Energy Transitions Commission

State of the transition

ETC Commissioners meeting

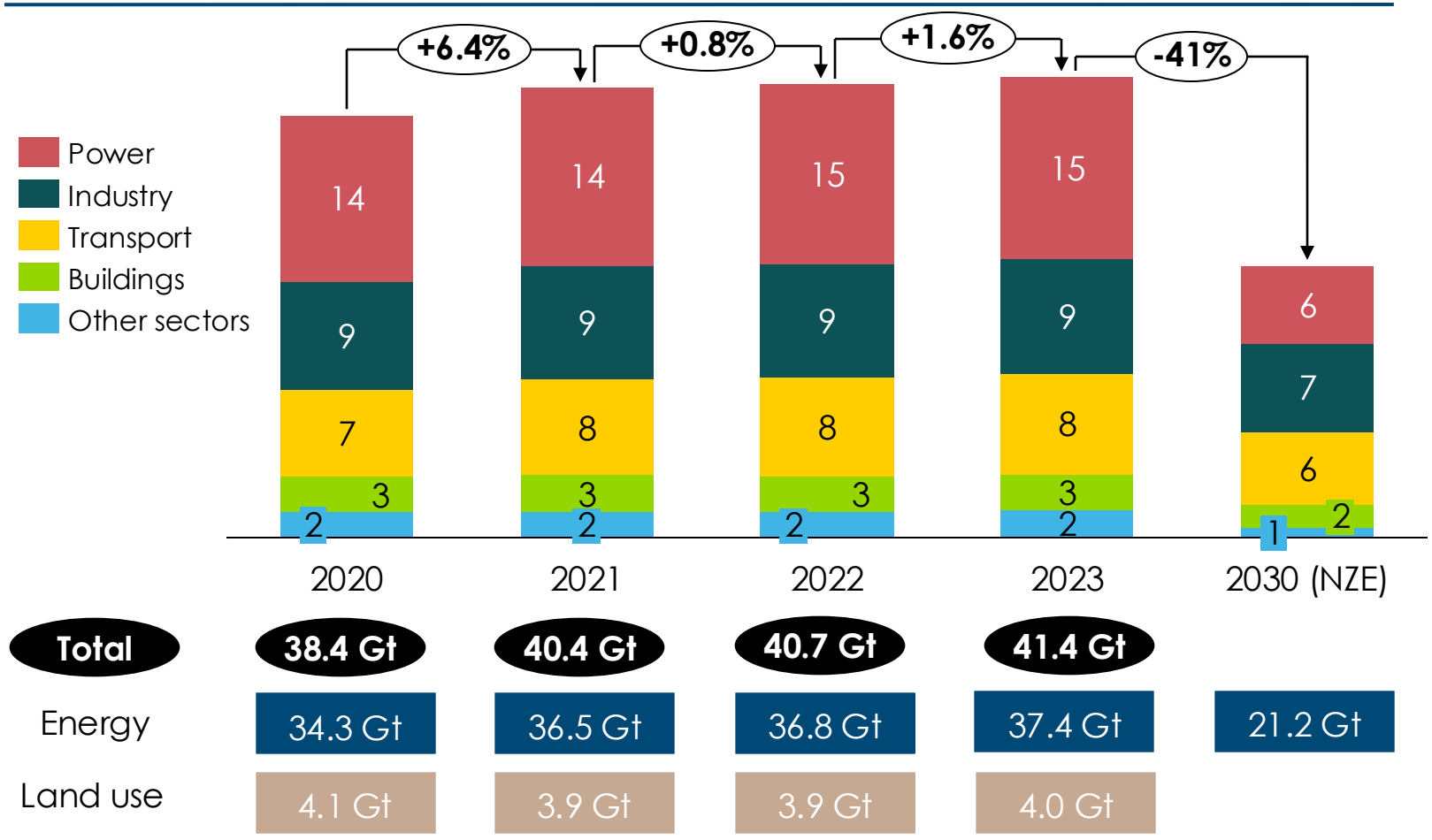
27th June 2024

Part 1: The state of emissions & key public debates

Emissions from the energy system rose to record high in 2023 and gap with 1.5C pathways continues to grow

Global CO_2 emissions from energy and land use change, 2020-2030

$GtCO_2$/year



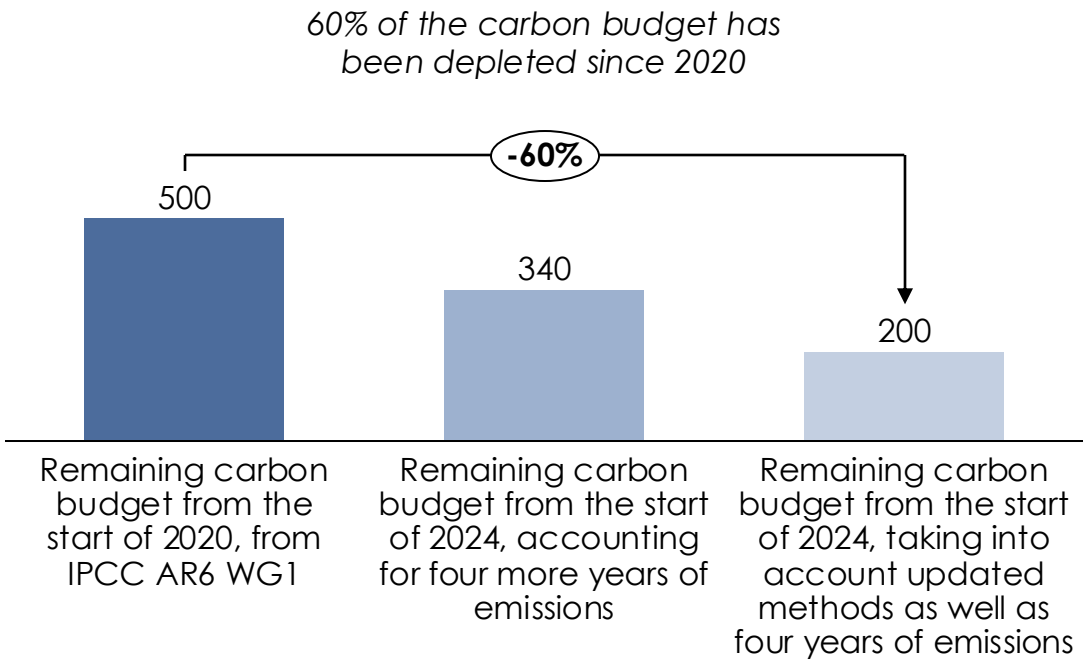
- Despite rising deployment of clean energy technologies, **global emissions have increased** in recent years – clean energy currently limiting growth
- The **gap between actual emissions and the required Net Zero trajectory is growing**, with annual reductions of 7-8% needed each year to 2030 to get on track.
- **Decarbonisation of power** is especially crucial this decade.

Sources: IEA (2021), *Net Zero by 2050*; IEA (2023), *CO2 emissions in 2022;* Friedlingstein et al. (2022), *Global Carbon Budget 2022;* Carbon Brief (2023), *Analysis: China's CO2 emissions in Q2 2023 rebound to 2021's record levels*; IEA (2024), *CO2 Emissions in 2023*; Pierre Friedlingstein et al. (2023), *Global Carbon Budget 2023*

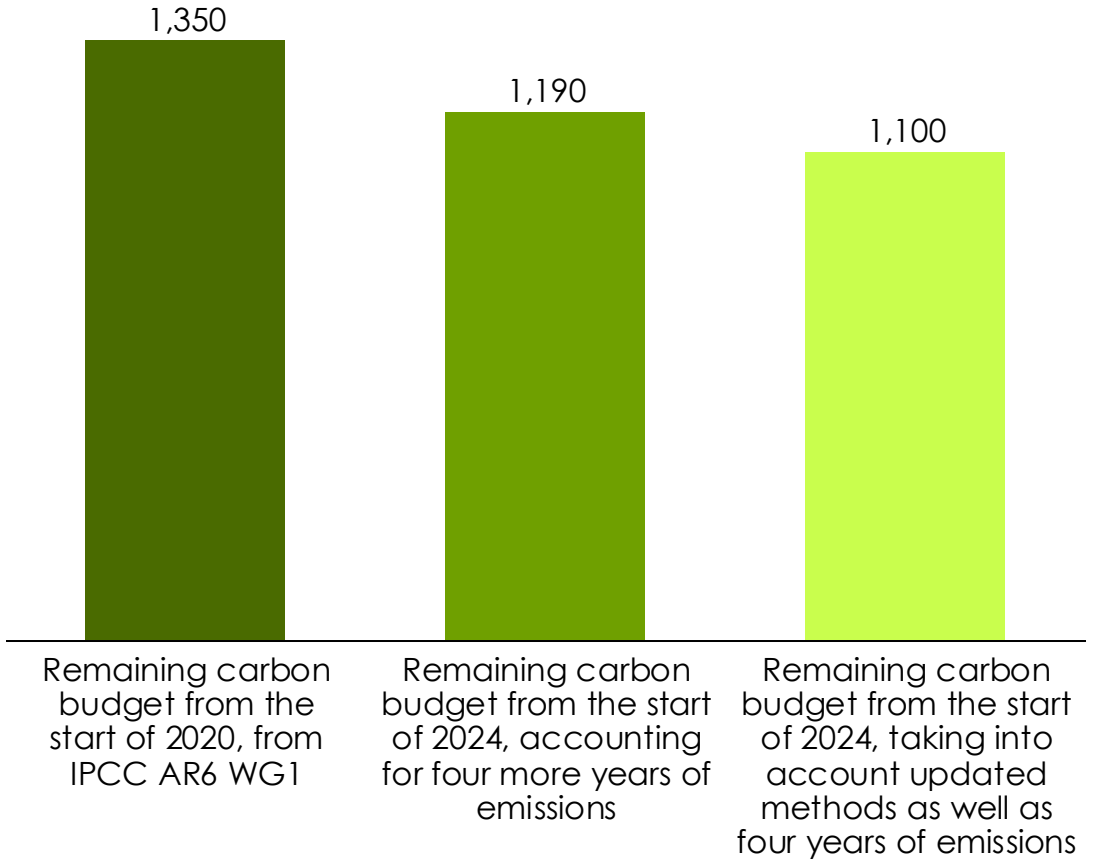
Carbon budgets to limit global average temperature increase to 1.5°C and 2°C have decreased, increasing the urgency of action in the short term

Carbon budgets for a given temperature rise, In $GtCO_2$

Budget for 50% chance of staying within 1.5°C



Budget for 50% chance of staying within 2°C



Source: Forster et. Al (2024) *Indicators of Global Climate Change 2023: annual update of key indicators of the state of the climate system and human influence*

As elections are undertaken around the world, unclear that major shifts in climate policy will emerge – US, possibly France as big swing factors

Non-exhaustive

National elections	Impact on climate policy	Details
United States President, Senate, House of Representatives	**Unclear**	• US climate and energy policies have seen significant developments, including the passage of the IRA • Renewable sources surpassing coal and nuclear power in electricity generation in 2022 – signal **a shift toward decarbonisation** • The **pace and depth of decarbonization** depend on the 2024 presidential election outcomes
European Union European Parliament	**Unclear**	• Centrist parties continue to hold a majority in the new European parliament • The **stronger presence of right-wing parties** could make ambitious new climate policies **harder to pass**
India General election	**Likely peripheral**	• The Modi-led government has been seen as a **climate leader comparing to other parties** • It also faces **criticism for its coal expansion and ties to fossil fuels** • Climate issues are **historically peripheral**, but they are **becoming more central** in political discourse
France National Assembly	**Likely negative**	• Green parties suffered losses in France • **Far-right parties** have made big gains
Mexico President, Senate, Chamber of Deputies	**Unclear**	• The new president Sheinbaum has a climate scientist background • Support **solar energy** and **electrified public transport** • Faced criticism for **limited environmental improvements** when she was Mexico City mayor

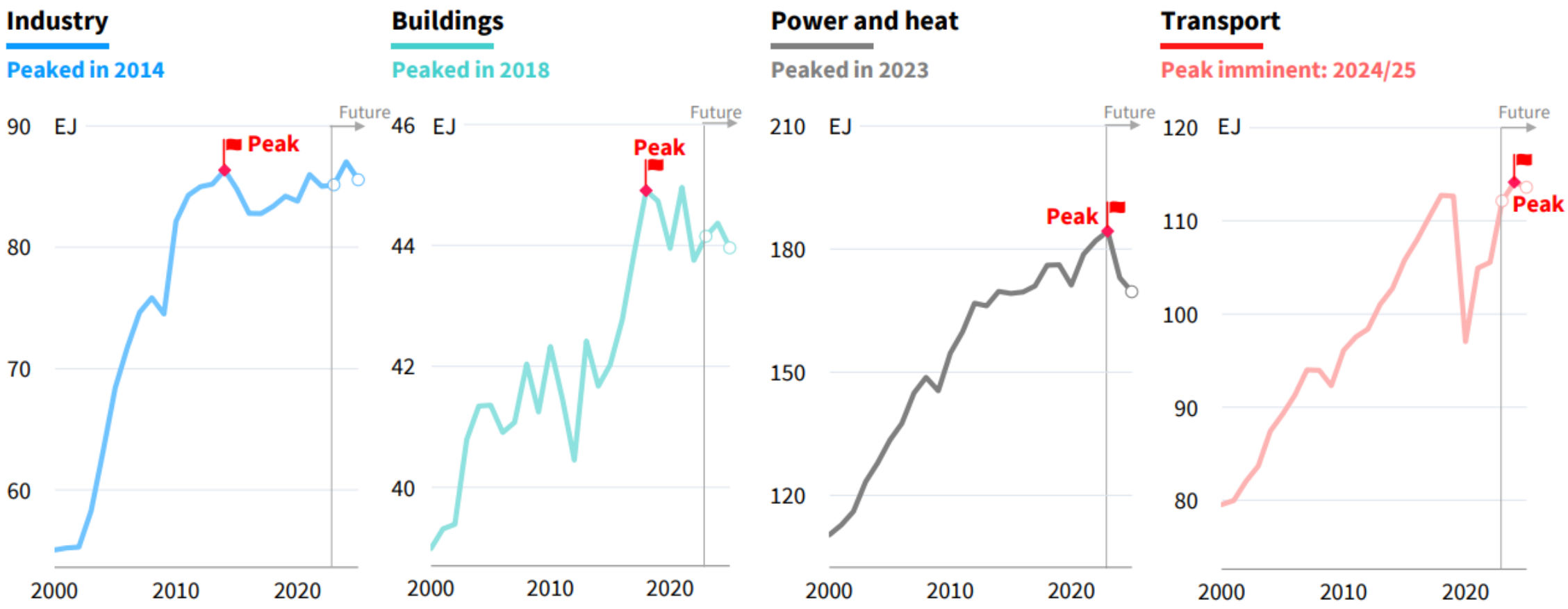
United Kingdom
House of Commons
	Likely positive	• Both parties aim to **maintain UK's 2050 net-zero target**
		• Conservatives emphasize an "**affordable and pragmatic**" transition
		  • Focus on avoiding additional costs for households
		• Labour party aim to "**restore strong global leadership**"
		  • Propose a new "**Clean Power Alliance**" to unite countries leading in climate action

Indonesia President, Parliament	**Likely peripheral**	• Prabowo likely to continue Jokowi's climate policies • Faces **challenges balancing coal dependency** with sustainable energy

Source: Climate Action Tracker (2024), *USA*; Euro News (2024), *The UK election and climate change: Where do political parties stand on 6 key issues?*; Carbon Brief (2024), *Experts: What do the European elections mean for EU climate action?*; Carbon Brief (2024), *India election 2024: What the manifestos say on energy and climate change*; Climate Scorecard (2024), *Indonesia's President-Elect Has a Good Climate Policy, but Will He Implement It?*; The Guardian (2024), *Mexico's new president ran on climate goals. Will she follow through?*

Peak fossil fuel demand for Industry and Buildings has already occurred; Power and heat, and Transport is happening now

Fossil Fuel demand by sector, EJ



Source: RMI (2024) *The Clean Tech Revolution*, based BNEF 2024 NEO.

Part 2: Progress towards the net zero energy system

The technologies which are deploying fastest are those most susceptible to mass production and easy deployment

Fastest progress

Slower progress

Solar PV, EVs and batteries		▪ Mass produced in large-scale, replicable factories ▪ Easily transported ▪ Easily deployed / installed
Heat pumps		▪ Mass produced in large factories ▪ Easily transported ▪ Complex installation
Wind		▪ Turbines supply chains very complex, scale of production is orders of magnitude smaller than PV/batteries ▪ Higher degree of customisation for projects ▪ Transport and installation more complex
Electrolyser and green H_2		▪ Can be mass produced, but balance of system costs and specific project complexities important
CCUS		▪ Customised engineering design and deployment
Large-scale nuclear		▪ Hugely complex large-scale systems

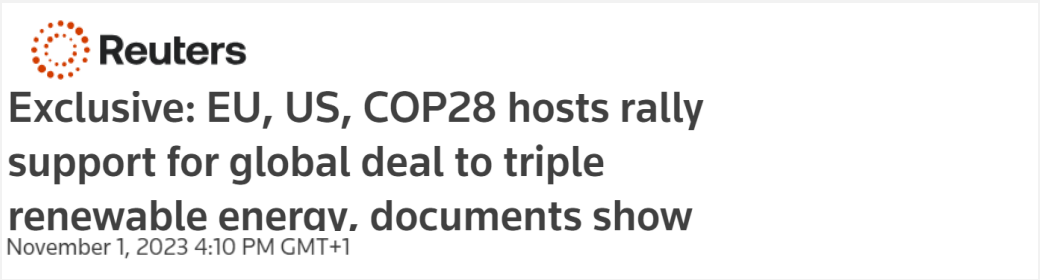
Key issue: opportunity for standardised and/or smaller scale units?

- *Standardised CCUS units?*
- *Small modular nuclear?*

Power

Trebling renewables – likely possible: address wind challenges; invest more in low- and middle-income countries

118 countries pledged to triple renewable energy capacity


Reuters

Exclusive: EU, US, COP28 hosts rally support for global deal to triple renewable energy, documents show

November 1, 2023 4:10 PM GMT+1


EURACTIV

Global coalition pledges to triple renewables, double energy efficiency improvements

Dec 2, 2023

How to get there?

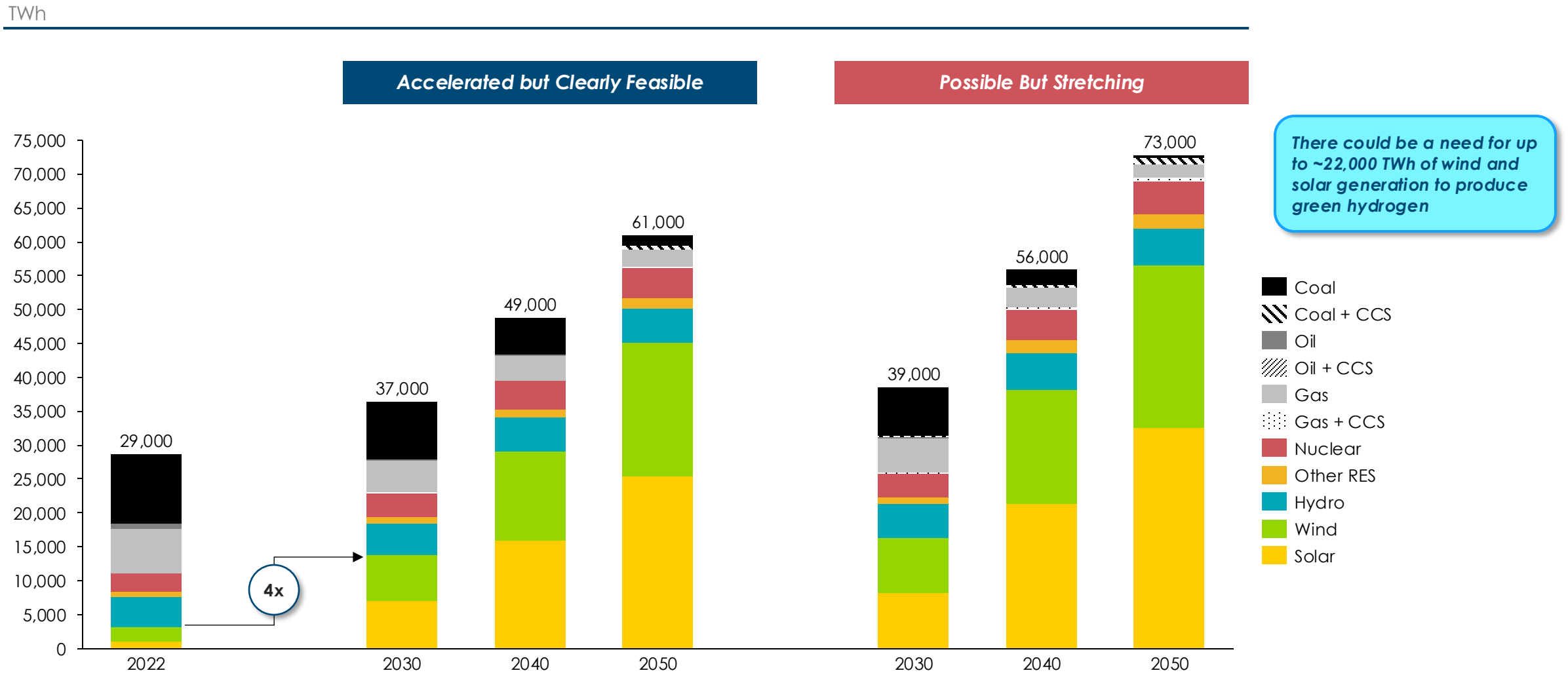
- **Strategic vision:** constantly raising ambition for clean power system
- **Faster permitting** – halving timescales for wind, solar
- Parallel **build-out of power grids**
- Fixing **wind supply chain challenges**
- Quadrupling of investment in **low- and middle-income countries**, to **~$650 bn p.a. by 2030**

Note: [1] The COP28 agreement included a global 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 (2023), *Interactive Data Tool – Global Installed Capacity*; ETC (2021), *Making clean electrification possible*. Euractiv (2023), *Global coalition pledges to triple renewables, double energy efficiency improvements;*

Global power generation will have to increase by 2-2.5* by 2050, with potential large additions for green hydrogen

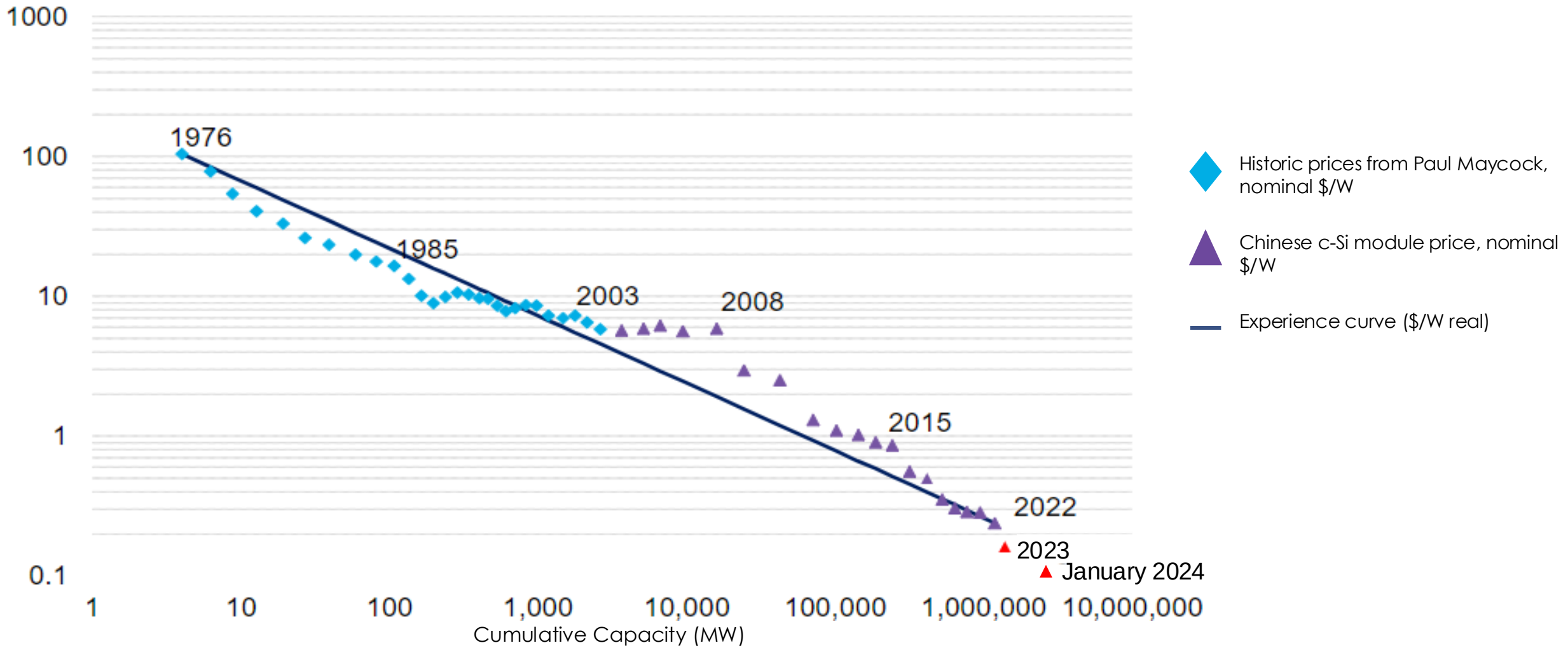
Global power generation by source



Note: Figures include power demand from DACCS from 2030 onwards. There could be a need for up to around 22,500 TWh of wind and solar generation to produce green hydrogen as it may be underestimated in the regional power generation analyses we have aggregated, relative to ETC's analysis of potential demand for low-carbon hydrogen
Source: Systemiq analysis for the ETC (2023).

The crystalline silicon PV experience curve shows the significant reduction in solar over the past 50 years

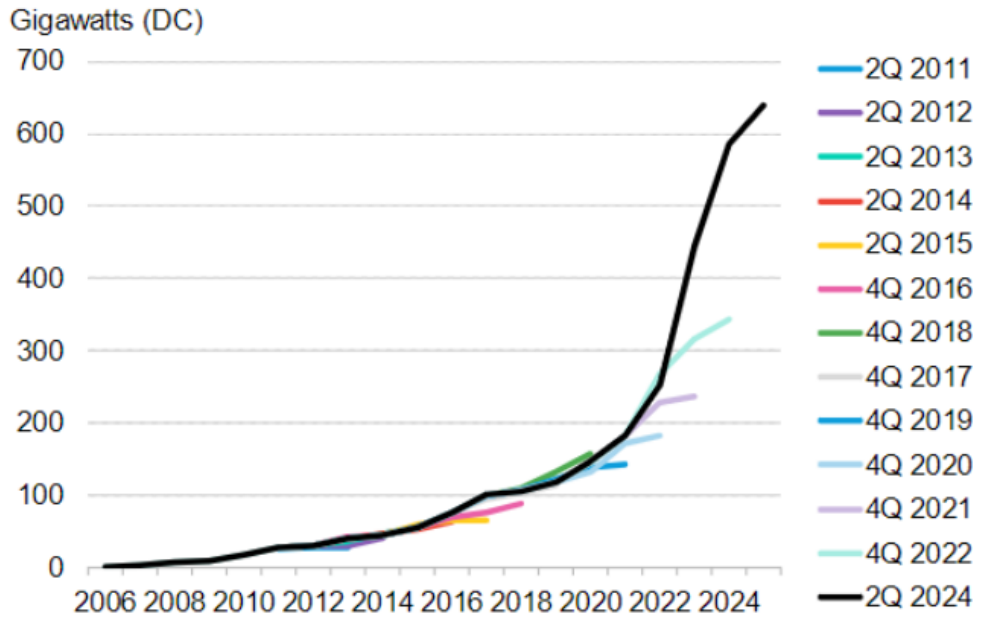
$/W (real 2023)



Whilst newest Net Zero scenarios assumes slowdown in solar over the long term, it may continue at a high level

BNEF forecasts of Solar new build vs realised deployment

GW

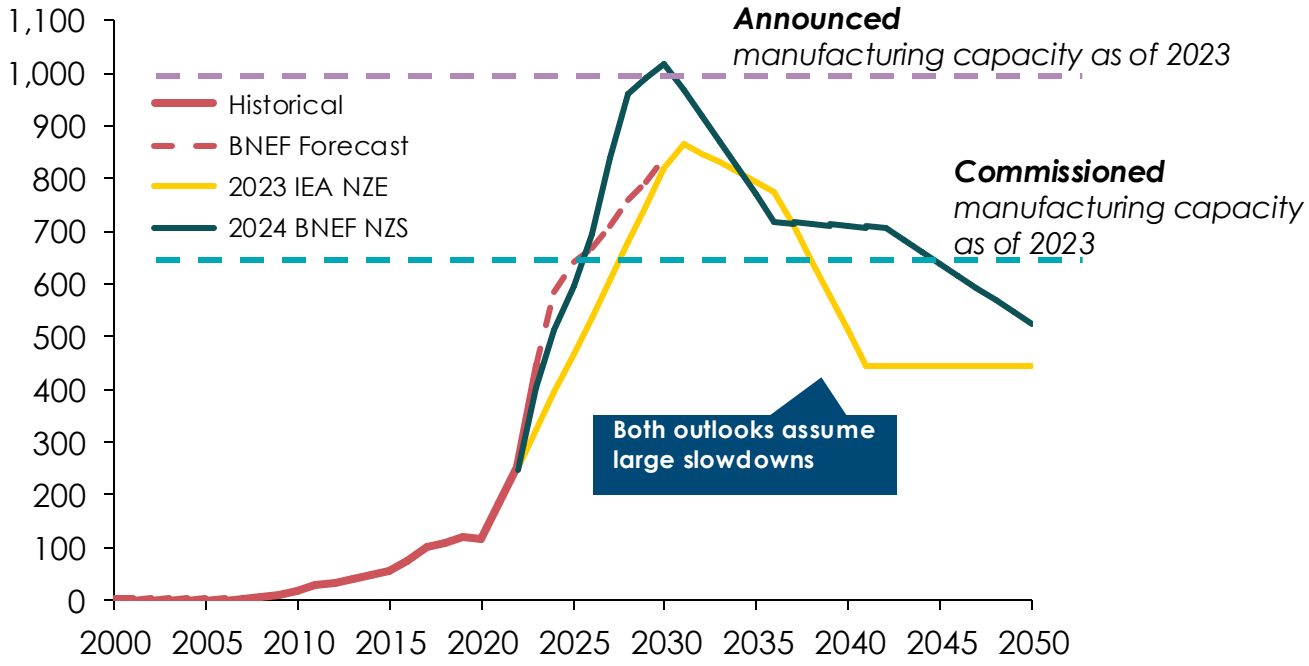


Source: BloombergNEF Note: Chart shows forecasts over 2011-2022, and current forecast to 2025.

Forecasters consistently underestimate the potential of solar additions, and we don't know how high these could reach

Annual solar PV installations compared to forecasts

GW



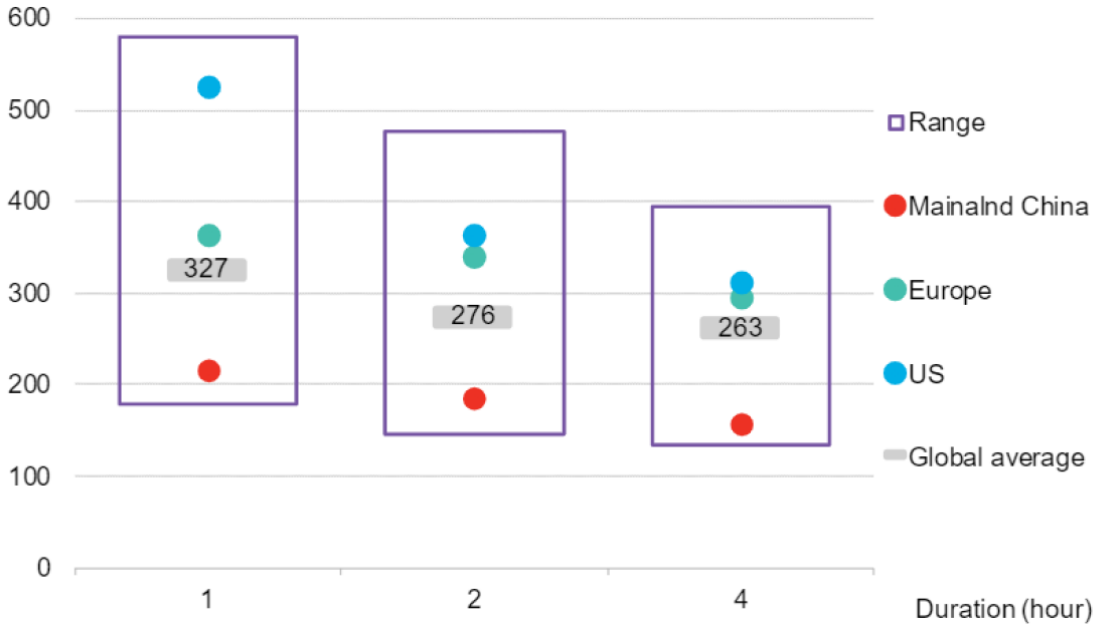
Whilst the newest IEA/BNEF Net Zero scenarios anticipate strong acceleration of solar through to 2030, deployments then start to tail off

Source: BNEF (2024), *Global installed capacity*; BNEF (2024), *2Q 2024 Global PV Market Outlook*; IEA (2023), *Net zero roadmap – update;*

In China, lithium-ion battery storage system prices were already the lowest in the world, and have fallen rapidly in the past 12 months

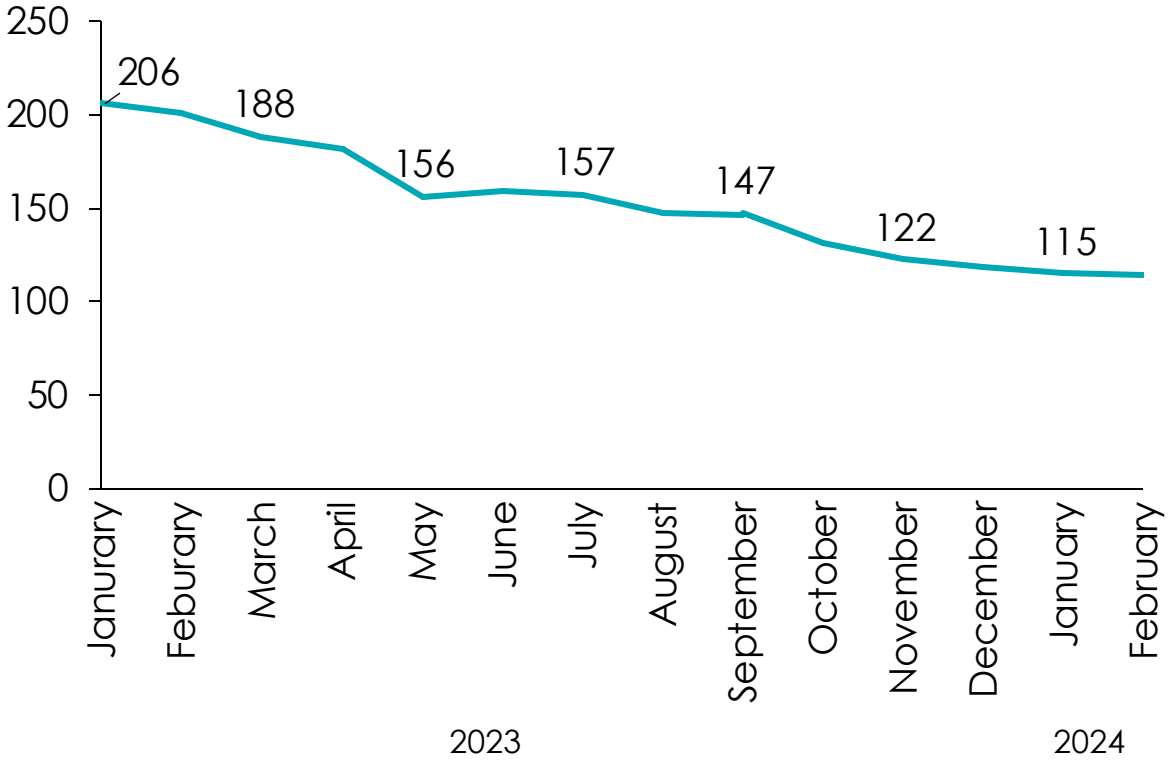
Turnkey LFP storage systems costs and ranges 2023, by region

$/kWh



Two-hour turnkey energy storage costs in China

$/kWh



Chinese turnkey battery storage systems were around 40% cheaper than other countries in 2023…

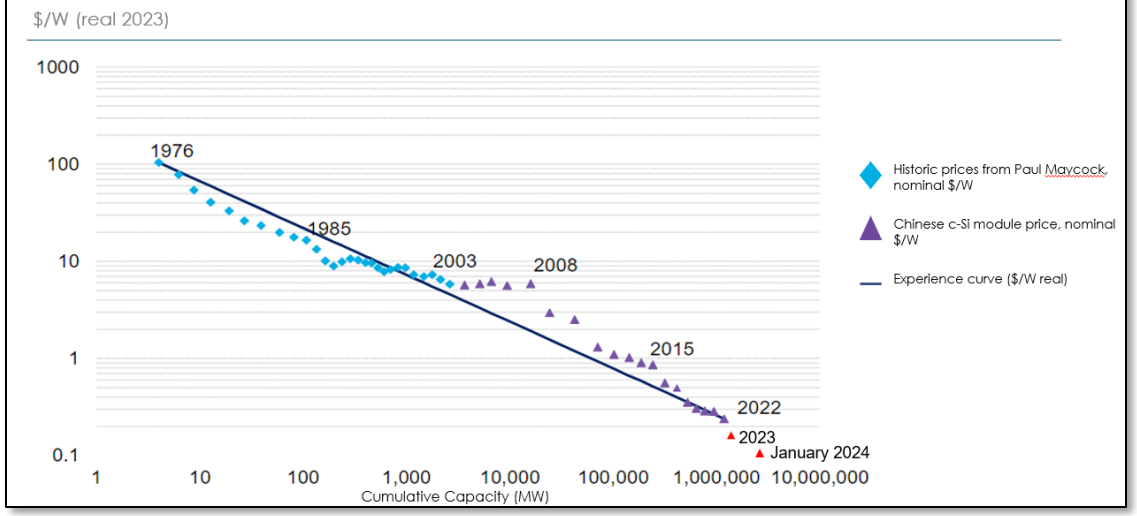
…and prices have fallen another 40% since January 2023

Notes: Average prices used for all project durations. Pricing based on useable capacity. Prices converted using December 2023 exchange rate.
Source: BNEF (2024), *1H 2024 Energy Storage Market Outlook*

Solar and battery price collapsing, opening up a new world of opportunities.

Falling solar costs

The crystalline silicon PV experience curve shows the significant reduction in solar over the past 50 years



Falling battery costs

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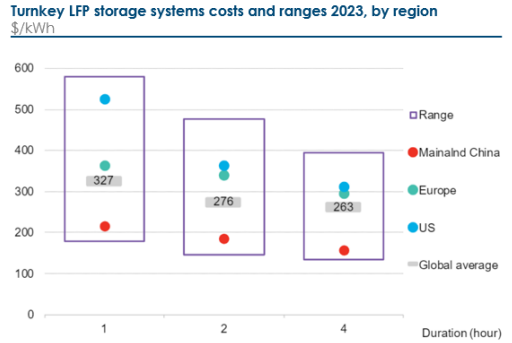

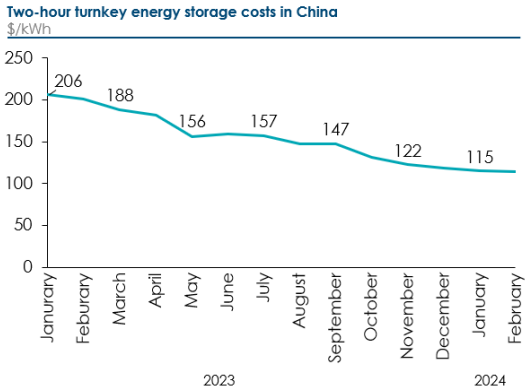

Chinese turnkey battery storage systems were around 40% cheaper than other countries in 2023...

...and prices have fallen another 40% since January 2023

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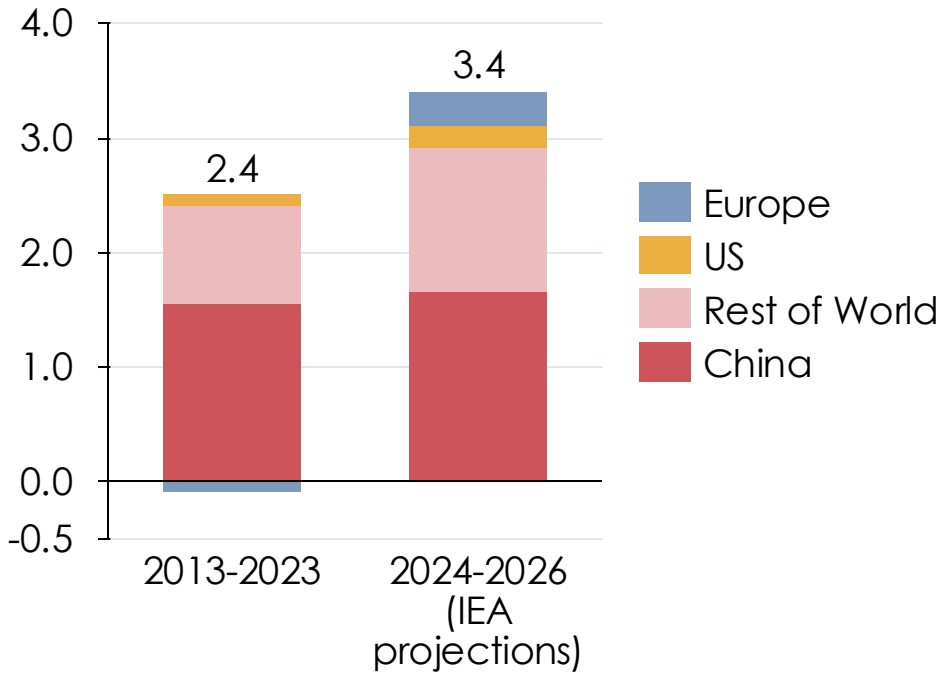
- Solar + batteries replacing diesel generators?
- Solar + batteries for 24h power
- Solar + batteries for new applications & unknown possibilities?

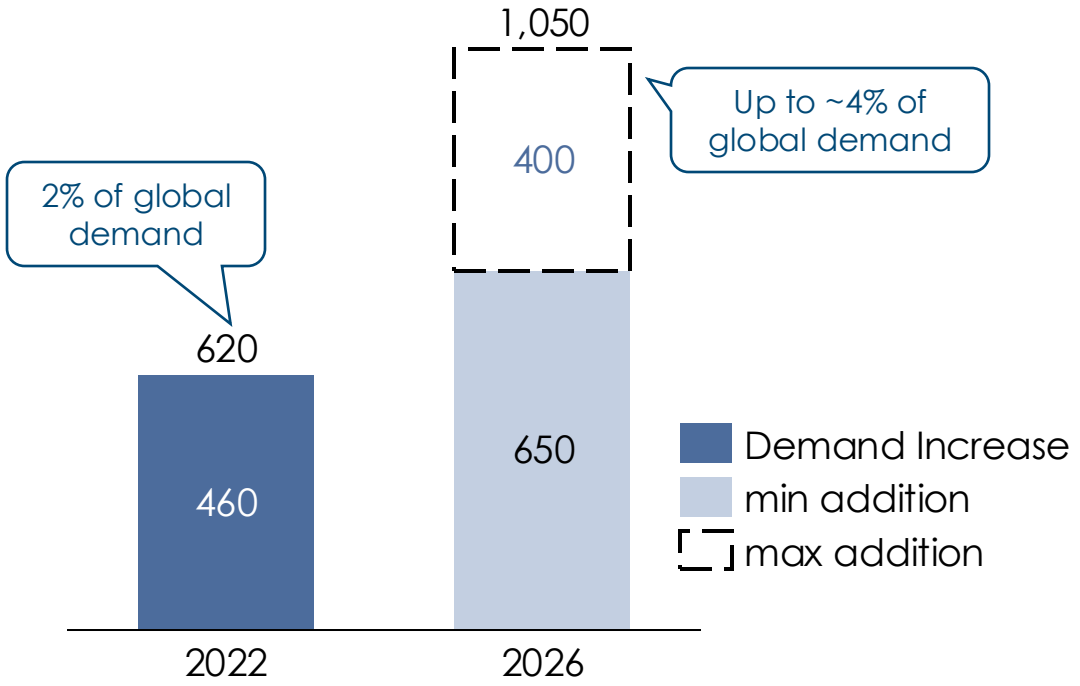
Demand is now entering an era of faster growth, predominantly met by wind and solar, with demand from data centres potentially set to surge

Annual percentage increase in global electricity demand, 2013-2023 (realised) and 2024-26 (IEA forecast), %



Global electricity demand is entering an **era of stronger growth at 3.4%** over 2024-2026

Electricity demand from data centres, 2022 (realised) 2026 (IEA forecast), TWh



Data centres may **double** their share of global electricity demand in 2026

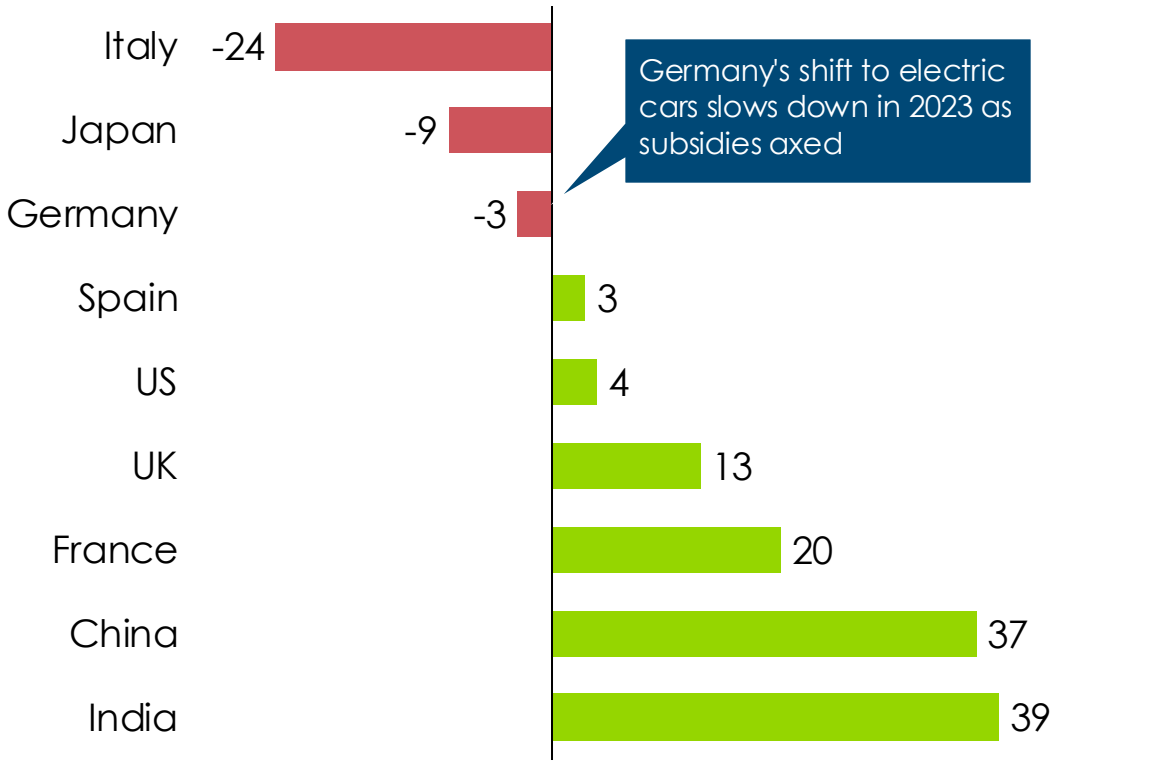
ETC to produce a 'short' on power demand growth in Autumn/Winter 2024

Source: Ember (2024), *Global Electricity market Review 2024*

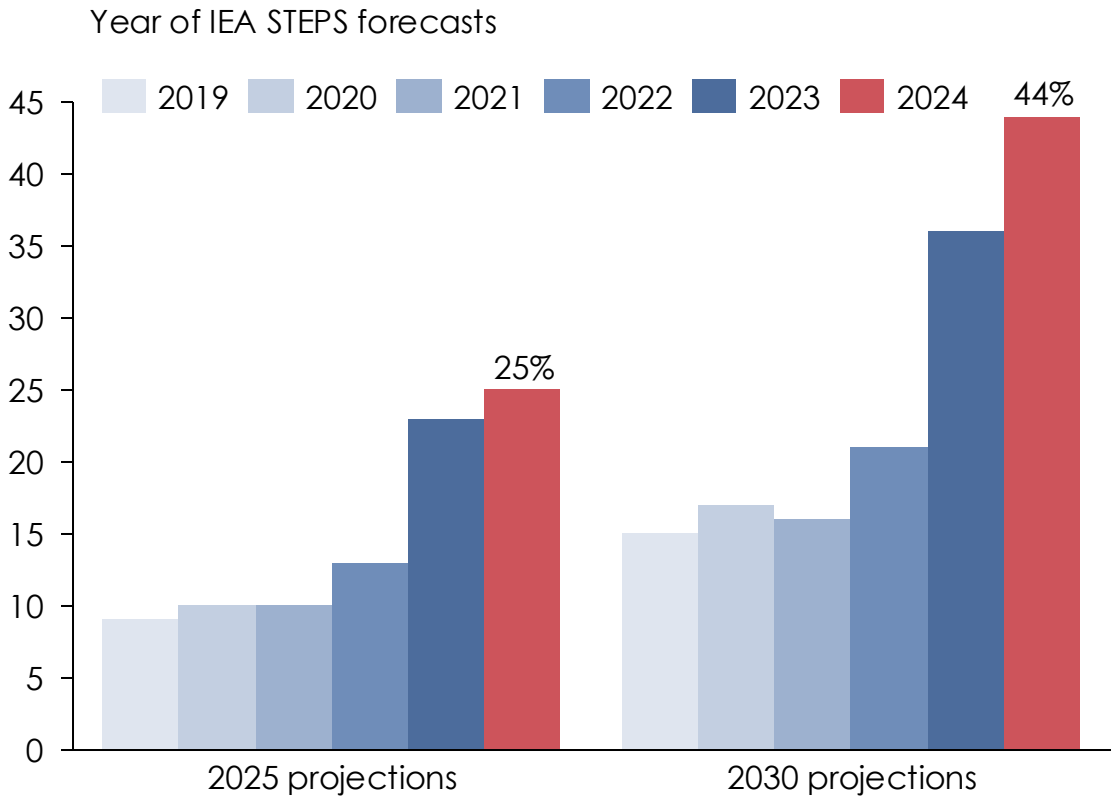
Road Transport

EV sales slow down in some regions, but it's a slow down from very rapid uptake

Passenger EV sale year-on-year change in select countries,
1Q 2024, %



Forecasts of electric vehicle's share of passenger vehicle sales
% of total sales



Similar to Solar: Expectations of EV sales this year are higher than BNEF's projections for 2030 made only two years ago.

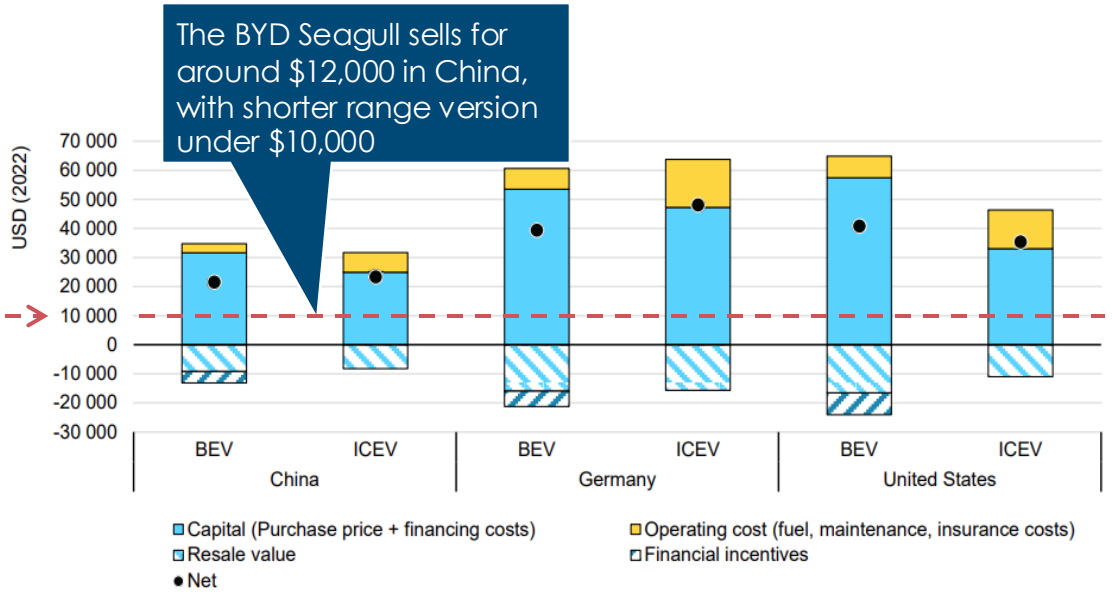
Source: Auke Hoekstra/IEA World Energy Outlooks; Hoekstra et al. (2017), *Creating agent-based energy transition management models…*; BNEF (2023), *Interactive data tool – Global installed capacity*; Hannah Ritchie/IEA Electric Vehicle Outlooks; BNEF (2022), *Long-term electric vehicle outlook*. Bloomberg (2022), *Chinese Oil Giant Brings Forward Its Key Carbon Deadlines;* BNEF (2024), *Electric Vehicle Outlook 2024*

Speed of uptake is dependent on total cost of ownership – the BYD model in China shows that low cost is achievable

BYD, official e-mobility partner of the UEFA EURO2024

Breakdown of the cost of ownership for a sales-weighted average medium-sized battery electric and conventional car purchased in 2022, 5 years after purchase, by country

USD (2022)



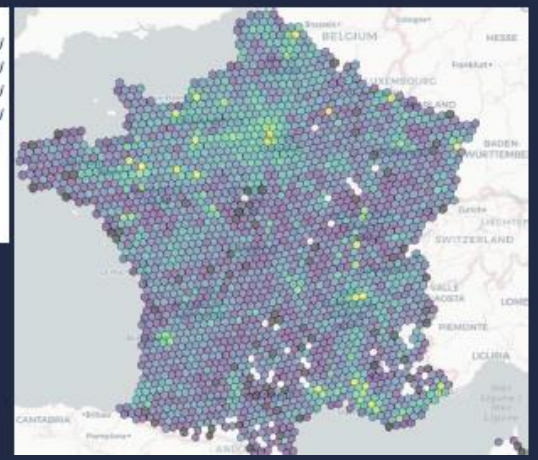
5 years after purchase. Financial incentives include subsidies, vehicle purchase tax exemptions and tax credits. All calculation assumptions are listed in Table 1 located in the general annex of this document.

Sources: IEA (2024), *Global EV Outlook 2024*

The availability of charging infrastructures is likely to become a key bottleneck for Heavy Duty Vehicles

Annual public charging installations need in France for 20% rolling truck population

power	#hex
30-40 MW	3
20-30 MW	18
15-20 MW	25
10-15 MW	85
5-10 MW	346
3-5 MW	566
2-3 MW	747
1-2 MW	473
<1 MW	82



>2,000 charging stations with > 1 MW power would be required in France only to meet the demand of 20% electric rolling truck fleet

Dedicated charging for heavy-duty vehicles is the next frontier

- The EU and the US target ~**30% of trucks sold in 2030** to be electric
- New EU regulation obliges member states to install a minimum of one charging hub (350kW+ chargers) every **60-100 km of road.**
- These targets should provide enough charging points to cover the 2030 E-HDV fleet but…
- …there is essentially no public charging infrastructure in place for HDVs currently, and **industry may struggle to ramp up** manufacturing and installation capacity to hit these targets.

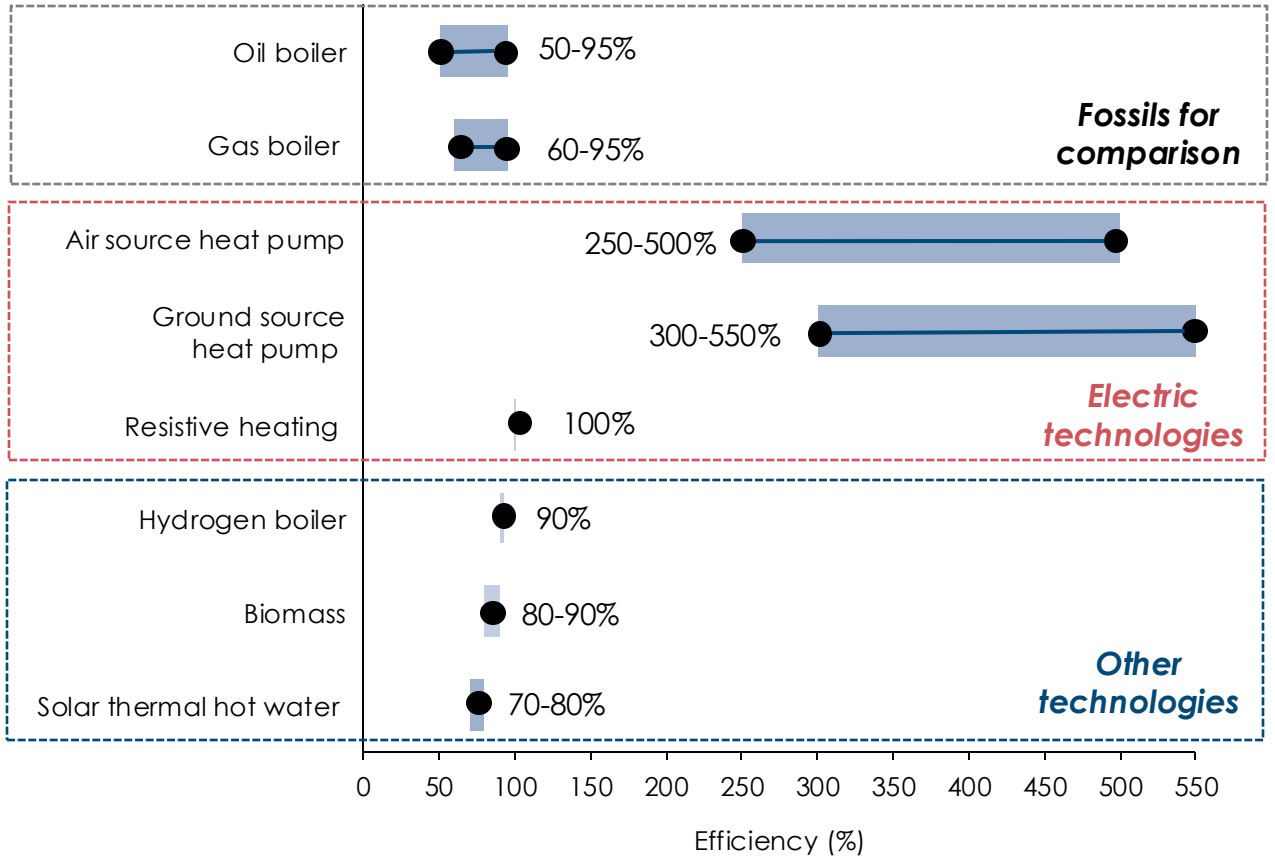
Notes: ETC modelling calculates that 33%-38% of HDVs sold in the EU would be electric in 2030, around 120k-140k.
Source: Systemiq modelling for the ETC; The ICCT (2022), *Biden wants all new commercial trucks to go electric by 2040;* T&E (2024), *EU reaches deal on near phase-out of diesel trucks*

Heat pumps

Heat pumps are a far superior technology, over 3 times as efficient as fossil fuel space heating technologies; they can also decarbonise the 50% of industrial heat which runs on low-medium temperature heat

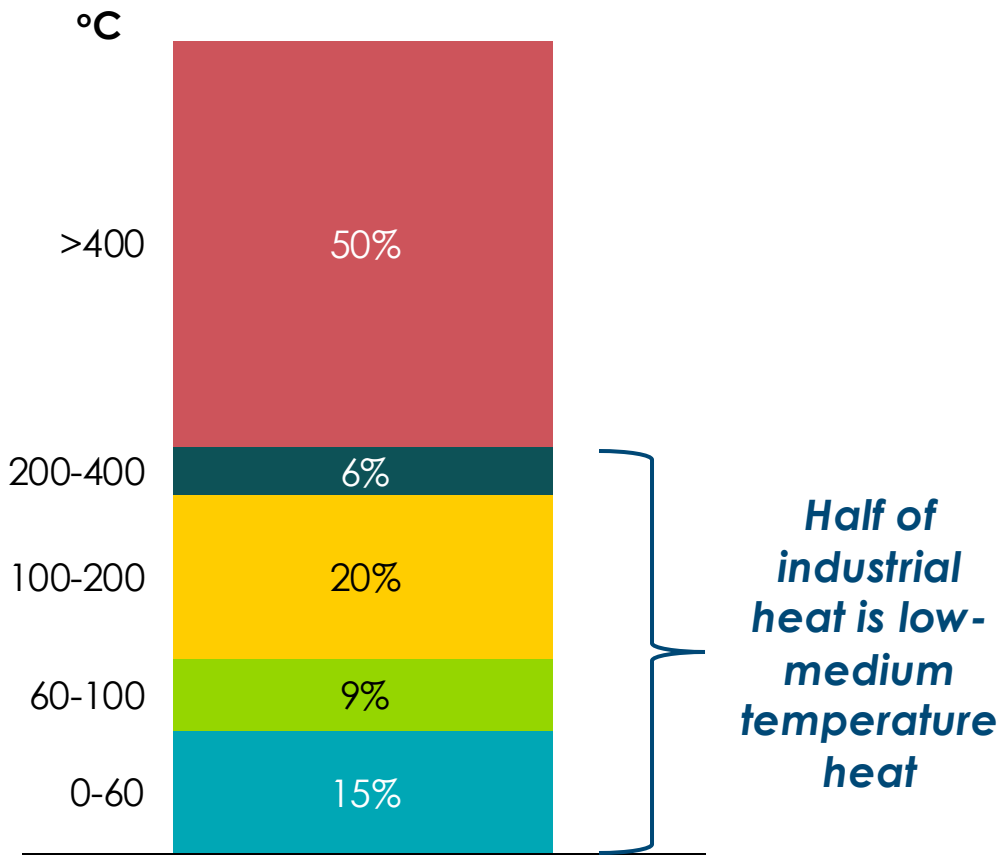
Efficiency of space heating technologies

%



Industrial heat demand by °C

% of total

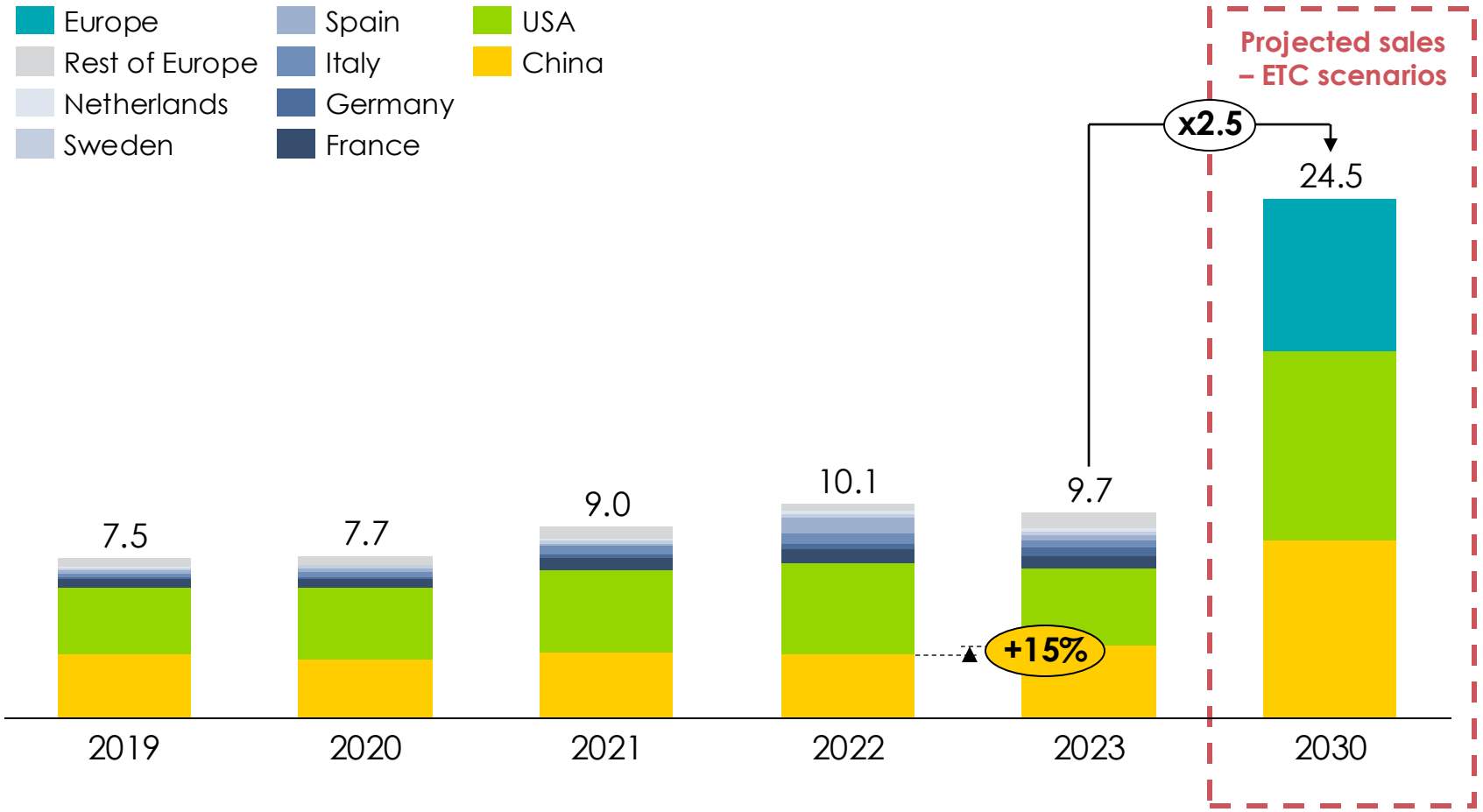


Sources: Systemiq analysis for ETC (2024); IEA (2022), *Future of Heat Pumps;* IRENA (2022), *Heat Pump Market and Costs;* IEA (2021) *NZE.;* IEA (2023), *Energy Efficiency Database.*

European and US heat pump sales hit a plateau in 2023, but kept rising in China; global sales need to more than double by 2030

Heat pump sales across key countries, 2019 – 2030 (buildings)

Million number of units sold per year



What caused a fall in sales in Europe and the US?

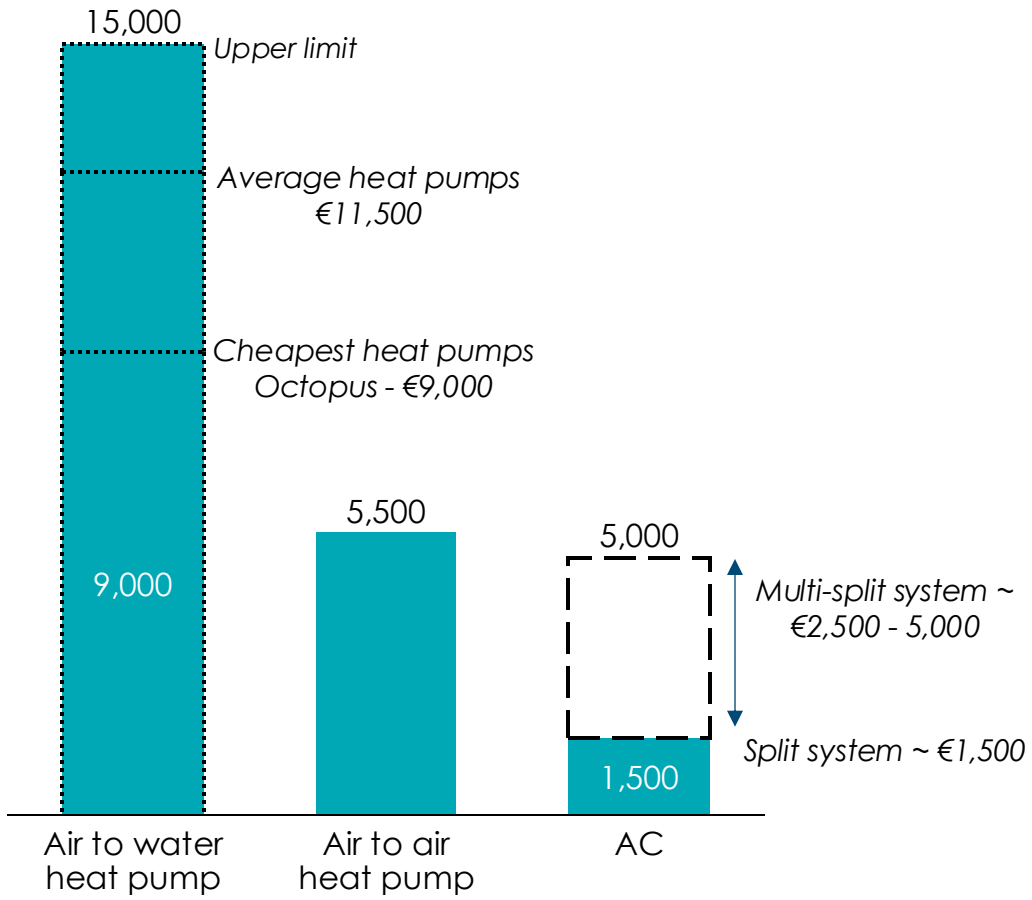
- **Shifts in policy**: potential for higher future subsidies delaying sales (e.g., Austria); reduced subsides in others (e.g., Italy)
- **Falling gas prices:** reduces the payback of heat pumps
- **Cost of living challenges**: global inflation is slowing consumers spending
- **Consumer backlash** e.g., reversing planned regulation in Germany and the UK

Source: ETC (2023), *Fossil Fuels in Transition;* EHPA (2023), *Market statistics*; EHPA (2024), *Pump it down: why heat pump sales dropped in 2023*; IEA (2024), *Heat pump sales in China and in the rest of the world, 2019-2023*; Energy Institute at HAAS (2024), *Why are heat pump sales decreasing?*
Note: 2030 projections for Europe and US are the average of the ETC's 'Ambitious and Clearly Feasible' and 'Plausible but Stretch' scenarios; China is from the IEA.

The main barrier to heat pump adoption remains the upfront capex cost; but AC units can be ~3-4 times cheaper than air-to-air heat pumps, suggesting costs can come down

Average capex cost (technology and installation)

€



We are unlikely to see cost reductions on the same scale as solar; but a fall of ~25% by 2030 is feasible - could it be higher?

Key drivers of cost reductions:

Capex ~40% of costs	Labour ~60% of costs
Heat pumps / ACs are already a mature technology	Installations will improve in quality and speed as installers gain experience
Growing competition and trade as market scales	Huge labour and skills gaps expected
Economies of scale	Subsidies are dampening potential falls in labour costs
Manufacturing capacity constraints – short-term risks, but short lead times of 1-3 years to ramp up	There is no one-size-fits all solution; designing an install will take time
Subsidies are dampening the impact of competition	

Significant driver of cost reductions	Large driver of cost reductions	Unclear / immaterial	Unlikely to reduce costs	Significantly unlikely to reduce costs

Sources: Systemiq analysis for ETC (2024).
Note: figures presented represent the average of costs from ETC literature review. Costs do not include the cost of retrofit measures or any subsidies.

The EU is leading the way with regulation to phase out fossil fuels; the UK and US have no regulation in place, while China plans are ambitious but do not explicitly ban fossil fuels

UK Heat and buildings strategy
Plans for a gas boiler ban in all new built homes *(not regulation yet)*

EU Revised European Building Policy Directive
A gradual phase-out of stand-alone boilers powered by fossil fuels, starting with the end of subsidies to such boilers from 1 Jan

China 14th Five-Year Plan – 2025 targets:

- Plans to retrofit 350 million m2 of existing buildings and construct 50 million m2 of ultra-low or zero-energy consumption buildings in the next 5 years → implying heat pumps as the most low-carbon solution
- Energy consumption caps in building operations
- Increase energy efficiency of new public and residential buildings by 20% and 30%

2025

2026
Requirement for zero emissions for all new public buildings

2028
Zero emissions for all new buildings

2030
Emission reductions of at least 60% in the building sector compared to 2015

2035
Phase out of fossil fuel based heating systems from all buildings (if not feasible as demonstrated to the Commission, then 2040 at the latest)

Source: Systemiq analysis for ETC based on public policy announcements

Hydrogen

Hydrogen hype is over – scaling up hydrogen is harder than hoped, with rising uncertainty over how useful it will actually turn out to be


PREMIUM • DAILY COVER

Green Hydrogen's Hype Hits Some Very Expensive Hurdles


Cost of electrolysers for green hydrogen production is rising instead of falling: BNEF


The Guardian view on hydrogen hype: it's perhaps not as green as you think

Editorial

Low carbon emissions in Europe cannot come at the cost of environmental destruction abroad


The Big Read Hydrogen power + Add to myFT

Lex in depth: how the hydrogen hype fizzled out

Once viewed as a superfuel that could decarbonise large chunks of the economy, the likely uses are shrinking dramatically

'Green hydrogen is triple the cost of grey in Europe — and doubling carbon taxes will not close the gap': study

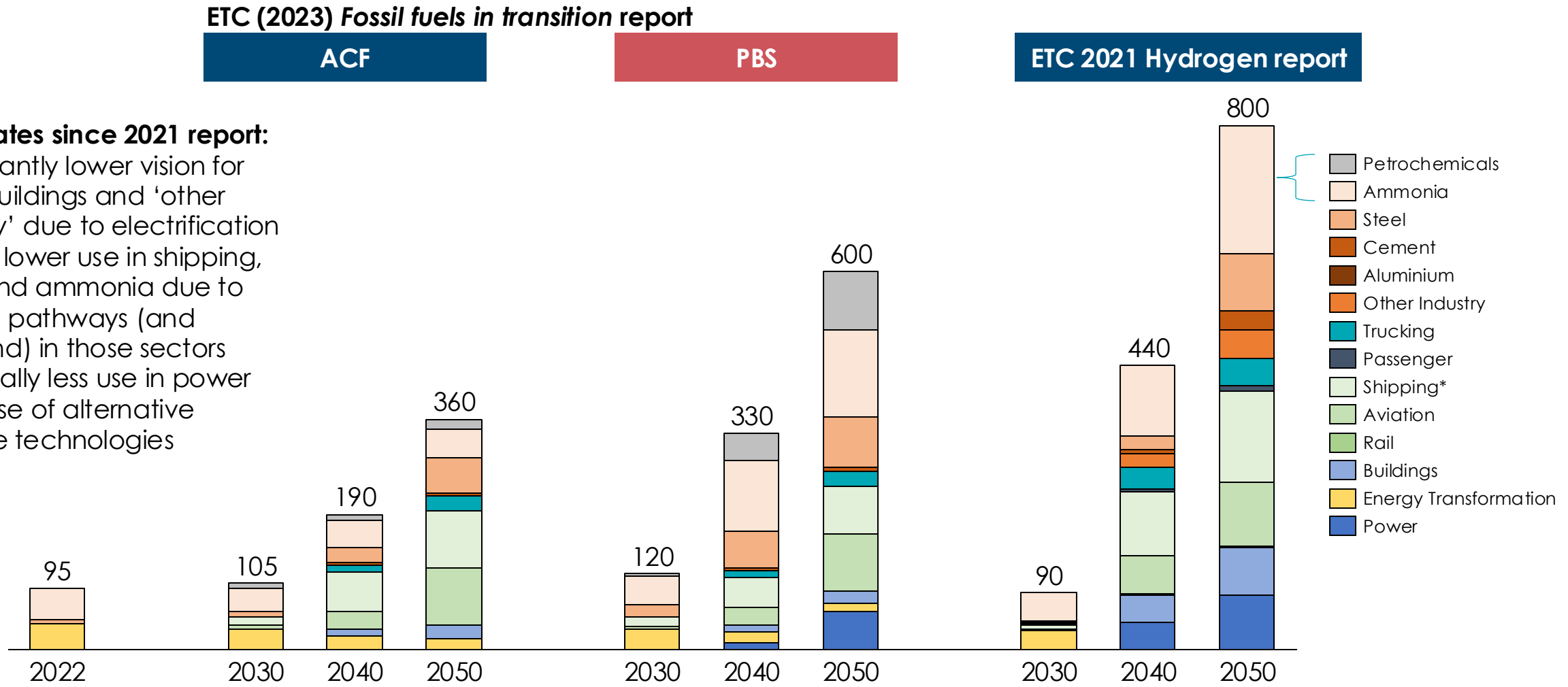
Source: Forbes (2024), *Green Hydrogen's Hype Hits Some Very Expensive Hurdles*; The Guardian (2023) *The Guardian view on hydrogen hype: it's perhaps not as green as you think*; Financial Times (2024), *Lex in depth: how the hydrogen hype fizzled out*;

Hydrogen demand in the ETC's new scenarios is slightly lower than previous estimates, but still 3-6x higher than current

Hydrogen demand by sector, in million tons of hydrogen (MtH_2) per annum

Key updates since 2021 report:

- Significantly lower vision for H2 in buildings and 'other industry' due to electrification
- Slightly lower use in shipping, steel and ammonia due to refined pathways (and demand) in those sectors
- Potentially less use in power because of alternative storage technologies

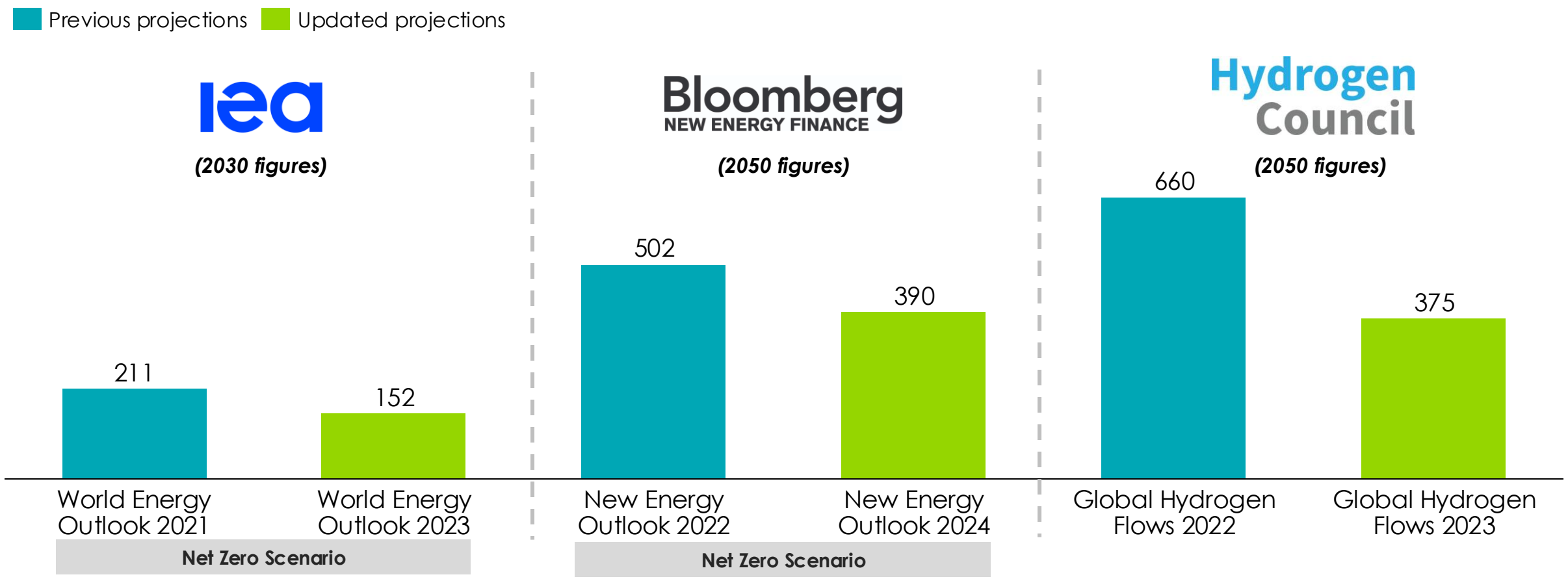


Note: ammonia does not include ammonia/hydrogen used in shipping, which is accounted for separately under 'Shipping', hydrogen consumption from trucking comes from MPP (2022), *Making Zero-emissions trucking possible,* Energy transformation = energy consumed in processing raw fossil fuels into useable energy products, mostly to convert crude oil to refined oil products. ACF=Accelerated but clearly feasible, PBS = Possible but stretched. Source: Systemiq analysis for the ETC (2023).

Other key bodies have also revised down hydrogen projections

Global hydrogen demand in 2030 (IEA) or 2050 (BNEF and Hydrogen Council)

Mt H2

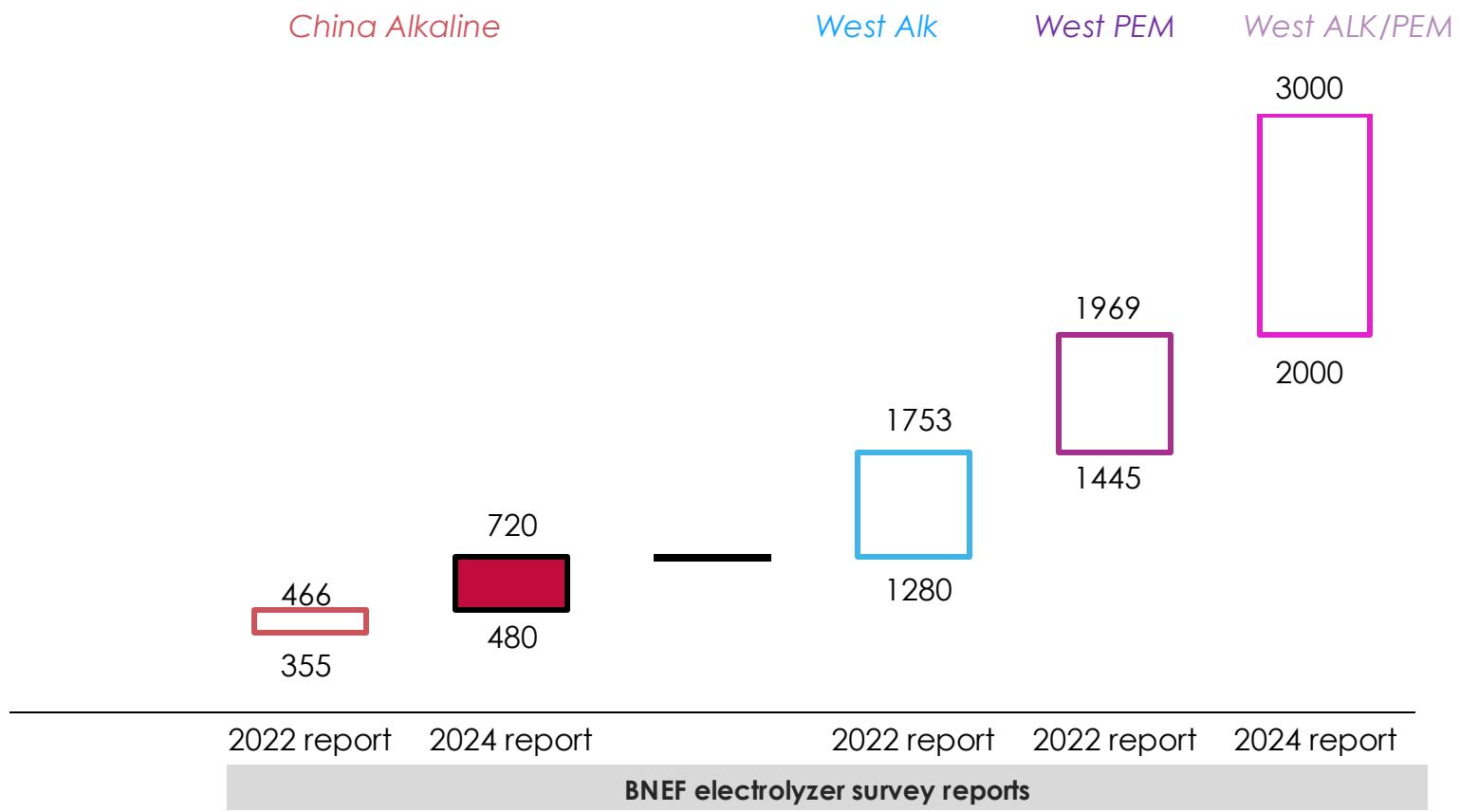


Source: IEA (2023), *World Energy Outlook 2023*; IEA (2021), *World Energy Outlook 2021*; Hydrogen insights (2024), *'Getting to net zero will need nearly a quarter less clean hydrogen than we initially predicted': BNEF*; Hydrogen insights (2023), *Half of all clean hydrogen produced globally could be transported long-distance by 2030, says Hydrogen Council*

Electrolyser prices have increased dramatically over the past years, and significant progress needs to be made to drive down costs of hydrogen by 2030

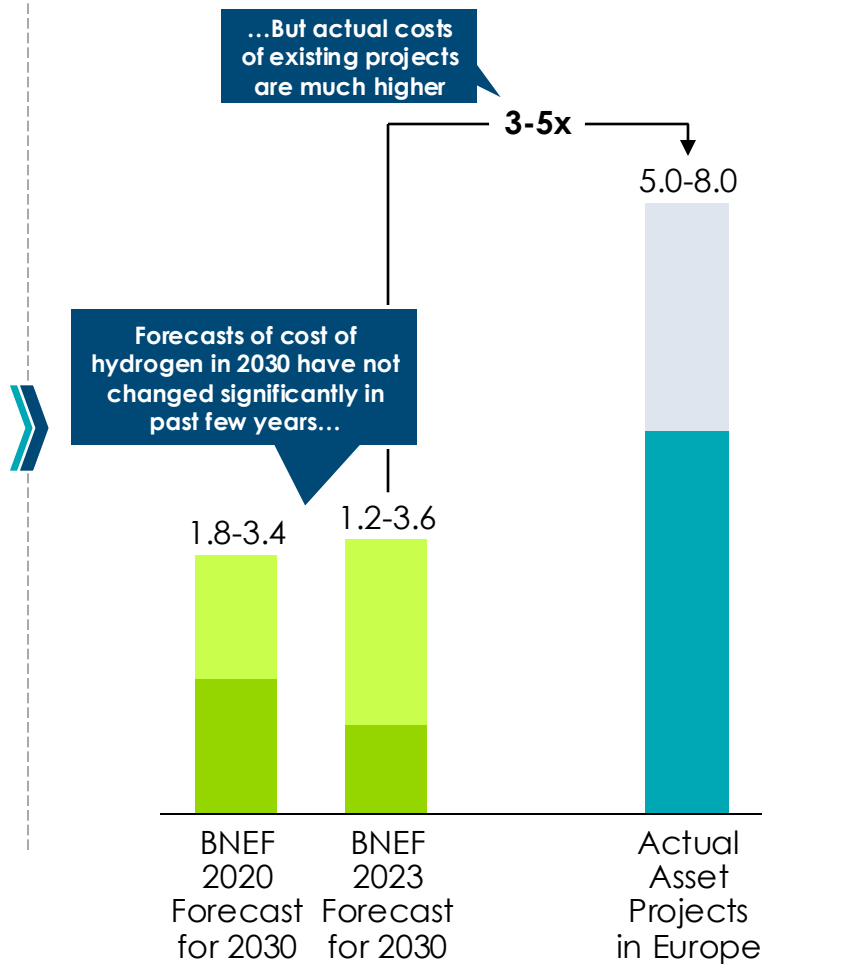
System capex forecast of large alkaline electrolysis projects

$/kW



Levelised cost of hydrogen

$/kg hydrogen



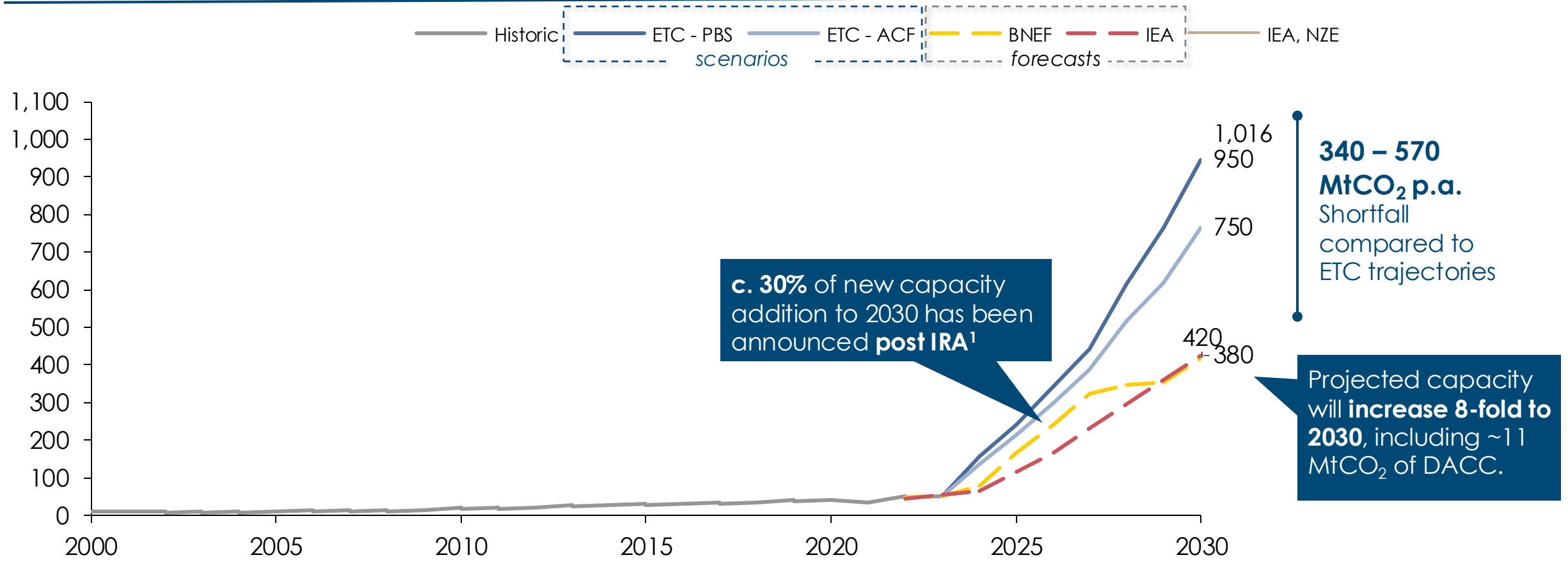
Note: ALK = Alkaline Electrolyser. PEM = proton exchange membrane electrolysis
Source: Systemiq analysis for the ETC; BNEF (2024), Electrolyzer Price Survey 2024: Rising Costs, Glitchy Tech

CCS

Projected CCUS capacity to 2030 includes ~8x growth from current levels, but falls well short of what is required for ETC's new pathways

Total Carbon Capture Utilisation and Storage (CCUS) capacity to 2030

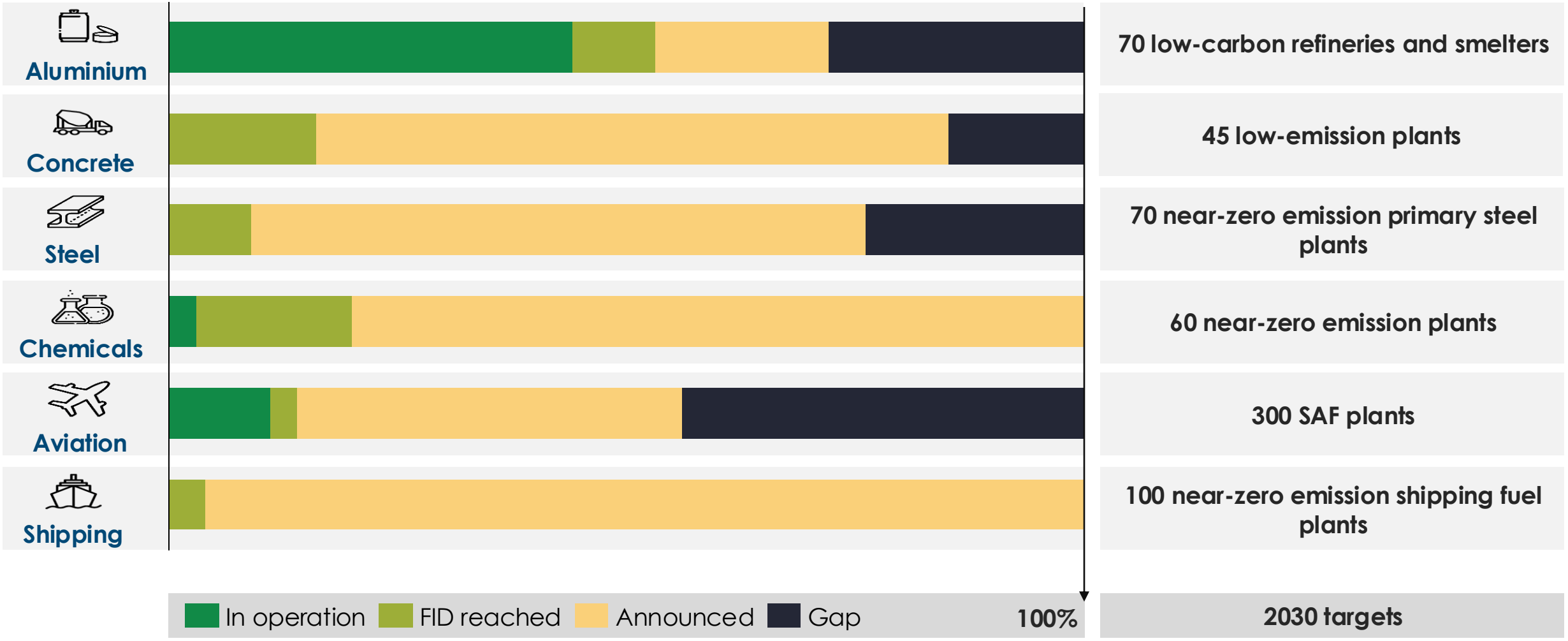
$MtCO_2$ p.a.



Note: [1] IRA = Inflation Reduction Act. The values presented here based on BNEF/IEA include direct air carbon capture (DACC) projects, but the volumes by 2030 are expected to be very low, 10-15 $MtCO_2$ p.a. of capacity. Values are rounded.
Source: Systemiq analysis for the ETC; BNEF (2024) *CCUS Projects Database 1h 2024;* IEA (2024), *IEA, Capacity of current and planned large-scale CO2 capture projects vs. the Net Zero Scenario, 2020-2030,* BCG (2023), *Impact of IRA, IIJA, CHIPS, and Energy Act of 2020 on Clean Technologies*

Part 3. Hard to abate sectors

Heavy Industry: Good progress for steel, aluminium and chemicals/ammonia, but decarbonising concrete and aviation remains slow



Source:; Mission Possible Partnership (2024), *Global Project Tracker.*

Direct electrification technologies are emerging, showing increasing potential against frontrunning solutions to decarbonize heavy industry high-temperature processes.

	Frontrunning decarbonization technology*	Direct electrification alternative	Key companies	Key challenges	Potential of direct electrification alternative
Aluminium	**Low-carbon anode (esp. Inert anodes) & Hydrogen Calcination.**	**Electrochemical metal oxide electrolysis**	BOSTON METAL	**Low development state** • Not in focus of major producers. **Challenging operations** • Requires significant green electricity **Manufacturing scalability challenges** • Need for costly high temperature resistant material.	**Major economic advantage** from streamlined production, like omitting smelter production step.
Steel	**Hydrogen-based direct induced iron (DRI).**	**Electrochemical metal oxide electrolysis**	BOSTON METAL Siderwin	**Low development stage** • Only tested at laboratory scale. **Challenging operations** • Process requires significant green electricity supply. **Manufacturing scalability challenges** • Need for costly and high temperature resistant material.	**Has potential for more economic operations and full GHG emission avoidance**, promising more flexible and scalable steel production better scalability through bypassing costly green hydrogen infrastructure.
Low – medium temp industry	**High temperature heat pumps**	**Heat pumps**	TRANE TECHNOLOGIES DAIKIN	**Constant and reliable temperature required:** challenge of relying on variable renewables → heat storage key **Cost:** upfront capex and electricity/gas price ratio **Awareness and early demand**	**Significant efficiency gains** – operating cost benefits with rebalanced energy prices

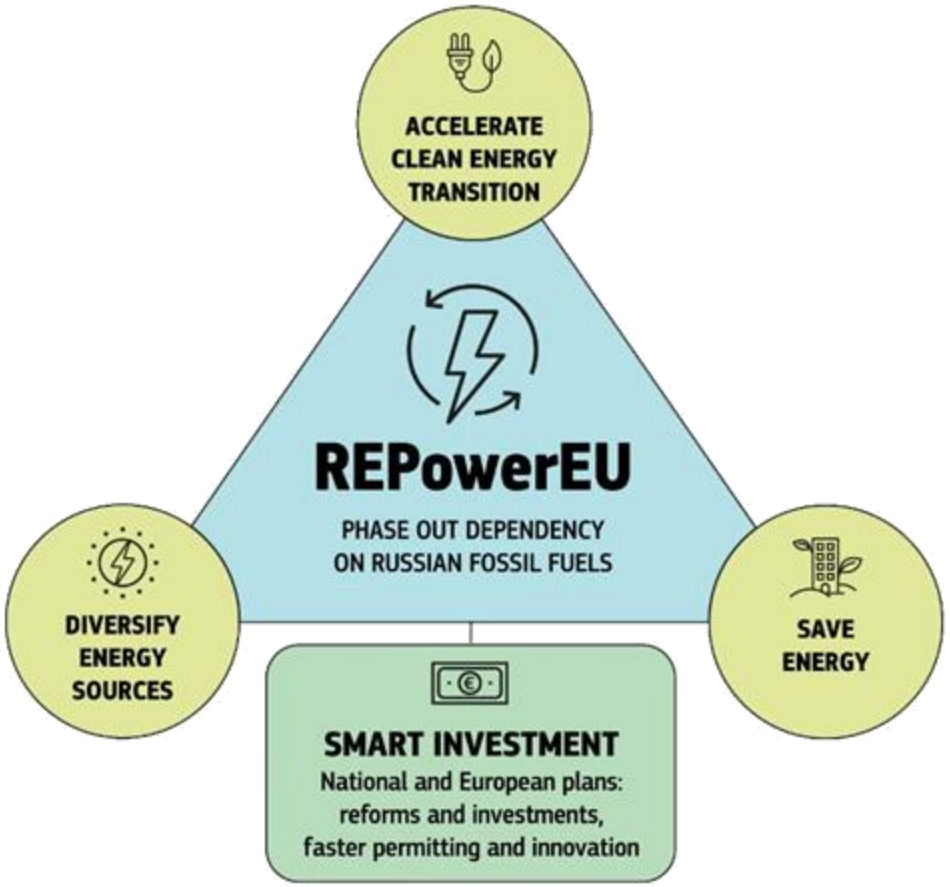
Impact on MISSION POSSIBLE PARTNERSHIP **Direct electrification alternatives might challenge MPP's decarbonization pathways via its frontrunning decarbonization technology.**

Source: Mission Possible Partnership (2022), *Cement/Aluminum/Ammonia/Steel Sector transition strategy reports;* Logos from respective company websites (2024).
Note: *MPP focus technology: raising question if they could be challenged; Listing on this slide does not include CCU/S technologies.

Part 4. Regions

EU

REPower EU has greatly accelerated the move away from Russian gas



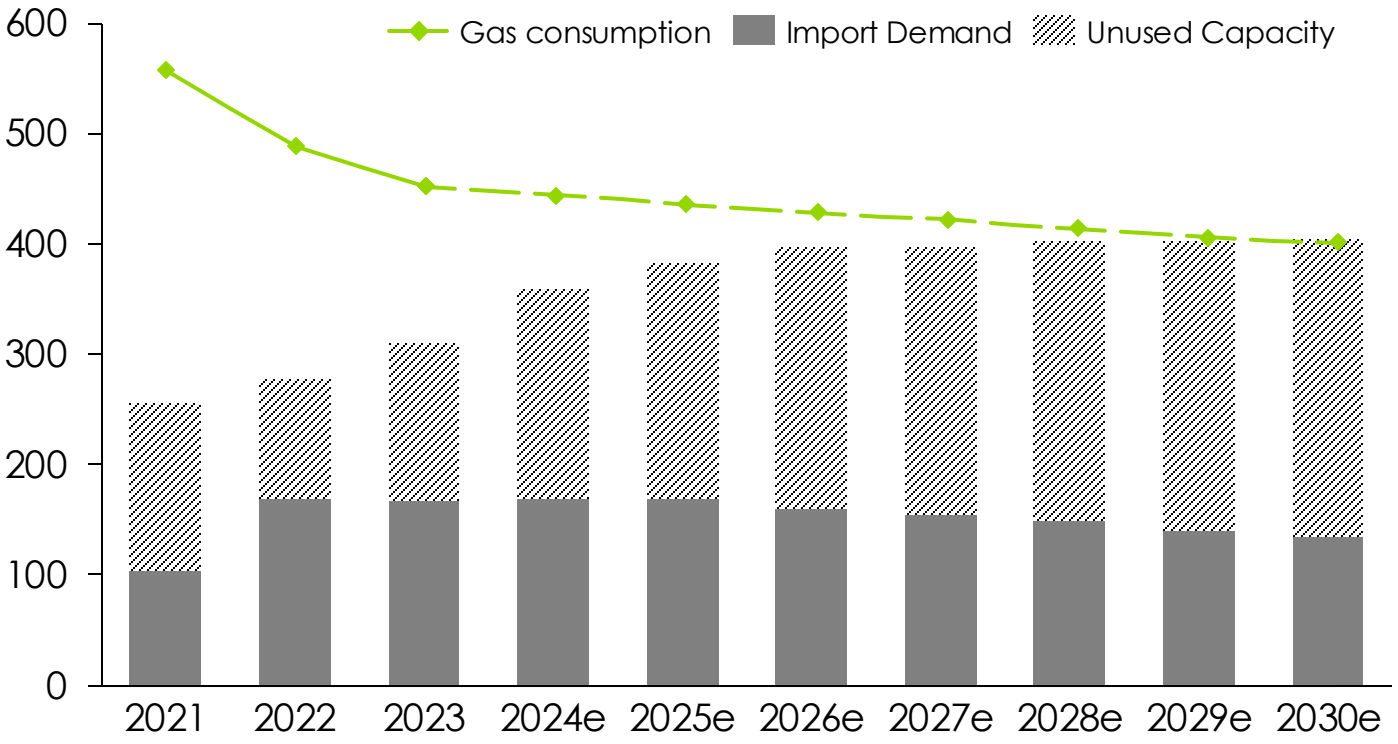
- Reduced gas consumption by 125 bcm (18% or approximately 1200 TWh)
- Overcome dependency on Russian fossil fuels (45% of imported gas in 2021 from Russia v. 15% in 2023)
- Ensured access to secure and affordable energy
- Produced more electricity from wind and solar than from gas for the first time ever
- Rapidly increased renewable energy installation

Source: EU Commission REPowerEU website

Europe's LNG capacity buildout outpaced demand but new gas terminals are still getting approved and coming online

LNG consumption v. import demand and capacity, 2021-2030

Billion cubic meters (bcm)



Less gas being consumed means less gas imports: while import capacity forecasted to meet total consumption, average utilization rate expected to be well-below 50%

Source: IEEFA "Europe's LNG capacity buildout outpaces demand" (October 2023)

Institute for Energy Economics and Financial Analysis

Europe's gas consumption falls to 10-year low as peak LNG demand nears

21 February 2024 (IEEFA) | Europe's gas consumption in 2023 fell to its lowest level in 10 years as countries scale up efficiency measures...

21 Feb 2024

Euractiv

Bratislava to build its first LNG terminal despite fossil fuel phase out

Fears that Slovakia's liquefied natural gas (LNG) terminal could end up as a stranded investment are reinforced by experts who warn that too...

09 Jan 2024

Reuters

Germany's Mukran LNG terminal receives operating permit

Germany's Baltic Sea import terminal for liquefied natural gas (LNG) at Mukran on Ruegen island has received its operating permit under...

10 Apr 2024

The Brussels Times

Belgium on track to open new gas power plant in Liège

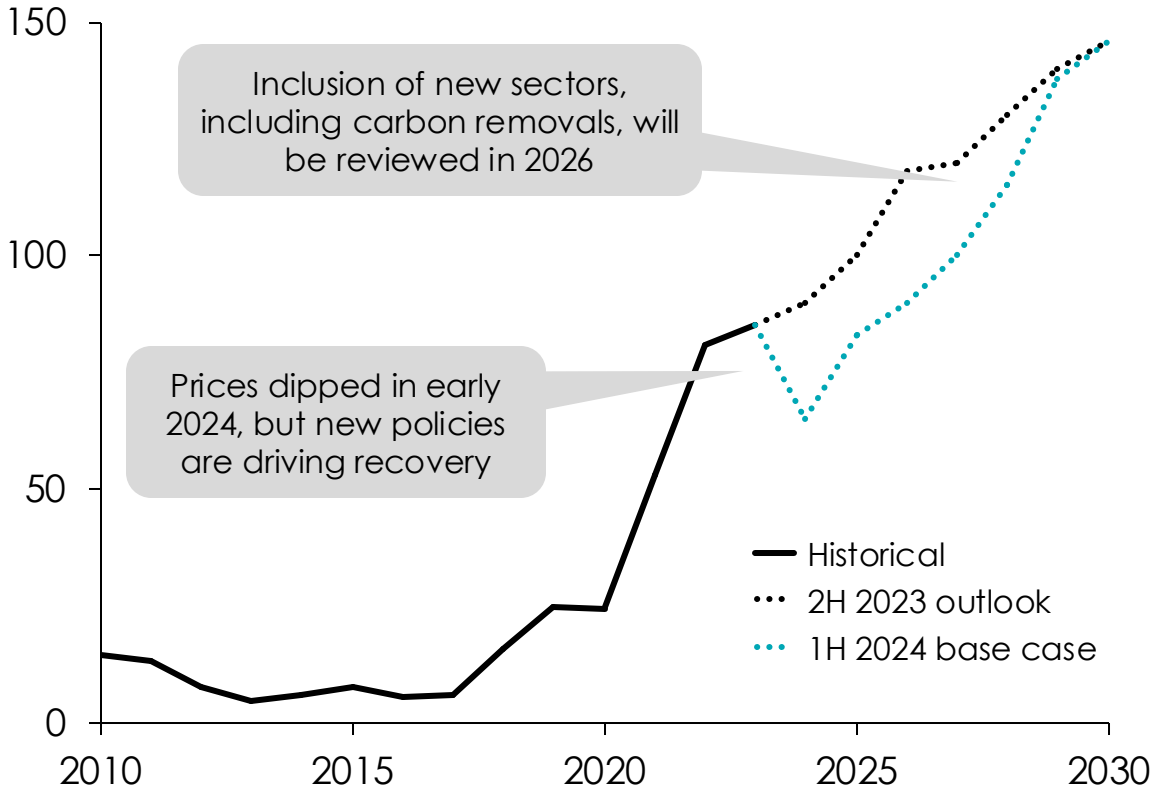
It will be one of the largest turbine-gas-steam plants in the world with power for more than one million homes each year.

1 month ago

Despite fluctuating carbon prices, EU ETS remains a strong market lever

Historical and forecast price of EU emission allowances

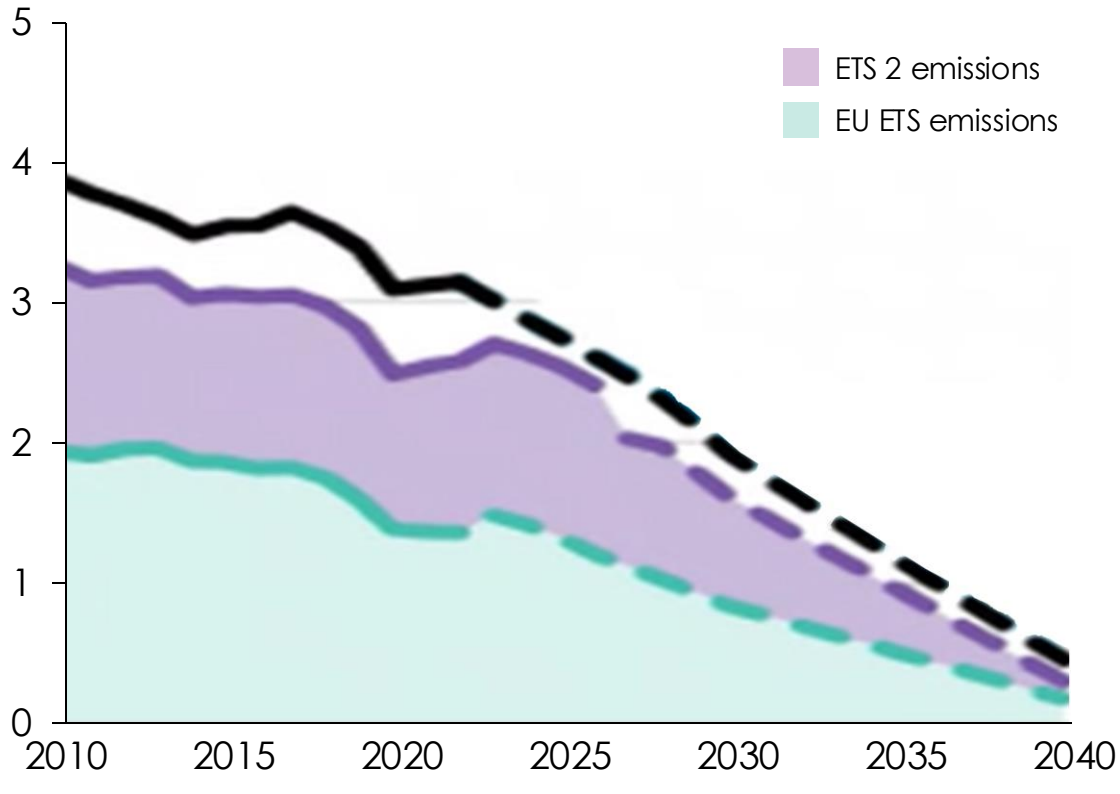
EUR/metric ton, nominal



Carbon price could reach 200EUR/t around 2035

EU ETS emissions caps and possible 2040 target

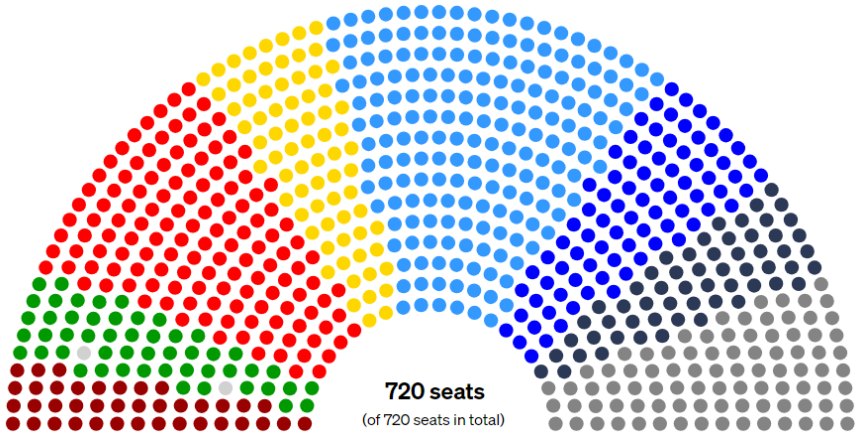
Billion metric tons of CO2e



EU ETS goes to zero by 2040

Note: sectors included in ETS are power generation and industrial plants (e.g., cement, steel, refineries); ETS2 includes buildings, road transport and other smaller industries not previously covered by ETS (e.g., ceramics, pulp & paper);
Source: BNEF; Trading Economics (2023) EU Natural Gas; ICE Endex (2023) Dutch TTF Natural Gas Futures (accessed 06/02/24); BNEF (2023), 2H 2023 LCOE Update

With Parliament moving to right, how will political priorities shift?



Group	Seats	Change
European People's Party	189	+13 ▲
Socialists and Democrats	136	-3 ▼
Conservatives and Reformists	83	+14 ▲
Renew	74	-28 ▼
Identity and Democracy	58	+9 ▲
Greens	53	-18 ▼
Left	39	+2 ▲
Nonaligned	88	+26 ▲

Participation: 51.08% (+0.42%)

EU Parliament

- Centre majority will become more resistant to climate policy, focus on economic security
- Right and far-right will 'hijack' climate issues

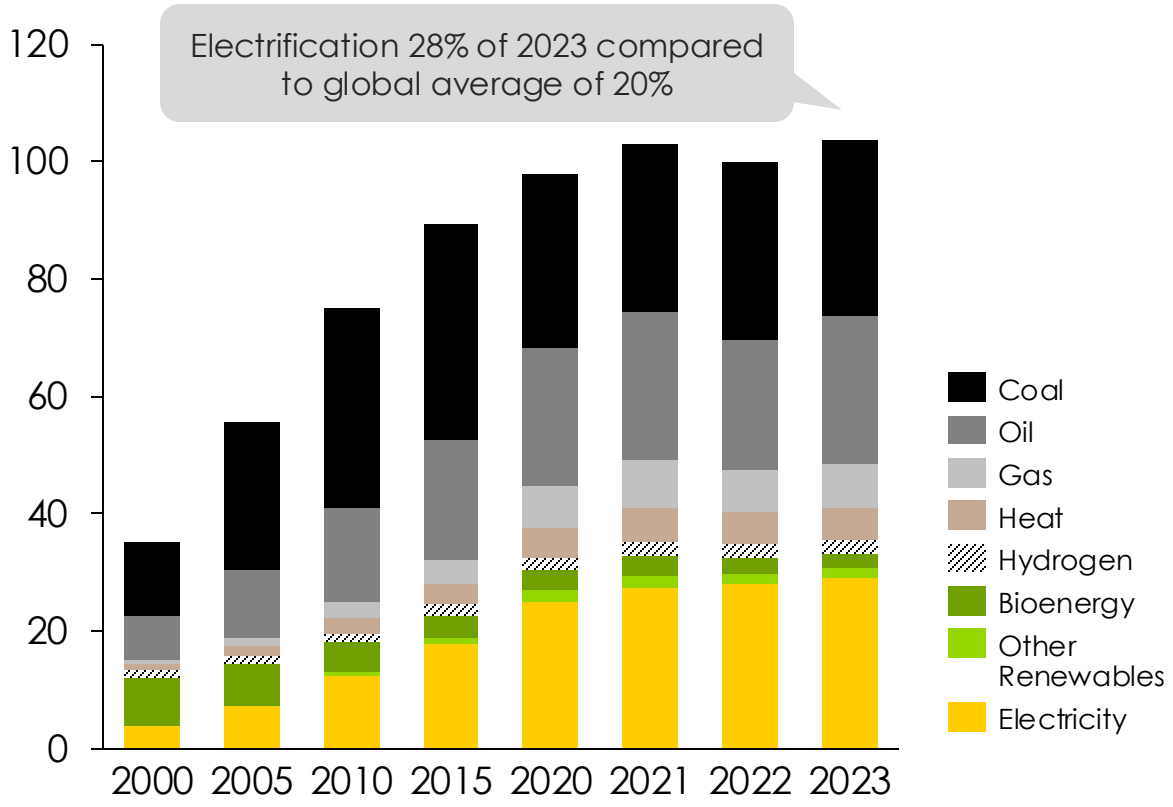
Member States

- 'Strategic security' and competitiveness to frame all future policy
- Climate-sceptic block likely to grow, making green policy harder to push through

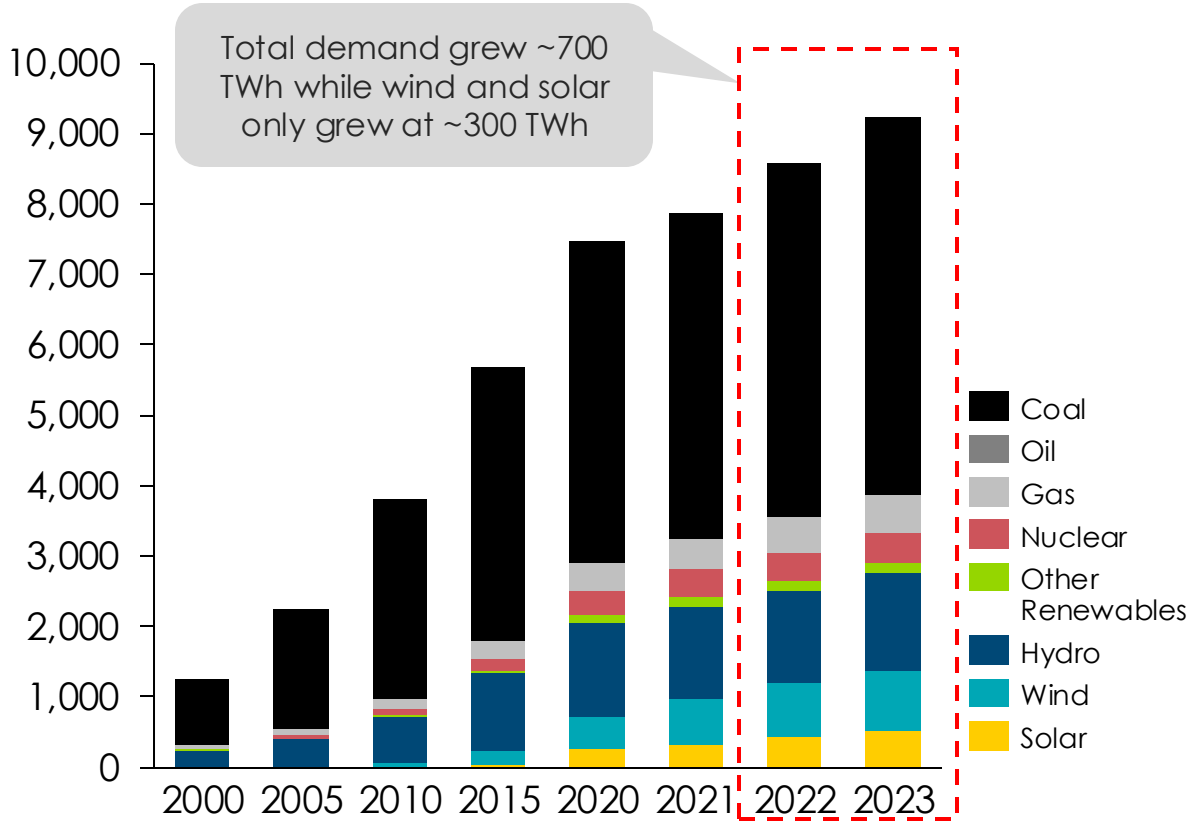
China

Growing electricity demand has outpaced renewable generation, meaning coal generation continues to grow

Final Energy Demand by Fuel (PJ)



Power generation by technology (TWh)



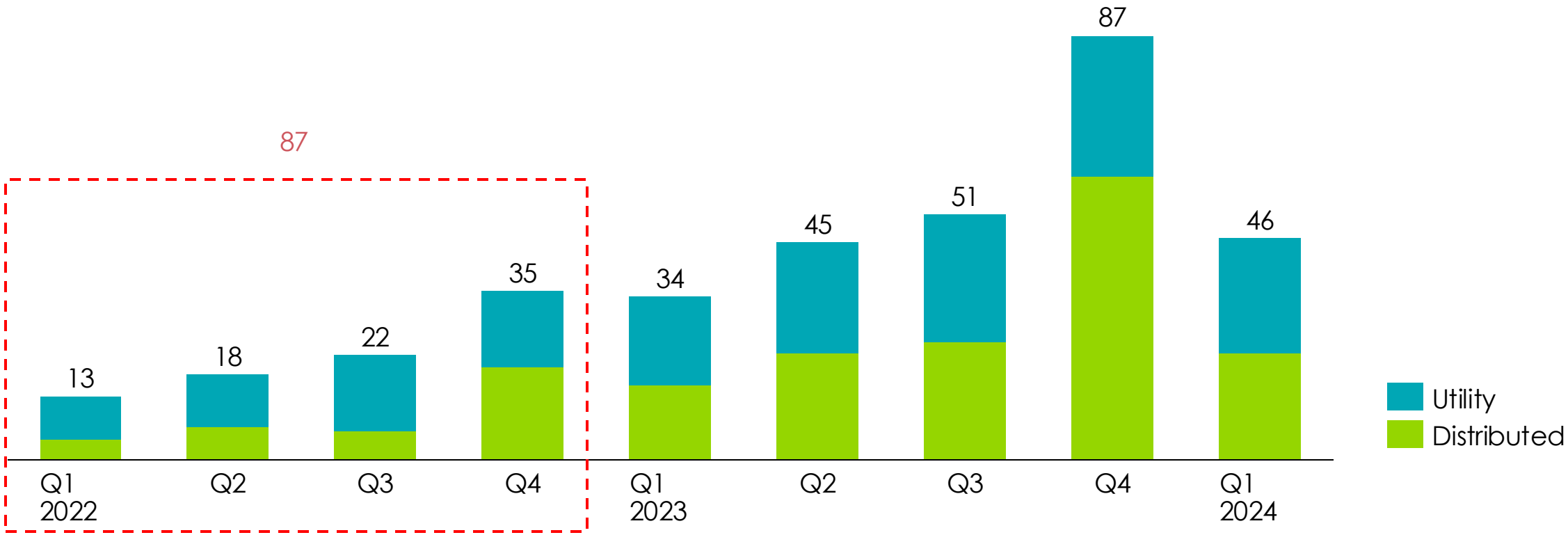
Given outlook for hydro generation, the maintained rate of renewables installation means that power emissions could have already peak

Source: BNEF World Energy Outlook 2023

Amount of solar capacity installed in Q4 of 2023 equal to amount of solar capacity installed in all of 2022

Solar capacity

GW installed per quarter

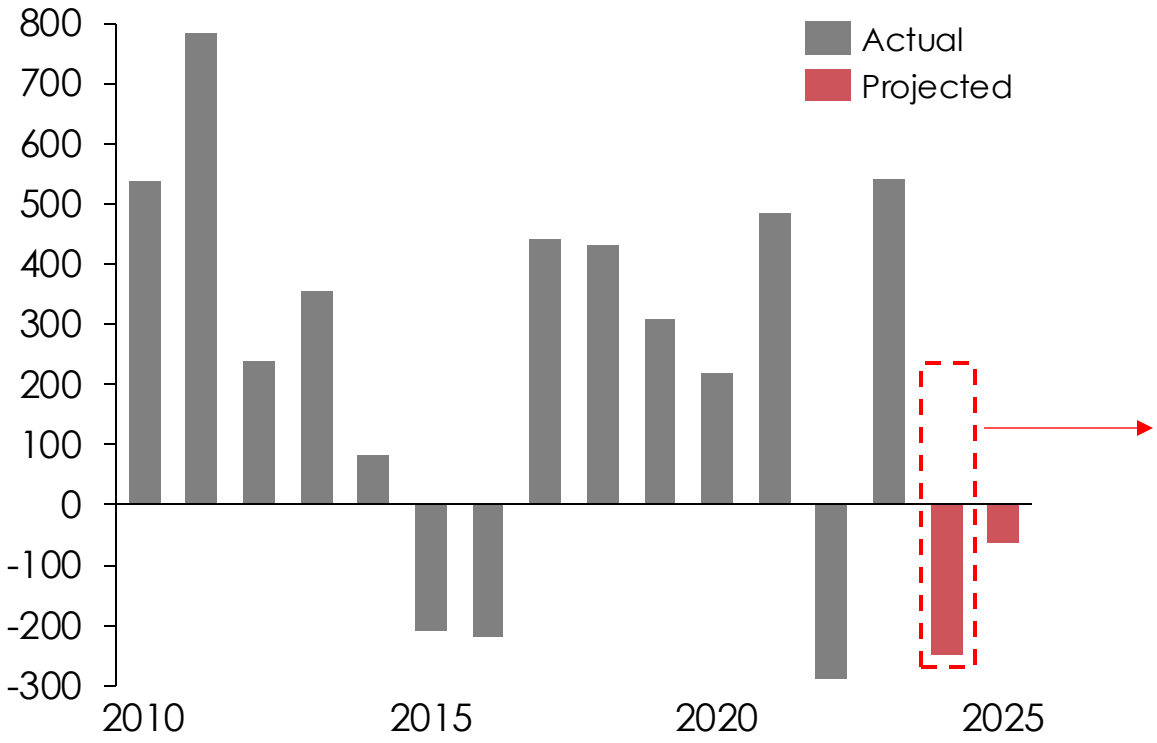


Source: Atlantic Council

Emissions from fossil fuels and cement may actually have peaked in 2023, with year-over-year emissions already dropping in March 2024

Annual change in emissions from fossil fuels & cement

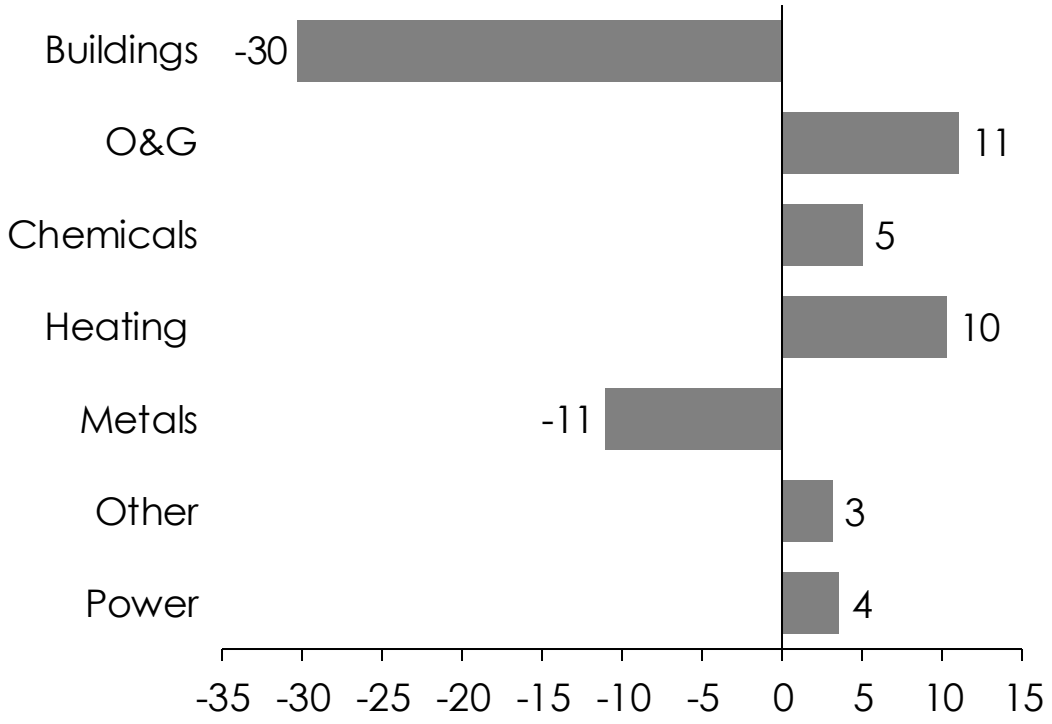
MtCO2



Q4 2023 predicted emissions to enter structural decline beginning 2024

Actual year-over-year change in emissions in March 2024

$MtCO_2$, by sector and fuel



Actual drop driven by clean energy growth and construction-industry contraction

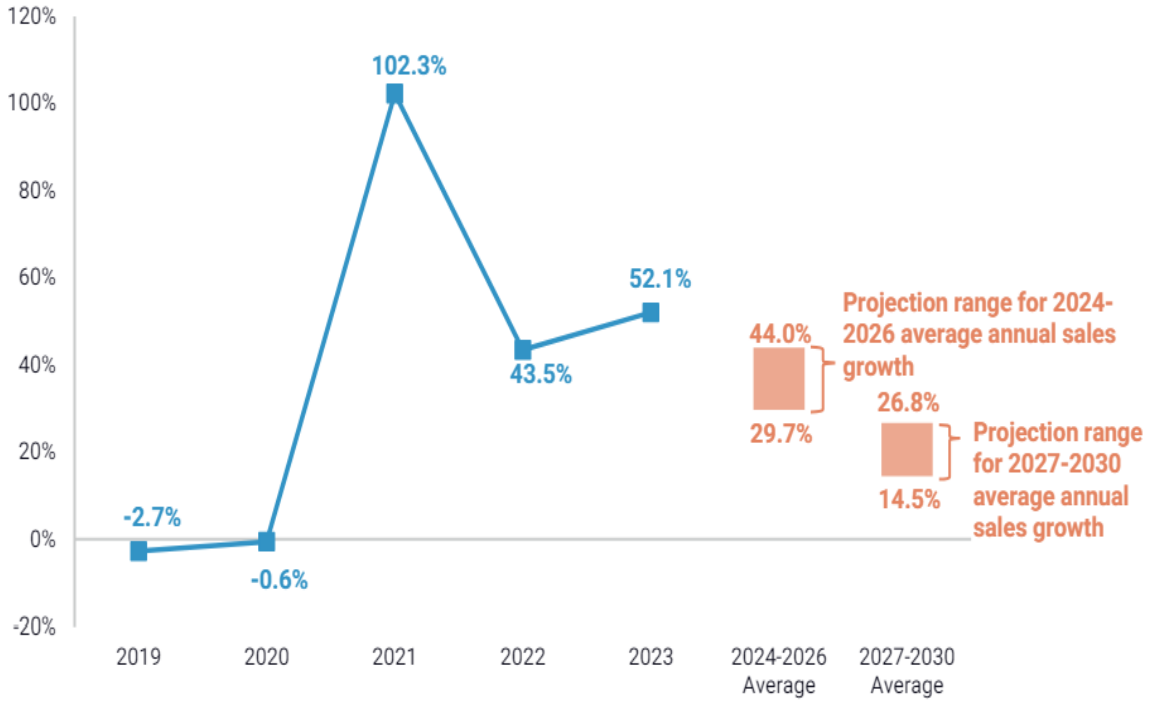
Source: Carbon Brief

US

Since the passing of the IRA, progress in electric vehicles and clean electricity deployment is mixed

Annual growth rate in electric vehicle sales

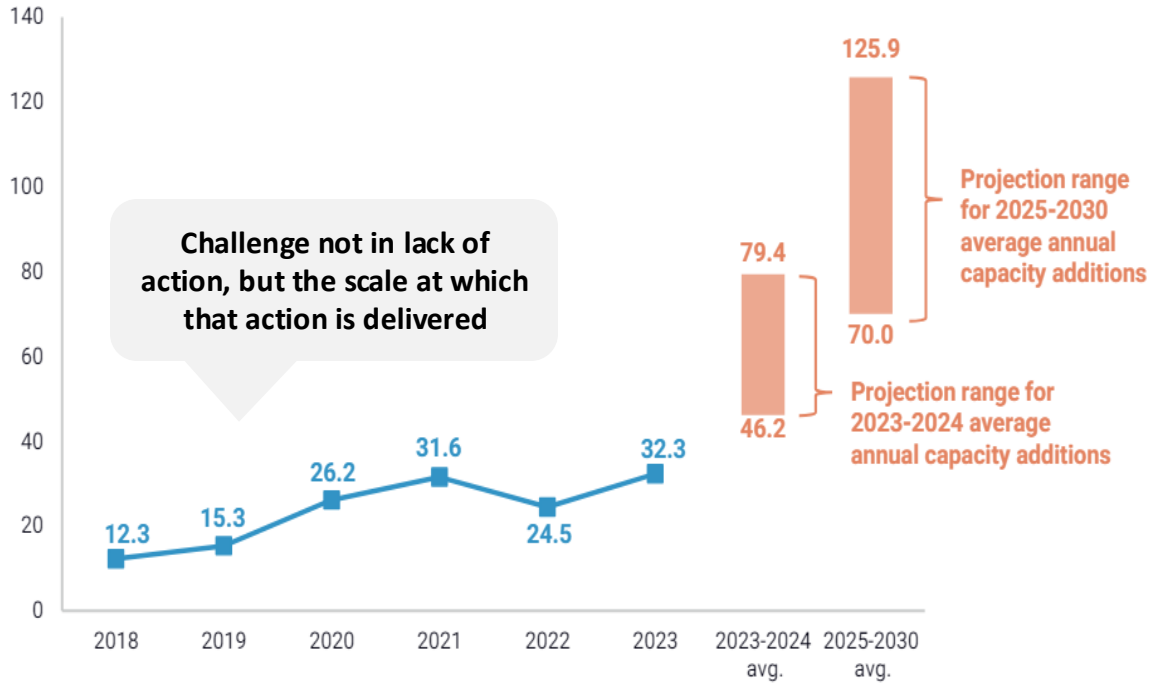
% increase year-over-year



EV deployment can remain on a track consistent with the IRA's 40% emissions reduction objective, even if annual sales growth slows in 2024, provided it stays in the 30-40% range.

Annual clean electricity capacity additions v projections

GW



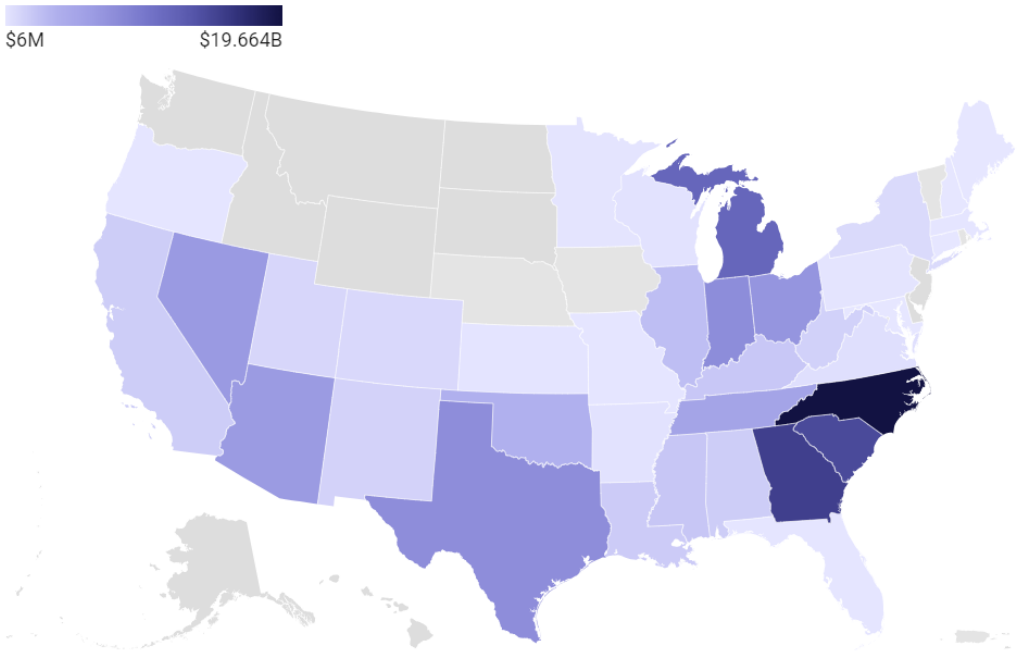
Even though investment in utility-scale clean electricity generation and storage capacity reached record levels in 2023, it is at risk of falling behind post-IRA projections.

Source: Rhodium Group Clean Investment in 2023: Assessing Progress in Electricity and Transport (Feb 2024)

Real impact seen through projects, jobs, and investments across clean energy related sectors

Sector	Projects	Investments	Jobs
EV	137	$77.6B	57.6K
Battery/Storage	51	$21....	15.2K
Solar	73	$14B	25.6K
Hydrogen	17	$6.1B	2.9
Wind	19	$2.9B	1.8K
Grid, Transmission and Electrification	16	$1.8B	2.3K
Energy Efficiency	133	$6M	200
Biofuel	1	N/A	40
Geothermal	1	N/A	N/A

Project, investment, and job creation per state
August 2022 to present

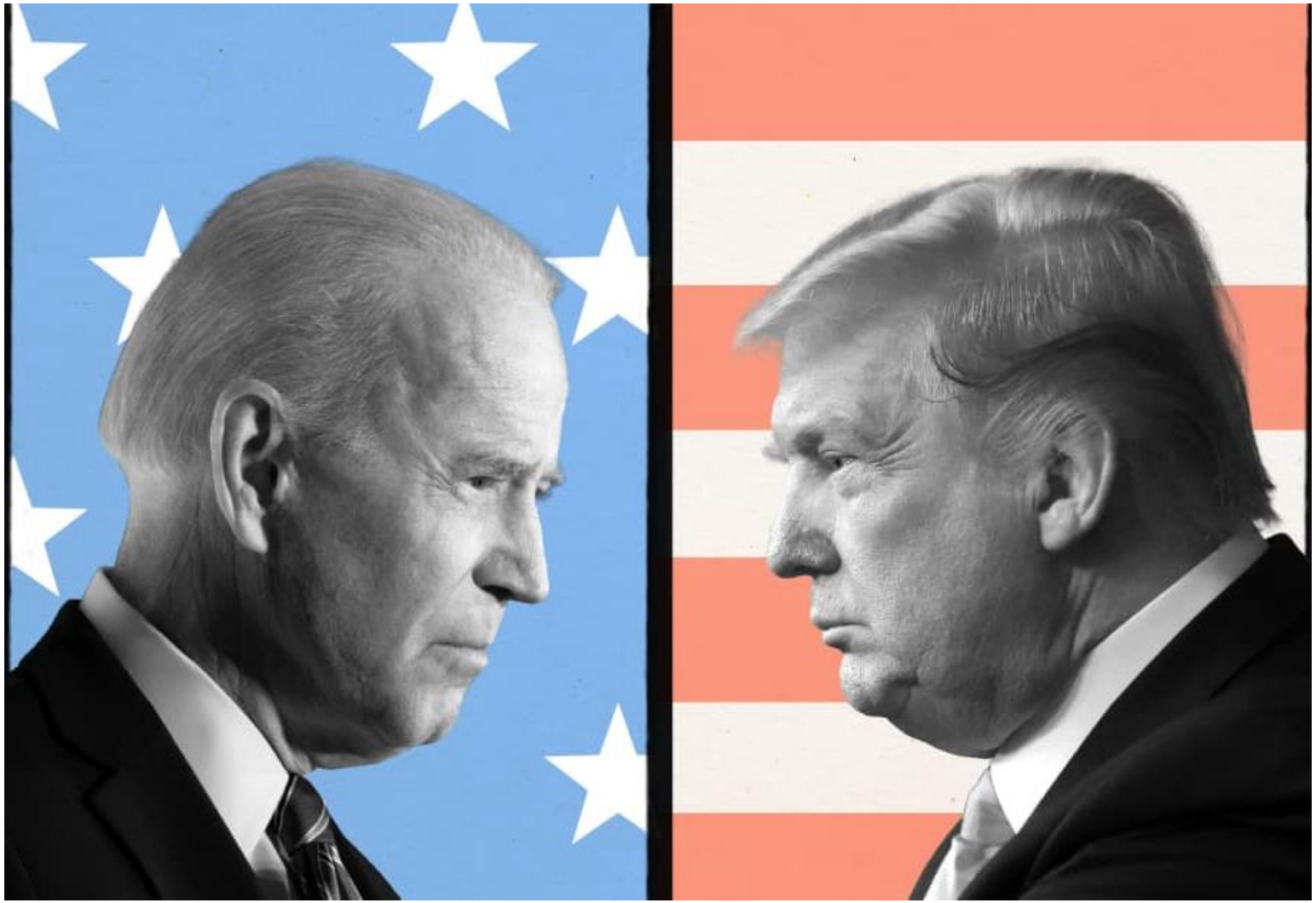


Source: Manufacturing Dive; E2

What could the future hold?

Biden

- Consolidate and expand federal legislation (IRA)
- Full force on permitting and build-out



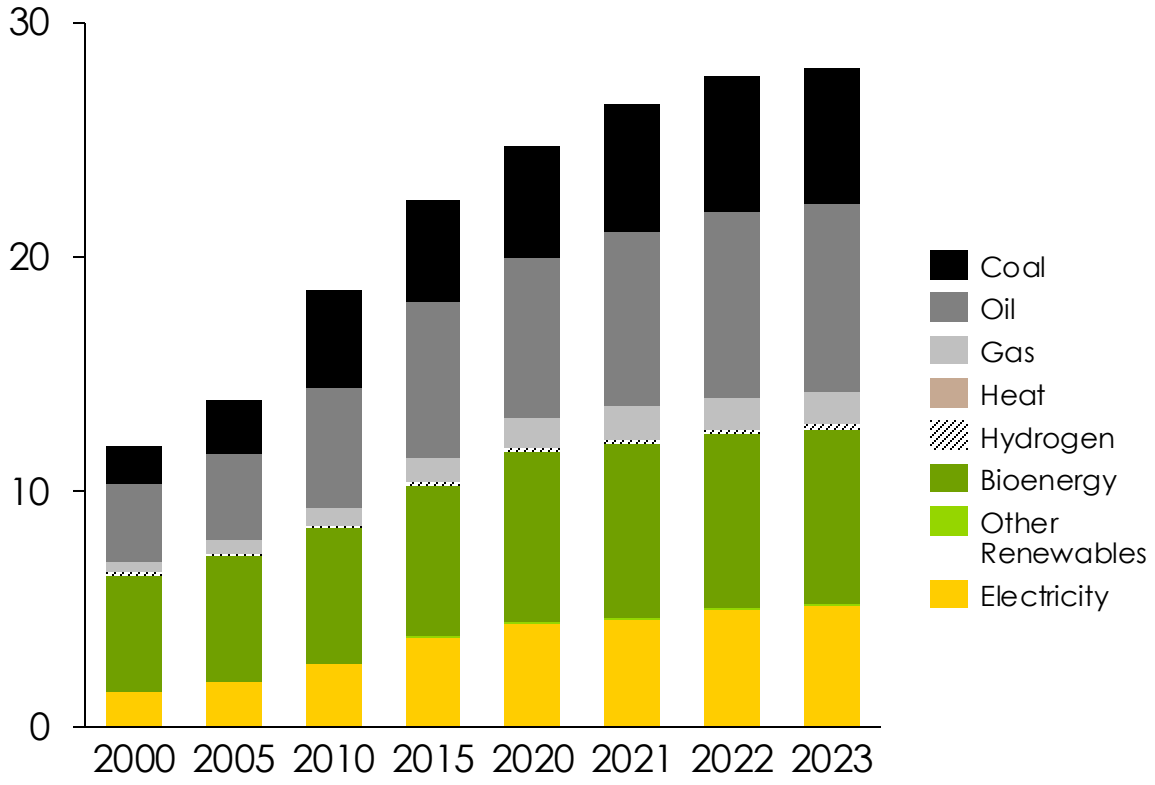
Trump

- Rebrand IRA
- Manufacturing jobs remain
- Executive actions could disrupt other areas (e.g., EVs and renewables)

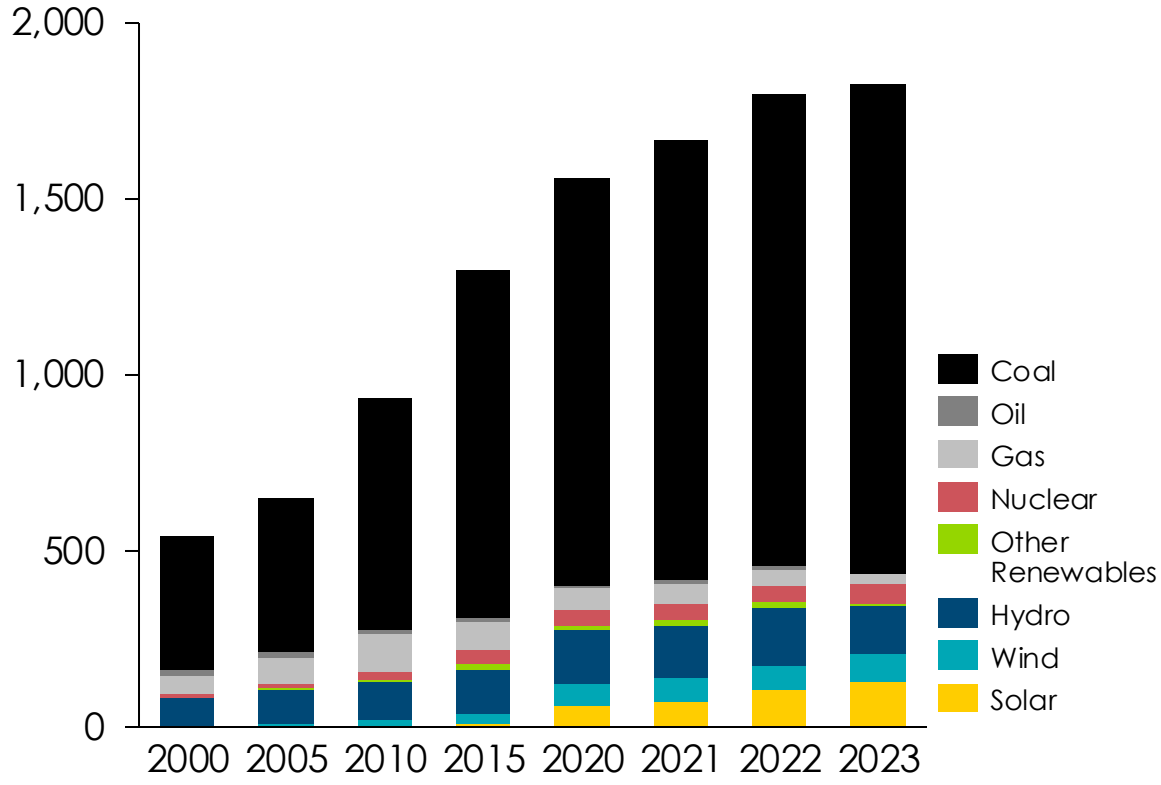
India

Electricity demand continues to grow, resulting in more coal generation

Final Energy Demand by Fuel (EJ)



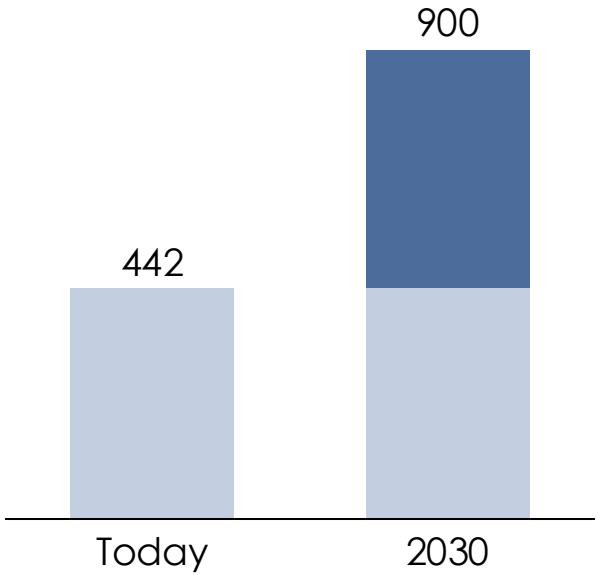
Power generation by technology (TWh)



Source: BNEF World Energy Outlook 2023

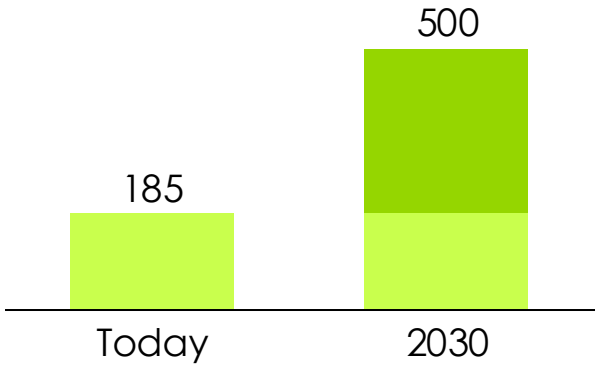
With power demand expected to continue rising faster than new renewable supply, question if coal can start phasing out before 2030

Power capacity, GW



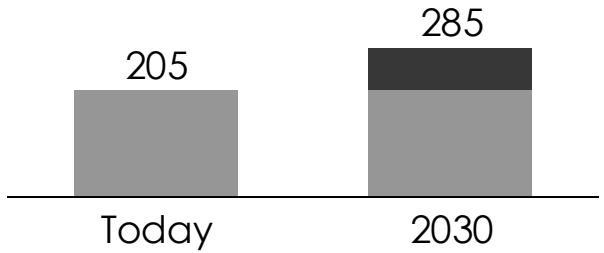
Total

Government aims to deploy 50GW per year of renewables starting in 2024



Renewables

Government has announced 80GW of new coal to be added by 2030



Coal

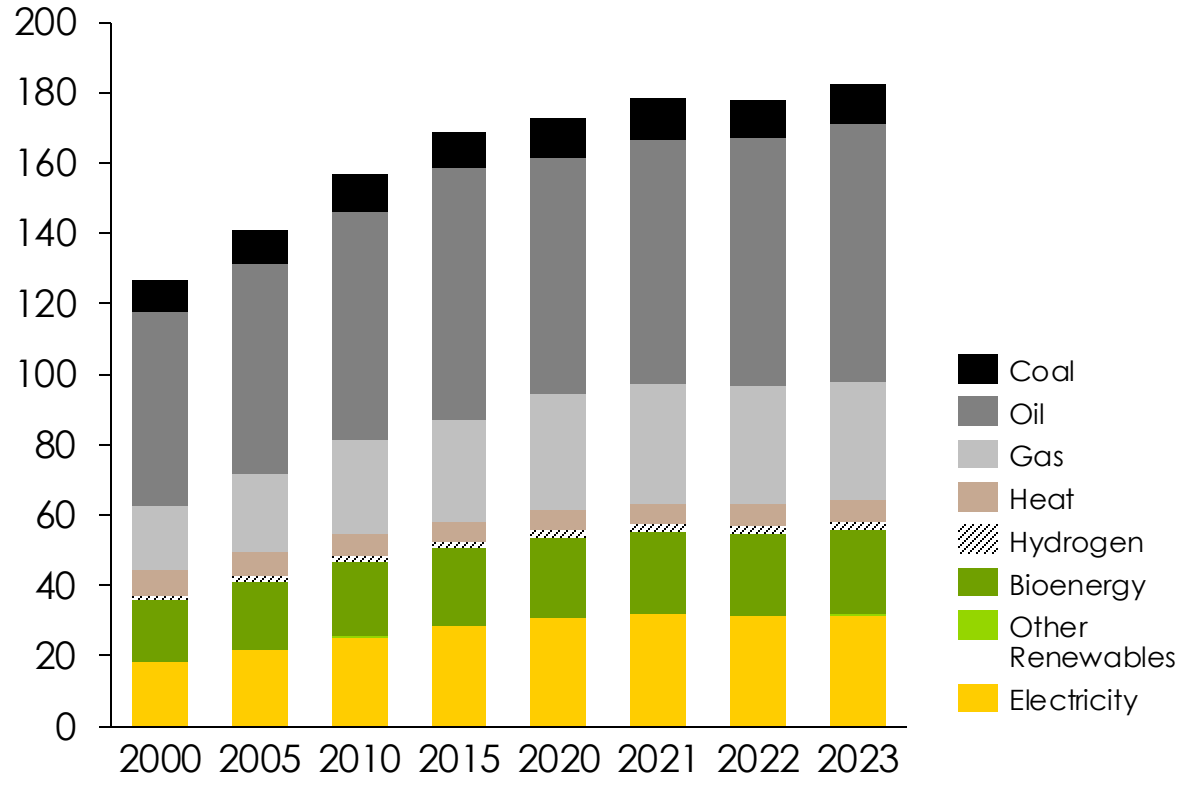
Annual growth, TWh/year

Note: Government expects to deploy 50GW RE per year by 2024
Source: CEEW, Reuters, NTPC

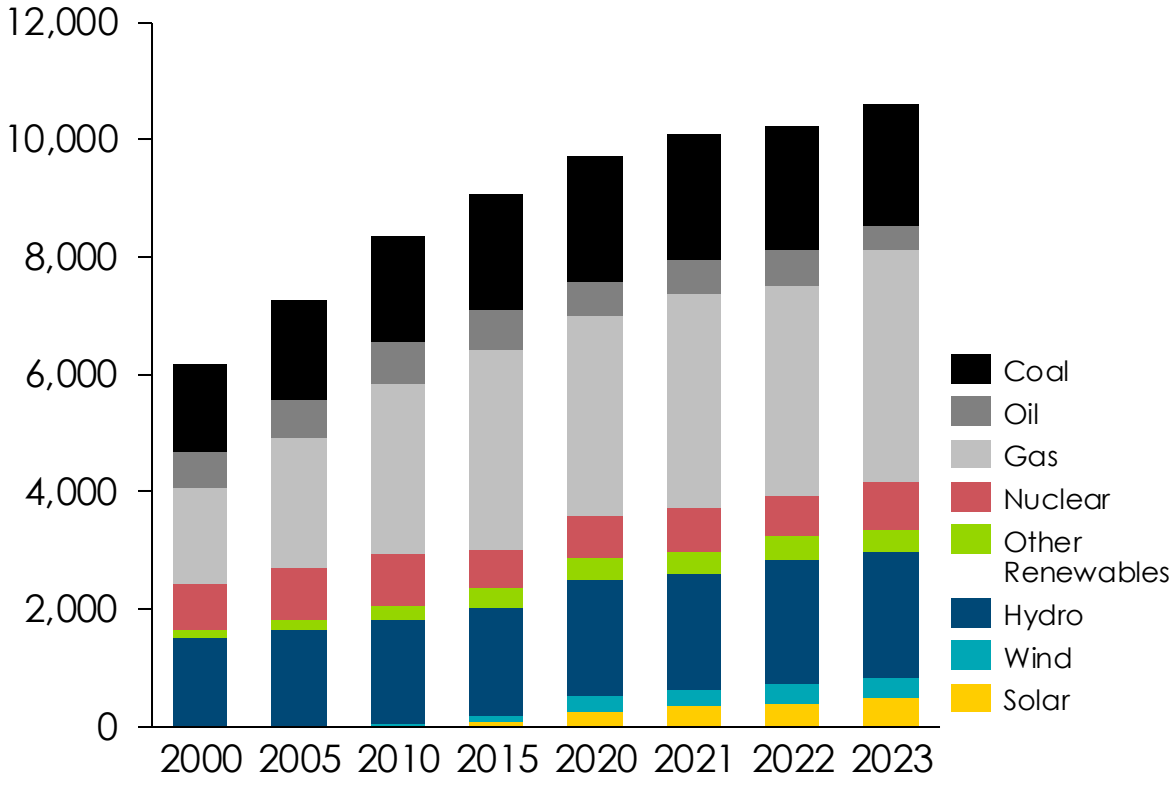
Rest of World

Electrification rates growing but seeing an increase in gas generation as well as renewables

Final Energy Demand by Fuel (EJ)



Installed capacity by technology (GW)

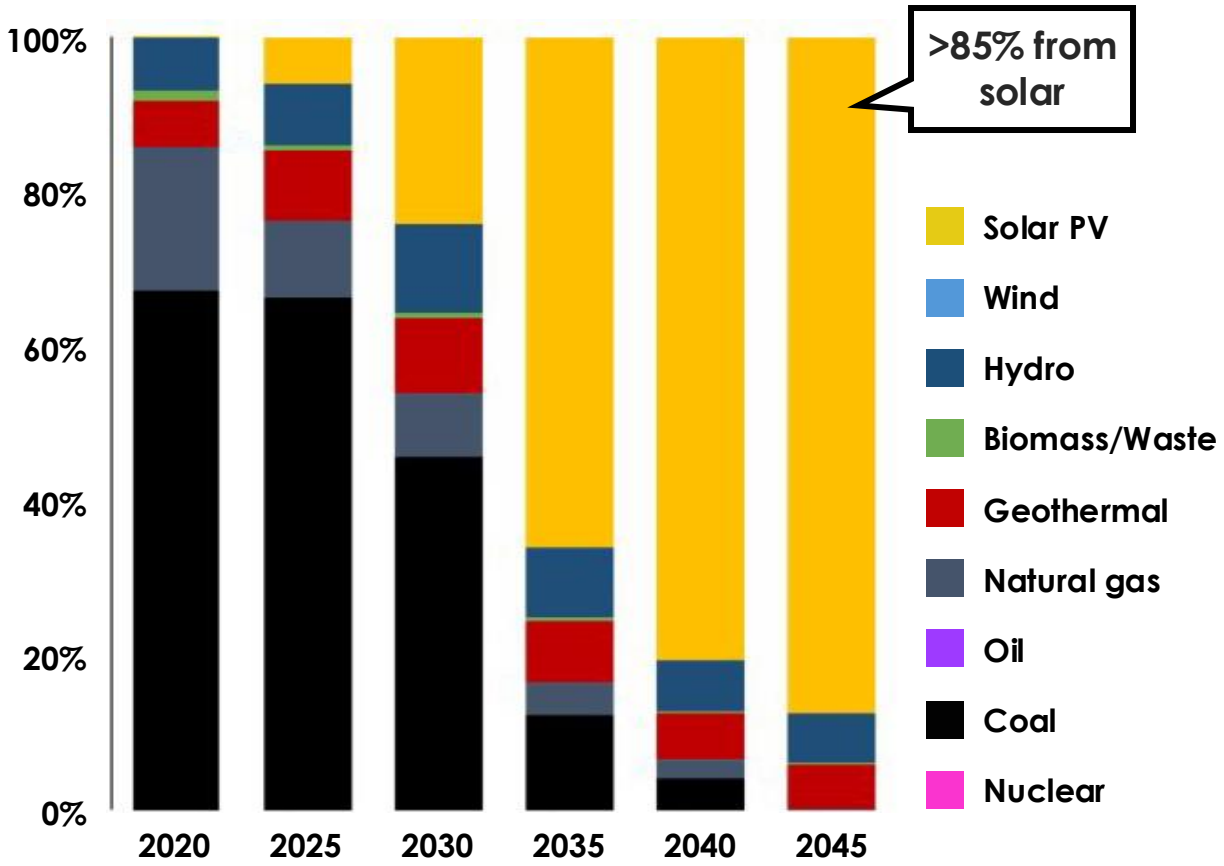


Source: BNEF World Energy Outlook 2023

Although Indonesia could radically decarbonize power system with solar, existing targets for 2030 are relatively unambitious

Indonesia power system, electricity generation

Generation share by fuel (%)



Climate targets and CAT review

Overall rating
CRITICALLY INSUFFICIENT

Policies and action	Conditional NDC target
against fair share **CRITICALLY INSUFFICIENT** 4°C+ WORLD	against modelled domestic pathways **CRITICALLY INSUFFICIENT** 4°C+ WORLD
Unconditional NDC target against fair share **CRITICALLY INSUFFICIENT** 4°C+ WORLD	**Climate finance** **NOT APPLICABLE**

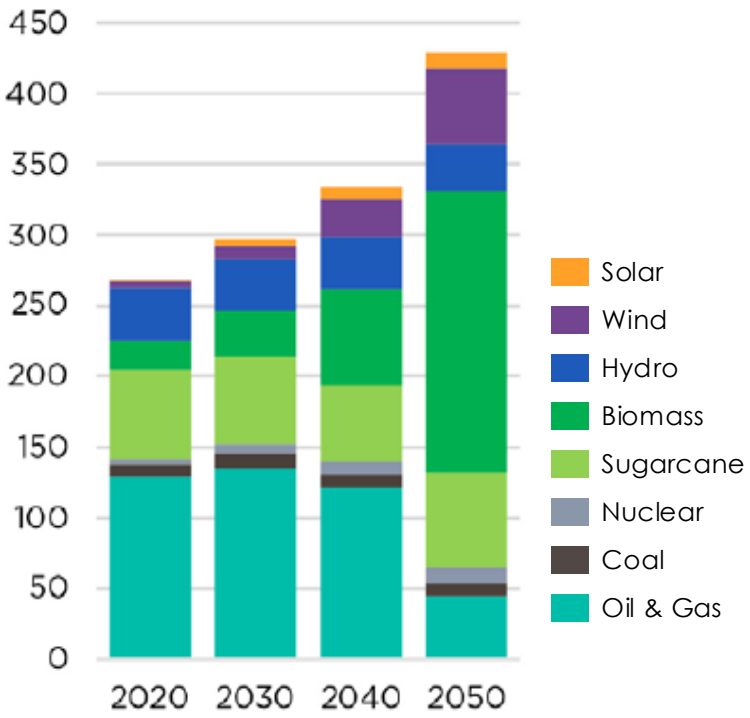
Net zero target	year **2060**	comprehensiveness not rated as **INFORMATION INCOMPLETE**

Land use & forestry	historically considered a **SOURCE**

Brazil's net zero pathways heavily depend on biofuels while disregarding the high potential for electrification using wind and solar

Primary energy consumption in Net Zero

Mtoe



Alternative technical route, restrictions around water and CCS availability; carbon budget of 24.9 $GtCO_2$

Solar power potential

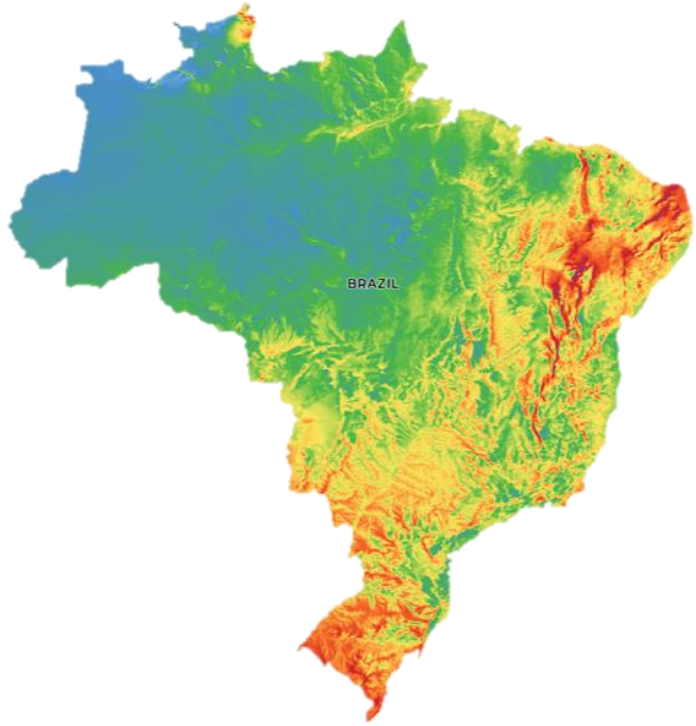
kWh/m^2

Long term average of DNI (1999-2018), yearly totals MWh/m^2

1.10 — 2.25

Wind speed (at 100 m height)

m/s



Mean wind speed at 100 m height, m/s

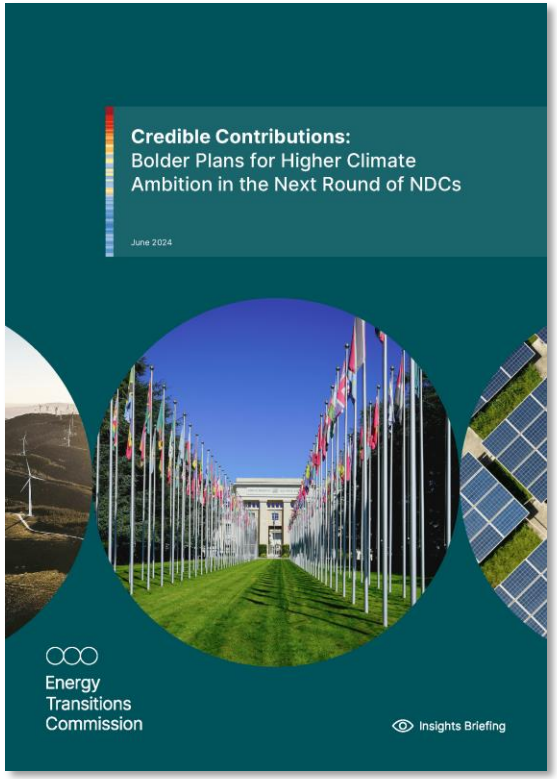
0 — 10

Note: passenger road transportation includes urban busses, light commercial vehicles, and 2-/3-wheelers

Source: CEBRI "Carbon Neutrality 2050" (2023); Projeto Decarboost "Uma Estratégia de Descarbonização para uma Economia Brasileira de Zero Carbono Líquido em 2050" (2023)

NDCs

NDCs 3.0: next round of Nationally Determined Contributions due at COP30



- **Governments can and must raise ambition** in the next round of Nationally Determined Contributions - the so-called "NDCs 3.0" due at COP30 in Brazil - if we are to limit the impact of climate change.
- Success in the low-carbon transition to date has been driven by **industry's response to ambitious government targets** - accelerating deployment and driving down costs. Industry recognises the opportunity in the next round of NDCs and calls on governments to prioritise delivering high-ambition NDCs which will provide certainty, unlock investment and accelerate technology deployment.
- In turn **industry can help government be confident** that progress towards a net-zero economy is both technically and economically possible – the technology is in place, commitments are being made, and the focus must now be on deployment

2 approaches to determining NDCs

"Least-cost approach" estimates the transition pathways for different countries which would result in global least cost reduction, given the differing potential for different countries to reduce emissions.

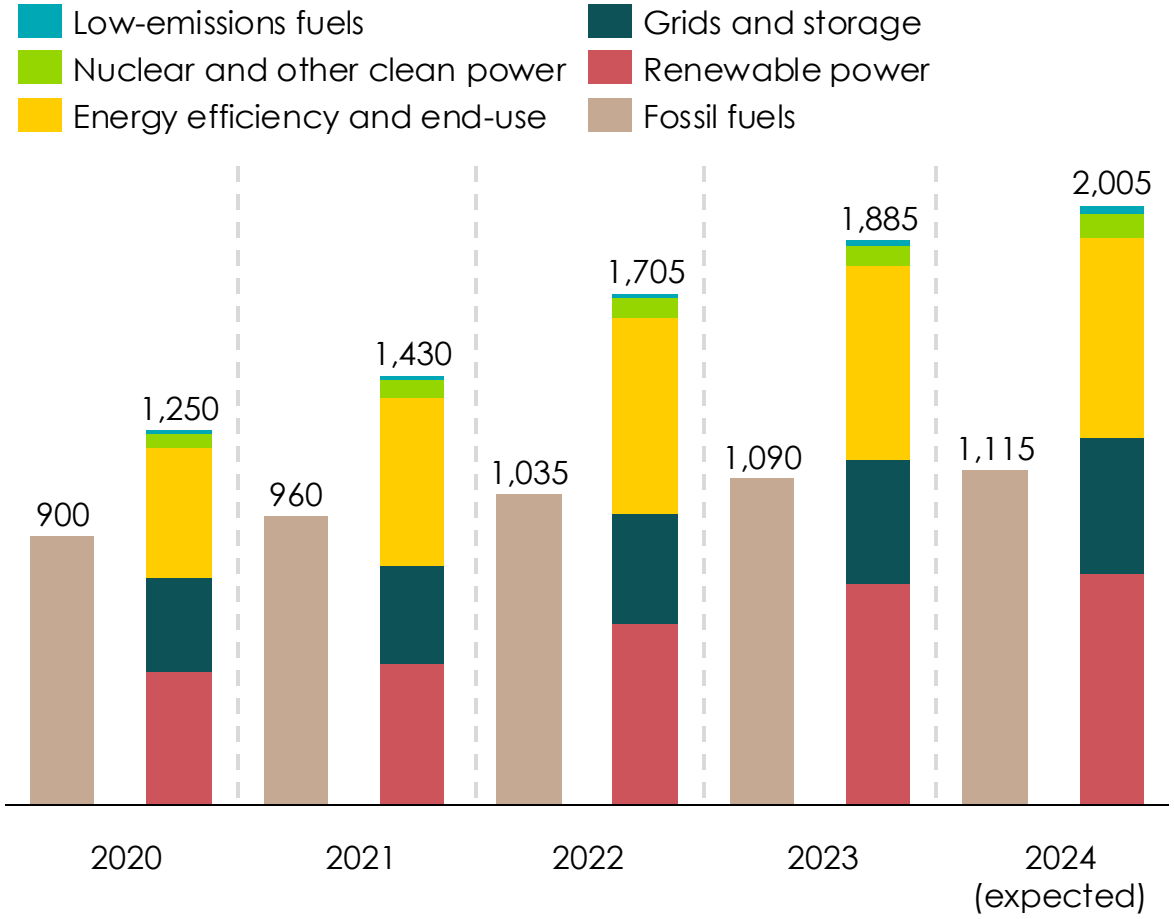
"Fair share approach" considers a range of academic study results that offer different viewpoints of what could be fair, including considerations on historical responsibility, capability, equality and cost effectiveness

Part 5. Progress phasing down the fossil system

Led by China and the EU, the world now invests nearly twice as much in clean technologies as it does in fossil fuels

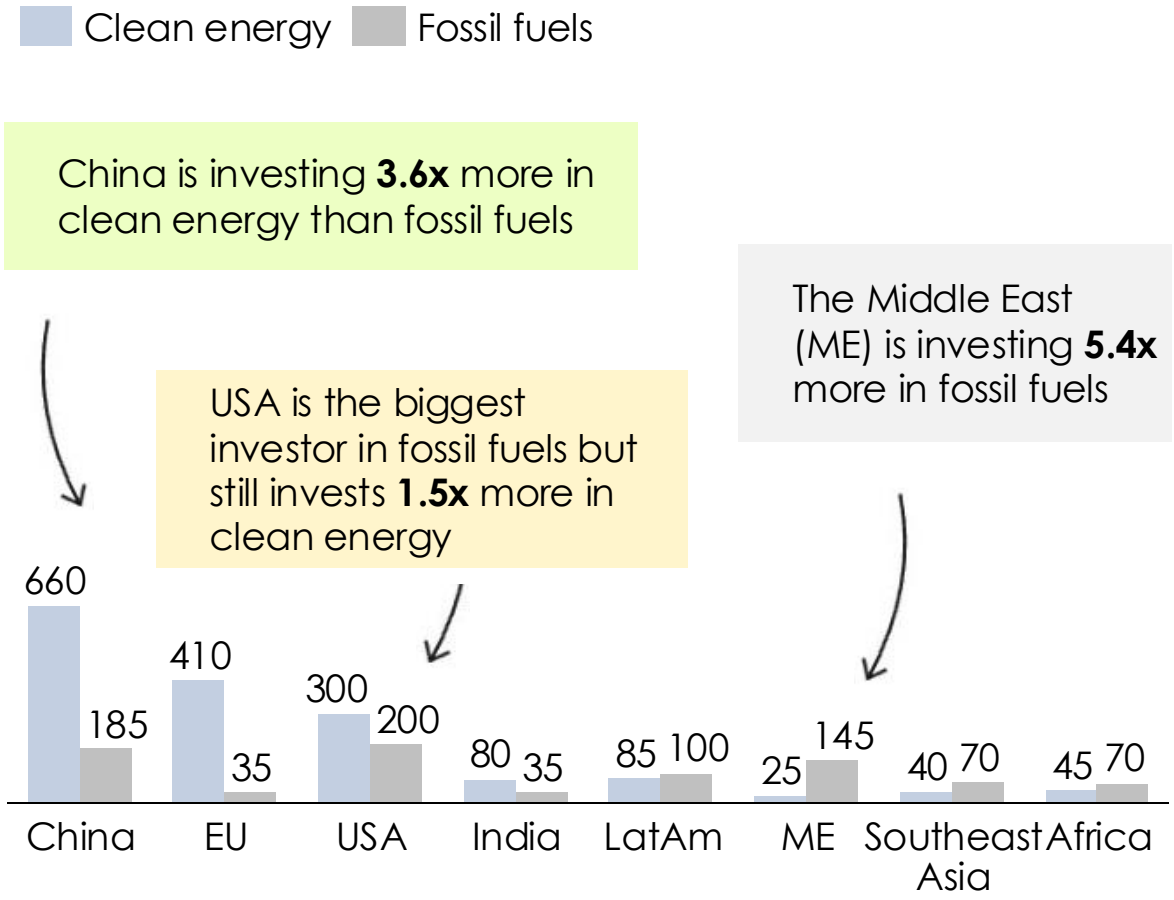
Global investment in clean energy and fossil fuels

Billion USD (2023); 2015–2024



Investment in energy by country or region in 2024

Billion USD (2023)



Source: IEA (2024), *World Energy Investment 2024*

There is an ongoing debate worldwide on phasing down fossil fuel projects

Qatar to increase LNG export capacity in bet on Asian demand

Gulf state's liquefied natural gas production capacity to rise nearly 85% before end of decade

Gas & LNG | LNG | Europe

Europe's gas consumption falls to 10-year low as peak LNG demand nears

Weekly data: US LNG export capacity expected to be 76% higher than EU demand

Analysis from the Institute for Energy Economics and Financial Analysis (IEEFA) raises concern that the US is headed for a liquefied natural gas (LNG) supply glut.

G7 countries commit to closing coal-fired power plants by 2035

The G7 (Canada, the US, France, Germany, Italy, Japan and the UK) collectively announced for the first time a date for the end of coal-fired power generation without CO2 capture and storage.

New coal plants in China soar despite President Xi's pledge to 'strictly control' dirtiest fuel

Big Oil's success in Namibia will push others to drill for growth

Law of averages could catch up with explorers, as typical success rate for a series of offshore wells is around a third

Source: Financial Times; Bloomberg; Energy Monitor; Institute for Energy Economics and Financial Analysis

Risks of fossil fuel infrastructure lock-in continue to arise

Why investment in fossil fuels might be continuing

- **Rising energy demand** in some regions where renewables growth are not keeping pace with demand
- **Lack of cheap low-carbon alternatives** mean purchases of fossil fuel consuming assets (boilers, vehicles) continues
- **Geopolitics** making it harder to access cheapest renewable technologies from China
- **Energy security** concerns meaning countries such as the US, continue to invest in LNG assets – partly as a counterpoint to China's growing int'l energy influence
- **"Last man standing" and "fossils as a bridging fuel"** mentality from a number of countries and companies

Risks of continued investment

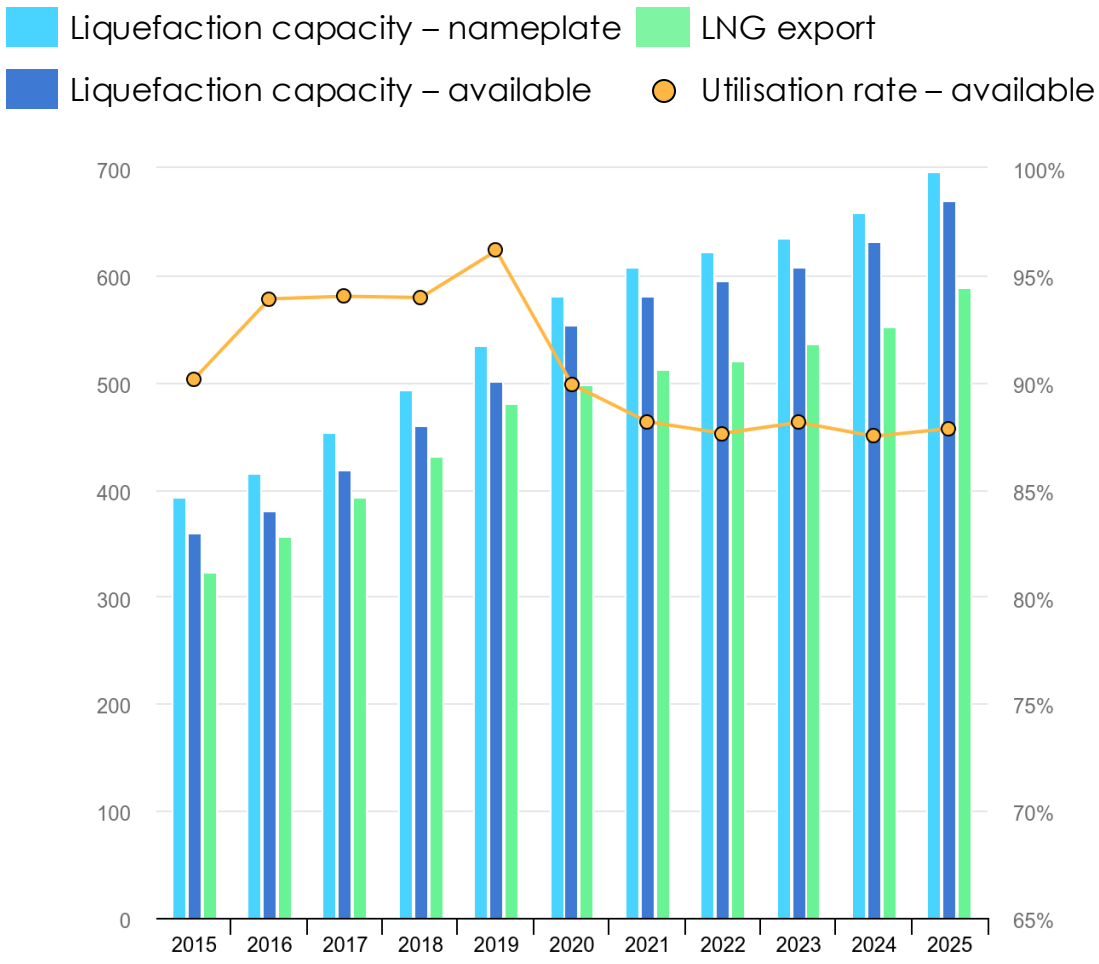
- Risk of **investment 'lock-in' for fossil fuel assets**, resulting in:
  - Significant number of stranded fossil assets
  - Slowing of the transition with maintained reliance of fossil assets, eroding the competitiveness of renewables
  - Extended demand lock-in, for example ~63[1] million non-electric/hybrid vehicles sold in 2023, likely to still be on road by ~2040.

Notes: 1. Out of 73 million vehicles sold in 2023,
Source: Our World in Data based on the International Energy Agency (2024)

Risks of fossil fuel investment lock-in are inherent in the global LNG market, which is facing an overcapacity issue

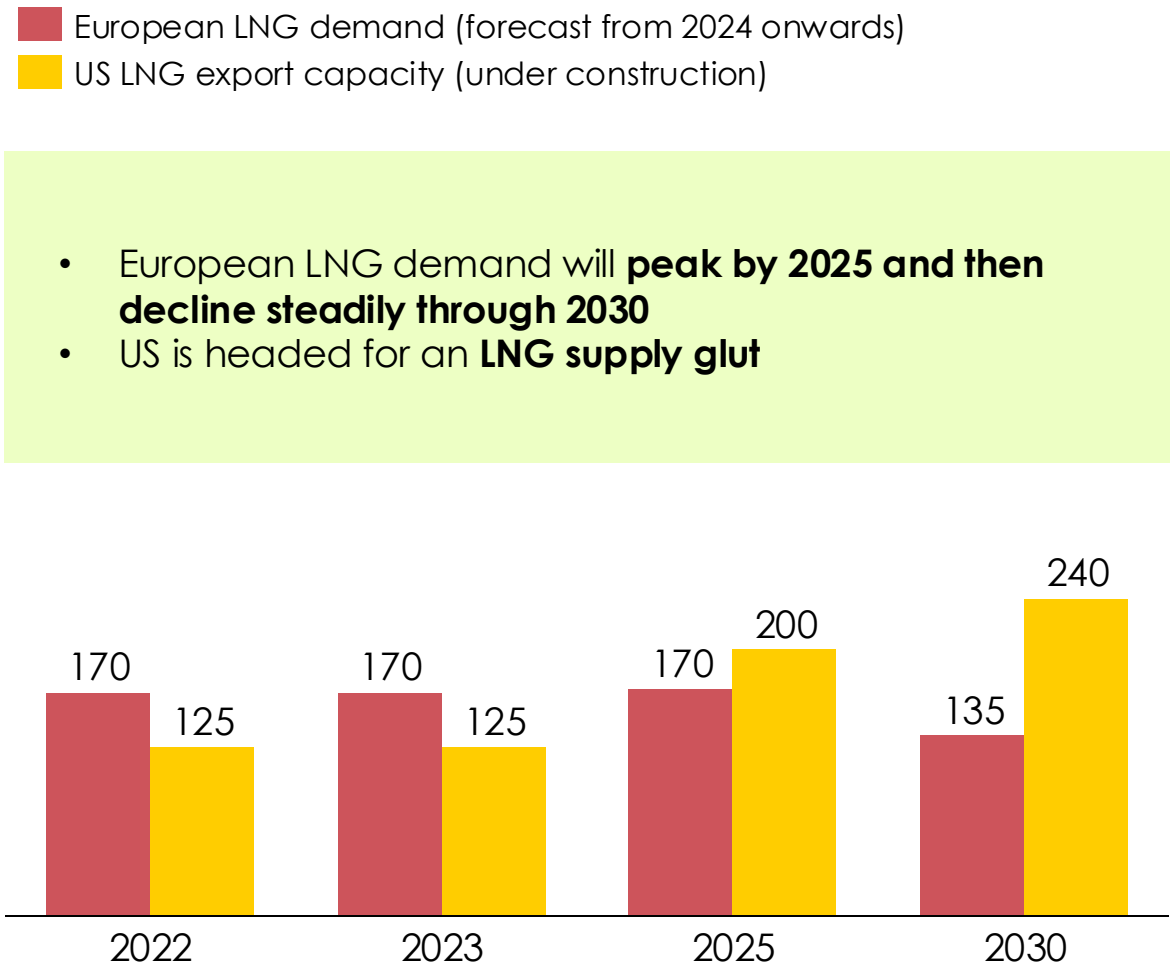
LNG trade and liquefaction utilisation rate

LNG trade and liquefaction -- bcm; utilisation rate – %; 2015-2025



European LNG demand vs.US LNG export capacity

bcm; 2023 – 2030



- European LNG demand will **peak by 2025 and then decline steadily through 2030**
- US is headed for an **LNG supply glut**

Source: IEA (2020), *Gas 2020*; Energy Monitor (2024), *Weekly data: US LNG export capacity expected to be 76% higher than EU demands*

Summary & conclusion for ETC work

Key conclusions

- Emissions still rising but close to peak
- Solar costs continue rapid decline, plus rising efficiency and new applications (light weight, integrated, agri-solo volatics, floating). Massive growth possible from existing capacity – but capacity still growing
- Battery innovation and cost decline
    - EVs will get cheaper and longer range
    - Battery storage cost falling fast
- Dampening of 'hydrogen hype'; electrolyzer costs not falling as anticipated
- Progress in heavy industry (incl. CCS), shipping and aviation needs to accelerate
    - Direct electrification technologies emerging
    - But molecules still needed in materials, chemicals and aviation sectors
- Most regions now invest more in renewables than fossil, but in e.g LATAM and Southeast Asia, fossil supply and demand investment still dominates, despite favourable renewables potential; significant lock-in risks

Implications for future developments, policy priorities… and ETC focus?

	Latest trends	Implications and policy / business priorities	Implications for ETC?
	**Emissions – still rising but close to peak overall and in key areas** (e.g., coal in China) Ambition or implementation gaps in NDCs which fail to reflect tech potential	Strengthening of NDCs to close ambition or implementation gaps Progress beyond coal in China and India essential	Follow up to NDC report Focus on identifying and communicating - Technology possibility - Barriers and how to overcome them
	**CDR & Deforestation** – deforestation reducing slightly but still major CO2 source Removal credit volumes still trivial but new ICVCM standards may encourage voluntary demand	Large scale removals needed to meet climate objectives o Supply from either engineered (DAC)or NBS o Demand from governments, compliance or voluntary markets	Key debate issue; should ETC contribute to current SBTi debate and refresh 2022 report ?
	**Power demand** - Even more electricity demand sooner? E.g. EVs, China, electric heat, electrified industry, AI?	Massive clean electrification even more important …using all available technologies	"Power system balancing" workstream vital 'Short' on power demand later in 2024 Assess role of nuclear in 2025 – large fission, fusion and SMR
	**Hydrogen** - Capacity commitments growing, but electrolyser cost reduction slower than hoped and demand growth limited	Policy focus on decarbonisation of existing demand – oil and gas upstream and refining plus ammonia /fertiliser production	ETC long-term scenarios reduced in FFiT report Further analysis in the "Carbon molecules" workstream Other ?

Implications for future developments, policy priorities… and ETC focus?

	Latest trends	Implications and policy / business priorities	Implications for ETC?
  	**Solar PV & batteries** – massive capacity growth and continued price decline **Wind** - huge potential/need; approaching tipping points, but slower than needed progress in some regions **Grid investment** vital; local, national and international	Solar + batteries increasingly competitive in sunny countries; more rapid decarbonisation possible in e.g., India, Indonesia, Africa; solar potential vs bio in Brazil Essential for policy makers to focus on detail of • Planning and permitting systems • Supply chain development • Financing capacity and cost of capital	Major debate issue on China costs & trade Major initiatives in: • Indonesia/South East Asia? • Brazil Focussed short on solar+ batteries potential? Follow through on offshore wind, power systems balancing, grids & interconnection work vital
	**EVs and batteries** – massive capacity and approaching up front cost parity But short term slow-down in e.g US	Policy reinforcement, charging infrastructure and low cost vehicles needed to overcome short term slowdown	Major debate issue on China costs and trade "Short "on road transport energy productivity potential in autumn
	**Heat pumps** (and A/C) • Major efficiency improvement potential • key challenges in installation	Strong policy focus on building heat decarbonisation and cooling efficiency vital • new build design & construction in developing world • existing building retrofit in the developed	Primary focus of ongoing Buildings workstream

Implications for future developments, policy priorities… and ETC focus?

	Latest trends	Implications and policy / business priorities	Implications for ETC?
	**CCUS** – progress picking up but still far behind need	Strong policy support for early multi company cluster developments Support for development of more modular / less bespoke solutions	Need to refine view in light of slow progress? Core technology for recycling carbon – to be covered in Carbon Molecules work
	**"Hard to abate" t**ransport and industry sectors; feasible pathways clear but implementation at early stage Possibly larger role for electricity	Strong policy support needed for first of a kind deployment …plus taxes / regulations / public procurement / voluntary green procurement to overcome "green premium"	Revisit role of electrification via molecules work Continued focus of MPP/ITA work; ETC to input on energy supply & productivity potential
	Others?		