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WisdomTree Europe

All Change for Renewable Energy

Mobeen Tahir, CFA

Director, Macroeconomic
Research & Tactical Solutions
WisdomTree Europe

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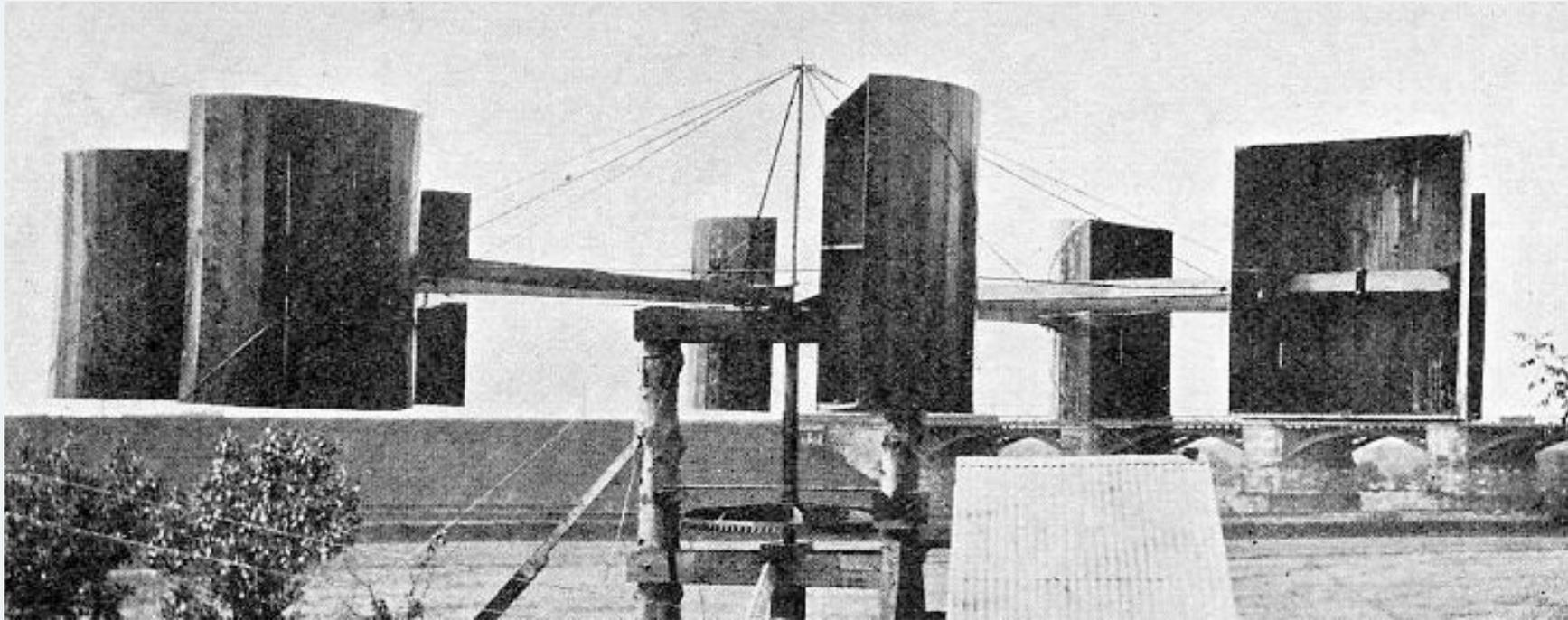


September 2023

All Change for Renewable Energy

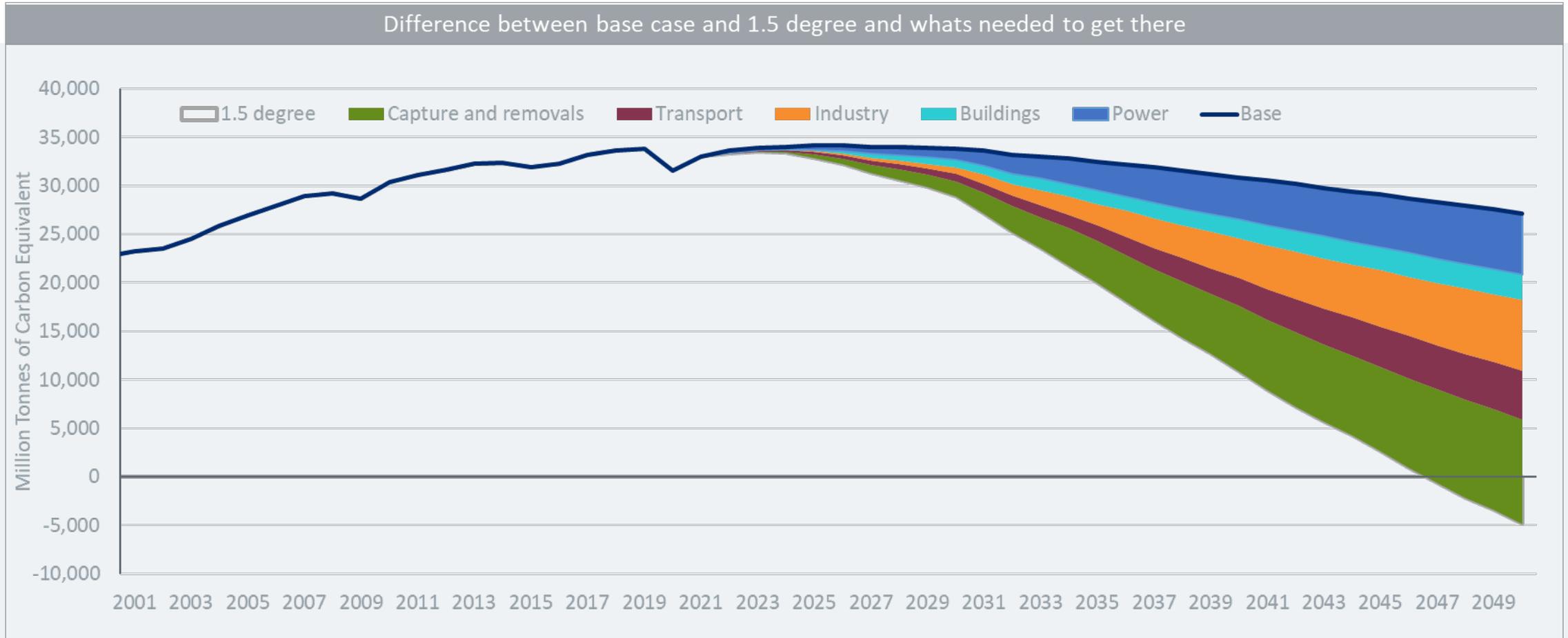


1887: James Blythe built a wind turbine
in his garden



Source: Engineeringhalloffame.org

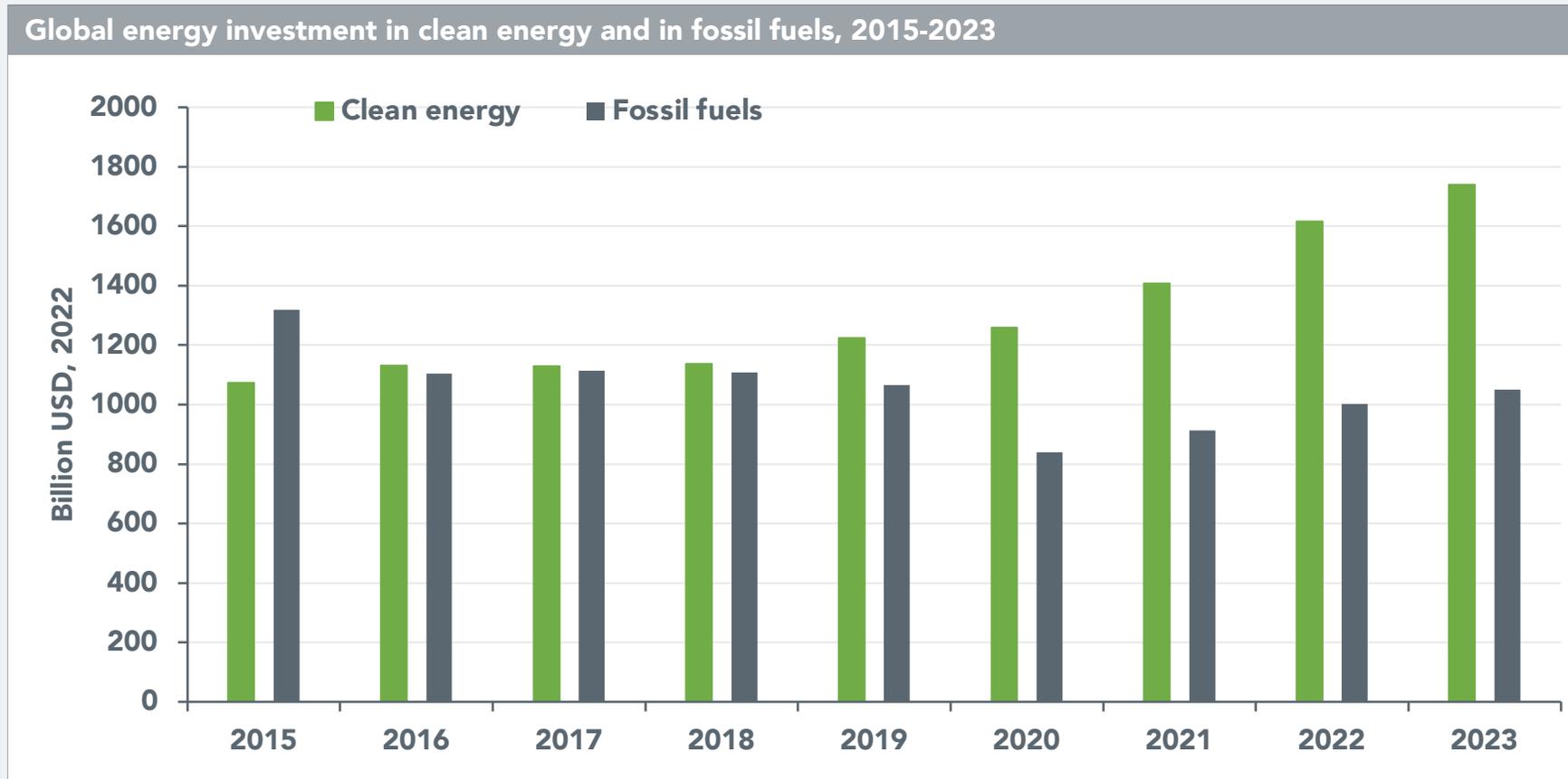
The pursuit of net zero requires multiple decarbonisation solutions



Source: Wood Mackenzie, 2023. **Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.**

The Paris Agreement is a legally binding international treaty on climate change. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

Global energy investment in clean energy and in fossil fuels



Source: IEA, Global energy investment in clean energy and in fossil fuels, 2015-2023, IEA, Paris <https://www.iea.org/data-and-statistics/charts/global-energy-investment-in-clean-energy-and-in-fossil-fuels-2015-2023>, IEA. Licence: CC BY 4.0. Historical performance is not an indication of future performance and any investments may go down in value.

Global Solar Installations Expected to Rise 56% in 2023



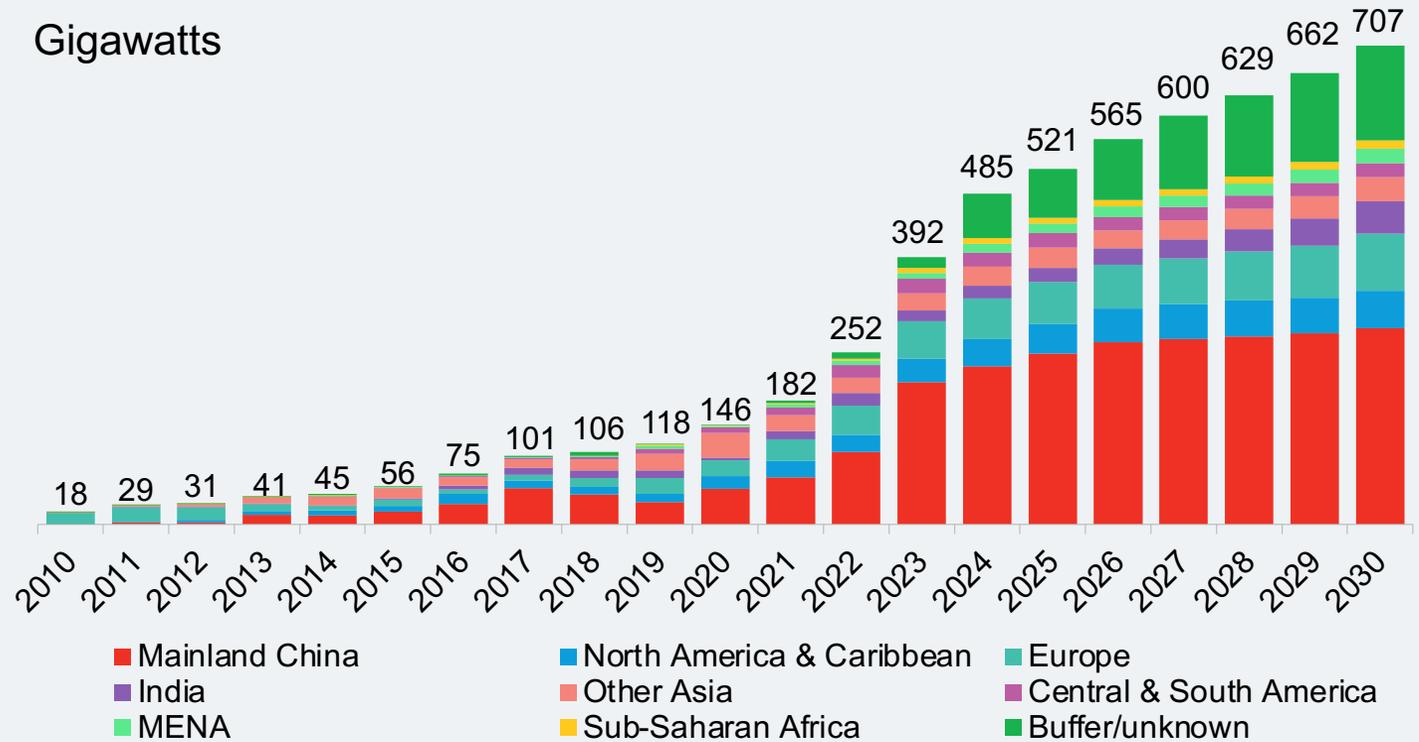
392GW

BNEF's current 2023 new build PV forecast*

14.5 US cents per Watt

Estimate of typical monocrystalline silicon monofacial module price by the end of the year

Gigawatts



Source: *BNEF is Bloomberg New Energy Finance, Aug 21 2023. PV is photovoltaic. <https://www.bnef.com/insights/32069>. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

Global cumulative offshore wind installations

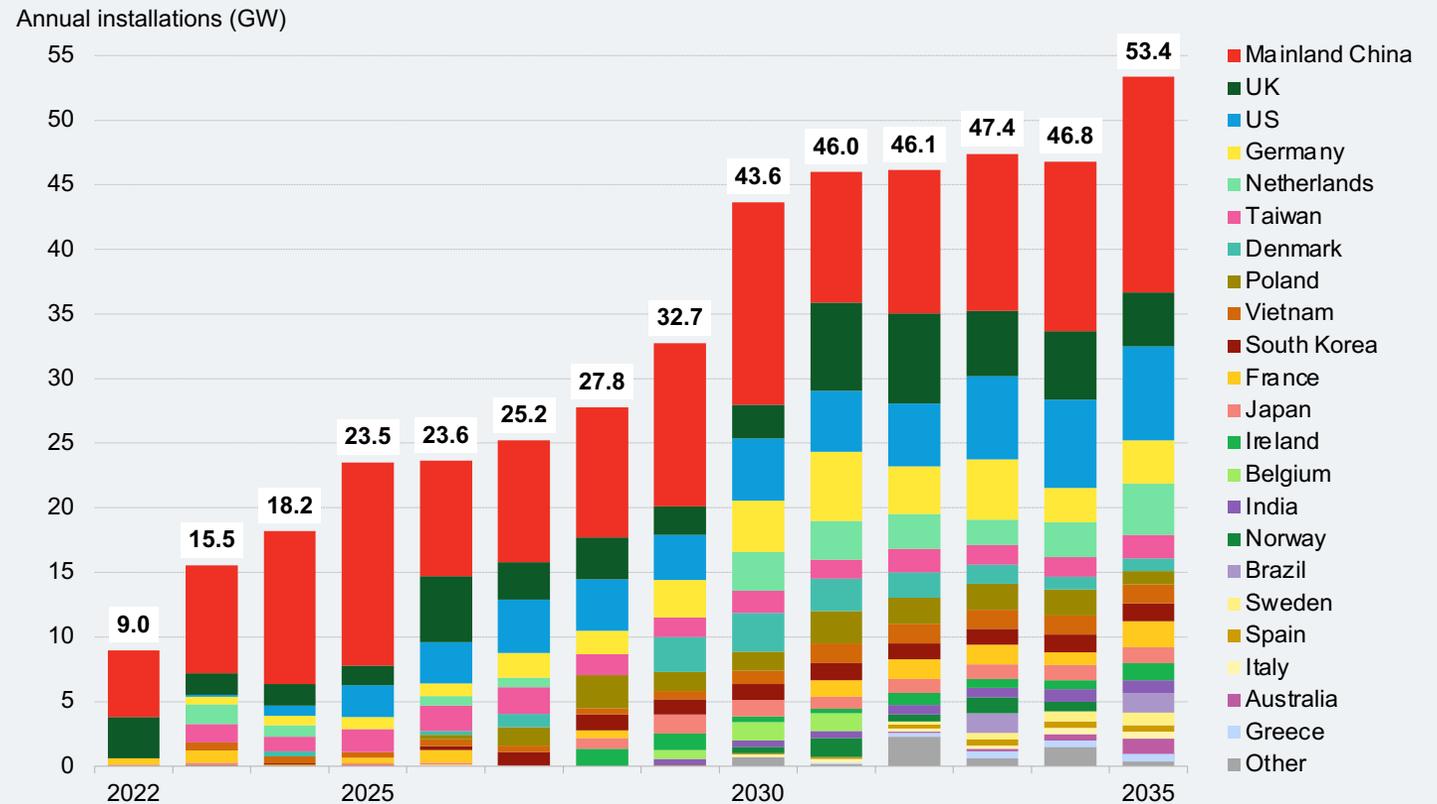


509GW

Cumulative global offshore wind installations by 2035

-44%

Change in cumulative 2030 floating offshore wind forecast compared to 2H 2022



Source: Bloomberg New Energy Finance, Jun 28 2023. <https://www.bnef.com/insights/31703>. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

Global levelized cost of electricity (LCOE) benchmarks: The rapid decline in battery storage costs



\$42/MWh

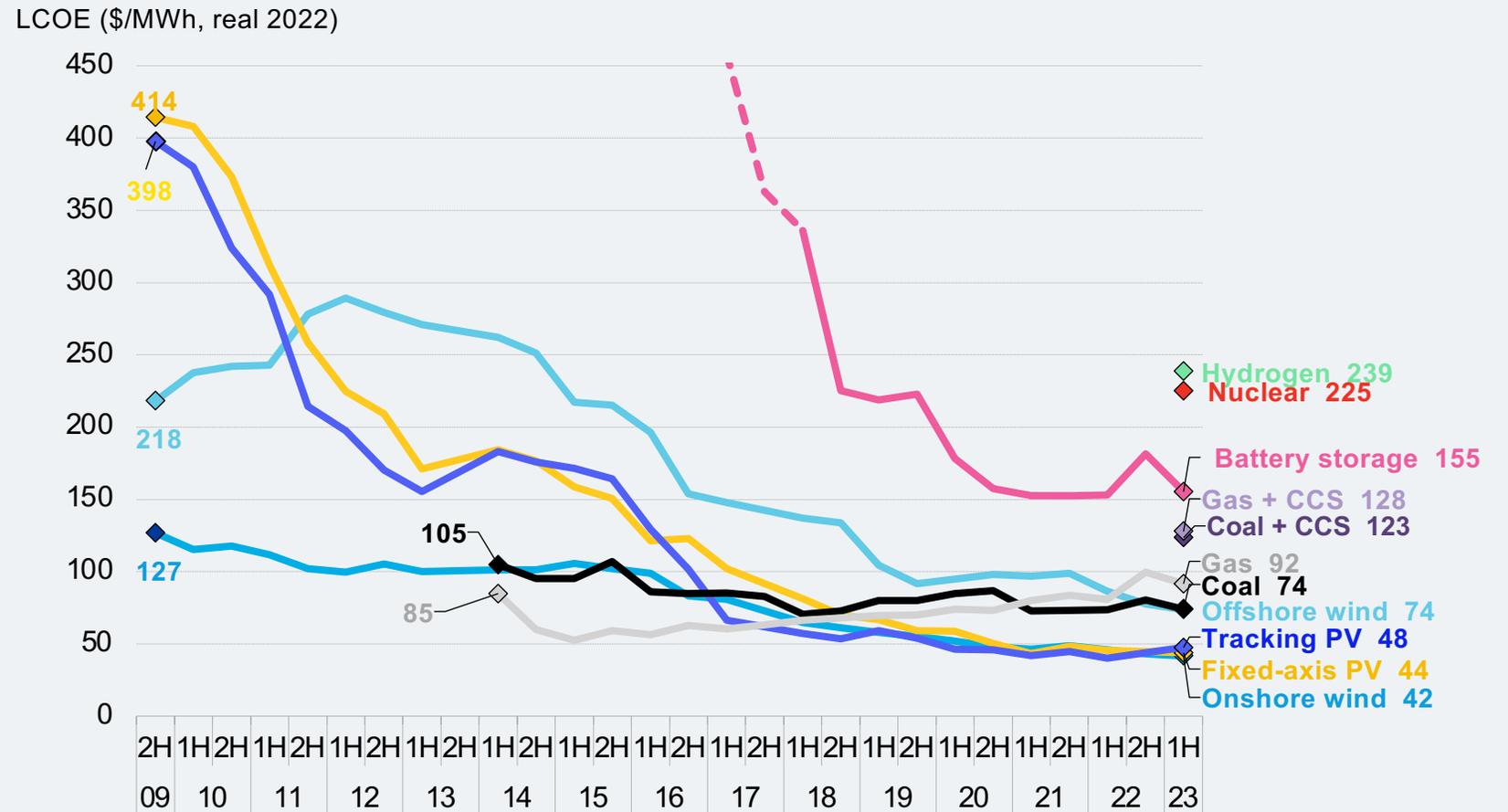
The global onshore wind LCOE,
which is BNEF's cheapest
benchmark

-12.5%

Change in the global four-
hour battery storage
benchmark since 2H 2022

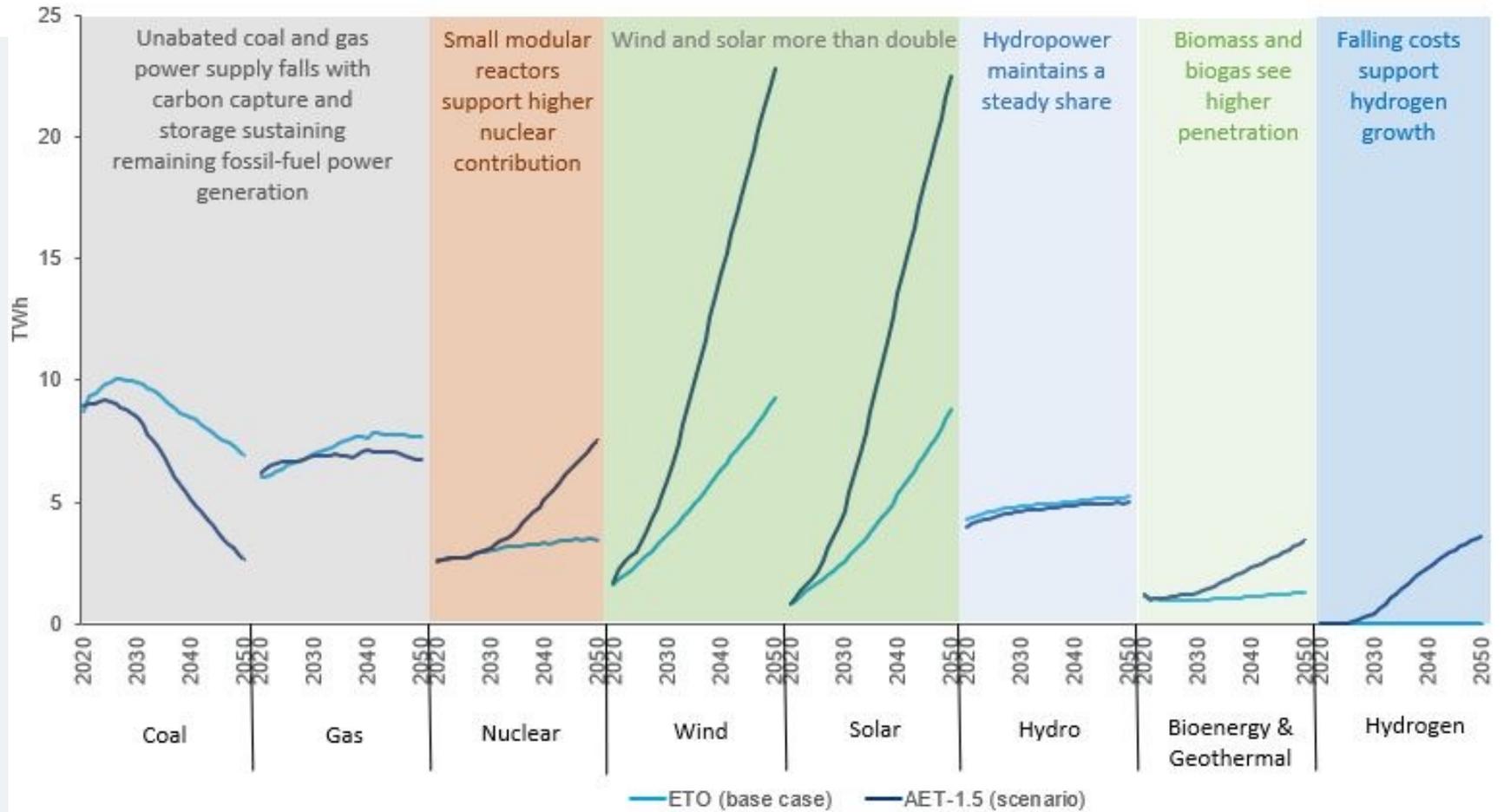
+6%

Change in debt costs for newly
financed projects since 2H
2022



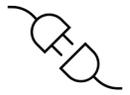
Source: Bloomberg New Energy Finance, Jun 07 2023. PV is photovoltaic. CCS is carbon capture and storage. <https://www.bnef.com/insights/31489>. Historical performance is not an indication of future performance and any investments may go down in value.

Wind and solar have a significantly large role to play in a net zero world



Source: Wood Mackenzie, 2023. ETO is the base case energy transition outlook. AET-1.5 is the accelerated energy transition scenario in which the world achieves net zero by 2050. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

End-use demand for energy is projected to peak by 2028 as electricity dominates



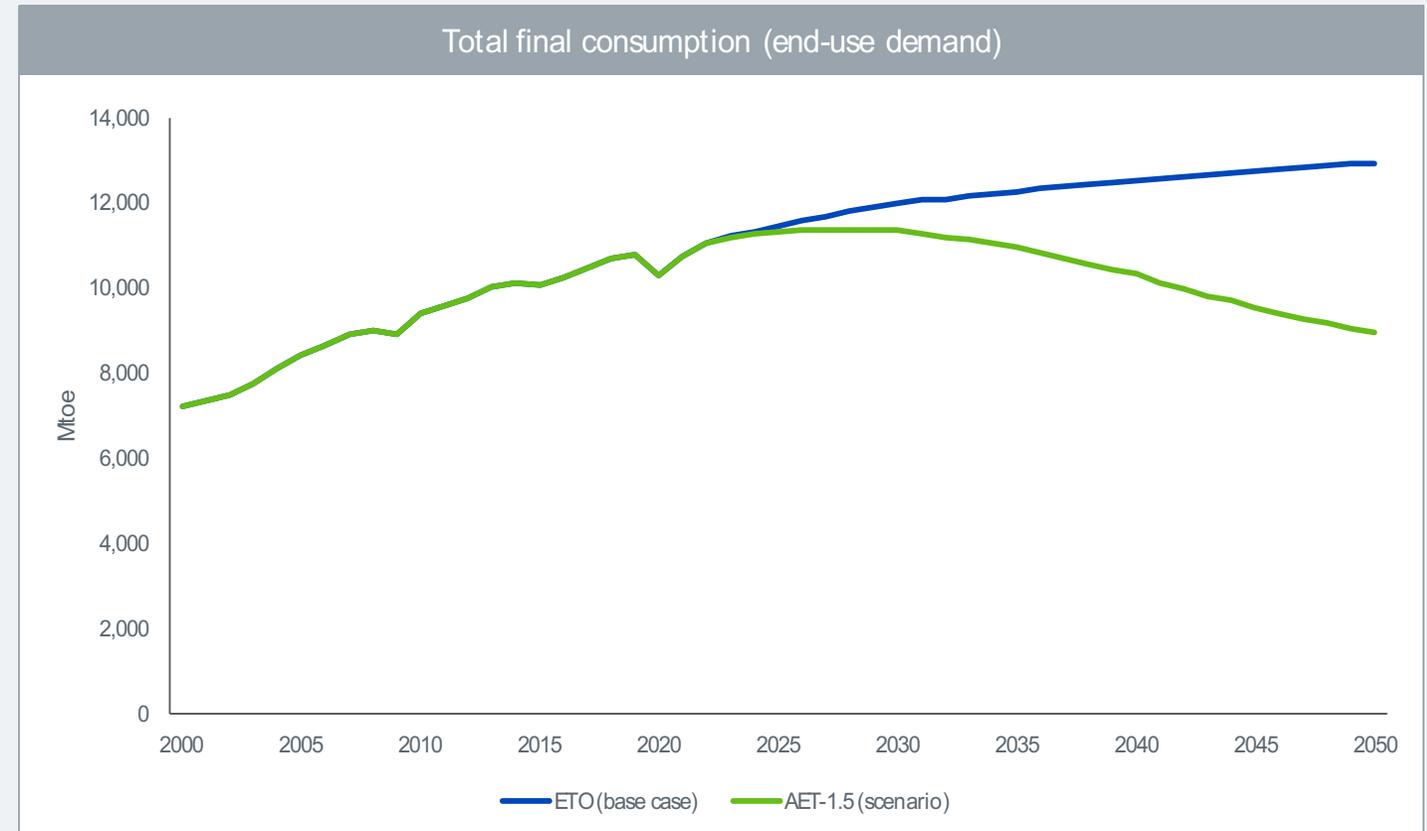
Rapid electrification of transport and buildings delivers efficiency gains versus fossil-fuel incumbents



Building stock investment and refurbishment lowers heating and cooling requirements

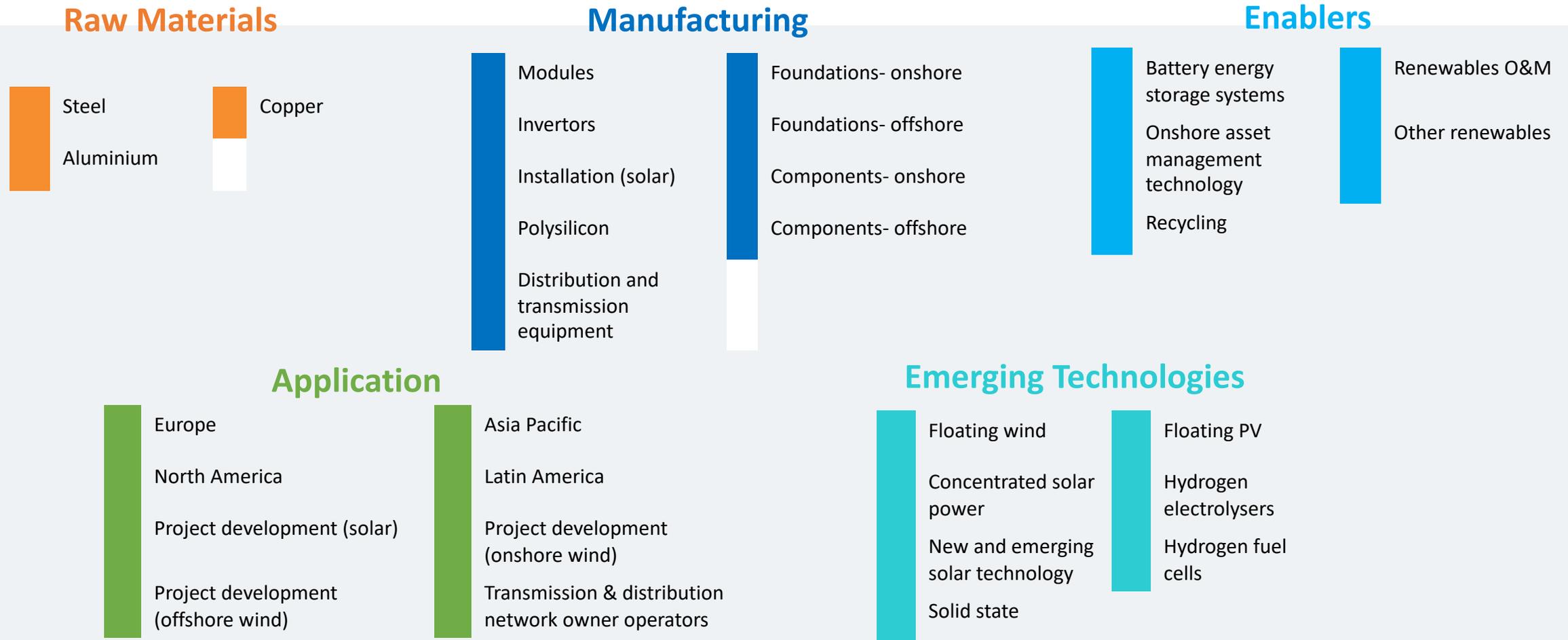


Removal of end-user subsidies and higher cost of carbon support shift in consumer behaviour



Source: WisdomTree, Wood Mackenzie. Mtoe is mega tonnes of oil equivalent. ETO is the energy transition outlook and serves as the base case scenario. AET 1.5 refers to an accelerated energy transition outlook consistent with a 1.5 degree scenario. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

How WisdomTree and Wood Mackenzie view the Renewable Energy Value Chain

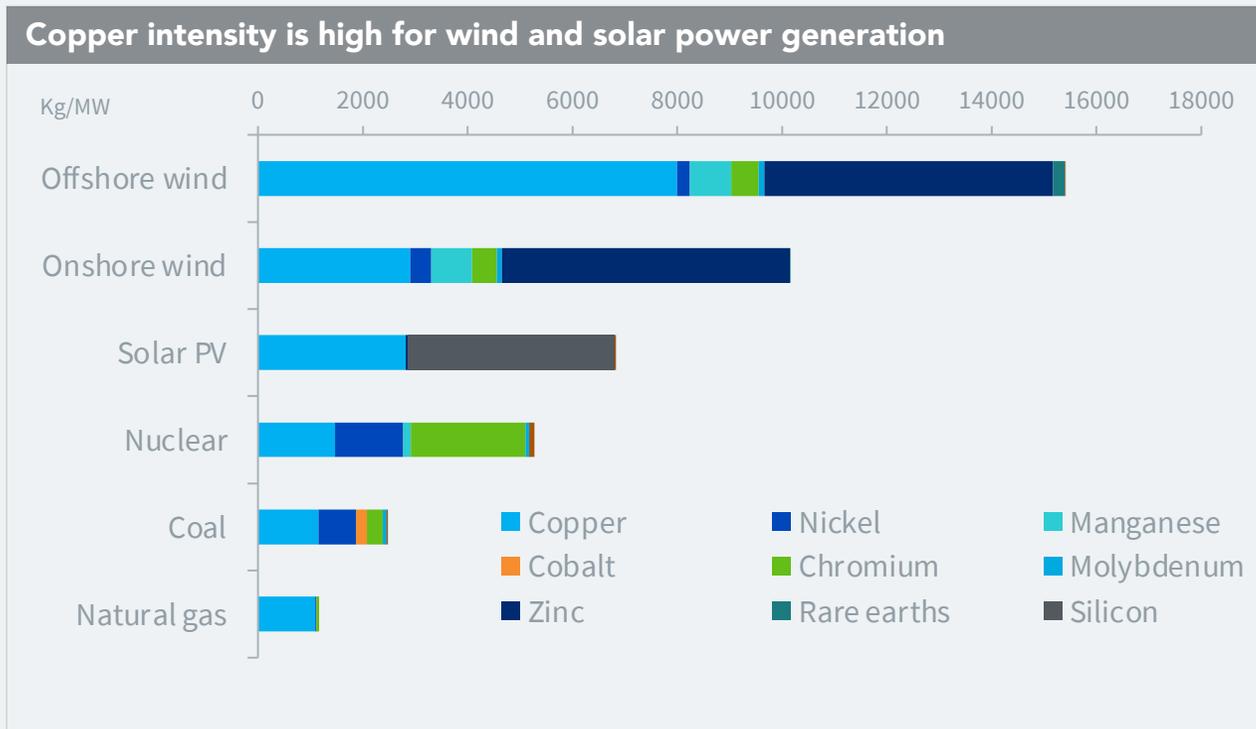


Source: WisdomTree, Wood Mackenzie, 2023. O&M refers to operations and maintenance and PV refers to photovoltaic.

Copper: The indispensable raw material



Renewable energy production requires large quantities of copper



Copper's integral role in renewable energy:

40%

of future copper demand growth will come from green technologies like wind, solar, and EVs¹

Irreplaceable

Copper's electrical conductivity, energy efficiency, malleability, and ductility make it hard to substitute

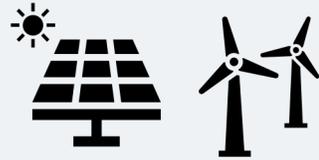
Copper can be reused repeatedly with no loss to its physical properties²

2.4x

Copper's annual demand rises from 29m tonnes in 2020 to 68m tonnes in 2050 in the 1.5°C scenario³

Source: IEA, Minerals used in clean energy technologies compared to other power generation sources, IEA, Paris <https://www.iea.org/data-and-statistics/charts/minerals-used-in-clean-energy-technologies-compared-to-other-power-generation-sources>, IEA. Licence: CC BY 4.0. October 2022. 1 and 3 from Wood Mackenzie, 2023. 2 from Copper Alliance, 2023. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

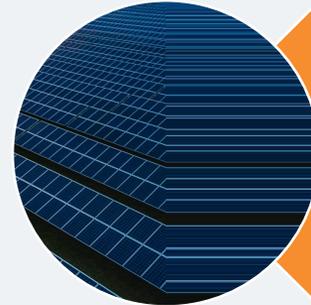
Manufacturing: The building blocks of renewable energy



Renewable energy production requires numerous components. This includes:



Invertors: Central in a solar energy system. It's a device that converts direct current (DC) electricity, which is what a solar panel generates, to alternating current (AC) electricity, which the electrical grid uses.



Modules: Photovoltaic modules, commonly known as solar panels are typically made with semiconductor material, usually silicon and convert solar power into electrical energy.



Wind turbine components: Wind turbines require components such as blades, towers, rotors, nacelles, and generators.

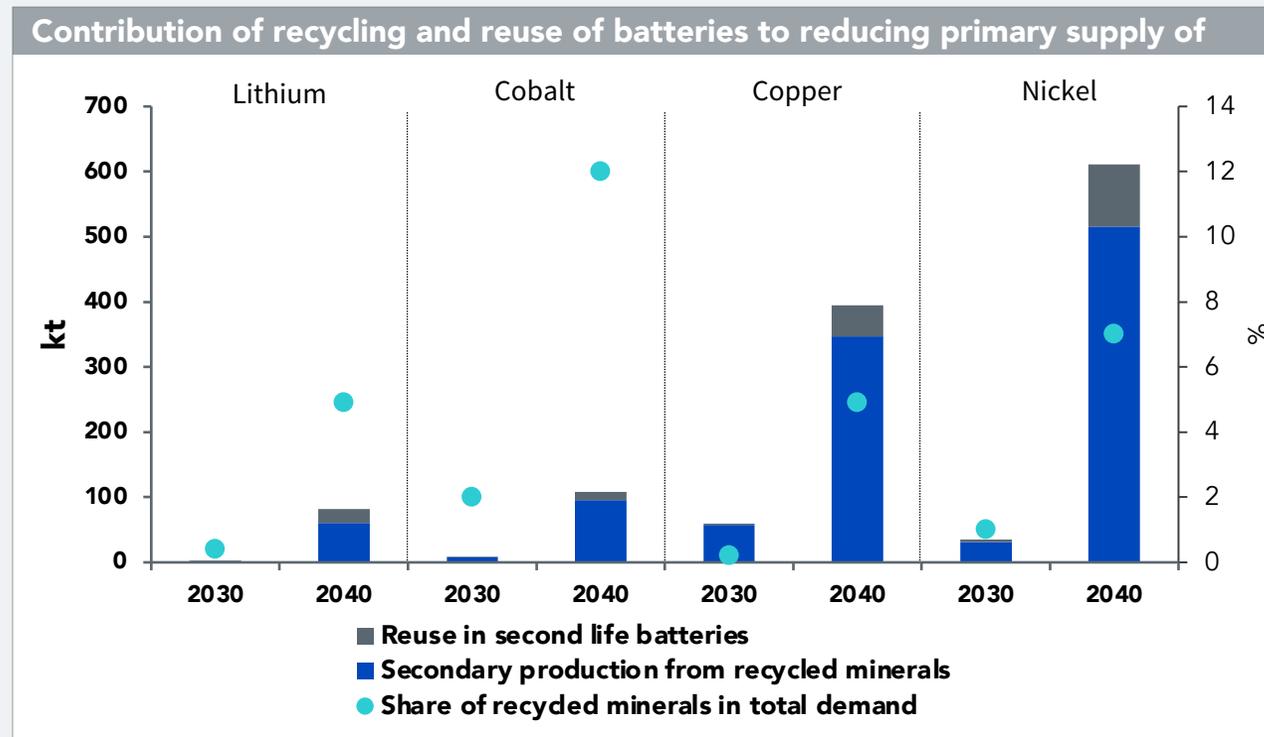


Distribution and transmission equipment: This includes bus bars, fuses, switches, transformers, high-voltage cables, lines etc.

Recycling: Enabling the sustainable growth of renewable energy



Improvements in recycling methods are helping recycled materials maintain their key properties



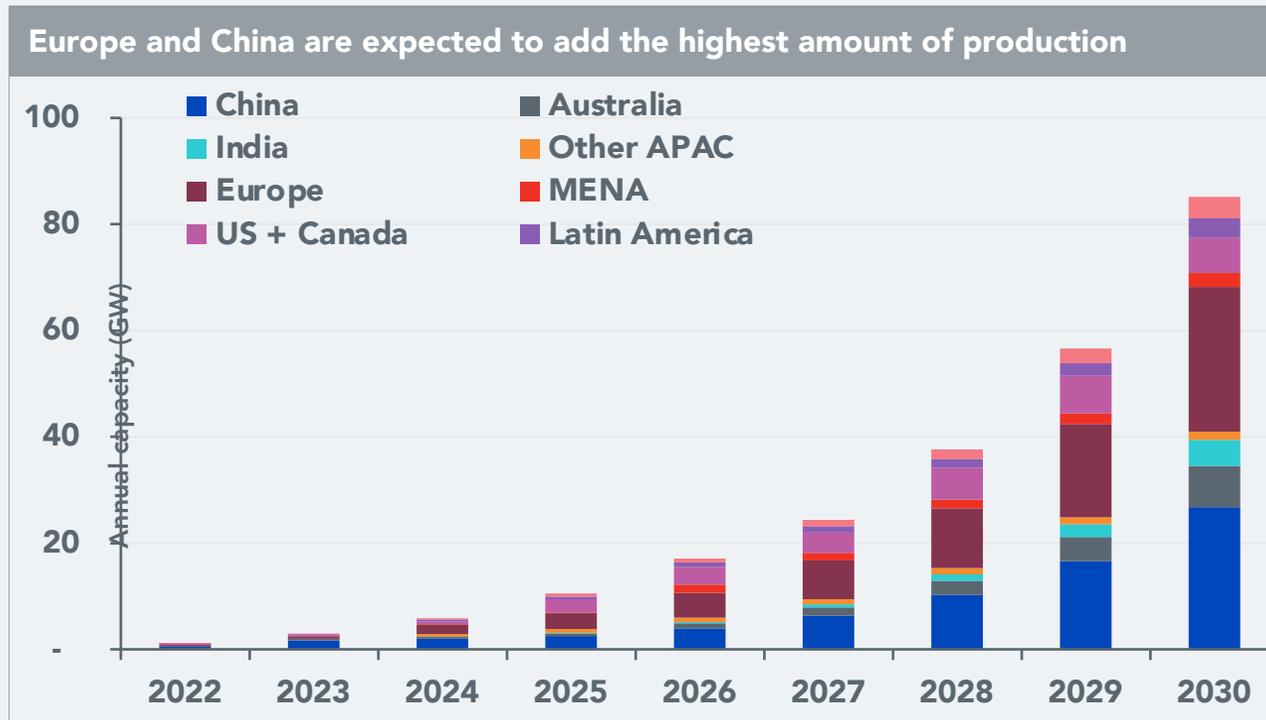
Recycling li-ion batteries has numerous benefits:

- Conserve** Recycling can help recover valuable resources like lithium, cobalt, nickel, and copper
- Save** Recycling can be more cost-effective and less energy-intensive than mining
- Protect** The circular economy model helps reduce harmful waste

Source: IEA, Contribution of recycling and reuse of batteries to reducing primary supply requirement for selected minerals in the Sustainable Development Scenario, 2030-2040, IEA, Paris <https://www.iea.org/data-and-statistics/charts/contribution-of-recycling-and-reuse-of-batteries-to-reducing-primary-supply-requirement-for-selected-minerals-in-the-sustainable-development-scenario-2030-2040>, IEA. Licence: CC BY 4.0. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

Hydrogen Electrolysers: Making green hydrogen a reality

Electrolysers produce hydrogen through the electrolysis of water



Green hydrogen accounts for 1% of all hydrogen production. Its growth can help decarbonise:



Transport

- Fuel for heavy-duty vehicles, ships, trains, and airplanes



Energy

- Decarbonising heat and heavy industries like steel and cement
- Renewable energy storage



Industry

- Renewable ammonia and methanol

Source: Bloomberg New Energy Finance (BNEF) October 2022. International Renewable Energy Agency 2023., ITM Power 2023. MENA refers to Middle East and North Africa. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

Bold ambitions and exciting innovations: Denmark's Energy Island

18

The island will be built 60 kilometres (km) offshore to benefit from stronger winds, be the size of 18 football pitches

600

Giant wind turbines could be housed on the island

3-4 GW

Capacity by 2030 and ultimately expanding to 10 GW



Bold ambitions and exciting innovations: Gansu Wind Farm, China

2010

First phase completed with a 5.16
GW capacity

7000

Wind turbines when finished,
with a capacity of 20 GW

2,383

Transmission line from the
hostile Gobi Desert



Bold ambitions and exciting innovations: Bhadla Solar Park, India

14,000

Acres of land making it the largest
solar farm in the world

10 million

Solar panels contained on the
farm

Robots

Used to clean the panels given
the sandy Rajasthan desert



Bold ambitions and exciting innovations: Dezhou Dingzhuang Floating Solar Farm, China

320

Megawatts (MW) capacity

8 MWh

Of battery storage and 100
MW of wind power also on the
farm



A challenging year for green strategies



Headwinds from China

Lower commodity prices

Higher financing costs



Source: Bloomberg, September 2023, WisdomTree. WTRENEN Index is the WisdomTree Renewable Energy Net Total Return Index. SPGTCCLNT Index is the S&P Global Clean Energy Net Total Return Index. Historical performance is not an indication of future performance and any investments may go down in value.



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