Energy Transitions Commission

ETC emerging insights: The role of firm low-carbon power – nuclear and geothermal

ETC Commissioners Meeting

19 March 2026

Agenda

- **Work programme context**
- How ETC's nuclear and geothermal work responds to current debates
- Next steps

The "Firm-low carbon power" workstream is entering final stages

CONTEXT

- In many regions of the world, **wind and solar will be the most cost-competitive and scalable** new clean electricity generation sources
- But in some places, fast growing demand, limited land availability, or the high cost of balancing the power grid **could make other clean sources attractive**.

ETC WORKSTREAM WILL EXPLORE

- **What is the role of nuclear and geothermal** electricity in future power systems, alongside wind and solar generation, in different regions of the world?
- Can they be delivered at low cost? Where needed, how can their deployment be scaled faster?

WORKSHOP SCHEDULE

- ☑ **Workshop 1 - The role of Nuclear** (2nd October 2025)
- ☑ **Workshop 2 - The role of Geothermal** (3rd December 2025)
- ☐ **Workshop 3 -** Key guidelines to scale Nuclear and Geothermal (23rd March 2026)

Agenda

- Work programme context
- **How ETC's nuclear and geothermal work responds to current debates**
- Next steps

Key messages

1. **There is growing focus on the potential role of nuclear and geothermal energy,** led by new technology development, rise in power demand from growing users (hyperscalers), and a favourable political environment.

2. **Risks related to supply chains, safety, waste, emissions and resource intensity are real** but, based on international experience, **are small in magnitude and manageable** with appropriate regulation, institutional capacity, and project design.

3. **New nuclear and geothermal are likely to remain higher-cost than clean alternatives across most geographies,** with significant regional variation driven by financing, replicable project pipelines, regulation and resource quality; **next-generation technologies are unlikely to materially reduce costs or speed up scale-up in the near term, but may enable location-specific niche applications (e.g. new build heat and power offtake systems).**

4. **Nuclear and geothermal can deliver comparable power system costs to wind- and solar-dominated grids, if deployed at limited shares (e.g. 10–20% generation); certain geothermal applications could deliver system benefits by providing seasonal balancing to offset peak power demand.**

5. **Nuclear and geothermal do not consistently deliver greater economic or societal benefits than other clean technologies**; perceived "higher gross value-add" reflects higher capital intensity rather than superior productivity, and job creation varies significantly by country and supply-chain depth.

6. **Country deployment of nuclear and geothermal technologies should be based on a rigorous assessment of costs, system value constraints, and associated benefits and risks. While these technologies do not meet deployment thresholds in many countries, new nuclear can play a role in specific contexts** (e.g. new nuclear in UAE, next-generation geothermal in USA).

In the debate, there are seven key viewpoints on nuclear / geothermal

“Nuclear power should be avoided, because it has security and safety risks that renewables avoid.”

“We need nuclear and geothermal because power systems can’t run on renewables”

"Nuclear is lower cost than alternatives"

“Small modular reactors offer a game-changing route forward for low-carbon power”

“We need firm power for data centres and renewables can’t offer this.”

“Nuclear delivers high employment prospects and economic growth compared to renewables”

“Next generation geothermal will unlock low-cost firm power around the whole world”

ETC work provides evidence-based perspectives

1. Nuclear is unsafe

Statement

Nuclear power should be avoided, because it has security and safety risks that renewables avoid

Who is making this statement?

GREENPEACE
SIERRA CLUB
Union of Concerned Scientists
Friends of the Earth International
Green America

Key evidence points

- Nuclear safety and proliferation risks are real but can be overstated
- High-level waste disposal is a key challenge that has yet to be fully resolved
- Nuclear can play a complementary role in renewables-dominated systems where institutional capacity exists to manage risks.

ETC assessment:	Overstated

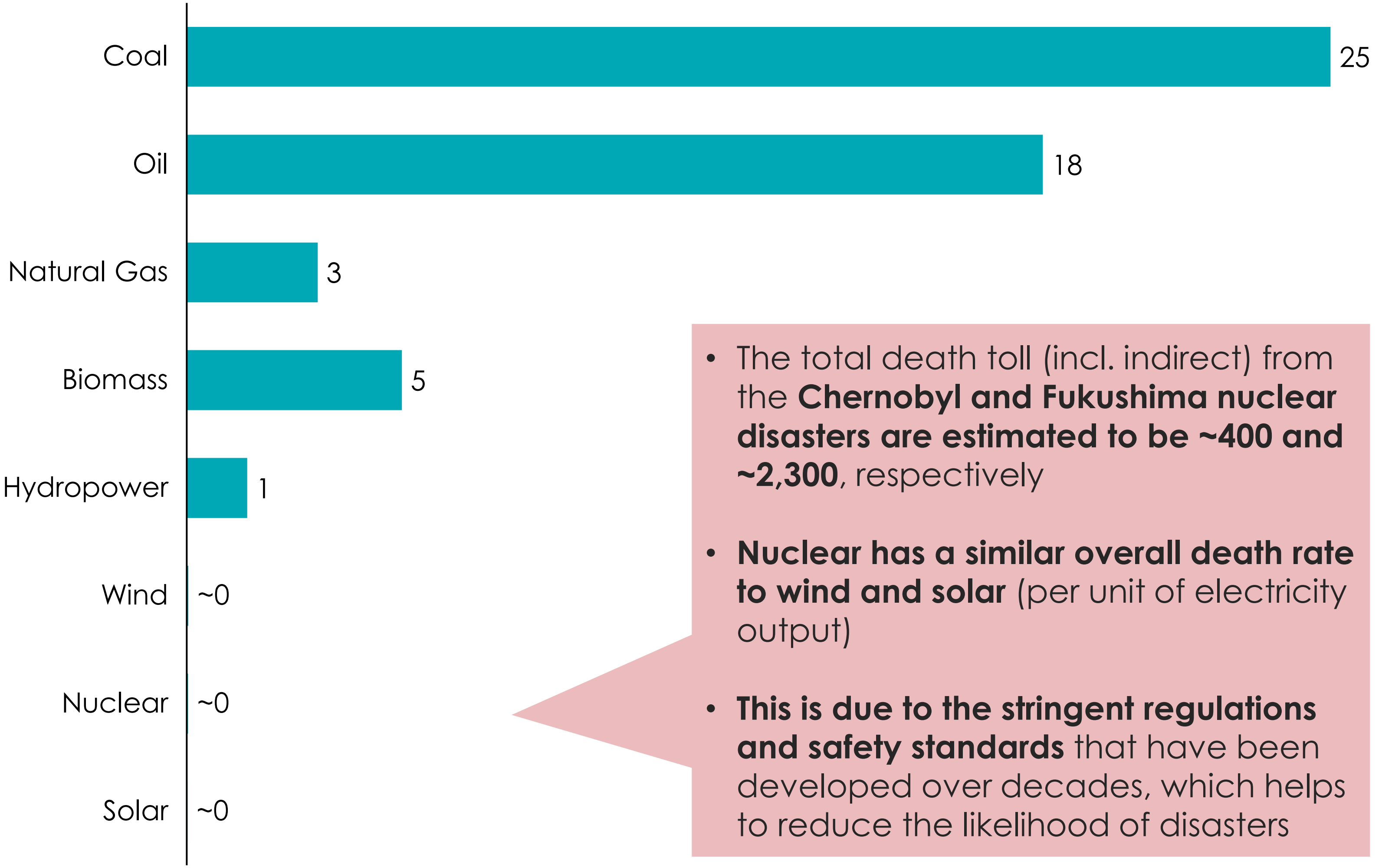
Accidents still shape public perceptions, however nuclear is statistically safer than many other electricity generation technologies

Key safety considerations: nuclear disasters

- **Historical accidents** (Chernobyl, Fukushima) continue to shape public safety perceptions despite high safety standards in recent decades

- **Higher concern in non-nuclear countries; lower in countries with long-standing nuclear programmes and trusted regulatory institutions (e.g. France, Sweden, US, UK, South Korea)**

Safety by electricity generation type (Our World in Data)
Deaths per TWh



- The total death toll (incl. indirect) from the **Chernobyl and Fukushima nuclear disasters are estimated to be ~400 and ~2,300**, respectively
- **Nuclear has a similar overall death rate to wind and solar** (per unit of electricity output)
- **This is due to the stringent regulations and safety standards** that have been developed over decades, which helps to reduce the likelihood of disasters

Notes: Death rates are measured based on deaths from accidents and air pollution per TWh of electricity. Our World in Data's estimates for Chernobyl and Fukushima include direct and cancer deaths from the accidents and indirect deaths from evacuation (stress, displacement from care settings, healthcare disruptions).
Source: Our World in Data (2020), *Death rates per unit of electricity production*; Our World in Data (2017), *What was the death toll from Chernobyl and Fukushima?*

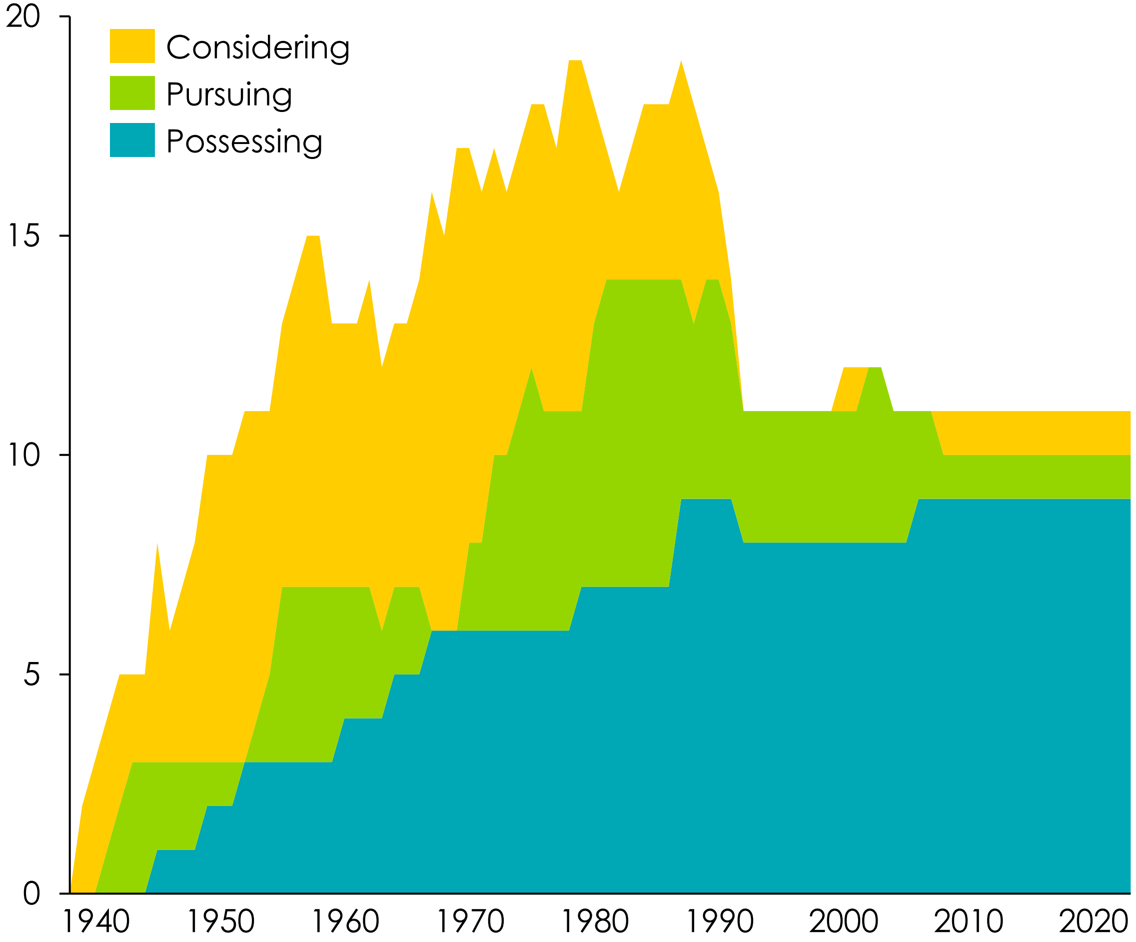
Proliferation risks require robust safeguards if nuclear scales, though fewer countries pursue weapons than during the Cold War

Key safety considerations: proliferation

- **Fuel cycle vulnerabilities** arise from dual-use enrichment and reprocessing technologies; civilian nuclear programs can mask or accelerate weapons-grade material production, as seen with Iran and North Korea.
- **Proliferation cascade risk** occurs via the spread of sensitive technologies and expertise to new countries, increasing the probability of state or non-state actors acquiring nuclear weapons capability

- The primary proliferation risk from civilian nuclear lies in **enrichment and reprocessing facilities,** not reactors themselves
- Scaling nuclear power requires **strong IAEA safeguards** and encouraging reliance on international fuel markets

Number of countries that consider, pursue, or possess nuclear weapons.



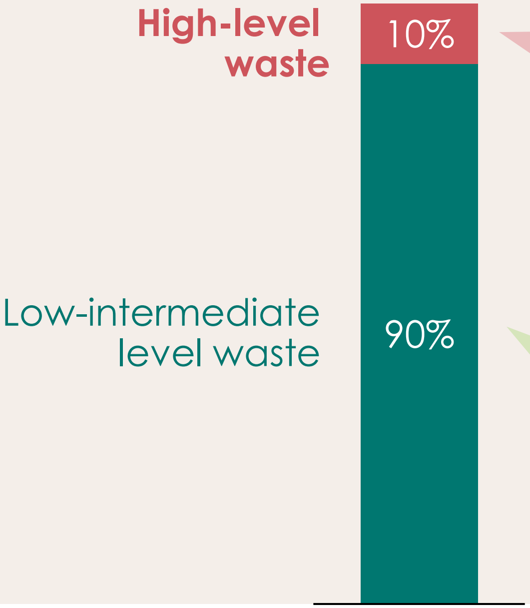
Source: Our World in Data (2024), *Nuclear Weapons*

Careful management is required for high-level nuclear waste; overall safety risks must be managed to maintain social license

Nuclear waste: low to high radioactivity levels

There are three different types of nuclear waste

- **Low-level waste (LLW)**, lightly contaminated materials (clothing, filters, and tools)
- **Intermediate-level waste (ILW)**, more radioactive materials (resins, sludges, reactor components).
- **High-level waste (HLW)**, spent nuclear fuel or vitrified reprocessing waste



- **Only a small fraction (<10%) is high-level waste**
- Long-term deep geological storage is needed - however many face challenges and delays

- **Over 90% of volumes are low- or intermediate-level waste** (protective clothing, tools, filters) which are routinely disposed of in engineered surface or near-surface facilities

France generates the following amounts of waste* per inhabitant per year:

13.8 t
of trade waste
(construction, industry, ag r iciculture, health care activities)

354 kg
of household waste

100 kg
of toxic industrial waste

2 kg
of radioactive waste
Of this waste:
60% is from the nuclelear industry, and 40% fron other setors

*Source ADEME (2016)

Public fear is often disproportionate: the scientific record shows nuclear waste is small in volume, highly regulated, and safely managed

Source: World Nuclear Association (2025) Radioactive Waste – Myths and Realities; IAEA (2023), Status and Trends in Spent Fuel and Radioactive Waste Management, which notes defence activities as a significant but uneven contributor; OECD-NEA (2021), Radioactive Waste Management and Decommissioning Review; Nuclear Decommissioning Authority (2014), Fact sheet: waste from defence activities; World Nuclear Association (2023) *Radioactive Waste Management*.

2. Nuclear is lower cost than alternative generation sources

Statement

Nuclear is lower cost than alternatives

Who is making this statement?

CEZ GROUP, Westinghouse, THIRD WAY, NEI Nuclear Energy Institute

Key evidence points

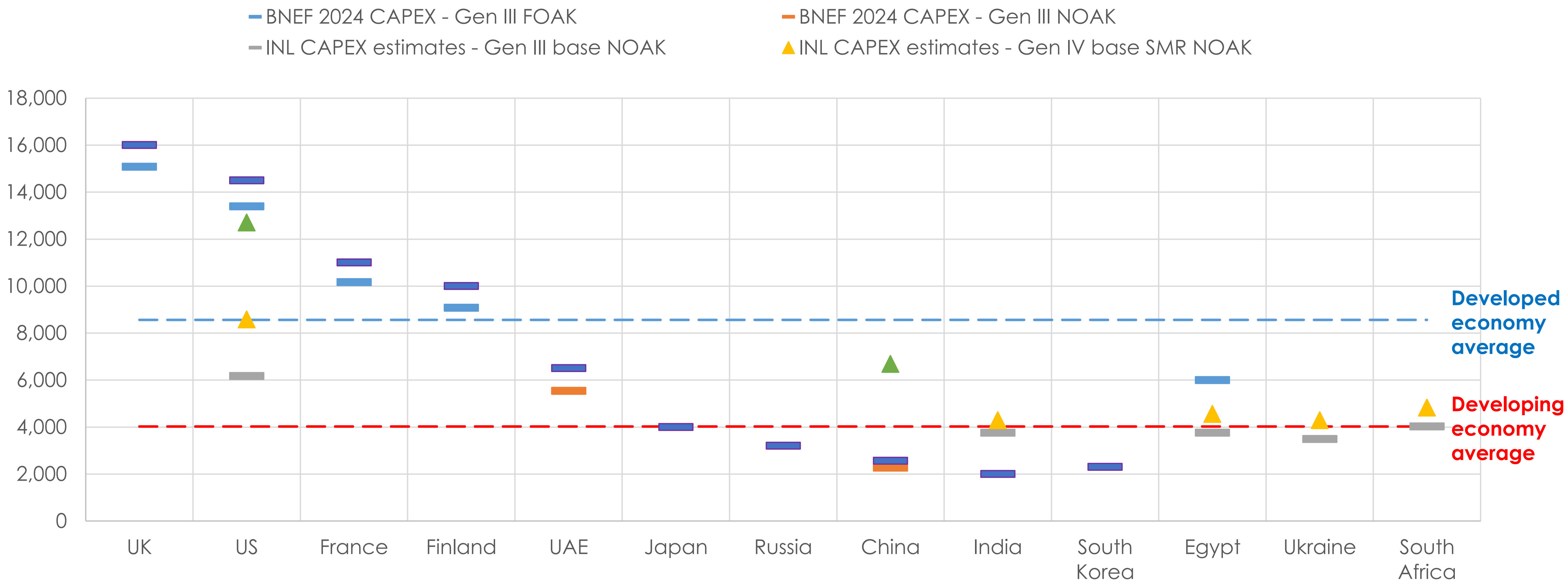
- Nuclear has a higher levelised cost of energy than other generation assets in most countries
- Low nuclear costs have been achieved in places with large fleet-based build out programmes
- However, wind and solar are always quicker and cheaper to build

ETC assessment:	Mostly false

CAPEX varies significantly by country, driven by regulation complexity and supply chain readiness / costs

CAPEX estimates by country, FOAK vs NOAK; Gen III vs Gen IV

$/kW, real 2024



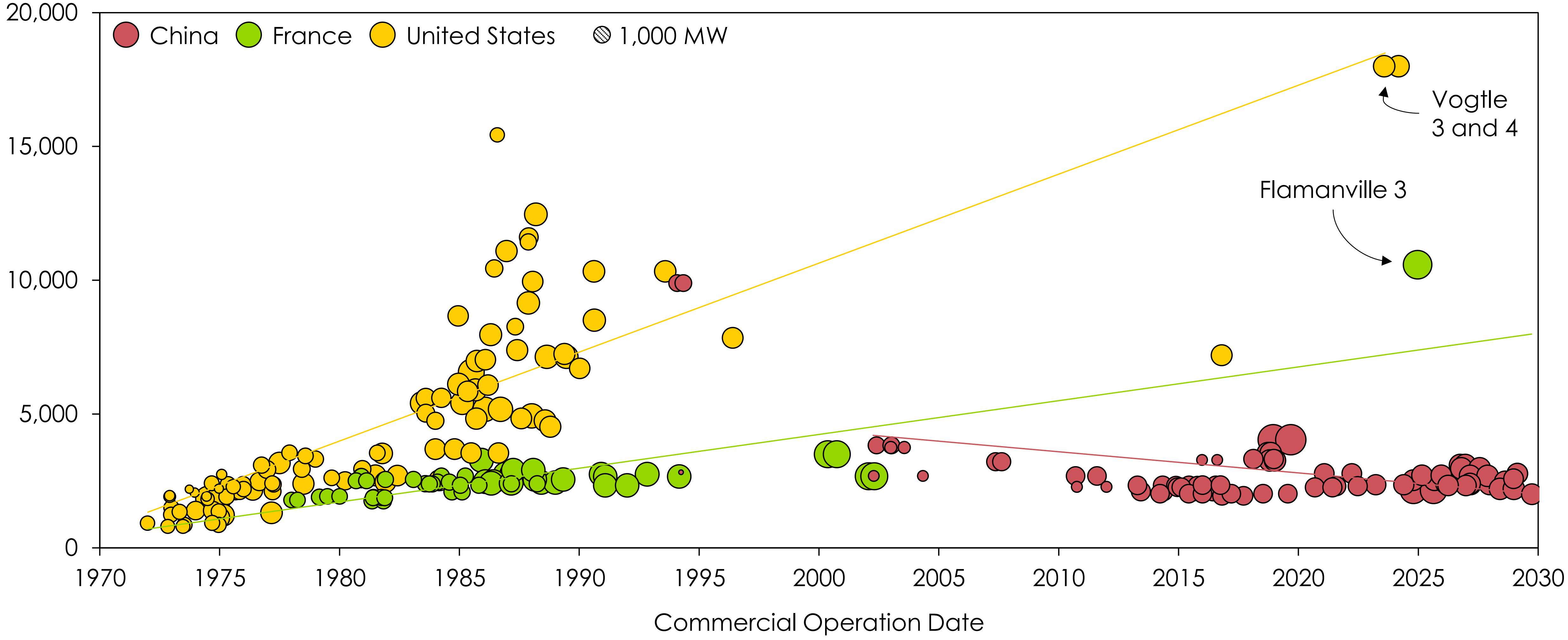
Notes: FOAK = 1st of a kind; NOAK = nth of a kind.

Source: BNEF (2025), *LCOE Data Viewer*; Energy Technologies Institute (2020), *The ETI Nuclear Cost Drivers Project;* INL (2024), *Nuclear Energy Cost Estimates for Net Zero World Initiative – 2024 Update*; Financial Times (2025), *Cost of Sizewell C nuclear project expected to reach close to £40bn;* Green Prizm (2024), *2023 Report on Chinese Nuclear Power Generation and Costs Analysis*

China has proven the effectiveness of standardised, programmatic deployment of large-scale, conventional reactors

Overnight CAPEX vs commercial operation date

$/kW, real 2024

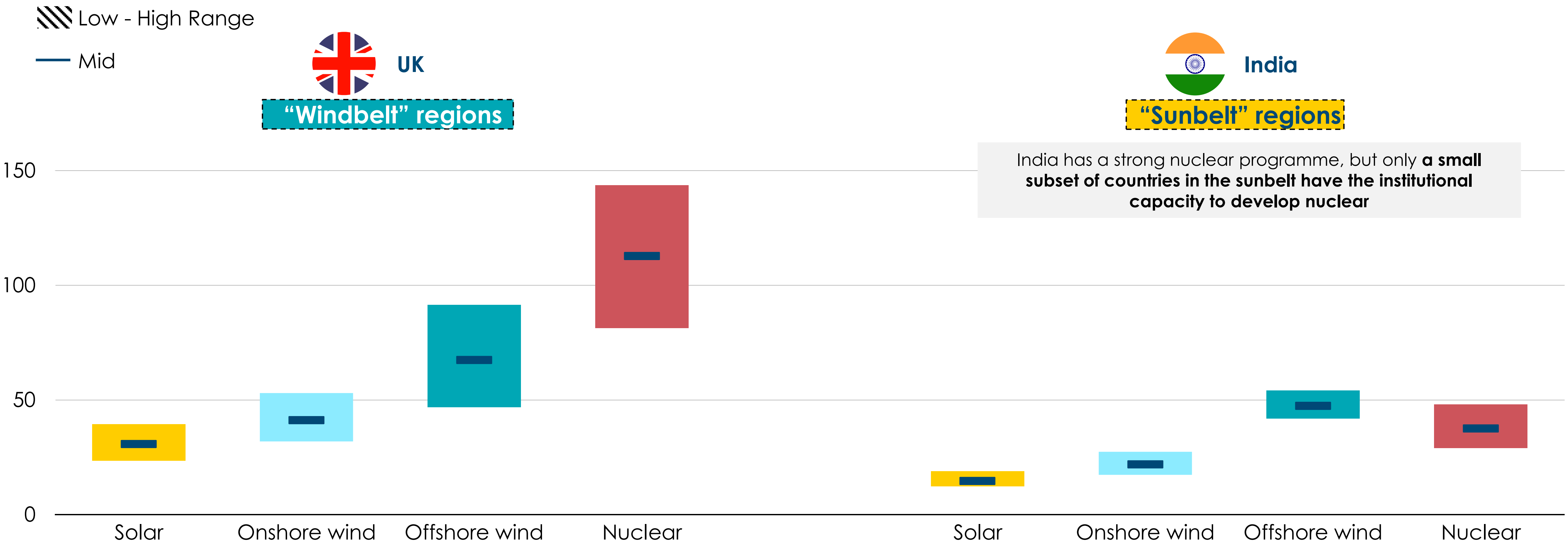


Nature (2025), Can China break the 'cost curse' of nuclear power?

“Sunbelt” vs “Windbelt” technology costs divergence is evident for wind and solar, but also nuclear where delivery capability exists

Estimated levelised cost of energy for 2050

$/MWh (real 2024$)



Source: Systemiq analysis for the ETC (2025); BNEF (2025), *LCOE: Data Viewer*

Key drivers of successful Gen III+ nuclear deployment in China and South Korea: low capital expenditure (CAPEX), low cost of capital (WACC), and short construction durations

$ **Low Overnight CAPEX**	$2,000-2,600/kW	Low overnight CAPEX due to lower labour costs, design standardisation and replication
+		
% **Low WACC**	3-5%	Lower-cost capital (generally state-backed, low risk)
+		
Short Construction Duration	5-7 years	Enabled by trained workforces, standardisation, technology exports, and long-term government programmes.

→

Low LCOE	$40-60/MWh	Significantly lower than European/US projects, driven by low WACC, low CAPEX, short construction durations

↓

Cheap electricity sold to grid:
$45-75/MWh

Sources: GreenPrizm (2023), *Summary of 2023 Report on Chinese Nuclear Power Generation and Costs Analysis*; Y. Rong et al. (2021), *Discount Rate of China's New Energy Power Industry*; IAEA (2016), *Nuclear Contracting Toolkit - Discount Rate*; Breakthrough Institute (2024), *China's Impressive Rate of Nuclear Construction*; Ritchie; Our World in Data (2020), *Nuclear Energy*; Financial Times (2024), *South Korea pushes to export nuclear reactors to Europe*; KEI (2022), *South Korea's Economic Rationale for Nuclear Energy*; World Nuclear Association (2025), *Nuclear Power in China*.

3. “Power systems need ‘clean firm’ generation sources”

Statement

We need nuclear and geothermal because power systems can’t run on high shares of intermittent renewables

Who is making this statement?

CATF Clean Air Task Force

CLEARPATH

World Nuclear Association

NIA Nuclear Innovation Alliance

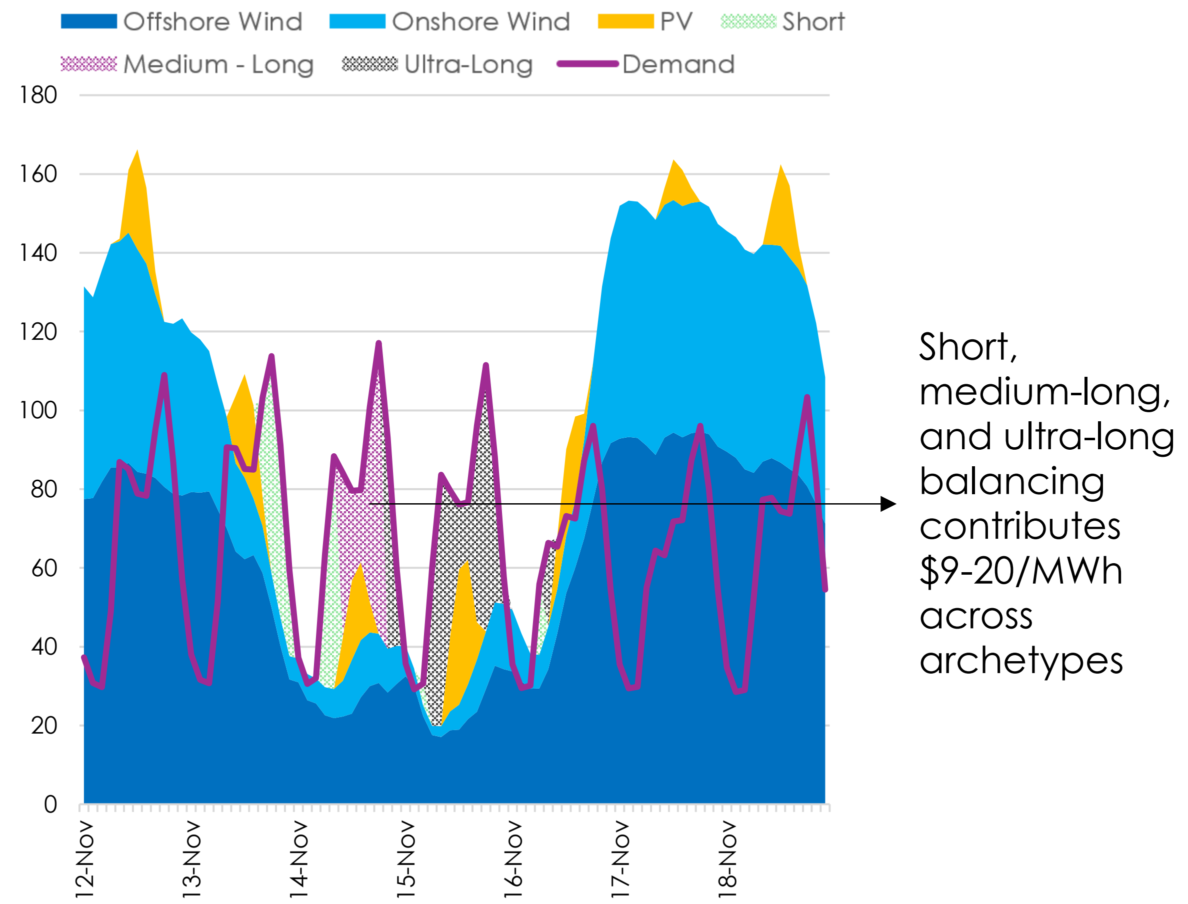
Key evidence points

- Power systems can run on high shares of intermittent renewables.
- Firm low-carbon power can provide system value, by reducing capacity overbuild, balancing, and grid costs
- Cost, delivery speed, and the declining costs of alternatives will limit it to at most ~10–20% of generation in most geographies.

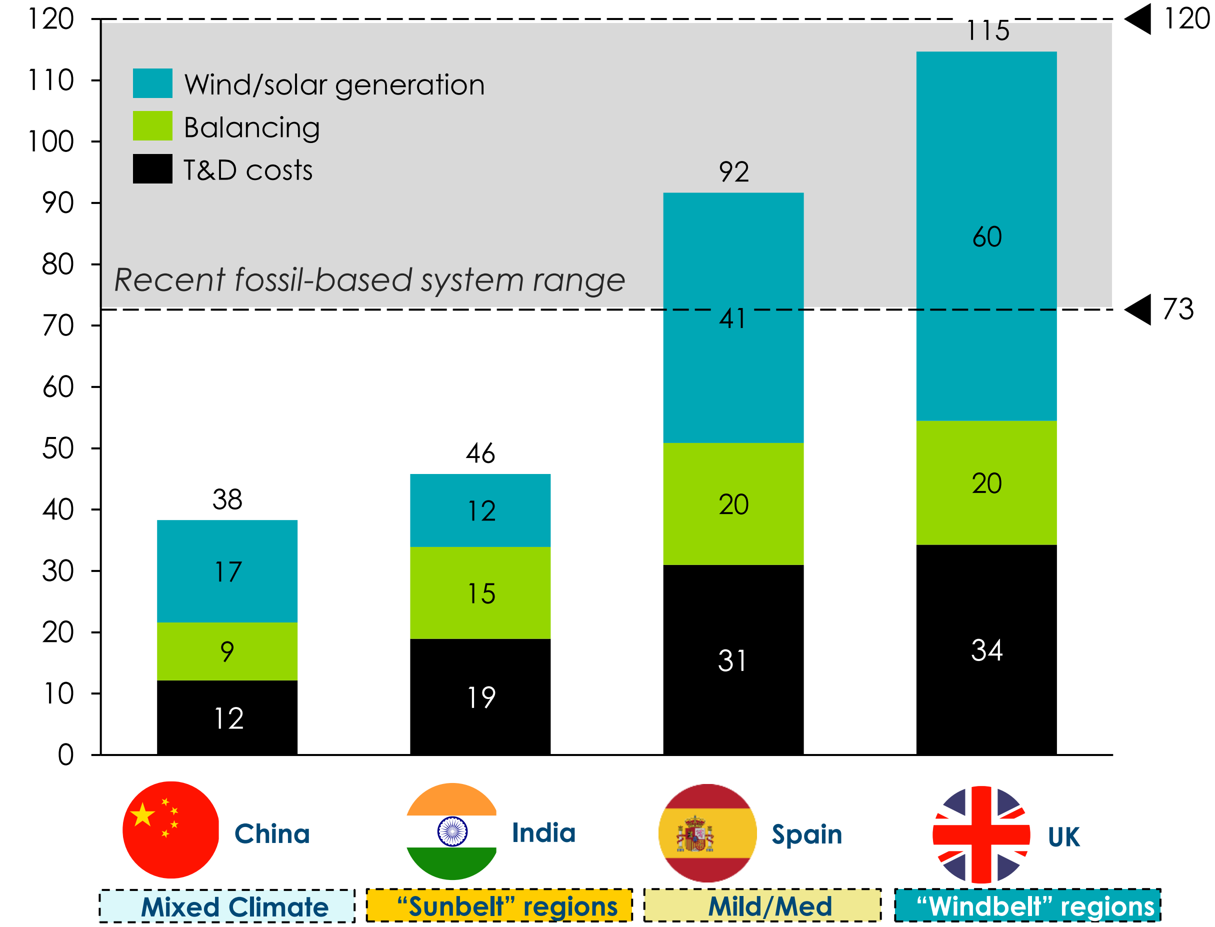
ETC assessment:	**Mostly false**

It is technically and economically feasible to run low-carbon power systems based primarily on variable renewables

Weekly balancing for selected November period
GW supply, demand, and balancing for each hour of the period



Total system cost estimates, 2050 (min. weather year)
$/MWh (real 2024$)

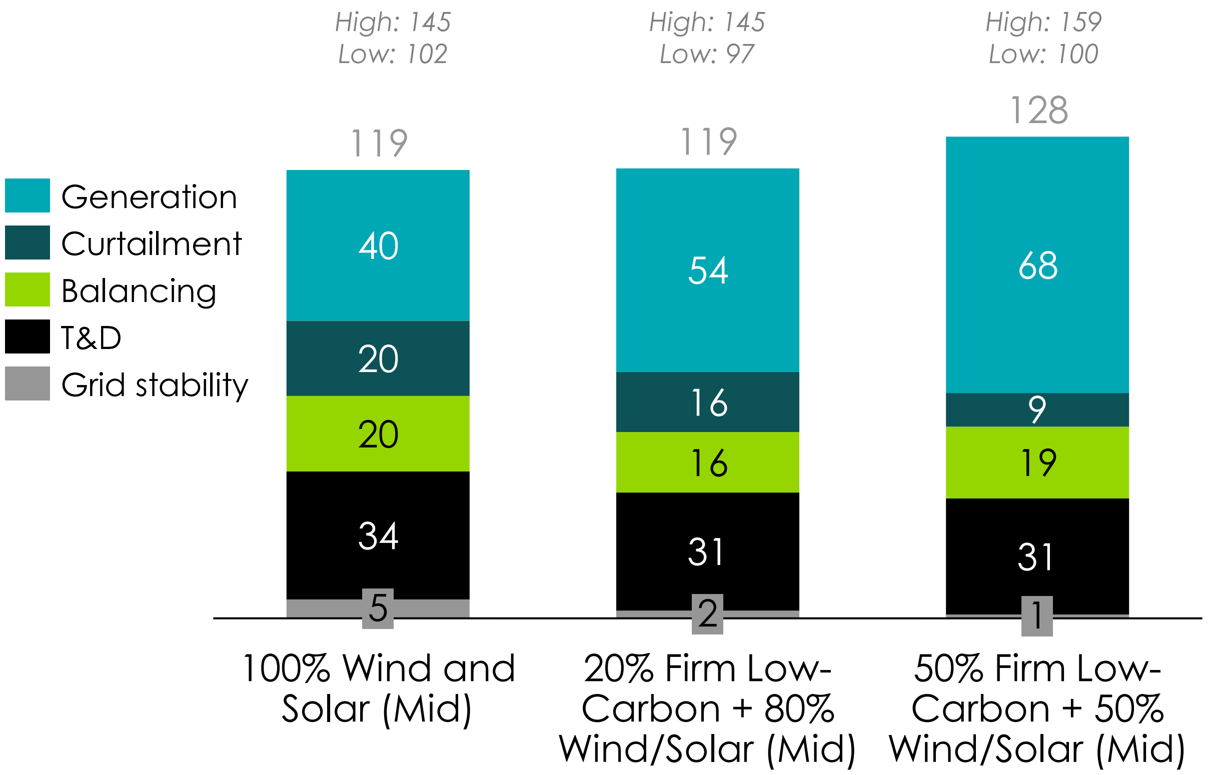


Note: T&D = Transmission and distribution.
Source: Systemiq analysis for the ETC; ETC (2025), *Power Systems Transformation: Delivering Competitive, Resilient Electricity in High-Renewable Systems*; BNEF (2025), *LCOE: Data Viewer*

Firm low-carbon power provides system value, but cost, delivery speed, and declining costs of alternatives likely limit role to ~10–20% of generation

Illustrative view of components of total system cost and variation by system, UK Case Study in 2050 (minimum weather year)

$/MWh (real 2024$)



System costs consistent at 0-20% nuclear share → ***System costs higher at >20% nuclear share***

Systems with Firm Low-Carbon…

- **Increase generation costs:** Firm Low-Carbon raises weighted average LCOE
- **Can lower curtailment costs**: need to overbuild generation decreases when Firm Low-Carbon is added
- **Can lower (but not eliminate) balancing costs at low nuclear penetrations**: as ultra-long duration balancing needs fall; as the share of Firm Low-Carbon rises, additional balancing costs occur to manage intra-day mismatches, as lower renewables overbuild reduces the number of hours of naturally concurrent supply and demand
- **Can lower grid stability and T&D costs:** Firm Low-Carbon (particularly nuclear) can provide a wider set of grid stability services than variable renewables

Key LCOE assumptions (mid):

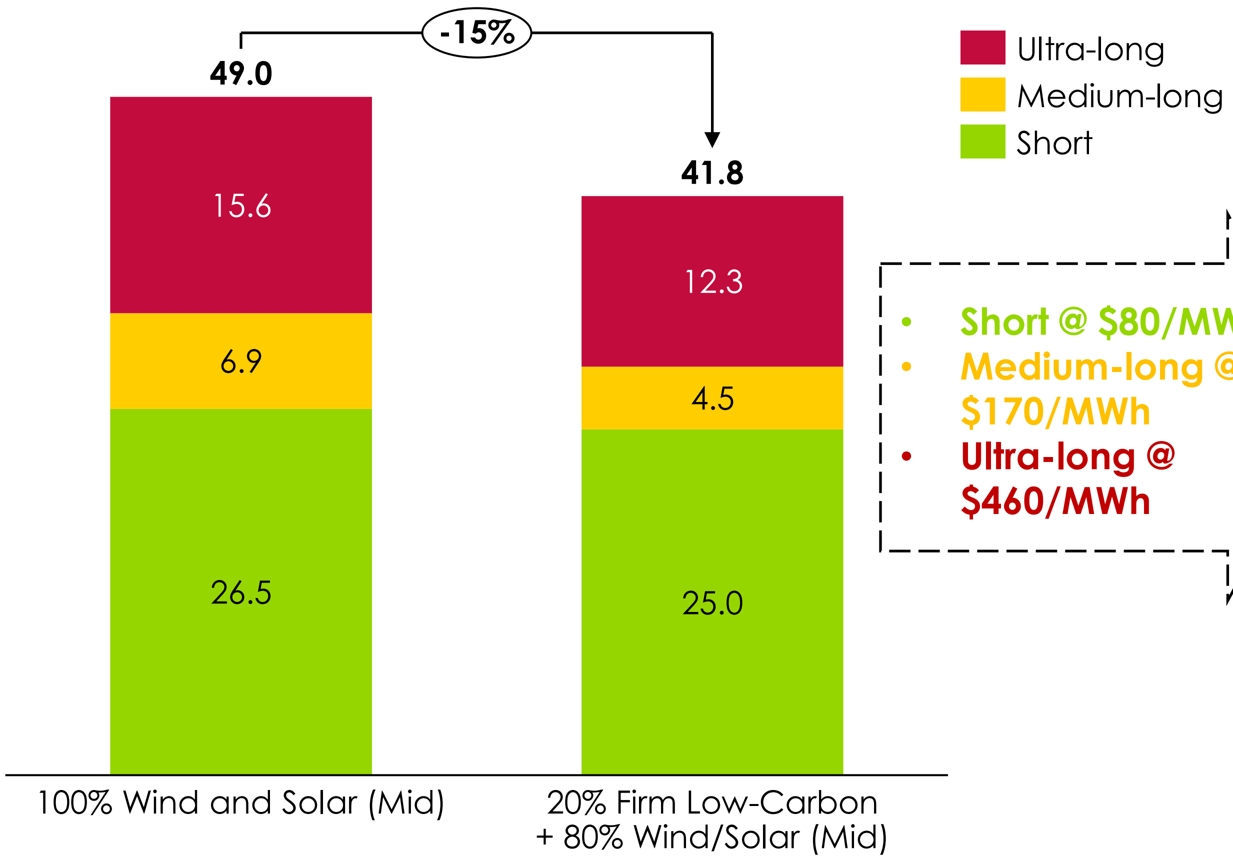
Offshore wind:
- 2024: $110/MWh
- 2050: $60/MWh

Firm Low-Carbon:
- 2024: $170/MWh
- 2050: $115/MWh

Notes: "20% nuclear" refers to the share of generation. T&D = Transmission & distribution. Sensitivities: Generation - BNEF's low, medium, and high 2050 CAPEX and OPEX estimates and assumptions for capacity factors, WACC, and lifetimes based on ETC modelling; Curtailment – surplus electricity at the weighted average wind & solar LCOE (assuming no nuclear is curtailed); Balancing – central CAPEX +/- 20% for high/low alongside high/low electricity input costs based on generation; Transmission & distribution - central CAPEX +/- $5/MWh for high/low. Source: Systemiq analysis for the ETC (2025); BNEF (2025), *LCOE Data Viewer*

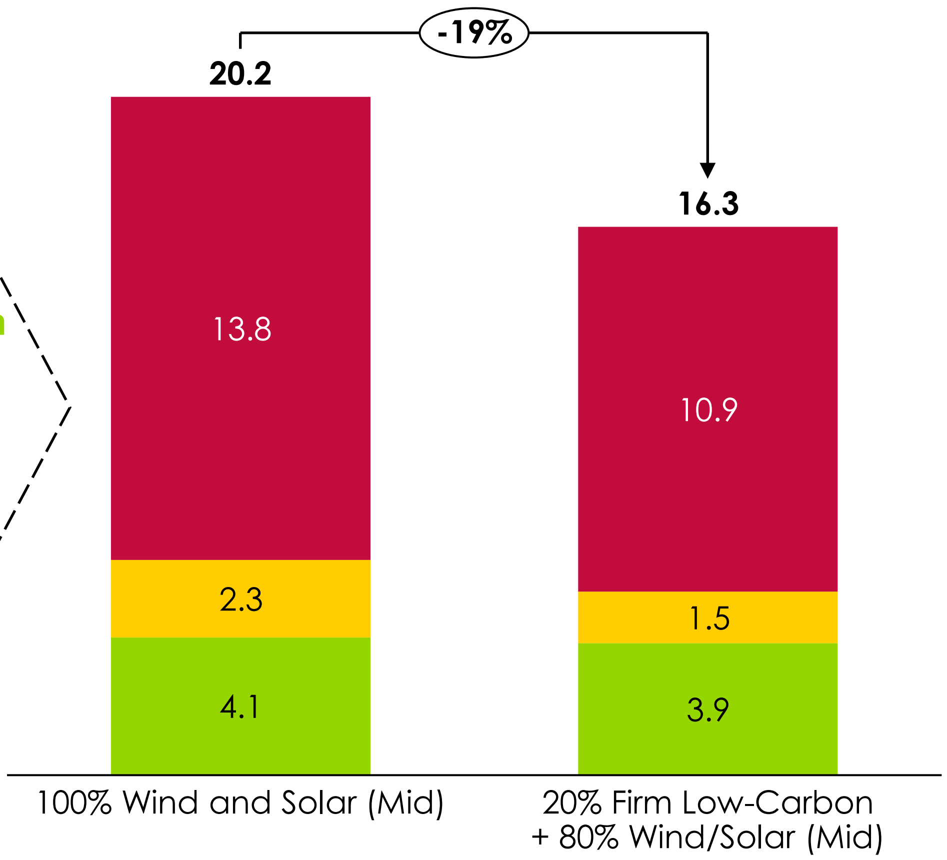
Firm low-carbon power on the system can reduce but not eliminate balancing needs

Annual demand met by balancing durations by supply scenario
TWh



- Short @ $80/MWh
- Medium-long @ $170/MWh
- Ultra-long @ $460/MWh

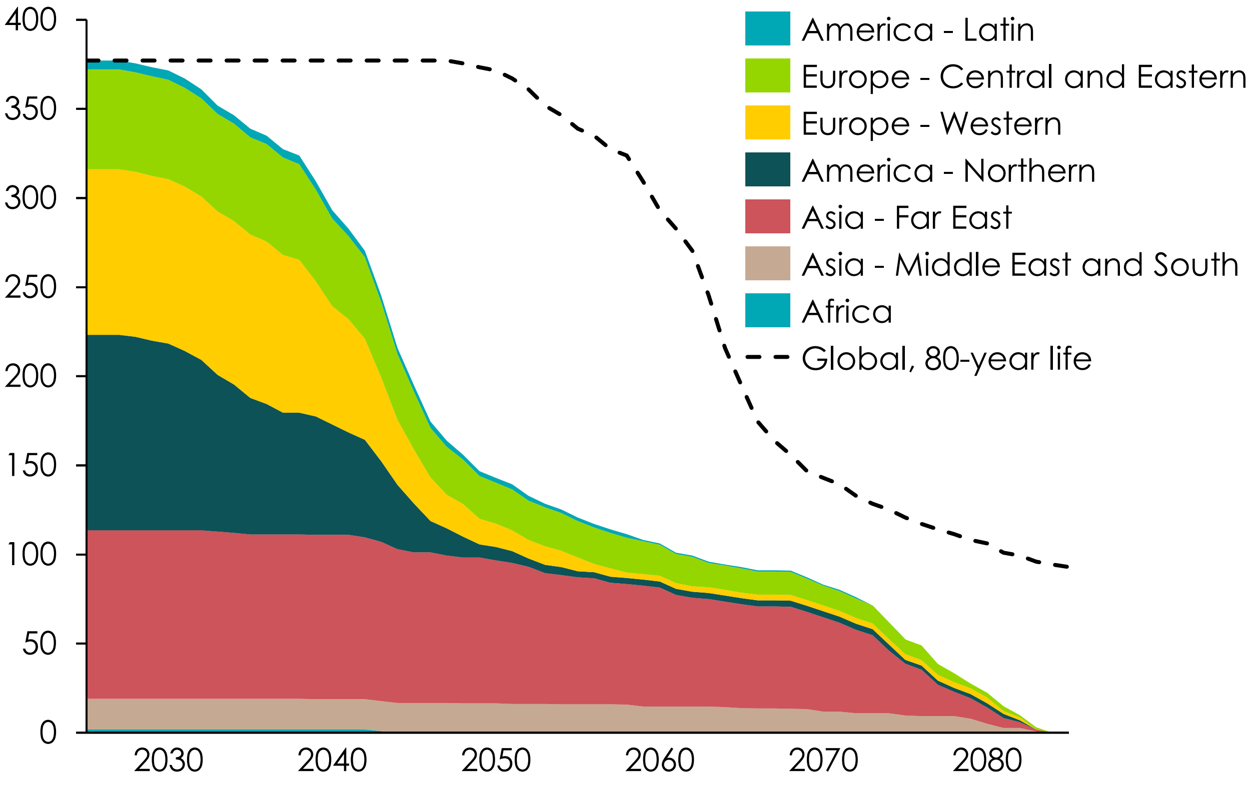
Illustrative UK system balancing cost by supply scenario
$/MWh (real 2024$)



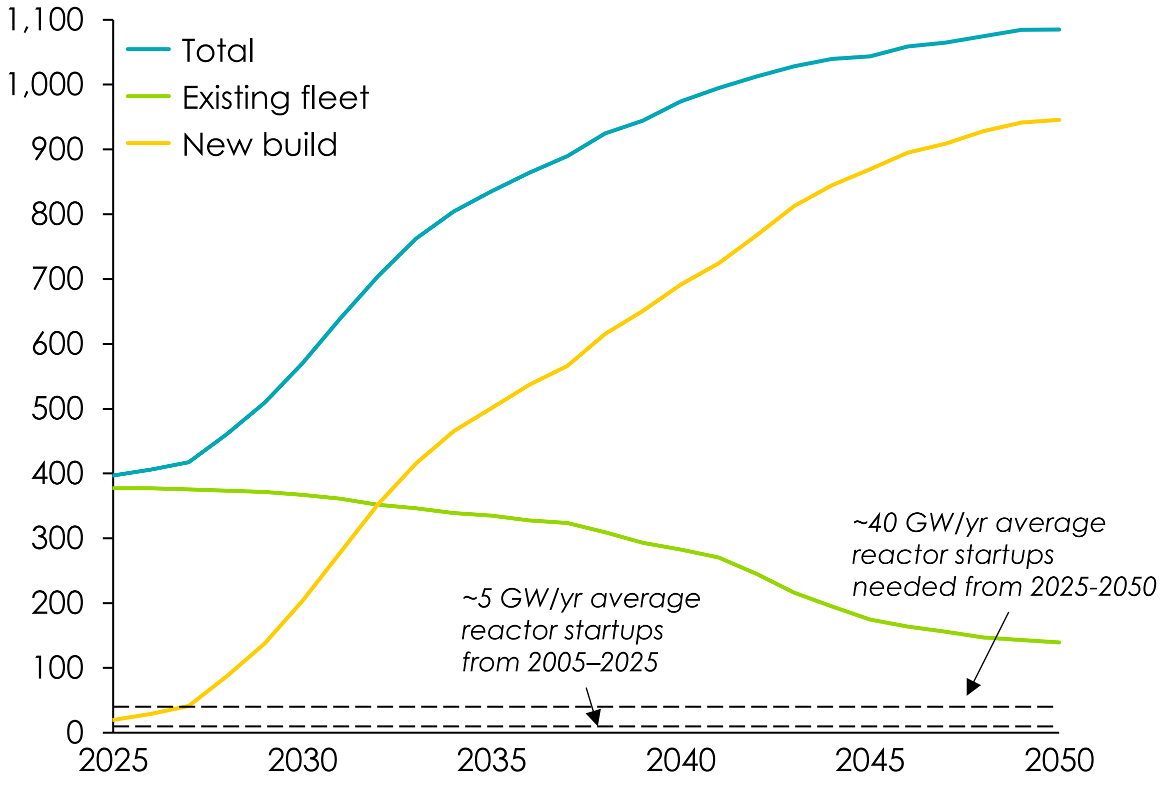
Notes: Weighted average wind and solar generation cost used as the storage input electricity cost. 2050 Levelised cost of storage estimates (LCOS) ($/MWh): Short = 80 – 131; Medium-long = 173 – 240; Ultra-long = 457. Sources: Systemiq analysis for the ETC (2025); BNEF (2025), *New Energy Outlook*, BNEF (2025), *LCOE Data Viewer*

Considering upcoming retirements of the existing fleet, around 40 GW per year of new reactors will be needed to meet a net-zero pathway

Capacity of existing nuclear fleet by year (assuming 60-year lifetimes) GW



Capacity needed to meet 10% of 2050 generation in a net-zero pathway (assuming 60-year lifetimes), GW



- Assuming 60-year lifetimes, the existing nuclear fleet capacity will half by 2050 and phase out by 2085
- If all reactors receive life extensions to 80 years, almost all capacity remains online in 2050 and 25% remains in 2080

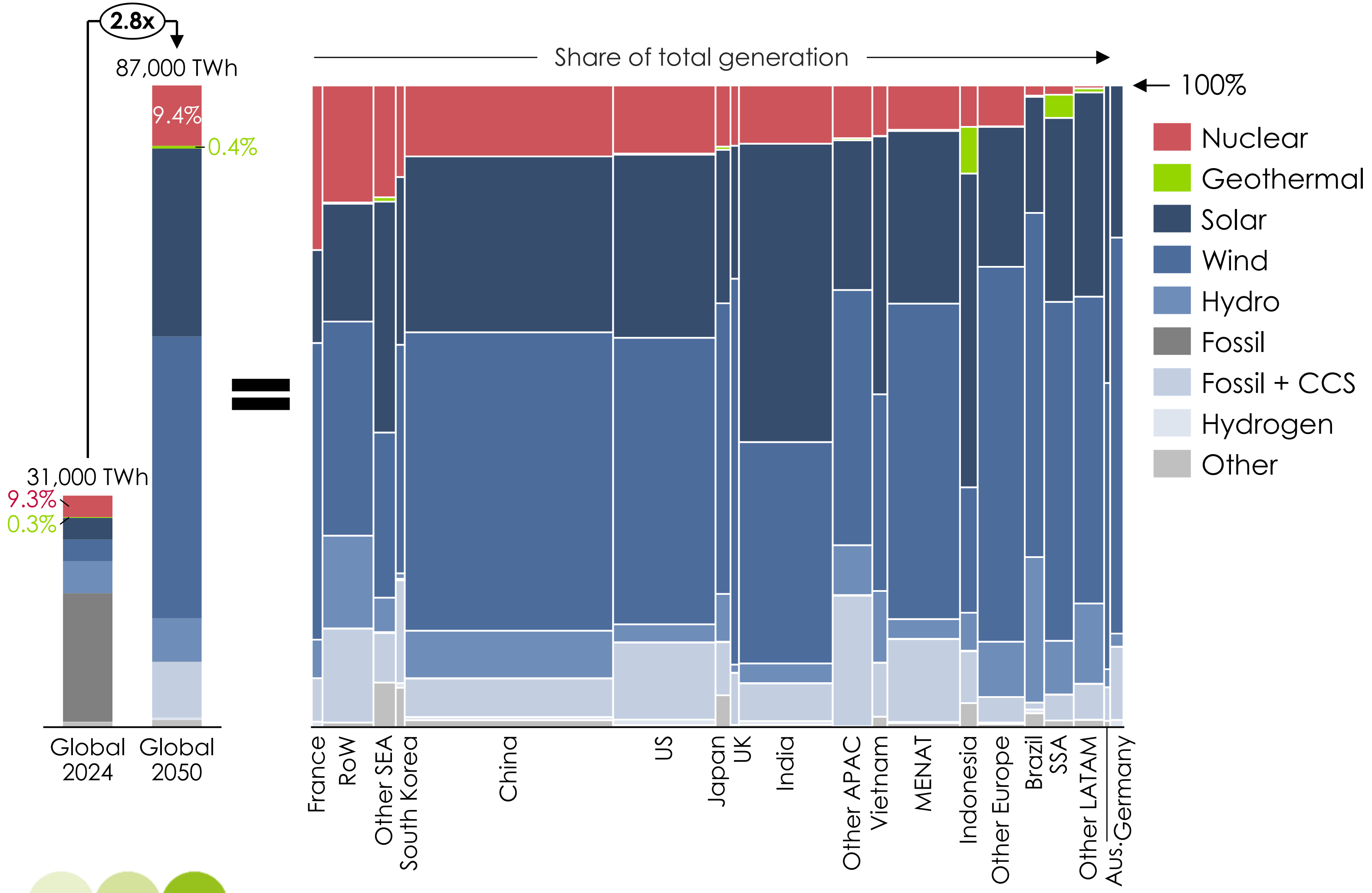
- ~1,100 GW needed in total by 2050, up from 380 today
- ~950 GW new build needed between now and 2050

Source: IAEA (2026), *Power Reactor Information System*, BNEF (2025), *New Energy Outlook*; Mycle Schneider (2025), *World Nuclear Industry Status Report 2025*

Nuclear could maintain a ~10% share of global generation in 2050 with an ambitious buildout, even as the global power system expands by ~3x

Share of nuclear and geothermal vs other technologies in BNEF's 2050 Net Zero Scenario

%



- ~10% of global generation by 2050 = ~3x today's levels, given demand growth
- Regional shares vary widely (0-25%)
- New nuclear deployment depends on system need, grid requirements, and deliverability constraints

Notes: RoW = rest of world, SEA = Southeast Asia, APAC = Asia-Pacific, MENAT = Middle East and Northern Africa, SSA = Sub-Saharan Africa, LATAM = Latin America
Source: BNEF (2025), *New Energy Outlook*

The role of nuclear depends on system benefits and deliverability

Six criteria determine the role of nuclear and geothermal by country

1. System need – when are nuclear/geothermal most valuable?

- **a) Power system benefits** → High value where wind/solar potential and alternative secure firm capacity are limited, increasing the need for reliable firm supply
- **b) Energy system benefits** → Attractive where heating demand is large and alternative solutions are constrained or costly

2. Deliverability – what enables rapid, low-cost deployment?

- **a) Delivery capability** → Experienced suppliers and workforce capable of standardised repeat build to deliver projects on time and on budget
- **b) Resource availability** → Secure nuclear fuel supply and cost-competitive geothermal resources
- **c) Regulatory capacity** → Credible, proportionate and predictable regulatory and siting frameworks across the project lifecycle
- **d) Financing availability** → Access to low-cost capital and credible risk allocation and revenue frameworks

System outcomes: Total system cost and resilience

Financial risk: Time and cost overrun exposure

Political durability: Institutional stability and public support

4. Small modular reactors will be a gamechanger for the role of nuclear

Statement

Small modular reactors (SMR) offer a game-changing route forward for low-carbon power

Who is making this statement?

NuScale, Rolls-Royce SMR, Kairos Power, X-energy, TerraPower, GE Hitachi, Holtec International

Key evidence points

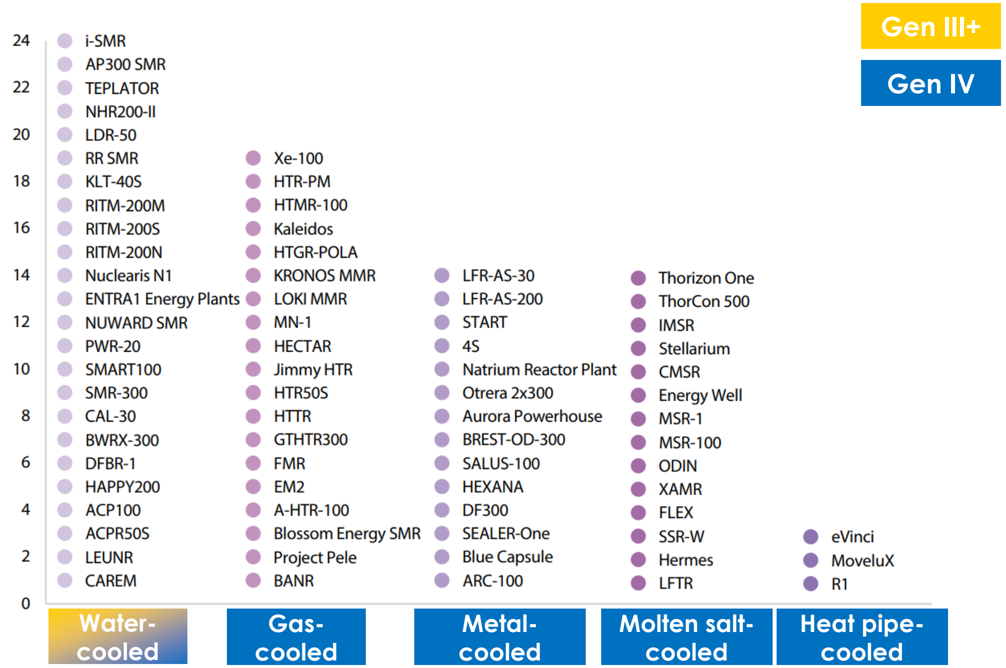
- Most SMR designs lack evidence of sustained, multi-unit pipelines.
- Leading SMR size, cost, and operational characteristics remain closer to large-scale nuclear than to more modular technologies (like solar and wind).

ETC assessment:	Unlikely (in the near-term)

SMRs will only deliver low costs if design consolidation and standardisation occurs; this has not been achieved in early SMR deployment

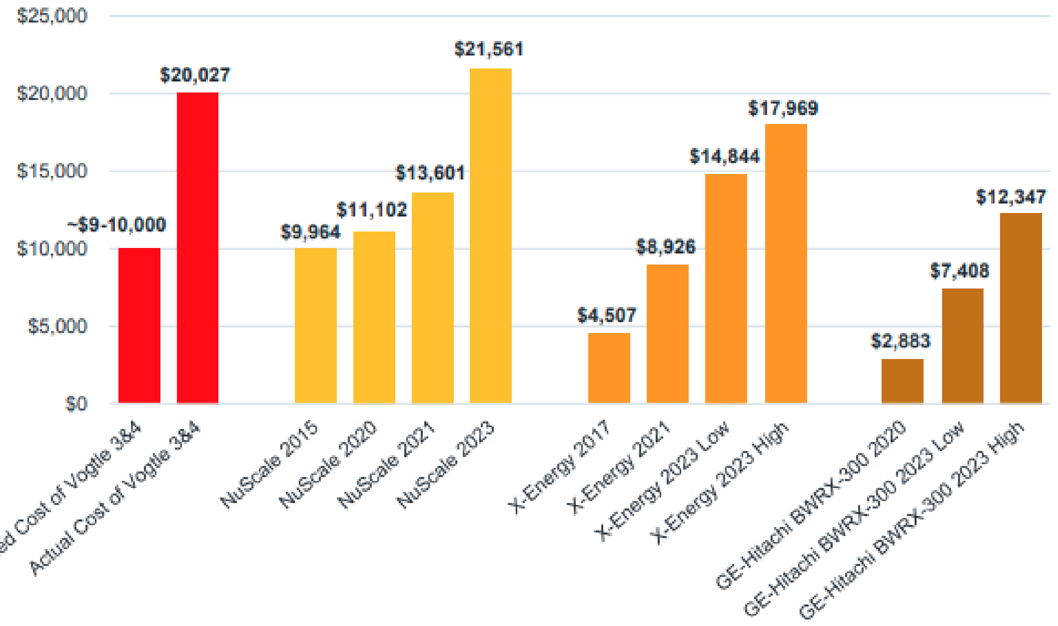
SMR concepts in development by reactor type

Number of concepts in development



Projected cost increases for proposed US SMR's

$/kW, real 2023



Key barrier:

- Consolidation is needed to unlock the standardisation and economies of scale that all SMR developers promise
- However, standardisation cannot happen with >100 designs competing for market share

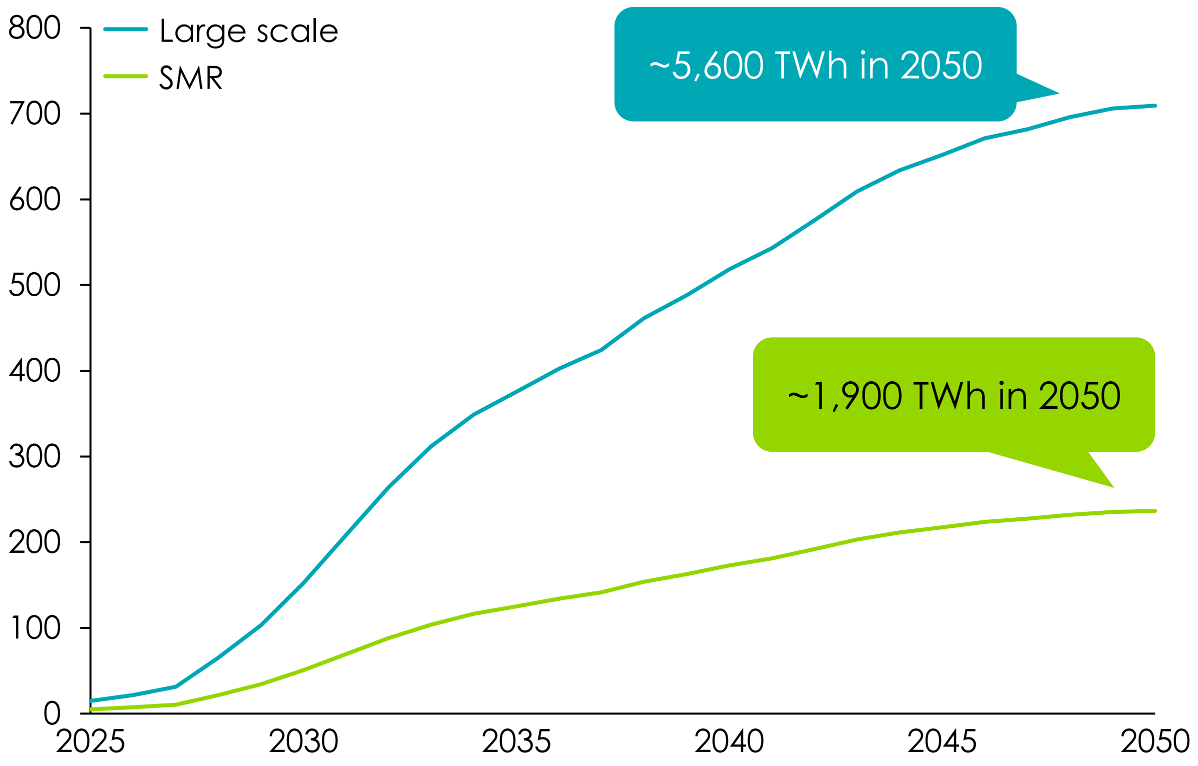
SMR vendors in the US have cited an increase in the following factors as cause behind rising costs;

- Inflationary pressures for construction materials
- Higher labour costs
- Increased interest rates
- Supply chain constraints for equipment

Source: IEEFA (2023) Small Modular Reactors; Still Too Expensive, Too Slow and Too Risky; Source: NEA (2025), *The NEA Small Modular Reactor Dashboard: Third Edition*.

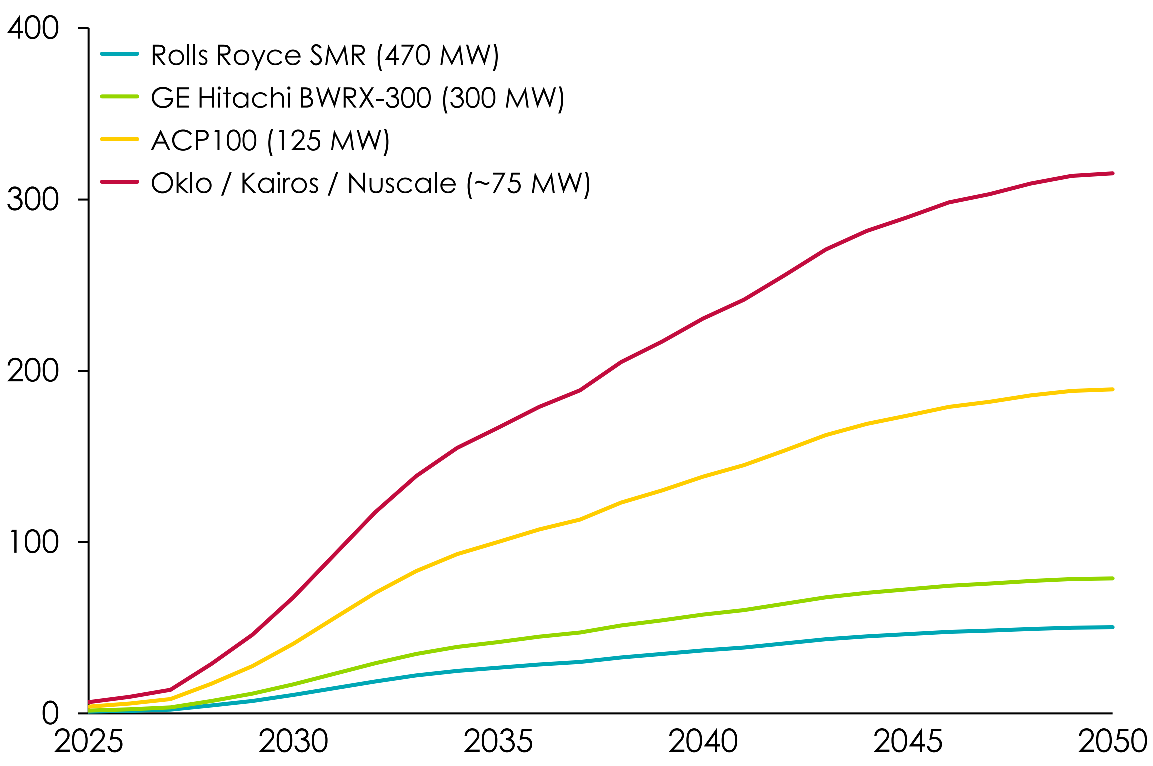
If SMRs scale to meet 25% of new builds, this could result in hundreds of units per leading SMR developer…

How many new SMRs are needed to meet 25% of new build needs?
GW



- Nuclear generation grows from 3,000 - 8,000 TWh from 2025 – 2050, meeting 9.4% of global generation in 2050
- 75% from growth is met by large-scale, 25% by SMR

How many units per SMR developer if each meets 10% of SMR growth?
units



If 10 SMR developers split 25% of nuclear growth equally, this could mean 300 x 75 MW units, 190 x 125 MW units, 80 x 300 MW units and 50 x 500 MW units by 2050

Source: BNEF (2025), New Energy Outlook

…However, SMR learning curve effects are inherently limited than more modular technologies like solar

Does this level of production allow sufficient scale to enable cost reduction from learning rates?

- **Modularisation** allows some repeated production
- **Standardisation** across whole supply chain needed for learning curve effects

Rolls Royce 470 MW SMR theoretical buildout

2025 → 2050

50 units cumulative
2 annual (average)
6 doublings

22% cost reduction from current level
(10% learning rate applied to 50% CAPEX)

Oklo / Kairos / Nuscale ~75 SMR theoretical buildout

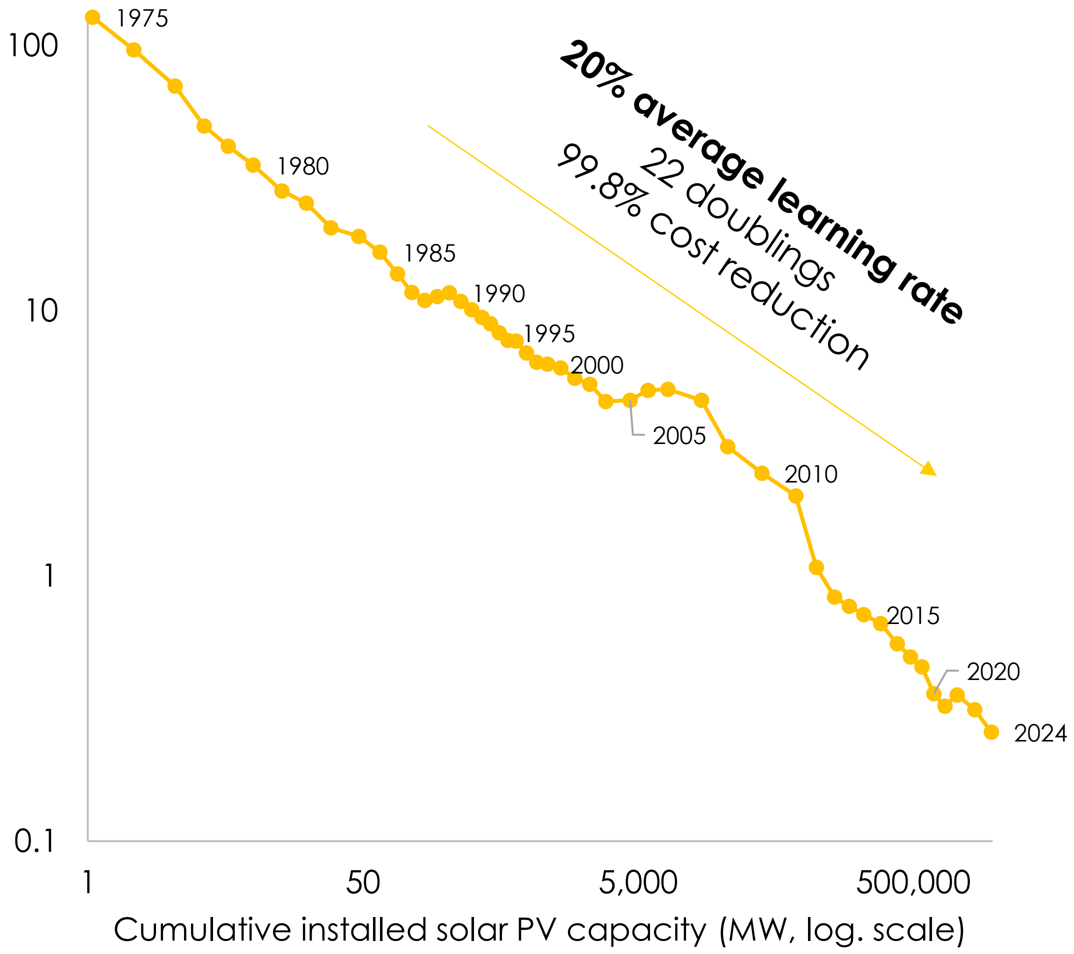
2025 → 2050

315 units cumulative
13 annual (average)
8 doublings

Max. 29% cost reduction from initial level
(10% learning rate applied to 50% CAPEX)

How does this compare to historic solar learning curve effects?

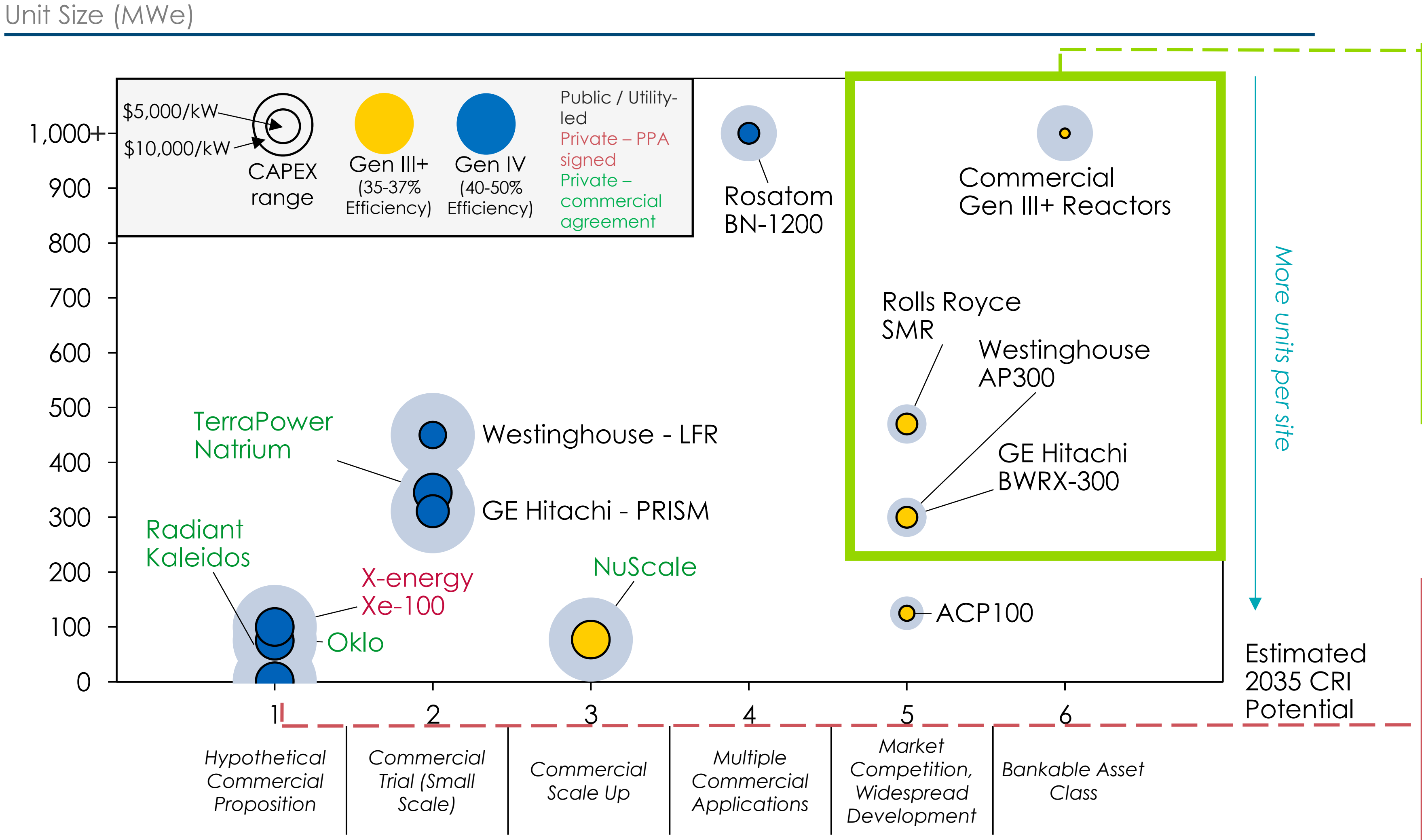
Solar module cost (2024$/W, log. scale)



Note: solar learning rate reflects decreasing module costs and increasing module efficiency; these trends are both expected to continue for solar, however efficiency increases will be limited for SMR technology.
Source: Our World in Data (2025), *Solar photovoltaic module prices vs. cumulative capacity*

Nuclear deployment the next decade will be dominated by designs using mature technology, large unit sizes, and standardised designs

Illustrative diagram of the unit size and Commercial Readiness Index (CRI) of selected designs



High near-term deployment potential:

1. **Conventional technology (Gen III+)**
2. **Large unit sizes** (e.g., 300+ MW)
3. **Standardisation and modularisation** (high project replicability)

Low near-term deployment potential:

1. **Advanced technology (Gen IV)**
2. **Small unit sizes**
3. **Low** standardisation

Notes: Circle diameter represents CAPEX scale. CRI 1 = TRL 2-8; CRI 2 = TRL 9. Commercial Gen III+ Reactors include reactors such as AP1000, EPR, APR-1400, HPR-1000. FOAK = first of a kind, NOAK = n[th] of a kind. Source: Systemiq analysis for the ETC (2025); ARENA (2014), *Commercial Readiness Index for Renewable Energy Sectors*

5. Data centres require nuclear or geothermal

Statement

We need firm power for data centres and renewables can't offer this

Who is making this statement?

amazon, Microsoft, Google, Meta, Goldman Sachs

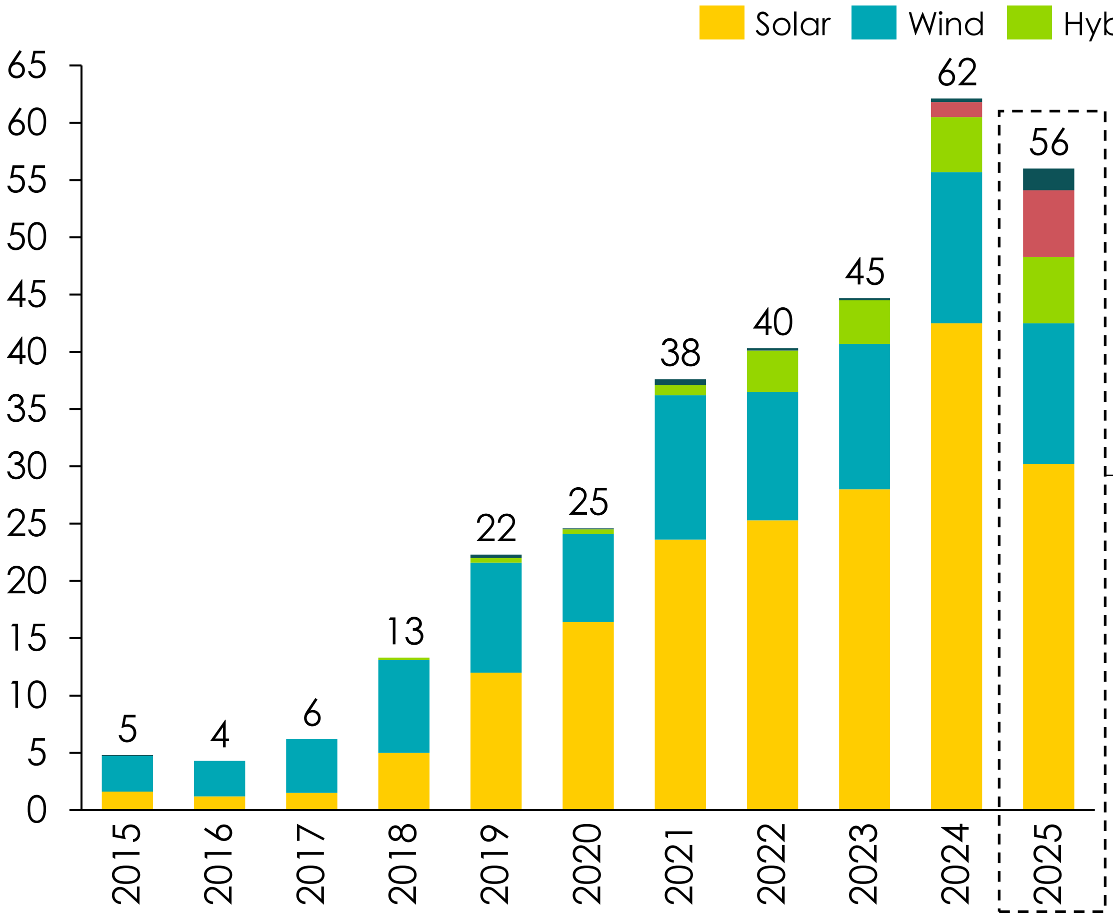
Key evidence points

- Data centres could catalyse nuclear and geothermal scale-up in some specific locations (e.g., the US)
- Wind, solar, grids, and dispatchable gas (with declining utilisation) can meet reliability needs at lower cost and faster deployment timelines in many cases.

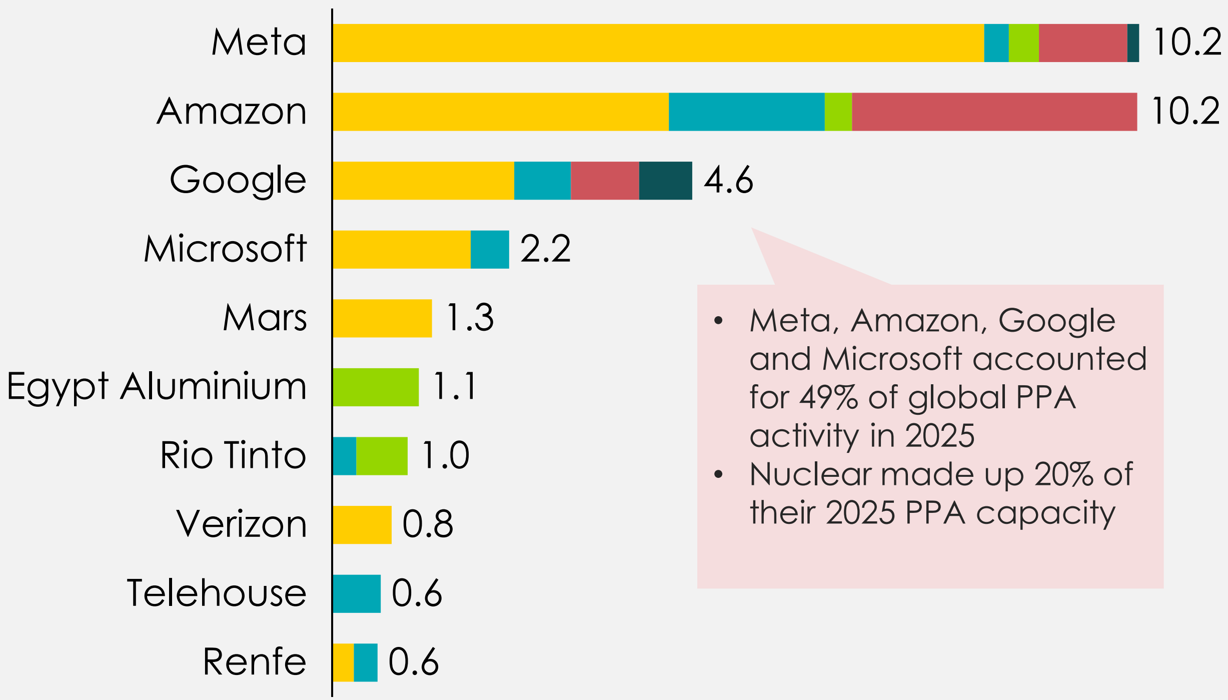
ETC assessment:	False

Corporate power purchase agreements are dominated by wind and solar, however nuclear makes up an increasing share

Global corporate power purchase agreement annual volumes (BNEF)
GW



Top 10 global corporate clean energy buyers in 2025 (BNEF)
GW



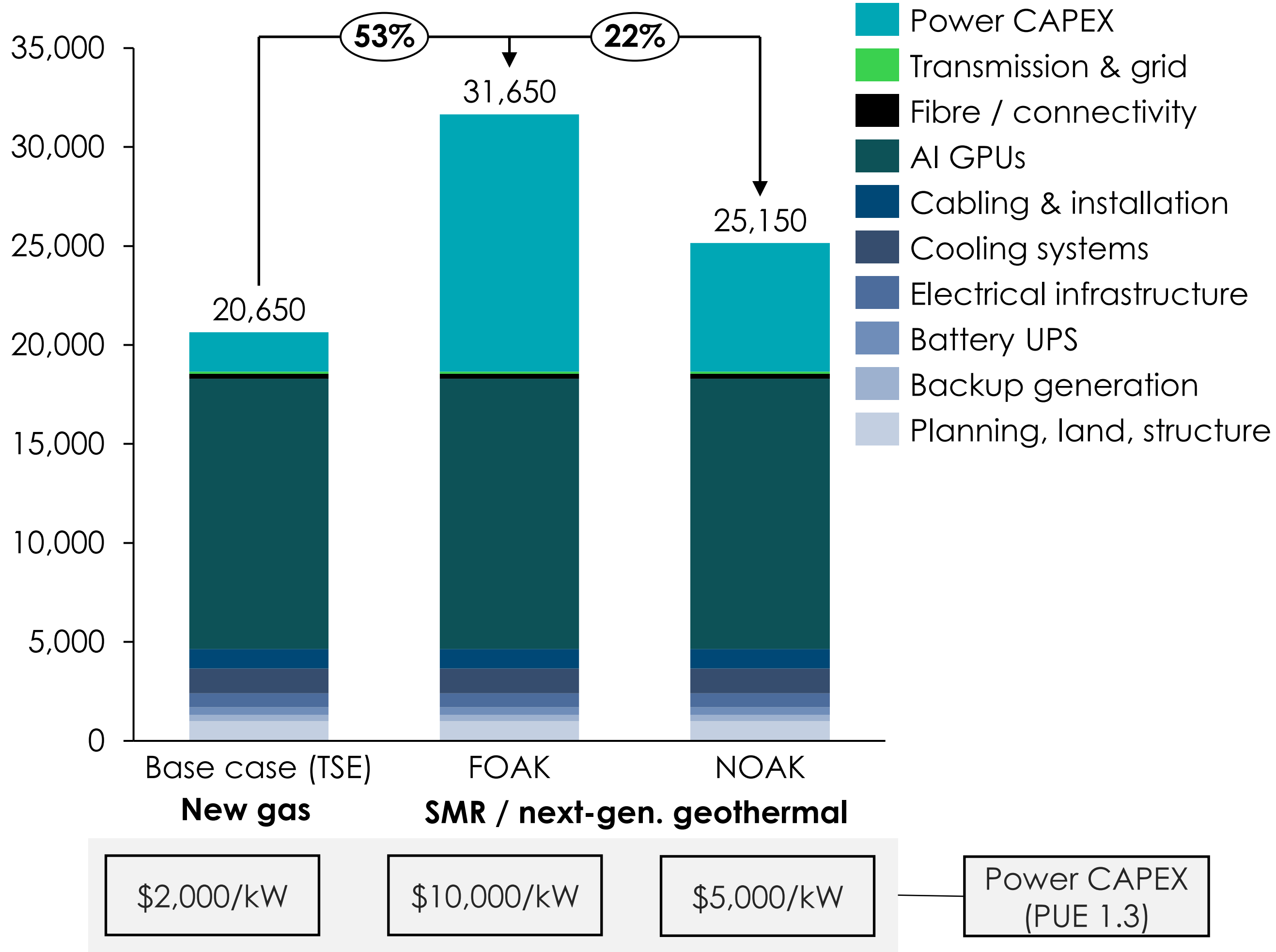
- Meta, Amazon, Google and Microsoft accounted for 49% of global PPA activity in 2025
- Nuclear made up 20% of their 2025 PPA capacity

Notes: “Hybrid” refers to co-located combinations of wind, solar, and storage.
Source: BNEF (2025), *1H 2026 Corporate Energy Market Outlook: Cooling Off*

Data centre CAPEX is sensitive to co-located power costs; SMR and next-gen. geothermal viability will depend on large cost reductions

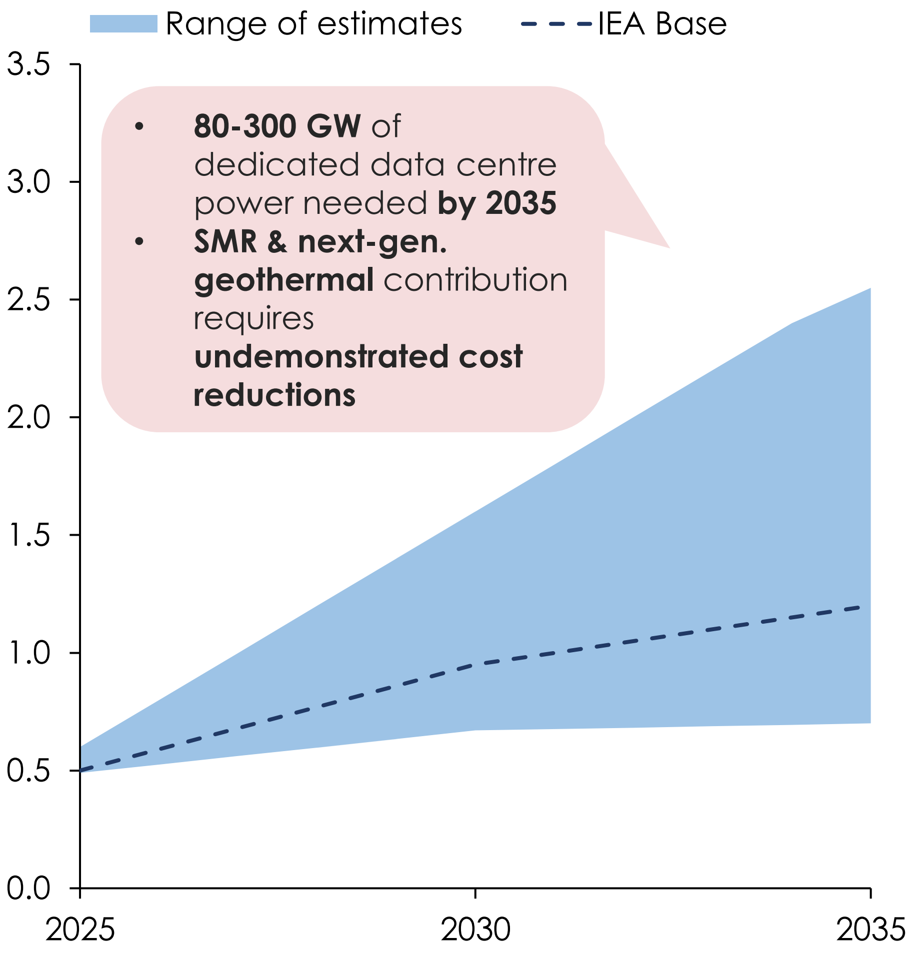
Data centre CAPEX breakdown and sensitivity to power prices

$/kW$_{IT\ capacity}$



Global data centre annual demand projections by scenario

000 TWh/year



Key uncertainty drivers

- Computing proliferation
- AI model scaling
- Jevons effect

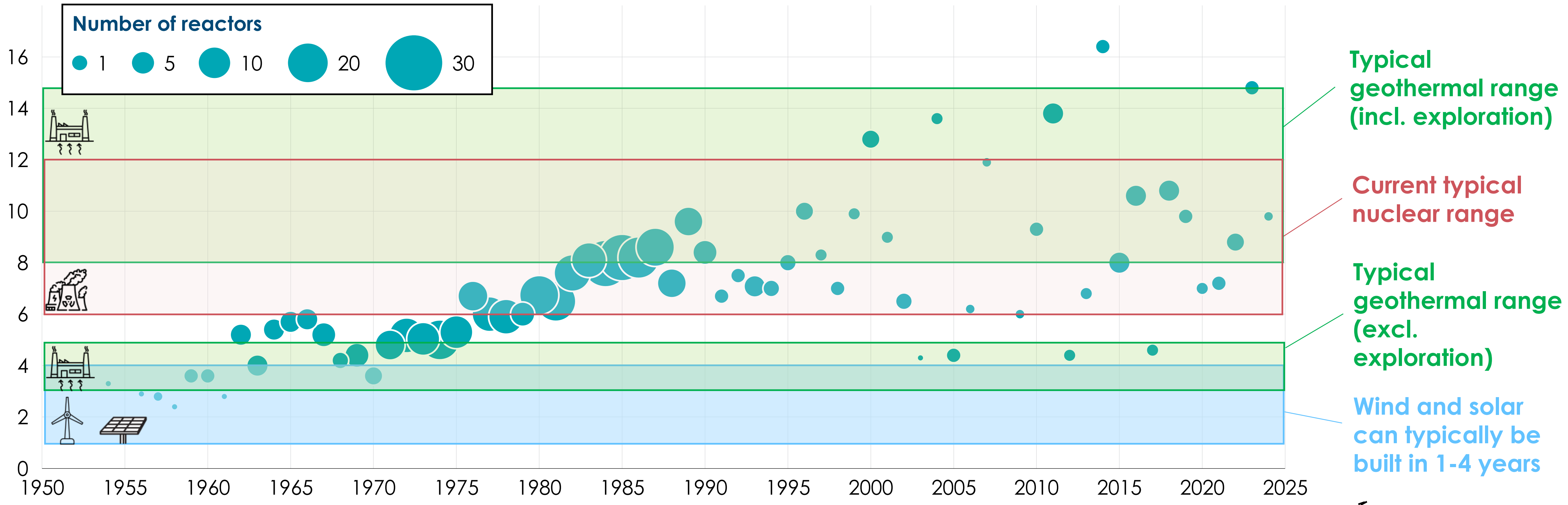
- Increasing compute efficiency
- Uptake uncertainty
- AI monetisation
- Supply chain grid connection constraints

Notes: SMR = small modular reactor GPU = graphics processing unit; PUE = power usage effectiveness; FOAK = first of a kind; NOAK = nth of a kind. TSE conventional data centre cost breakdown used with "Servers & IT hardware" swapped with Bernstein GPU cost estimates. Sources: BNEF (2025), *New Energy Outlook*; IEA (2025), *Energy and AI*; Thunder Said Energy (2025), *AI energy: industrial demand and the Jevons effect?*; Thunder Said Energy (2025), *Data-centers: the economics?*; Investing.com (2025), *How much does a GW of data center capacity actually cost*

Nuclear and geothermal are unlikely to provide sufficient short-term capacity for data centre demand, due to long lead times

Average durations from final investment decision to commissioning over time

Years



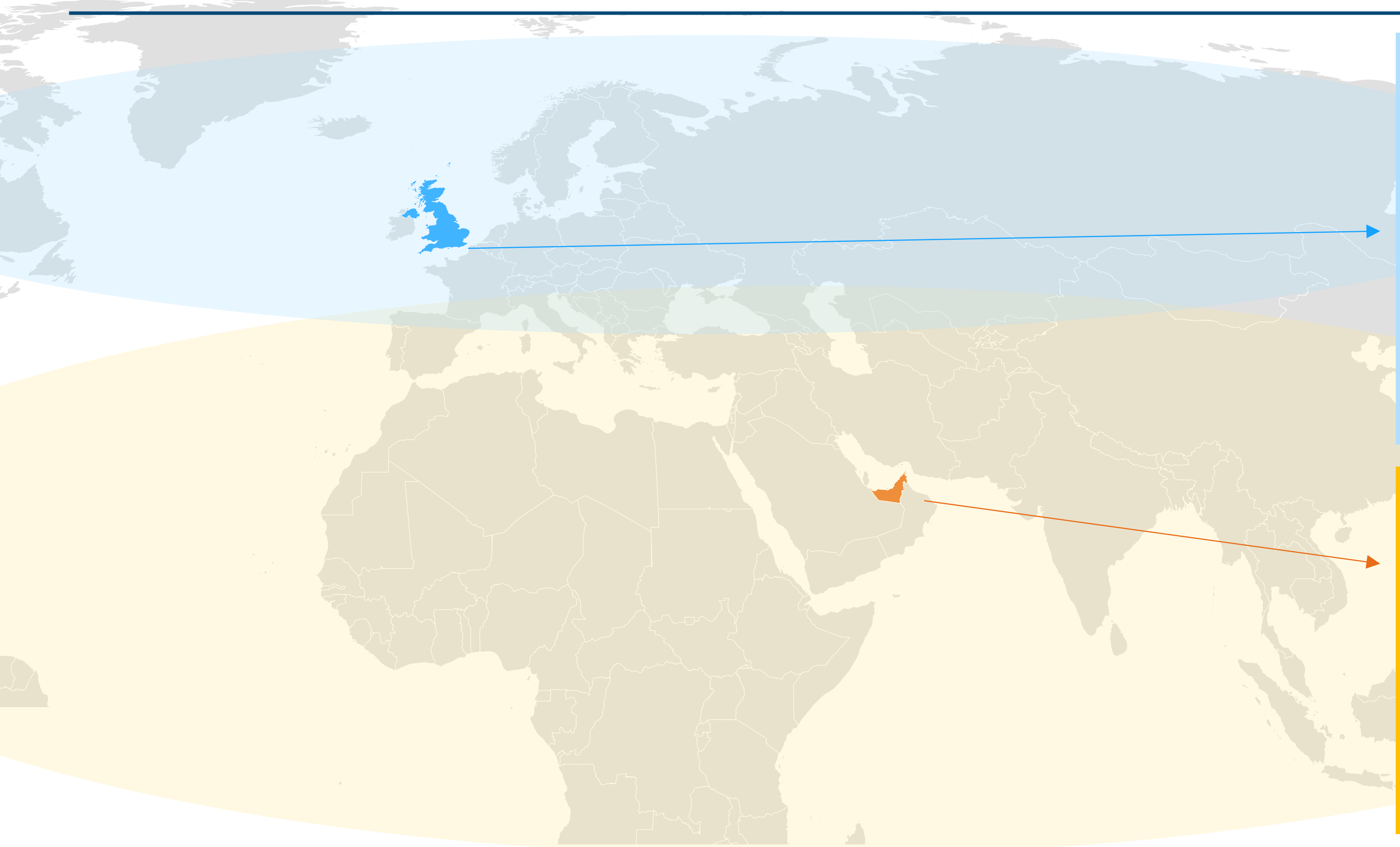
Average nuclear construction times have increased significantly, particularly in the West

New nuclear could add 1,000 TWh in the next 10 years while solar will add 10,000 TWh

Sources: Adapted from Mycle Schneider Consulting (2024), *The World Nuclear Industry Status Report 2024*; Financial Times (2025), *Can the nuclear industry find a better way to build?*; A. Gumber (2024), *A global analysis of renewable energy project commissioning timelines;* British Geological Survey (2023), *Evidence report supporting the deep geothermal energy white paper: The case for deep geothermal energy - unlocking investment at scale in the UK*

Renewables and storage are increasingly offering 24/7 clean power solutions across the "Windbelt" and the "Sunbelt"

Optimal renewables and storage system configuration to meet continuous baseload demand varies by region



UK – "Windbelt" solution

Centre for Net Zero modelling (2025)

- ~80% renewables (offshore wind + solar + BESS), ~20% gas
- 120 MW, 24/7 with COD 2028-30
- 43% cheaper than nuclear SMR
- 23% cheaper than gas-only

Implied LCOE: ~$90/MWh

Abu Dhabi – "Sunbelt" solution

Masdar / EWEC (under construction)

- 5.2 GW solar PV + 19 GWh battery
- Delivers 1 GW baseload, 24/7
- ~$6bn investment, online ~2027
- Zero gas backup required

Implied LCOE: ~$55/MWh

Note: Both scenarios assume 100% load-matching, however reliability statistics are not provided. Abu Dhabi LCOE is an illustrative estimate based on published capex of ~$6bn (AED 22bn), 30-year project life, 5% WACC, 1.5% annual O&M, and one battery replacement. Actual tariff not yet disclosed. UK figures derived from CNZ published annual costs (medium DESNZ cost assumptions). Source: PV Magazine (2025), *Masdar, EWEC announce 5 GW/19 GWh solar-plus-storage project in Abu Dhabi*; Centre for Net Zero (2025), *How to accelerate the UK's AI revolution – Powering data centres at speed and low cost*

6. Nuclear delivers high employment prospects and economic growth

Statement

Nuclear delivers high employment prospects and economic growth compared to renewables

Who is making this statement?

NEI Nuclear Energy Institute · IAEA · World Nuclear Association · NEA Nuclear Energy Agency

Key evidence points

- While nuclear projects can deliver high local employment during construction, this is driven by their high cost rather than capital efficiency.
- Long-term employment and gross value add are comparable to other clean generation technologies.

ETC assessment:	Overstated

Value added conundrum: nuclear can deliver high employment and local economic benefits vs renewables because of its high cost and complexity

Nuclear gross value add (GVA) conundrum:

High capital cost
$8,000-16,000/kW (Western)

Labour

Construction

=

High employment impact
~70% local content achieved

Skilled jobs

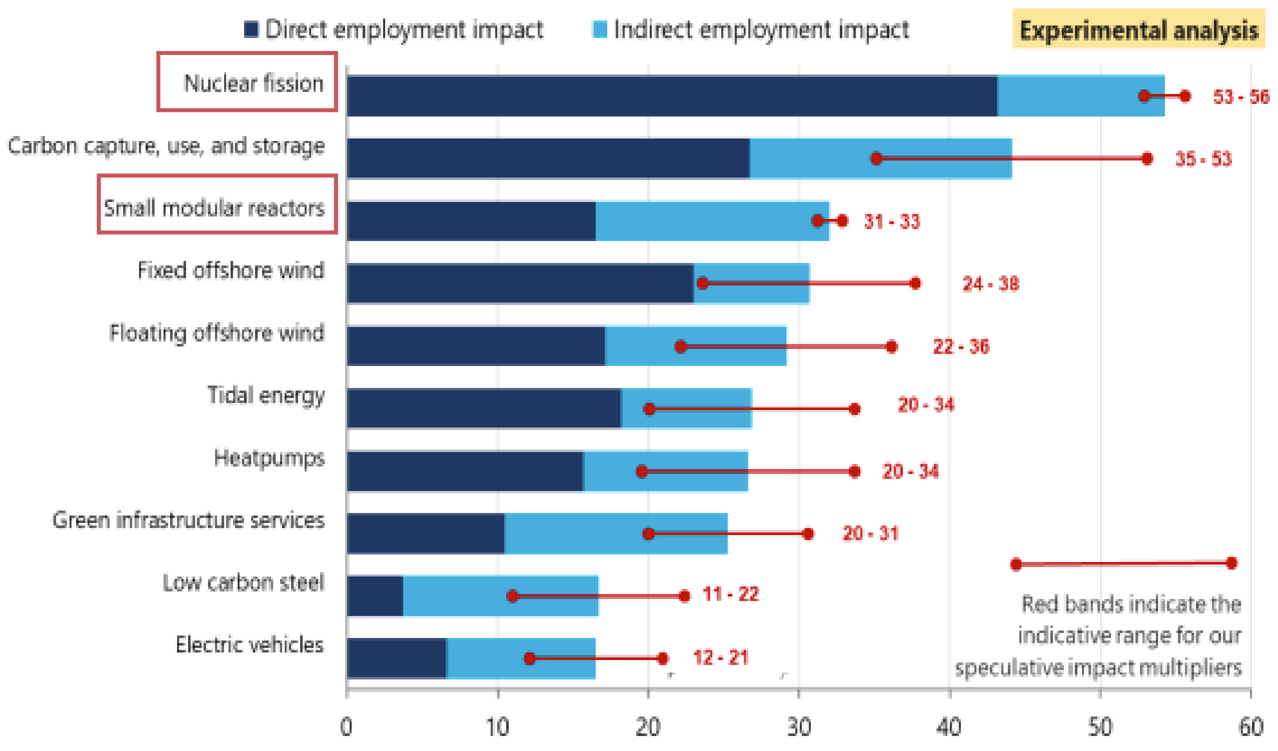
High GVA

The same factors driving nuclear's high cost, complex, labour-intensive construction, are what generate outsized domestic economic benefits

Nuclear may deliver high UK job impact per £ invested driven by labour-intensive construction and long-lived service phases…

Indicative ranges for the employment impact of £1 billion government investment

£ billion, 2023 prices



Questions for discussion:

- Do these figures resonate with your experience?

Why does nuclear score highly?

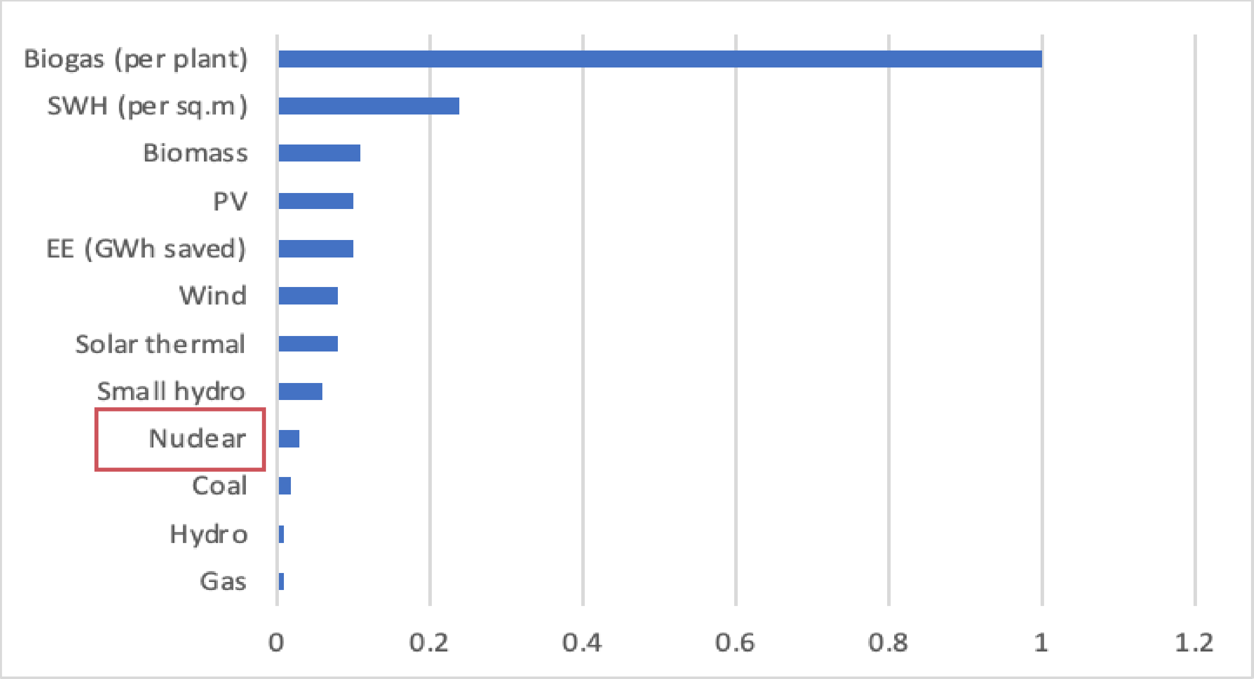
- **Labour-intensive construction and long-lived service phases** (O&M, decommissioning) are mapped to domestic, high-employment sectors
- Renewables score lower **as capital goods and equipment are often imported**, with fewer localised jobs captured in UK input–output tables
- Nuclear's decommissioning tail provides an additional employment stream not present for most renewables.
- **SMRs** are included in the modelling and also show high UK job multipliers, driven by **construction** and **long-term service phases**

Source: Tony Blair Institute for Global Change & Oxford Economics (2024), *The UK's Competitive Advantage in Green Innovations: Capturing Growth from the Global Green Transition*.

…however, cross-country evidence showcases that nuclear's impact varies with economic structure and methodology

Level of employment per Rs. Million invested, India

Jobs per 1,000,000 rupees spent



Why does nuclear score low?

- In India, a large share of nuclear spend maps to **equipment/engineering sectors with low jobs-per-₹ in India's I-O tables**; the **on-site civil works share is smaller** than for decentralised renewables, so fewer domestic jobs are recorded per ₹ invested
- **Imported reactor components/services are treated as non-domestic and don't create Indian jobs** in the model, lowering nuclear's measured employment intensity.

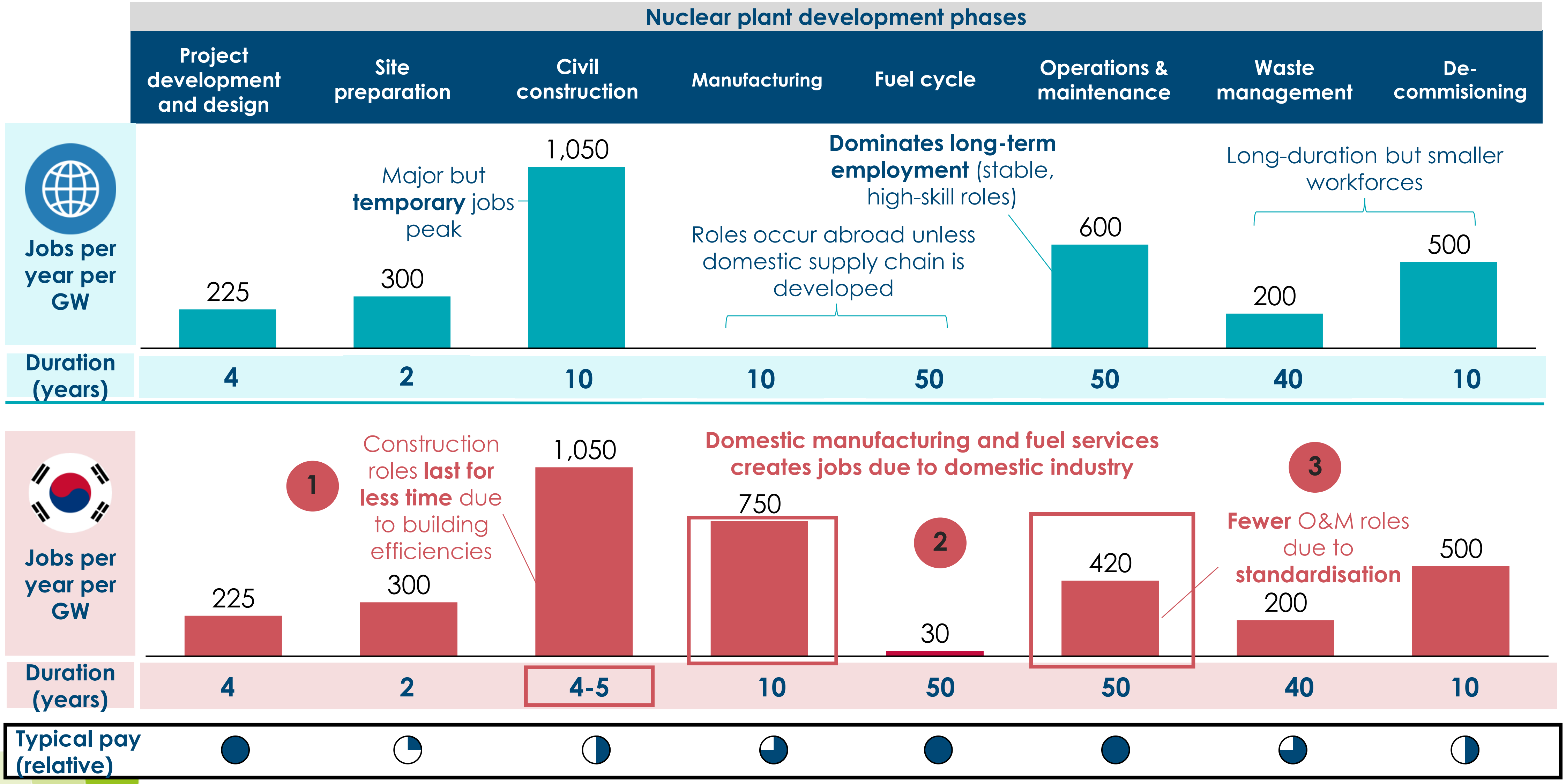
Key assumptions

- Direct, indirect and induced effects calculated using India's national input–output tables.
- Imported inputs are excluded from value-added and job counts.
- Results are from the Green Economy (GE) scenario, which limits nuclear build and emphasises renewables; when averaged over the horizon, nuclear yields fewer lifetime job-years

Source: B. Sudhakara Reddy (2014), India's Energy System Transition – Survival Of The Greenest

Civil construction creates the most jobs but durations vary by country; highly-specialised and highest-pay manufacturing jobs only exist in a few countries

1 GW Light Water Reactor; 10-year build, 50-year operation (top – global average; bottom – South Korea)



Source: Systemiq analysis for the ETC (2025); OECD-NEA & IAEA (2018), *Measuring Employment Generated by the Nuclear Power Sector*

7. Next-generation geothermal will be a gamechanger for the role of geothermal

Statement

Next-generation geothermal will unlock low-cost firm power around the whole world

Who is making this statement?

Key evidence points

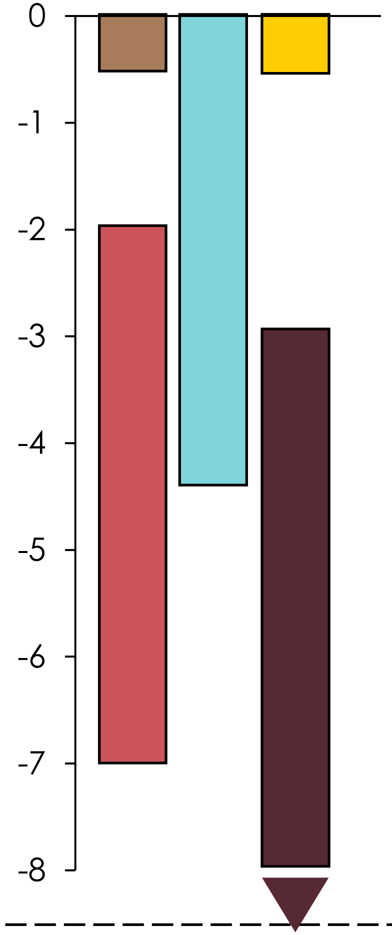
- Countries with the best resource and supply chains (incl. the US) have a near-term opportunity to commercialise next-generation geothermal
- However, significant technical, cost, and scalability risks remain

ETC assessment:	Uncertain

Confidential

Next-generation geothermal is deeper, hotter, and lower maturity than conventional geothermal options

Geothermal Technology	Typical depth (km)	Temp (°C)	Use Case	Geo potential	Sector	TRL
Ground source heat pumps		4 - 25 °C	Heating, Cooling	Global	Resi., Industry	TRL 9
Geothermal energy storage		< 100 °C	Storage	Global	Resi., Industry	TRL 9
Conventional hydrothermal		10 - 120 °C (heat) 80 - 300 °C (power)	Heating, Power	Shallow resource	Grid, Industry	TRL 9
Next-gen. technologies						
Enhanced geothermal systems (EGS)		80 - 300 °C	Heating, Power	Global	Grid, Industry	TRL 7
Closed loop geothermal systems (CLGS)		80 - 300 °C	Heating, Power	Global	Grid, Industry	TRL 6
Superhot rock		375 - 500 °C	Heating, Power	Global	Grid, Industry	TRL 3-5

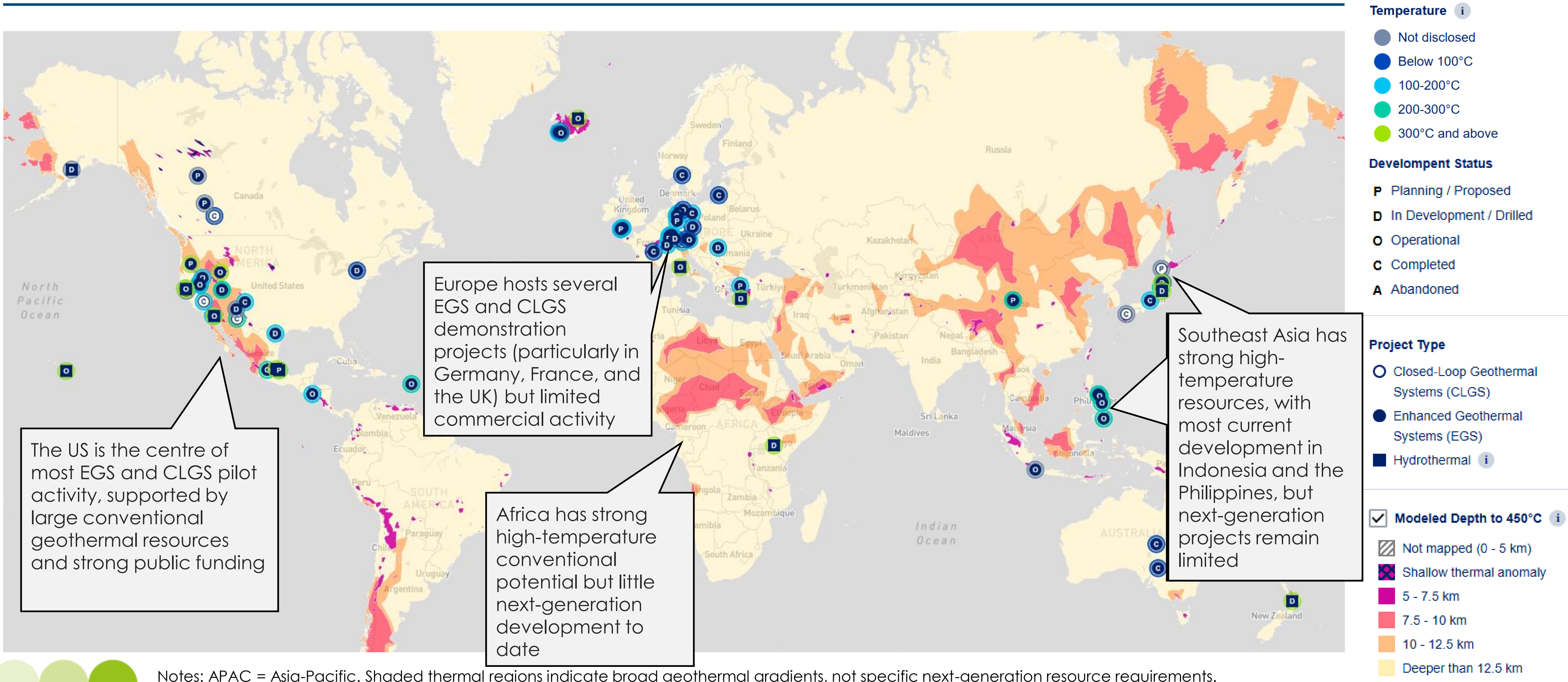


Heating Cooling Storage Power | Global Shallow resource | Resi. Industry Grid

Notes: Underground energy storage parameters refer to underground thermal energy storage (excluding more nascent options such as geothermal mechanical storage).
Assumed TRL scale: TRL 1-3 = Research to Proof of Concept; TRL 4-6 = Lab to Pilot Demonstration; TRL 7-9 = Prototype Demonstration to FOAK / Full Commercial Deployment

Next-generation geothermal power project development is expanding, with activity concentrated in North America, Europe, and APAC

Global geothermal project deployment map



The US is the centre of most EGS and CLGS pilot activity, supported by large conventional geothermal resources and strong public funding

Europe hosts several EGS and CLGS demonstration projects (particularly in Germany, France, and the UK) but limited commercial activity

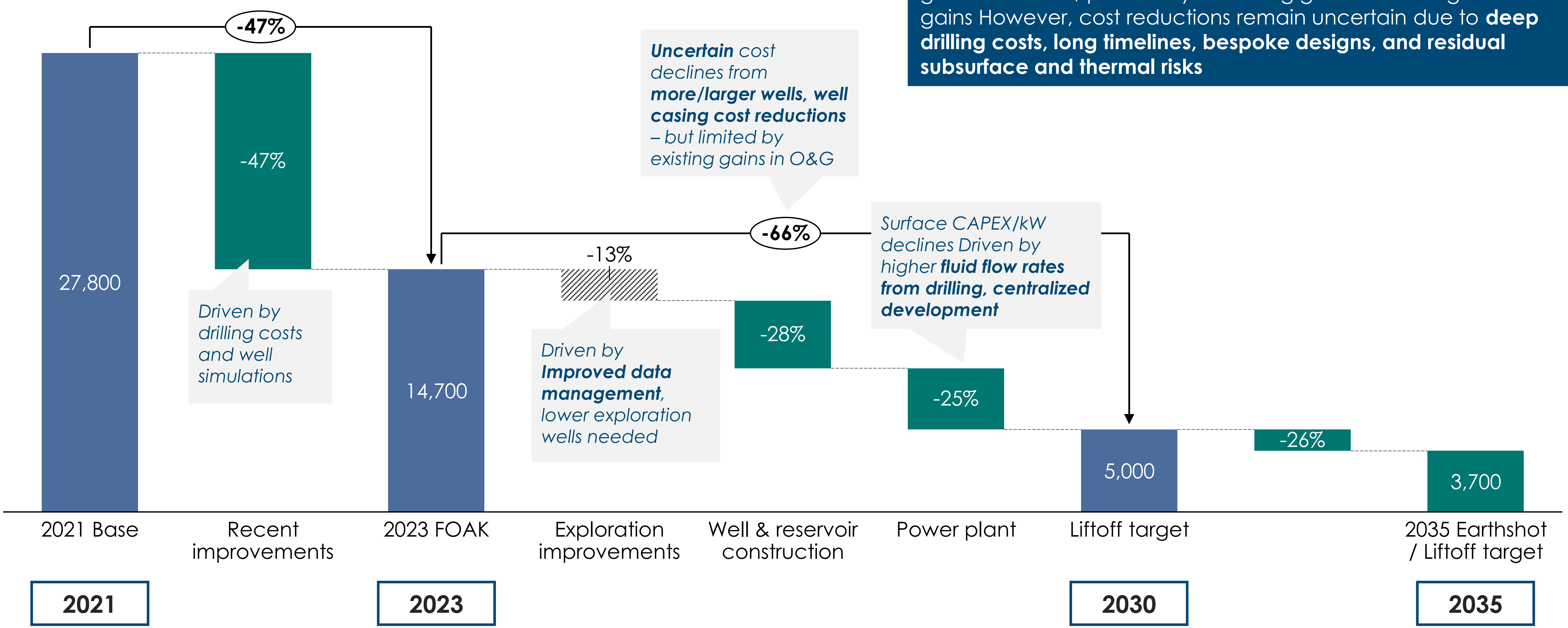
Africa has strong high-temperature conventional potential but little next-generation development to date

Southeast Asia has strong high-temperature resources, with most current development in Indonesia and the Philippines, but next-generation projects remain limited

Notes: APAC = Asia-Pacific. Shaded thermal regions indicate broad geothermal gradients, not specific next-generation resource requirements.
Sources: Clean Air Task Force (2025), The Next Generation of Geothermal Energy. Available at: https://www.catf.us/shr-map/

Next generation geothermal has the potential to reduce costs, but significant uncertainty remains

EGS CAPEX decline drivers (based on US DoE data)
$/kW$_e$, real 2024



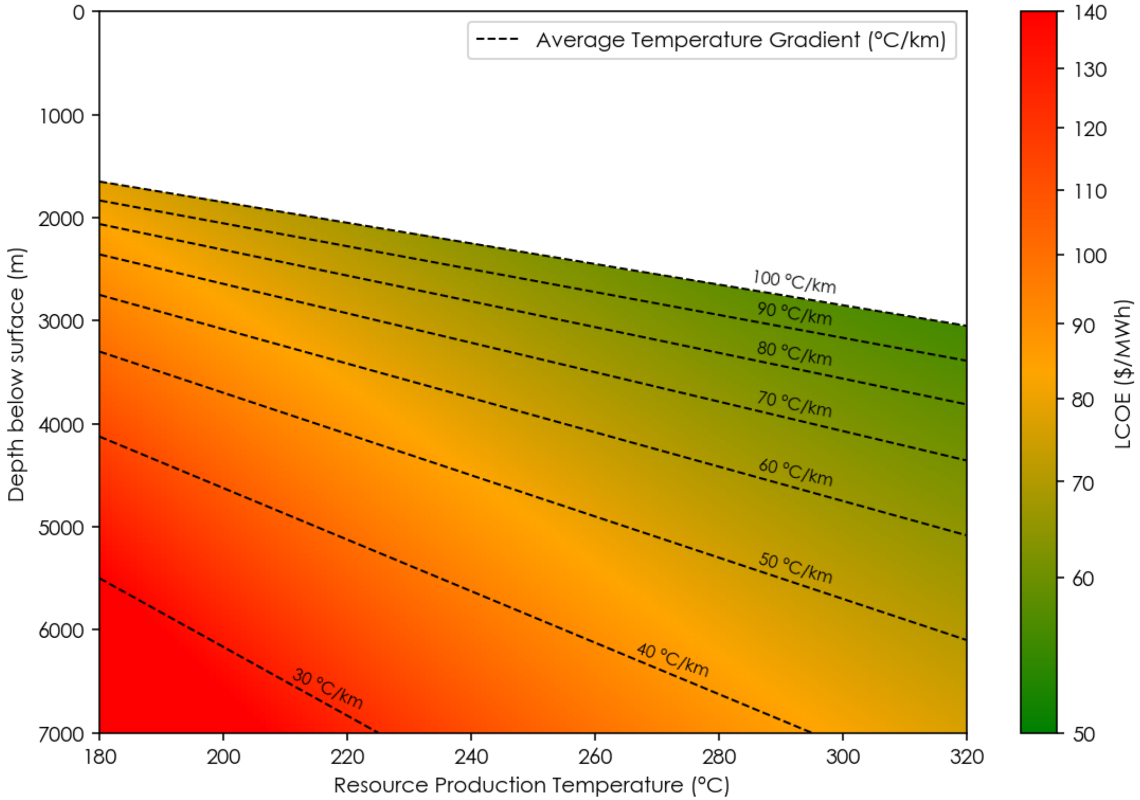
Next-generation geothermal **shifts risk from subsurface uncertainty to engineering performance** by leveraging oil and gas innovations, potentially unlocking greater learning-curve gains However, cost reductions remain uncertain due to **deep drilling costs, long timelines, bespoke designs, and residual subsurface and thermal risks**

Notes: EGS = enhanced geothermal systems
Source: US DoE (2024) *Pathways to Commercial Liftoff: Next-Generation Geothermal Power Updated*

Next-generation geothermal costs vary widely depending on geology; they are driven by depth, temperature gradient, and financing risk

Illustrative EGS cost variation by depth and temperature (2035 costs, constant WACC)

Depth below surface – m; heatmap LCOE – $/MWh, real 2024



- **Shallower, hotter sites deliver the lowest cost:** LCOE drops sharply where high temperature gradients allow production at <3 km depth
- **Most of the world sits in the 15-45 °C/km range**, requiring deeper drilling and pushing LCOE estimates above $80/MWh at 2035 costs
- **Reducing development and operational risk is critical** to lowering WACC, which would shift LCOEs downward

Typical temperature gradients by region:

Low gradients: 15-30 °C/km	**Moderate gradients: 30-45 °C/km**	**High gradients: 45-100+ °C/km**
E.g., UK, Eastern US, Central/Eastern Europe, Brazil	*E.g., Australia, Northern India, Northwest Africa, Northern Canada, Southwest UK*	*E.g., East African Rift, Iceland, Western US, New Zealand, Indonesia, Philippines, Central Andes (Chile, Bolivia, Argentina)*

Notes: EGS = enhanced geothermal systems, WACC = weighted average cost of capital, LCOE = levelised cost of energy. Source: Systemiq analysis for the ETC (2025); NREL (2025), *2025 Geothermal Drilling Cost Curves Update*; Koenraad F. Beckers (2019), *GEOPHIRES v2.0: updated geothermal techno-economic simulation tool*; US DoE (2024) *Pathways to Commercial Liftoff: Next-Generation Geothermal Power Updated*; F. Kolawole (2023), *Global distribution of geothermal gradients in sedimentary basins*; J. Limberger (2017), *Geothermal energy in deep aquifers: A global assessment of the resource base for direct heat utilization*

Agenda

- Work programme context
- How ETC's nuclear and geothermal work responds to current debates
- **Next steps**

Next steps

Workshop 3 - Key guidelines to scale nuclear and geothermal

23 March 2026

Report drafting with member reviews

April – May 2026

Report publication and communications campaign

Summer 2026 onwards

We propose a joint report covering both nuclear and geothermal

Role of nuclear and geothermal in low-carbon power systems (~60 p)

Chapter 1: *Context & introduction*	Systems context
Chapter 2: *Nuclear costs & technology outlook*	Technoeconomic trends
Chapter 3: *Geothermal costs & technology outlook*	Technoeconomic trends
Chapter 4: *System value*	System-level insights
Chapter 5: *Wider benefits and risks*	System-level insights
Chapter 6: *Considerations for country deployment*	Guidelines and strategies for selected countries

Focus of the upcoming workshop (pointing to Chapter 6: Guidelines and strategies for selected countries)

Notes: [nuclear symbol] is relevant for nuclear; [geothermal symbol] is relevant for geothermal