

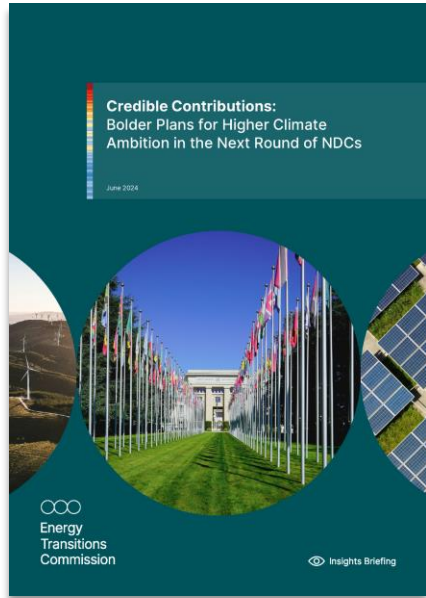


Energy
Transitions
Commission

Insights across our “Barriers to clean electrification” series

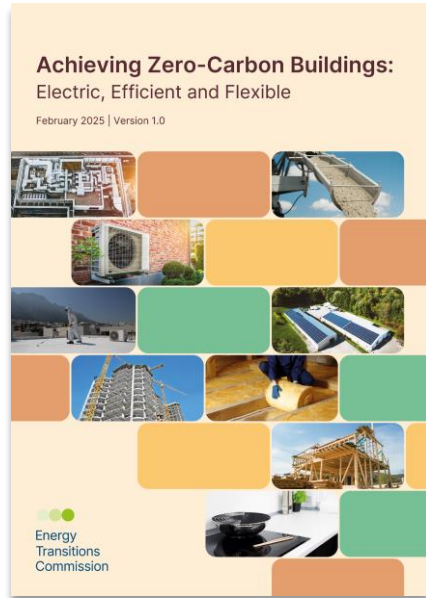
ETC Webinar
July 2025

The ETC's 2025 webinar series



February 13th

Credible Contributions: Bolder Plans for Higher Climate Ambition in the Next Round of NDCs



April 10th

Achieving Zero-Carbon Buildings: Electric, Efficient and Flexible



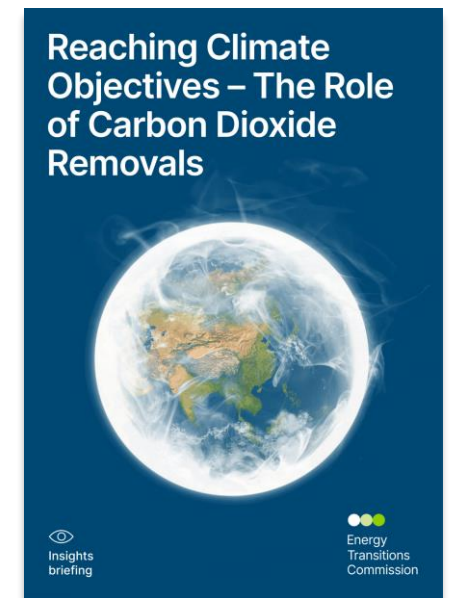
July 15th

Insights across our "Barriers to clean electrification" series



October 1st

The Role of Hydrogen & Bio energy



November 25th

Reaching Climate Objectives: the role of carbon dioxide removals



Agenda for today

1. Key messages from the ETC's *Barriers to Clean Electrification* series
2. Remarks from the OECD
3. Q&A



Context for the barriers series



ETC has evolved from successfully setting out the case for a scale up of the clean energy system, to how to transition faster

Phase 1 2017-2020

Is Net Zero feasible?
Describing a coherent mid-century vision



From 80% decarbonisation to 100%

Clean energy can decarbonise the last 20% of emissions at manageable costs.

Phase 2 2020-2022

How to achieve Net Zero?
Scaling the clean energy system of the future – technologies, regions, sectors



The clean energy system will be dominated by electrification, with roles for bio, H2, CCUS and CDR

Required technologies, system change, actions and policies, and costs.

Phase 3 2023-2025

How to transition faster?
Overcoming the barriers to clean electrification



Perceived blockers can and must be overcome

No fundamental barriers to the transition that cannot be overcome.

- ✓ Net-zero by mid-century now the accepted goal
- ✓ Visions for role of clean electricity consistently increasing
- ✓ Pathways for the hard-to-abate sectors now clear



Barriers to clean electrification – key messages



Streamlining Planning and Permitting – Key Messages

Putting into place simple measures to streamline planning and permitting can reduce wind and solar project development times by more than half

Key messages:

- **Long planning and permitting times are significantly holding some countries back** (i.e. UK, France); whilst others can build much quicker (i.e. China, Vietnam)
- Measures to overcome **regulatory** and **administrative challenges** and **build societal support** can significantly reduce project development times.


Report impact:

- **Guides governments and policymakers to accelerate** renewables deployment.
- **Support developers, local government and civil society to build societal support** and increase community and environmental benefits.




Streamlining planning and permitting can reduce project development times by more than half for wind and solar projects

Offshore wind $\div 2$



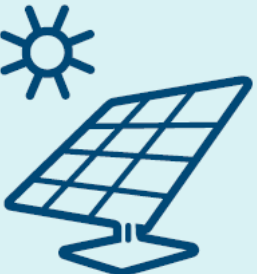
From a 12 year indicative timeline to a 5.5 year expedited timeline.

Onshore wind $\div 2$



From a 10 year indicative timeline to a 4.5 year expedited timeline.

Solar $\div 4$



From a 4 year indicative timeline to a 1 year expedited timeline.

- Expedited timelines assume that **social and environmental standards** for projects are **either maintained or strengthened**.
- To achieve maximum project time savings, it is likely that the **entire set of proposed solutions** would need to be implemented where these are not currently utilised in respective countries, and **more stages of project development** would need to be **conducted in parallel**.



Note: Project development time savings are illustrative examples for countries with strong democratic processes. Illustrative examples of good practice project development timelines have been indexed against: UK for offshore wind, Spain for onshore wind, France for utility-scale solar.

Several types of barriers contribute to slowing deployment rates



Regulatory

Lack of strategic vision

Lack of dedicated land

Complex regulation

Inflexible permits

Adverse legal system

Land ownership issues



Administrative

Multiple authorities in charge of permitting

Lack of capability and resources

Lack of digital permitting infrastructure

Lack of data aggregation



Societal support

Understanding scale up challenge

Protecting biodiversity

Local socio-economic concerns



Network availability

Network system capacity

Queues to connect to grid

Lack of strategic infrastructure planning

(Network availability will be the focus of a forthcoming briefing)



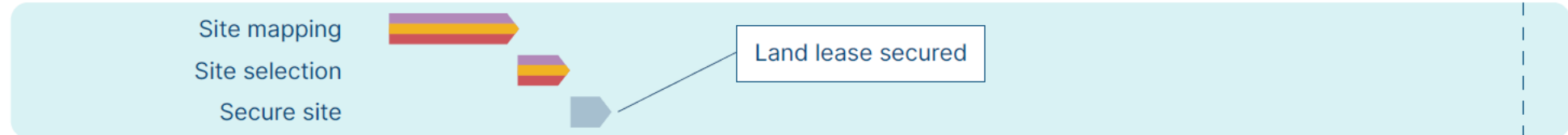
Onshore wind in Spain can take around 10 years of project development...

Onshore

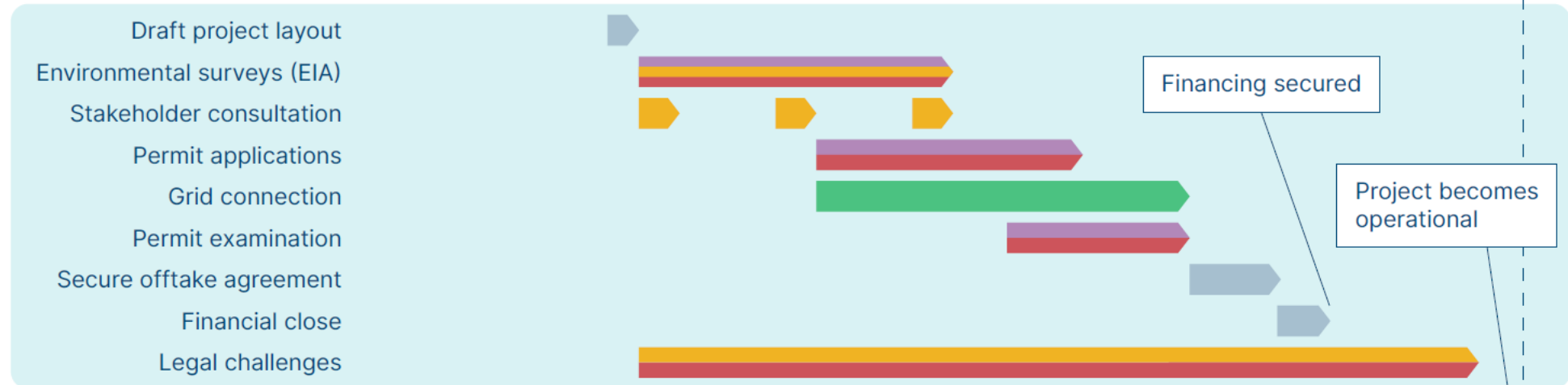
Renewable project development stages – illustrative example for onshore wind in Spain



Pre-development



Development



Construction



Years: 0 1 2 3 4 5 6 7 8 9 10

Key: Colours refer to barriers which slow down the pace of project development

Regulatory

Administrative

Societal support

Network availability

External factors



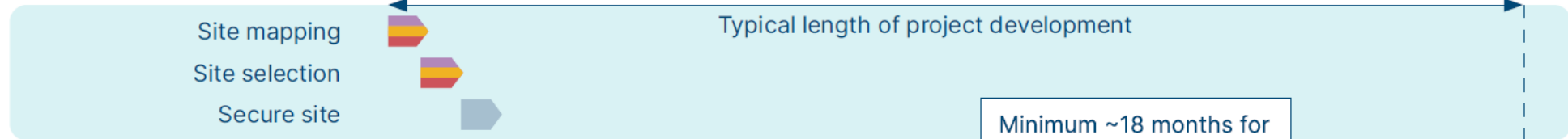
...Mitigating the key barriers can save over 5 years

Onshore

Renewable project development stages – illustrative example for expedited onshore wind farm deployment



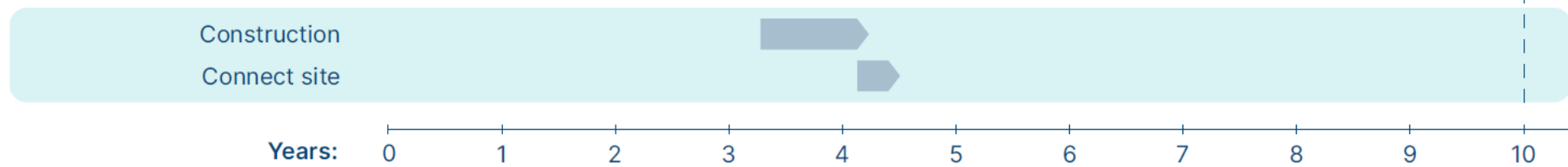
Pre-development



Development



Construction



Key: Colours refer to barriers which slow down the pace of project development

■ Regulatory	■ Societal support	■ External factors
■ Administrative	■ Network availability	



Action required in the short term, with a critical role for governments



- **National/regional governments and policymakers bear the largest responsibility for driving progress** given that they can unlock most regulatory and administrative barriers. They must take bold action by:
 - setting a strategic vision for the power system;
 - improving permitting processes and enforcement;
 - enabling better information and systems.
- In the short term, governments should prioritise solutions such as:
 - giving priority status to land available for wind and solar projects;
 - applying the “rule of positive silence” which automatically grants permit applications after a period of time has elapsed,
 - encouraging solar panel installations on all suitable public buildings,
 - and ensuring sufficient staffing within permitting departments.



- **Wind and solar developers** should use best-practice to deliver projects that minimise environmental and social impacts and work for local communities.



- **Local authorities and civil society** should increase community awareness of the energy transition and contribute to effective stakeholder engagement.



Clean Energy Technology Supply Chains – Key Messages

No fundamental barriers at a global level to scaling clean energy supply over the medium to long-term for the energy transition, short-term actions required to enable rapid scale-up

Key messages:

- Three cross-cutting risks exist in the short to medium-term:
 - **Scaling supply quickly** enough to meet rising demand
 - **Environmental and social impacts** of supply
 - **High geographic concentration**
- Growing clean energy manufacturing market presents an opportunity across all major regions – scaling clean energy supply chains is **not a zero-sum game**.

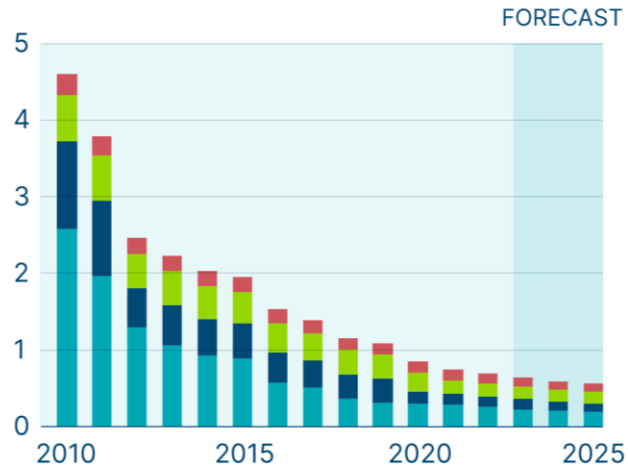
Report impact:

- The report calls for **strong business and industry action** to address short-medium term challenges
- Policymakers able to **acknowledge trade-offs** between a fast, low-cost energy transition, and near-shoring objectives.



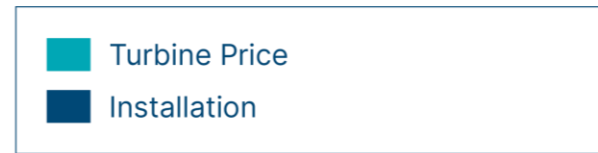
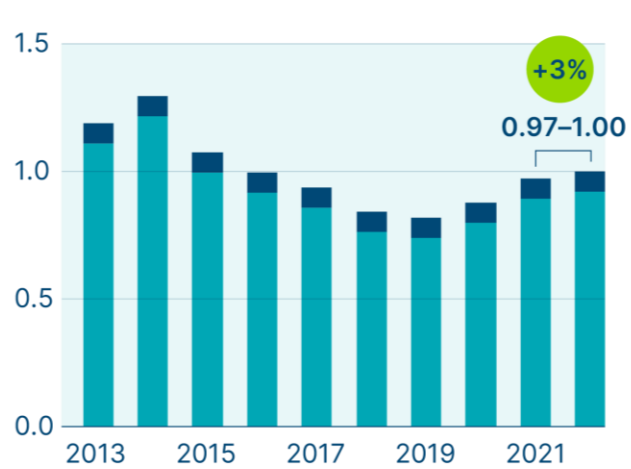
In recent years disruption in global supply chains has led to price rises for wind and batteries

Solar PV capex benchmark
2022 \$/W(DC)



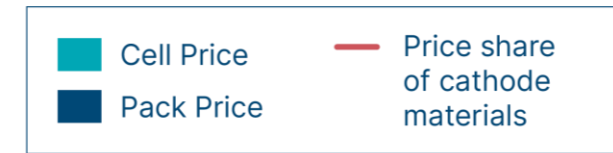
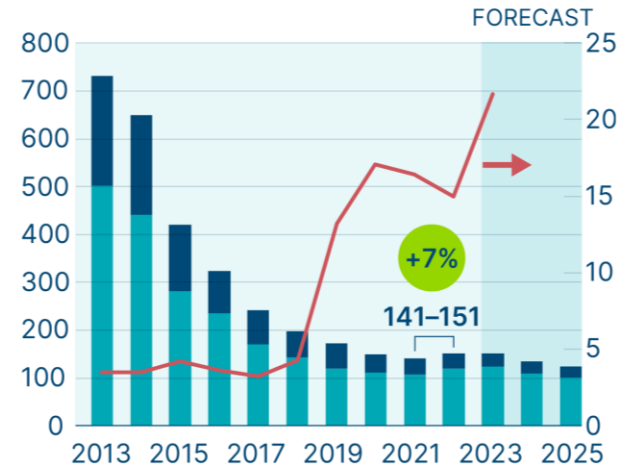
Solar: slowing of price reductions in 2022 due to tight supply for polysilicon and increased freight costs, alongside higher commodity prices, but expected to keep falling from 2023.

Wind turbine price by signing date
2022 \$m/MW



Wind: cost increases driven by increasing prices of copper, aluminium and steel from 2020 onwards, alongside higher freight and shipping costs; however, **prices have been falling in China.**

Li-ion battery survey price
2022 \$/kWh (LHS); % of total price (RHS)



Batteries: first-ever price rises in 2022 as prices of cathode materials (Li, Ni, Co) have risen sharply in past year; will take several years to recover to previous trend.



Three cross-cutting risks pose challenges over the short-to-mid term

1

While sufficient mineral and metal resources are available globally, issues around scaling supply at a fast enough pace to meet demand could be a problem for some raw materials, in particular lithium and copper, and for **complex components** within supply chains.

2

Supply chains for solar PV and battery manufacturing are highly concentrated geographically at several stages. Future growth expectations for these markets means that clean energy manufacturing is not a 'zero-sum game'.

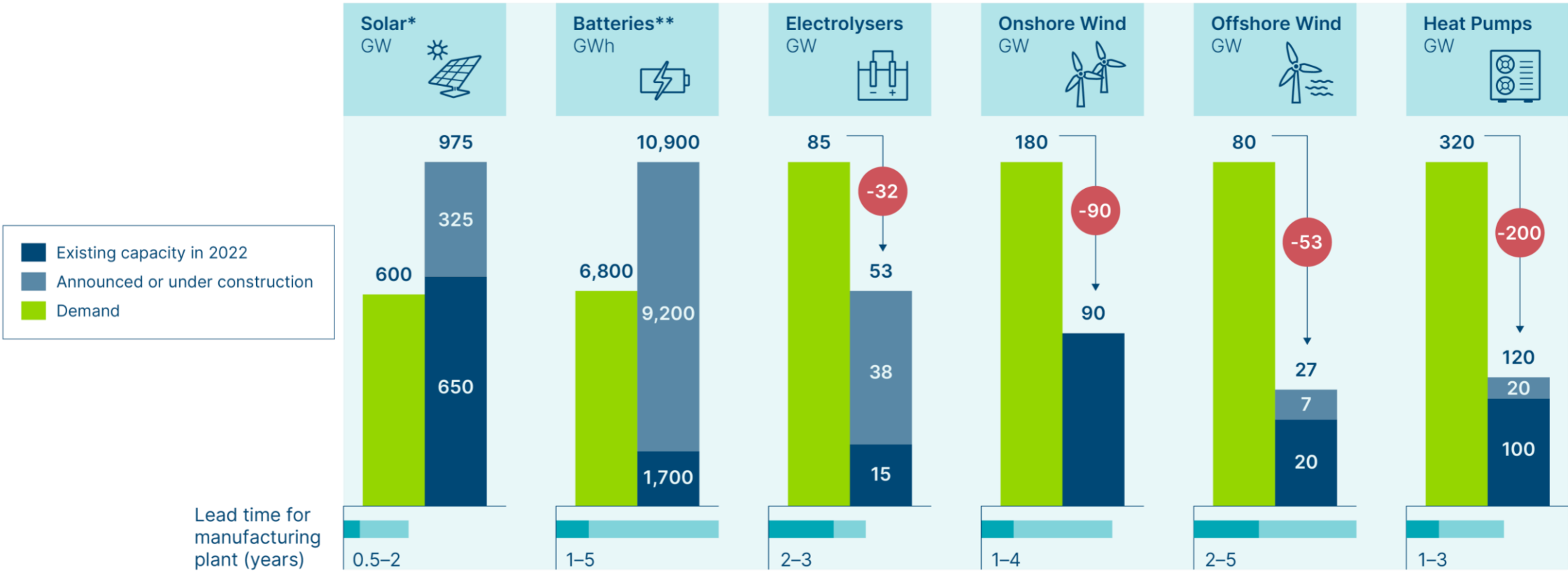
3

There are some wider environmental and social concerns around materials and mining, such as around labour and human rights, carbon, and other local resources, that need to be addressed appropriately.



Short manufacturing lead times mean that, at a global scale, manufacturing and assembly of clean energy technologies should be able to scale to meet deployment

Share of existing, announced and remaining gap to 2030 in manufacturing capacity for clean energy technologies
GW / GWh



*Solar PV installations could significantly exceed 600 GW p.a. in 2030, and therefore the total manufacturing capacity of ~975 GW p.a. should not necessarily be seen as drastic overcapacity

**Not all announced battery capacity is likely to be constructed

Source: ETC (2021), Making clean electrification possible; ETC (2021), Making the hydrogen economy possible; BNEF (2023) – Interactive data tool; BNEF (2022), Global electrolyzer outlook 2030; IEA (2023), Energy technology perspectives; IEA (2022), The future of heat pumps



Supply chains for complex equipment or components could face short-term delays

Offshore Wind Installation Vessels



- Offshore wind projects can require multiple **vessels to carry out transport and installation**.
- Wind **turbines keep increasing in size**, with spans over 250 metres – vessel builders unsure about future vessel requirements.
- Potential **shortages of installation vessels beyond 2025 could hold back ~35 GW** of offshore wind.

High-Power Grid Transformers



- High-power, large-scale transformers are **highly specialised, complex components** – often very labour-intensive.
- Seeing **rising costs and longer lead times**, especially in the US.
- Further potential constraints from **regulation of use of F-gases** in transformers, exacerbating shortages.

Battery Cathode Materials



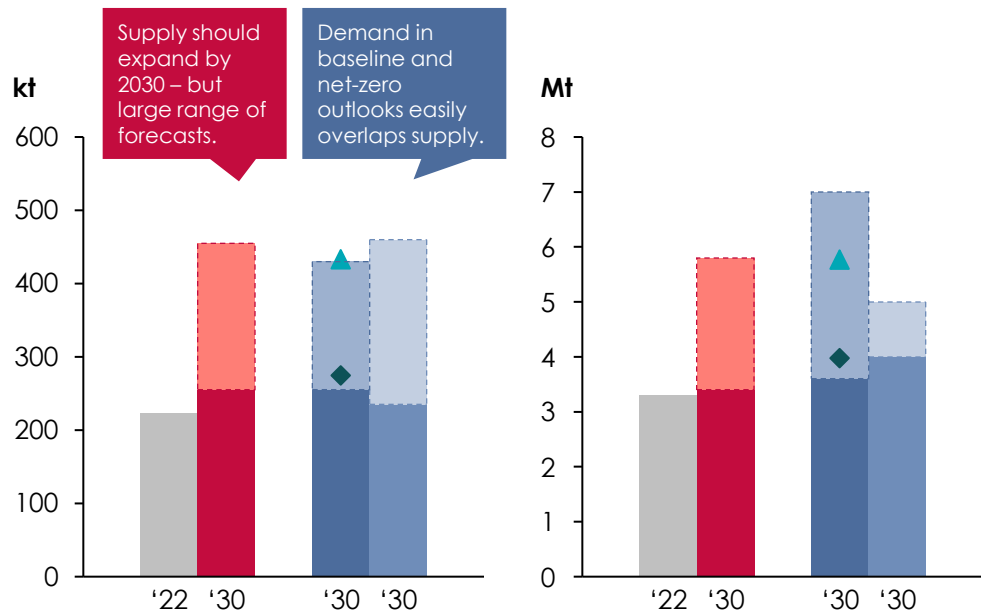
- Capacity could be constrained by lack of refined materials – **highest risk is for class 1 nickel**.
- Building new manufacturing capacity requires **high-specification equipment** (e.g. kilns), can risk delays.
- Building up manufacturing capacity in Europe or N. America from very low base: **lack of experience of building and operating complex plants**.

Delays or high prices could materialise – but these would likely be resolved over short term (1-3 years), so do not pose a fundamental risk to energy transition

The short-term challenge: Estimated supply growth for key materials could be insufficient to meet rapidly rising demand by 2030

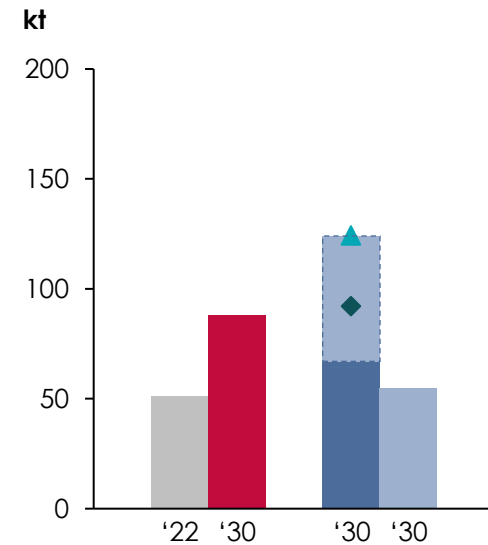
Demand and supply forecasts for key energy transition materials in 2030

Nickel, Copper = Million metric tonnes; Cobalt, Lithium, Neodymium = Thousand metric tonnes;



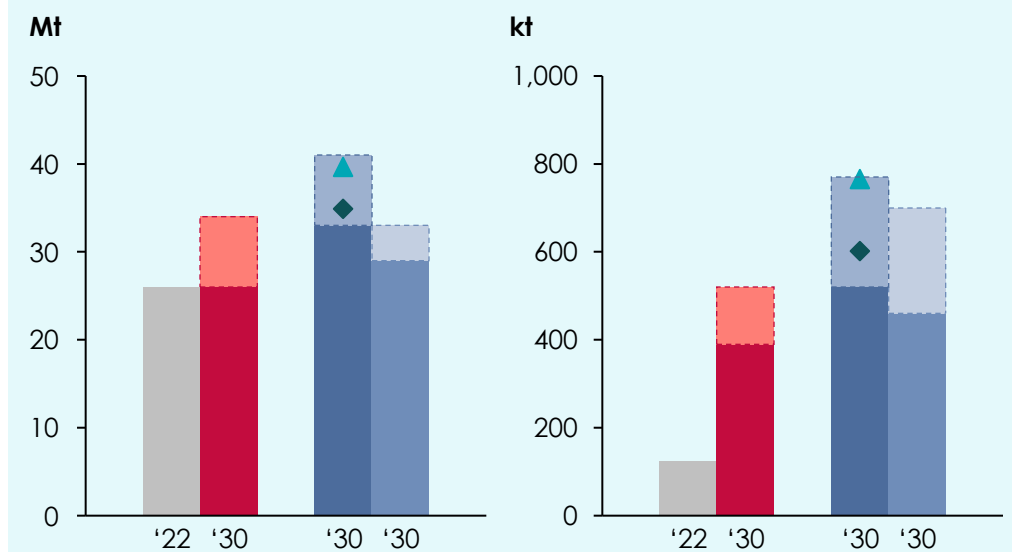
- Cobalt**
- Demand forecasts falling sharply after shift to low-cobalt NMC.
 - Some uncertainty over stability of DRC supply.

- Nickel**
- Rapid supply expansion in Indonesia.
 - Can shift to LFP batteries to reduce demand



- Neodymium**
- Rising but uncertain demand growth from wind + BEVs.
 - Supply can respond to high prices quickly.

Even with supply expansions, future demand growth for copper and lithium would exceed supply in 2030



- Copper**
- Used in all clean energy technologies, demand difficult to substitute.
 - Supply expansion tricky due to ore grades, low investment.

- Lithium**
- No viable substitution across battery chemistries at the moment.
 - Supply expanding but not quickly enough - gaps likely through to 2030.

2022 Supply
 2030 - Supply
 2030 - ETC Demand, Baseline
 2030 - ETC Demand, With Max. Efficiency and Recycling
 2030 - Net-Zero Demand
 2030 - Baseline Demand

Ranges

Source: Systemiq analysis for the ETC; IEA (2023), *Energy technology perspectives* and IEA (2022), *World Energy Investments*; BNEF (2023), *Transition Metals Outlook*; ICF/RMI (2023), *Net zero roadmap to 2050 for copper & nickel mining value chains*; S&P Global (2022), *The future of copper*; &P Global Market Intelligence (2022), *Lithium project pipeline insufficient to meet looming major deficit*; Benchmark Mineral Intelligence (2023), *Albemarle's turbo-charged demand data showcases lithium's growing supply problem*; Albemarle (2023), *Strategic update*; McKinsey & Co. (2023), *Bridging the copper supply gap*; McKinsey & Co. (2022), *Lithium mining: How new production technologies could fuel the global EV revolution*

High-level recommendations for governments and industry

Fundamental driver: a strategic vision for the energy transition, including net-zero targets, supporting sectoral targets (e.g. GW capacity deployment, ICE phase out ban dates), policies that send clear signals on the pace and scale of clean energy deployment, and clear volume needs (e.g. copper Mt).

1

Addressing supply-demand imbalances

- *Demand*: Accelerate improvements in **materials and technology efficiency** through targeted incentives and research and development, as well as support for circular economy business models.
- *Demand*: Create economic incentives for **scaling recycling** and the secondary supply of critical materials
- *Supply*: Accelerate permitting, expand and de-risk investments, and engage with local communities to **expand supply from the mine site to manufacturing**.
- International **engagement and data sharing** to understand demand and supply forecasts and potential constraints and increase transparency, e.g. via IEA outlooks and round-tables with governments and industry.

2

Developing sustainable and responsible supply chains

- **Strong regulations on environmental impacts** of clean energy technologies, starting with **carbon intensity**. Aim to decarbonise and decrease impacts at the mine site and throughout manufacturing value chains, by driving clean energy procurement, increased process efficiency and best-practise environmental standards.
- **Use purchasing power to drive projects** with high environmental and social standards.
- **Define and adopt high-quality voluntary** environment and social standards.
- **Improve and require supply chain traceability** through industry-wide engagement and trusted third-party auditors.

3

Ensuring diversified, resilient and secure supply

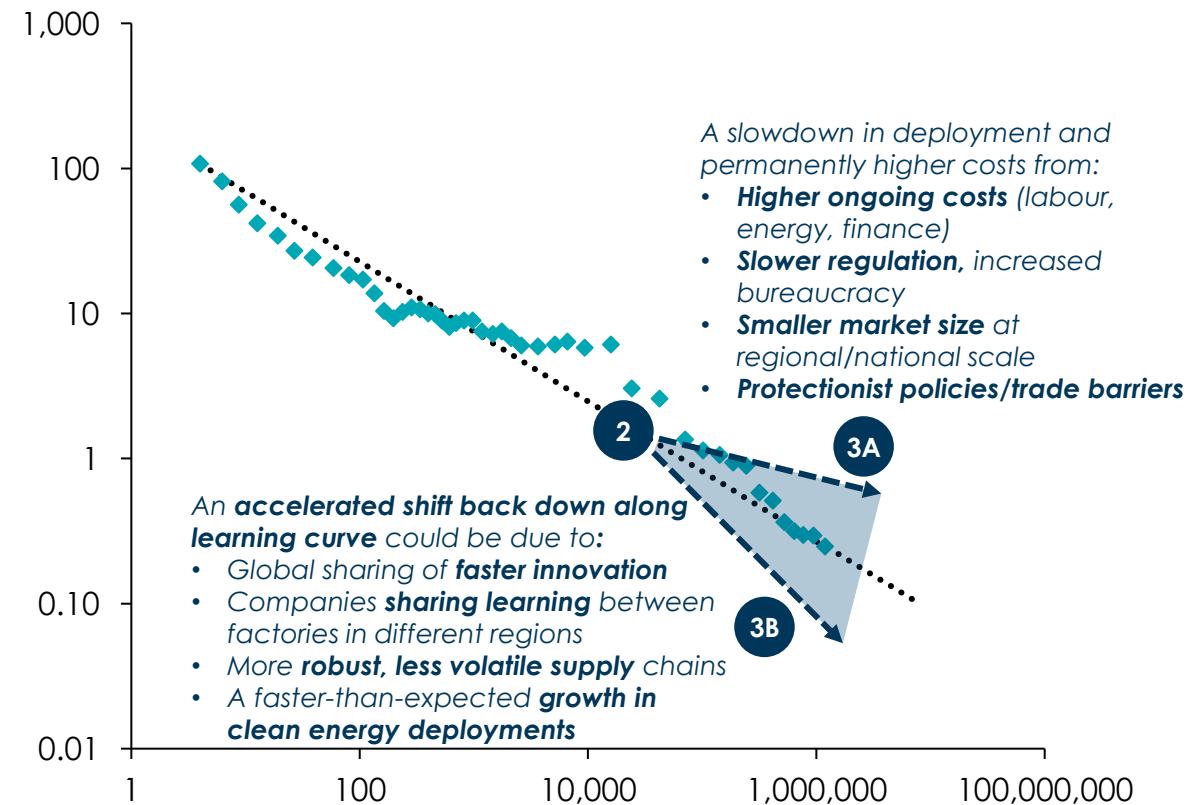
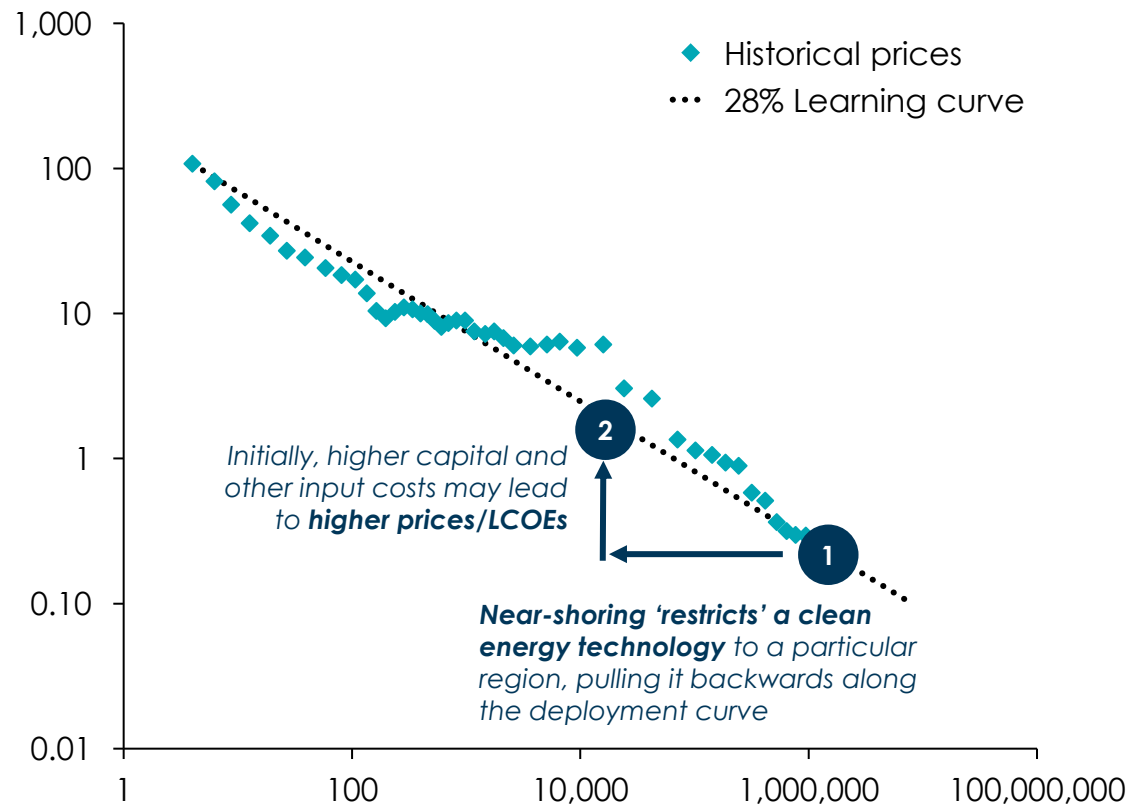
- **Adopt strategies to diversify supply** for mining, refining and manufacturing:
 - This can include friend-shoring, signing joint ventures and off-taker agreements, and agreeing strategic partnerships with key companies and countries.
 - **Focus action on location of production**, not ownership – to allow strong competition across markets.
- **Where near-shoring is assessed as strategically beneficial**, develop a suite of actions to **maximise benefits of near-shoring** of value chains, including alignment of near-shored industries with domestic growth areas.



Near-shoring would lead to higher costs, moving back and up the learning curve; but a mix of policy and market dynamics could bring rapid cost declines after a few years

Solar Example: Initially, near-shoring dynamics can be seen as moving back and up a clean energy technology 'learning curve', and a range of factors will influence how costs come down in future years

Solar learning curve: US\$/W (Y-axis); MW (X-axis)



Source: BNEF (2022), 4Q Global PV market outlook; Helveston et al. (2021) Quantifying the cost savings of global solar photovoltaic supply chains; Way et al. (2022) Empiricallygrounded technology forecasts and the energy transition

Overcoming Offshore Wind Turbulence – Key Messages

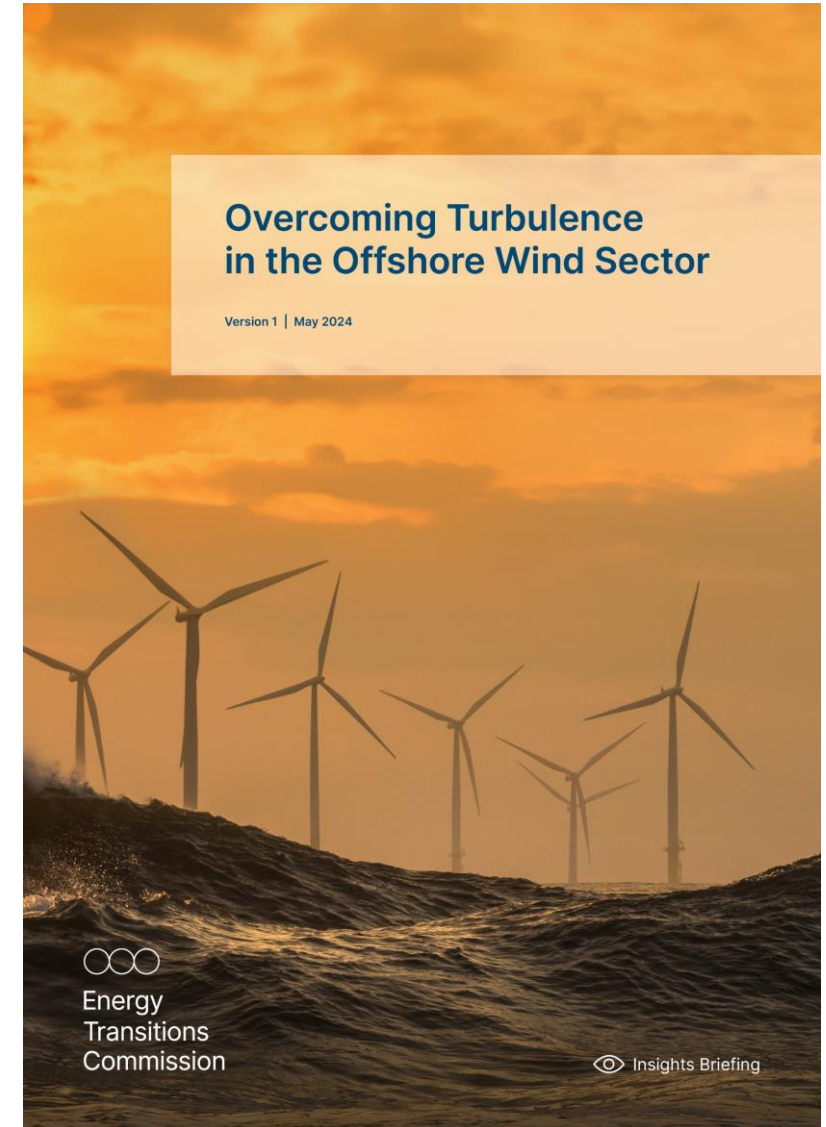
Governments and the offshore wind industry must join forces to restore confidence in the market, drive down costs and accelerate the clean energy transition

Key messages:

- Offshore wind is **already delivering large-scale clean electricity** at a competitive cost around the world...
- But in 2022-2023, inflation, supply chain bottlenecks and higher interest rates led to **rising offshore wind costs** in most markets
- While increases were significant, they're mostly expected to be **short-term**

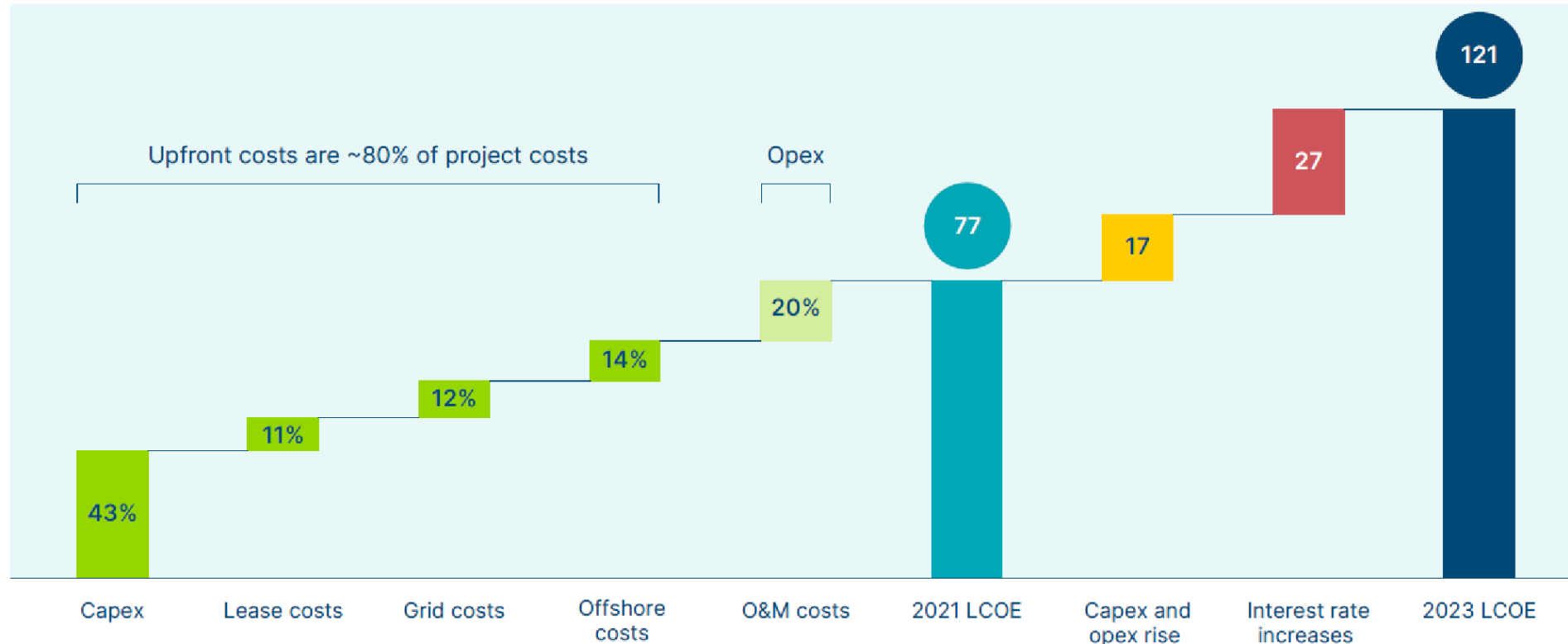
Report impact:

- **Guides governments and industry to closely collaborate** to relaunch confidence in offshore wind markets and bring down costs
- **Promotes setting ambitious targets, reducing risks of non-delivery, streamlining planning and permitting, achieving economies of scale and addressing supply chain bottlenecks** to achieve aim



In the US, offshore wind costs increased 60% from 2021 to 2023

US offshore wind LCOE progression from 2021–2023
\$/MWh, nominal prices



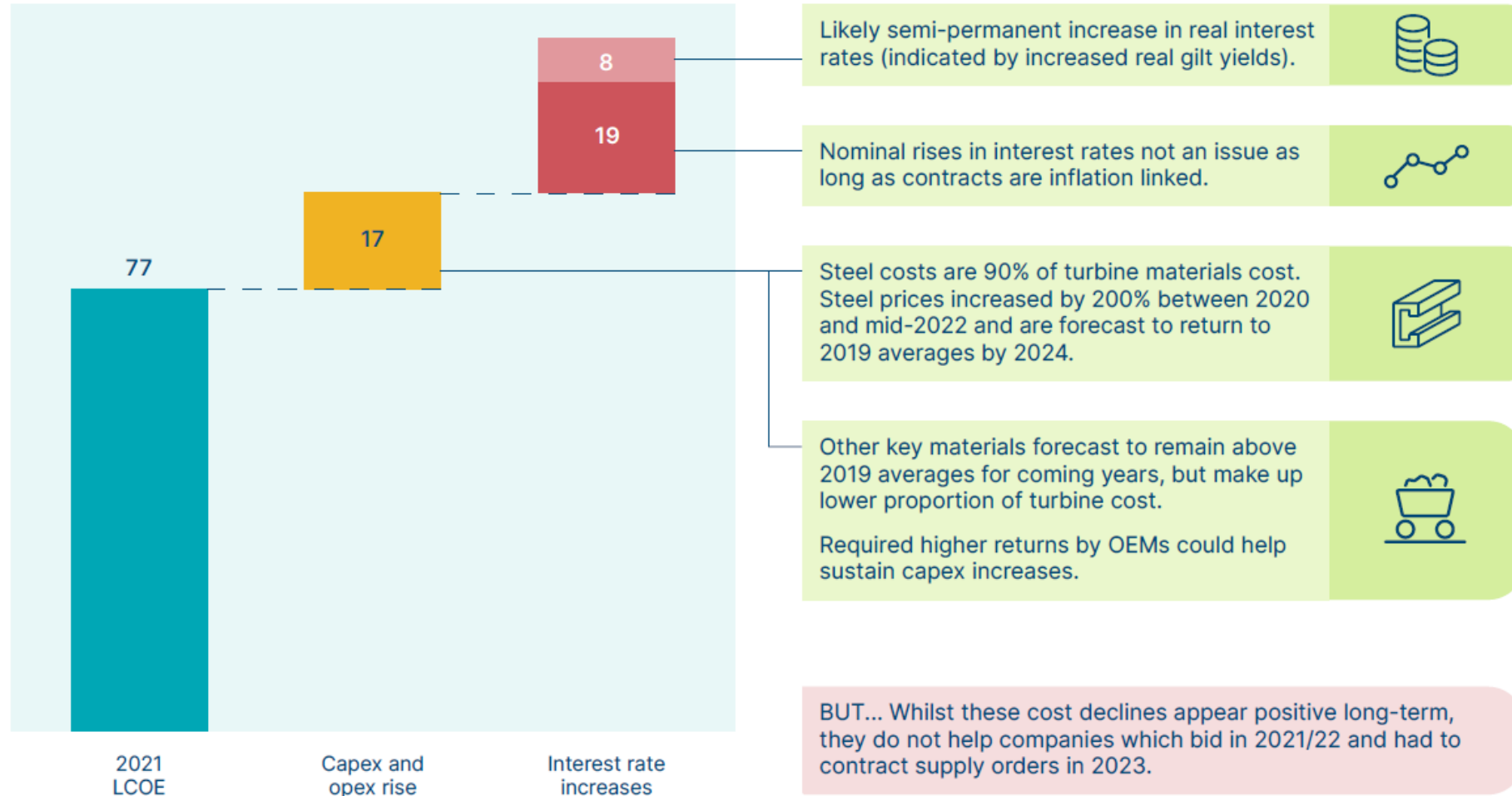
Source: US Department of Energy (2022), *Offshore Wind Market Report: 2022 Edition*; BNEF (2023), *The \$49 Million Fine That May End More US Wind Deals*.

Notes: 2021 LCOE assumes a 30% inflation tax credit, without this cost would be ~\$100/MWh; the US have recently increased their inflation tax credit to 40%, which is excluded here for ease of reference, this would reduce 2023 LCOE by \$7/MWh.



The largest cost increases will prove temporary, but somewhat higher prices could persist over the medium term

US offshore wind LCOE progression from 2021–2023
\$/MWh, 2021 nominal prices

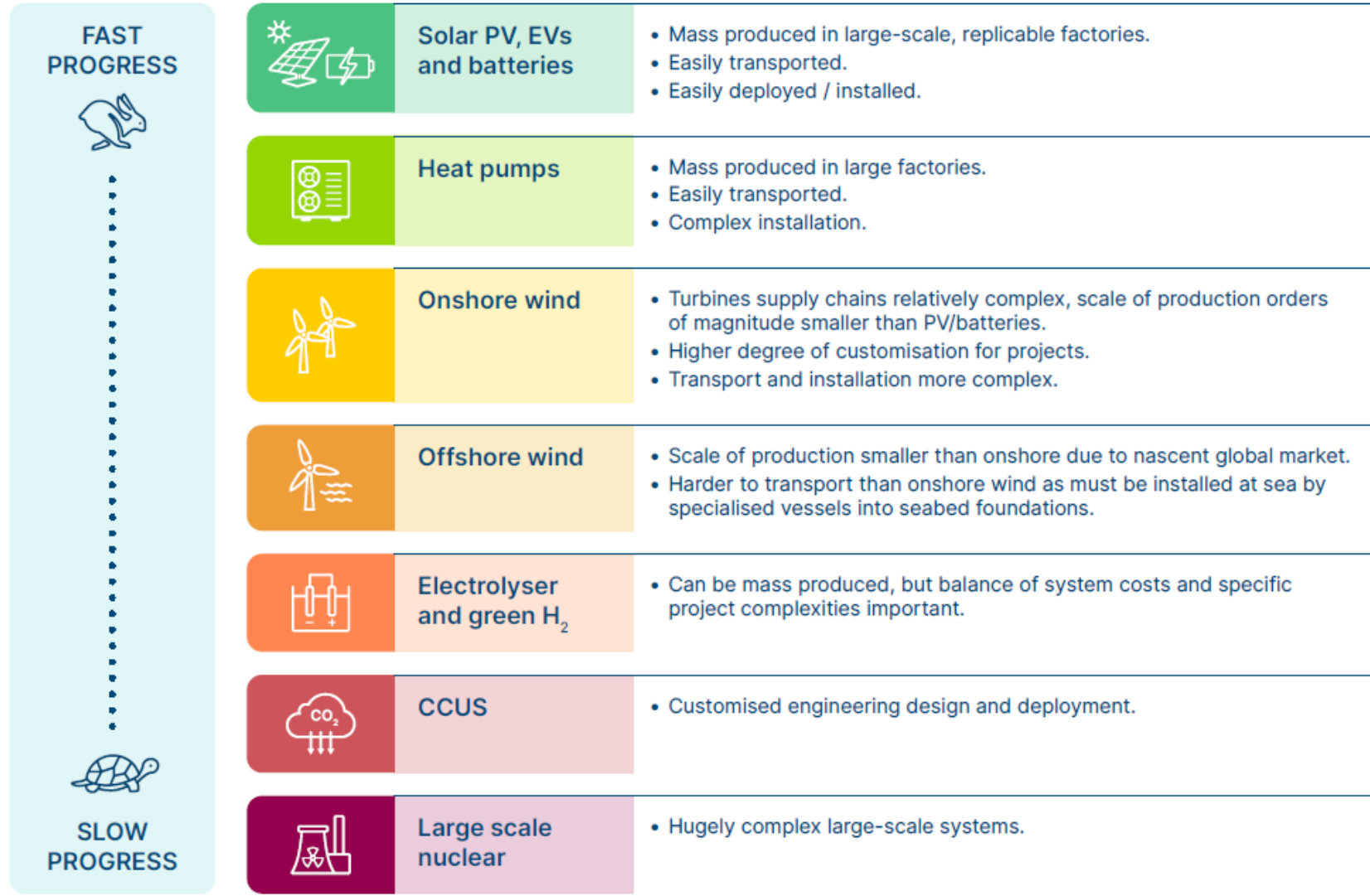


Source: Systemiq analysis for the ETC; BNEF (2023), *The \$49 Million Fine That May End More US Wind Deals*; BNEF (2023), *Transition metals outlook*; BNEF (2023), *Industrial Metals Outlook 2H 2023: Heading Into the Storm*.

Note: Real cost effects estimated by modelling a 2% real interest rate rise, from 5% to 7% based on a project cost of \$1.8 bn for a 1 GW wind farm with 30% equity, 70% debt. Nominal increases are the net of BNEF interest rate increases minus the real effect.



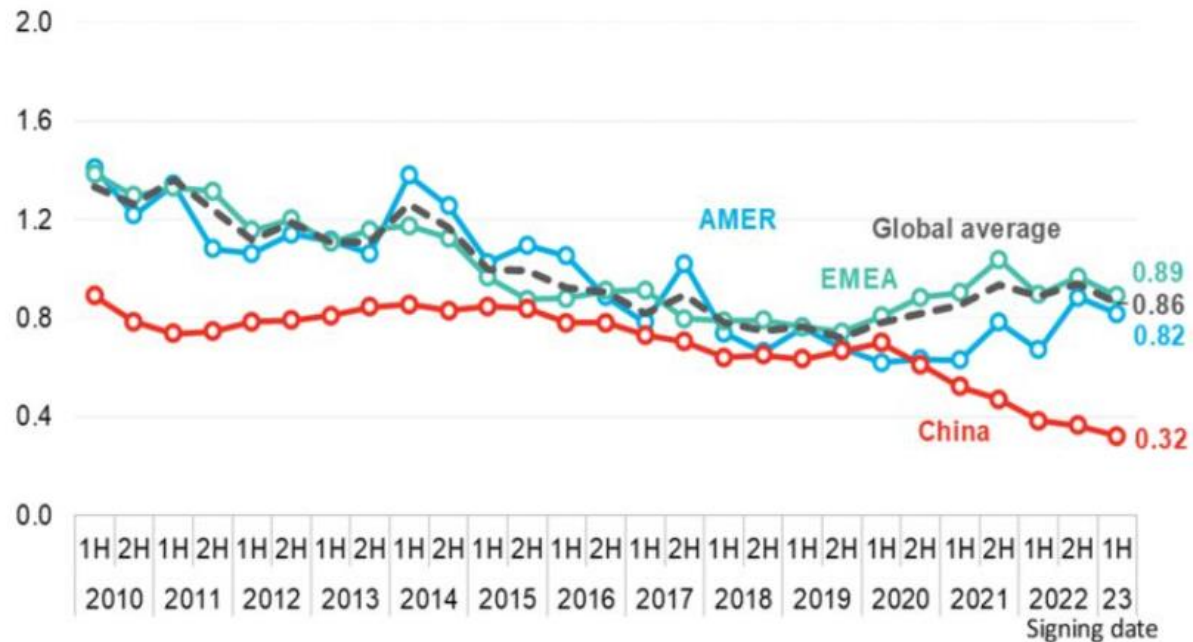
Technologies which are reducing in cost fastest are those most susceptible to mass production and easy deployment



China demonstrates that further cost declines are possible, as turbine prices have continued to get cheaper despite rising costs elsewhere

Turbine prices in China have decreased in recent years






\$ million/MW, nominal 2023



- Turbine prices in most **Western markets have increased since 2020**, whilst Chinese turbines have decreased by **over 50%**.
- Falling costs have been driven through **ambitious national targets** for offshore wind deployment, which enabled China to **standardise** and benefit from **increased efficiencies** and **economies of scale**.
- China also offers the largest turbines in the world, with 3 companies offering **16-18 MW** turbines.



Five key recommendations to relaunch the confidence cycle and drive down costs

Key recommendation	Specific examples	Why?
<p>1</p> <p>Strategic planning, targets and constant flow of auctions.</p> 	<ul style="list-style-type: none"> • Set strategic GW targets, as part of integrated strategic vision of the power system (i.e. German 30 GW by 2030 target). • Maintain clear schedule of auctions (annual auctions to be used where possible). • Host dedicated auctions to address gaps in generation profiles, either by technology (e.g., offshore/floating wind) or for delivery in specific time blocks or times of year. 	<ul style="list-style-type: none"> • Provides certainty that the scale of the overall business will be large. • Firms can invest with confidence that there will be a large offshore wind market beyond 2030.
<p>2</p> <p>Contract and auction design to incentivise completion and removal of optionality.</p> 	<ul style="list-style-type: none"> • Implement inflation adjustment mechanism(s) and ensure any price caps set are responsive to market dynamics. • Remove optionality from government-backed contracts, limiting developer option to cancel or pull out, accepting somewhat higher prices. • Ensure auction design optimises for long term systems benefits, as opposed to short-term tax revenues for governments. 	<ul style="list-style-type: none"> • Reduces risk of sudden setbacks to volume (i.e. as seen in the US). • Increases confidence contracts lead to quick supply chain orders.
<p>3</p> <p>Streamline planning, permitting, and grid connection processes; and reinforce power grid.</p> 	<ul style="list-style-type: none"> • Streamline planning and permitting (taking actions to address regulatory, administrative & societal support challenges). • Reinforce transmission networks to enable increased offshore wind deployment. • Accelerate grid connection processes. 	<ul style="list-style-type: none"> • Ensures more rapid translation of auctions into orders. • Reduces uncertainty which comes with the long length of time under permitting.
<p>4</p> <p>Encourage harmonisation of turbine components and sizes</p> 	<ul style="list-style-type: none"> • Explore harmonising regulation and non-price criteria across regional markets where possible. • Consider developing guidelines on turbine heights together with industry and supply chain. 	<ul style="list-style-type: none"> • Enables benefits from economies of scale. • Provides clearer signals to supply chain to scale for a given size of turbine.
<p>5</p> <p>Address specific supply chain bottlenecks</p> 	<ul style="list-style-type: none"> • Take targeted action to address critical supply chains gaps (e.g. coordination to ensure transport system is equipped to move turbines across country). • Balance local content requirements with required pace and cost of deployment. 	<ul style="list-style-type: none"> • Ensures specific bottlenecks do not disrupt the overall development process. • Provides more confidence to other areas of the supply chain.



Building Grids Faster – Key Messages

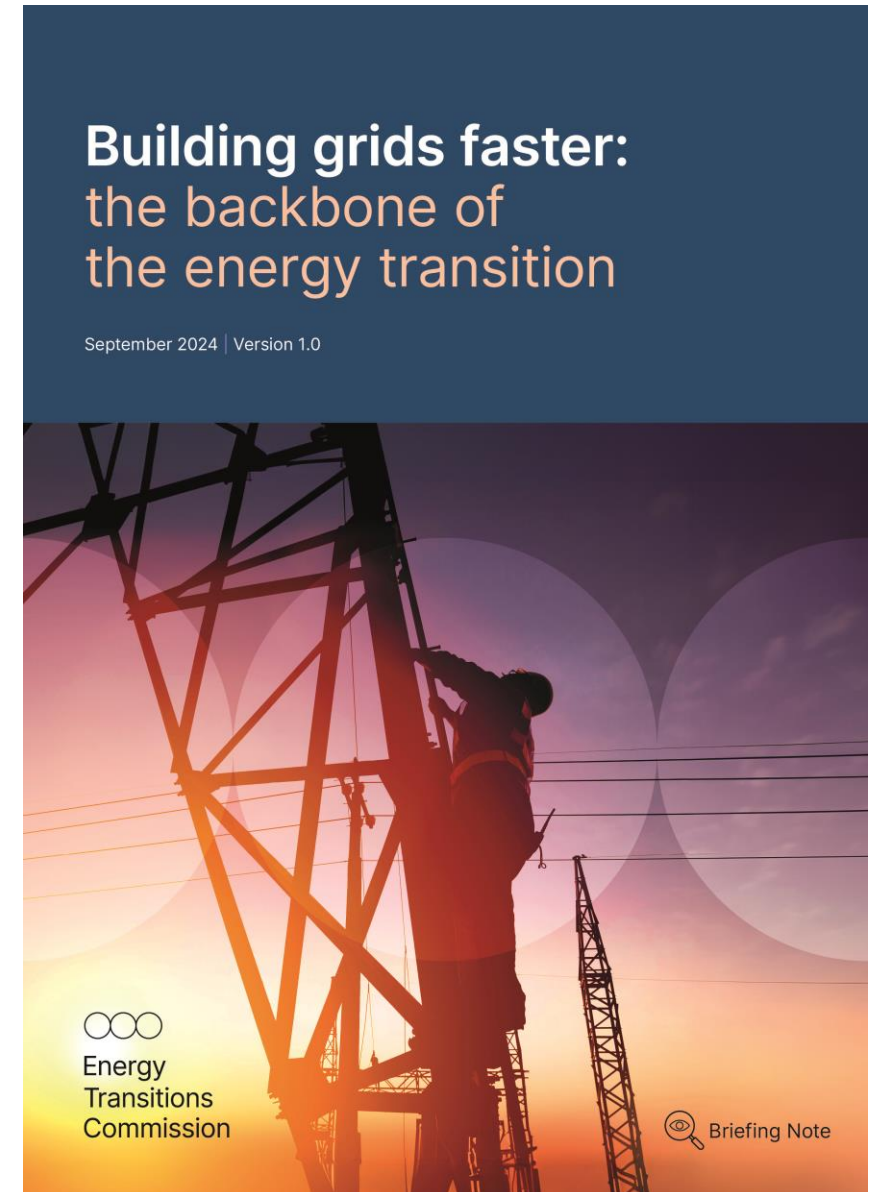
Policymakers and industry must fast-track building grids to deliver the energy transition at the pace and scale required

Key messages:

- Electricity supply and demand will increase rapidly towards 2050, and **grids must build out faster** to meet this
- **Grid build in most developed countries (i.e. US, Europe) has been slowing** in recent years, whilst **some developing countries (i.e. China, India) are building at pace**
- **Delaying grid build will slow renewables deployment** and delay emissions savings, these delays can be avoided

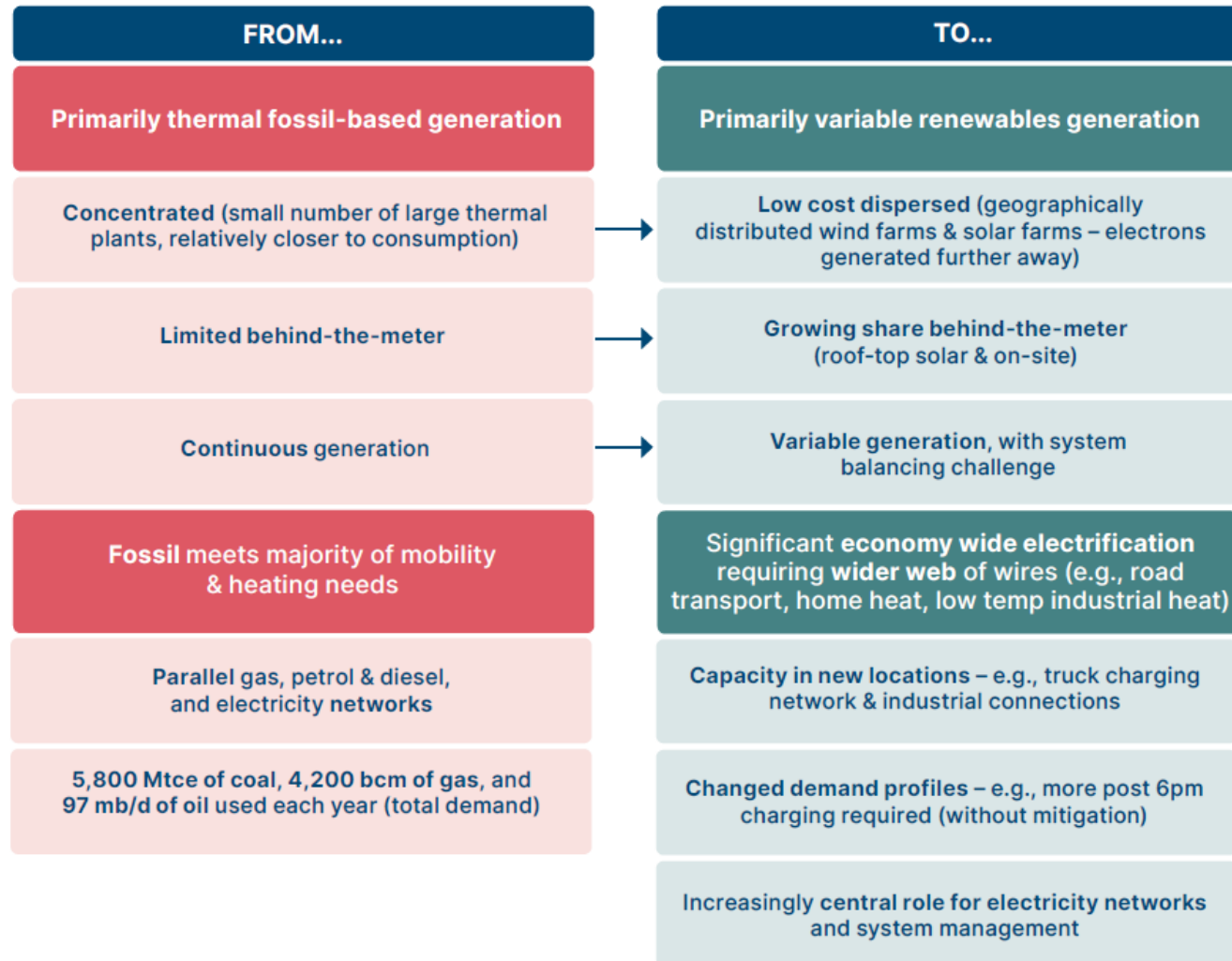
Report impact:

- **Calls on policymakers and industry to take action to fast-track the grid build** and deliver the transition at the pace and scale required.
- Outlines required actions across: **Strategic vision; Slow permitting and approvals; Skills, components and materials gaps; Access to finance**



Moving to highly-electrified power systems requires a much wider web of wires

Key features of power systems

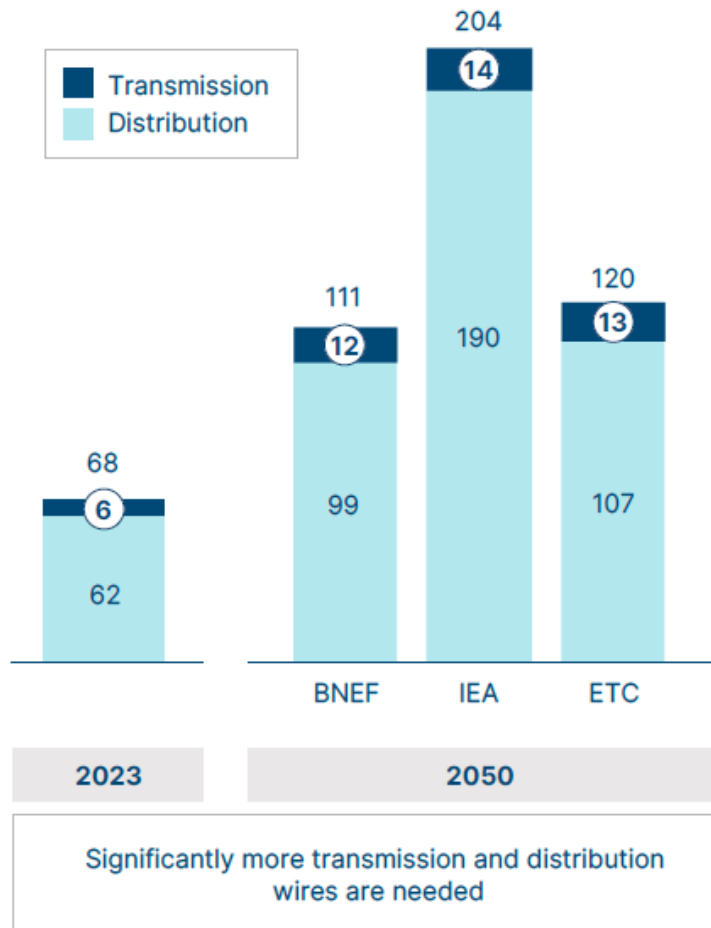


Source: Systemiq analysis for the ETC.

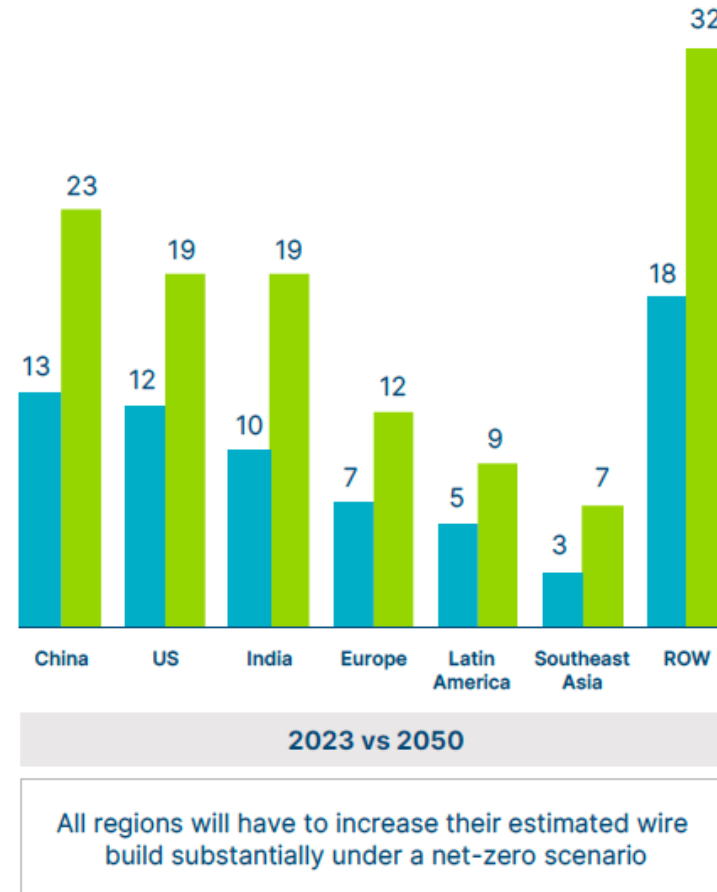


Network build will have to increase dramatically across regions

Estimated wires required under various assumptions
Million km



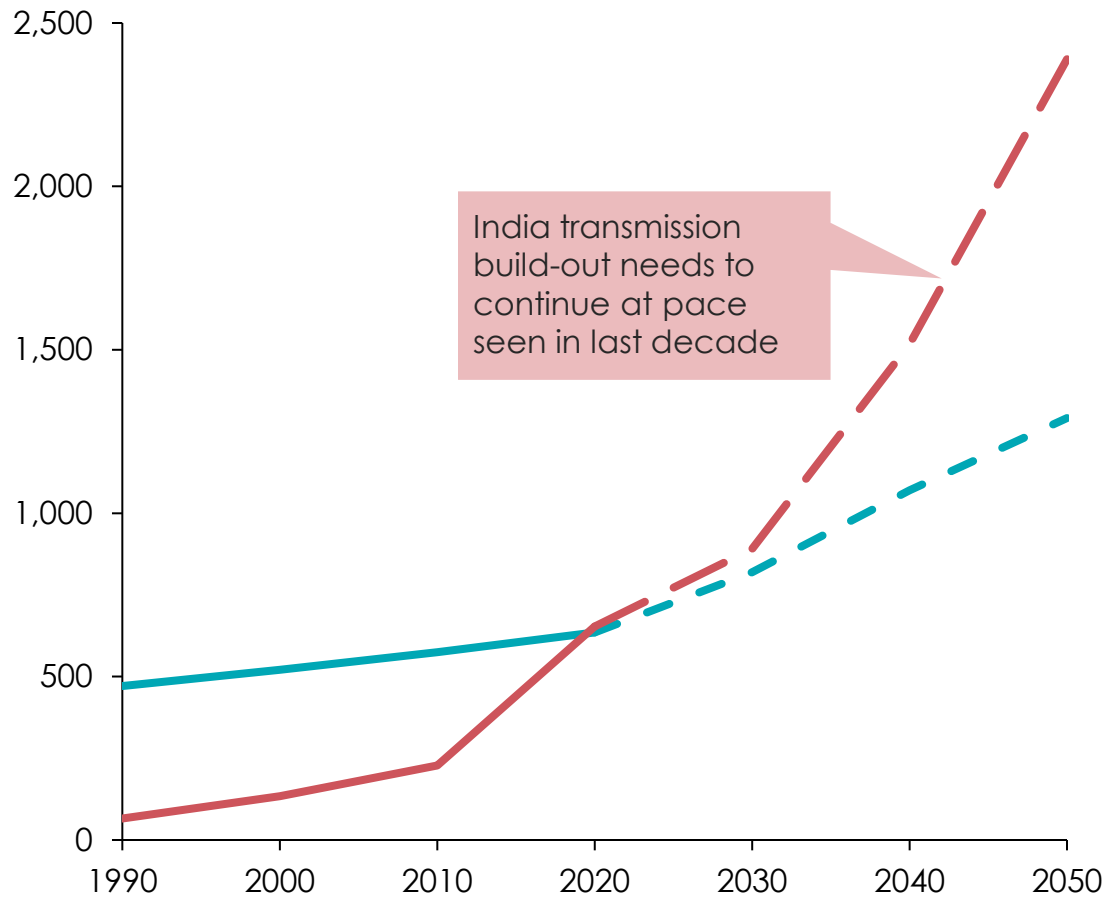
Estimated wires required from 2023 to 2050
Million km



Grid growth in many developed markets (US, Europe) has been very slow for decades, whilst others (India, China) are building at record pace

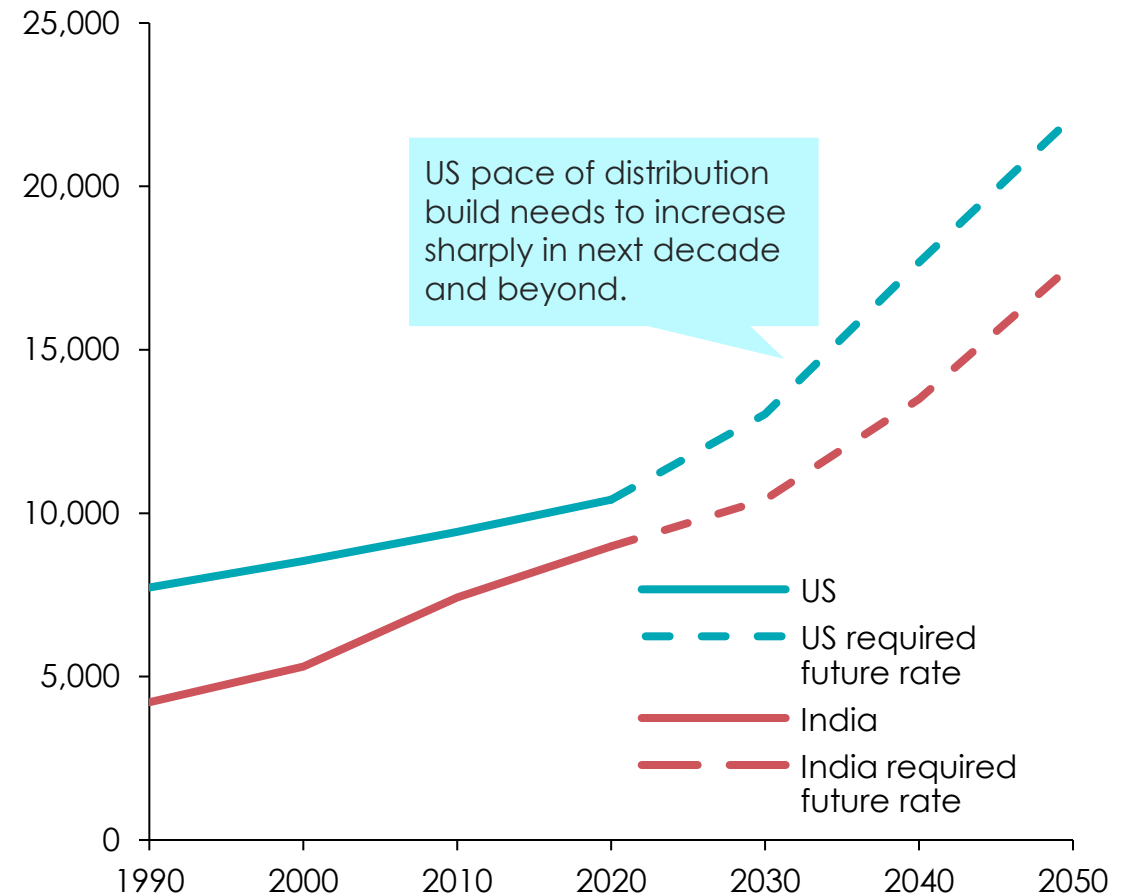
Historical and forecast transmission build rate, US and India

Thousand km of wires



Historical and forecast distribution build rate, US and India

Thousand km of wires

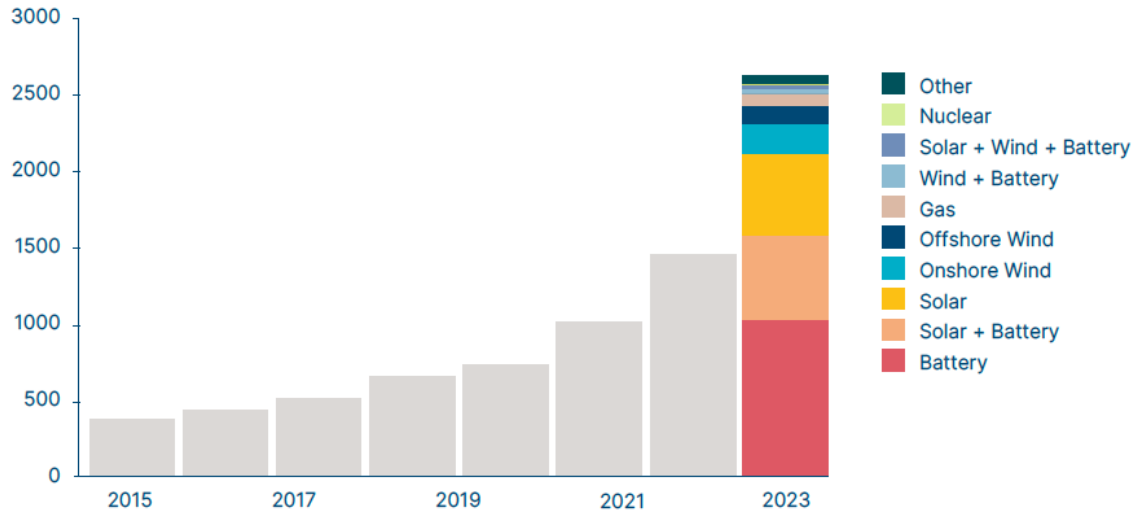


Notes: US historical build rate calculated on assumption of 1% grid growth in transmission and distribution per year from 1990 – 2022; Princeton modelling outlines that from 2013 to 2020 transmission lines have expanded at only 1% per year. Source: BNEF (2021) Power Grid Long Term Outlook 2021; BNEF (2023) New Energy Outlook Grids; Princeton Zero Lab (2022) Preview: Final REPEAT Project Findings on the Emissions Impacts of the Inflation Reduction Act and Infrastructure Investment and Jobs Act

Low grid build is leading to long wait times for renewable generation to connect & high congestion payments

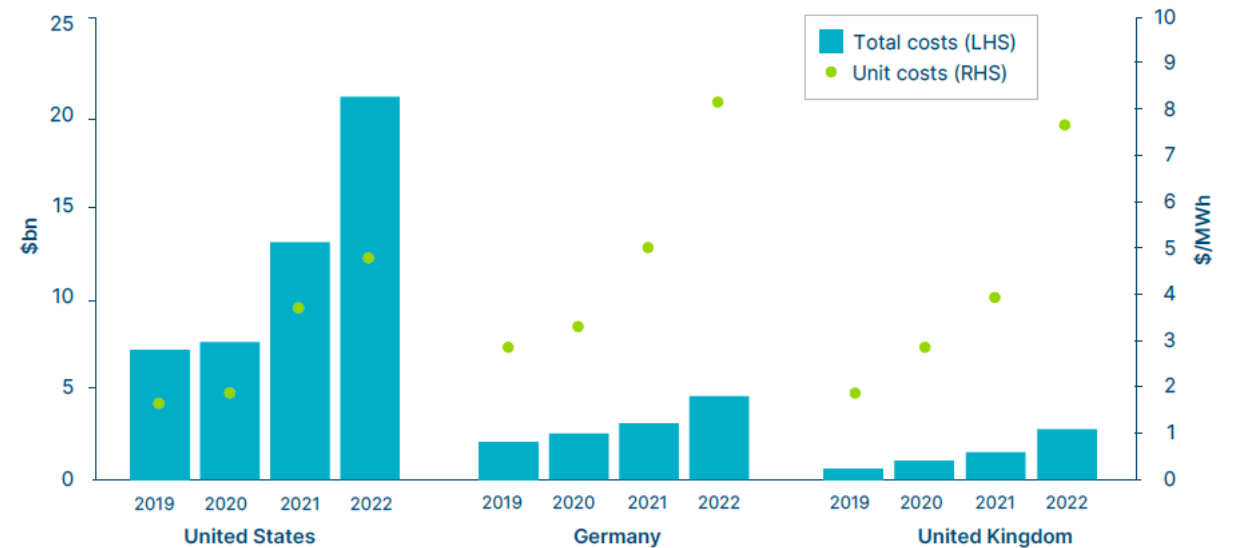
US grid connection queue sizes (2015-2023)

GW



Annual transmission grid congestion estimates in select regions

\$bn and \$/MWh



Projects in queues are growing, in 2023 the US had 1450 GW of wind and solar capacity in queue (equal to ~50% current global W&S capacity)

Lack of grid connection is causing congestion power systems, with associated costs totalling in billions for some regions



Delivering the transition at pace and scale requires accelerating grid build and optimisation. Policymakers must take action across four critical areas

		Greatest relevance		
		Tx	Dx	Ix
i. Implement a strategic vision for network expansion by a future date	Ensuring grid plans are: <ul style="list-style-type: none"> Aligned with decarbonisation targets and planning horizons. Integrated with plans for generation siting. Developed across as wide a geographic area as possible (e.g., across regions, countries). Targeted to develop a coordinated expansion approach for distribution networks. 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ii. Address slow permitting & approvals and societal acceptance	<ul style="list-style-type: none"> Regulatory and legislative reform to address regulatory and administrative blockages (e.g., slow consenting, multiple authorities in charge/lack of resources). Improve societal support via actions to increase community buy-in and reduce opposition. 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
iii. Address skill, component and materials gaps	Rapidly and sustainably scale up supply and coordination across key stakeholders for: <ul style="list-style-type: none"> Specific materials, such as copper. Specific components, such as transformers, subsea cables, and cable-laying vessels. Skills, particular for linesmen; power engineers; planners etc. 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
iv. Reform financing structures & increase access to finance	<ul style="list-style-type: none"> Reform existing investment approach to enable anticipatory investment ahead of need. Improve routes to provide sufficient financing for grid assets in developing countries. 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>



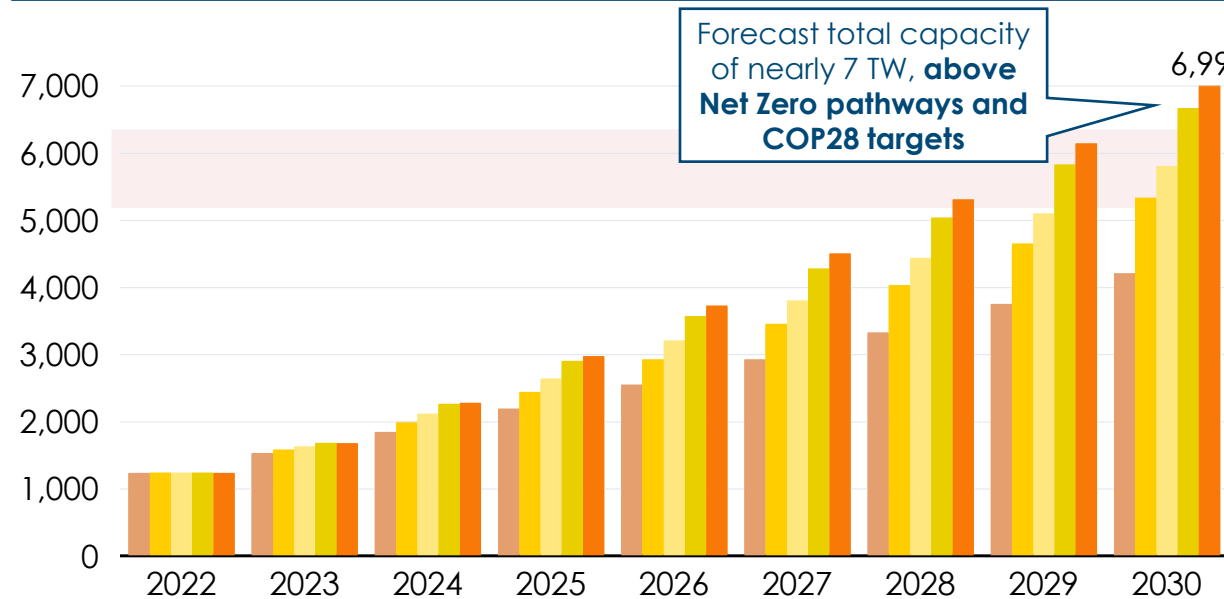
**How has the world
changed since our reports
were published?**



Solar capacity forecasts are powering past pathway for 1.5C, thanks to enhanced manufacturing, while wind capacity lags, hampered by restricted growth outside China

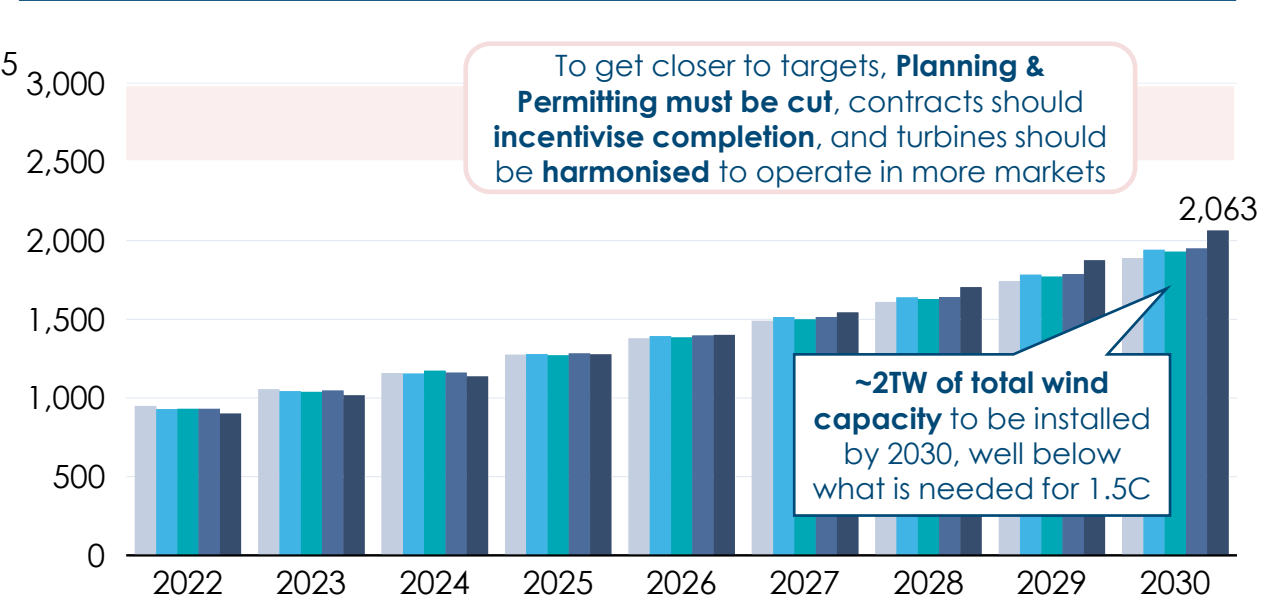
Recent solar forecasts are now aligned to ETC 2030 milestones

GW total capacity installed



Recent wind forecasts still fall behind ETC 2030 milestones

GW total capacity installed



October 2022 forecast October 2023 forecast June 2025 forecast Range for 1.5C Net Zero Pathways and COP28 Targets¹
 June 2023 forecast June 2024 forecast

October 2022 forecast October 2023 forecast June 2025 forecast
 June 2023 forecast June 2024 forecast

Solar capacity forecasts keep accelerating due to manufacturing capacity buildup and the modularity of panels

Continued slow growth for wind ex-China, where barriers are higher (e.g. supply chain, land allocation, permitting)

Note: ¹ The COP28 presidency has a target to treble renewables (incl. solar, wind, hydropower, bioenergy, geothermal) by 2030. This would involve a roughly 5x increase in solar PV and 3x increase in wind from 2022.

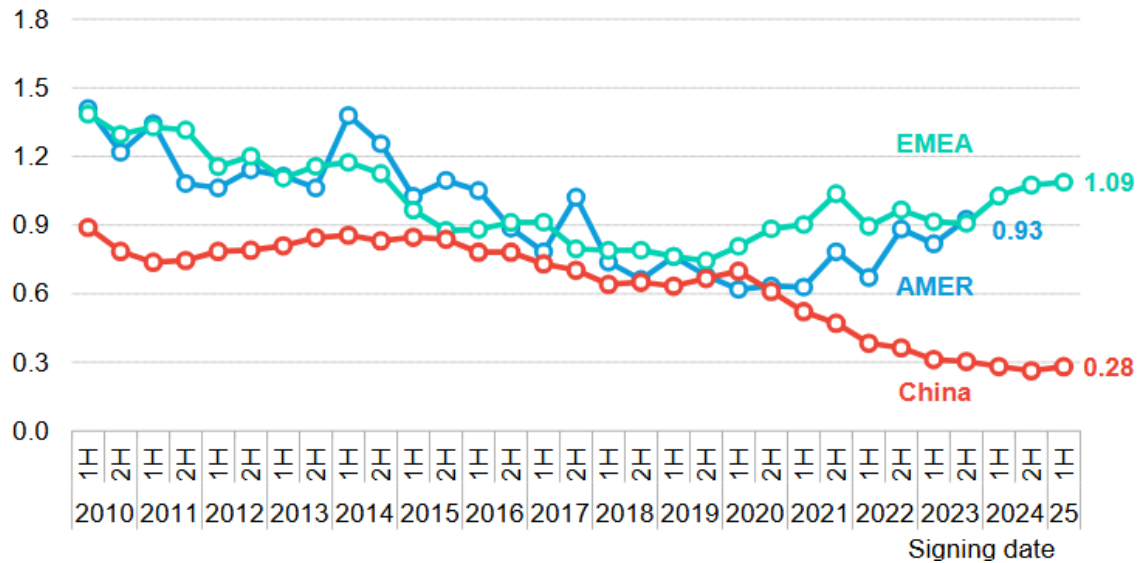
Source: Systemiq analysis for the ETC; BNEF (2022/23/24/25) *Global Installed Capacity*



Chinese turbines continue to be more competitive than alternatives

Onshore wind turbine price per region

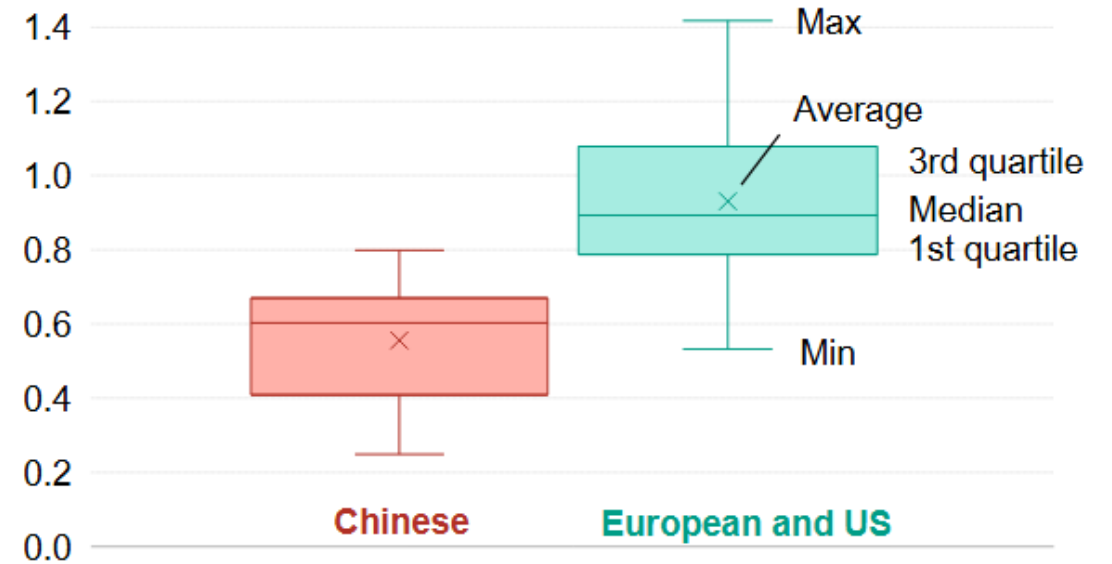
\$ million per megawatt (nominal)



Chinese turbine prices have declined 60% since 2020, while prices in Europe, the Middle East and Africa have climbed 35%

Chinese and Western wind turbine prices outside China

\$ million per megawatt (nominal), contracts signed 2021 onwards



Source: BloombergNEF. Note: Excludes turbine prices in China. Prices for contracts signed from 2021 onward.

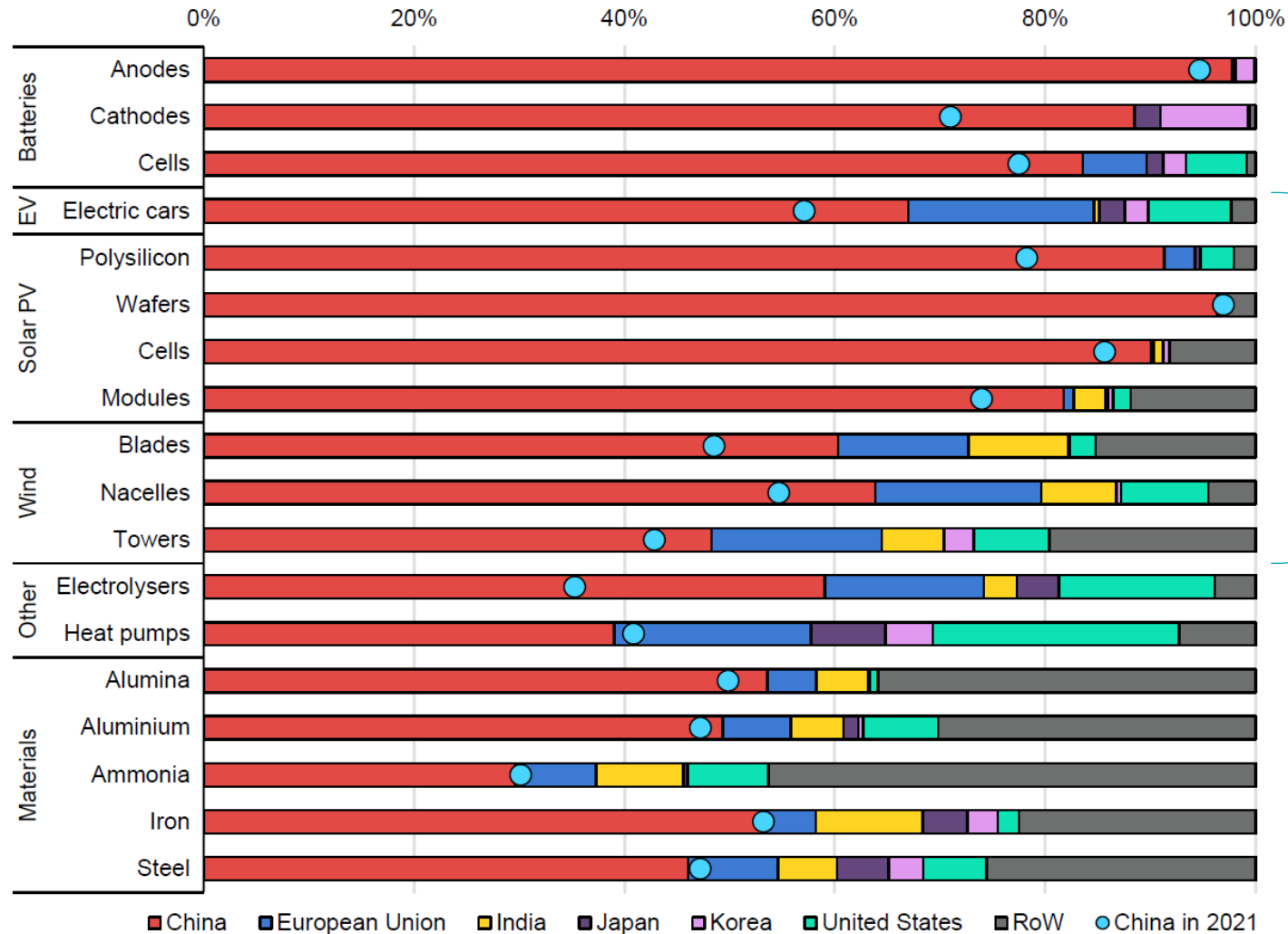
The median price of Chinese turbines sold outside the country is 33% lower than European & US turbine makers






Note: RHS chart excludes turbine prices in China.
Source: BNEF (2025) Wind Turbine Price Index 1H 2025.

China continues to produce and install significant share of clean tech

Installed global manufacturing capacity by country/region 2023



2024 Clean Tech Additions		
	China	Rest of the World
 EV (million units)	11.3 (65%)	6.2 (35%)
 Solar (GW)	339 (57%)	261 (43%)
 Wind (GW)	86 (70%)	37 (30%)

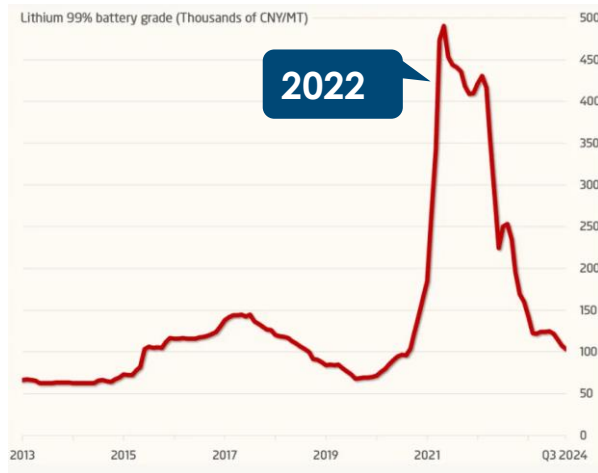
Source: IEA (2024) Clean Technology Perspectives

¹BNEF (2025) Electric Vehicle Outlook 2025. ²BNEF (2025) Capacity: BNEF Solar Forecasts. ³BNEF (2025) Capacity: BNEF Wind Forecasts.



Most metal bottlenecks have been overcome, though copper prices in the US have risen alongside trade tensions

Lithium 99% battery-grade price, Global
Thousands of CNY/MT



Lithium prices have returned to long-run averages

Cobalt price, Global
LME Cobalt Cash (\$/metric ton)



Cobalt prices have returned to long-run averages

Copper price, US
\$/pound



Copper prices have continued to rise in the US due to tariff pressures

Source: Vroni (2024) *Surge and Slump: Lithium Prices from 2020 to 2024*; CarbonCredits.com (2024) *Cobalt Crunch: Prices Plummet, Supply Challenges Loom in the Race to Net Zero*; Trading Economics (2025) *Copper*.

Latest ETC briefing on trade and industrial policy sets out key principles for global clean tech trade



PRICE-PARITY HAS ALREADY BEEN REACHED

- 1 Aim for diversified supply chains but **not complete autarky**
- 2 Think straight about **different dimensions of “security”**
- 3 **Vary policy by sector** to reflect different starting points and inherent characteristics
- 4 Use **tariffs in a fact-based and WTO compliant** fashion
- 5 Focus primarily on the **location of employment and value added**, rather than ownership.
- 6 Work with China to **increase climate finance flows to lower income countries** to support the accelerated deployment of clean technologies

PRICE-PARITY NOT POSSIBLE IN NEAR-FUTURE

Significant green cost premium at B2B level, either in perpetuity or for several decades



Decarbonisation needs **carbon pricing or equivalent regulation**



Many sectors either **internationally traded or inherently international**



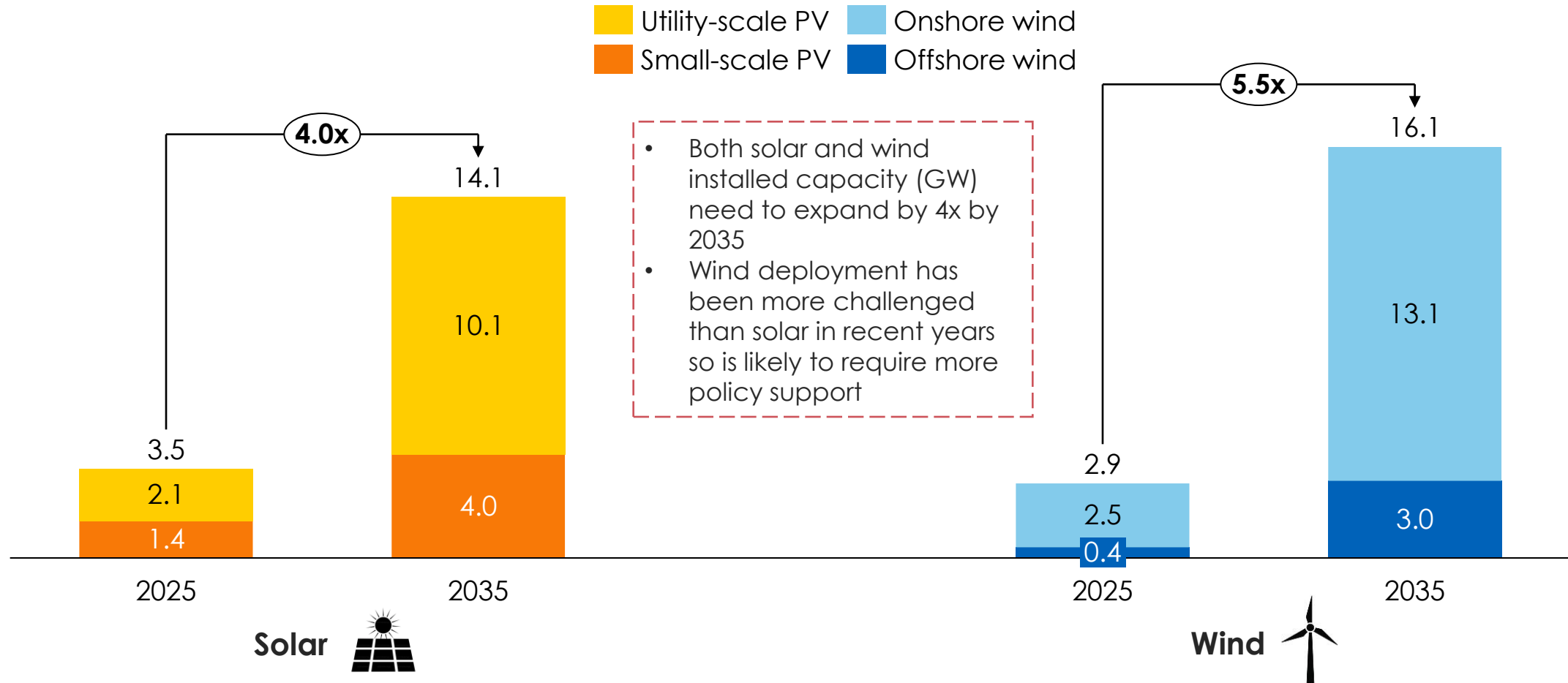
- Unless there are **globally agreed carbon prices** covering hard-to-abate sectors...
- Domestic carbon prices or equivalent regulation / targets must be accompanied by **CBAMs or regulations which apply to imports...**
- Otherwise, production will move to other countries and **decarbonisation will not occur**



Policy should target 4x solar and 5.5x wind generation by 2035 to align with net zero buildout rates; the latter is likely to require stronger support

Global generation change in BNEF NZS broken down by wind and solar

'000 TWh



Source: BNEF (2025), *New Energy Outlook*

Upcoming ETC 2025 Webinars (UK time)

1 October 2025 13.00-14.30 **ETC Webinar – The Role of Hydrogen & Bio energy**

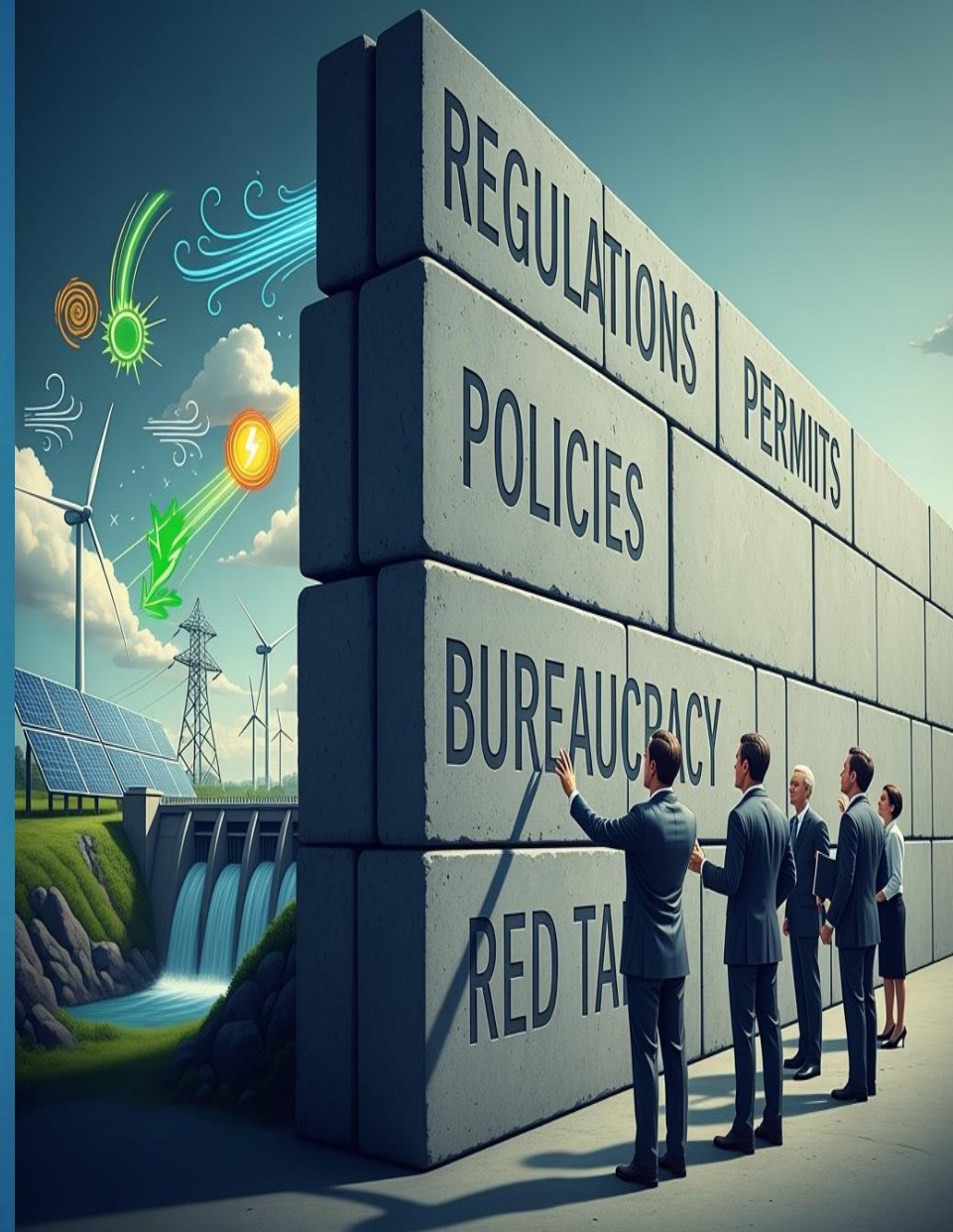
25 November 2025 13.00-14.30 **ETC Webinar – Reaching Climate Objectives: the role of carbon dioxide removals**



Diagnostic Toolkit for Reducing Regulatory Barriers to Renewable Energy

Empowering Policymakers at National, Regional, and Local Levels

July 2025



A Diagnostic Tool for Policymakers for Screening Regulations



Our Unique Approach

A

Self-Assessment Screening Tool for all levels of government (national, regional, local)

B

Regulatory barriers across 10 different markets

C

Evidence-based scores and good practice examples

Typology of Common Regulatory Barriers - Part 1



Outdated Legal Frameworks

- Lag behind technological innovation
- Include unclear definitions, rights and obligations



Market access and remuneration

- New services need new remuneration rules
- Double taxation and grid fees
- Heightened legal and financial risks deterring investment



Misaligned Spatial Planning

- Lack of comprehensive spatial plans
- Outdated frameworks delaying deployment
- Misalignment between national, regional, and local objectives

Typology of Common Regulatory Barriers - Part 2



Complex Permitting Processes

- Systems designed for traditional thermal plants
- Multiple authorities with unclear approval sequencing
- Inconsistent timelines and criteria



Misaligned Grid Access Rules

- "First come, first served" model causing long queues
- Limited transparency in connection processes
- Failure to prioritize grid-efficient projects



Grid Investment Challenges

- Structural disincentives for grid expansion
- Bias towards capital-intensive grid build-out
- Lack of enabling frameworks for efficient grid use

What's next

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Roll out of the tool by countries to screen for where to prioritise and what needs change

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OECD to use the tool across countries/regions to screen for barriers

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OECD to deep dive based on the analytical framework of the tool and propose concrete changes



Energy Transitions Commission

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