heim in southwestern Norway. In April this year, it initiated work on the impact assessment of a plot of land in Øygarden municipality, west of Bergen, to assess the possibility of establishing a nuclear power plant comprising up to five SMRs.

A Norsk Kjernekraft subsidiary has also submitted a proposal for an assessment programme for an SMR plant in Grenland in southern Norway.[265]

3.5.9 Peru

In March 2025, the Peruvian congress approved a declaration calling for the introduction of nuclear energy and the installation of small modular reactors to diversify the country's electricity mix.

The decision states: "Small modular reactors must be installed to take advantage of the uranium resources found in the national territory and to promote sustainable energy development in the country."

3.5.10 Rwanda

In October 2020 Rwanda’s government approved the establishment of the Rwanda Atomic Energy Board (RAEB), which is intended to coordinate research and development of nuclear energy activities in the country.

In September 2023 the RAEB signed an agreement with Dual Fluid Energy, a Canadian-German nuclear technology company founded in 2021, for the construction of a demonstration Dual Fluid reactor – a liquid fuel, lead-cooled, high-temperature fast reactor.

In 2024 the RAEB signed a memorandum of understanding with NANO Nuclear Energy that could lead to the deployment of SMRs and microreactors.

3.5.11 Singapore

Singapore has committed to reach net zero greenhouse gas emissions by 2050.[266] It relies on imported natural gas to fuel 94% of its electricity generation.[267] The small, population-dense city-state has limited opportunities for installing renewable energy.

Singapore’s Nationally Determined Contribution submission to the UNFCCC stated that it is building its capabilities in nuclear science and technology to better understand the implications and benefits of advanced nuclear energy technologies for Singapore. Agreements with Emirates Nuclear Energy Corporation and the Ministry of Climate and Enterprise of Sweden, in October 2024 and November 2024 respectively, aim to facilitate capability building in nuclear technology, as well as having signed a '123 Agreement' with the USA.

In his Budget 2025 speech, Singapore prime minister Lawrence Wong announced that his government will study the potential deployment of nuclear energy.[268] In September 2025 Singapore’s Energy Market Authority appointed Mott MacDonald to conduct a study of advanced nuclear energy technologies.[269]

4 Assessment of overall global nuclear capacity

4.1 Overall assessment of global nuclear capacity for 2050

Global nuclear capacity would reach 1446 GWe if national government targets for nuclear capacity by 2050 are met, including those targets that would in part be met by reactors classified by World Nuclear Association as under construction, planned, proposed and potential as of 1 November 2025, and reactors currently operable continuing to operate to 2050, unless specified in the country assessments.

If achieved, this would exceed the approximately 1200 GWe global target set in the Declaration to Triple Nuclear Energy, first announced at the United Nations COP28 climate change meeting.

In 2050, 189 GWe of reactors operable in 2025 would have been in operation for less than 60 years. A minimum 60 years of operation is assumed for all currently operable reactors, except for those scheduled to be shut down as part of a phase-out policy (*e.g.* Spain's nuclear reactors) or because of specific technical limitations (*e.g.* the UK's AGR reactors).

An additional 213 GWe of reactors operable in 2025 would still be in operation in 2050 if their operation were extended to up to 80 years, with approximately two-thirds reaching 60-70 years of operation and one-third 70-80 years.

All 76 GWe of nuclear capacity under construction as of 1 November 2025 is assumed to be in operation by 2050.

A total capacity of 104 GWe is assumed for reactors considered as planned, according to the World Nuclear Association definition.

A total of 298 GWe is assigned to reactors categorized as proposed by World Nuclear Association.[271] Reactors with the categorization of 'potential' represent 24 GWe of nuclear capacity in 2050.

The 542 GWe capacity assigned to the government target category is a summation of national capacity targets set by governments minus any part of that national capacity target that would be met by reactors in the categories above.

Figure 4.1 Capacity of reactors operating in 2050

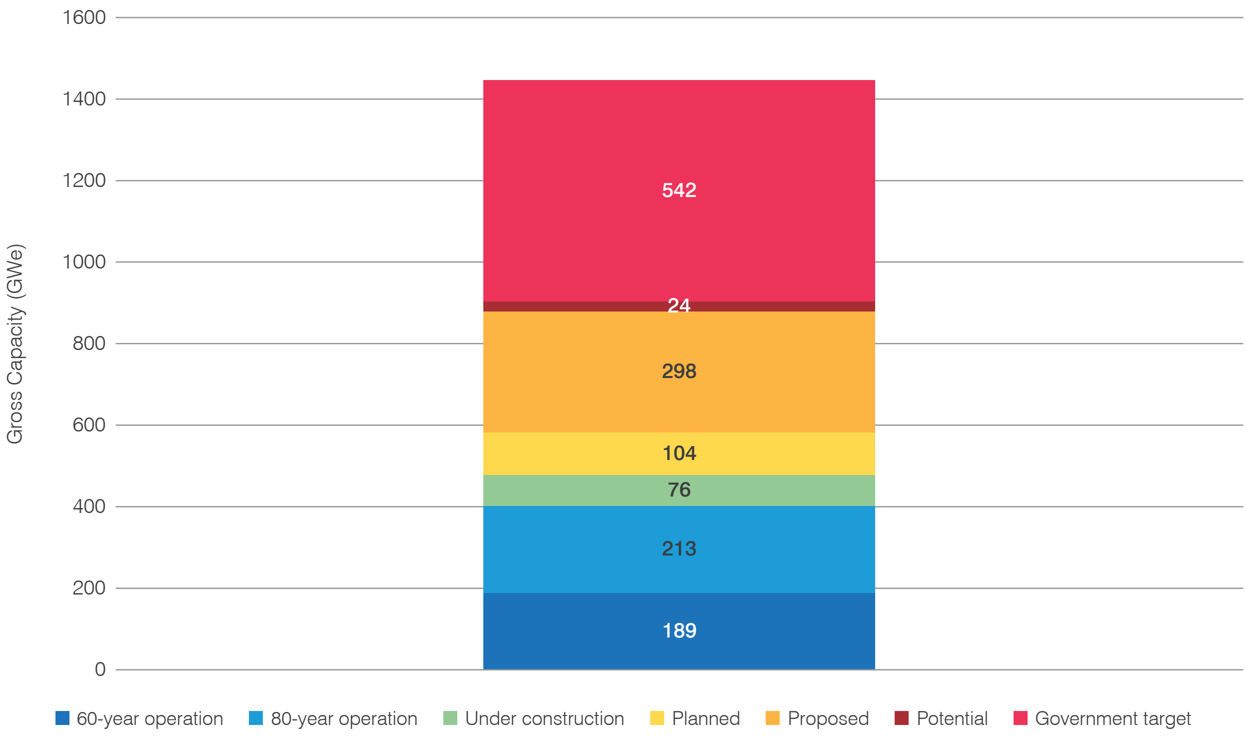
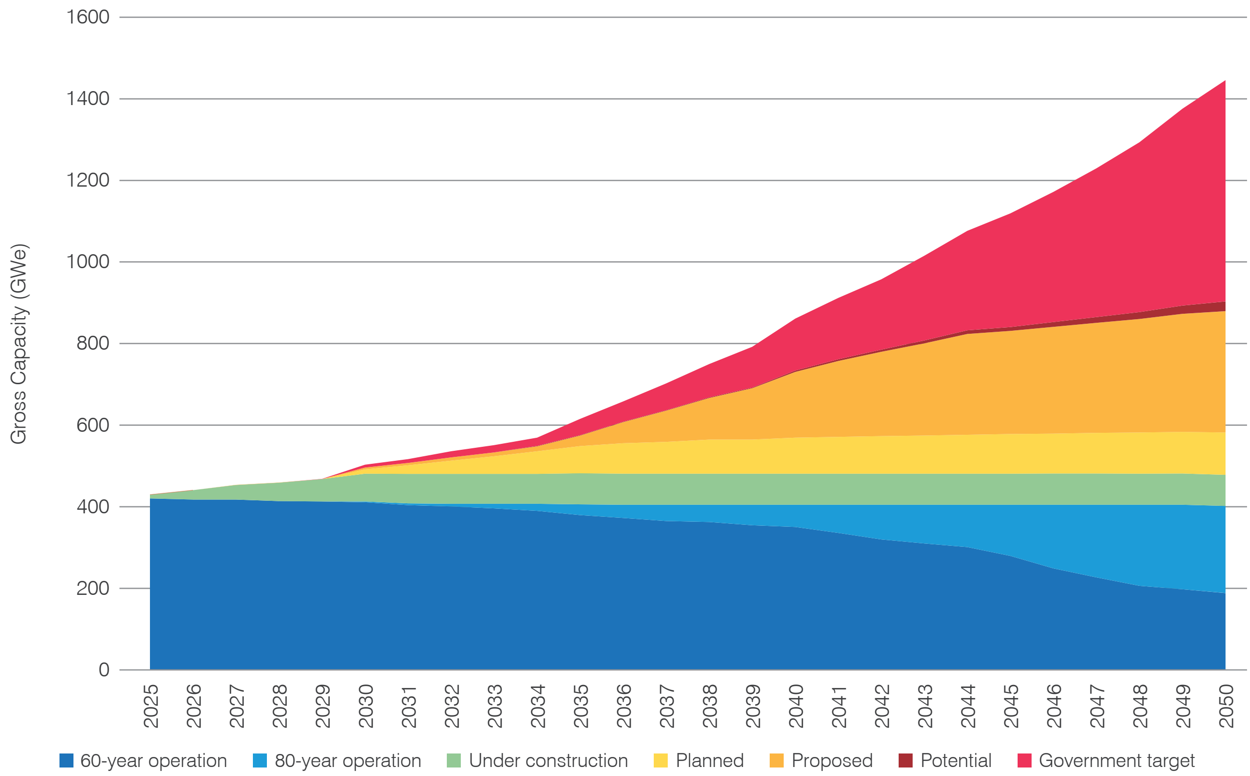


Figure 4.2 Global nuclear capacity 2025-2050



The chart above shows the global capacities for reactors in each category based on the combined capacity trajectories proposed for each country.

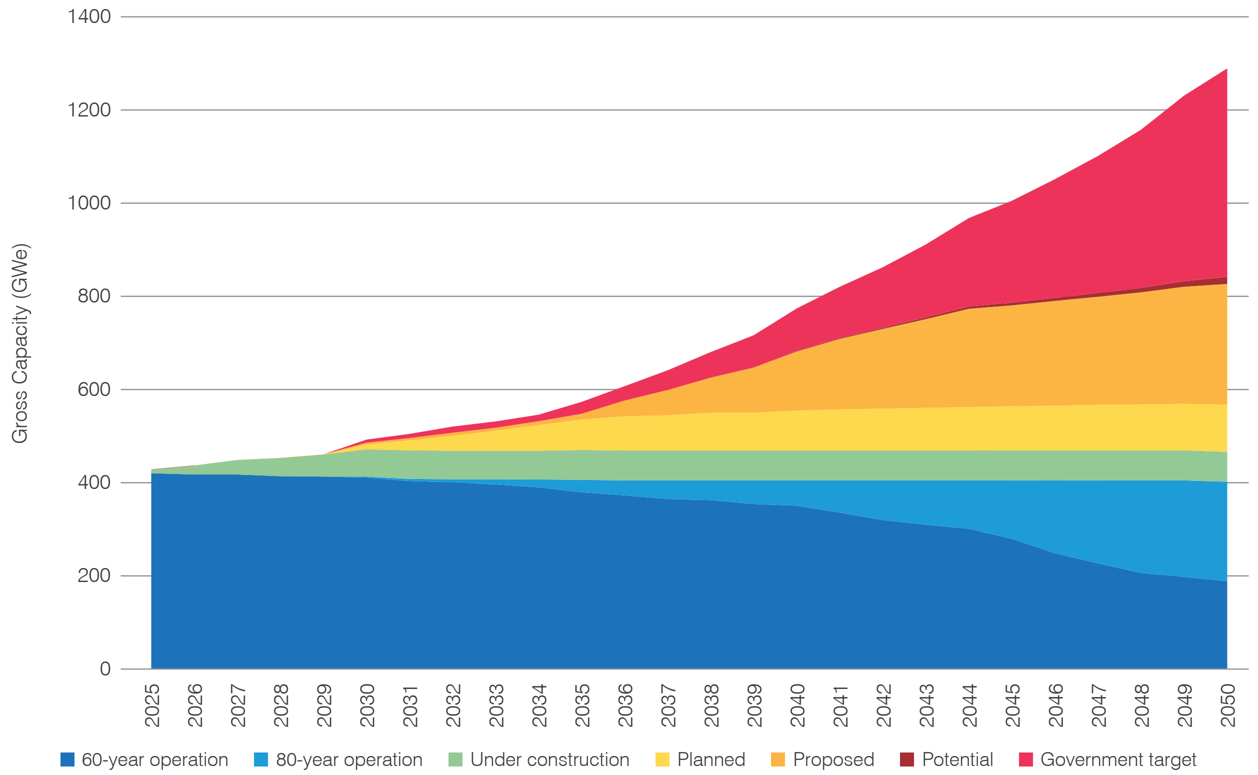
With almost all operating reactors assumed to continue operating, the increase in nuclear capacity to 2030 comes primarily from the completion of reactors currently under construction, with capacity reaching 502 GWe.

Planned reactors contribute the largest component of additional generation to 2035, with total capacity reaching 615 GWe.

Beyond 2035 proposed and potential reactors as well as capacity assigned to the additional programme of build required to reach government targets contribute to the growth in global capacity. A growing proportion of reactors operable in 2025 only continues to operate if operating lifetimes are extended beyond 60 years.

Total global capacity would reach 861 GWe in 2040 under this scenario, before reaching 1119 GWe in 2045 and 1447 GWe in 2050.

Figure 4.3 Nuclear capacity in countries that operate nuclear reactors in 2025, for the period 2025-2050



Out of the projected total global nuclear capacity of 1446 GWe in 2050, 1289 GWe is in countries where nuclear reactors already operate. This 1289 GWe capacity alone would be sufficient to meet the Declaration to Triple Nuclear Energy capacity goal.

The capacity targets for countries with operable reactors in 2025 are dominated by just five countries, with China, France, India, Russia and USA having a total of 980 GWe of nuclear reactors in 2050.

New entrant countries, including those countries with their first reactors under construction in 2025, see their total nuclear capacity reaching 157 GWe by 2050.

Figure 4.4 Nuclear capacity in China, France, India, Russia and USA, for the period 2025-2050

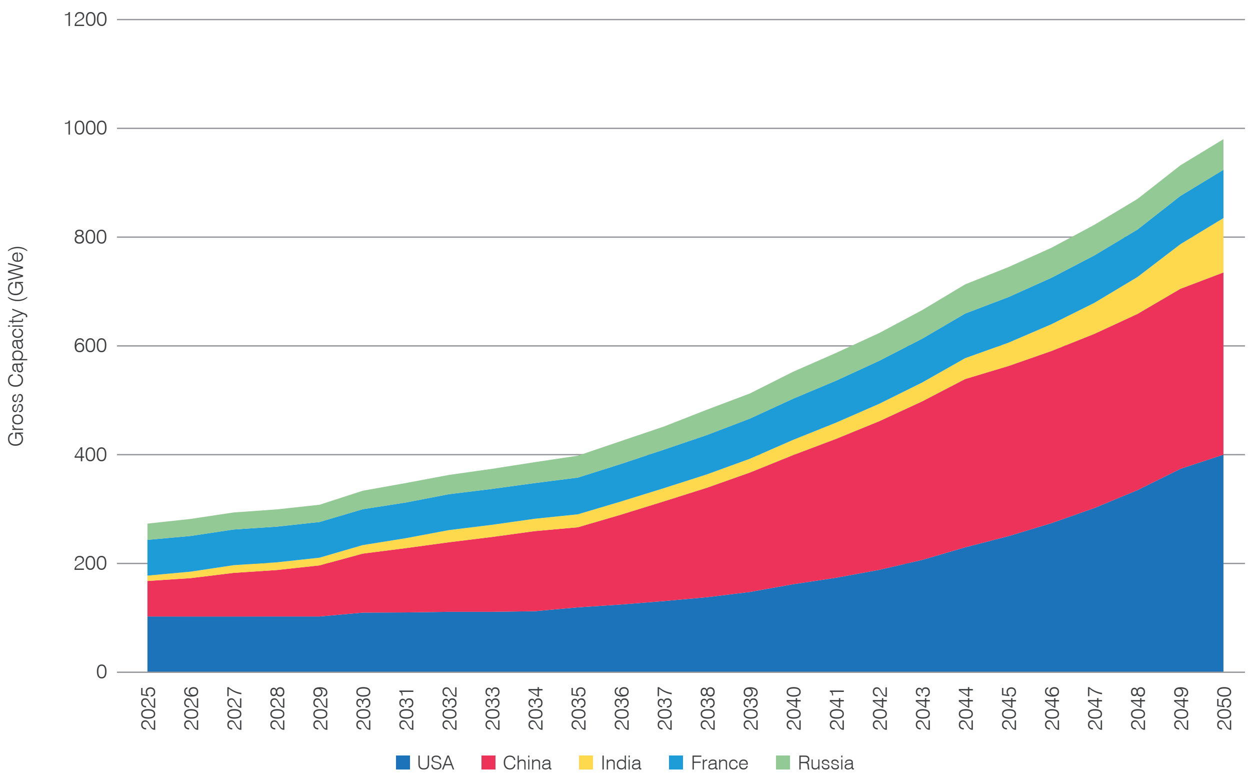
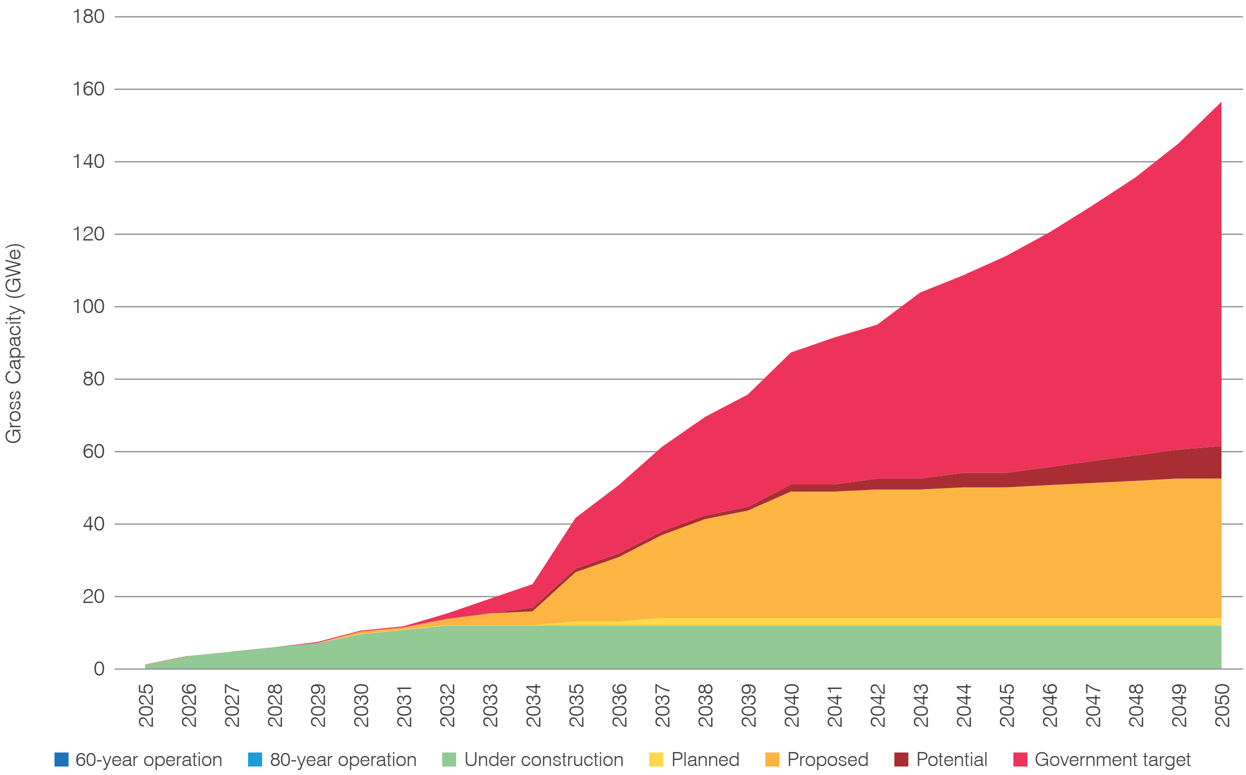


Figure 4.5 Nuclear capacity in countries not operating nuclear reactors in 2025, for the period 2025-2050



4.2 Analysis of potential for extended operations

According to the analysis set out above, the 189 GWe of reactors that would have operated for less than 60 years, and 213 GWe that would have operated for 60-80 years would make up just under one-third of the global capacity meeting that target.

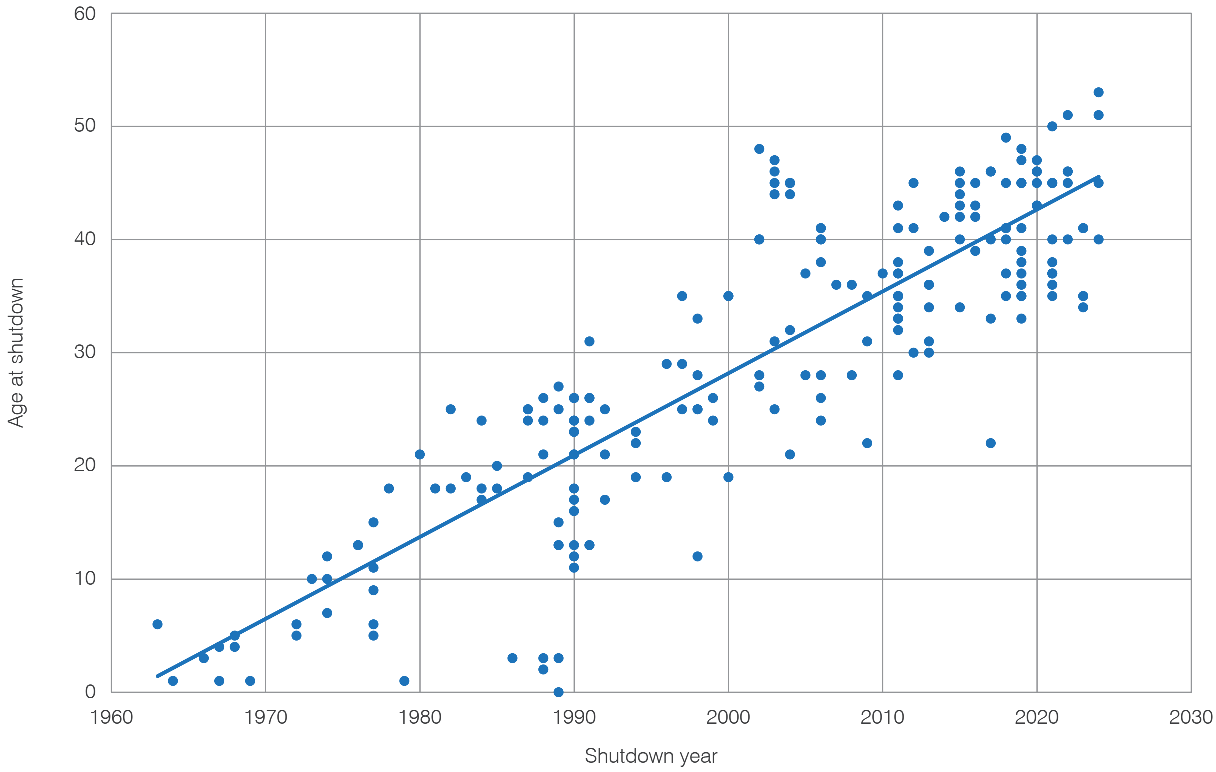
Extending the operating lifetimes of nuclear power plants is among the most cost-effective ways of securing additional low-carbon generation, according to the International Energy Agency.[272]

In 2025 the mean age of the world's operable nuclear power reactors was 32 years. As of June 2025, there were 43 operable reactors that commenced operation more than 50 years ago, representing around 10% of currently operable reactors.

Analysis carried out for the *World Nuclear Performance Report* has shown that there is no overall trend suggesting an age-related decline in capacity factor, with those reactors that have operated for 40 years or more continuing to perform well.

Additionally, the average age at which nuclear reactors have been permanently shut down has been steadily increasing over time. In 2024 the average age of those reactors permanently shut down was 48 years.

Figure 4.6 Average age at which reactors have been permanently shut down



Over the ten years from 2015 to 2024, the average age of reactors being permanently shut down increased by 5.5 years, continuing a trend that has been ongoing for several decades. There is no indication of a tailing off or ceiling on reactor operating lifetime being reached.

In the USA almost all operable reactors have applied to extend their operating licences from 40 to 60 years, and more than half have either applied, or intend to apply for subsequent licence extensions to operate for up to 80 years.

A limited number of reactors would not be suitable to extended operation to 2050, for example the four AGRs operating in the UK, where cracking of the graphite moderator bricks is expected to result in the closure of those reactors in the coming decade.[273]

However, it is not only technical challenges that will determine the length of operation of existing nuclear reactors.

Politically-motivated phase-outs have resulted in high performing reactors closing prematurely. Germany decided to shut its reactors, despite excellent performance and the potential for decades more operation, with some reactors having operated for only 35 years. Continued operation would have had many benefits, including helping to speed the transition away from fossil fuels for electricity generation and lowering the cost of electricity in Germany for both individual, commercial and industrial users.

Spain plans to close all its reactors by 2035, with four reactors closing in 2030. Following a February 2025 plenary session of the Spanish Congress that voted in favour of calling on the government to reverse the phase-out decision, and the April 28 2025 Iberian Peninsula black-out, the conversations among all relevant stakeholders have started and there is some potential for this decision to be reversed.[274]

To maximize the use of existing reactors, governments will need to continue to support their operation, in energy policy and through equitable treatment in electricity markets.

4.3 Analysis of new capacity requirements

Table 4.1 displays the five-year average for new grid connected capacity required each year to meet the global capacity targets shown in figure 4.1. The table also shows the five-year average annual capacity required to meet those targets additional to the capacity categorised as under construction, planned, proposed or potential, as of 1 November 2025, represented as ‘Government targets’ in figure 4.1.

Table 4.1 Five-year average grid connection requirements

	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050
Average annual new grid connections capacity required (GWe/year)	14.4	22.3	49.2	51.6	65.3
Average annual new grid connections capacity required in addition to capacity represented by under construction, planned, proposed and potential categories (GWe/year)	1.4	6.5	17.5	30.2	52.8

A 65.3 GWe annual increase in nuclear capacity in 2046-2050 would be approximately double the peak historic capacity increase achieved in the mid-1980s.

The assumptions set out in this report are that, for most countries, planned reactors are deployed between 2035 and 2040 and proposed reactors are deployed between 2040 and 2050. The exception to this assumption is for countries with on-going construction programmes, where deployment is expected to happen around 5 years earlier. China has an ongoing new build programme, and also more planned and proposed reactors than any other country, with 48 GWe of 104 GWe of reactors planned globally, and 180 GWe of the 298 GWe reactors proposed globally.

The effect of assuming earlier construction of planned and proposed reactors in China is to bring forward a significant proportion of the reactor construction in these categories, with the consequence that there is a slowdown in the modelled deployment of planned and proposed reactors from the mid-2040s. It is in the final 5 to 10-year period that the share of new nuclear capacity assigned to additional capacity associated with government targets increases most rapidly.

The 542 GWe of additional capacity associated with government targets beyond projects assessed as planned, proposed or potential is not yet supported by identified projects, and the level of commitment through policy or other governmental measures varies significantly from country to country.

Several national targets rely heavily on an expansion of nuclear capacity where there is currently little or no ongoing construction, or identified reactors planned or proposed for deployment. This includes the 293 GWe of new nuclear capacity required to meeting USA's 400 GWe target. Based on the assumptions in this study, nuclear capacity in the USA would need to rise from 250 GWe to 400 GWe between 2045 and 2050. In comparison, the largest global increase in nuclear capacity over a similar time period occurred between 1983 to 1988, when just over 100 GWe of capacity was added.

4.4 Concluding remarks

National nuclear capacity goals to 2050 exceed the global tripling target and reflect strong alignment between national objectives and global decarbonization needs. Achieving these ambitions will require unprecedented construction rates, strategic lifetime extension of existing reactors, and significant policy and market reforms. If nations deliver on their commitments, nuclear power would play a critical role in ensuring secure, affordable, and net zero-compatible energy for a rapidly expanding and electrified global economy.

A substantial share of the required capacity growth depends not only on reactors already under construction or formally planned, but also on large-scale programmes for proposed, potential, and government-targeted capacity that are not yet supported by firm investment decisions. Bridging the gap between stated ambitions and practical implementation will require sustained political will, timely regulatory approvals, financial innovation, and a coordinated effort between governments, industry, and the financial sector.

The continuation of existing reactors is shown to be an essential element in achieving 2050 goals. Ensuring that these reactors remain in operation—where safe and practical—will relieve pressure on new-build programmes and reduce overall system costs. However, this will require governments to adopt consistent and long-term policy positions, avoiding abrupt or politically motivated phase-outs that undermine energy security and increase dependence on fossil fuels. Reactors scheduled for closure for non-technical reasons represent a lost opportunity both for emissions reductions and for moderating the scale of new construction that would otherwise be required.

For new capacity additions, the magnitude and pace of construction implied by national targets exceed historical experience, meaning that the nuclear industry must undergo a major transformation in capability, scale, and global coordination. Without such changes, the sector risks facing bottlenecks in manufacturing, skills, regulatory review, and fuel cycle infrastructure.

At the same time, emerging nuclear nations will require expanded international cooperation, including technology transfer, skills development, and financing frameworks that can support first-of-a-kind deployments in new markets.

Financial institutions, both public and private, will have an increasingly important role in enabling nuclear growth at the required scale. The alignment of climate finance mechanisms with nuclear investment, and the adoption of technology-neutral or explicitly inclusive financing policies, will be critical to ensuring that capital can flow to nuclear projects on terms compatible with large-scale deployment. Multilateral institutions will also need to expand their participation, particularly to support new-entrant countries and facilitate the construction of both small modular reactors and large gigawatt-scale facilities.

If governments uphold their stated ambitions, if regulatory and market frameworks are adapted to support both existing and new reactors, and if the nuclear industry expands its capacity to deliver at scale, the world's nuclear fleet can more than triple by 2050. This would not only meet but exceed the declaration made at COP28, placing nuclear energy at the core of the global strategy for climate mitigation, energy security, and economic development. Failure to act, however, would leave a significant gap in global decarbonization pathways, increasing reliance on fossil fuels and raising the long-term cost and difficulty of achieving net-zero emissions.

In summary, national goals for nuclear capacity growth represent a coherent and ambitious vision for the future of low-carbon energy. Realizing this vision will require collective commitment, long-term planning, and international cooperation on a scale not previously seen in the nuclear sector. If these conditions are met, nuclear power can deliver sustained, large-scale, and reliable low-carbon electricity, and contribute significantly to meeting the energy needs of a rapidly changing world.

Appendix 1: Impact on demand for nuclear fuel services

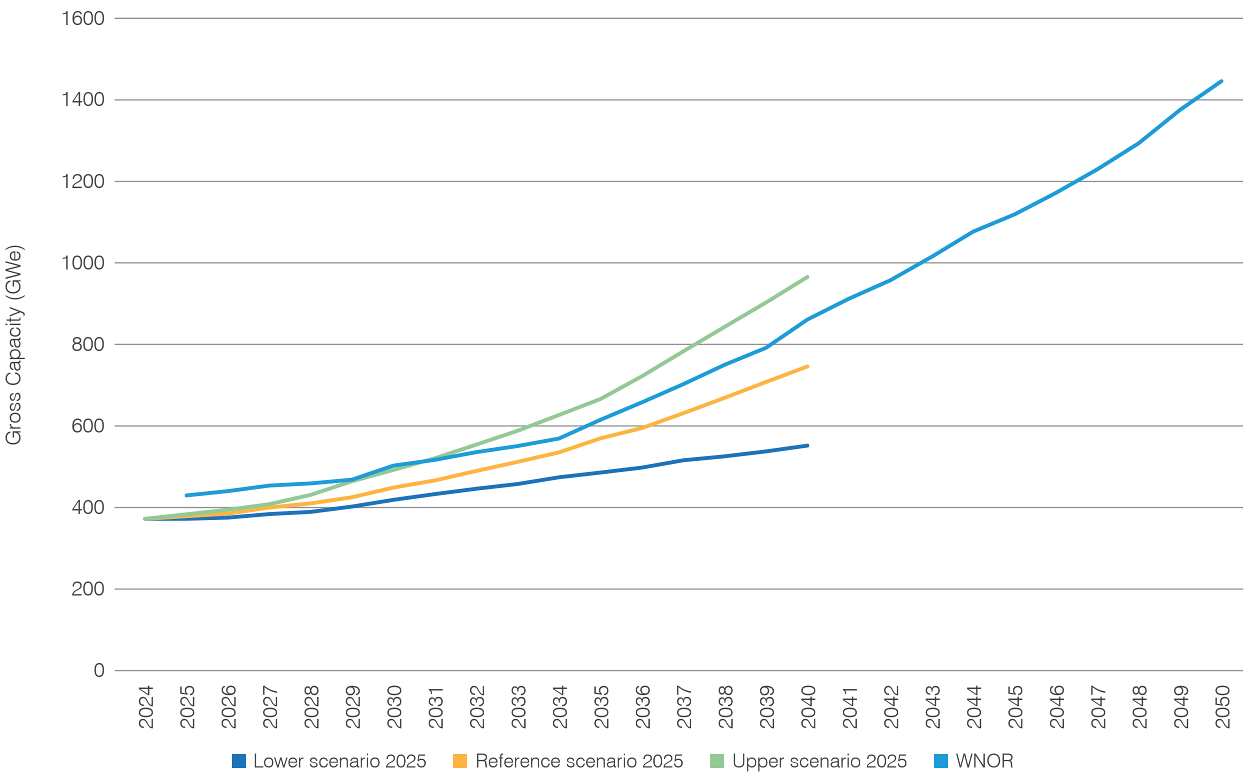
The 2025 edition of World Nuclear Association's *World Nuclear Fuel Report* presents three scenarios for nuclear capacity growth for the period 2025-2040 – referred to as the Reference, Upper and Lower Scenarios. Figure A1.1. shows the projected nuclear generation capacities in these scenarios alongside the *World Nuclear Outlook Report* (WNOR) projection of nuclear capacity.

The trajectory for nuclear capacity outlined in the WNOR between 2025 and 2040 lies predominantly between the *World Nuclear Fuel Report's* Reference and Upper Scenarios. Note that the *World Nuclear Fuel Report's* capacity figures do not include the operable nuclear capacity classified as in a suspended operation status by the International Atomic Energy Agency (IAEA) – such as reactors that have not restarted in Japan following their shutdown after the March 2011 accident at the Fukushima Daiichi nuclear plant. Approximately 20 GWe of nuclear capacity was classed as suspended operation in 2024.

A nuclear capacity increase to 1200 GWe to meet the Declaration to Triple Nuclear Energy goal would need to be supported by growth in the supply of uranium and fuel services.

The front end of the nuclear fuel cycle consists of uranium mining, conversion, enrichment and fabrication. For the level of global nuclear capacity in 2025, approximately 70,000 tU per year is required to fuel the nuclear fleet. According to the 2025 edition of the *World Nuclear Fuel Report*, in the Upper Scenario almost 200,000 tU per annum of uranium would be required to support the 2040 capacity projection of 966 GWe. For 1200 GWe of global nuclear capacity, annual uranium requirements would be 250,000 tU, assuming no significant change in the mix of different reactor types.

Figure A1.1 World Nuclear Fuel Report generation capacity scenarios compared to WNOR



As of 2025, annual primary production of uranium was around 60,000 tU, so over a fourfold increase in annual uranium production would be needed to fuel the tripling of global nuclear capacity.

Some considerations for the required growth in uranium production include:

- New mines will be needed for additional supply as well as to replace depleted assets.
- There are sufficient uranium resources to meet high growth scenarios in 2050. However, resources in the ground need to be brought into production in a timely manner. Resources need to be explored, developed and licensed, along with associated infrastructure developments before these can become operating uranium mines. The lead times from exploration to first commercial delivery are long.
- The economics of extracting the uranium from the deposits will play a role in how quickly and when mines will come online.
- Uranium is a very abundant mineral, and it can be found all over the world. At the same time, uranium mining is currently largely concentrated in a few countries (such as Kazakhstan, Canada and Australia) while demand for uranium exists across the globe. Geopolitical factors and uncertainties could raise supply risks for the uranium to get from where it is mined to where it is needed.

Uranium could be considered as a strategic mineral by certain countries and regions in order to achieve their set goals of reaching certain nuclear capacities and ensuring security of supply.

In the subsequent stages of the front end of the nuclear fuel cycle, growth in capacity would also be required to support the tripling global nuclear capacity goal. Where conversion is concerned, the market remains tight and if existing LWR technologies will continue to dominate in the mix of the global reactor fleet, then conversion will remain an essential process. Similar to uranium mining, conversion primary production capacity will need to increase by over threefold based on the assumption that a large portion of the reactor fleet will continue using LWR technology. Challenges in ensuring a sufficient supply of conversion include:

- As of 2025, there were only four conversion suppliers globally. Production capacities would need to be increased significantly and new plants would need to be developed.
- Uranium conversion facilities are capital-intensive plants that requiring financing.
- Reliable and sufficient supplies of essential materials used in the conversion process, such as hydrofluoric acid, would be required.

For enrichment, while the market on a global level is able to meet the nuclear reactor fleet demand, the regional perspective is somewhat different largely due to geopolitical risks and uncertainties. With only four enrichment providers globally, some countries or regions are diversifying their supply to move away from production from certain producers. Where new build is concerned, this may include more advanced technologies with such reactors requiring higher levels of enrichment, thus new enrichment plants and facilities would also be needed.

Fabrication of fuel assemblies is a highly engineered and technical stage of the nuclear fuel cycle. Each fuel assembly must be tailored to a particular reactor design. While there is sufficient capacity to supply fabrication services for the global nuclear fleet, this would need to significantly increase to support the tripling of global nuclear power capacity. The reliable availability of materials required for fabrication, such as zirconium, is also important.

The growth estimates provided here are based on reactor fuel efficiencies and reactor requirements. Newer reactor designs, including small modular reactors (SMRs) and advanced reactors, may have different fuel efficiencies and therefore reactor requirements. In the 2040s, recycling spent fuel and advanced fuel cycles could reduce fresh uranium needs.

For all stages of the front end of the nuclear fuel cycle it is clear that significant financing would be needed to support the expansion of existing facilities as well as building new plants. A key factor – not limited to fuel supply in the nuclear industry – is the availability of a skilled workforce.

While there has been substantial political support for growth in nuclear capacity globally, from a fuel perspective, timely decisions would need to be made for fuel supply capabilities to be ready when they are needed.

Appendix 2: Nuclear capacity or generation in energy scenarios

Several international organizations have developed global energy scenarios that provide different possible versions of the future. Those scenarios that are net-zero or 1.5-degree-aligned have been developed to reflect the increasingly urgent requirement of achieving the 1.5 °C goal of the Paris Agreement. The scenarios provide information and policy implications regarding future energy systems to governments and businesses and can strongly influence their energy strategies.

While almost all climate mitigation scenarios include nuclear in their analysis and acknowledge the continuous role that nuclear should play in the future, the specific method and results for nuclear energy are various. This appendix reviews the future of nuclear energy under major energy scenarios[f], compares their results against the Declaration to Triple Nuclear Energy and the results from this report.

A2.1 Summary of selected energy scenarios

A2.1.1 IEA Net Zero Emissions by 2050 Scenario

The International Energy Agency (IEA) develops and updates three scenarios using its Global Energy and Climate (GEC) Model: the Stated Policies Scenario (STEPS), the Announced Pledges Scenario (APS) and the Net Zero Emissions by 2050 Scenario (NZE). These scenarios are frequently referred to by policymakers, the media, and analysts, and underpin the IEA's flagship annual publication, the *World Energy Outlook* (WEO).[278]

The STEPS extrapolates existing policies that are in place and under development. The APS assumes that all climate commitments, including net-zero targets, made by governments and industries will be met in full and on time. Both the STEPS and APS are exploratory scenarios, which do not target a specific outcome but rather establish sets of starting conditions and consider where they may lead. In contrast, the NZE is a normative scenario, which shows a pathway to achieve defined outcomes – such as reaching net zero carbon emissions by 2050. The STEPS, APS and NZE are associated with temperature rises of 2.4 °C, 1.7 °C and 1.5 °C (with a 50% probability), respectively.

In the 2024 edition of WEO, the IEA projects significant nuclear growth under the NZE where gross nuclear power capacity grows from 416 GWe in 2023 to 1017 GWe by 2050. Nuclear capacity in 2050 in the STEPS and APS is 647 GWe and 874 GWe, respectively. Notably, in all scenarios nuclear contributes to roughly 7-9% of total electricity generation, which is slightly lower than the 2023 level (9.3%), while the share of renewables surges from 30% to 73-88%; hydrogen, ammonia, as well as fossil fuels with CCUS, also play more significant roles in power generation.

[f] The scenarios are chosen based on their extent of relevance to nuclear, data availability, as well as influence.

Table A2.11: Nuclear power capacity, nuclear electricity generation and share in total generation in WEO 2024[279,280]

Scenario	2023 (GWe)	2030 (GWe)	2040 (GWe)	2050 (GWe)	Nuclear electricity generation in 2050 (TWh)	Share of total generation in 2050
STEPS	416	478	557	647	4460	7.6%
APS	416	508	748	874	6055	8.6%
NZE	416	554	896	1017	6969	8.7%

In the GEC Model, the operating lifetimes of nuclear reactors are assumed to be 45-60 years, unless otherwise specified. Other factors that might affect the analysis include a lack of consideration of non-electricity nuclear applications, namely nuclear for hydrogen or industrial process heat, as well as not including advanced reactors in the mid-to-long term.

From the policy and regulatory perspective, the IEA notes that compared with other sources of generation, additions of nuclear power capacity are more affected by government policies.

Finally, energy savings and efficiency improvements might be assumed to a degree that compromises the NZE's plausibility. The 2050 global energy supply per capita is reduced by 28% compared with the 2023 level, which would be highly ambitious within the context of global economic growth especially from emerging markets during this period. The overall low energy demand projection contributes to a lower 2050 nuclear capacity result.

A2.1.2 Shell: The 2025 Energy Security Scenarios

Shell regularly publishes energy scenarios based on its own World Energy Model (WEM). In its publication titled *The 2025 Energy Security Scenarios*, Shell presented three energy scenarios to 2050: Archipelagos, which envisions a world that focuses on short-term national border and resource security; Surge, which features stronger economic growth, mainly driven by boosting AI technologies; and Horizon, which is defined as realizing net-zero emissions by 2050 and achieving 1.5 °C target[281].

In Horizon, nuclear grid power capacity grows to 494 GWe in 2040 and slightly declines from then to 479 GWe in 2050. The share of nuclear in total electricity consumption in Horizon is 4.5% in 2050, less than half of the 2023 level. It is worth noting that apart from grid electricity generation, the report also provides projections for nuclear capacity used for power-to-liquids (liquid hydrocarbon fuels), and hydrogen production[g], which in Horizon amounts to 34 GWe and 108 GWe, respectively.

While its dataset does not distinguish between large-scale reactors and SMRs, Shell emphasizes the role of SMRs in Horizon and Surge. The latter projects SMRs to ramp up in the 2040s to meet the demand from data centres but also industrial electric furnaces and ships. This does not lead to a larger nuclear capacity in 2050 compared with 2025, but in the longer-term Surge indicates 1157 GWe nuclear capacity (including non-electricity capacity) in 2100. The nuclear capacity in Horizon in 2100 (1166 GWe) is very close to Surge, but with more capacity in generating hydrogen and less capacity in power-to-liquids and power generation.

[g] For power-to-liquids and hydrogen, the figures represent the GW of electricity capacity needed as input to produce the energy carrier.

The WEM used by Shell is similar to the IEA GEC model in the sense that they both generate economic pathways to meet a calculated energy demand but not the least cost pathways, as technical and political factors are also considered[282]. There are unique characteristics of the WEM that might affect its nuclear projection. WEM explicitly mentioned that it applies annual deployment rate constraints at a country level for nuclear and renewable sources, and assumptions concerning public acceptance, energy security and safety consideration predominate the constraints for nuclear growth[283].

Table A2.22 Nuclear power capacity, nuclear electricity generation and share in total generation in Shell scenarios

Scenario	2025 (GWe)	2030 (GWe)	2040 (GWe)	2050 (GWe)	Nuclear electricity consumption in 2050 (TWh)	Share in total electricity consumption in 2050
Archipelagos	456	480	446	390	1897	3.5%
Surge	456	480	435	429	2292	3.3%
Horizon	457	489	494	479	2669	4.5%

A2.1.3 BP Net Zero and Equinor Bridges scenarios

BP and Equinor both have scenarios – namely BP's Net Zero scenario[283] and Equinor's Bridges scenario[284] – that are broadly consistent with the Paris Agreement climate goals.[h]

Although their data disclosures are less detailed than those of Shell, and do not include generation capacity figures, they do provide their visions of the future amount of nuclear energy consumption. In BP's Net Zero scenario, nuclear electricity generation increases by 117% from 2680 TWh in 2022 to 5820 TWh in 2050, accounting for 8.4% of total generation in 2050. Equinor's Bridges scenario depicts nuclear generation to increase by 74% from 2676 TWh in 2020 to 4647 TWh in 2040, but then decline to 3655 TWh in 2050, accounting for 7.3% of total generation in that year – which is lower than the nuclear generation in 2050 (4529 TWh) under the Equinor's reference scenario Walls.

Both scenarios project significantly less total electricity generation in 2050 (68,970 TWh and 49,889 TWh) compared with the IEA's NZE (80,194 TWh).

Table A2.33 Nuclear electricity generation and share in total generation in BP's Net Zero scenario and Equinor's Bridges scenario

Scenario	2020 (TWh)	2030 (TWh)	2040 (TWh)	2050 (TWh)	Share in total electricity generation in 2050
BP Net Zero	2690	3270	4550	5820	8.4%
Equinor Bridges	2676	3781	4647	3655	7.3%

[h] While Equinor's Bridges is compliant with 1.5°C target, bp stated that its Net Zero scenario cannot be compared directly with the COP21 Paris Agreement climate goals, as it does not include all GHGs or all sectors of the economy. By an indirect inference, bp concluded that CO2e emissions from its Net Zero scenarios are broadly in the middle of the ranges between IPCC 1.5 °C pathways and 2 °C pathways.

A2.1.4 Bloomberg NEF Net Zero Scenario

Bloomberg NEF's New Energy Outlook 2025 encompasses two scenarios: Economic Transition Scenario (ETS), and Net Zero Scenario (NZS, which aims to achieve net zero emissions by 2050). In its Net Zero Scenario installed nuclear electric capacity reaches 1085 GWe in 2050, and generation from nuclear is 8146 TWh, accounting for 9.4% of total electricity generation. The results are close to the IEA's NZE figures for nuclear[285].

Table A2.5: Nuclear power capacity, nuclear electricity generation and share in total generation in New Energy Outlook 2025.

Scenario	2025 (GWe)	2030 (GWe)	2040 (GWe)	2050 (GWe)	Nuclear electricity generation in 2050 (TWh)	Share in total generation in 2050
ETS	393	424	500	505	3780	7.1%
NZS	397	570	974	1085	8146	9.4%

A2.1.5 IAEA Reference Data Series No. 1 (RDS-1)

The International Atomic Energy Agency (IAEA) provides its projections of energy, electricity and nuclear power up to 2050 in its annual publication Reference Data Series No. 1 (RDS-1), *Energy, Electricity and Nuclear Power Estimates for the Period up to 2050.*[286] Two scenarios are considered, with the Low Case assuming the continuation of current trends and the High Case being more ambitious, with stronger national policies to expand nuclear and enabling factors in place. As an exploratory scenario it does not explicitly adhere to any climate targets such as net zero emissions by 2050 or constrain the rise in average global temperature below 1.5 °C or 2 °C. Nevertheless, the High Case provides a view of future nuclear power under stronger climate policies.

The IAEA projects 514 GWe of nuclear capacity in the Low Case and 950 GWe in the High Case by 2050. The share of nuclear in the total electricity mix would be 6.9% and 12.8% in 2050 in the Low and High Cases, respectively. SMRs would account for 24% of the capacity added by 2050 in the High Case and 6% of the capacity added in the Low Case.

The scenarios are calculated under the same total energy and electricity demand estimation, which is generated by IAEA's Model for Analysis of Energy Demand (MAED). The nuclear projections are generated mainly based on external experts' inputs in the IAEA's annual Consultancy Meeting on Nuclear Capacity Projections up to 2050, which takes a country-by-country, project-by-project 'bottom-up' (*i.e.* exploratory) approach, considers all operating reactors, possible licence renewals, planned shutdowns and plausible construction projects for the next few decades and builds the estimates for both cases.

Table A2.6: Net nuclear power capacity, nuclear electricity generation) and share in total generation in IAEA RDS-1

Scenario	2023 (GWe)	2030 (GWe)	2040 (GWe)	2050 (GWe)	Nuclear electricity generation in 2050 (TWh)	Share in total generation in 2050
Low Case	372	414	491	514	4157	6.9%
High Case	372	461	694	950	7666	12.8%

A2.1.6 UNECE Carbon Neutrality and Carbon Neutrality Innovation Scenarios

The United Nations Economic Commission for Europe (UNECE) *Carbon Neutrality in the UNECE Region: Technology Interplay under the Carbon Neutrality Concept report* uses three scenarios to illustrate possible versions of the future of the UNECE region[i]: Reference Scenario; Carbon Neutrality Scenario, which uses the same technology, innovation, and infrastructure assumptions as the Reference Scenario but imposes a carbon neutrality constraint by 2050; and Carbon Neutrality Innovation Scenario, which applies different technology assumptions on carbon capture, use and storage (CCUS), nuclear power, as well as hydrogen, driven by innovation and policies that accelerate the uptake of innovative technologies.

In contrast to the significantly reduced nuclear role in the Reference Scenario, nuclear capacity in the Carbon Neutrality Scenario would reach 604 GWe in the UNECE region in 2050, generating 4400 TWh, account for around 20% of total electricity generation.

Under the Carbon Neutrality Innovation Scenario – where SMRs are assumed to have the same capital costs as large reactors but they have much shorter construction times and are capable of operating more flexibly – nuclear capacity reaches 874 GWe in the UNECE region in 2050, generating 6235 TWh, around 28% of total electricity mix. SMRs would contribute to 454 GWe of the total capacity in 2050, a greater amount than from large reactors (420 GWe).

Table A2.7: Nuclear power capacity, nuclear electricity generation and share in total generation in UNECE analysis

Scenario	2025 (GWe)	2030 (GWe)	2040 (GWe)	2050 (GWe)	Nuclear electricity generation in 2050 (TWh)	Share in total generation in 2050
Carbon Neutrality				604	4400	20%
Carbon Neutrality Innovation	340	449	636	874	6235	28%

A2.1.7 IPCC Sixth Assessment Report

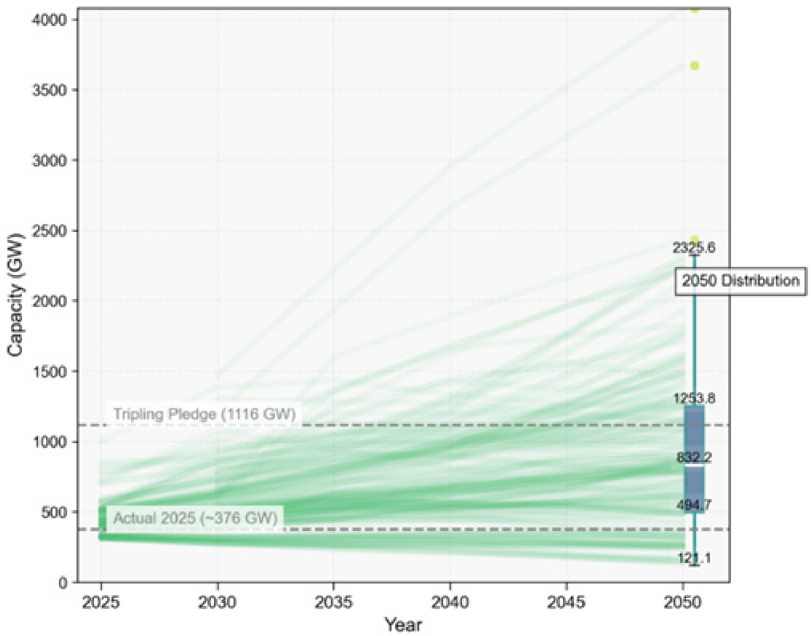
The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6), published in 2022, includes extensive analysis of global emissions trajectories and mitigation pathways.[287] The IPCC assesses several scenarios from the scientific literature, many of which are generated using integrated assessment models (IAMs).[288] These scenarios explore how policy, technology, and societal choices can align with various long-term temperature goals, including the 1.5 °C and 2 °C targets under the Paris Agreement.

Regarding nuclear energy, the AR6 confirms its role as a low-carbon supply option in many mitigation scenarios. However, the pathways vary significantly depending on regional context, societal preferences, and assumptions regarding cost and policy feasibility. Among all AR6 scenarios categorized

[i] UNECE regions include 56 countries, see: https://unece.org/member-states

as ‘C1’ or ‘C2’, which implies a pathway in alignment with limiting warming to 1.5°C (with a greater than 50% probability), with no or limited overshoot (C1), or high overshoot (C2). (The overshoot refers to the extent to which global average temperatures exceed the target 1.5°C increase, before returning to 1.5°C or below by 2100.[289]) In these scenarios nuclear capacity in 2050 ranges from 121 GWe to over 2000 GWe, with a median of 832 GWe, lower quartile of 495 GWe and upper quartile of 1254 GWe. Around 80% of 1.5°C-target-aligned scenarios project an expansion of nuclear capacity, and 31% envisage nuclear capacity to be more than triple by 2050 (see Figure A2.1).

Figure A2.1: Nuclear capacity pathways 2025-2050 (IPCC AR6 C1&C2 scenarios)



A2.2 Comparative analysis of the scenarios and WNO 2025 results

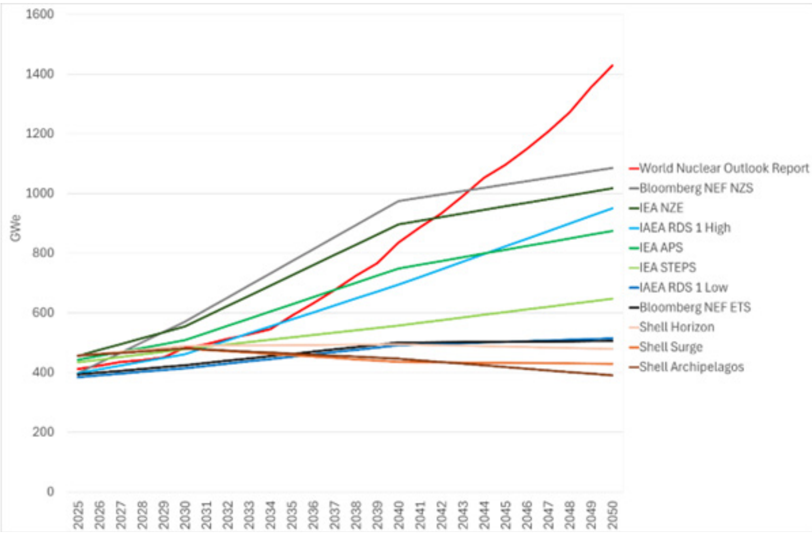
Within energy scenario modelling, nuclear prospects are highly dependent on two main factors:) cost or economic factors; and policy or societal factors.

From the cost perspective, in scenarios that disclose their techno-economic assumptions (such as the IEA World Energy Outlook and NGFS scenarios), the levelized cost of electricity (LCOE) for nuclear – particularly in North America and Europe – is set at relatively high levels, largely due to elevated capital costs. The projected LCOE for nuclear shows little to no decline over time towards 2050 (*i.e.* the assumed learning rate is very low). Interestingly, the difference in nuclear cost assumptions between baseline and net-zero scenarios is often minimal. In contrast, net-zero scenarios assume much more significant cost reductions for other low-carbon generation technologies, including solar PV, onshore and offshore wind, and fossil fuels with CCUS. At the same time, the LCOE fails to capture system-level costs incurred by integrating new plants into the grid. This can lead to an underestimation of the system costs of variable renewables, and in turn, a diminished economic competitiveness for dispatchable sources such as nuclear.

From a policy standpoint, some of the top-down (*i.e.* normative) studies reviewed here – including the IEA World Energy Outlook and Shell scenarios – mention non-cost-related policy or societal limitations that restrict the scale-up of nuclear energy. For example, in their methodological notes, these reports often take into consideration that nuclear development is more heavily influenced by policy and public acceptance than other technologies. Shell applies a limit in its model on the annual deployment rate of nuclear power.

The various scenarios provide a large range of projections for nuclear capacity in 2050, from 271 GWe to 1085 GWe, even those with similar climate targets (*i.e.* limiting the increase in average global temperatures to 1.5 °C or achieving net-zero emissions by 2050).

Figure A2.2: Compilation of global scenarios with capacity projections



From the perspective of nuclear growth, the scenarios discussed in this Appendix can be classified into two broad categories. The first category includes scenarios that show nuclear capacity at least doubling (*i.e.* exceeding 800 GWe) between 2020 and 2050. This category includes Bloomberg NEF NZS, IEA NZE and IEA APS, as well as the IAEA RDS-1 High Case.

The second category of scenarios, which includes the scenarios of Shell, IEA STEPS, and Bloomberg NEF ETS, as well as the IAEA RDS-1 Low Case, are characterized by a more moderate increase in nuclear capacity, or even a decline.

Those scenarios with the highest nuclear capacities, Bloomberg NEF NZS and IEA NZE, are both designed to achieve net-zero emissions. The next highest nuclear capacity scenario is the IEA APS scenario, which includes policies that have been announced by government that have the objective of reducing emissions, although they are estimated not to be sufficient to achieve it.

Of those scenarios with lower nuclear capacity, two of the three Shell scenarios (Archipelagos and Surge) and the Bloomberg NEF ETS are not designed to achieve net-zero, The Shell Horizon scenario is designed, achieve net zero emissions does have only a modest increase in nuclear capacity to 2050. However, subsequently, both the Horizon and Surge scenarios see nuclear capacity increasing, both reaching more than 1150 GWe by 2100.

The capacities projected for the scenarios reviewed in this appendix all fall short of both the objectives of the Declaration to Triple Nuclear Energy, and the total capacity projected by the country-by-country reviews in this document. However, the ranges of the projections of the IAEA RDS-1 and the scenarios set out in the World Nuclear Association Fuel Report encompass much of the variations in nuclear capacity projected by the scenarios described in this appendix.

For governments to meet the capacity goals set out in this document will require multiple actions on policy, regulation and financing, as well as a substantial increases in the capacity of the nuclear supply chain and fuel cycle services.

References

[1] World Nuclear Performance Report 2025, *World Nuclear Association*, September 2025

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