

World Energy Markets Outlook

How are AI and sovereignty driving a new energy paradigm in an uncertain world?

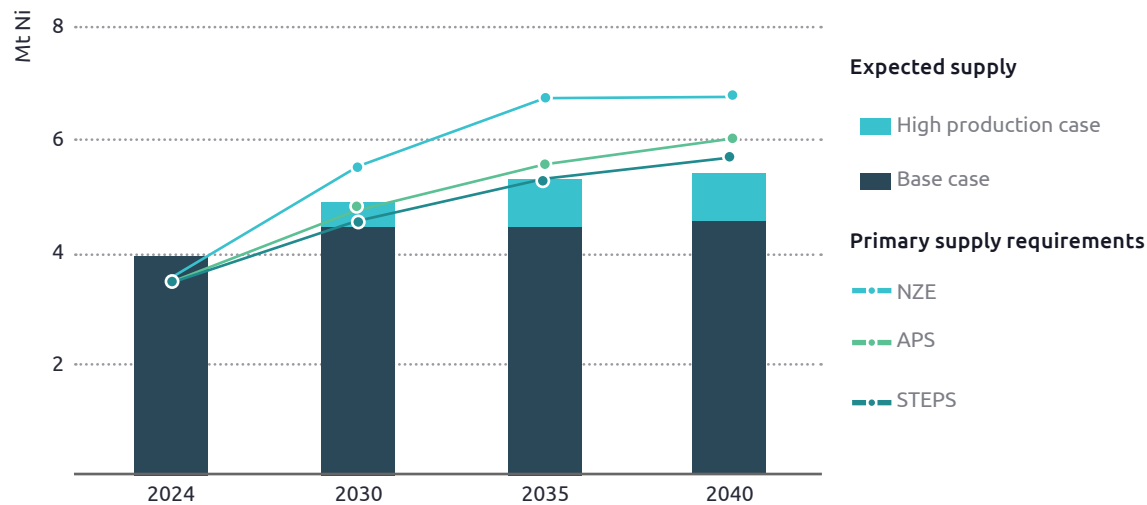
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FIGURE 1
Expected mined nickel supply from existing and announced projects and primary supply requirements by scenario



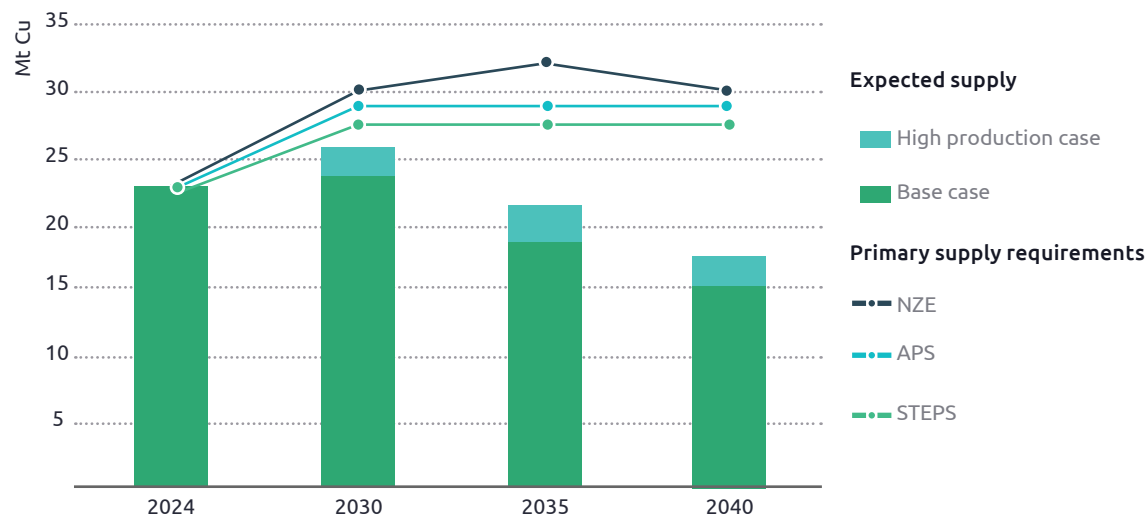
Source: Global Critical Minerals Outlook 2025

- According to Global Critical Minerals Outlook 2025 report by IEA, in the near term, the nickel market is likely to remain in surplus under both the STEPS and APS, driven largely by high investment in recent years, especially in Indonesia.
- However, with lower supply projections this year, the surplus disappears after 2030 in the base case supply scenario.

Note: NZE - The Net Zero Emissions by 2050 Scenario; APS - The Announced Pledges Scenario; STEPS - The Stated Policies Scenario



FIGURE 2
Mined copper supply from existing and announced projects and primary supply requirements by scenario



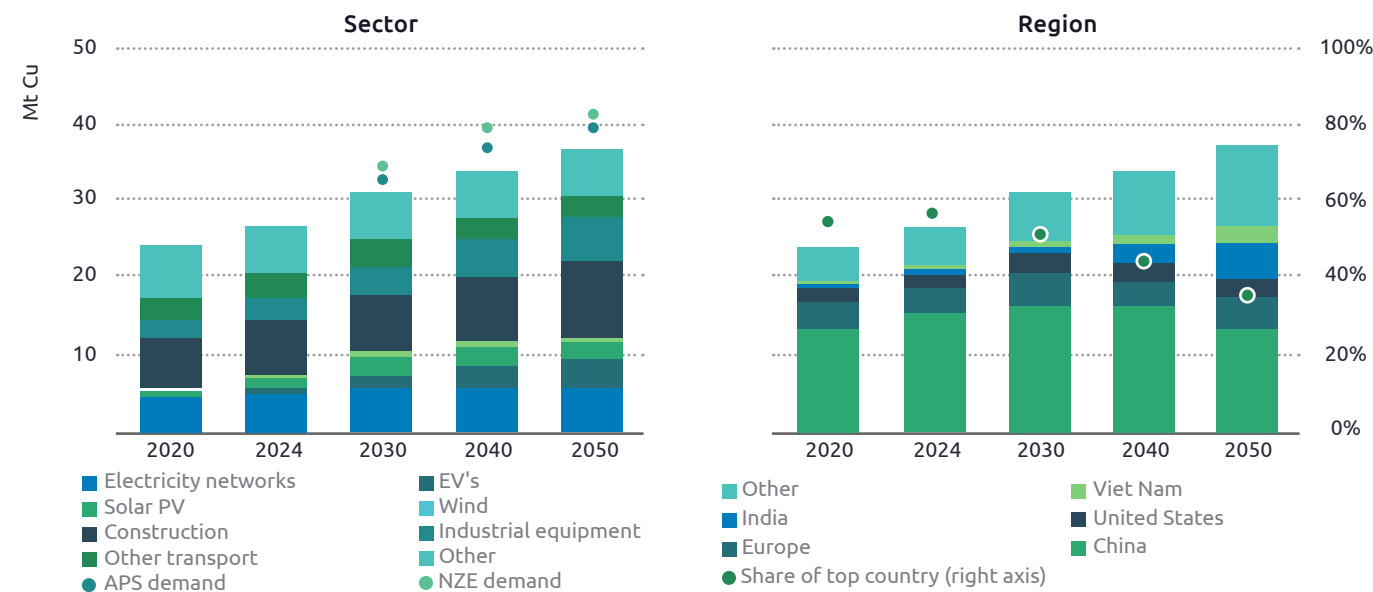
Source: Global Critical Minerals Outlook 2025

- According to Global Critical Minerals Outlook 2025 report by IEA, there is set to be a 30% supply deficit by 2035 in the STEPS. This supply gap widens to 35% in the APS and over 40% in the NZE Scenario in the same year. Even in the high production case, there is a 20% supply deficit by 2035 in the STEPS.
- The supply deficit starts forming from around the late 2020s in the base case and slightly later in the high production case under the STEPS. This supply gap is driven by declining copper ore grades.

Note: NZE -The Net Zero Emissions by 2050 Scenario; APS - The Announced Pledges Scenario; STEPS - The Stated Policies Scenario



FIGURE 3
Copper demand by sector and region in the STEPS



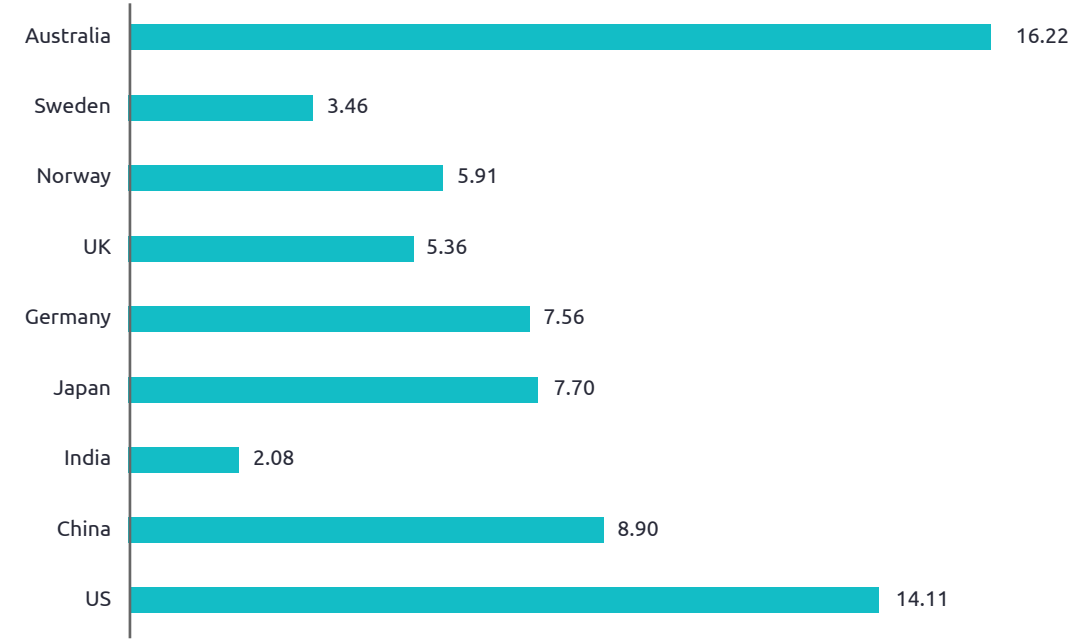
Source: Global Critical Minerals Outlook 2025

- According to Global Critical Minerals Outlook 2025 report by IEA, construction and electricity networks remain the largest sources of copper demand in 2024, while EVs are the fastest-growing source of demand.
- China alone was responsible for almost 60% of global refined copper demand in 2024. The United States was the second-largest source of demand with just over 6% of demand, with Germany the third-largest source with 4% in 2024. Looking ahead, major new sources of refined copper demand emerge in Asia outside of China.

Note: NZE -The Net Zero Emissions by 2050 Scenario; APS - The Announced Pledges Scenario; STEPS - The Stated Policies Scenario



FIGURE 4
CO₂ emissions per capita (2024) (in tons)

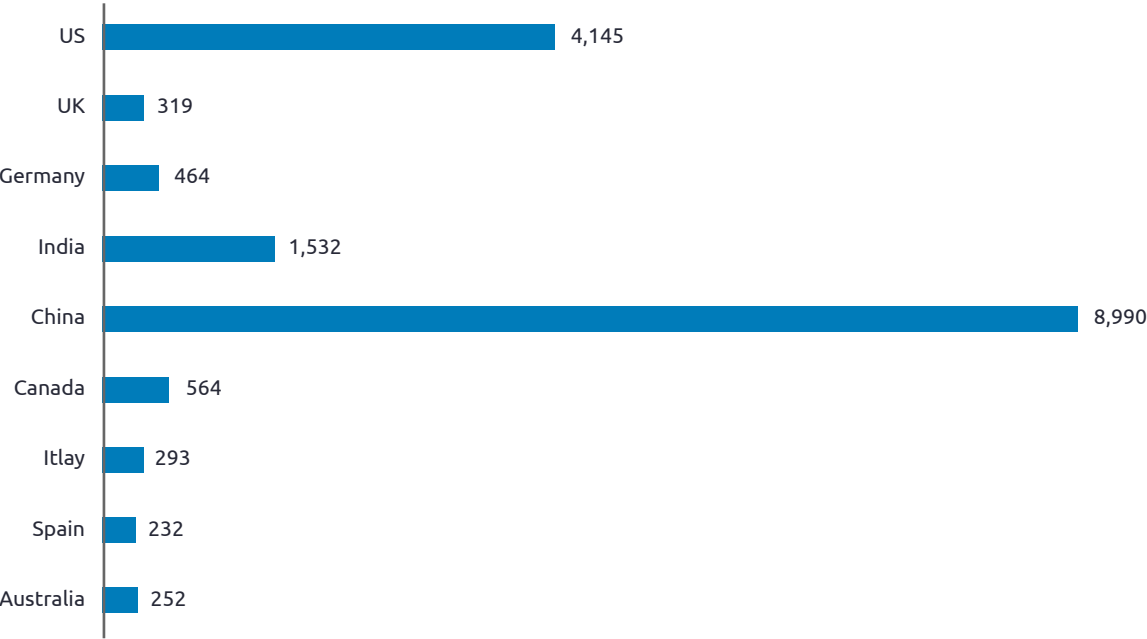


- Australia leads with the highest per capita emissions at 16.22 tons, followed by the U.S. (14.11 tons).
- India has the lowest among the listed countries at 2.08 tons, reflecting lower industrial and energy consumption per person.
- China (8.90 tons) emits more per capita than most European countries, but less than the U.S. and Australia.
- European nations like Germany, UK, Norway, and Sweden show moderate to low emissions, indicating stronger efficiency and decarbonization efforts.

Source: Ourworldindata.org



FIGURE 5
Electricity consumption (TWh) by major countries in 2024

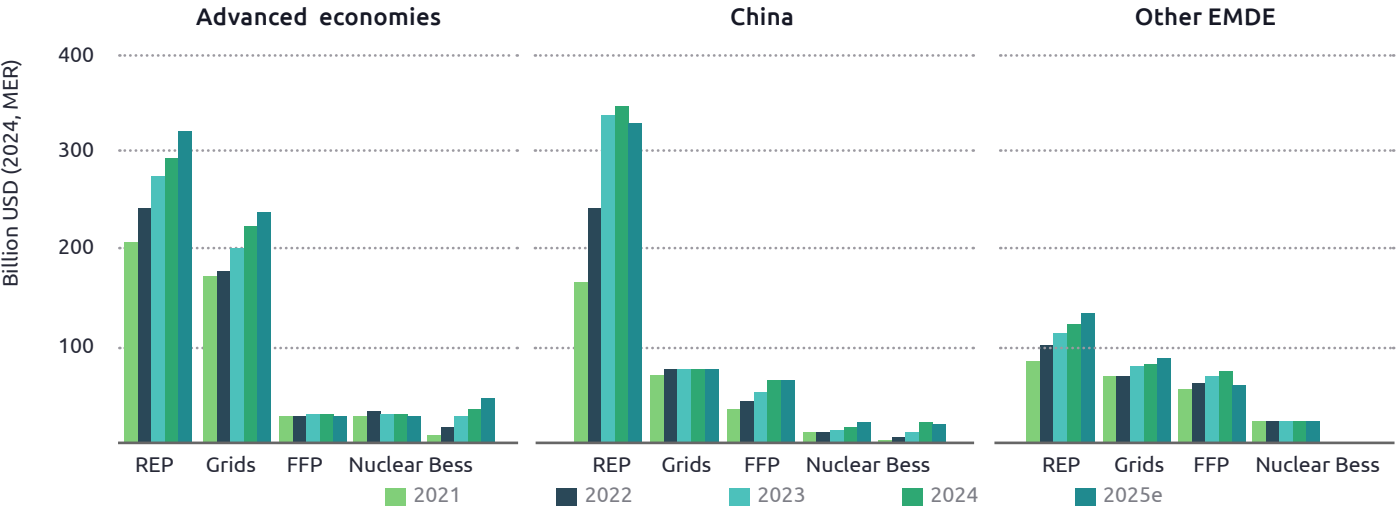


- China leads with 8990 TWh, followed by the U.S. (4145 TWh) and India (1532 TWh)—reflecting their large populations and industrial bases.
- European countries like Germany, UK, Italy, and Spain show moderate consumption, consistent with energy efficiency and mature economies.

Source: Enerdata



FIGURE 6
Annual investment in the power sector by region and category, 2021-2025

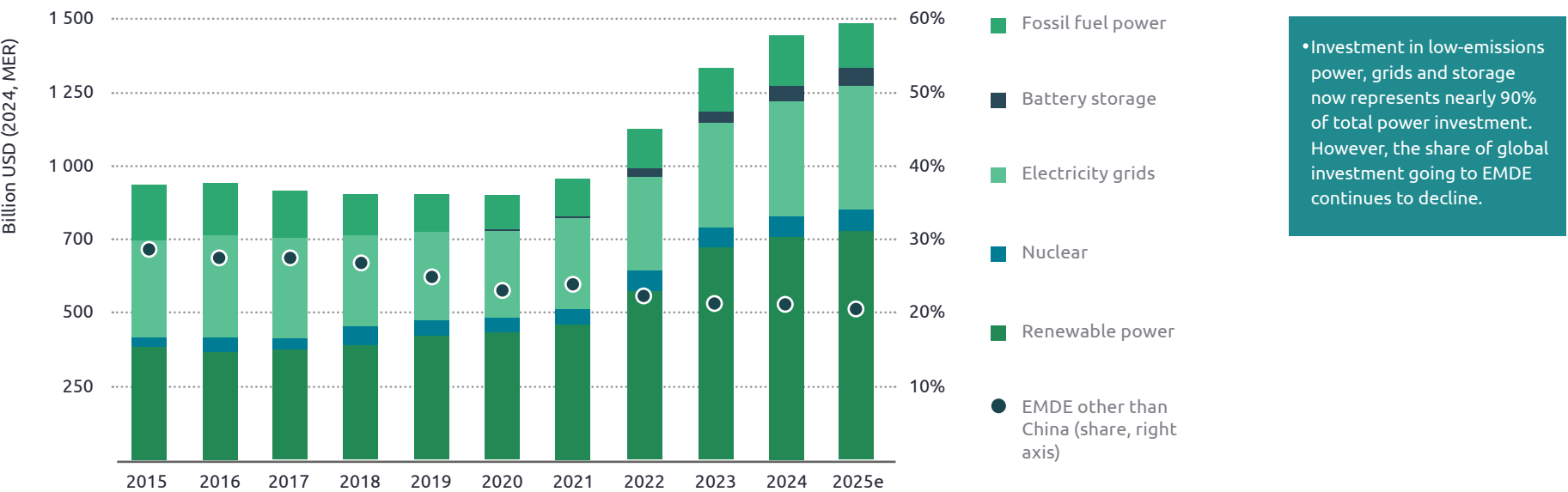


- Low-emissions generation, battery storage and grids saw record investment in advanced economies, China and other EMDE in 2024.
- Fossil generation investment is also rising due to new projects in China but is set to decline in other EMDE in 2025.

Note: EMDE = emerging market and developing economies, REP = renewable power; FFP = fossil fuel power; BESS = battery energy storage system. Spending on BESS in other EMDE is estimated at less than USD 2 billion in 2024, and can barely be detected on the chart. Pumped hydro storage is included under REP. 2025e = estimated values for 2025.



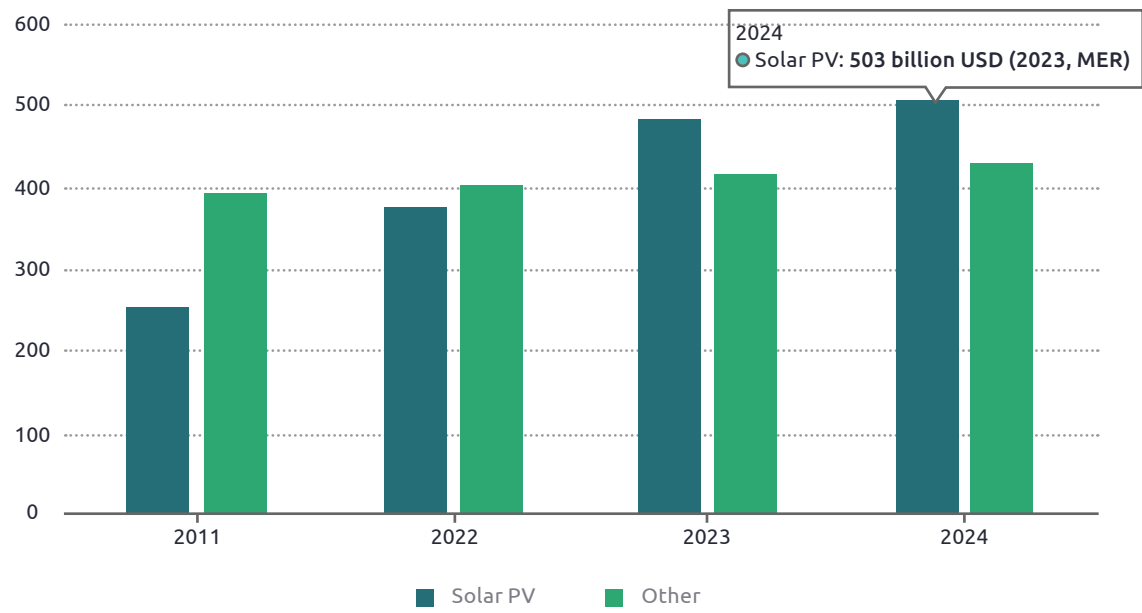
FIGURE 7
Global annual investment in the power sector by category, and EMDE share, 2015-2025



Note: EMDE = emerging market and developing economies; MER = market exchange rates; 2025e = estimated values for 2025. Investment throughout is measured as ongoing capital spending on new and existing power capacity. Fossil fuel power includes unabated and abated power. Low-emissions generation = renewables, nuclear, and fossil fuels or non-renewables waste equipped with CCUS. Pumped hydro storage is included under renewables, not battery storage



FIGURE 8
Global annual investment in solar PV and other generation technologies



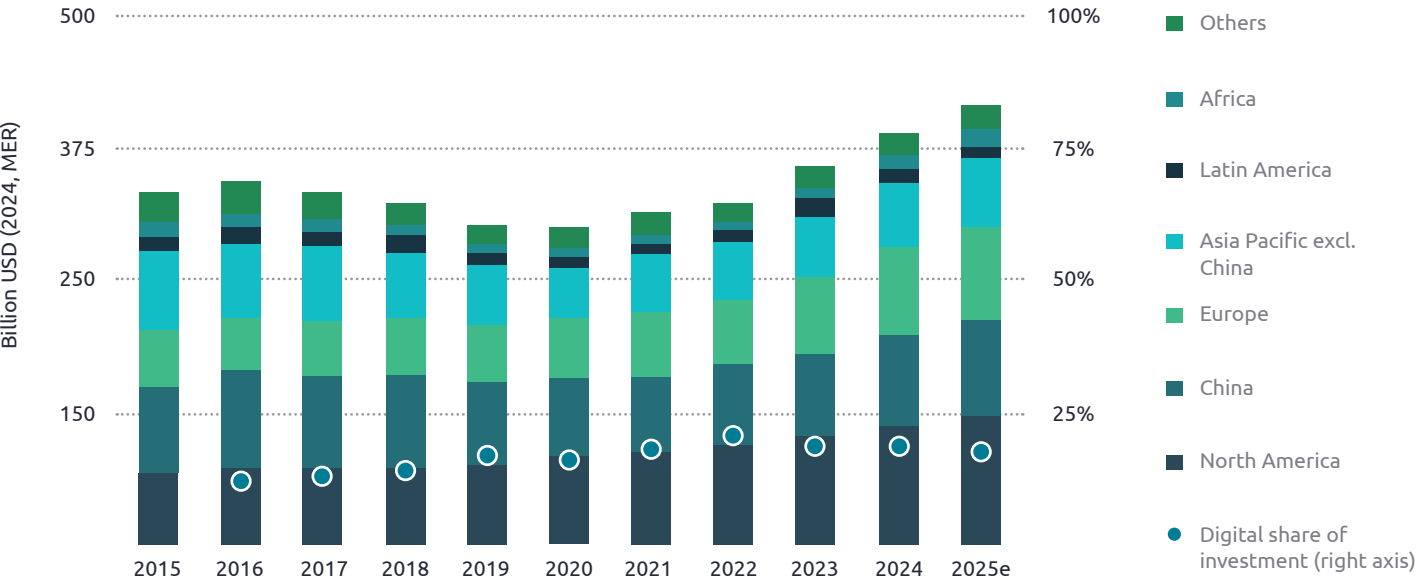
- IEA estimates that solar PV investment will exceed \$500 billion, making it the largest single item in global power sector investment
- Others: Wind power investment remains robust but trails solar PV and is part of the \$2 trillion clean energy total.
- Nuclear power investment is projected at \$80 billion, nearly double 2018 levels.
- Coal investment is rising, with 50 GW of unabated coal plants approved in 2023, mostly in China—the highest since 2015.

Source: IEA- World Energy Investment 2025

Note: 2024 values are estimated. Other = Electricity generation from all other technologies including coal, oil, natural gas, hydro, wind and nuclear.



FIGURE 9
Investment in power grid infrastructure by geography & digital share



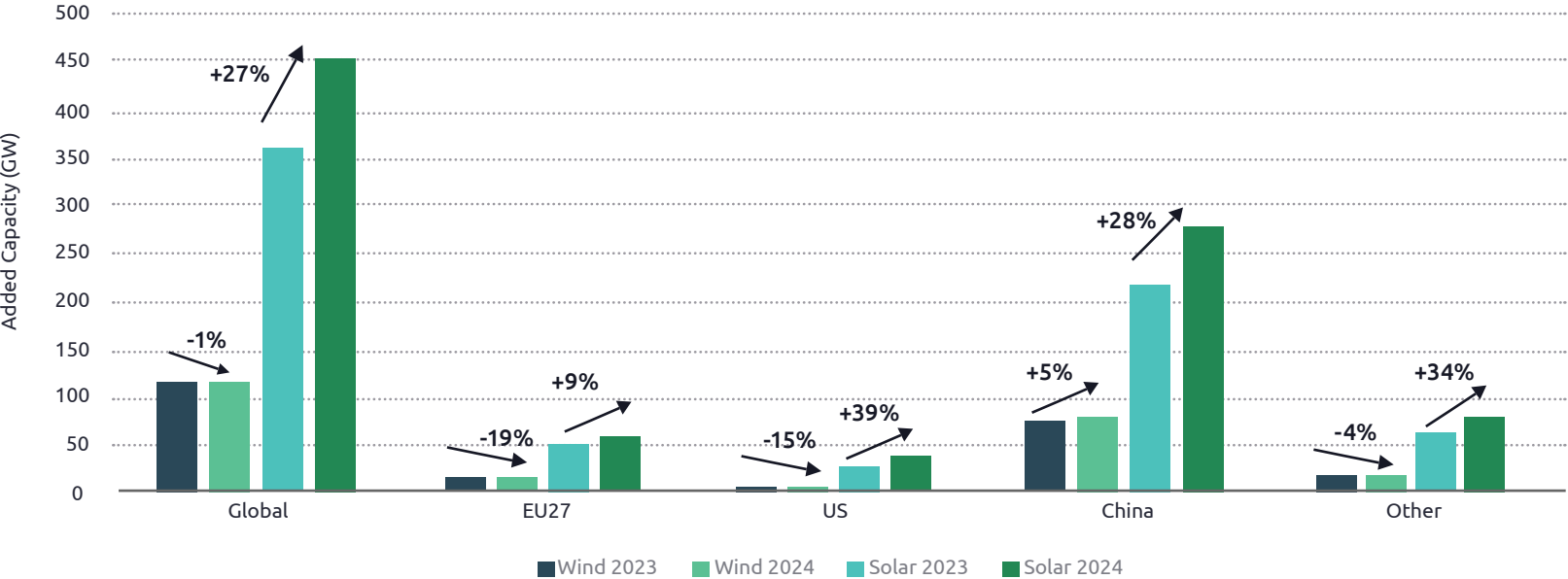
- Grid investment reached a new high of USD 390 billion globally in 2024 and is set to surpass USD 400 billion for the first time in 2025, 20% higher than a decade ago.
- Advanced economies and China continue to lead grid investment, as they have historically.
- While investment is expected to keep climbing, rising component costs mean growing budgets deliver less on the ground.

Source: IEA- World Energy Investment 2025, IEA analysis based on transmission and distribution companies' financial statements, S&P Capital IQ data (2025), Global Transmission data (2023).

Note: 2025e = estimated values for 2025. Digital investment includes smart meters, automation and management systems, end-point communication systems, transformers, EV charging infrastructure and analytics software.



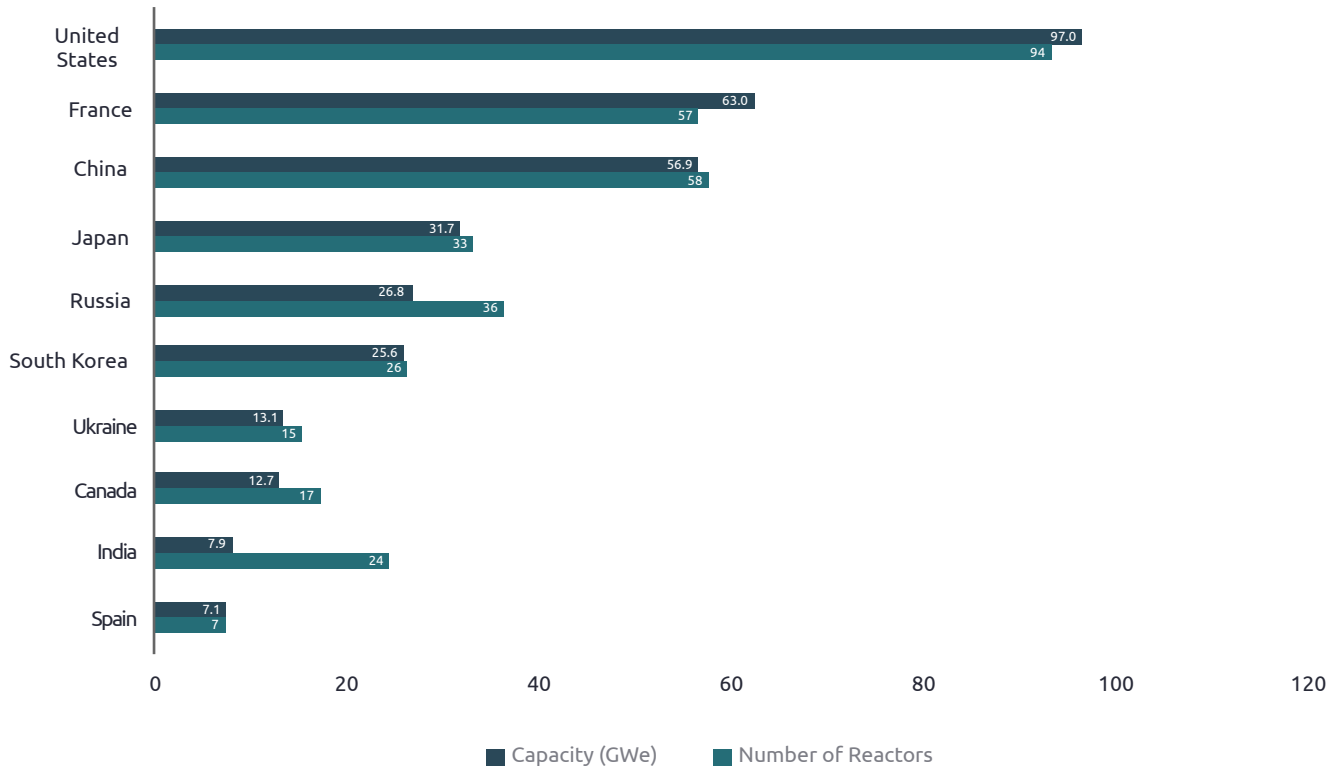
FIGURE 10
Global added wind and solar capacity in 2023 and 2024



Source: Renewable Energy Capacity Statistics 2025 July (IRENA)



FIGURE 11
Nuclear - Total Operable Reactor Net Capacity

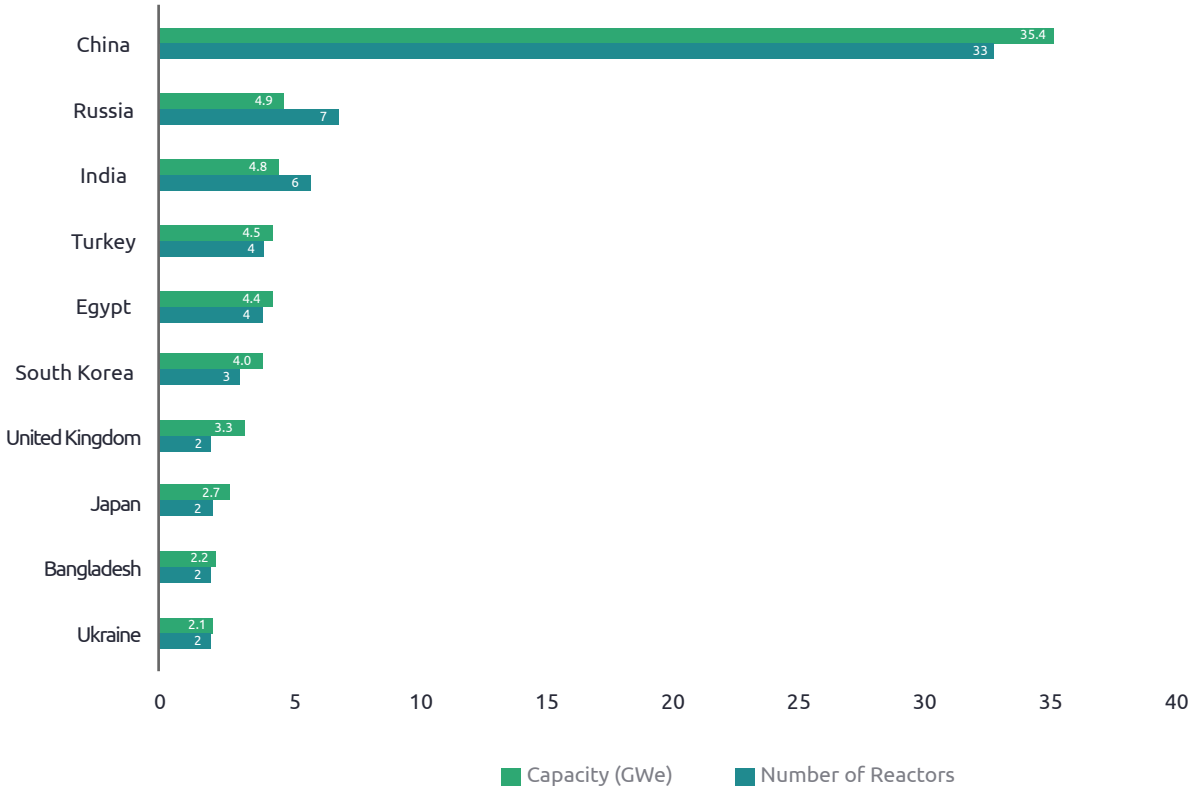


- In 2025, there were 439 nuclear reactors in operation in 32 countries around the world with total capacity of 397.6 GWe
- The United States had the largest number of nuclear power reactors in operation at the time, at 94 units with highest capacity of 97.0 GWe
- Followed by China and France, with 58 and 57 reactors under construction, having capacities of 56.9 GWe and 63.0 GWe, respectively

Source: World Nuclear Association - Reactor Database



FIGURE 12
Nuclear - Reactor Under Construction

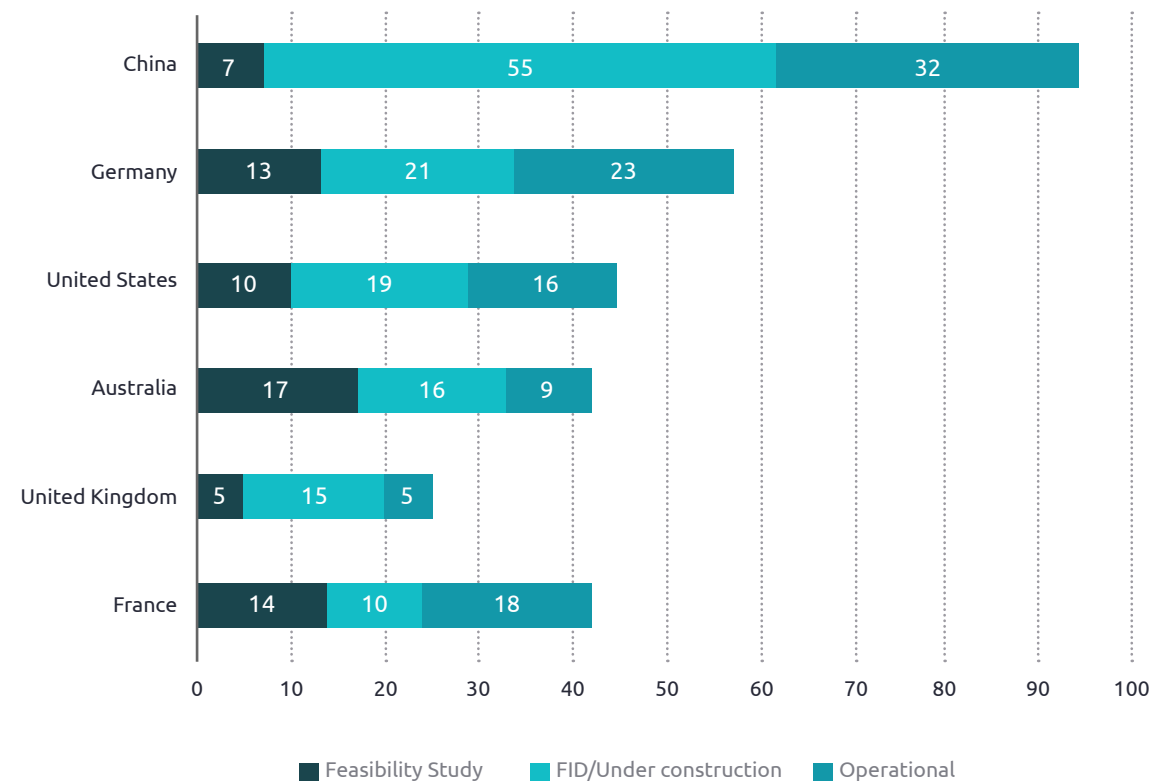


- In 2025, there were 70 nuclear reactors under construction worldwide with total capacity of 71.9 GWe
- China ranked first with 33 units with capacity of 35.4 GWe
- Followed by Russia and India, with 7 and 6 reactors under construction, having capacities of 4.9 GWe and 4.8 GWe, respectively
- In 2024, 4 nuclear reactors were permanently shut down worldwide, 2 reactors were from Canada with capacity of ~1.0 GWe

Source: World Nuclear Association - Reactor Database



FIGURE 13
Hydrogen production projects (2020-2025)

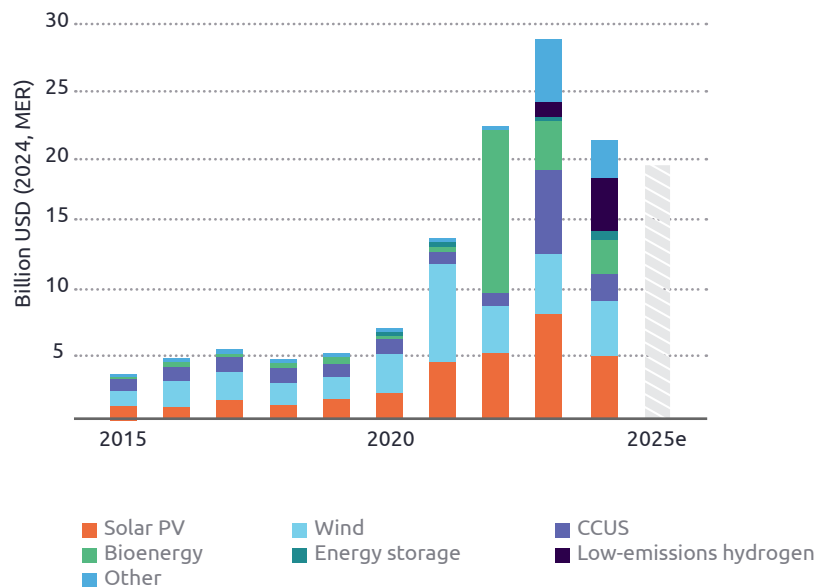


- Hydrogen production reached almost 100 Mt in 2024, but less than 1% was based on low-emissions hydrogen technologies
- Persistent barriers to final investment decisions in hydrogen production projects are causing delays and cancellations
- Low-emissions hydrogen production to remain more costly than unabated fossil-based routes in most regions in the mid-term
- China dominates electrolyser manufacturing and costs, raising concerns of repeating solar PV and battery trends, but using Chinese electrolysers abroad offers only modest savings

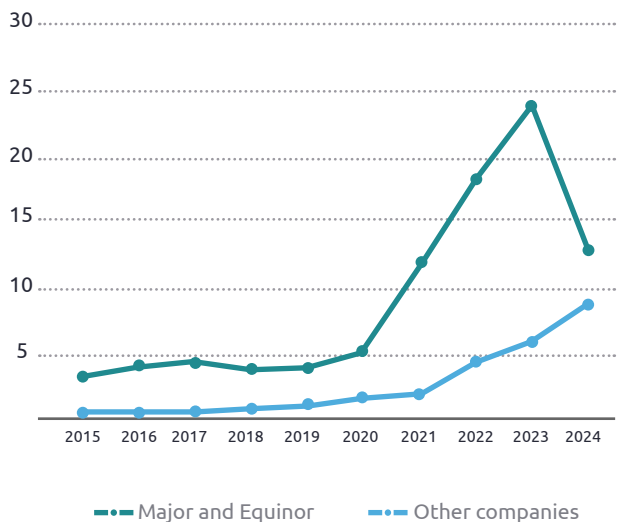
Source: IEA



FIGURE 14
Clean energy investment in oil and gas sector, 2015-2025



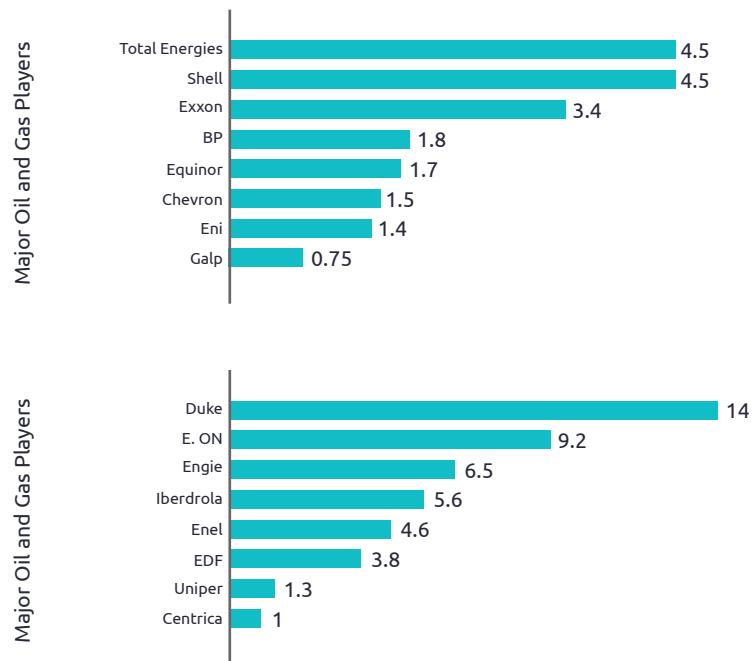
Source: IEA World Energy Investment Report - 2025



- Oil and gas sector invested ~\$22 billion in low emissions energy tech in 2024, ~25% less than in 2023, and is set to fall by a further 10% in 2025
- ~60% of low emissions investment by the O&G industry in recent years has come from BP, Equinor, Shell and TotalEnergies
- For 2030 low emissions investment target BP cut from 50% to 10–15%; Shell cut from 15–20% to 10%; Equinor slashed from 30% to 13% of their CAPEX
- While smaller firms and NOCs like ADNOC, Petronas, Saudi Aramco, and Sinopec, doubled its collective spending between 2022 and 2024



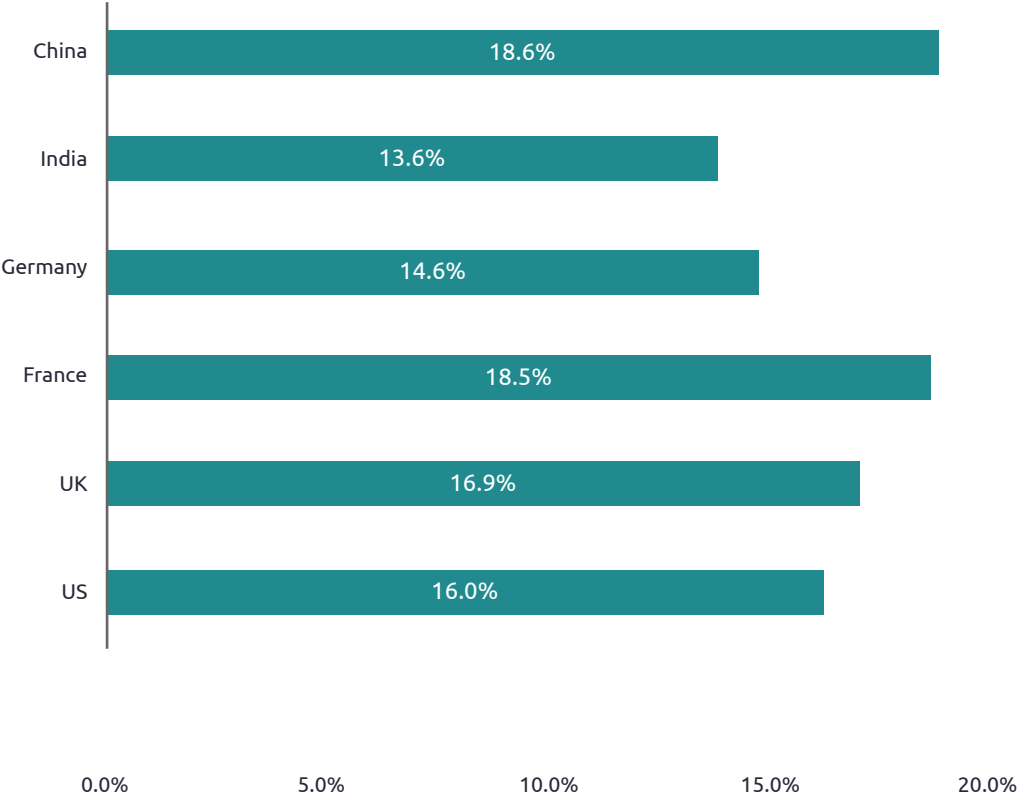
FIGURE 15
Clean energy investment by selected major companies, 2025



Source: IEA World Energy Investment Report - 2025



FIGURE 16
Electrification Rate (%) 2024



- Based on the 2024 data, China (18.6%) and France (18.5%) lead in electrification rates, reflecting strong integration of electricity across sectors.

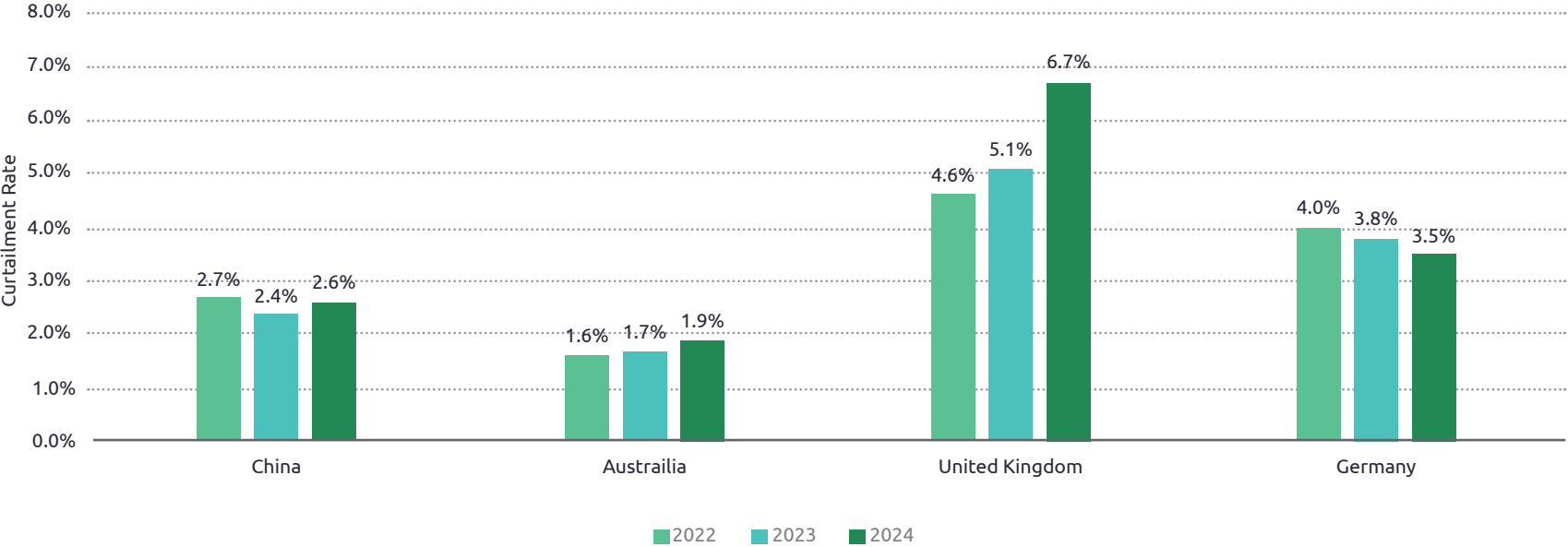
The UK (16.9%) and US (16.0%) follow closely, showing mature but slightly slower electrification progress.

- Germany (14.6%) and India (13.6%) trail behind, with India's rate highlighting ongoing development challenges.

Source: Ourworldindata.org



FIGURE 17
Variable renewable energy (VRE) Curtailment Rate in other countries excluding United States – 2022-2024

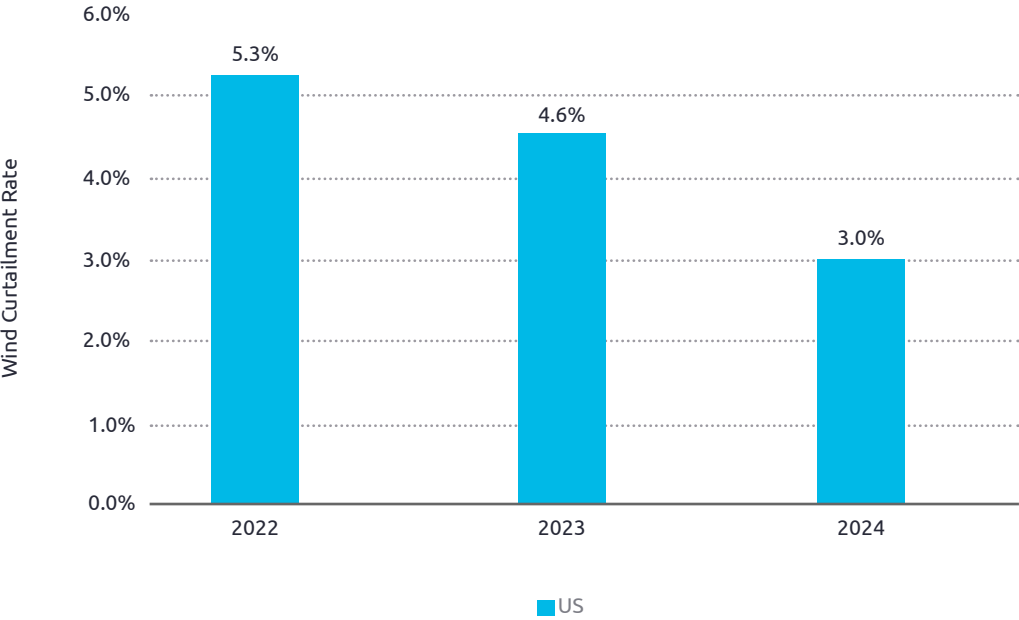


Source: IEA Renewable 2023 & 2024; Clean Wire Energy, Secondary Sources

Note: China’s 2024 VRE curtailment rate is based on the 2022–2023 average, as the government aims to keep it below 3%



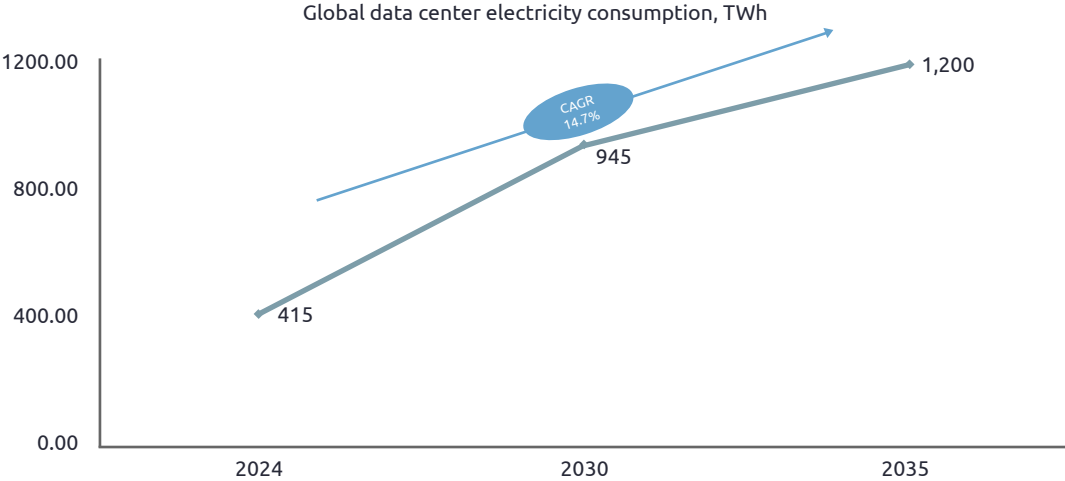
FIGURE 18
Wind Curtailment Rate across all ISOs in United States – 2022-2024



Source: Ourworldindata.org



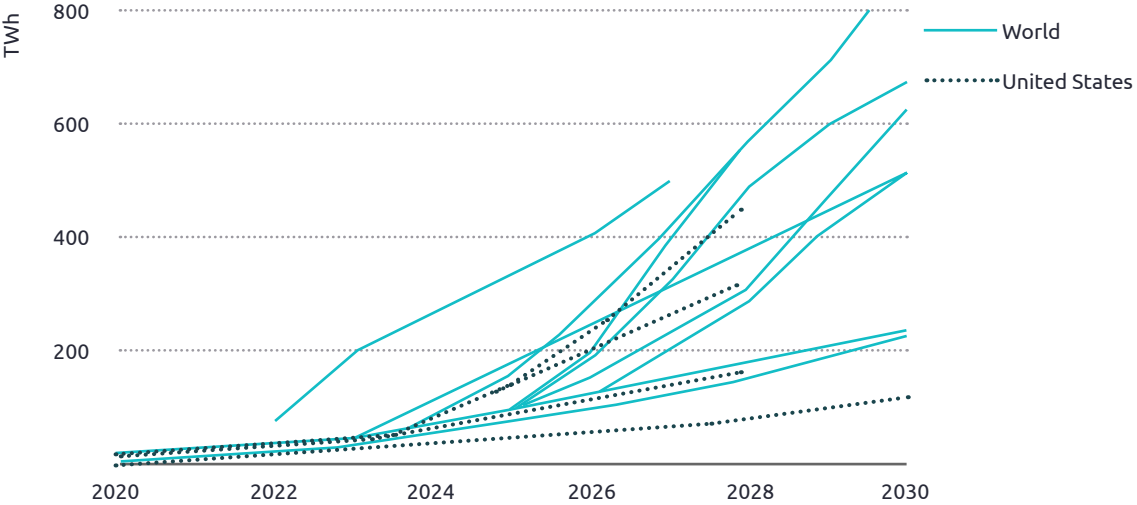
FIGURE 19
Global electricity demand from data centers is set to more than double by 2030



Source: IEA: Energy and AI-2025



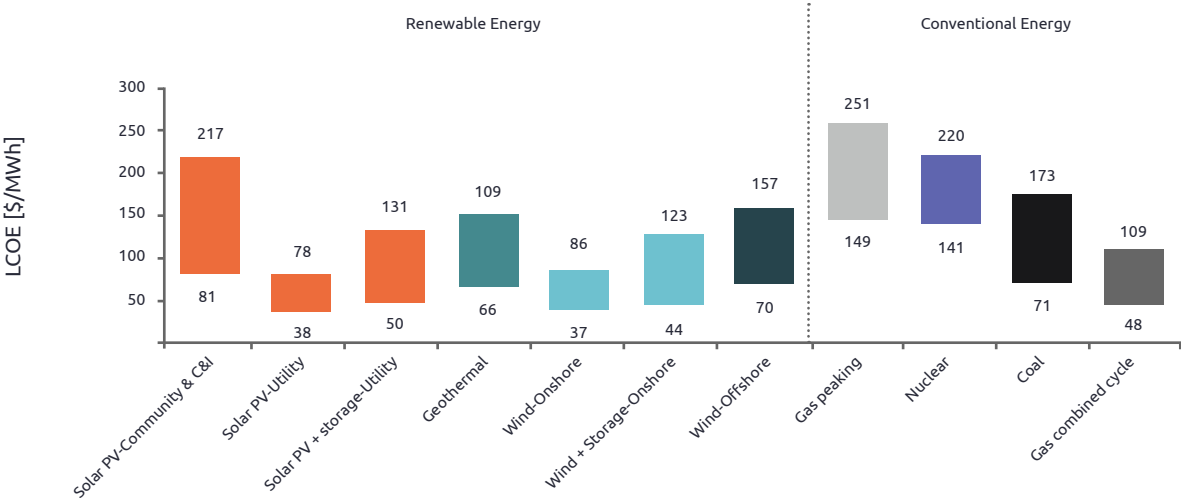
FIGURE 20
Estimated data centre electricity demand due to AI, 2020-2030



Source: IEA: Energy and AI-2025



FIGURE 21
Levelized Cost of Energy comparison - U.S. (\$/MWh)

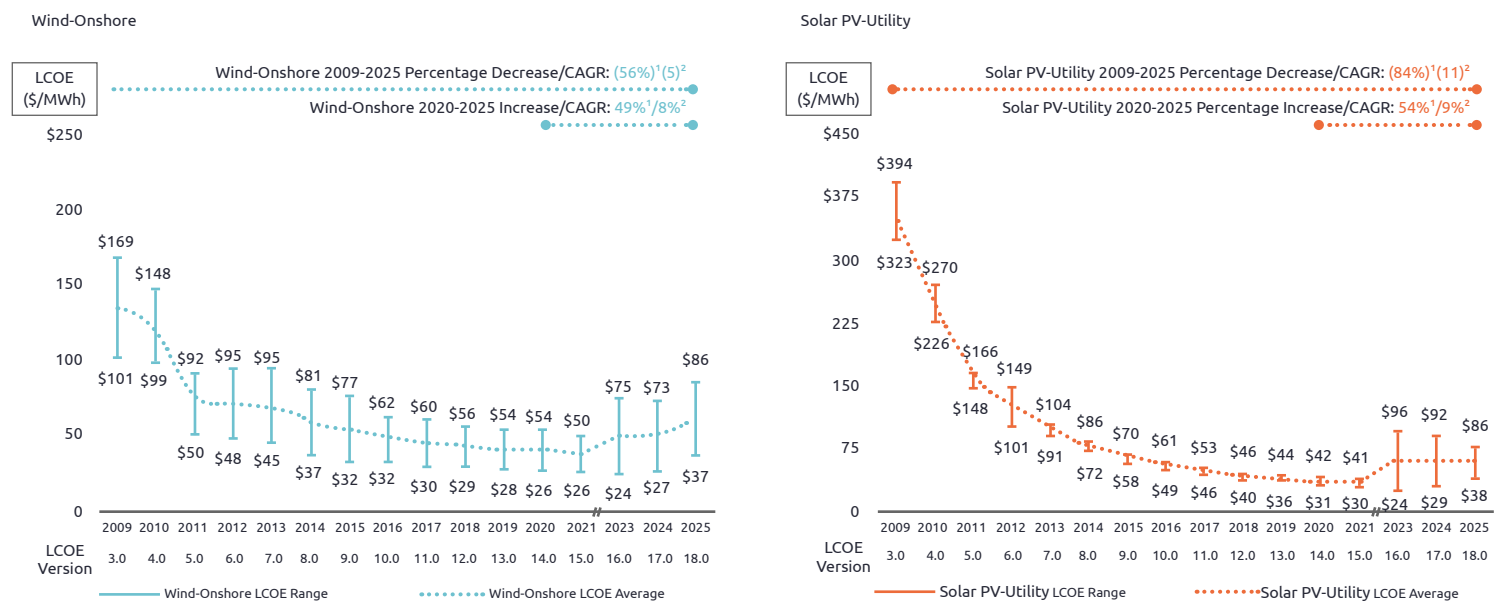


- Selected renewable energy generation technologies remain cost-competitive with conventional generation technologies under certain circumstances
- Renewable energy will continue to play a key role in the buildout of new power generation in the U.S. This is particularly true in the current high power demand environment, where renewables stand out as both the lowest-cost and quickest-to-deploy generation resource

Source: 2025 Lazard’s Levelized Cost of Energy Analysis



FIGURE 22
Historical renewable energy LCOE



• This year's analysis shows a divergence in trends between wind and solar with solar costs declining slightly and wind costs increasing, likely reflecting the difference in supply chain conditions across each technology

Source: Lazard estimates and publicly available information.

- 1. Reflects the average percentage increase/(decrease) of the high end and low end of the LCOE range.
- 2. Reflects the average compounded annual growth rate of the high end and low end of the LCOE range.

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