



Nuclear Power and Secure Energy Transitions

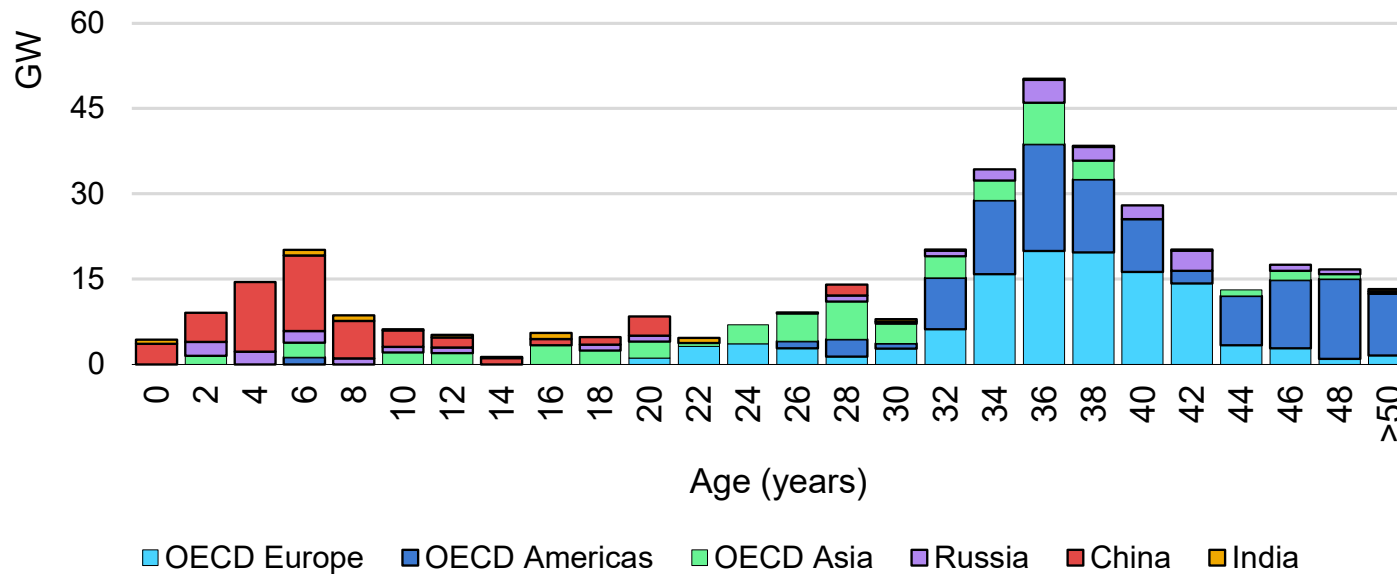
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Nuclear has been subject to boom and bust cycles in the past

Age distribution of operational nuclear capacity by region, end of 2021

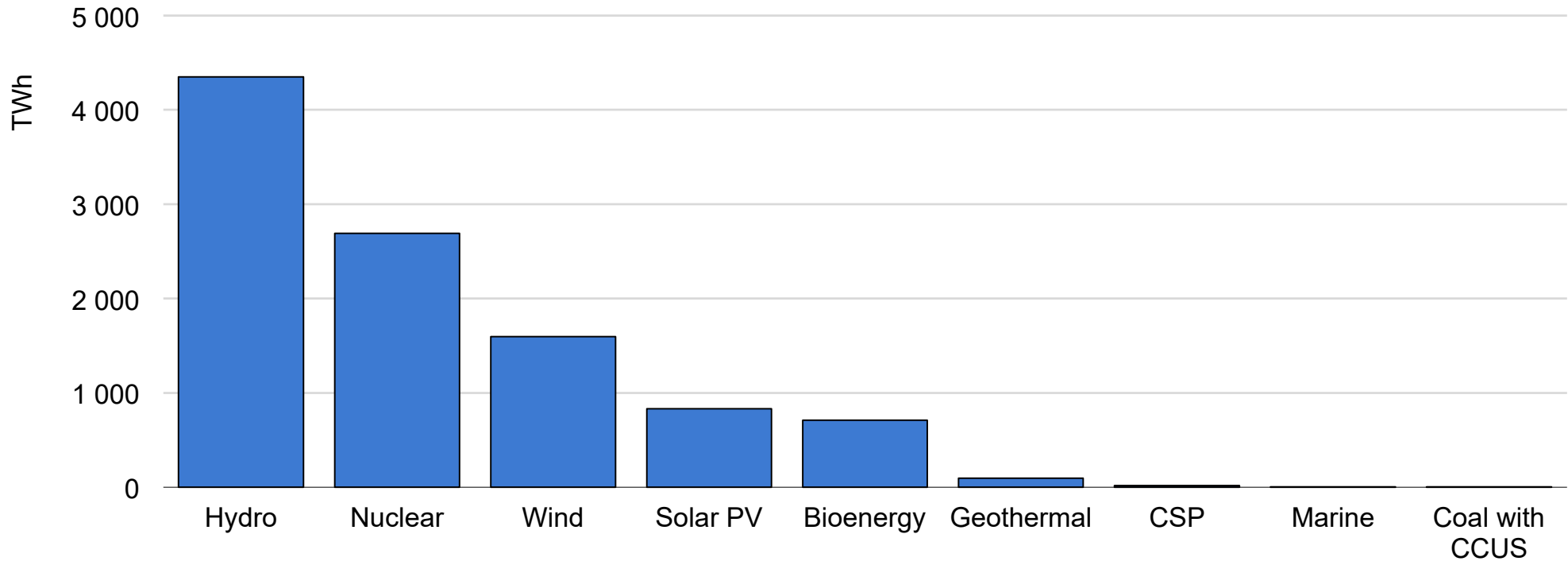


Investment in nuclear energy soared after the 1973 oil crisis in advanced economies, but has diminished due to cost overruns, safety concerns and the decline in cost of alternative sources like natural gas.

- Russia's invasion of Ukraine and disruptions in global energy supply have made governments rethink their energy security strategies, targeting diverse and domestic supplies
- Governments in over 70 countries have committed to achieving net zero emissions, covering three-quarters of global emissions and economic activity
- Peaking CO₂ emissions this decade and starting a long-term decline is essential to keep the door open to limiting climate change to 1.5 °C
- The policy landscape is changing, opening up opportunities for nuclear to make a comeback

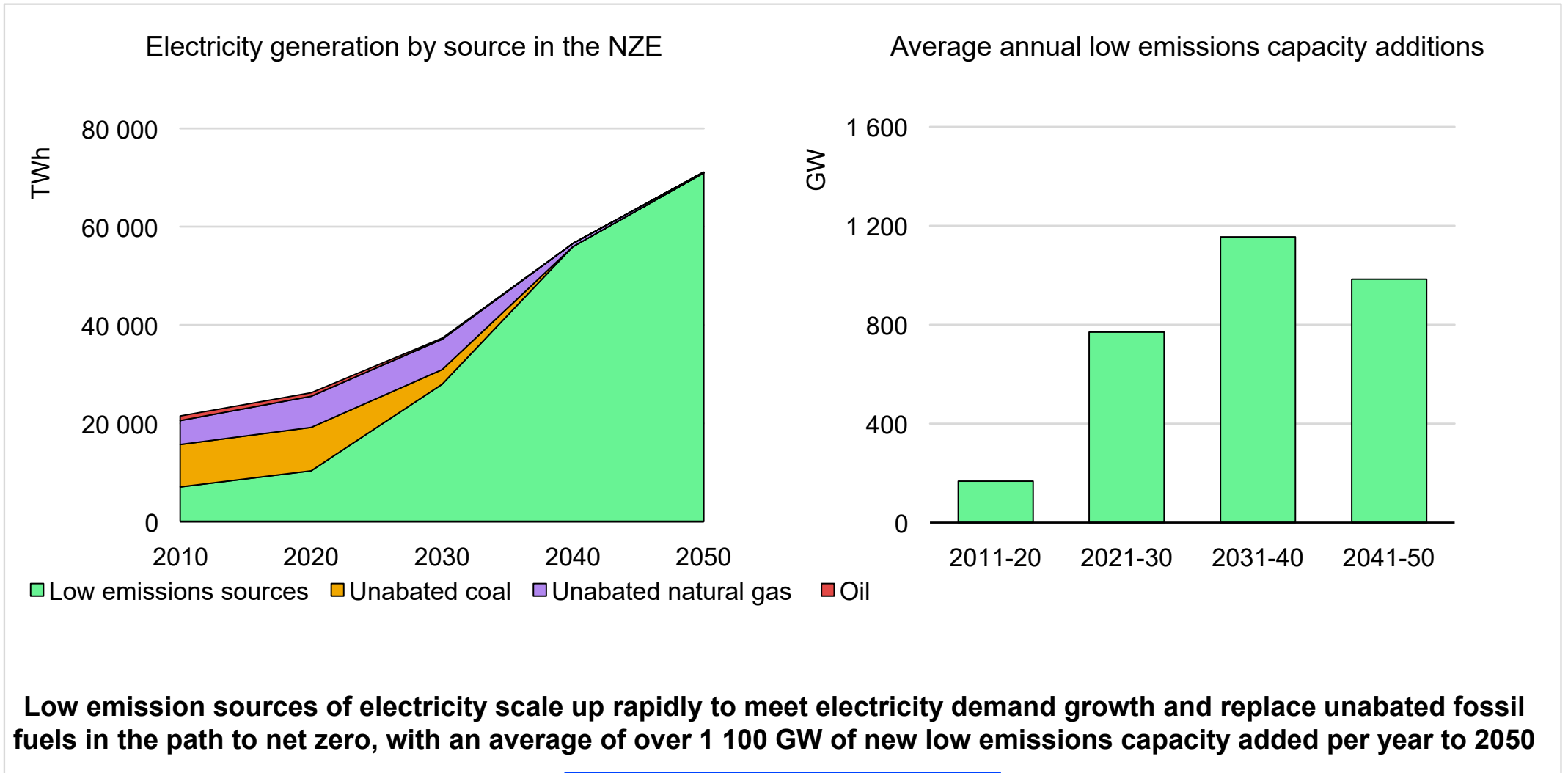
Nuclear is the second largest low emissions source today

Low emissions electricity generation by source worldwide, 2020



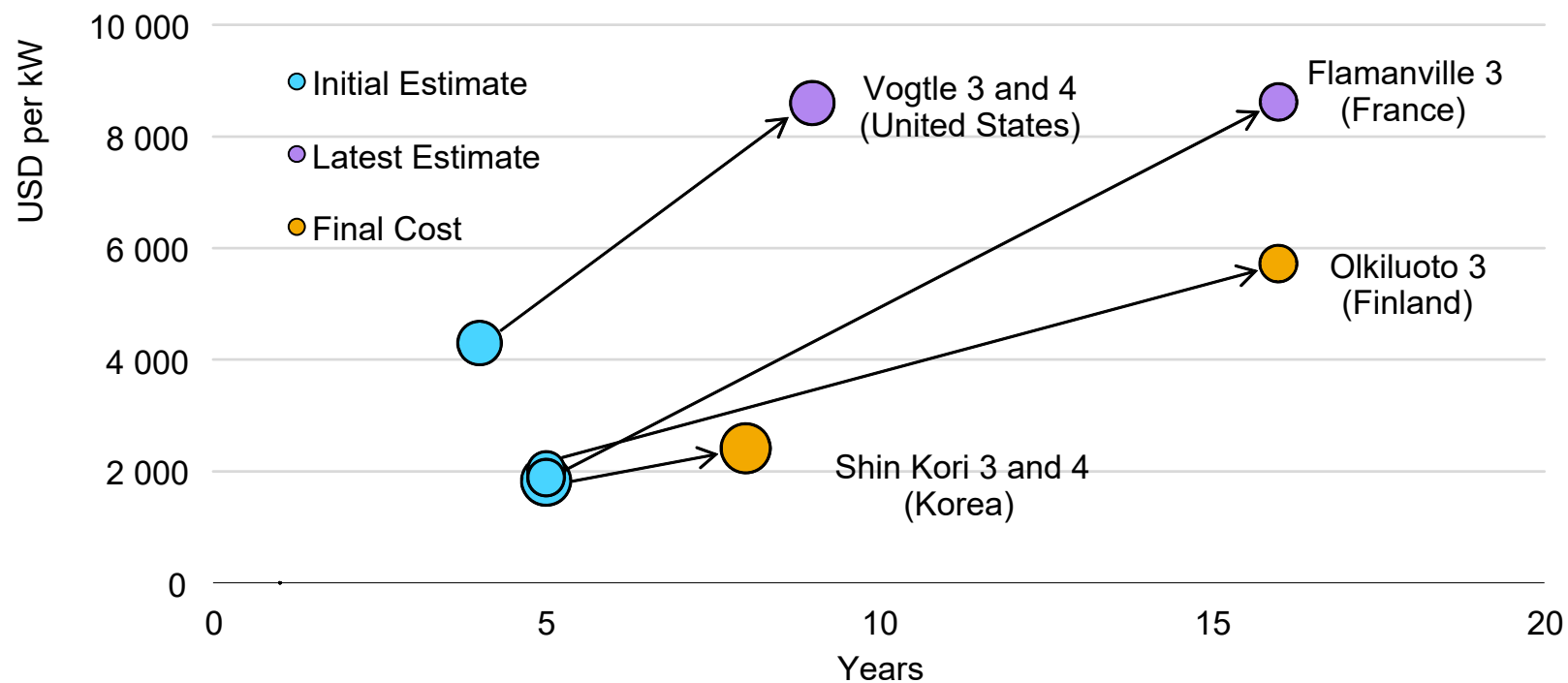
Nuclear power produced more low emissions electricity than solar PV and wind combined in 2020, and each year helps to avoid about 1.5 Gt of CO₂ emissions around the world

The future is electric and low emissions



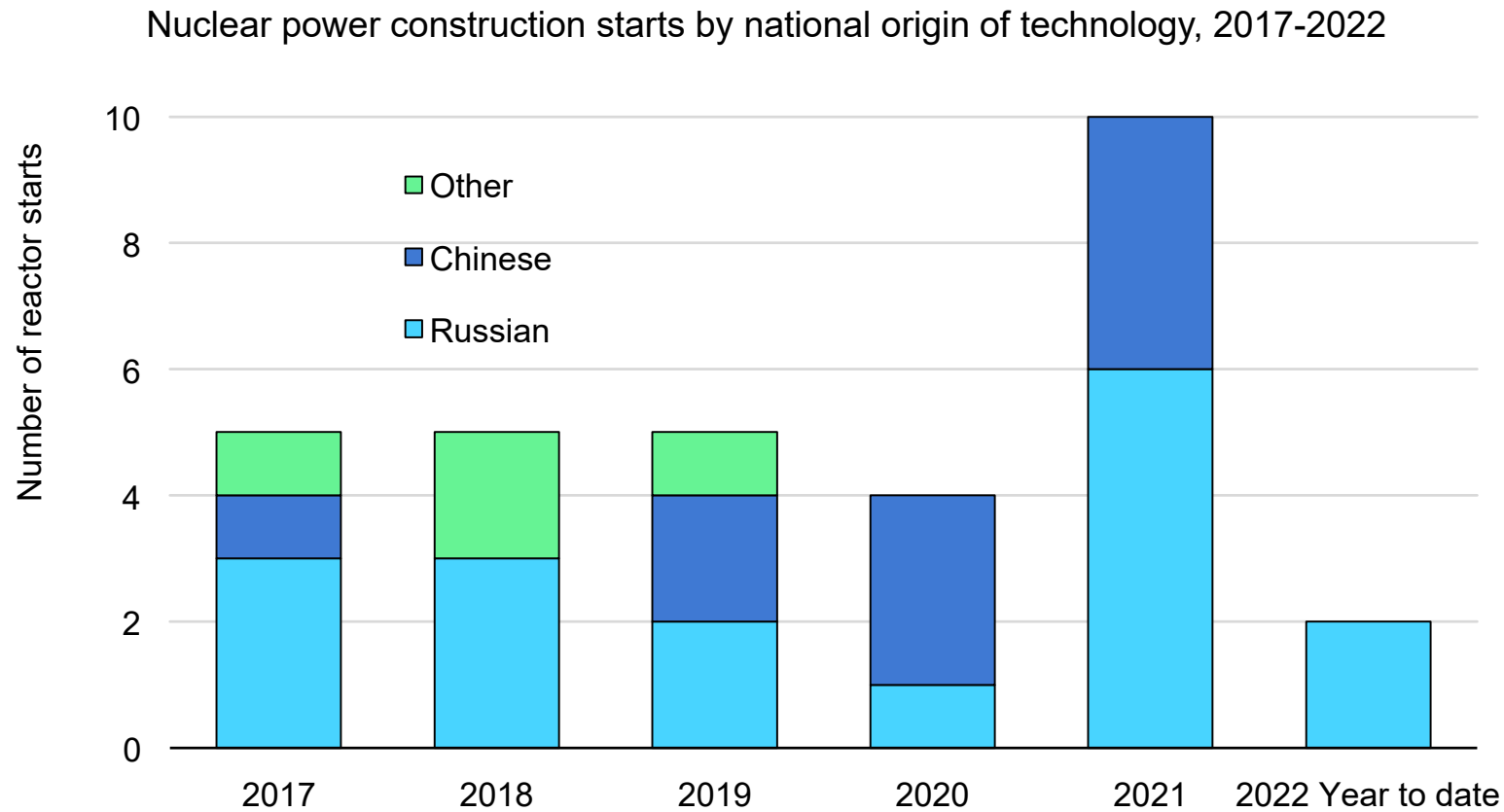
Delays and cost overruns have troubled the nuclear industry

Overnight cost and construction times for selected recent nuclear projects



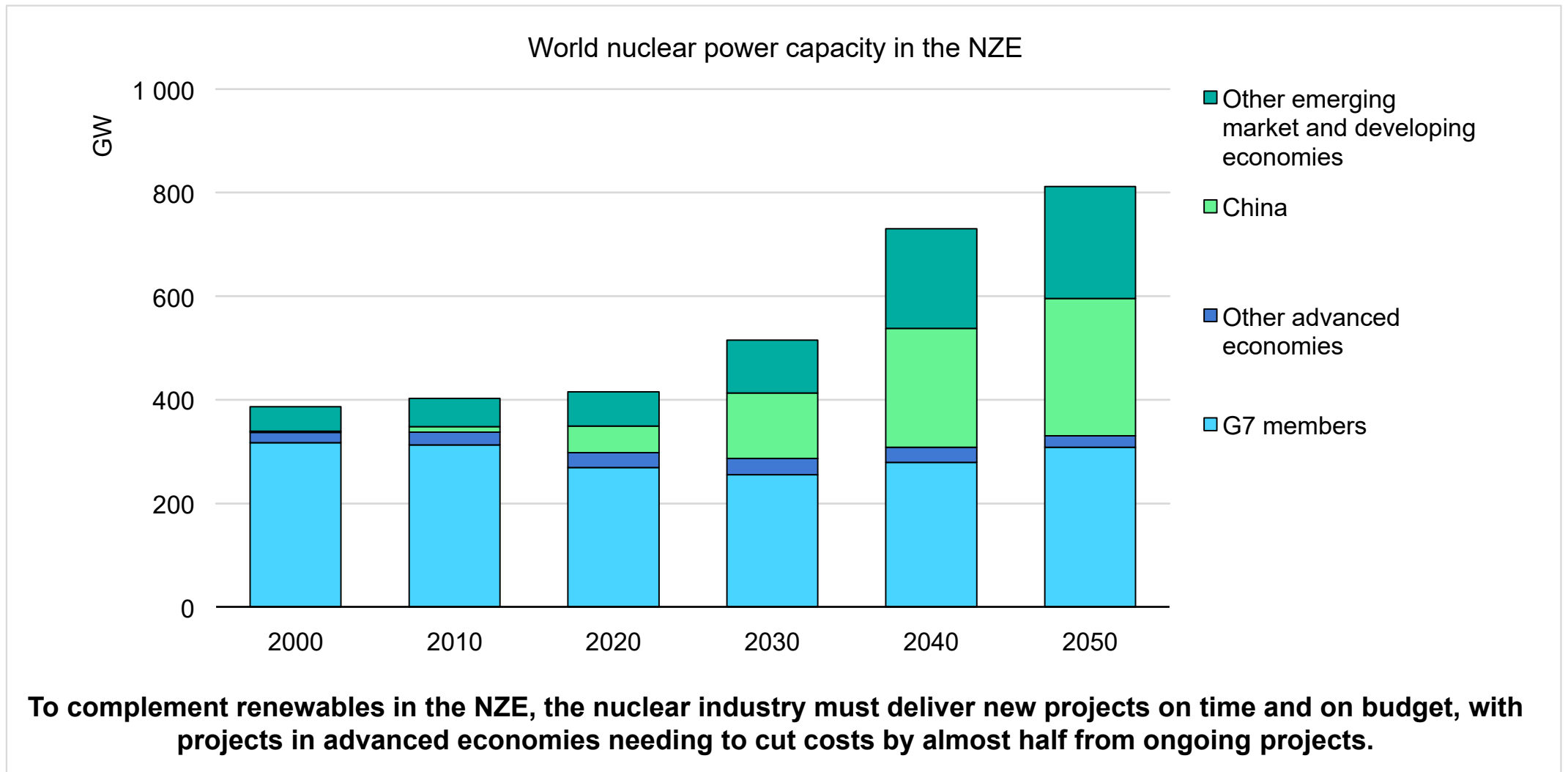
Although advanced economies have nearly 70% of global nuclear capacity, investment stalled decades ago and the latest projects are running far over budget and behind schedule.

Nuclear market leadership shifting from advanced economies

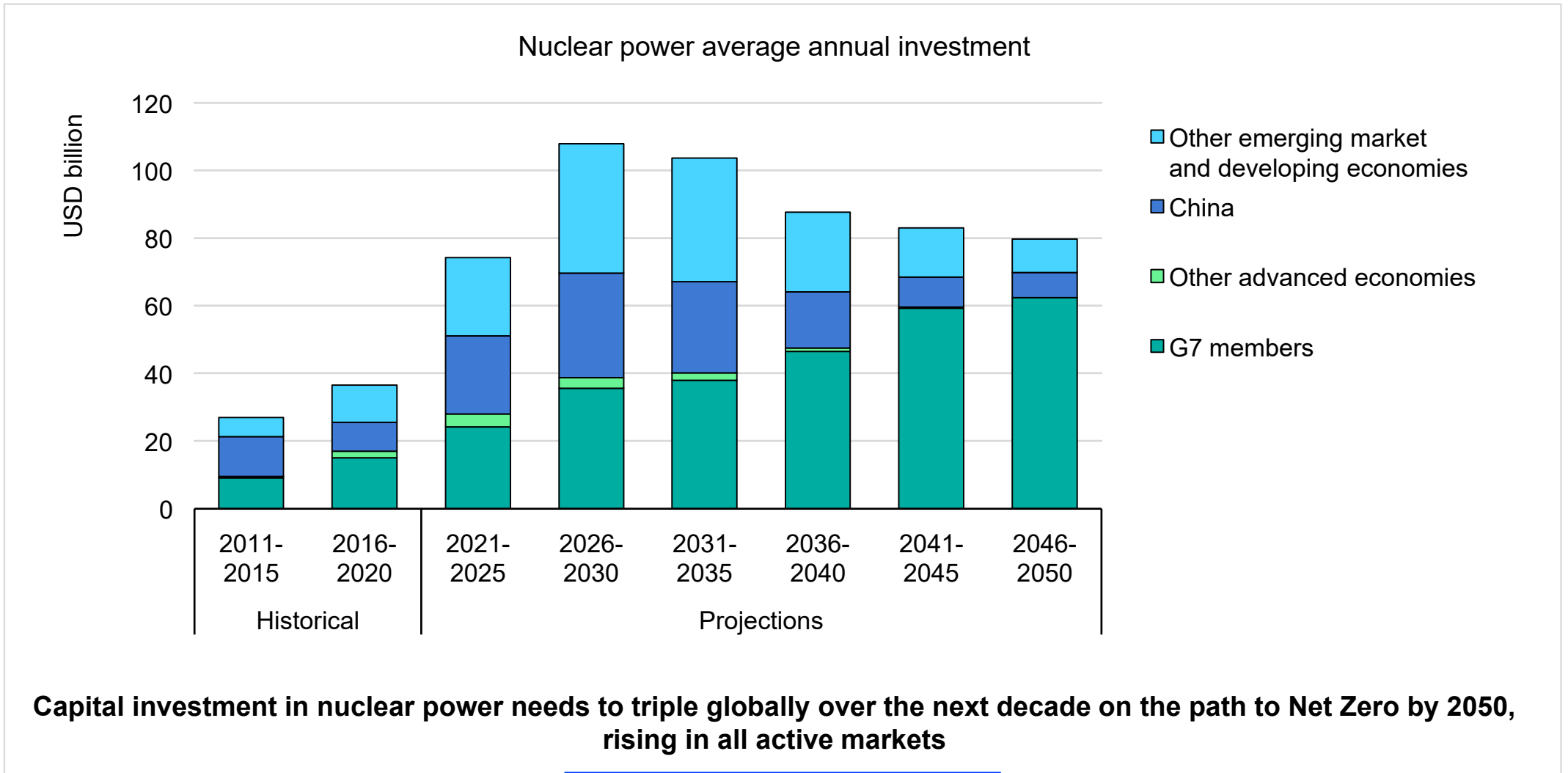


Of the 31 reactors that began construction since the beginning of 2017, all but four are of Russian or Chinese design.

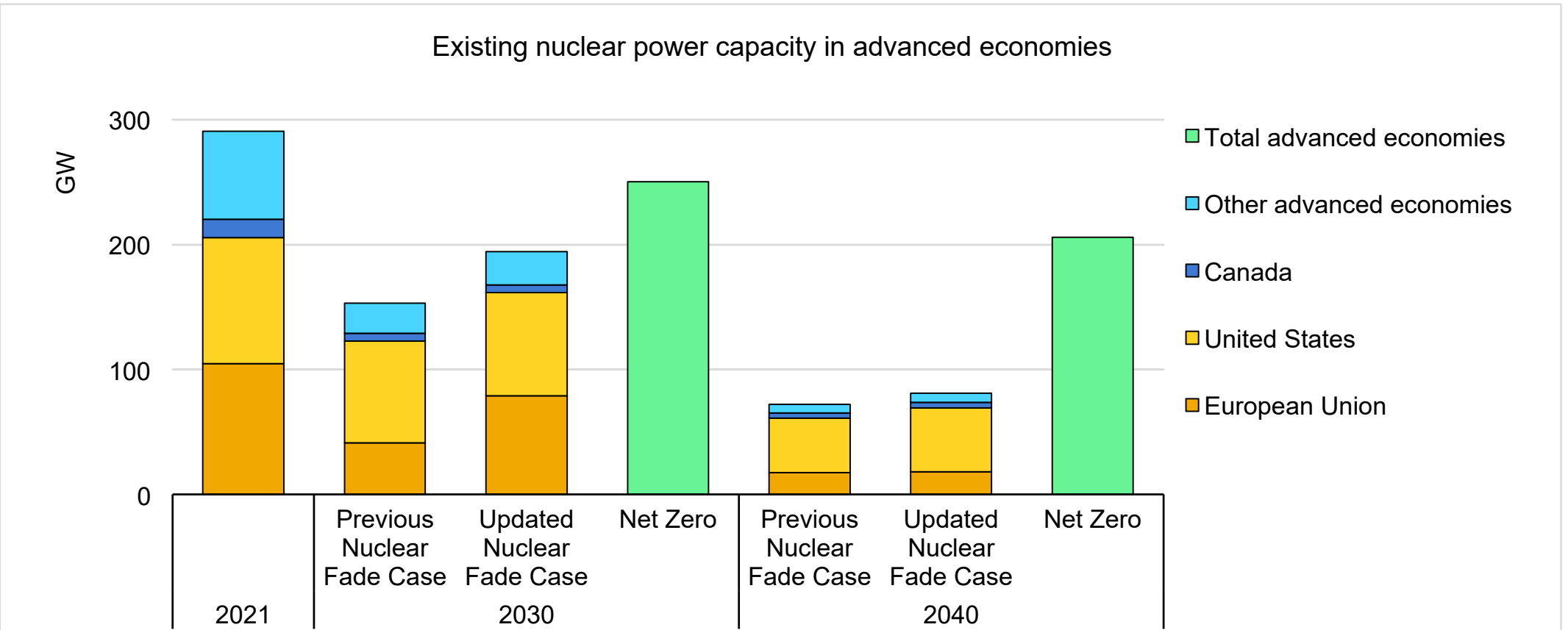
Nuclear capacity doubles to 2050 on the path to Net Zero



Investment in nuclear power must step up



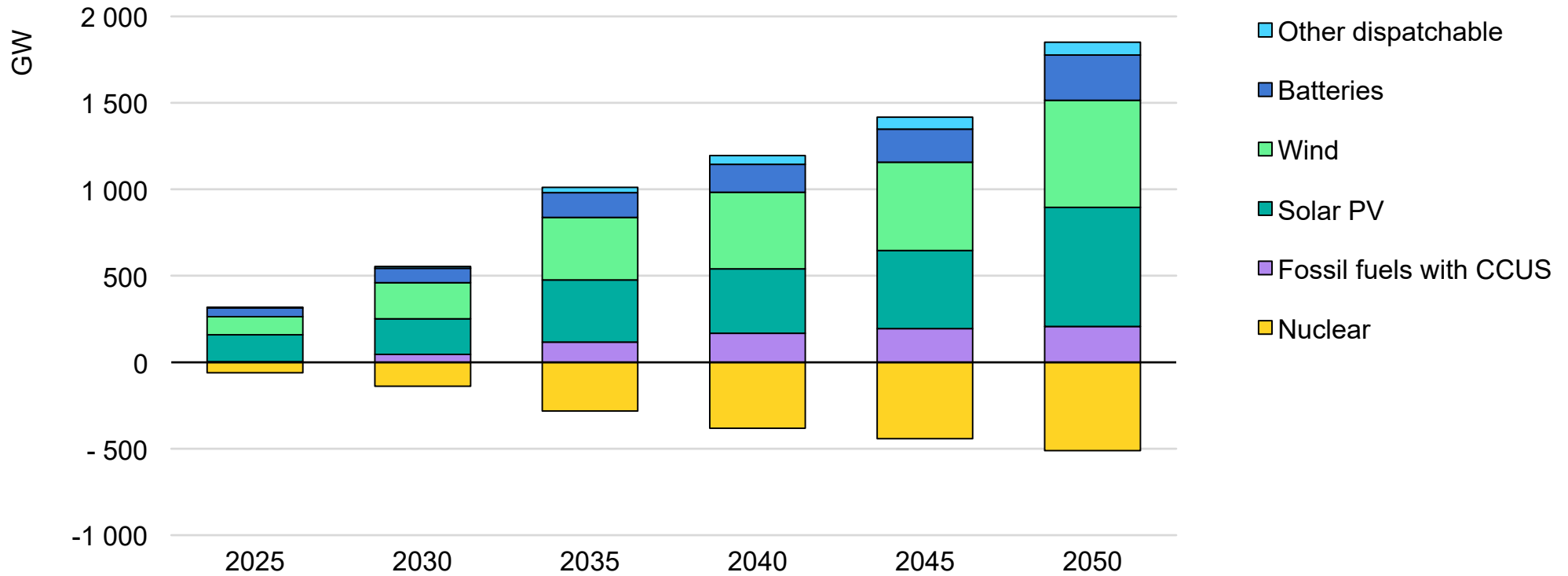
Nuclear could still face a steep decline in advanced economies



Lifetime extensions have been granted for 50 GW of nuclear capacity since 2019, but the existing fleet of nuclear reactors can contribute much more to affordable and secure clean energy transitions.

The path to net zero with less nuclear is narrower

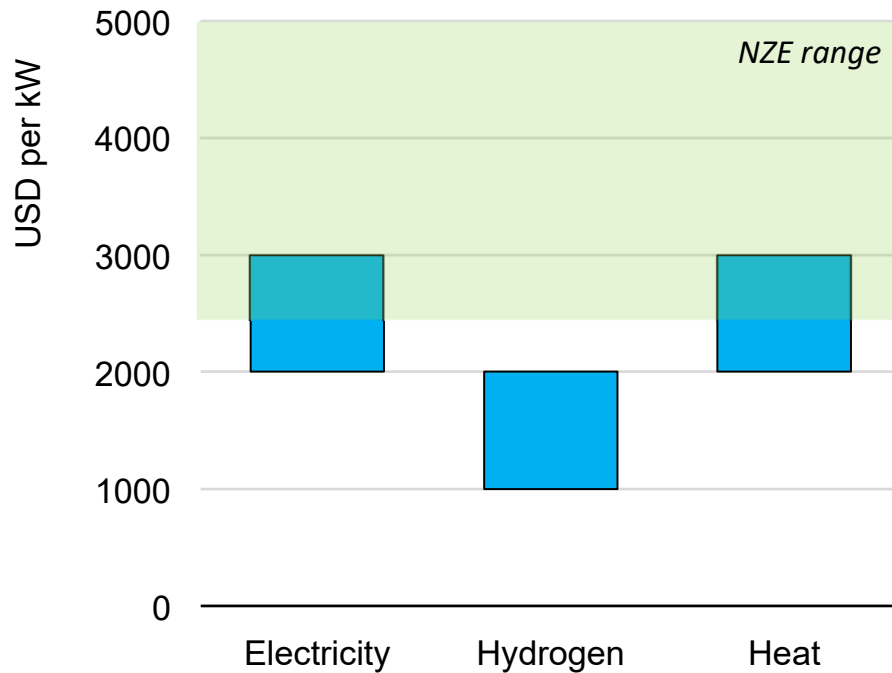
Change in capacity in the Low Nuclear Case relative to the NZE



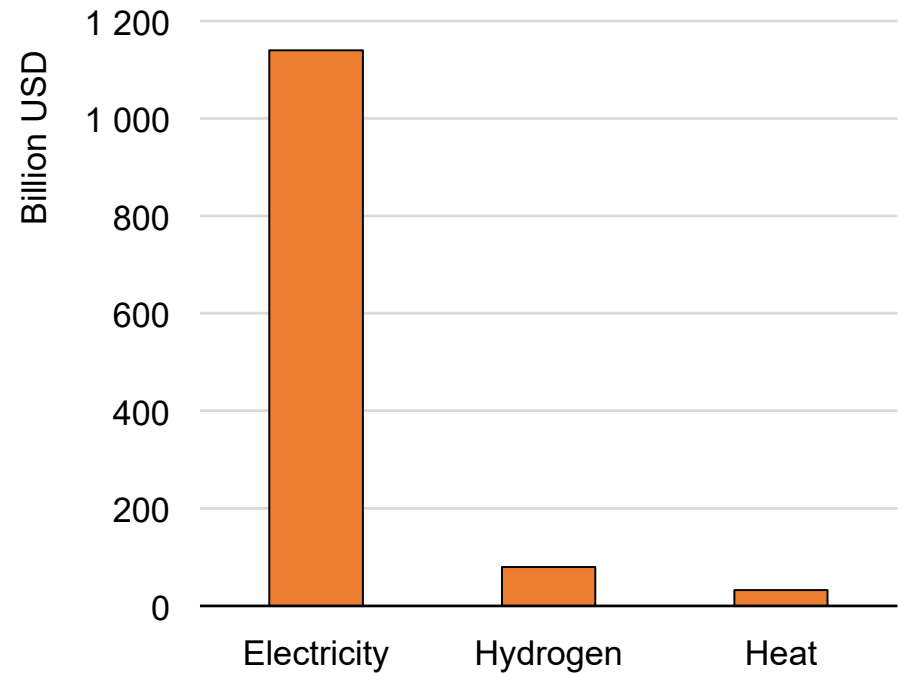
While reaching net zero by 2050 would still be possible, failing to step up nuclear construction or extend lifetimes , would cost consumers USD 20 billion more per year and strain supply chains and the need for critical minerals

A larger role can open up with lower nuclear costs

Nuclear cost levels to compete in 2030



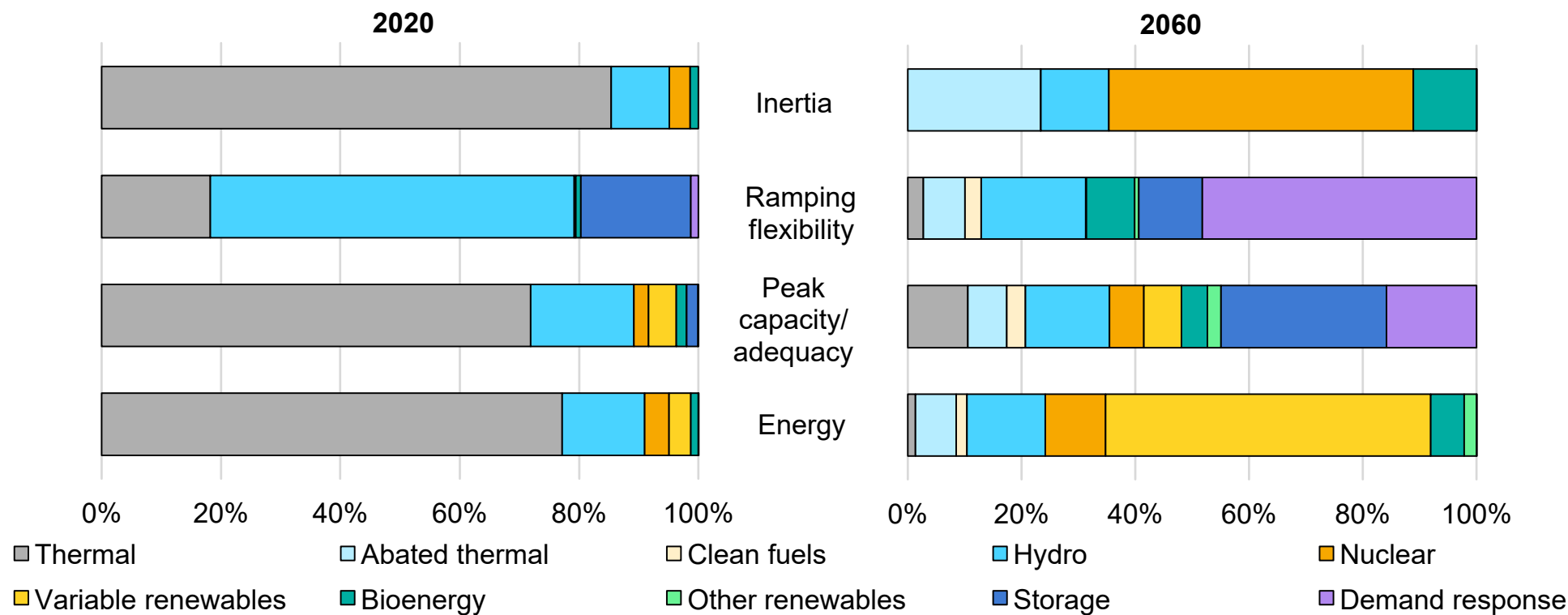
Market size for low emissions sources in the NZE, 2031-40



**Nuclear energy can deliver low emissions electricity, heat and hydrogen.
Further cost declines than in the NZE would enable it to capture higher market shares.**

Nuclear can provide key system services

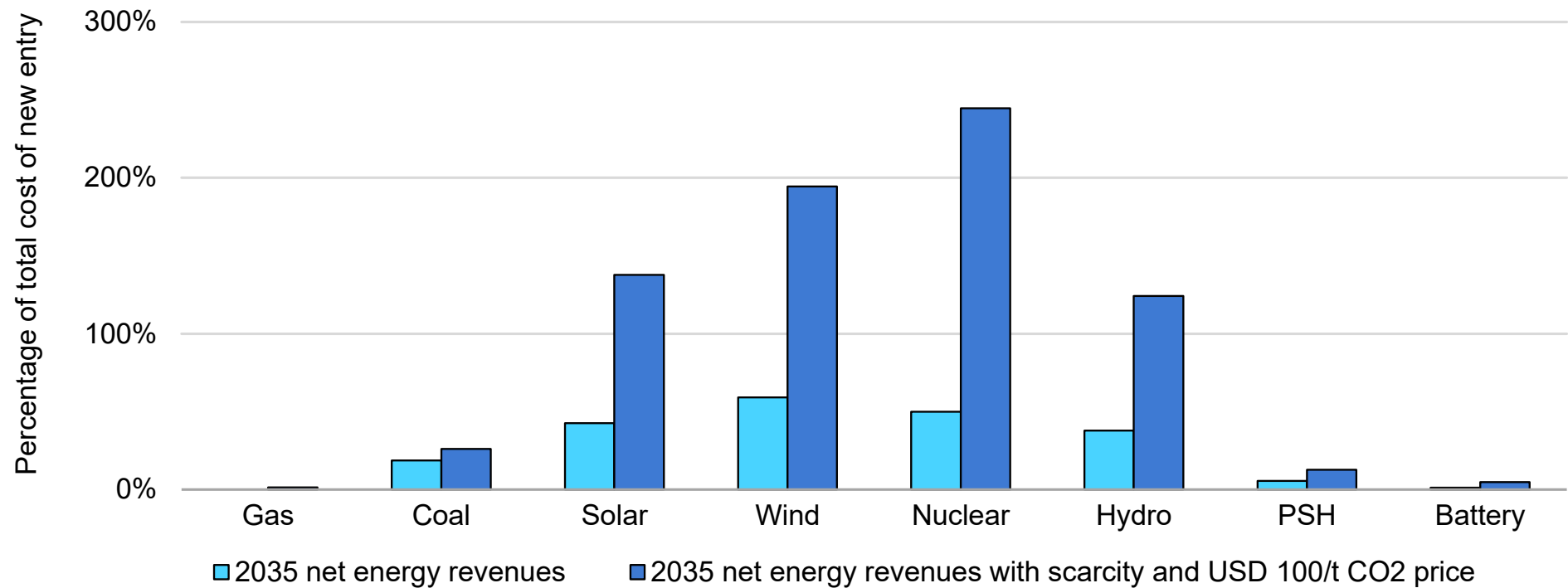
Contribution to electricity system services by resource in China



Alongside other dispatchable sources, nuclear power can contribute to the reliability, stability and security of power systems to a greater degree than its share of generation alone suggests

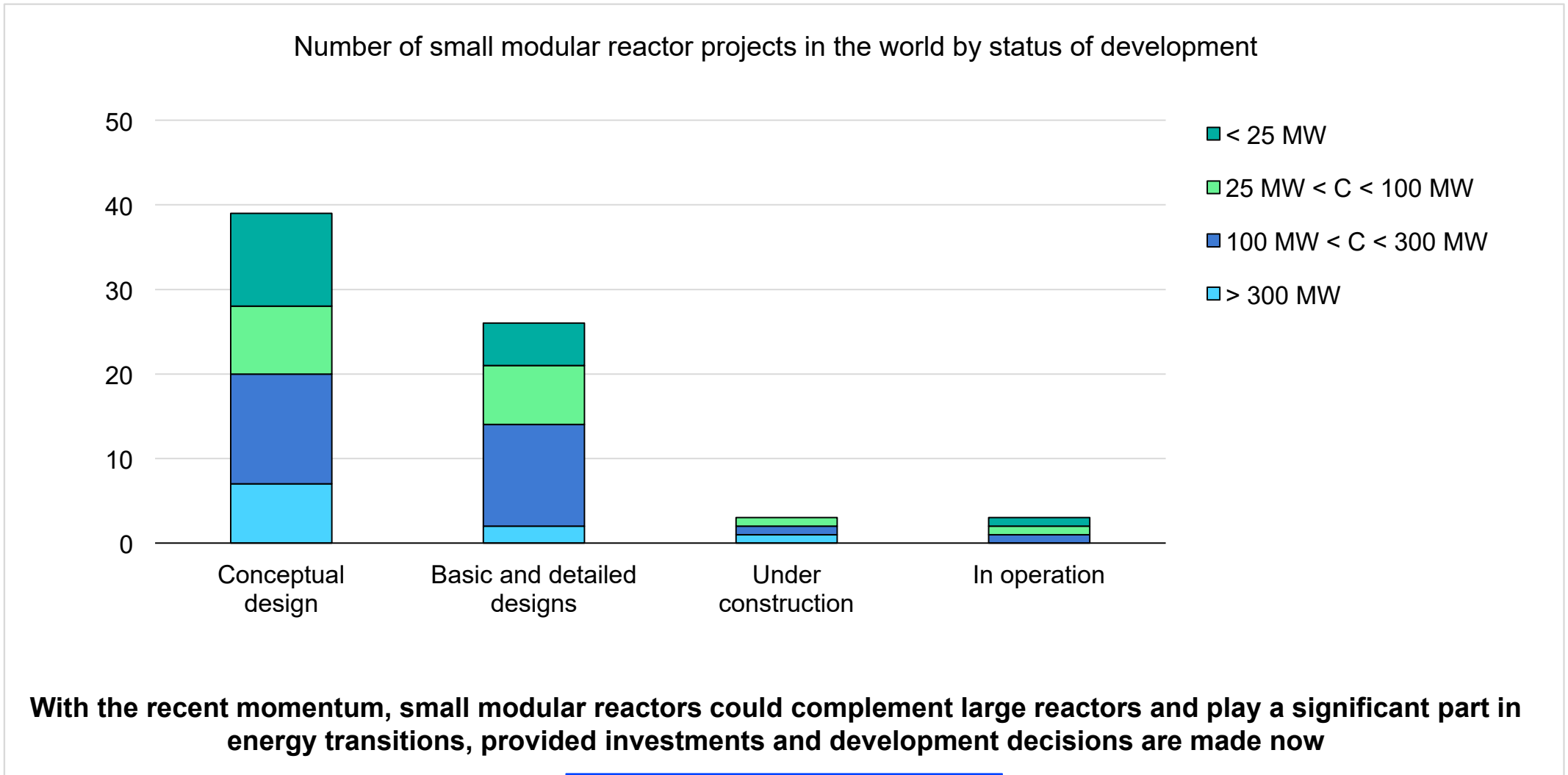
Market designs and risk mitigation can boost nuclear

Impact of CO2 price and capacity scarcity pricing on profitability of electricity generation in China by type, 2035



Carbon pricing and capacity remuneration can boost the competitiveness of nuclear and other low emissions generating options vis-à-vis fossil fuel based generation. This would lower the need for out-of-market incentives.

The net zero challenge has stimulated a burst of activity on SMRs



Conclusions

- In countries where it is accepted, nuclear energy could play an important role in ensuring rapid and secure energy transitions.
- Energy transitions with less nuclear would be more difficult and costly.
- Investments in nuclear must step up fast. Existing nuclear plants must be extended.
- The nuclear industry has to deliver new projects on time and on budget.
- Electricity market designs must recognise the value of dispatchable low emissions capacity.
- Governments should promote efficient and effective safety regulation, implement solutions for nuclear waste disposal and create financing frameworks for new reactors.
- Net zero would require innovation in many areas. Small modular reactors are a promising technology.
- The IEA stands ready to support the security, affordability and sustainability of energy through an all fuels and all technologies approach.

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