Energy Transitions Commission

10 YEARS

Barriers to climate action: transitional costs, distributional issues and politics

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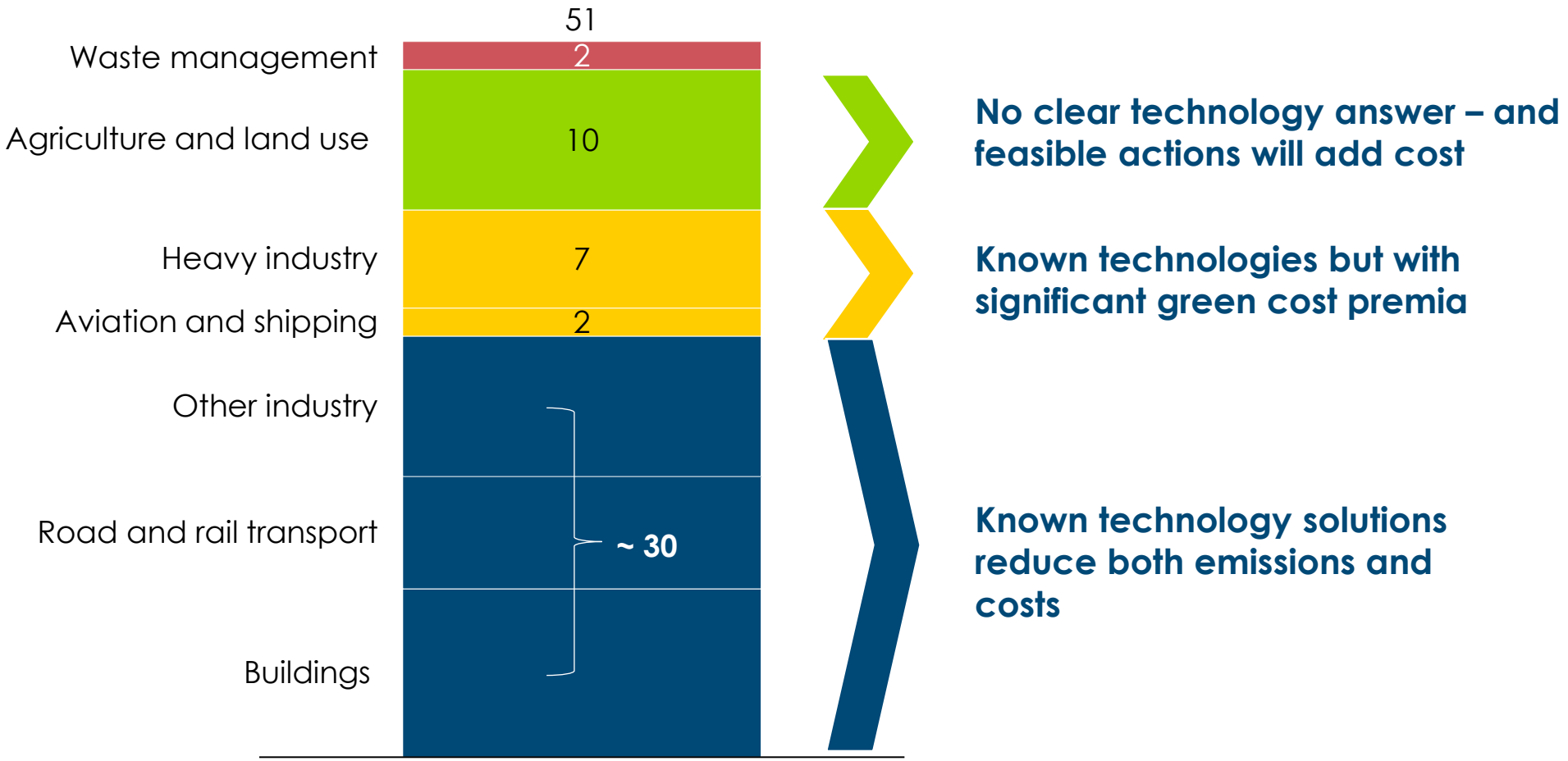
Chair, Energy Transitions Commission

The Global School of Sustainability at LSE

3rd of February 2026

GHG emission by broad sector

Gt CO_{2eq}



Estimates of remaining carbon budget

Gt CO_2

Temperature (°C)	Estimated remaining carbon budgets from the beginning of 2025 (Gt CO_2)				
Avoidance probability:	17%	33%	50%	67%	83%
1.5	320	200	130	80	30
1.6	620	420	310	240	160
1.7	910	640	490	390	290
2	1790	1310	1050	870	690

Minus 2025 emissions:

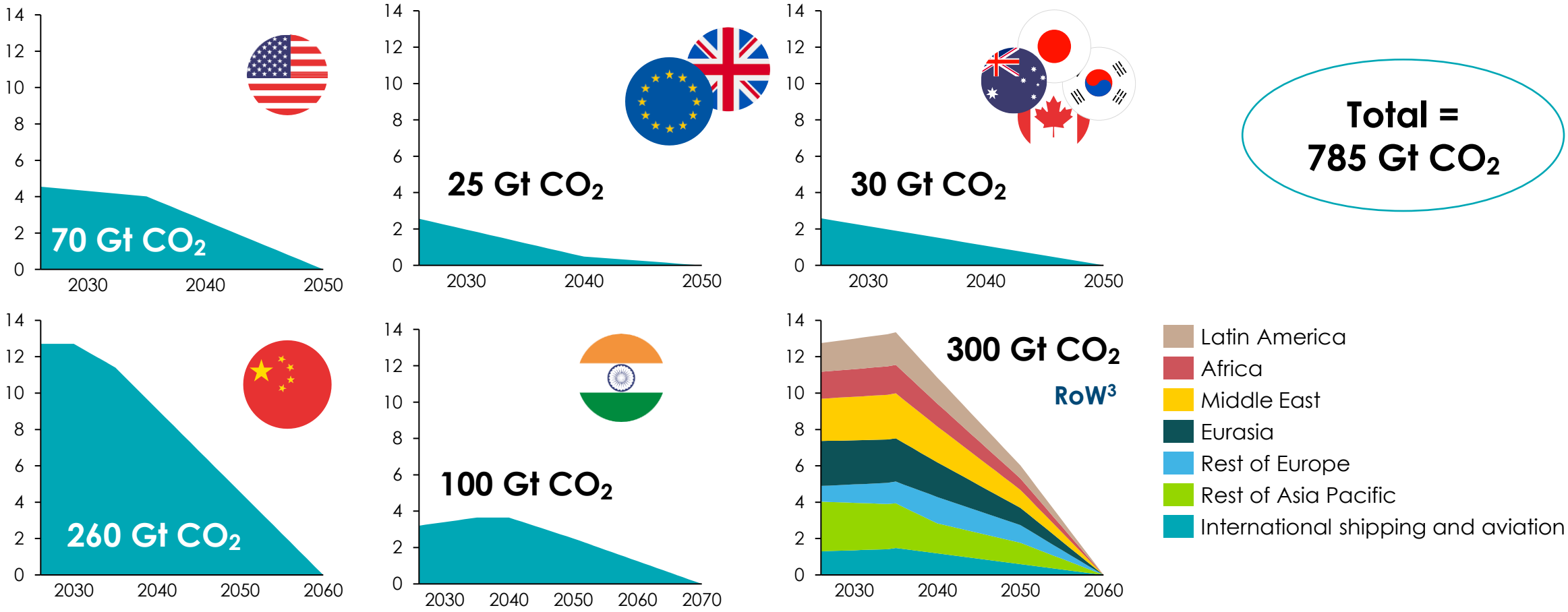
- Energy ~39
- Land use ~4

Remaining at January 2026		
	50%	67%
1.5C	87	37
2C	1007	827

Note: these relationships between CO2 emissions and temperature depend on the assumptions made about the level of other GHG emissions.
Source: Copernicus (2025), *Indicators of Global Climate Change 2024: annual update of key indicators of the state of the climate system and human influence.*

Cumulative future energy related emissions implied by current NDCs and pledges

Gt CO_2

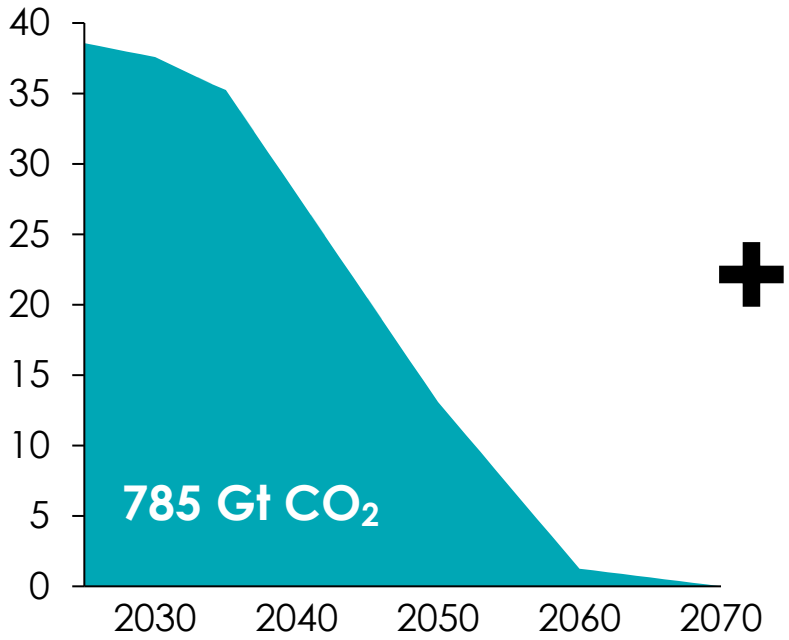


Source: IEA (2025) World Energy Review; JRC/IEA 2025 Report (2025) *GHG emissions of all world countries*; Climate Change Tracker (2025), *Current Remaining Carbon Budget and Trajectory*.

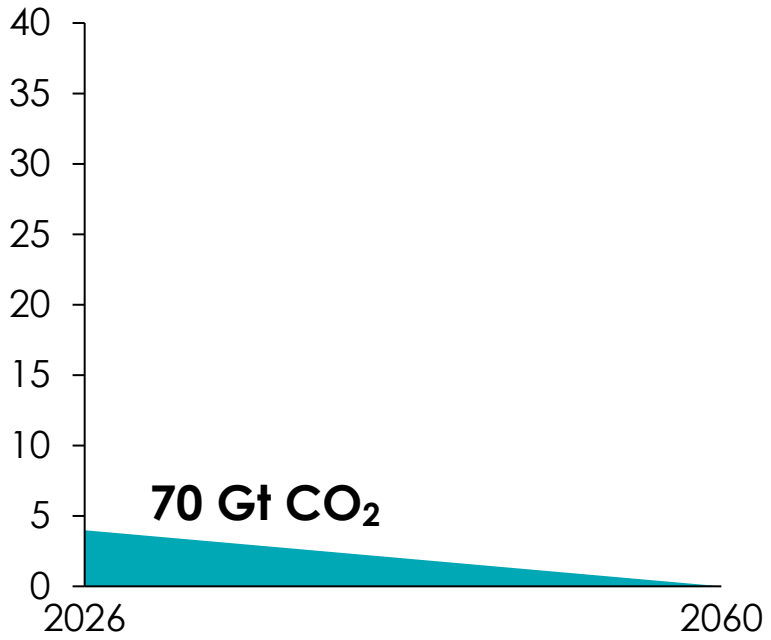
Cumulative CO_2 emissions versus remaining budget

Gt CO_2

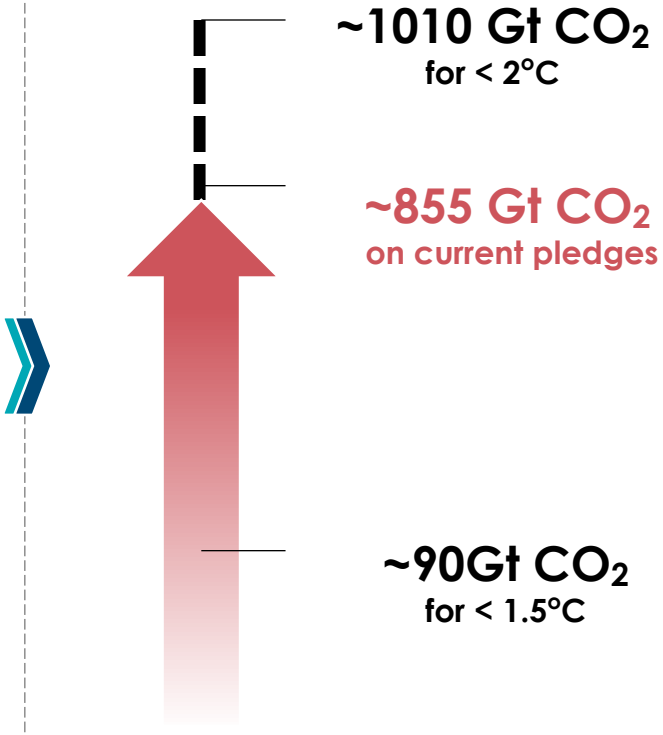
Energy and industry related



Land-use change



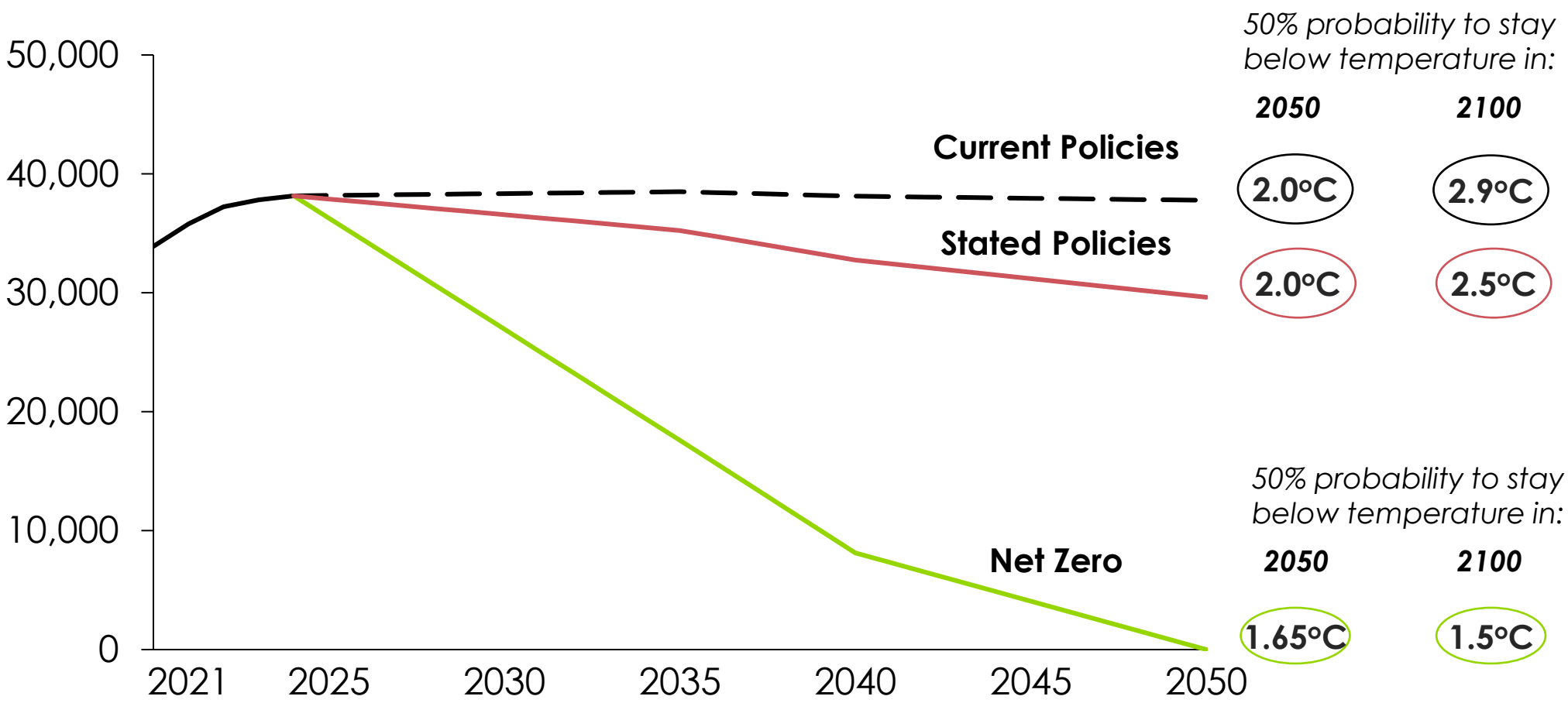
Remaining carbon budget 50% likelihood



Source: IEA (2025), World Energy Review; JRC/IEA 2025 Report (2025), *GHG emissions of all world countries;* Climate Change Tracker (2025), *Current Remaining Carbon Budget and Trajectory.*

IEA emission scenarios 2024 and implied peak temperature

Energy-related Mt CO_2

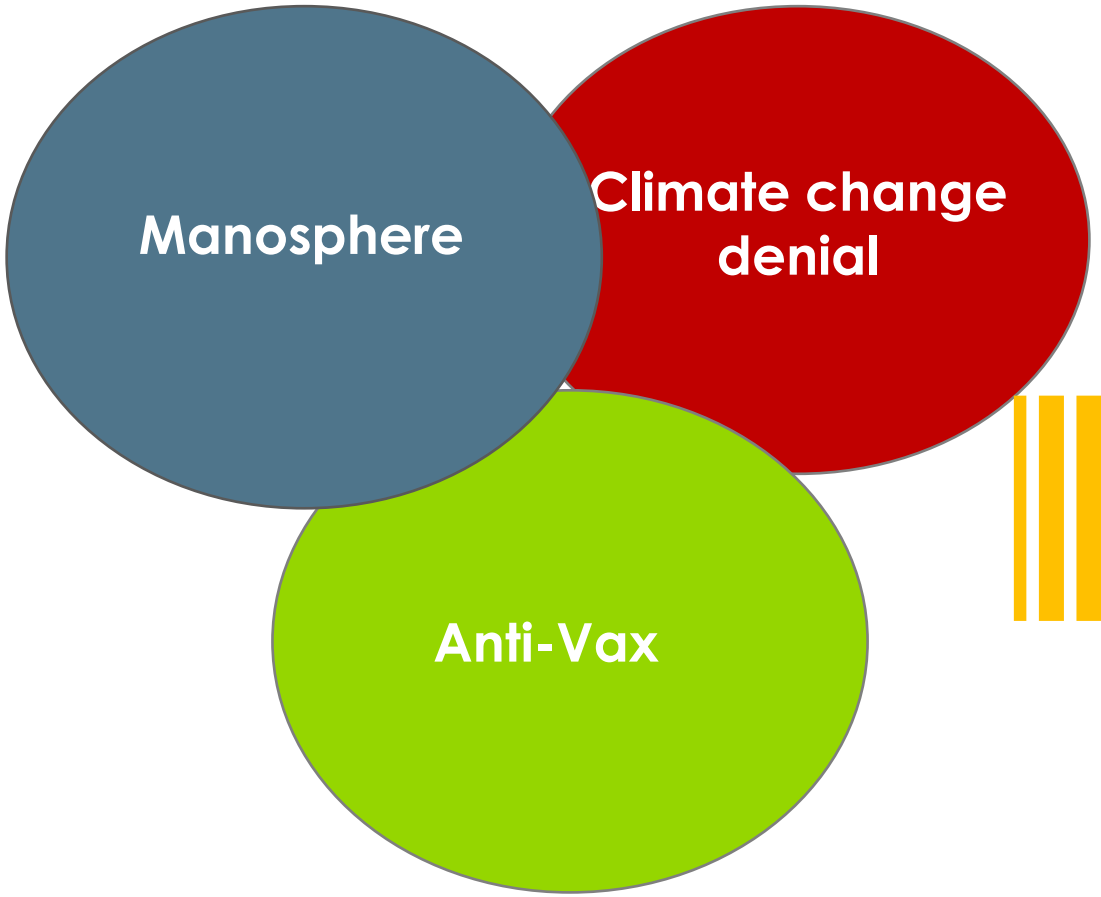


Note: IEA Scenarios have emissions interpolated between 5-10 years; using Current Policies: A.4a; Stated Policies: A.4b; Net Zero: Table A.4c.
Source: IEA (2025), *World Energy Outlook 2025*.


VLADIMIR PUTIN
ON THE HISTORICAL
UNITY OF RUSSIANS
AND UKRAINIANS

- IRA not continued/reversed – US will not achieve committed target of 48-52% reduction (from 2005 level) by 2030
- US will not become major driver of clean tech development and cost reduction alongside China
- US will not provide significant support to capital flows to developing countries
- US exit from Paris process and UNFCCC may encourage other countries to do same and/or dilute emission reduction targets

+0.2°C to reasonable estimate of global warming by 2100?



Oxfordshire County Council pass Climate Lockdown 'trial' to begin in 2024

Residents will be confined to their local neighbourhood and have to ask permission to leave it, all to *'save the planet'*

Scrapping net zero deadline could save Britain £14bn a year

Projected cost of 2050 plan is equivalent to 0.4% of GDP or £500 a year per household

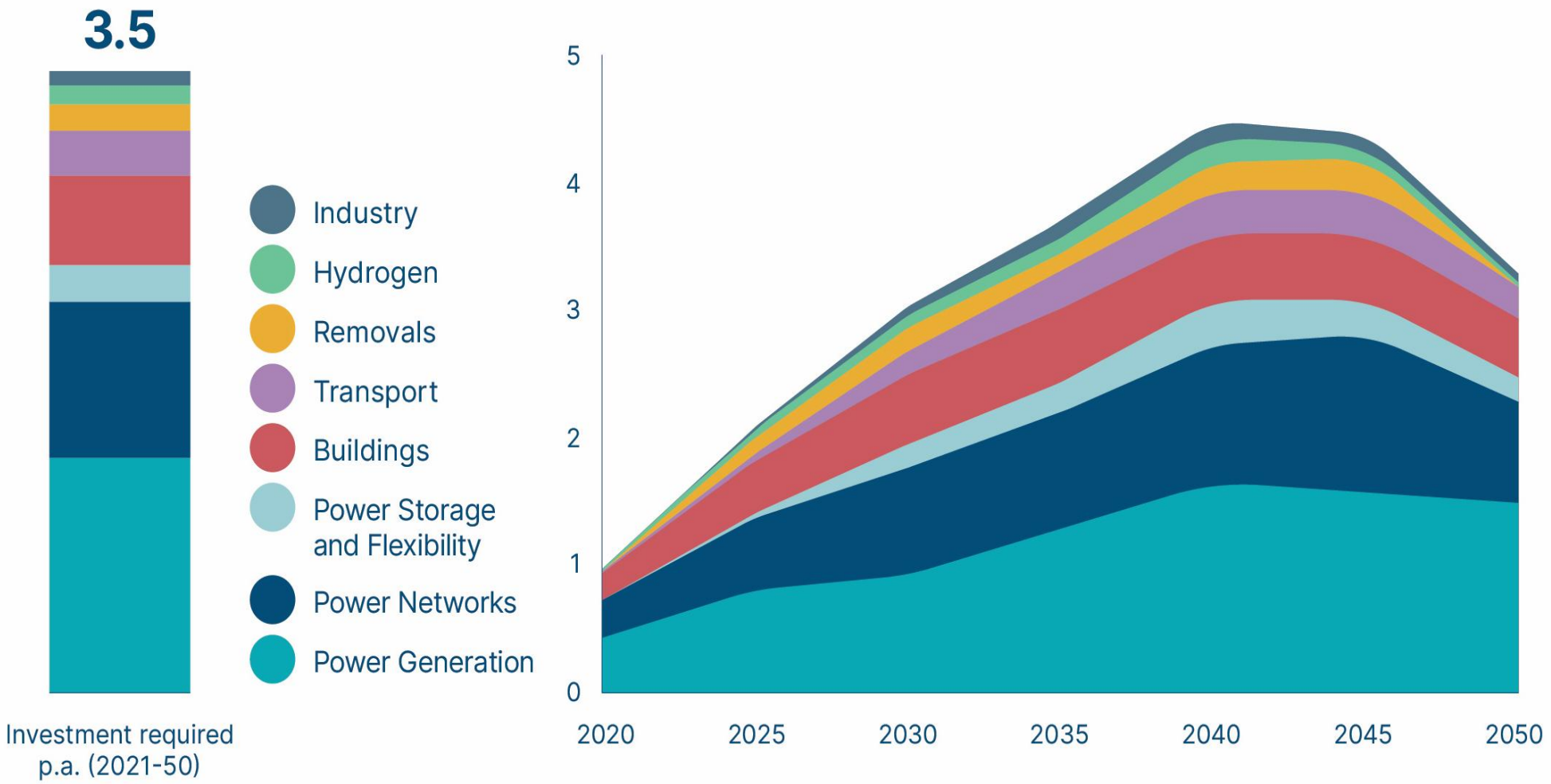
UK energy costs likely to halve by 2050, says system operator

Modelling by independent body Neso forecasts sharp fall in expenditure from 10% of GDP as shift to renewables continues

Source: The Times (2025), *Scrapping net zero deadline could save Britain £14bn a year*; FT (2025), *UK energy costs likely to halve by 2050, says system operator.*

Annual capital expenditure in the energy system

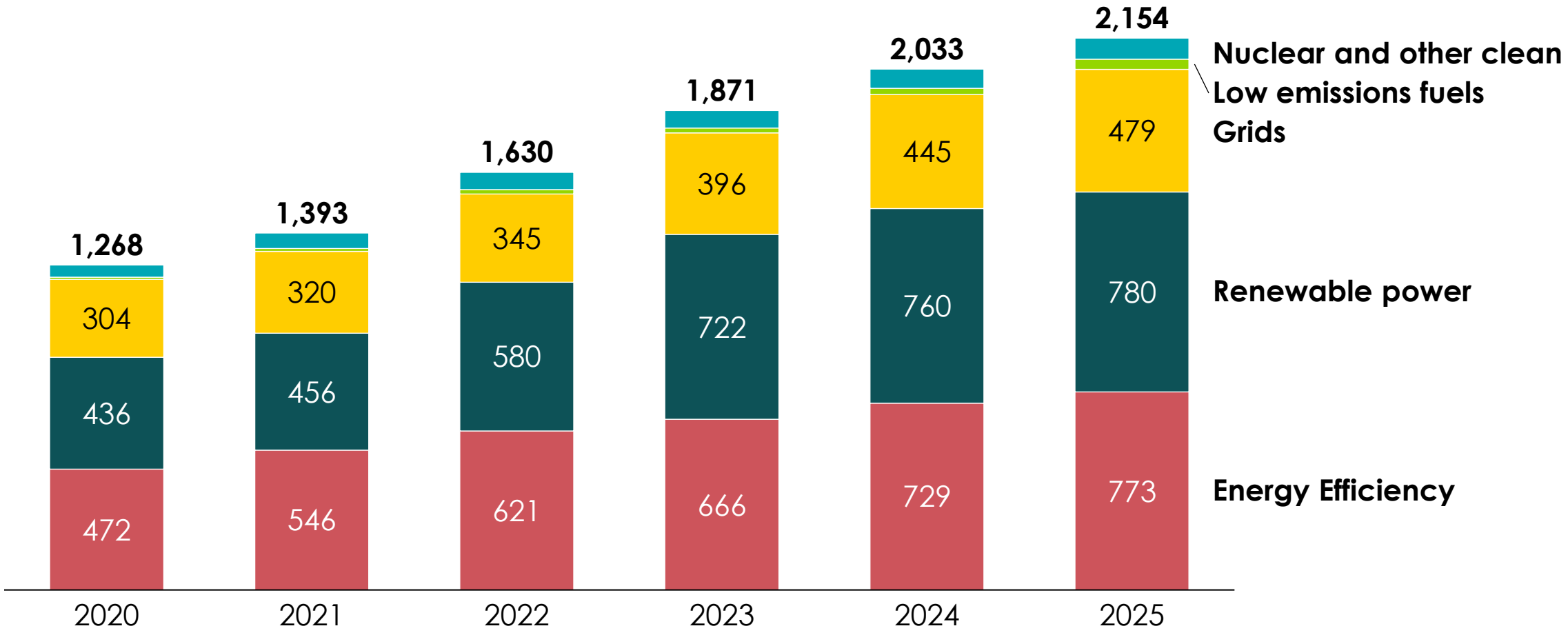
Trillion $



Source: ETC (2023), *Financing the Transition.*

Clean energy investment, 2020-2025

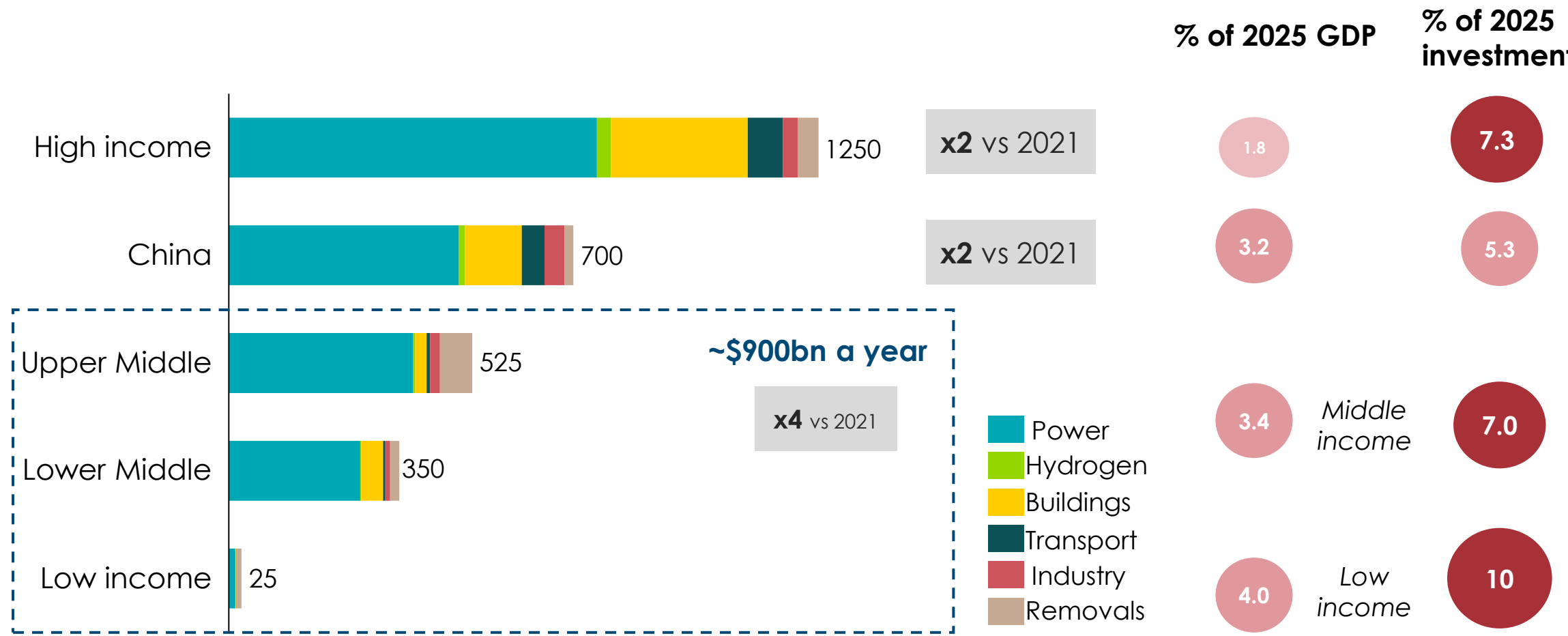
$bn



Source: IEA (2025), *World Energy Investment 2025.*

Required investment by country type, 2026-2030

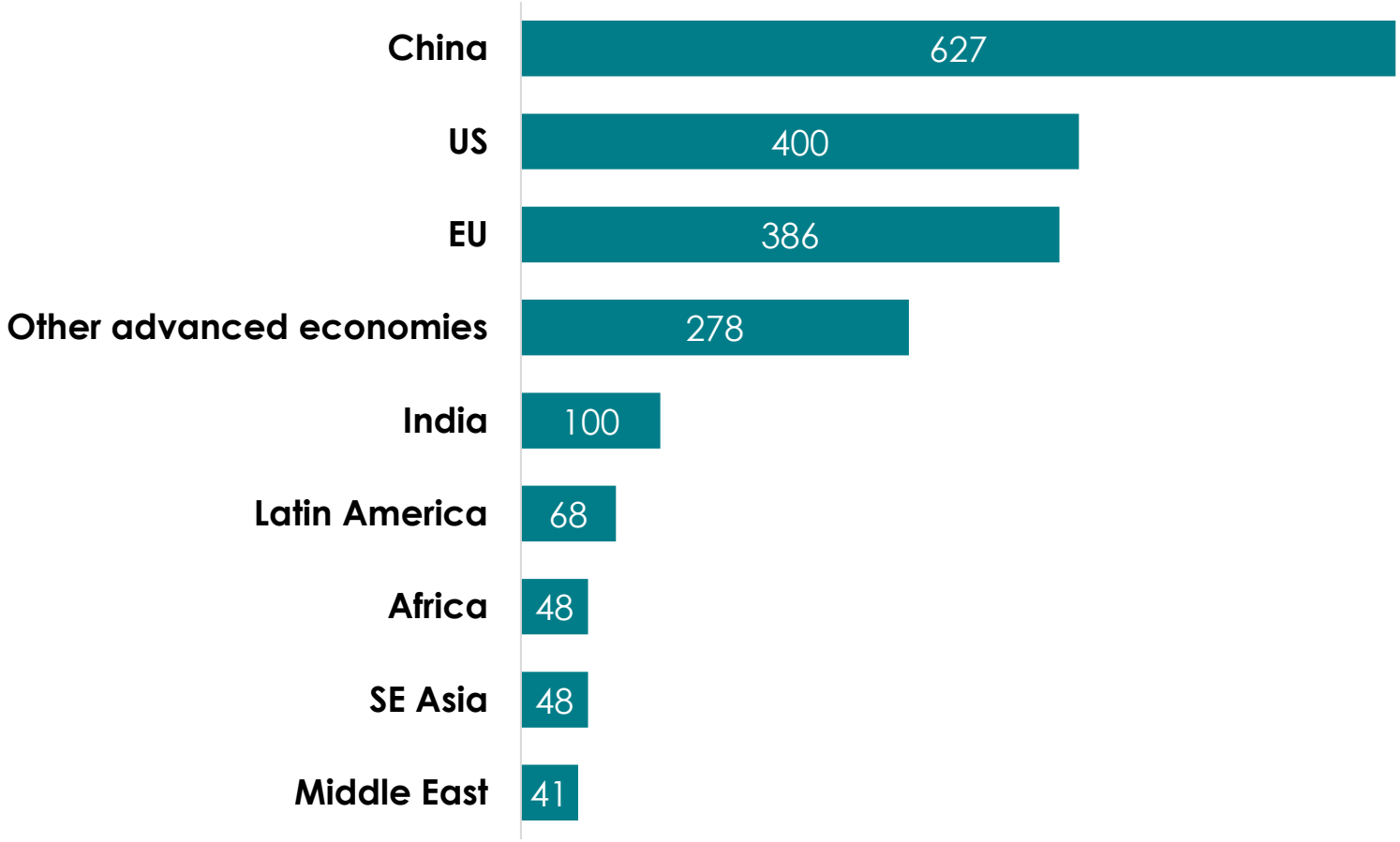
USD billion per annum



Note: 2025 GDP projections based on GDP in market exchange rate terms. Total investment is assumed to grow in line with GDP.
Source: SYSTEMIQ analysis for the ETC (2022); SYSTEMIQ (2021), *Investments for green recovery and transformational growth 2020–30: Technical Note;* IMF (2022), *World Economic Outlook October 2022.*

Clean energy investment 2025

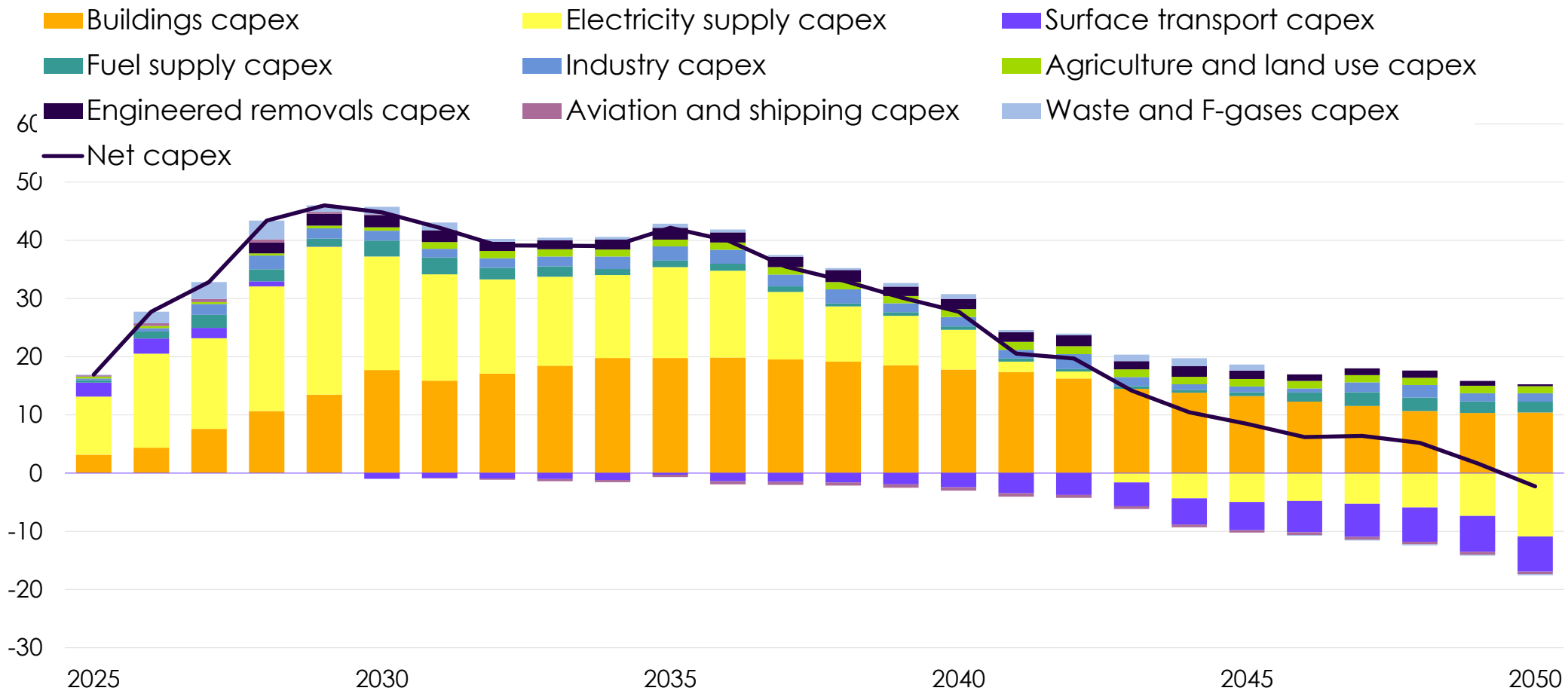
$bn



Source: IEA (2025), *World Energy Investment 2025*.

Additional investment to deliver UK net zero by 2050 commitment

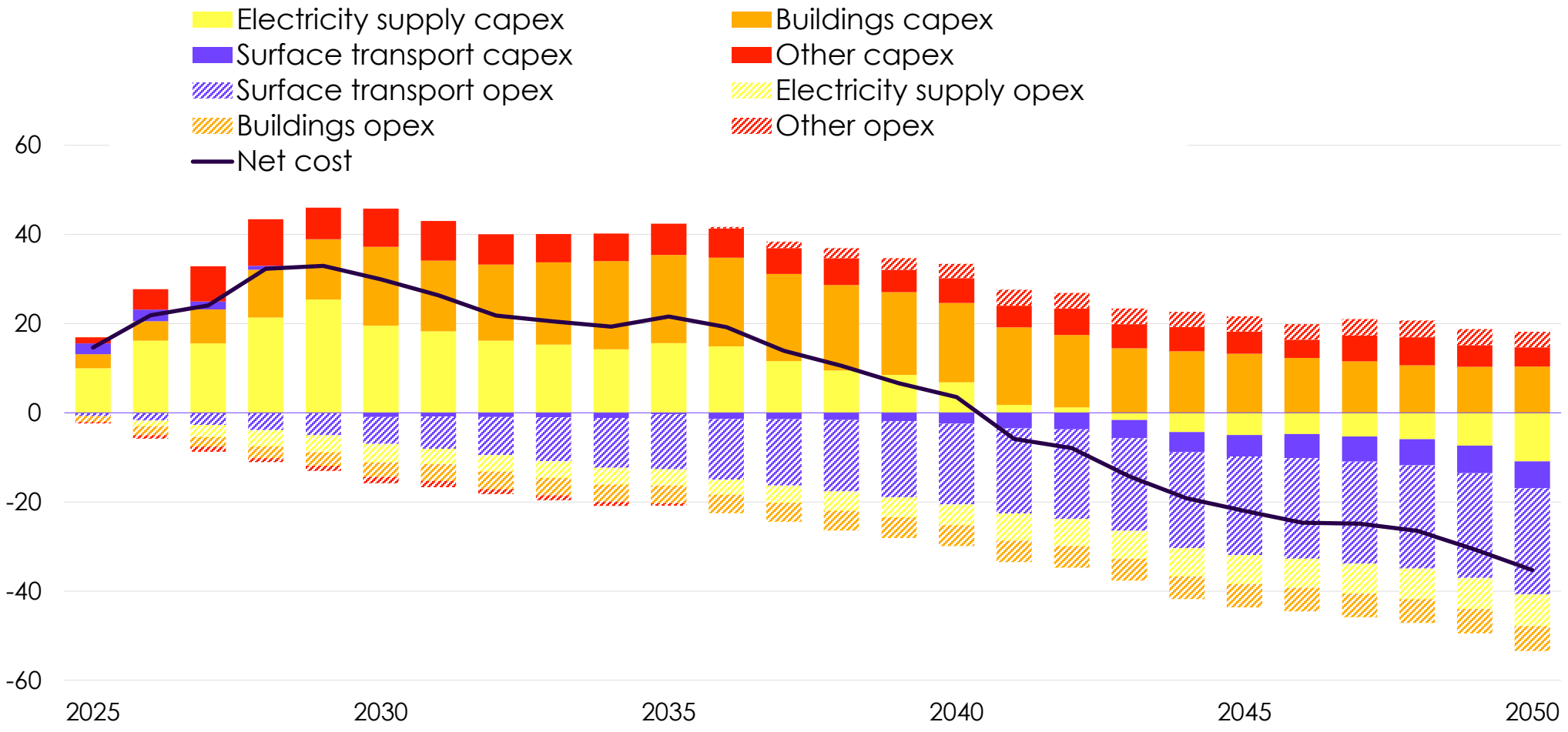
£bn/yr



Source: CCC (2025), *The Seventh Carbon Budget*.

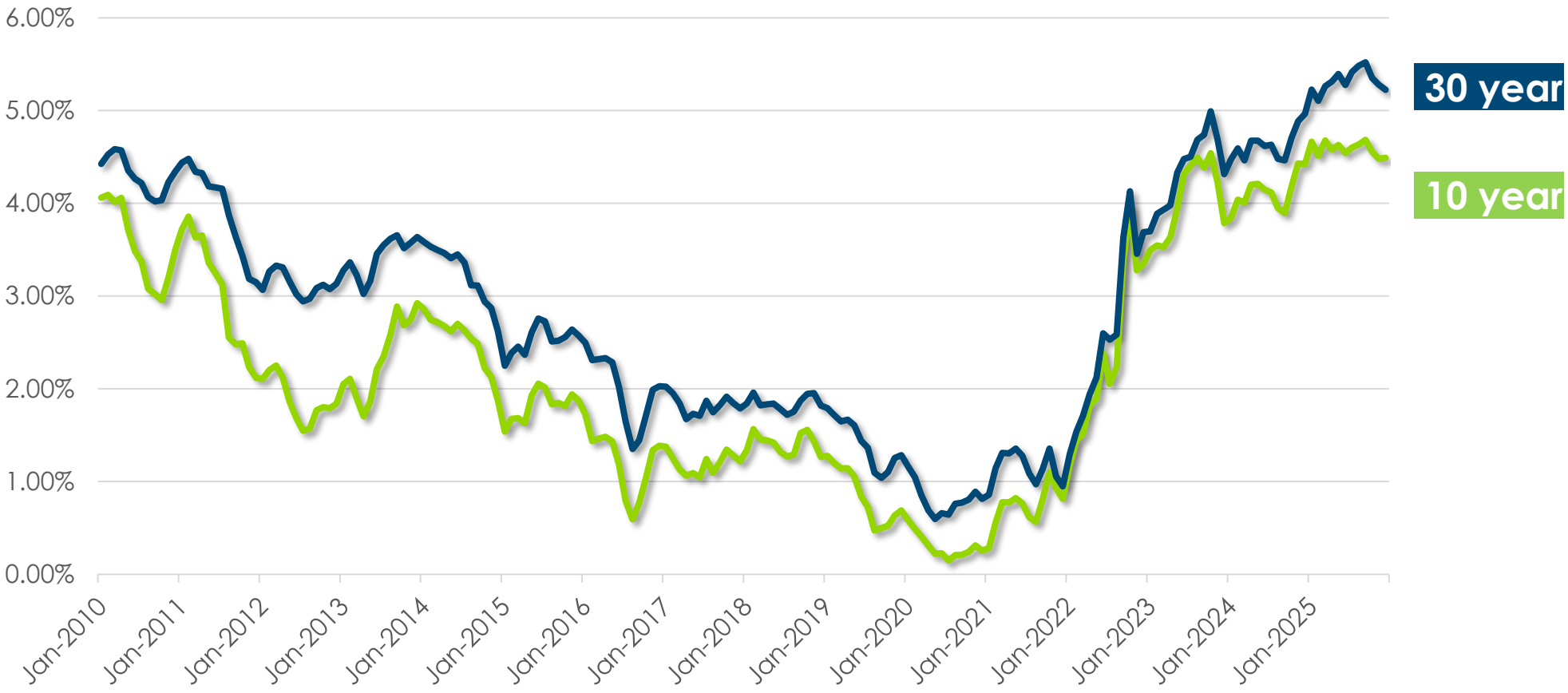
Increased investment vs operating cost savings in UK path to net zero emissions

£bn/yr



Source: CCC (2025), *The Seventh Carbon Budget*.

UK 30- and 10-years gilt yields 2010-2026



Source: UK Debt Management Office (2025), *Gilt Market Data.*

Rising prices at UK offshore auctions

£ per MWH, 2024 prices

AR 4 2022

11 GW awarded @ £37.5 per MWh (2012 prices)

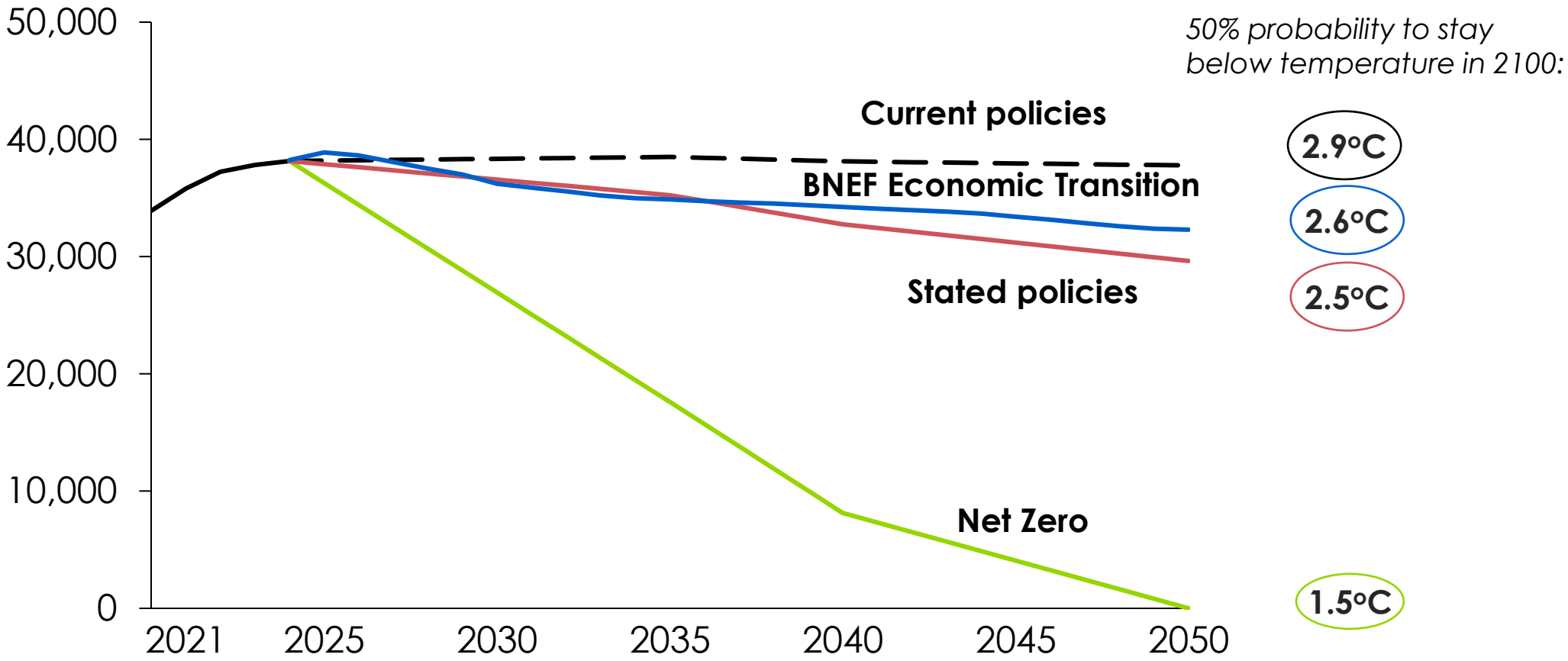
AR 7 2026

8.4 GW awarded @91.2 per MWh

Source: UK Department for Energy Security and Net Zero (2025), *Contracts for Difference (CfD) Allocation Round 7: results.*

IEA and BNEF emission scenarios 2024 and implied peak temperature

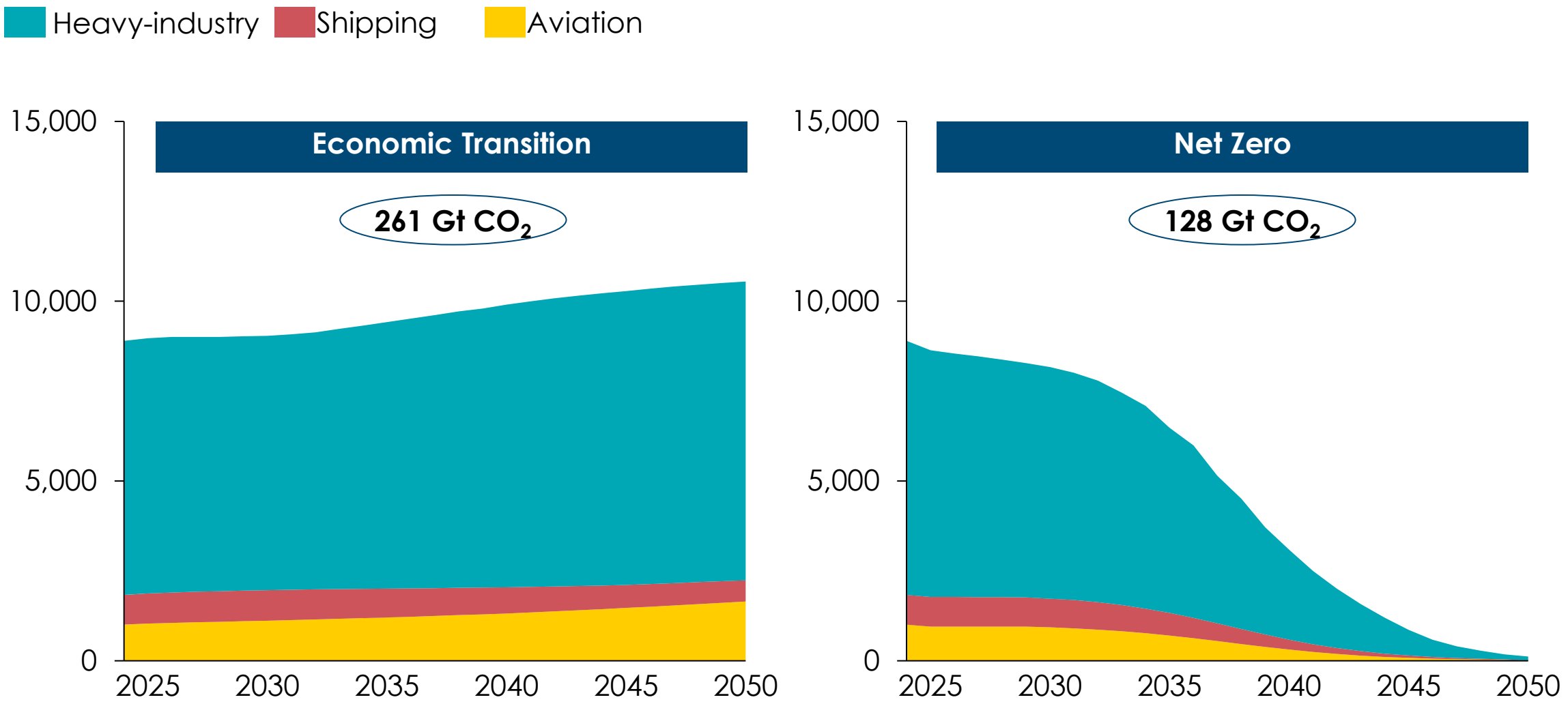
Energy-related Mt CO_2



Note: IEA Scenarios have emissions interpolated between 5-10 years.
Source: IEA (2021), *Net Zero by 2050*; BNEF (2025), *New Energy Outlook 2025*.

Emissions from energy-intensive industries, BNEF Scenarios

Mt CO_2

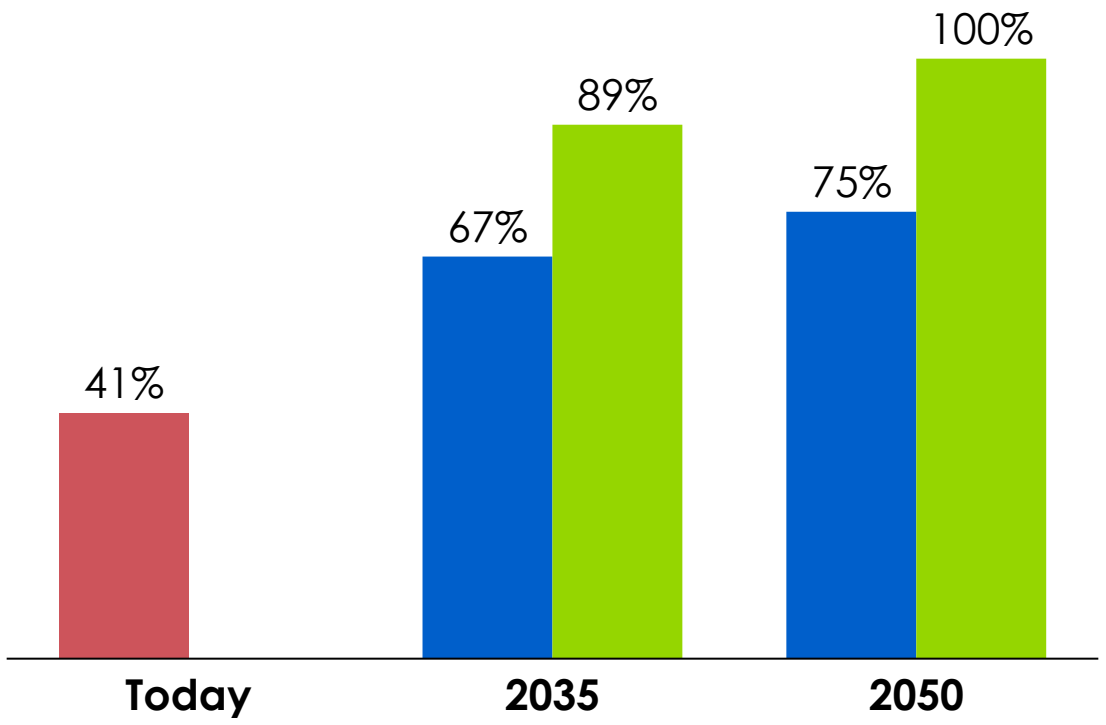


Source: BNEF (2025), *New Energy Outlook 2025.*

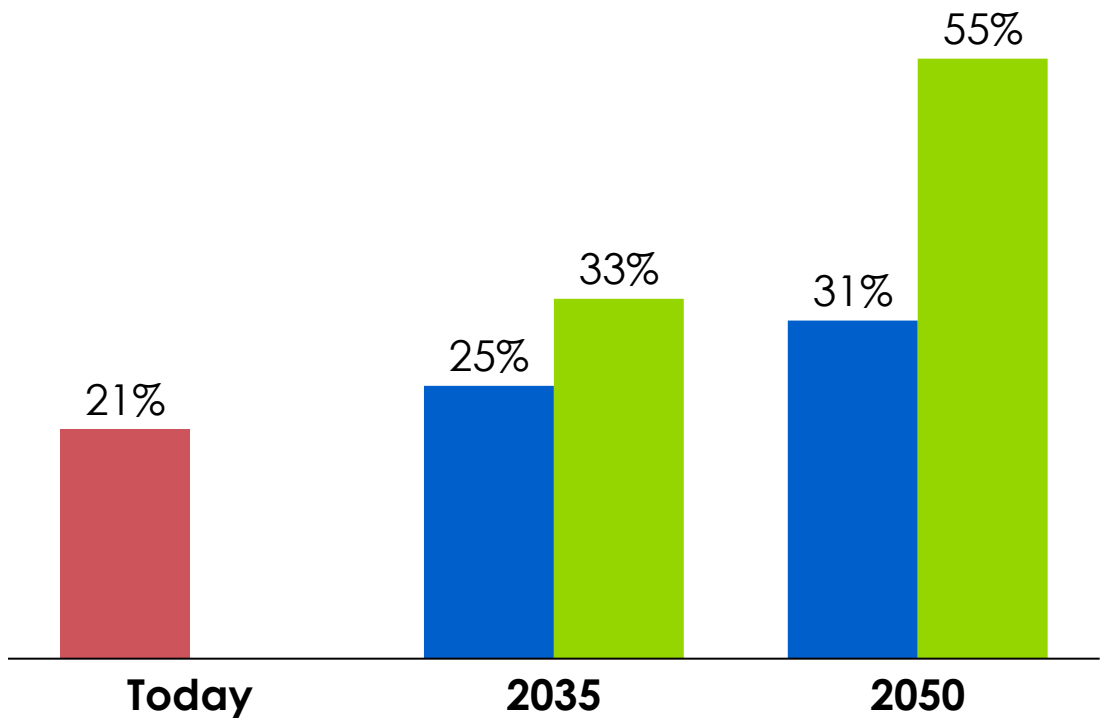
Electrification and clean generation

BNEF Economic Transition IEA Net Zero

Clean Generation as share of Electricity Supply



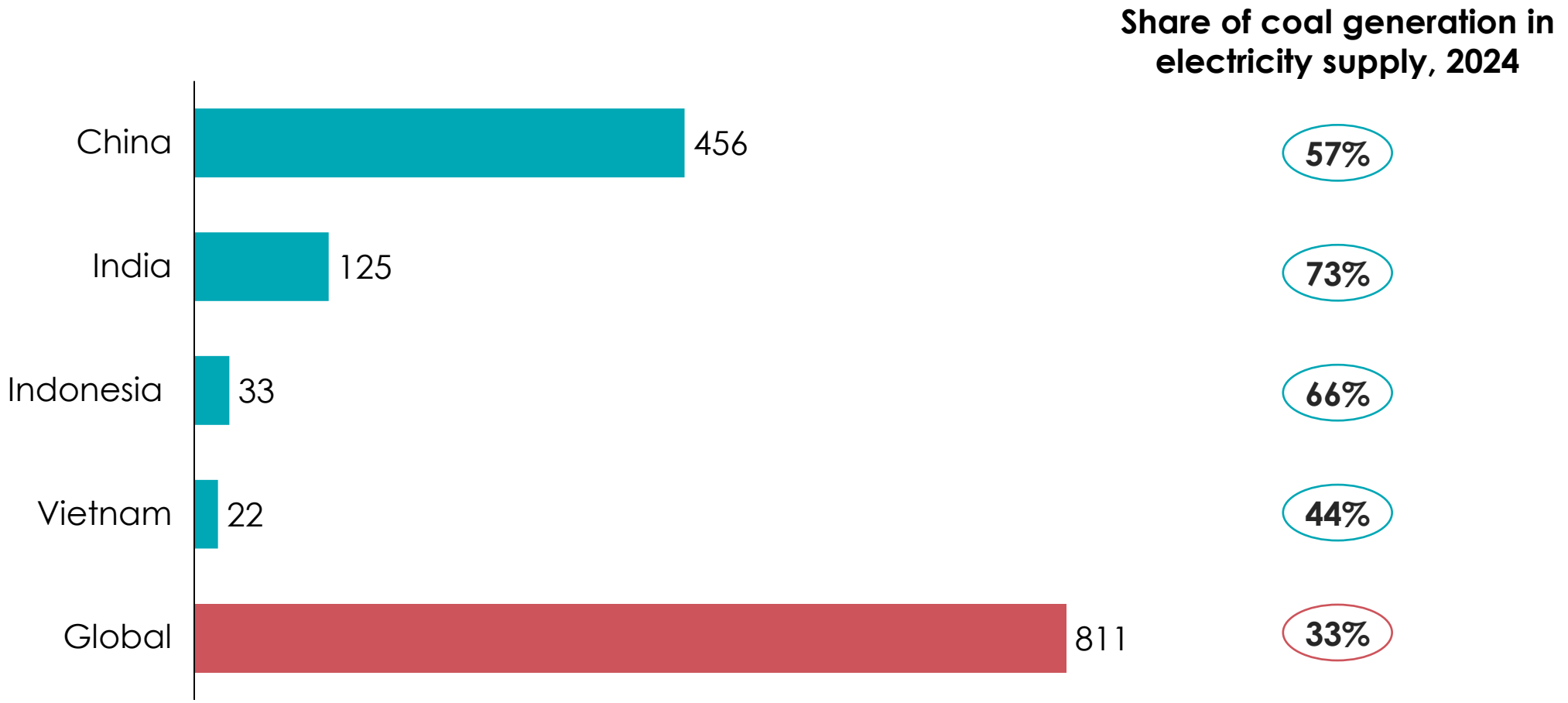
Electricity as share of Energy Demand



Note: Clean generation includes nuclear and abated fossil fuel.
Source: BNEF (2025), *New Energy Outlook*; IEA (2025), *World Energy Outlook 2025*.

Added coal capacity 2014-2024

GW



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

Cost of early coal phase out: illustration

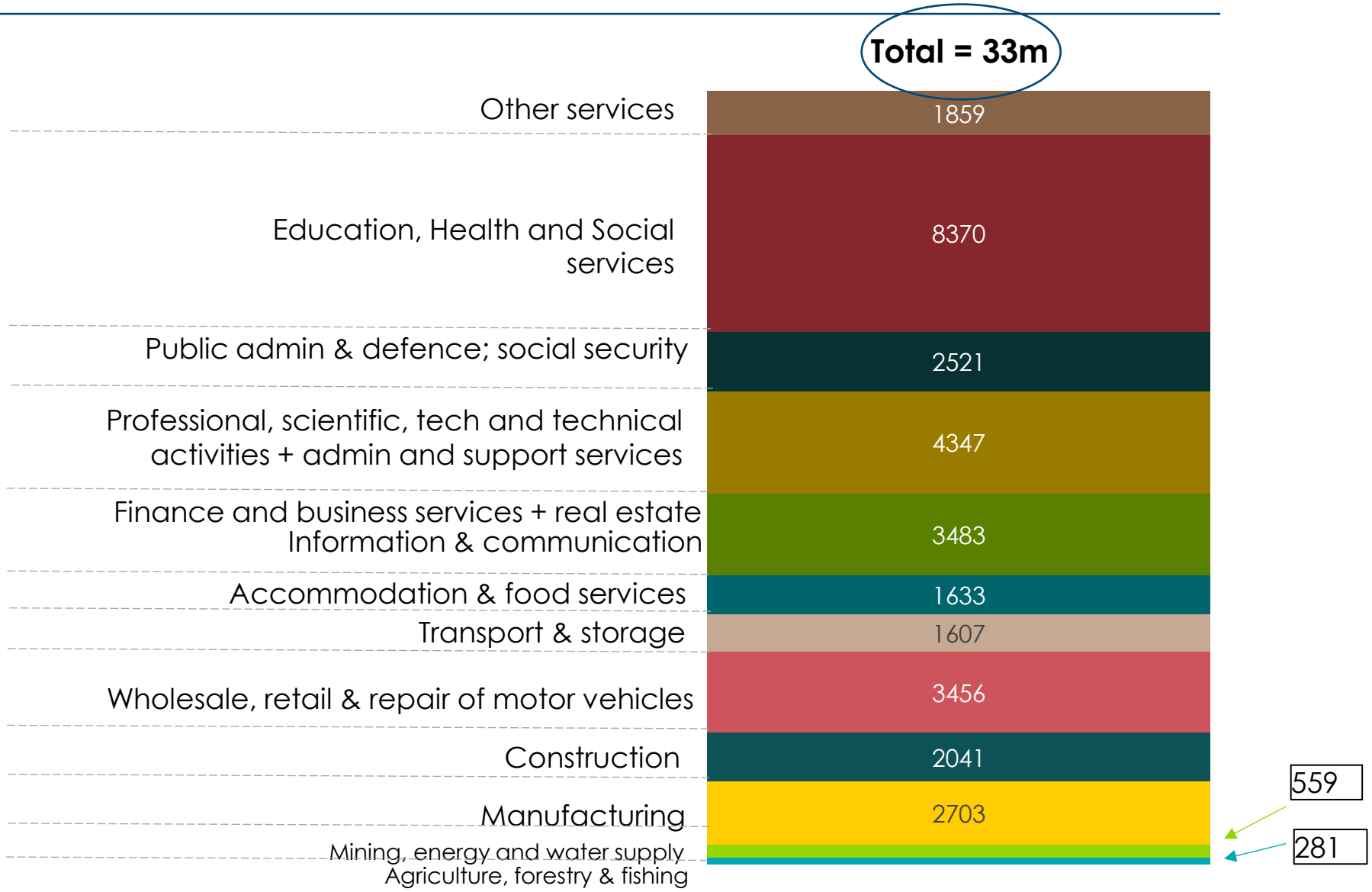
Source: ETC (2023), *Financing the Transition.*

4 big misses in the 2020s

Required action in 2020s for 1.5°C limit	Early run down of existing coal generation	End of deforestation	Methane emission reduction	Carbon removals
				
Required reductions in annual emissions (2021-2030) *Gt CO2e*	-3.5	-3.6	-4.6	-3.5
Actual change in annual emissions (2021-2024) *Gt CO2e*	0.2	0.9	-0.1	-0.1

Notes: Methane emissions expectations only account for NDCs and Global Methane Pledges commitments; *MSCI CDR credit volume calculated by multiplying projected market size ($) by ETC average cost of carbon removal in each year ($/tCO$_2$).* Source: ETC (2021), *Assessing the commitments from COP26*; ETC (2021), *Keeping 1.5°C Alive*; WRI (2025), *Deforestation and Restoration Targets Tracker* (Beta); IEA (2025), *World Energy Outlook 2025*; MSCI Carbon Markets (2025), *Frozen Carbon Credit Market May Thaw as 2030 Gets Closer*; Crippa et al. *(2025), GHG emissions of all world countries - 2025 Report.*

UK employment by industry, April – June 2024



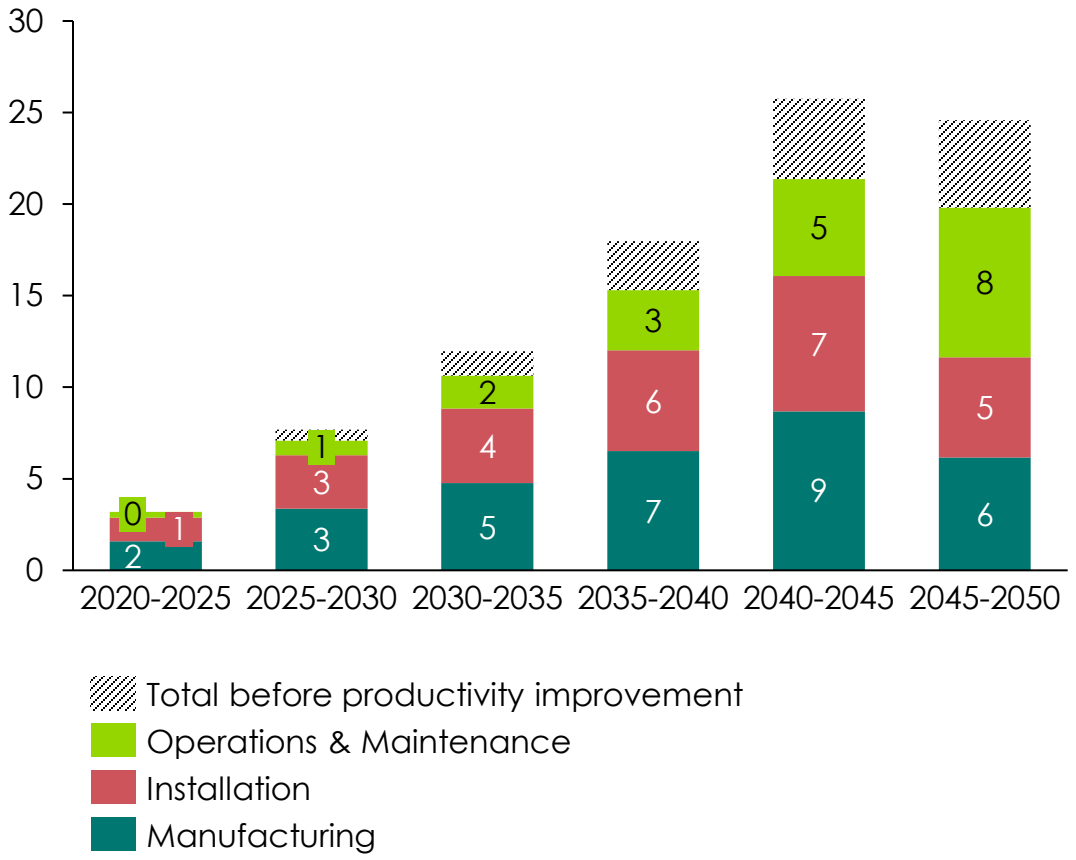
Source: ONS (2026), *EMP13: Employment by industry.*

Making solar panels

Employment creation in renewable power

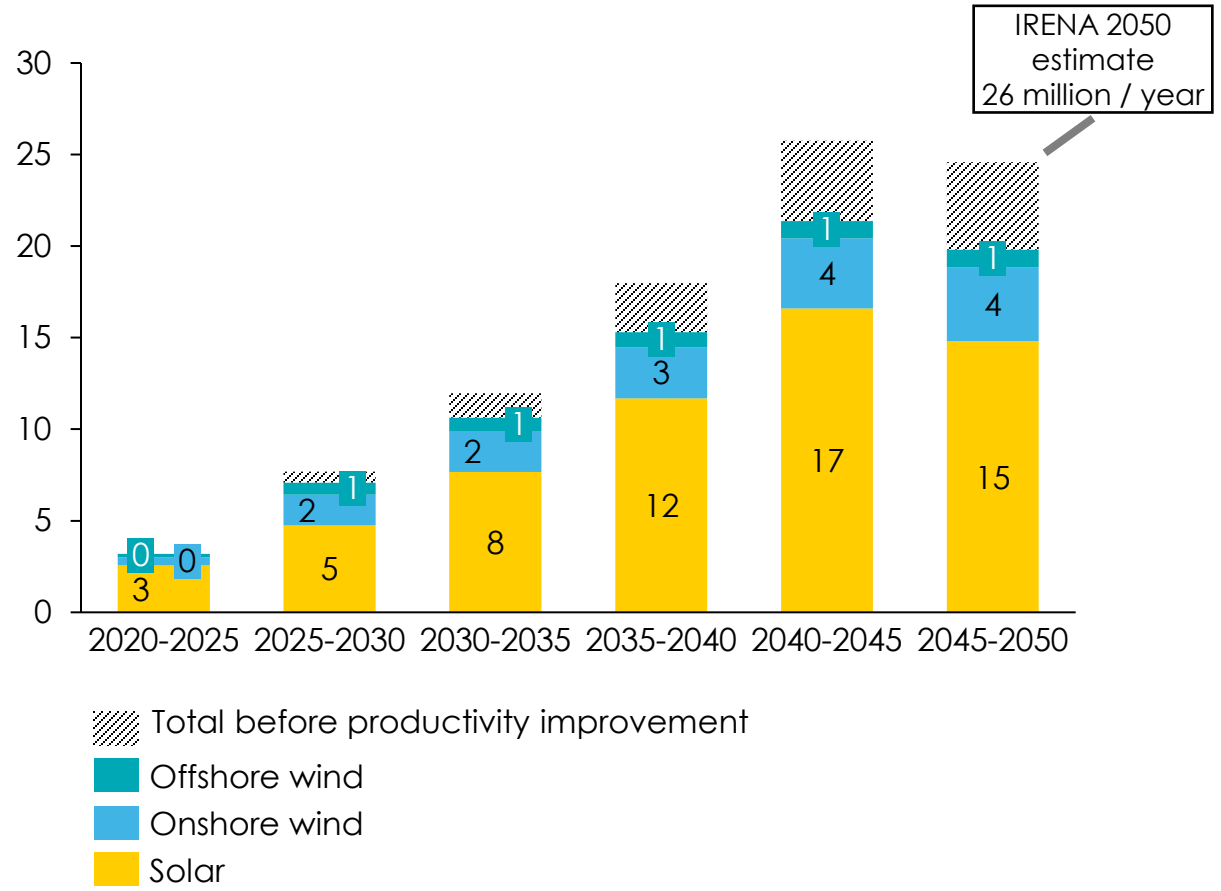
Global jobs by type

Millions



Global jobs by technology

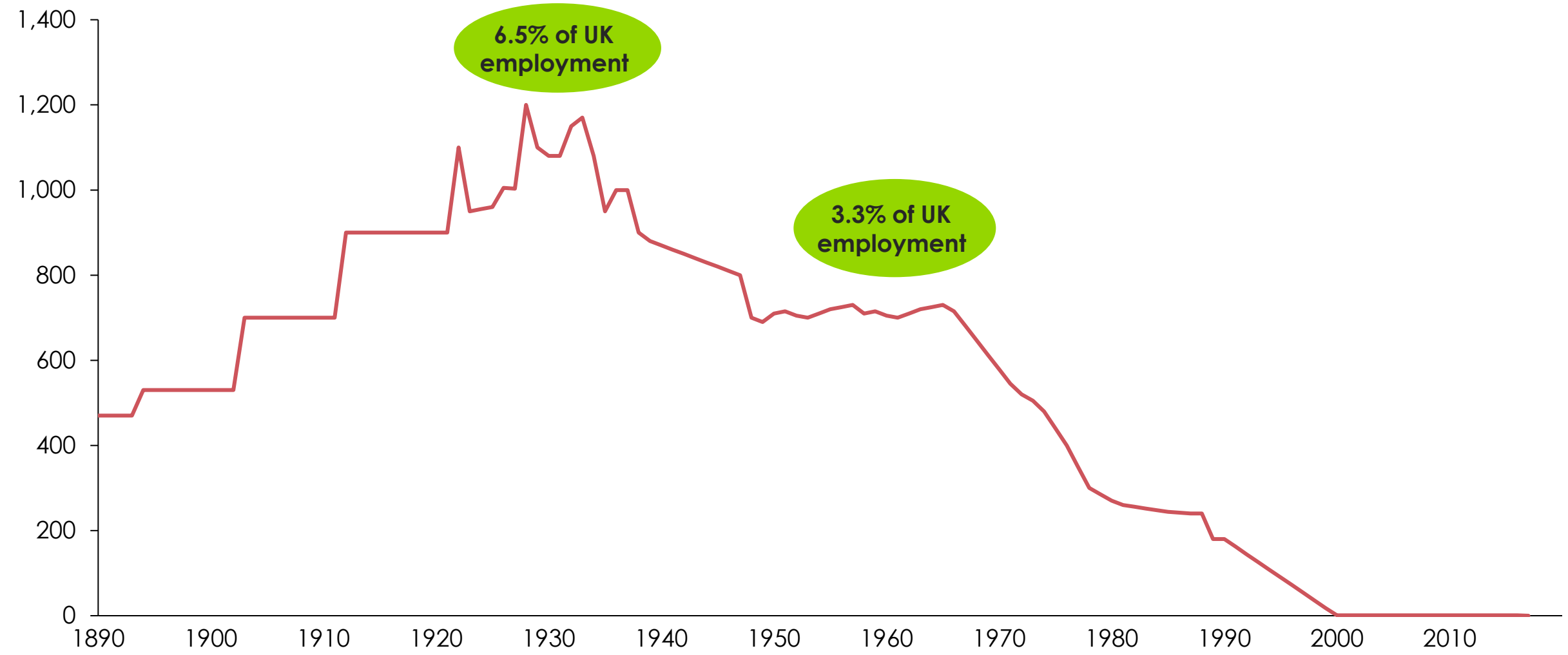
Millions



Source: ETC (2021), *Making Clean Electrification Possible*.

UK employment in coal mining 1880-2010

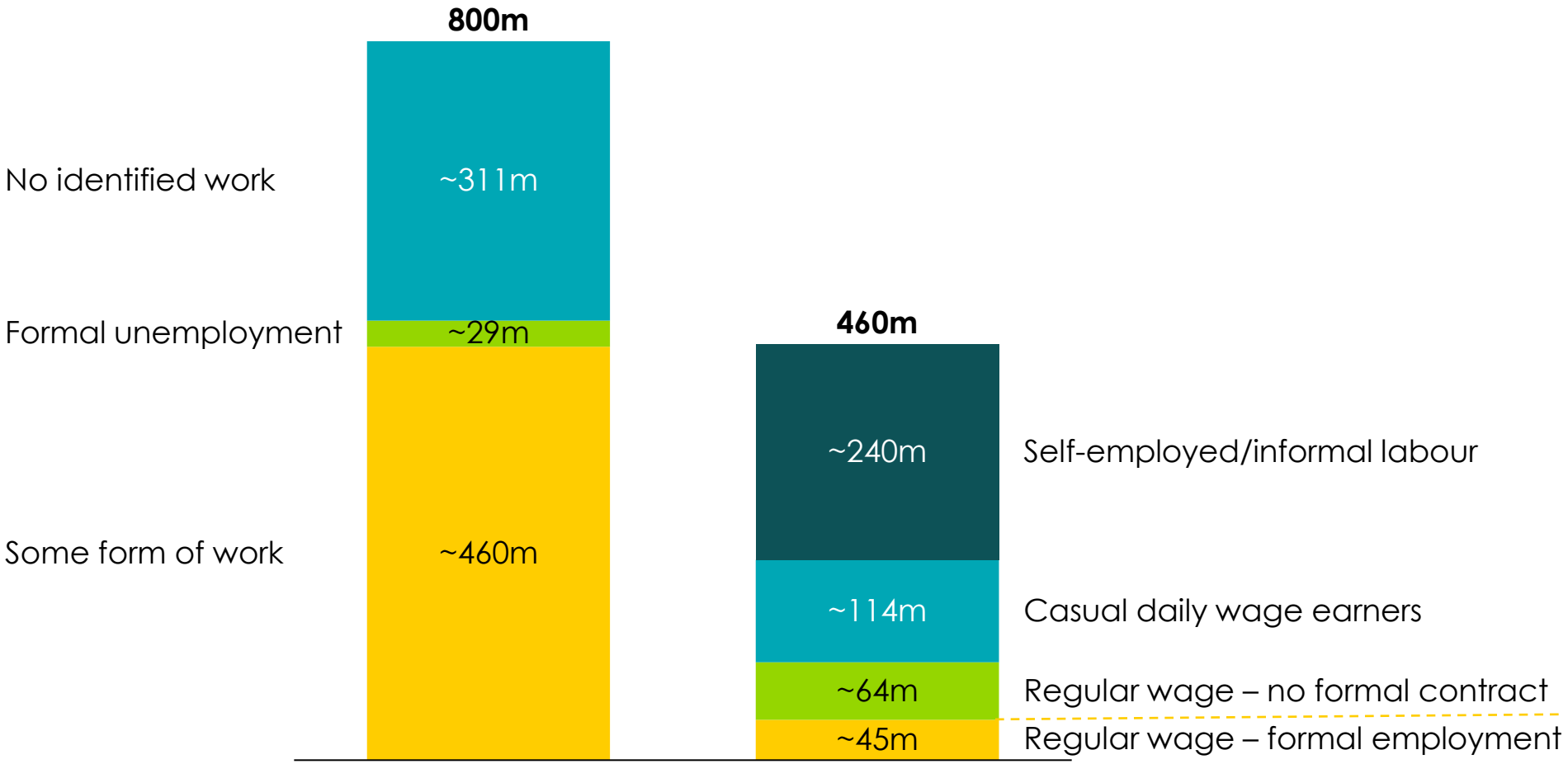
Thousands of jobs



Source: Gov.UK (2025), Historical coal data: coal production, availability and consumption 1853 to 2024

India's job creation challenge

Working age population (2019)



Change from 2012-2019

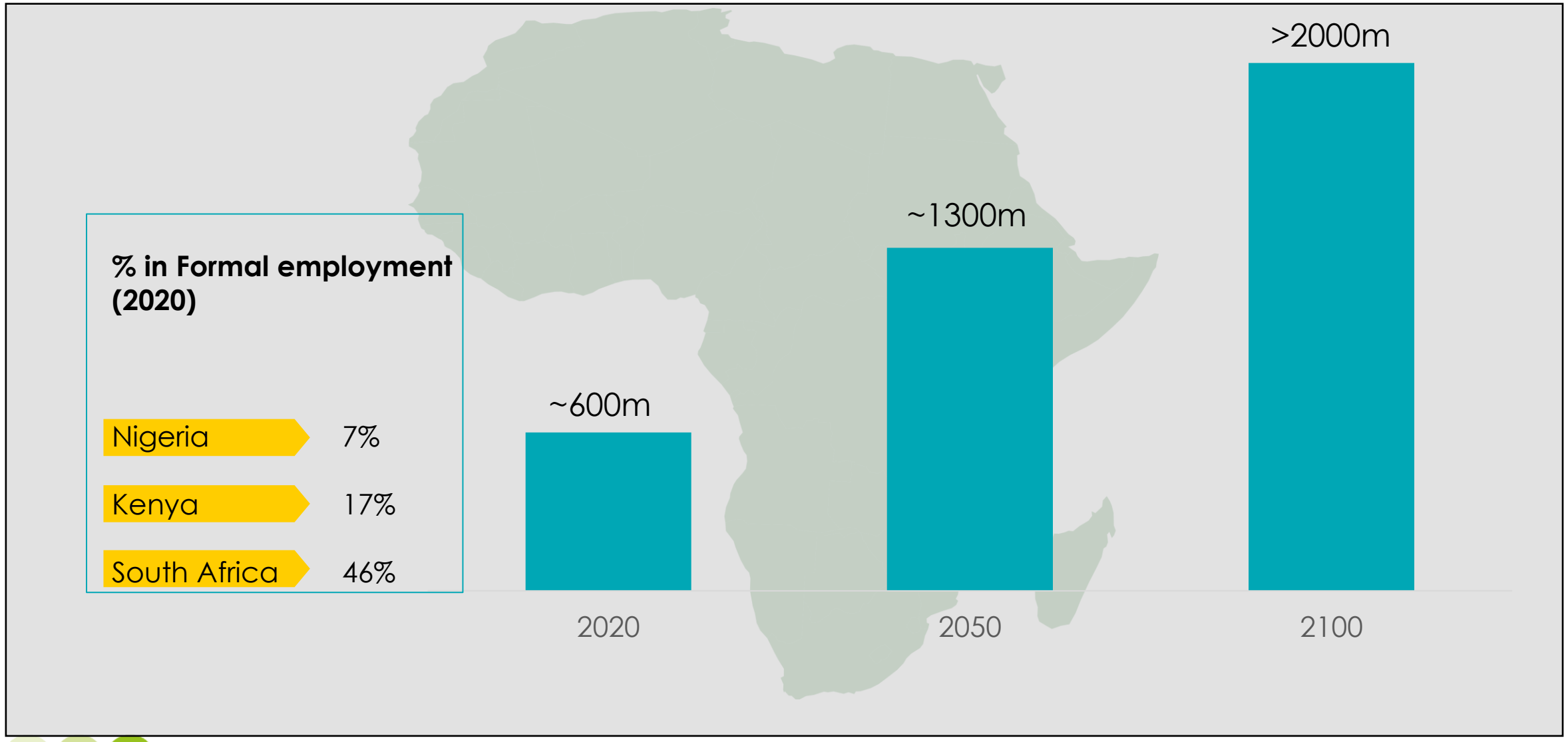
GDP + 58%
(6.7% per annum)

Working age population + 130m

Identifiable employment + 2m

Source: Azim Premji University (2023), The State of Working India, Centre for Sustainable Employment,

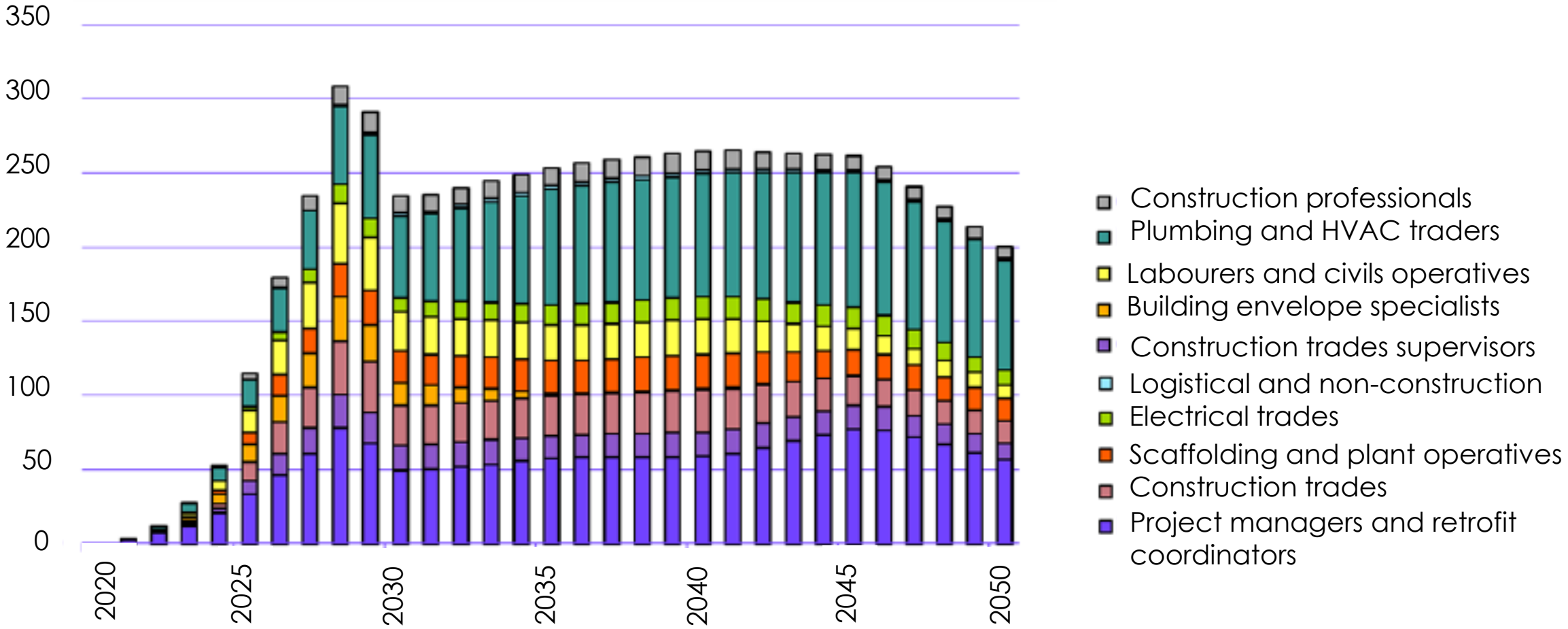
Africa working age population



Source: ACEIR (2023), *Demographic Challenges for Global Labor Markets in the 21st Century, Africa in a Changing World*

Additional UK full-time equivalent jobs above 2019 levels

Climate Change Committee forecasts, 2020



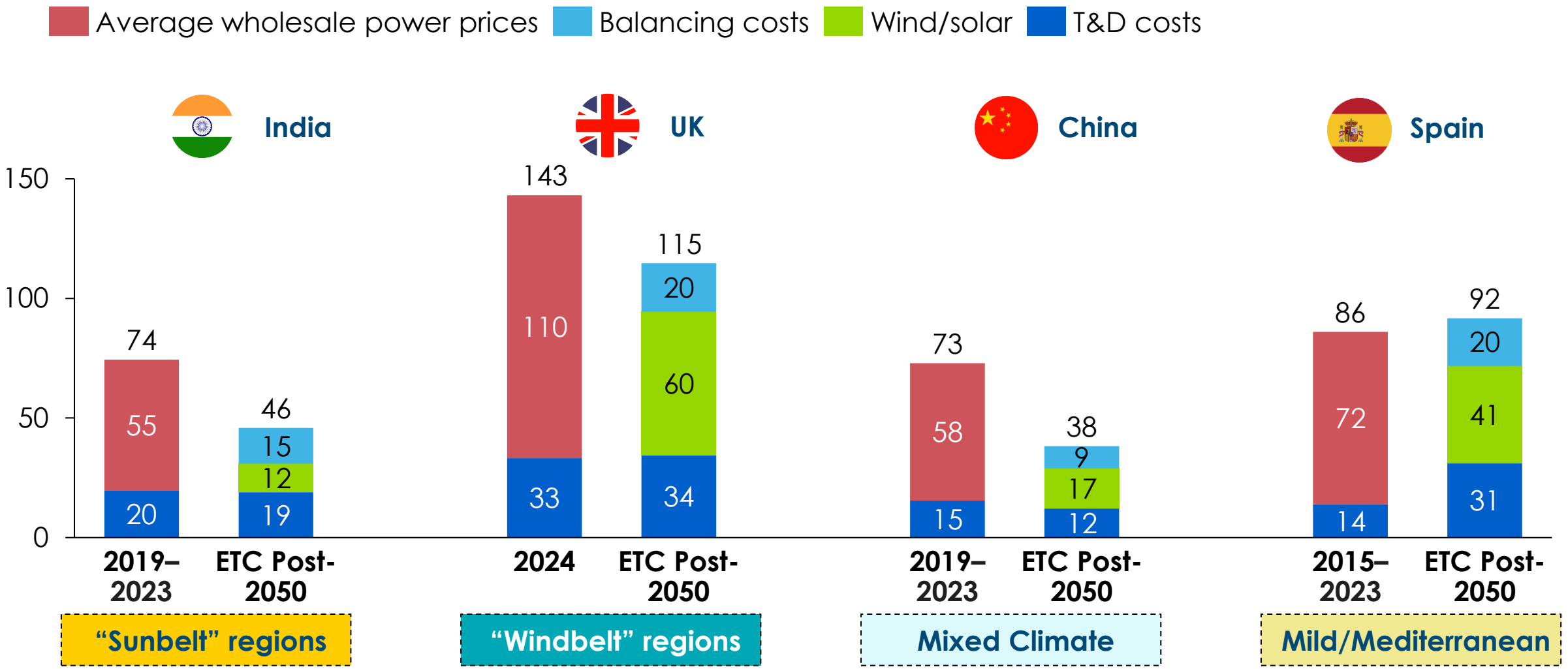
Source: Climate Change Committee (2020), *The Sixth Carbon Budget*


INSTAVOLT


Carrier

Total system costs (generation, balancing, and grids), recent vs post-2050

$/MWh (real 2024$)



Note: T&D = Transmission and distribution.
Source: ETC (2025), *Power Systems Transformation: Delivering Competitive, Resilient Electricity in High-Renewable Systems.*

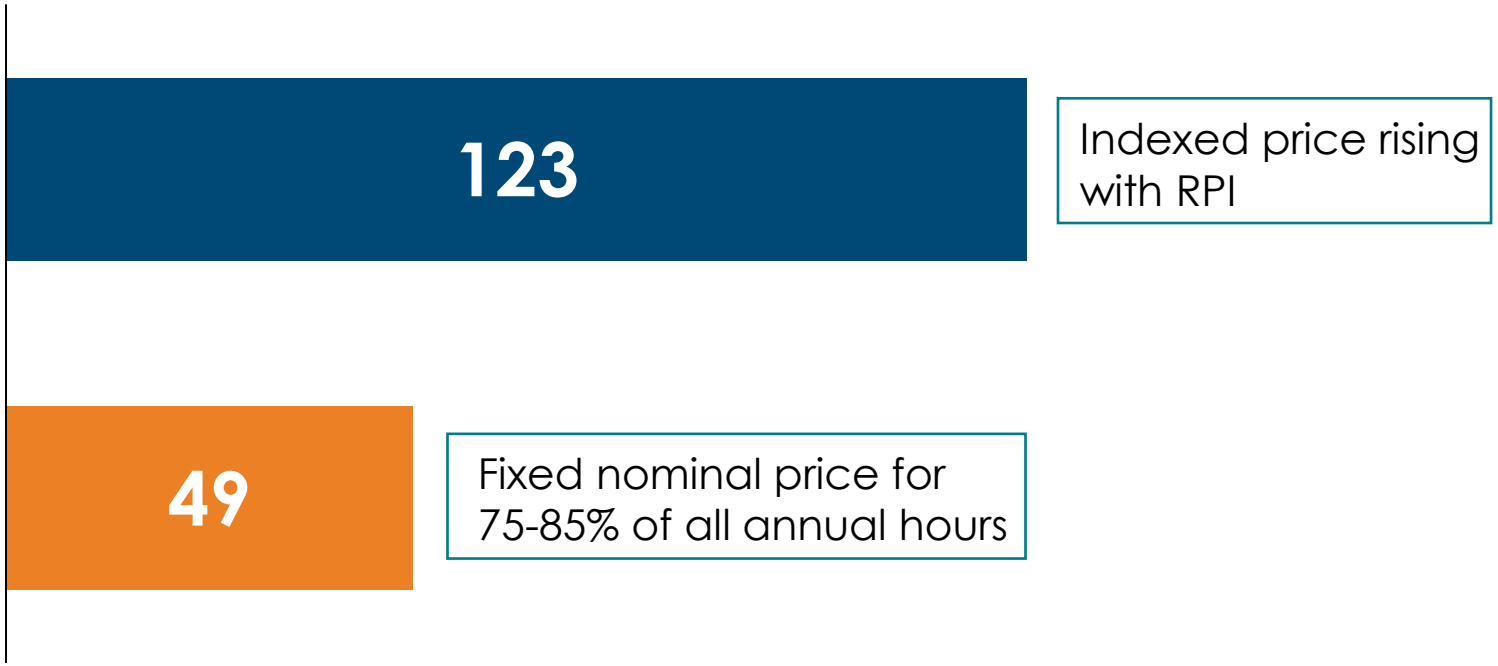
Clean power auctions in UK and India

$ per MWH price

UK January 2026

AR 7 Offshore wind

8.4 GW awarded @ £91.2 per MWh



India November 2025

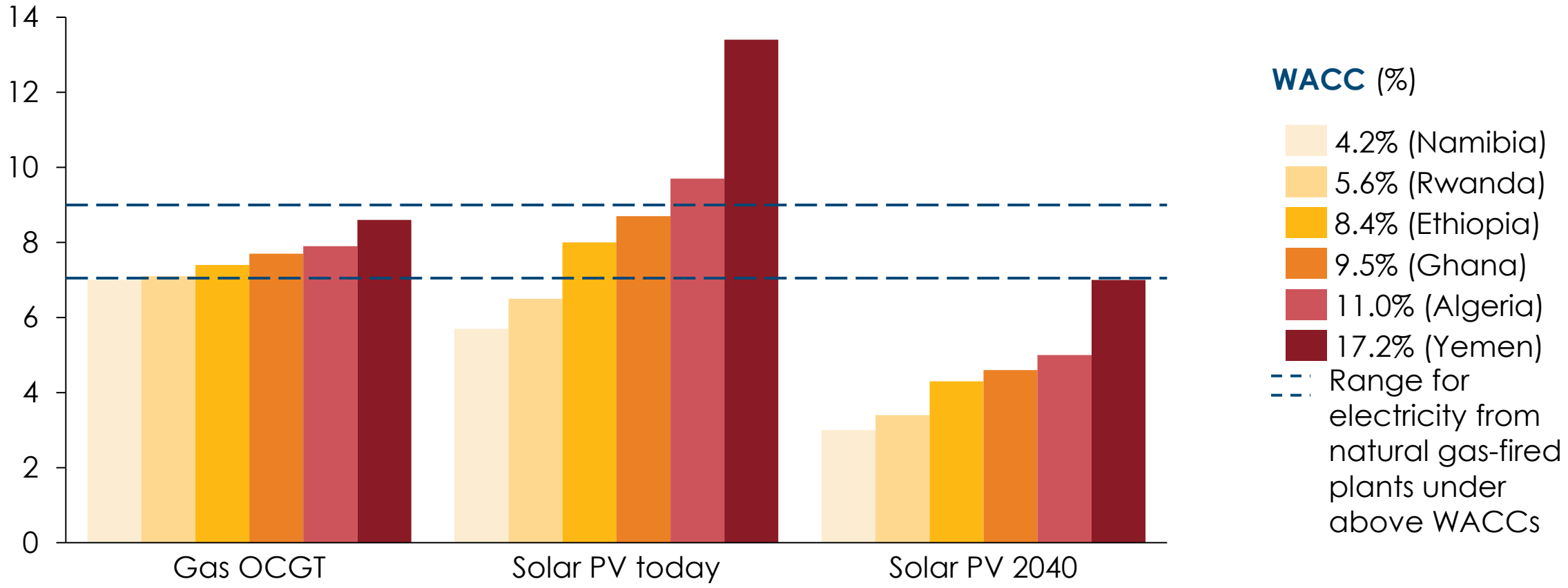
REMCC round the clock

1GW awarded @ ₹4.33 per kWh

Source: MERCOM (2025), *Renewable Power Auction*; UK Government (2025), Contracts for Difference (CfD) Allocation Round 7: results.

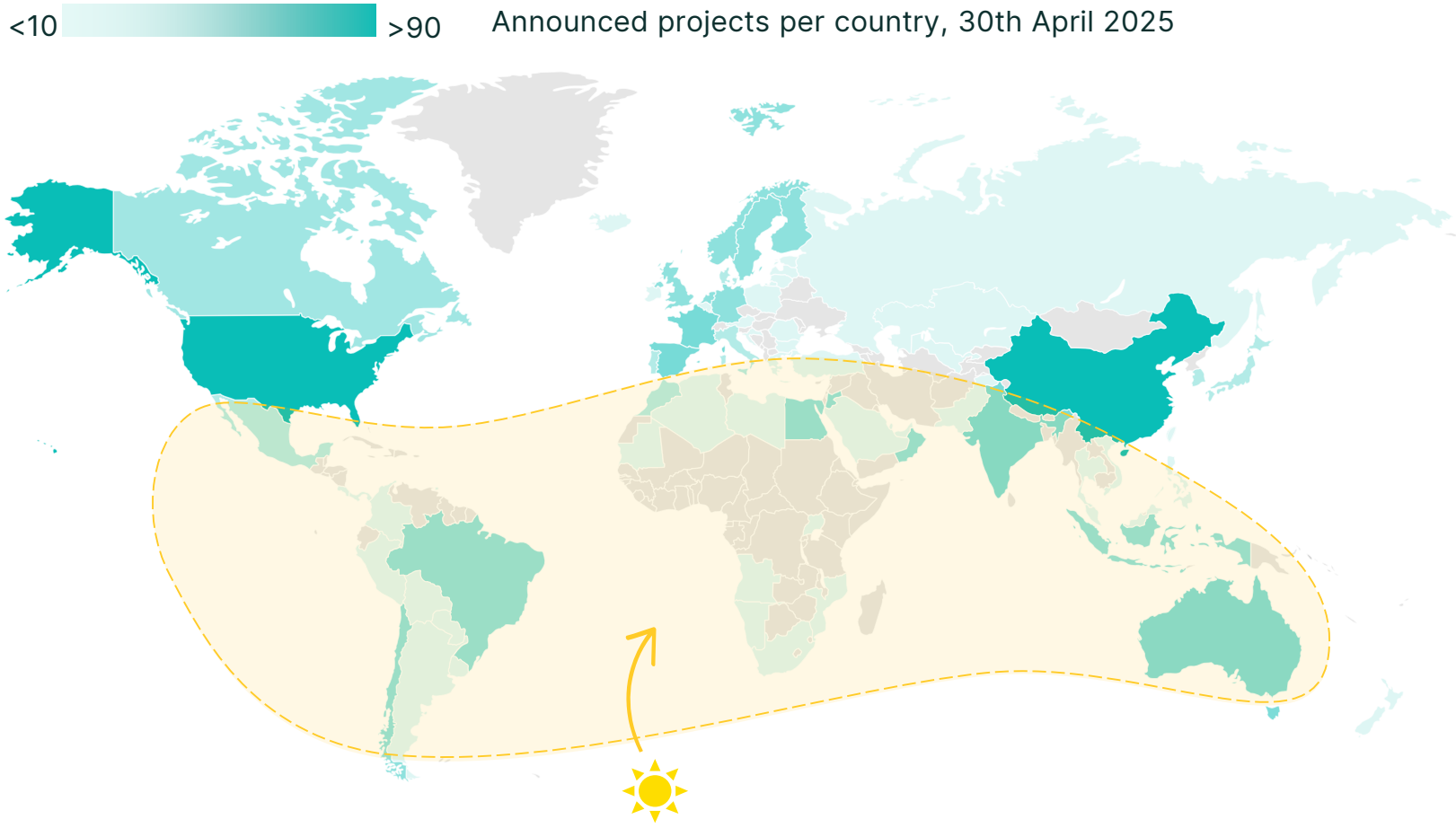
Levelized cost of energy

USD ct/kWh



Sources: All values on CAPEX, OPEX, and fuel costs are taken from IRENA (2021b) and expressed in 2015 U.S. dollars; we used the 2015 fuel costs for natural gas from the same source. Other assumptions included a 35-year lifetime for OCGT plants and a 30-year lifetime for solar PV (Oyewo et al. 2022), a 40% efficiency and 50% average capacity factor for OCGT plants, and a 19% average capacity factor for solar PV plants. (The CF of solar PV differs from country to country, although typically by a few percentage points at most [Sterl et al. 2022]). The WACC values represent the real (inflation-adjusted) 2021 numbers for solar PV on a country-by-country level, and are taken from IRENA (2023b).

Clean industrial projects by location



Total and announced projects

Top 20 countries, by total project count

EMDE country in the new industrial sunbelt

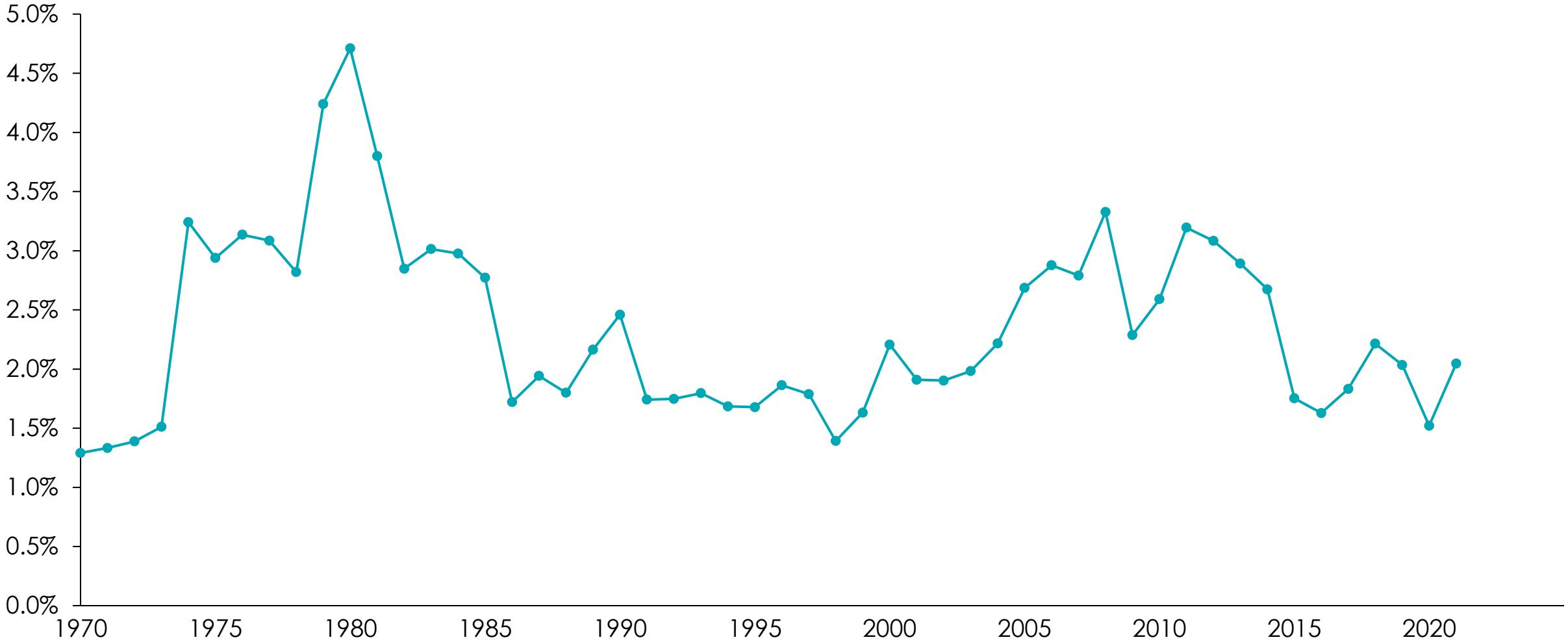
Non-EMDE country in the new industrial sunbelt

Country	Announced	Total*
China	96	142
United States	92	108
Australia	46	48
India	36	41
Canada	25	39
France	34	36
Spain	28	32
Norway	19	27
Egypt	25	25
Brazil	19	23
Sweden	19	22
Germany	18	21
Chile	21	21
Oman	15	17
Jordan	14	14
Netherlands	11	13
Finland	11	13
United Kingdom	13	13
Indonesia	11	12
Mexico	9	9

Includes projects that are at the announced, reached final investment decision (FID) and operational

Source: MPP (2025), *Global Project Tracker Insights.*

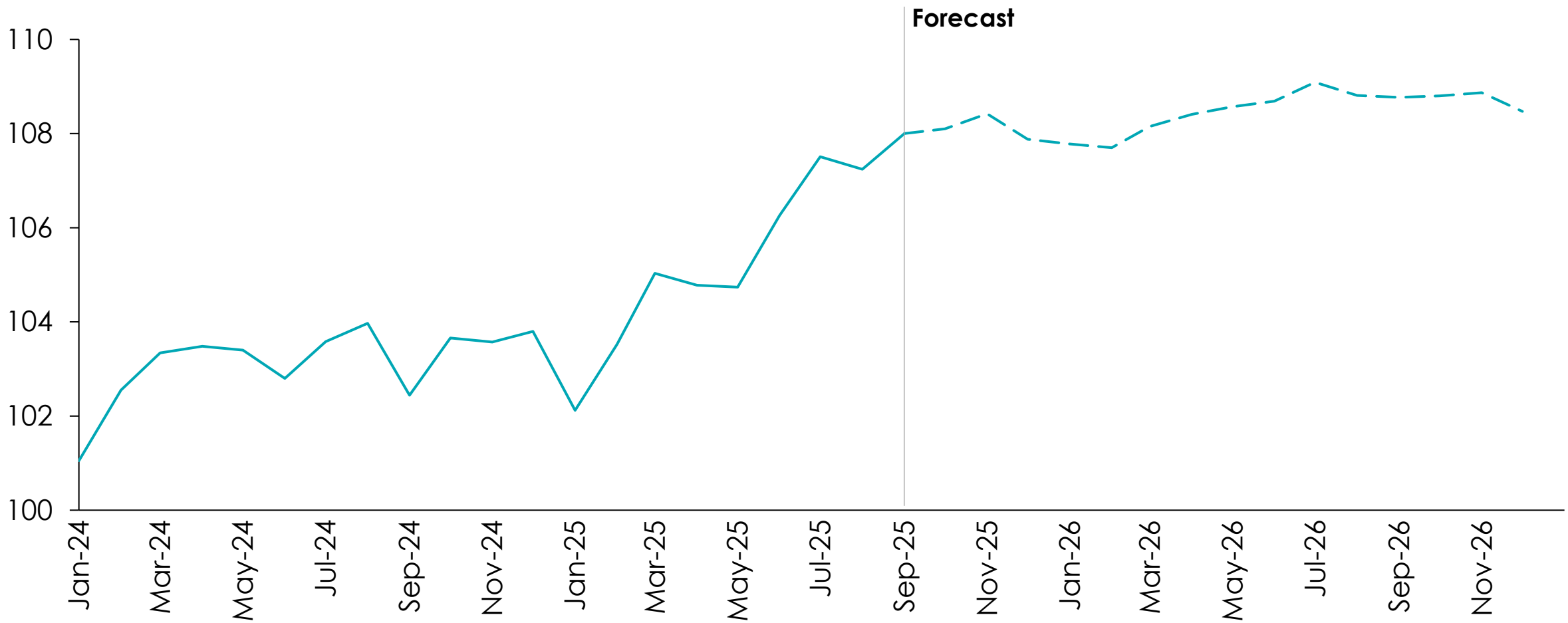
Oil supply economic rents as % of global GDP



Source: World Bank (2025), Data: Oil rents (% of GDP).

Global oil supply, 2024-2026

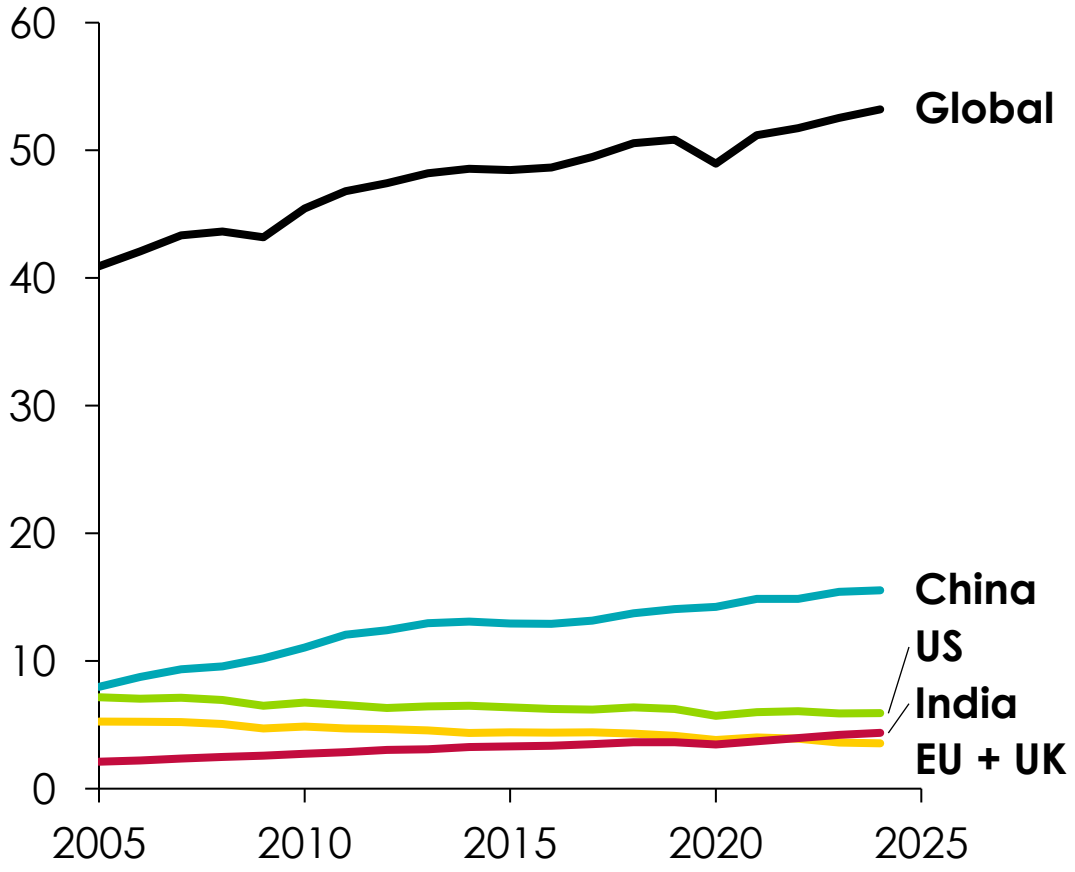
mb/d



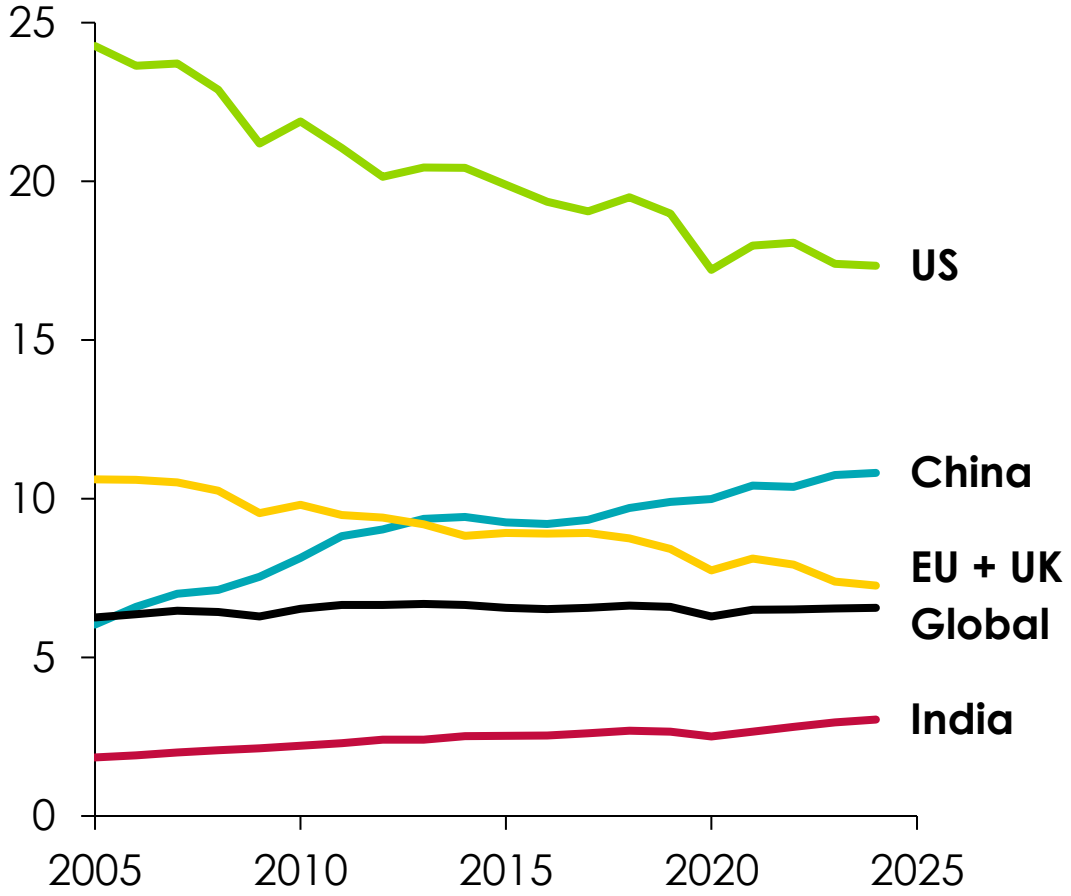
Source: IEA (2025), *As oil market surplus keeps rising, something's got to give.*

Greenhouse gas (GHG) emissions by country

GHG Emissions Gt CO_{2eq}



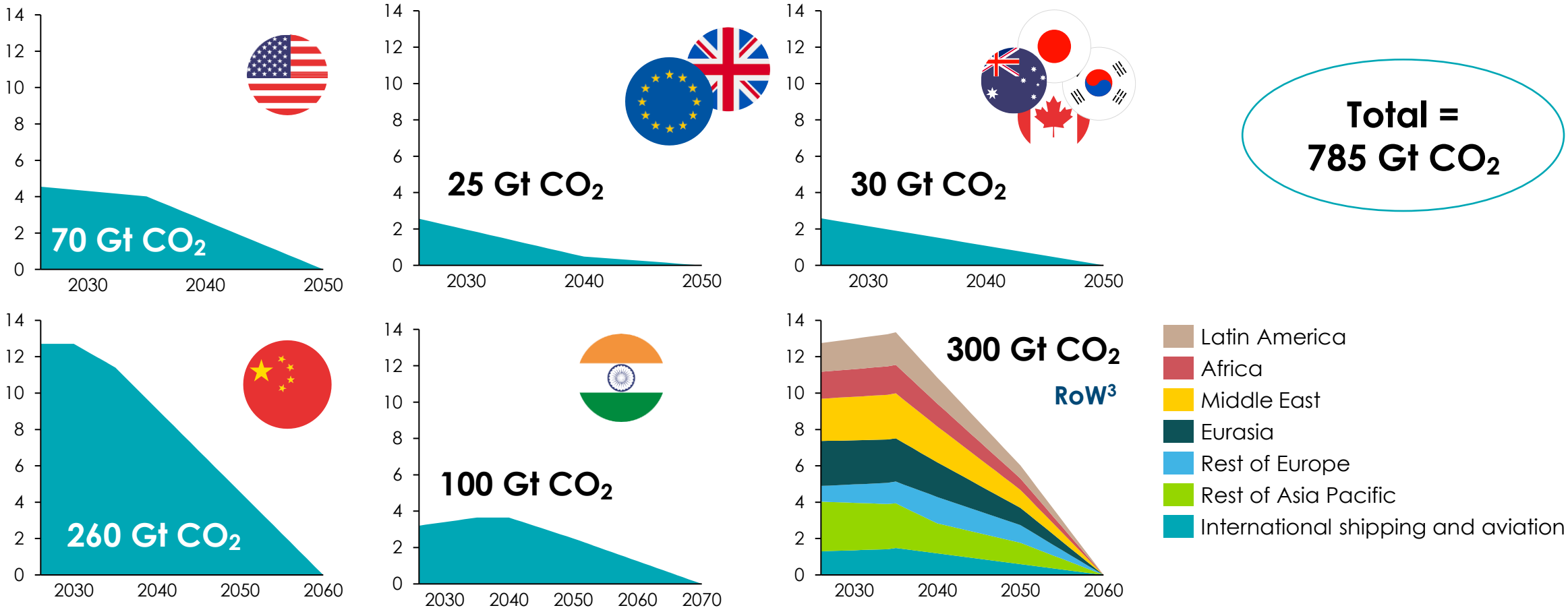
Emissions per capita ($tCO2_{eq}$/per annum)



Source: EDGAR (2025), *GHG emissions of all world countries.*

Cumulative future energy related emissions implied by current NDCs and pledges

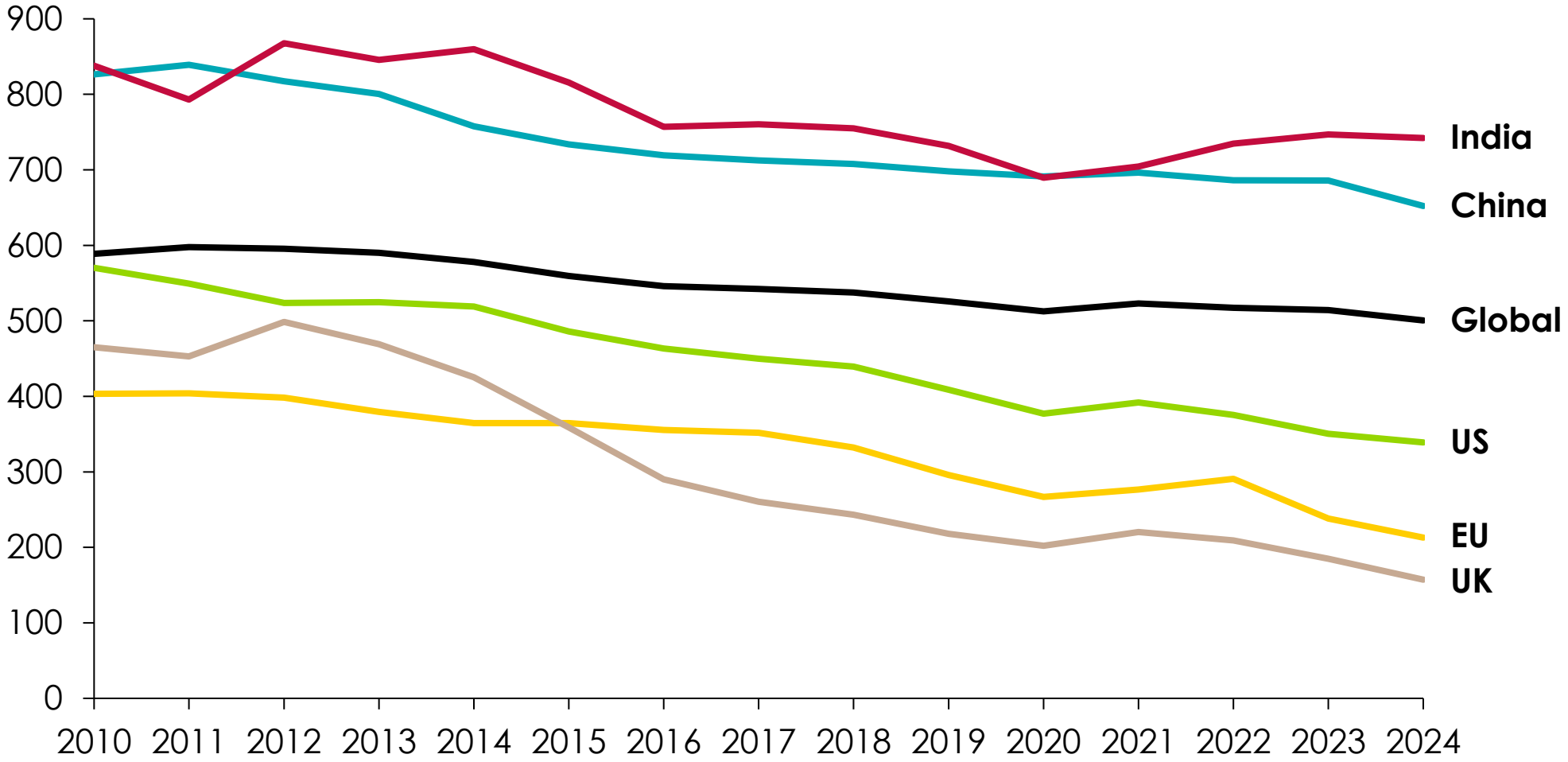
Gt CO_2



Source: IEA (2025) World Energy Review; JRC/IEA 2025 Report (2025) *GHG emissions of all world countries*; Climate Change Tracker (2025), *Current Remaining Carbon Budget and Trajectory*.

Carbon intensity of electricity generation

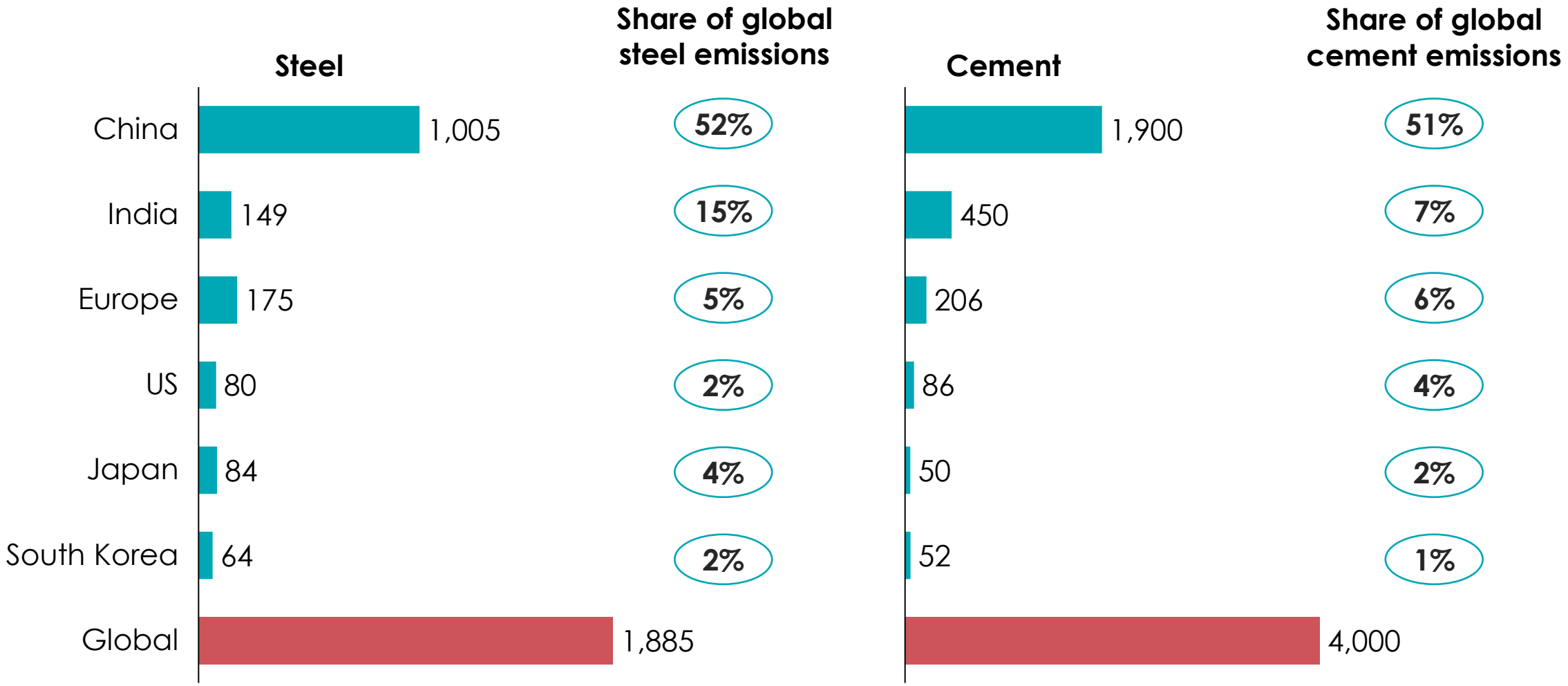
gCO_2eq/kWh



Source: Ember (2025), *Carbon Emissions Intensity*.

Crude Steel & Cement production and emissions, 2024

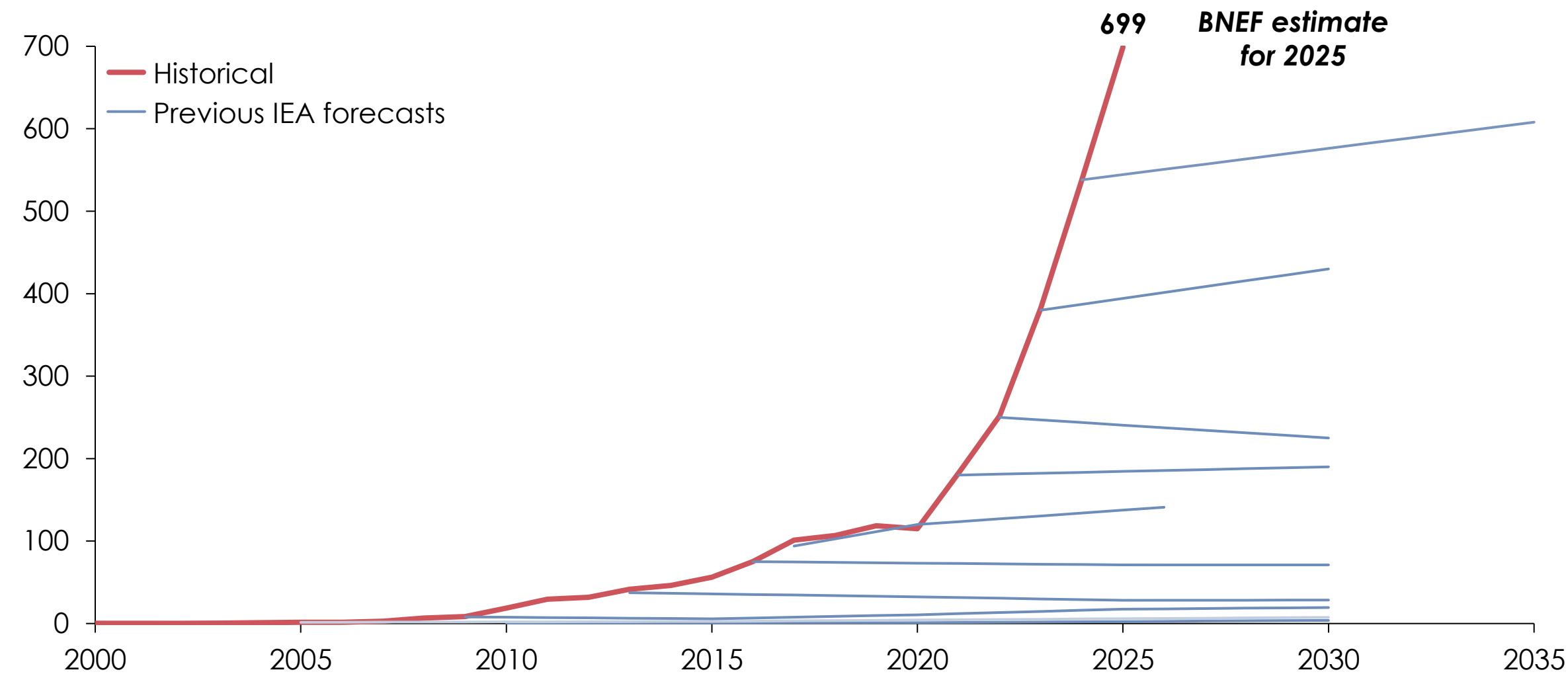
Million tonnes



Source: World Steel Association (2025), *World Steel*; Global Cement (2025), *Global Cement Top 100 2026;* BNEF (2025), *New Energy Outlook 2025*.

Annual solar PV installations compared to IEA forecasts

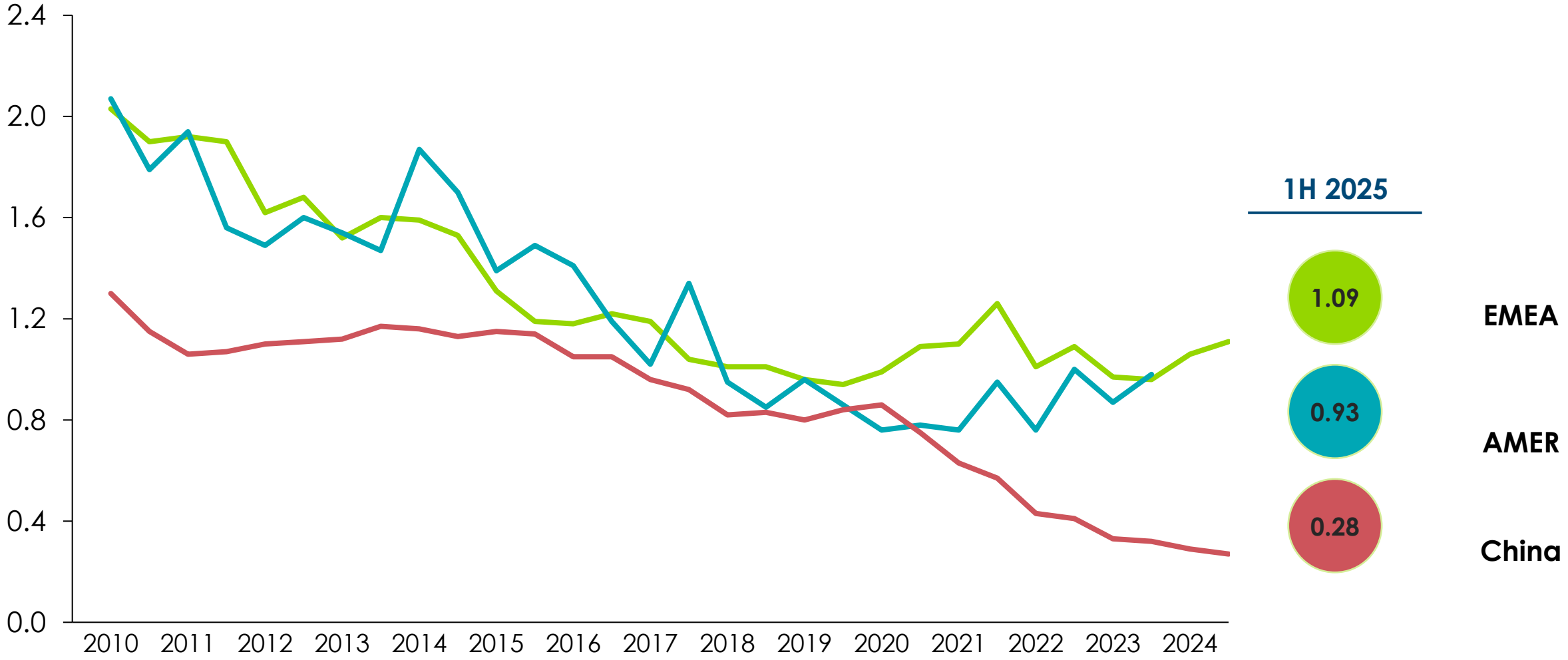
GW



Source: IEA (Various), *IEA New Energy Outlook*; BNEF (2025), *Global Installed Capacity*.

Wind turbine prices by region, 2010-2025

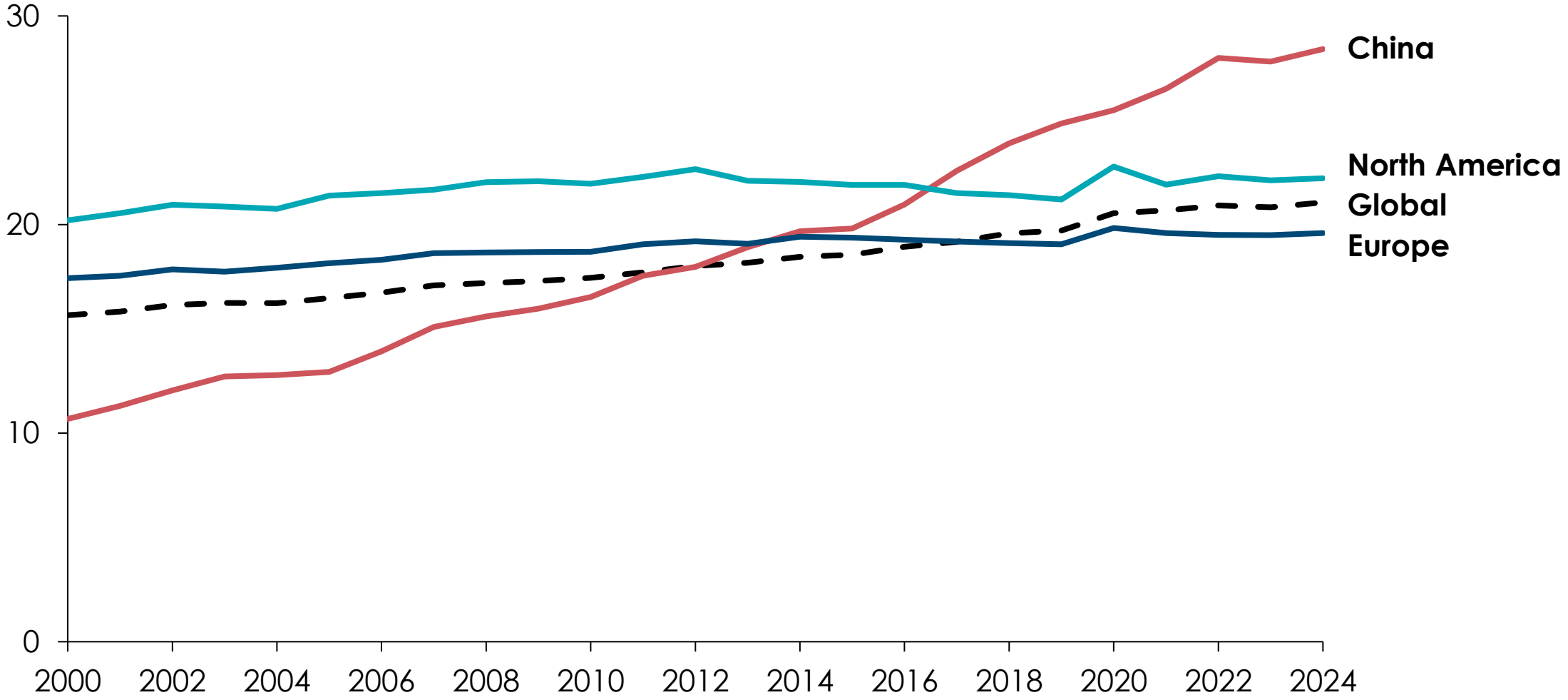
$ million/MW, 2025 real



Source: BNEF (2025), *Wind Turbine Price Index 1H 2025: Still on the Rise;* U.S. Bureau of Labor Statistics (2025), *Consumer Price Index for All Urban Consumers (CPI-U), All Items, US City Average, Not Seasonally Adjusted.*

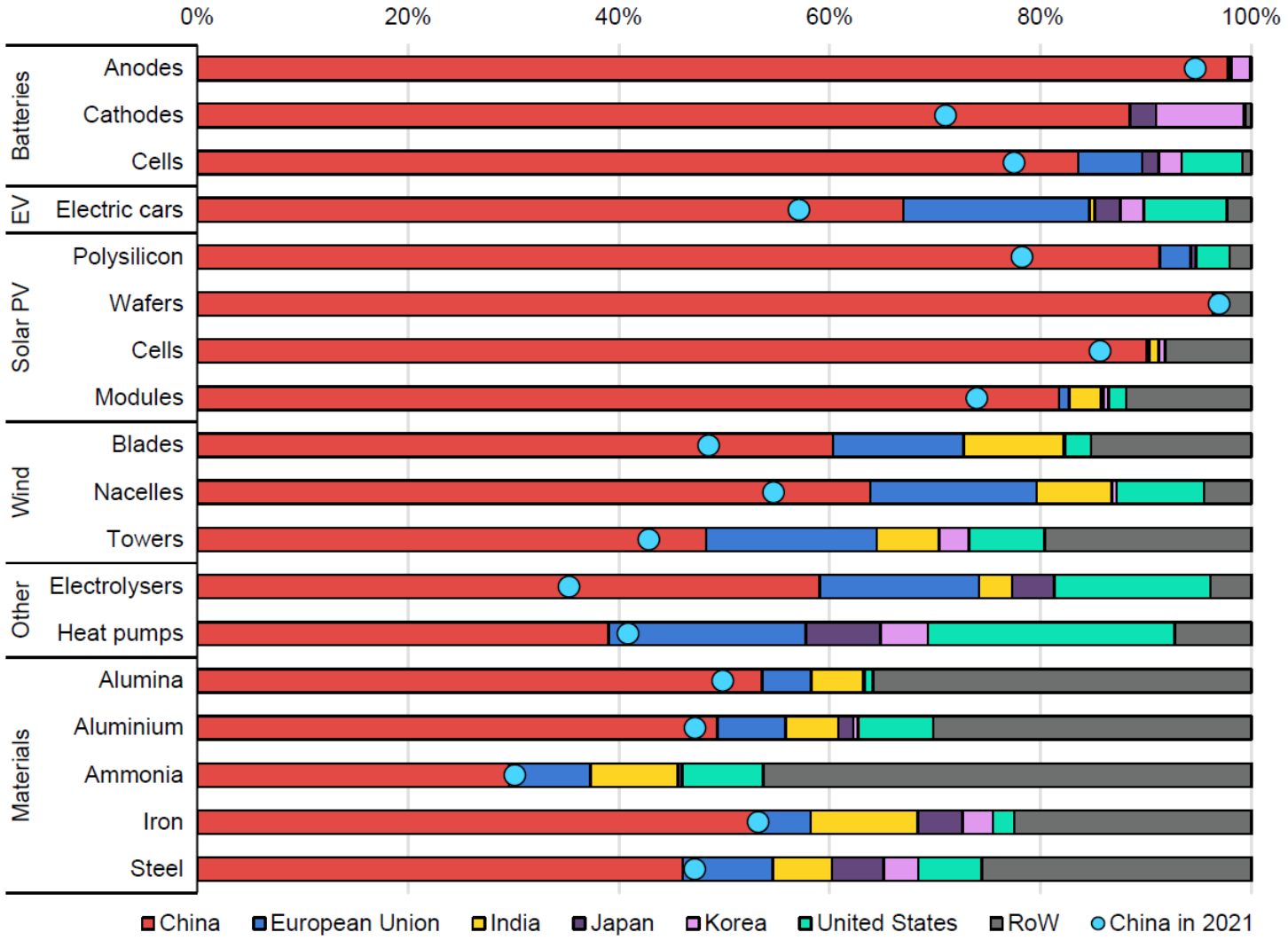
Electricity share of final energy demand

%



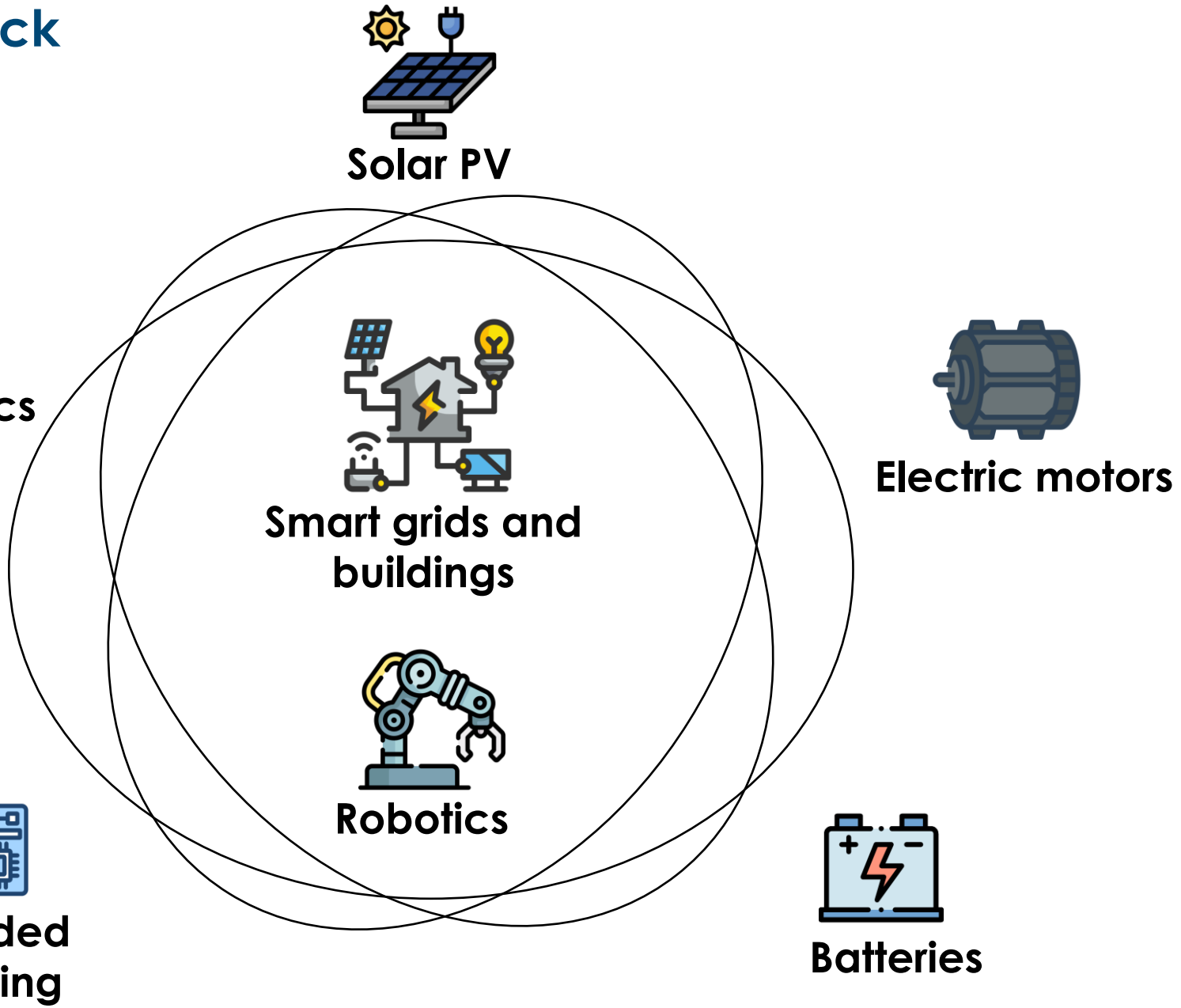
Source: BNEF (2025), *New Energy Outlook*.

Installed global manufacturing capacity by country/region 2023

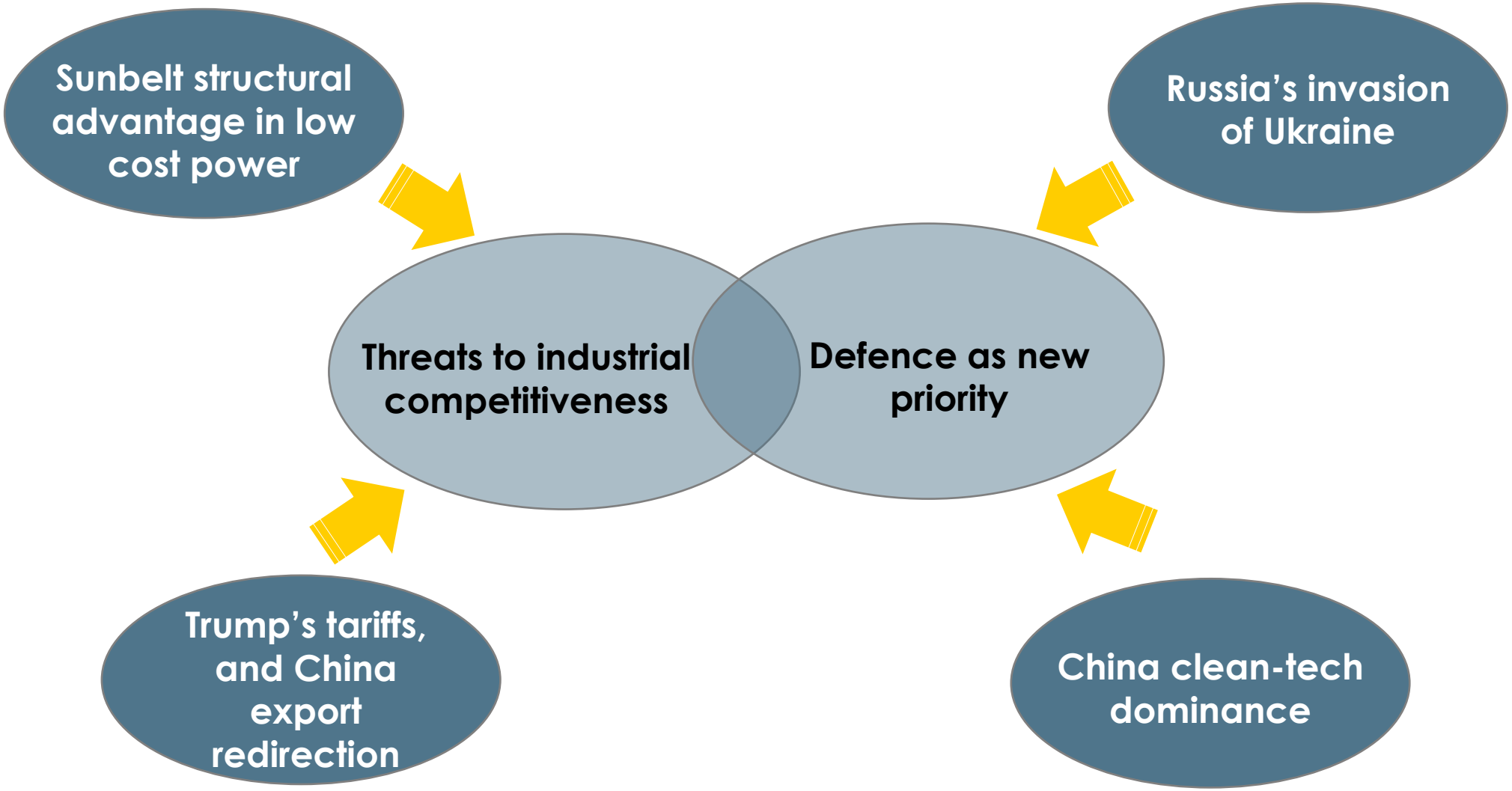


Source: IEA (2024), *Clean Technology Perspectives.*

The electro tech stack

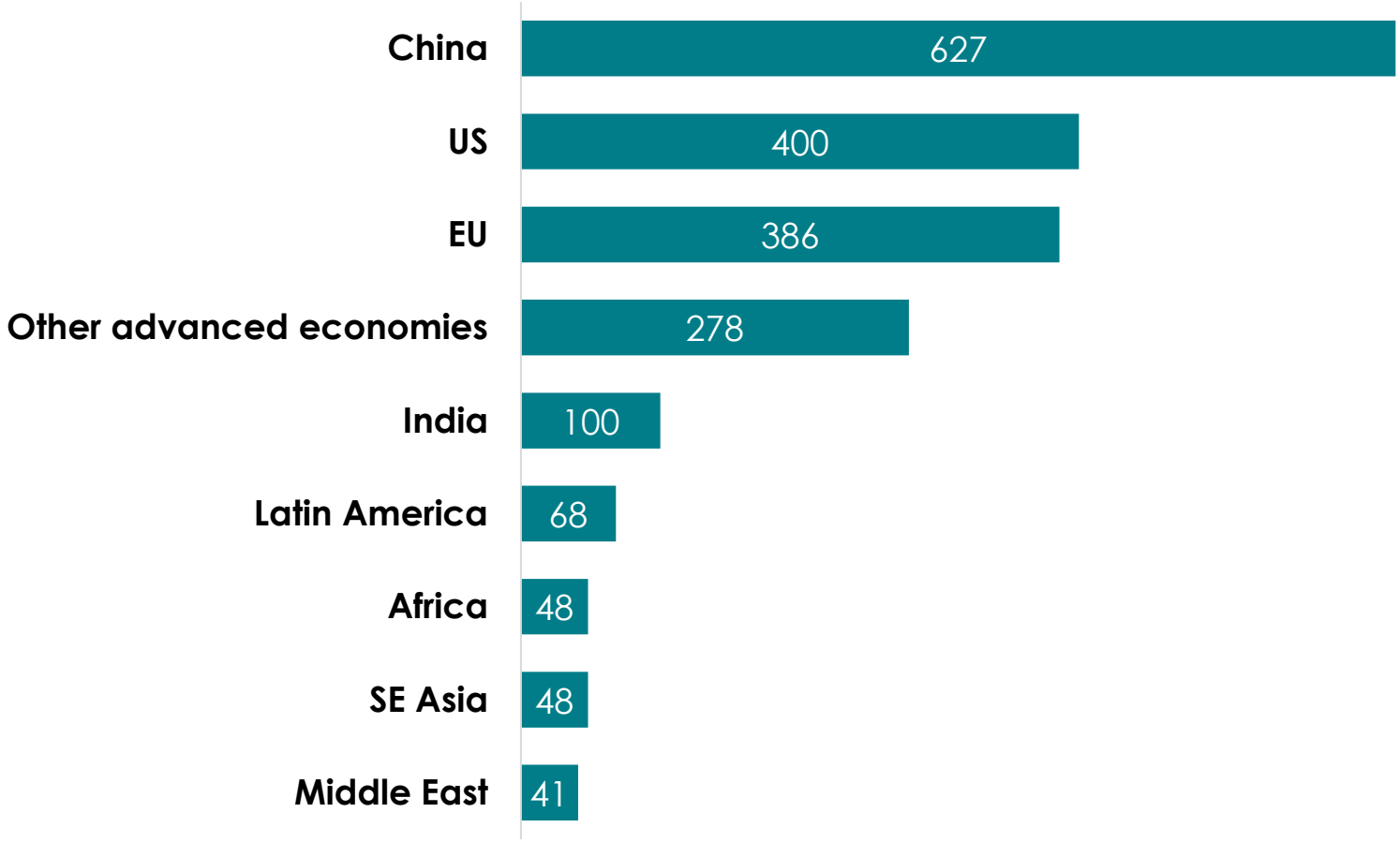


Europe's perfect storm



Clean energy investment 2025

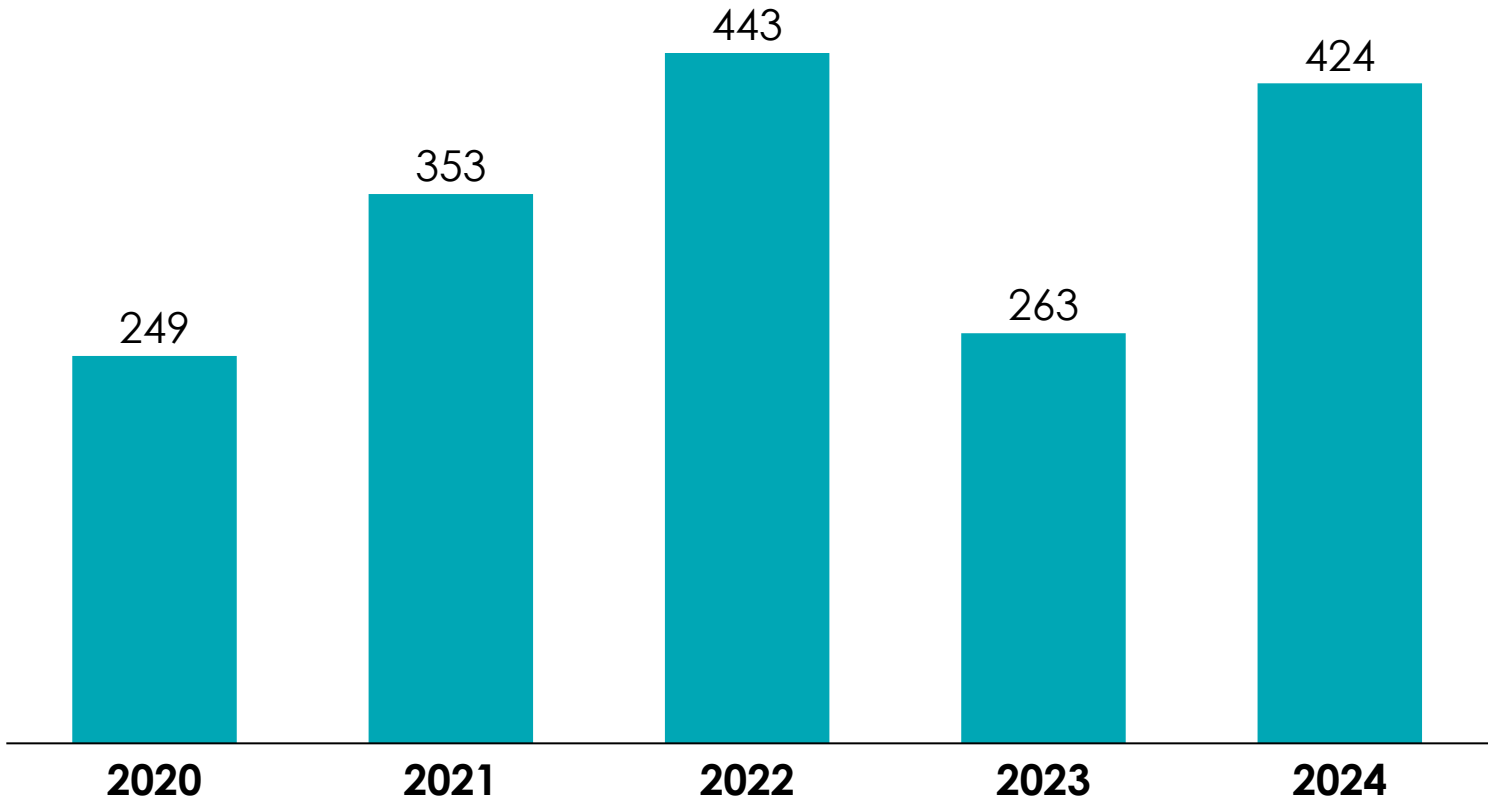
$bn



Source: IEA (2025), *World Energy Investment 2025,*

China current account surplus 2020-2025

$Bn



Trade surplus: **$1200bn**

Current account surplus for first 3 quarters: **~$500bn**

2025 latest estimates

Source: The Global Economy (2025), *China: Current account, in dollars.*

The economics of the energy transition – challenges and opportunities

Investments

- Cost to some category of consumer
- Cost of capital crucial issue

Costs of going fast enough

- Subsidies for early tech deployment
- Double running gas grid and expanded electricity system
- Retiring existing coal plants before end of life

Distributional issues

- Jobs: both opportunity and threat more limited than often suggested
- Within countries: residential heat harder than shipping
- Between countries: global sunbelt cost advantage
- Economic rents: demand reduction vital to transition beyond fossil fuels

China opportunity and challenge

- Faster emissions reductions essential – including hard to electrify sectors
- Clean-tech dominance: global low-cost opportunity but local industry threat
- Climate finance: the most important provider?