Energy Transitions Commission

Building the new and phasing down the old:

Reflections one year on from COP28's tripling renewable commitments and *Fossil Fuels in Transition*

ETC Commissioners Meeting

31st October 2024

Agenda

1. Recap on state of the clean and fossil debate following COP28
2. State of the clean transition
3. Comparing outlooks for fossil fuels
4. Deep dive on current trends in coal, gas and oil

Key Messages

- Despite strong pace of clean energy scale up – particularly solar and EVs – it is yet to reach some areas, with slow progress in heavy industry/mobility and low-carbon fuels like hydrogen and CCUS

- Fossil debate not won – despite agreement at COP, O&G sector not showing signs of phase-down. In short-term, increase in profitability and rush to LNG may suggest the opposite.

- Key regions such as EU and US are declining, not growing fossil use. However China, India showing ~5% growth.

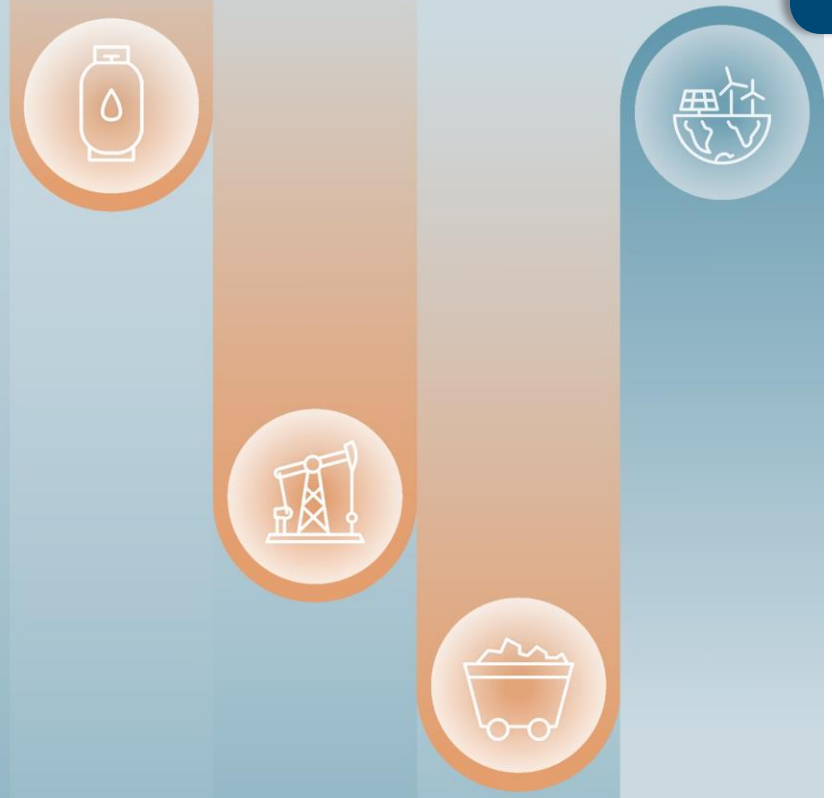
- Convictions on coal point to decline – key data point will be China. Need to continue to phase out capacity in power / run flexibly.

- For gas, uncertainty remains about long-term role in power, buildings and industry.
  - Growing LNG market risks locking in uses where lower-carbon fuels may be cost competitive in the long terms (e.g. solar+batteries in power). In buildings and industry, policy will need to play a firmer role in reducing role for gas.
  - Risk of methane leakage, including in LNG, risks locking-in high emission fuel.

- For oil, passenger transport trend is clear: oil is already and will be displaced. Policy commitments should hold firm.

Fossil Fuels in Transition:
Committing to the phase down in all fossil fuels

November 2023



Energy Transitions Commission

Fossil Fuels in Transition: Committing to the phase-down of all fossil fuels (2023)

To meet the COP21 Paris Agreement targets, the world can and must rapidly phase down production and use of coal, oil, and gas by 2050. This decline must start now.

Key points:

- It is **technically and economically feasible** and required to significantly reduce fossil fuel demand across sectors. Policies are required to deliver these reductions.
- Reducing emissions from production, transport and processing of fossil fuels (scope 1 and 2) is essential, but there is a vital but limited role for point source **CCS and carbon dioxide removals**.
- Commitments must drive down the largest proportion of emissions which comes from the use of fossil fuels.
- If the world is to limit global warming to 1.5°C, 90% of all currently estimated fossil fuel resources must be **left in the ground**. Investment in fossil fuel supply must decline significantly.
- Policies and commitments from oil and gas companies, governments, COP28 and the financial sector are crucial in the short-term and by mid-century.

Two headline commitments from COP28: transition away from fossil, and triple renewables

At COP28 in Dubai, 195 parties agreed to:

1) *"**Transitioning away from fossil fuels in energy systems**, in a just, orderly and equitable manner, **accelerating action in this critical decade,** so as to achieve net zero by 2050"*

2) *"Commit to work together to **triple the world's installed renewable energy generation capacity** to at least 11,000 GW by 2030, taking into consideration different starting points and national circumstances"*

But developments this year highlight positive growth for both fossil and renewables

Clean

BloombergNEF

New Solar to Meet Most of Europe's Power Demand Growth in Winter

The Guardian

China to head green energy boom with 60% of new projects in next six years

The Guardian

US power grid added battery equivalent of 20 nuclear reactors in past four years

energynews

WindEurope: Waiting for permits holds up European wind projects

Energy-Storage.News

Massive growth potential continues for battery storage in UK and Ireland, co-location emerging

Fossil

CNBC MARKETS BUSINESS INVESTING TECH POLITICS VIDEO INVESTING CLUB

ENERGY

Exxon still expects fossil fuels to make up the majority of energy market in 25 years

Forbes

Rising 18% This Year, Will Exxon Mobil's Run Continue Following Q2 Results?

OPEC forecasts 18% global oil demand growth by 2050 on energy security, accessibility concerns

FINANCIAL TIMES

Opinion Lex + Add to myFT

The LNG glut will chill the gas ambitions of oil majors

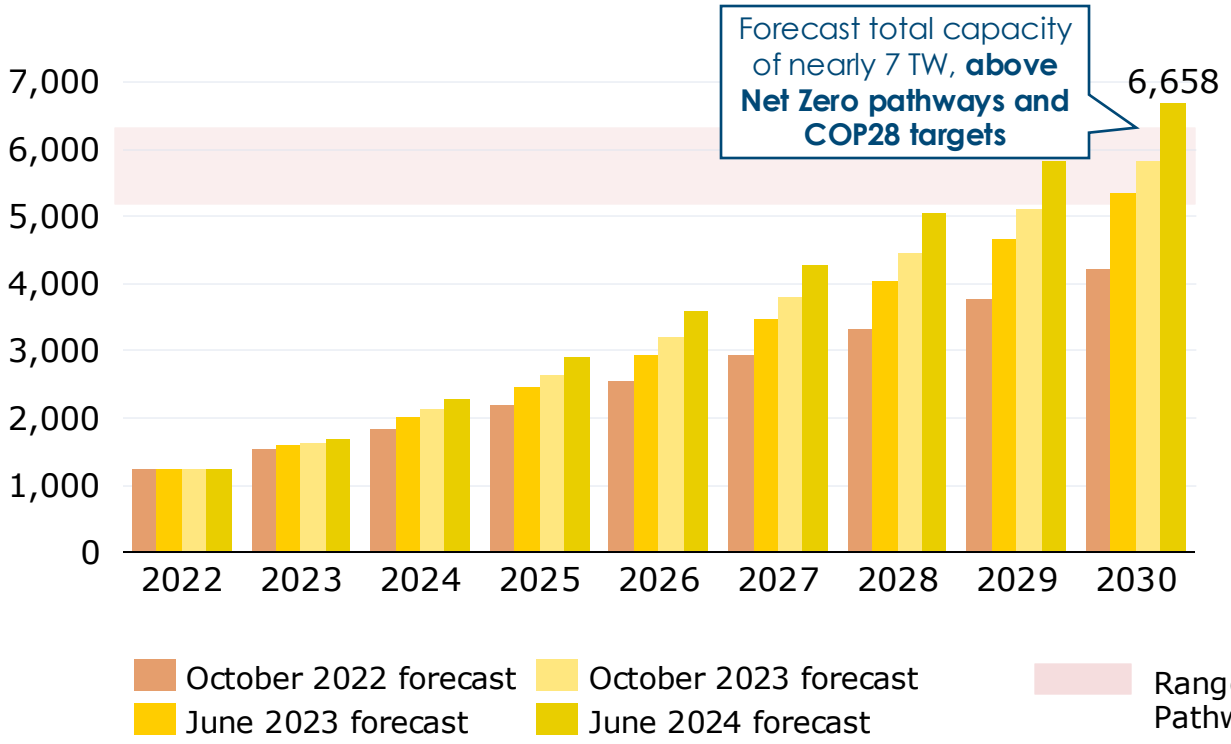
An influx of gas well into the next decade would be an unhelpful headwind for the energy transition

State of the clean transition

Renewables capacity is taking off – progressing towards the global 'tripling' by 2030

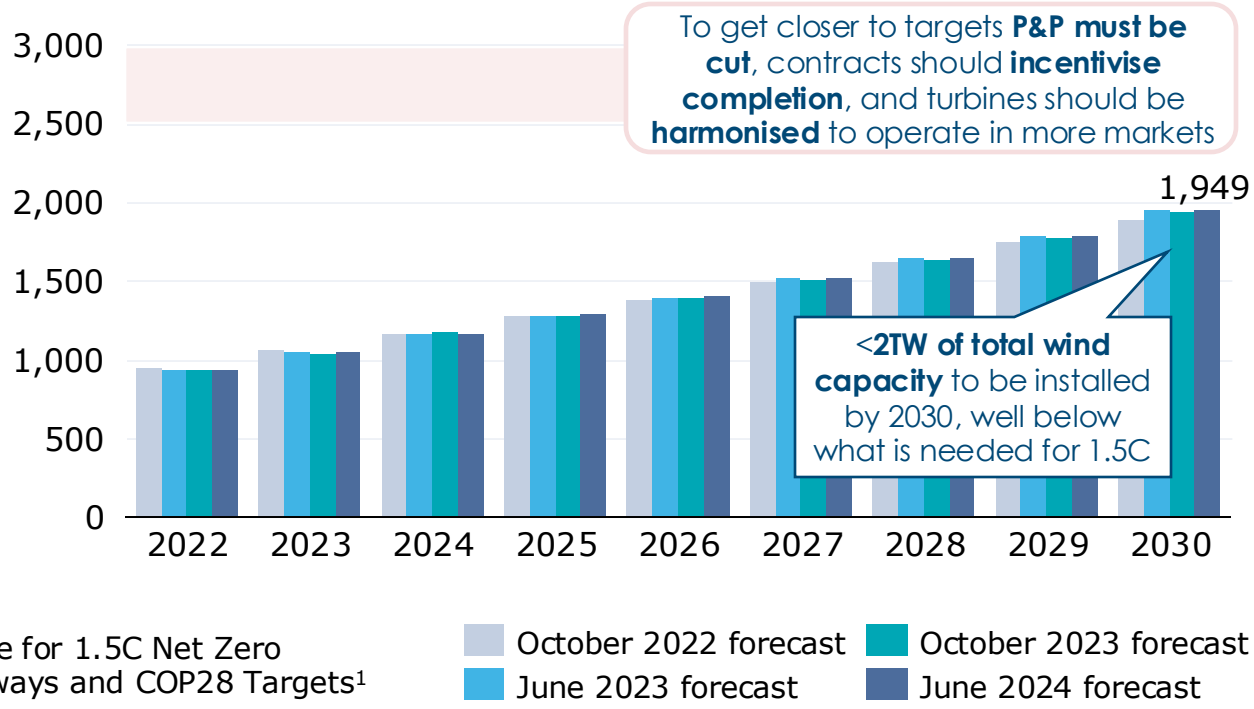
Recent solar forecasts are now aligned to ETC 2030 milestones

GW total capacity installed



Recent wind forecasts still fall behind ETC 2030 milestones

GW total capacity installed



Solar 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)

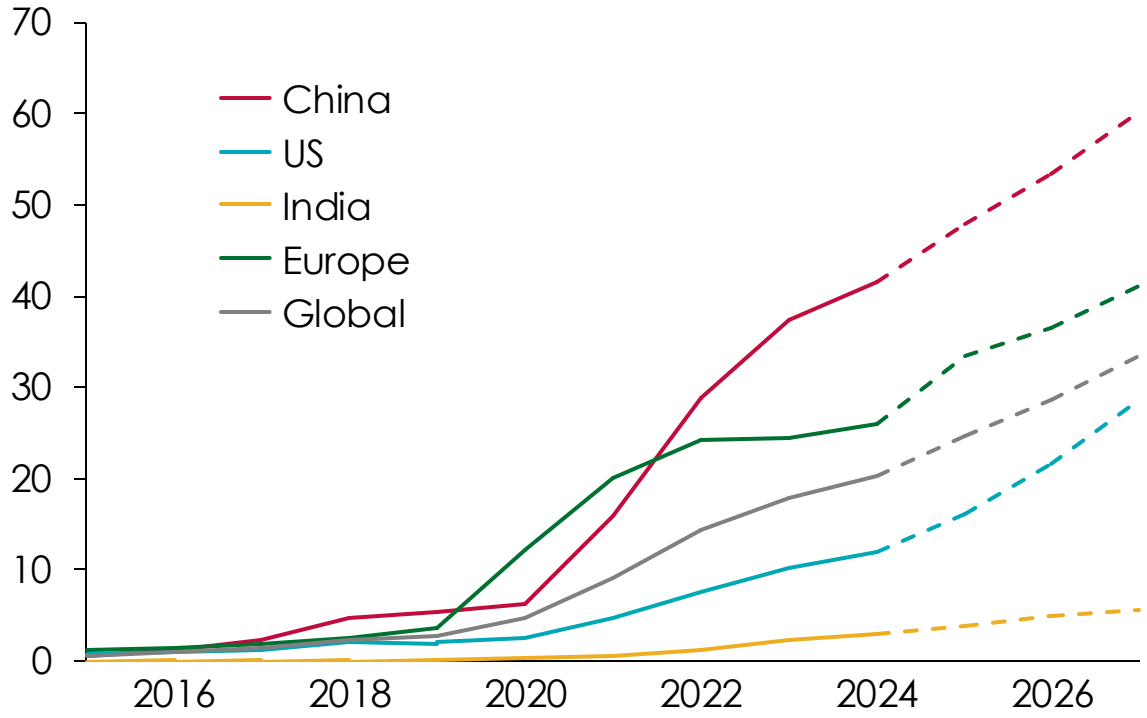
Note: [1] The COP28 presidency has a target to treble renewables (incl. solar, wind, hydropower, bioenergy, geothermal) by 2030. This would involve a roughly 5x increase in solar PV and 3x increase in wind from 2022.

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

EV sales continue to grow at pace, despite slowdowns in some markets

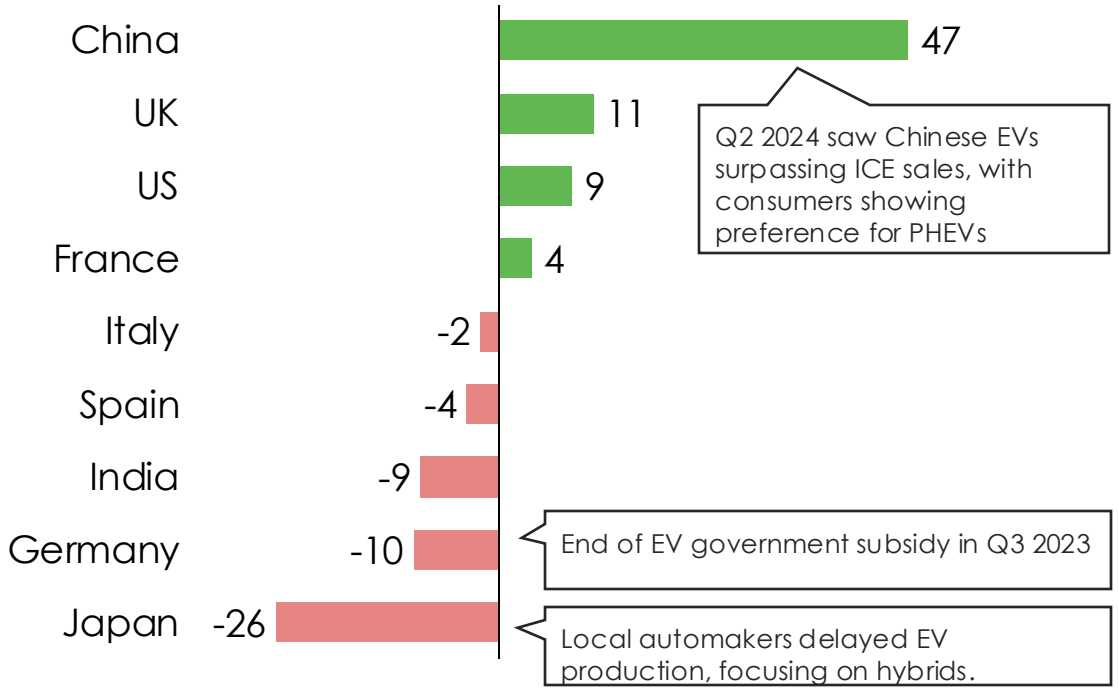
EV sales share development in key markets

%



Q2 2023 to Q2 2024 EV sales development in key markets

%



Source: BNEF (2024), *Long-Term Electric Vehicle Outlook 2024*

Speed of uptake is dependent on total cost of ownership – Chinese manufacturers such as BYD now selling family sized cars for low cost

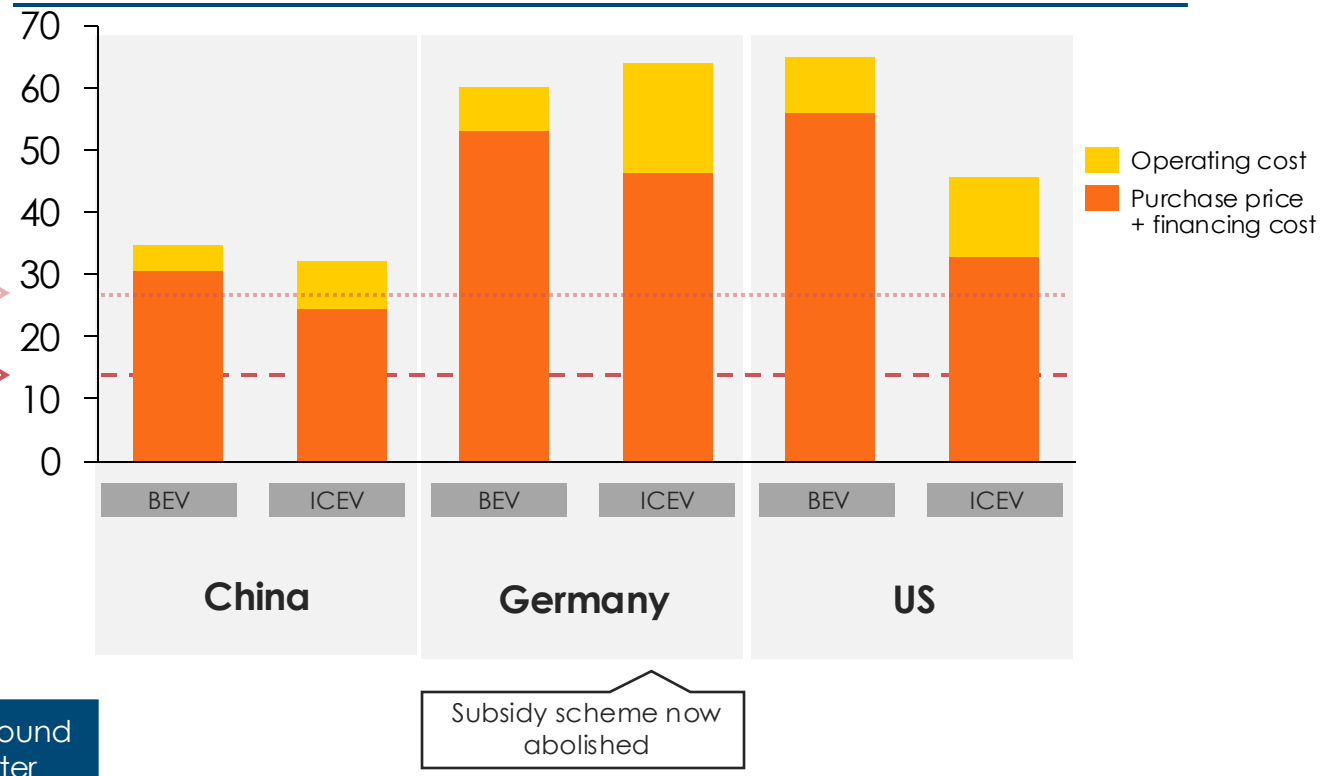
BYD Seagull – small family sized car for ~$10-12,000

Note: medium sized EVs typically cost around $10-15,000 more than small

The BYD Seagull sells for around $12,000 in China, with shorter range version under $10,000

Purchase and operating costs for medium-sized BEV and ICE

USD $1000s (2022 purchase costs)

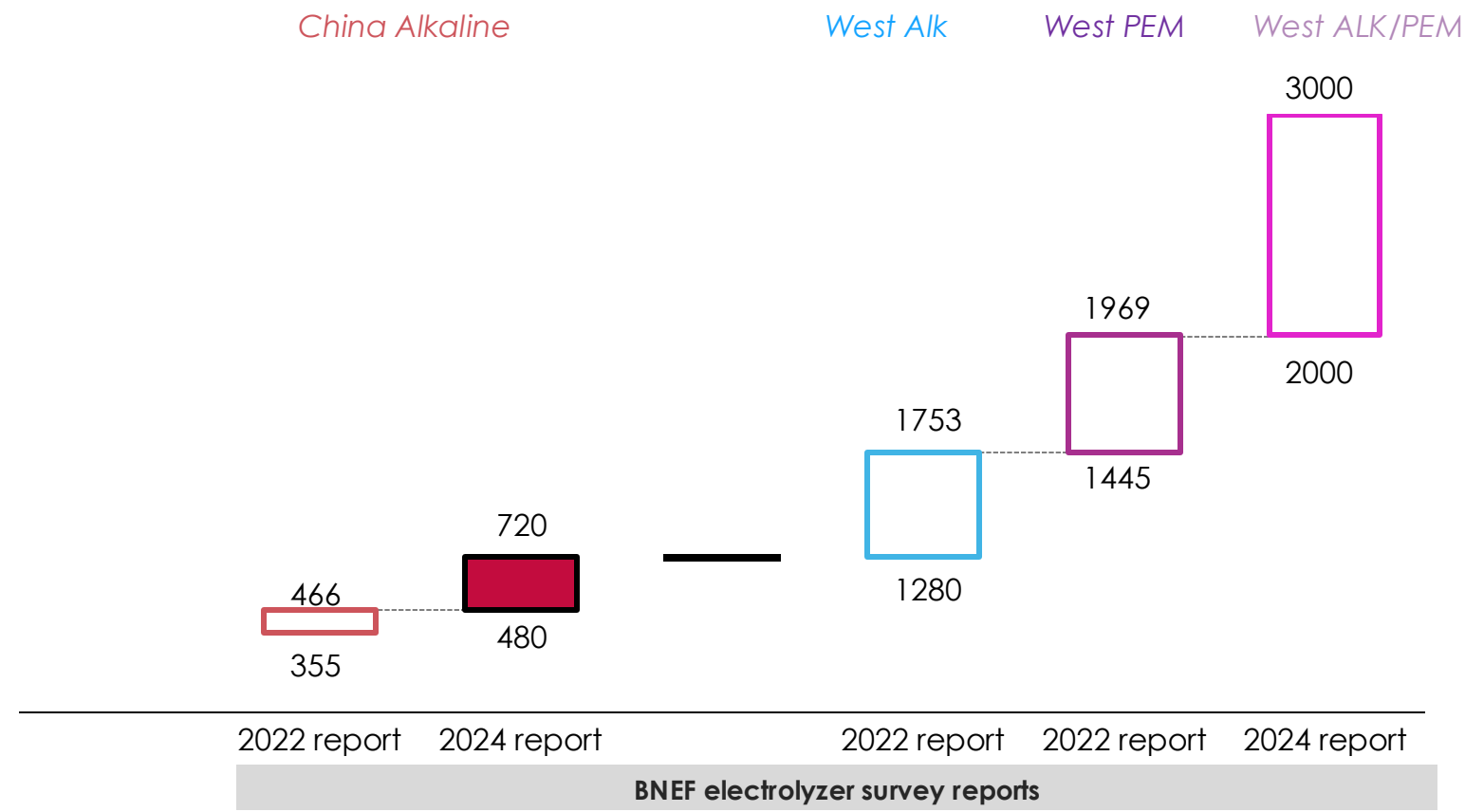


Notes: subsidies included in EV purchase price in RHS chart: China: $4,700; Germany: $5450; US $8000.
Sources: IEA (2024), *Global EV Outlook 2024. Electrek (2024) BYD's new EV, starting at less than $10000, is stoking fear*

Electrolyser prices have increased dramatically over the past years, and significant progress needs to be made to drive down H2 costs by 2030

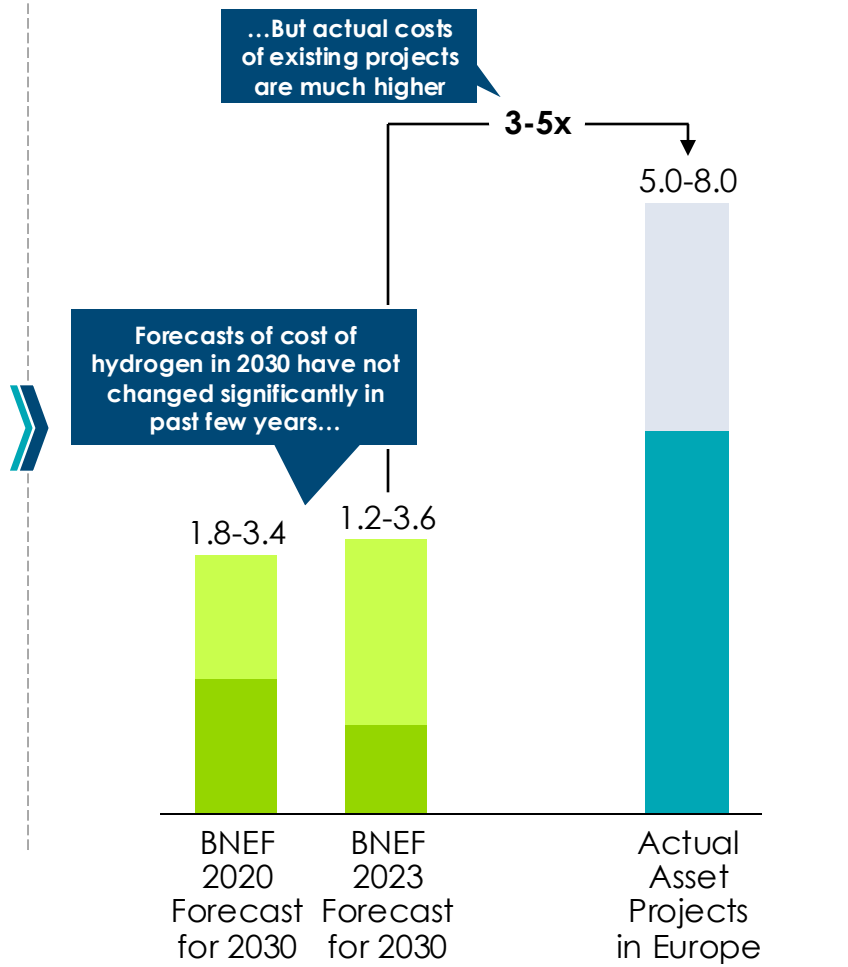
System capex forecast of large alkaline electrolysis projects

$/kW



Levelised cost of hydrogen

$/kg hydrogen

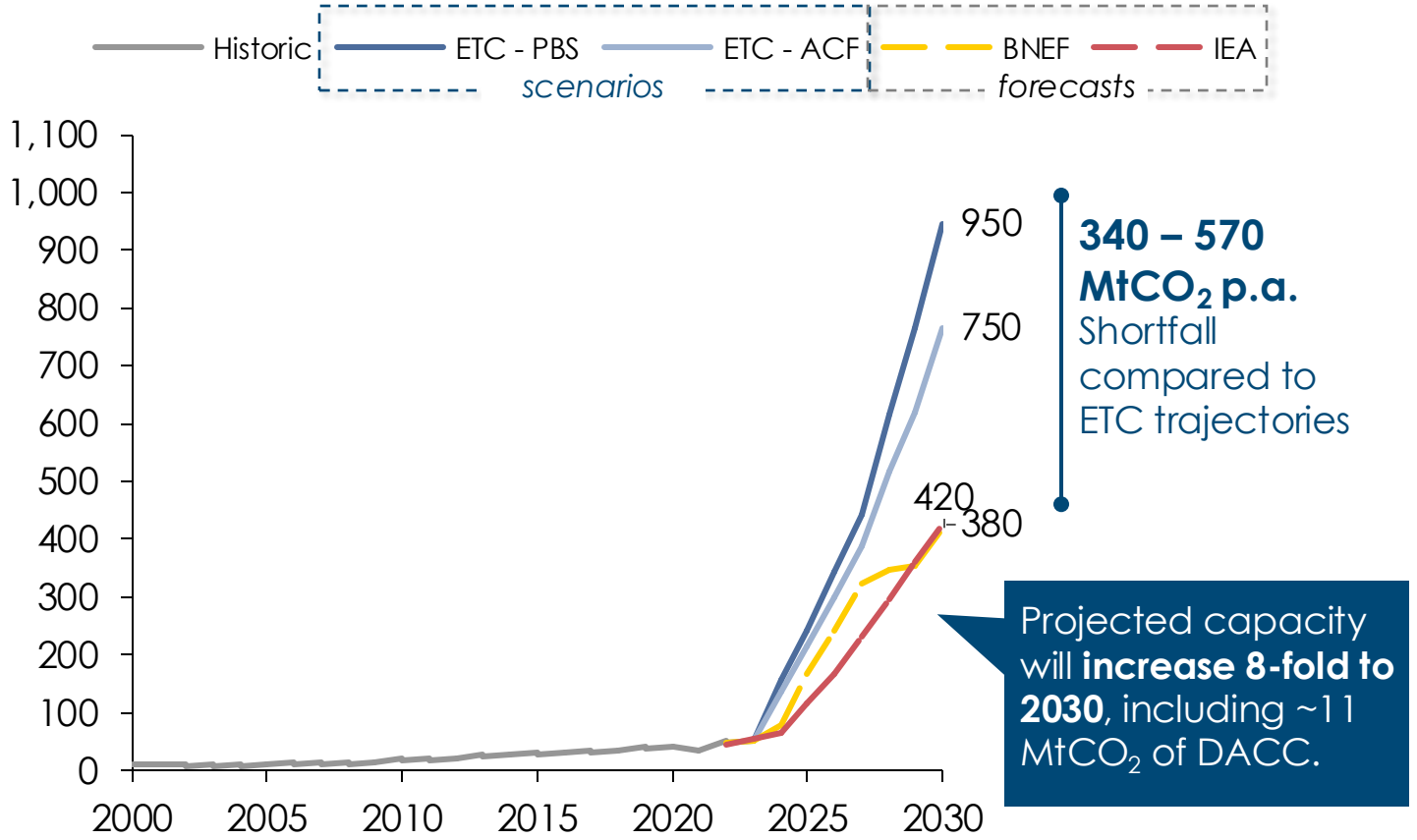


Note: ALK = Alkaline electrolyser. PEM = Proton Exchange Membrane electrolyser.
Source: Systemiq analysis for the ETC; BNEF (2024), *Electrolyzer Price Survey 2024: Rising Costs, Glitchy Tech*

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.

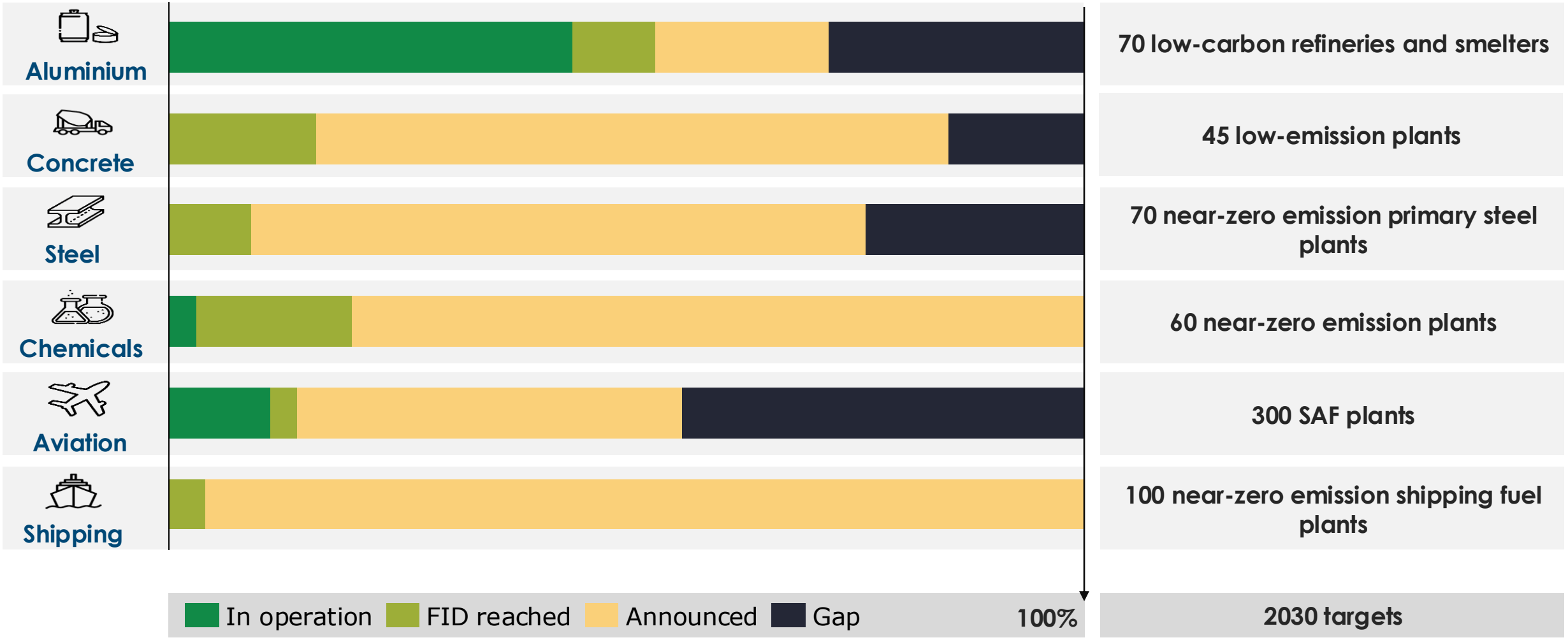


Key developments:

- 45% of announced capacity is in US, driven by IRA; 30% in Europe driven by carbon price + national policy support
- Projects increasingly extending beyond fossil, into bioenergy, iron and steel, Direct Air Capture
- UK committed £22bn subsidy to 2x CCUS clusters over 25 year period

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*

Heavy industry and mobility: big gap between number of announced projects and those past FID; lack of firm offtake identified as key barrier



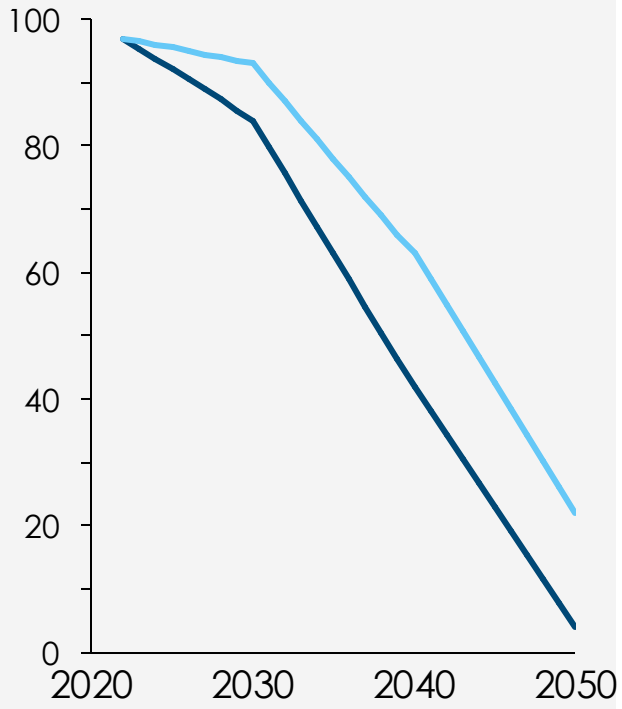
Source: Mission Possible Partnership (2024), *Global Project Tracker.*

Outlook for fossil fuels

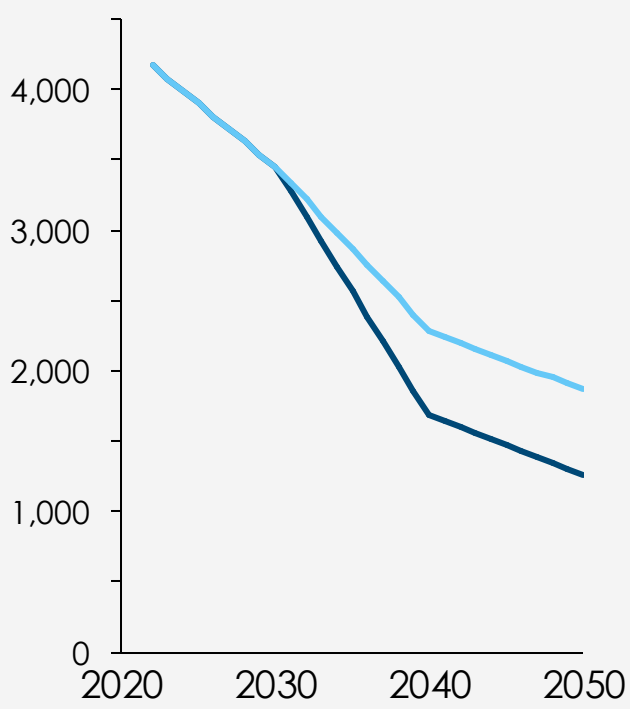
Reminder: in 2023 ETC published two scenarios for fossil fuels: Ambitious but Clearly Feasible (ACF) and Possible but Clearly Stretching (PBS)

Global – ETC scenarios

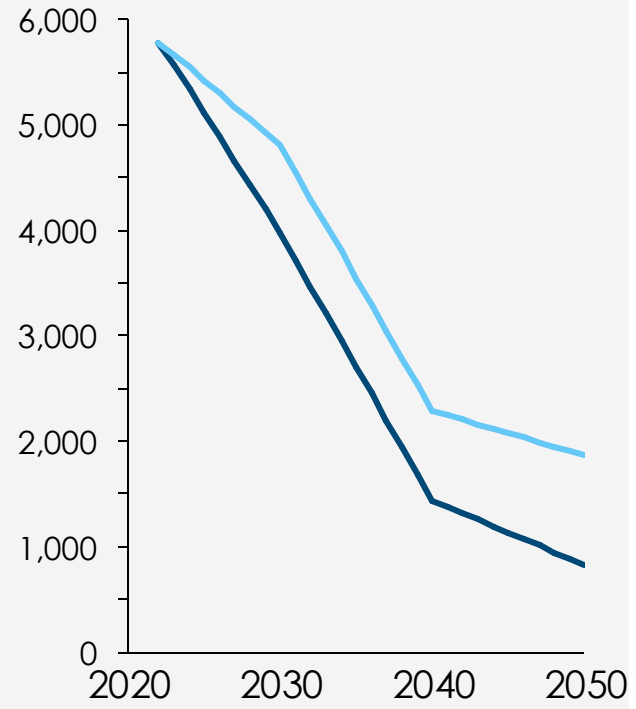
Oil consumption
Mb/d



Gas consumption
bcm



Coal consumption
Mtce



ETC - Possible but Stretching Scenario

ETC - Ambitious but Clearly Feasable Scenario

Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

To understand trends in fossil fuels, important to look at normative vs. descriptive pathways, and current trends by fuel

Normative climate scenarios

Outlines the necessary emission reduction trajectory to meet the Paris Agreement targets.

Examples*:

- **ETC – Possible but Stretching Scenario (PBS)**
- **IEA – Net-Zero Scenario (NZS)**
- **BNEF – Net-Zero Scenario (NZS)**
- **BP – Net-Zero Scenario (NZS)**
- Shell – Sky 2050

**Bold are compared in subsequent slides*

Descriptive scenarios

Outlines the emission reduction trajectory that will/might occur based on current policy and economic considerations.

Examples:

- **IEA – Stated Policies Scenario**
- **IEA – Announced Pledges Scenario**
- **BNEF – Economic Transition Scenario (ETS)**
- **BP – Current Scenario**
- Shell – Archipelagos

Included for comparison:

- ETC – Ambitious but Clearly Feasible Scenario (ACF)[1]

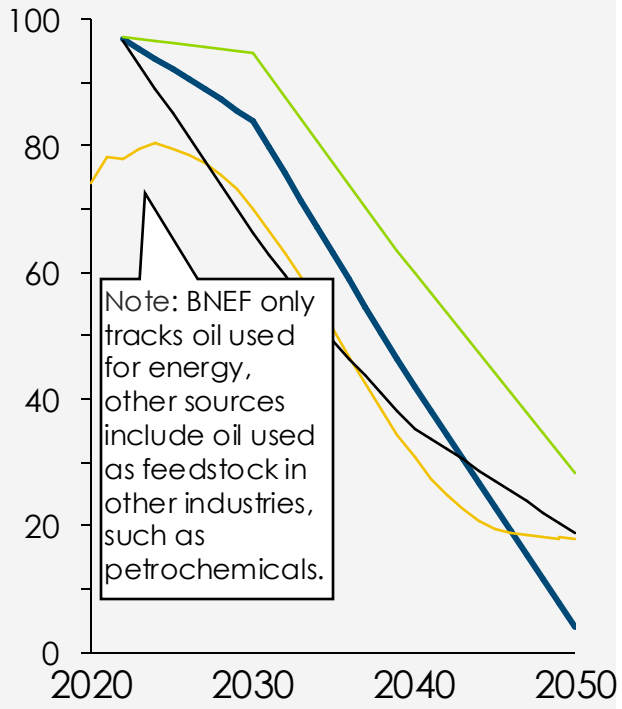
Key input assumptions: current trends by fuel (including fossil and low-carbon fuels).
Deep dive on current trends for fossil fuels coming later in presentation.

Notes: 1) The ETC scenarios have been categorized as either normative or descriptive: PBS aligns more closely with net-zero scenarios. Whilst the ACF is a mixture of descriptive (in very short term) and normative (longer-term) it is shown for comparison purposes alongside descriptive scenarios.
IEA stated policies considers firm policy commitments only whereas announced pledges considers potential impact if climate pledges beyond policy commitments are met.

Normative scenarios point to large declines in all fossil fuels to 2050

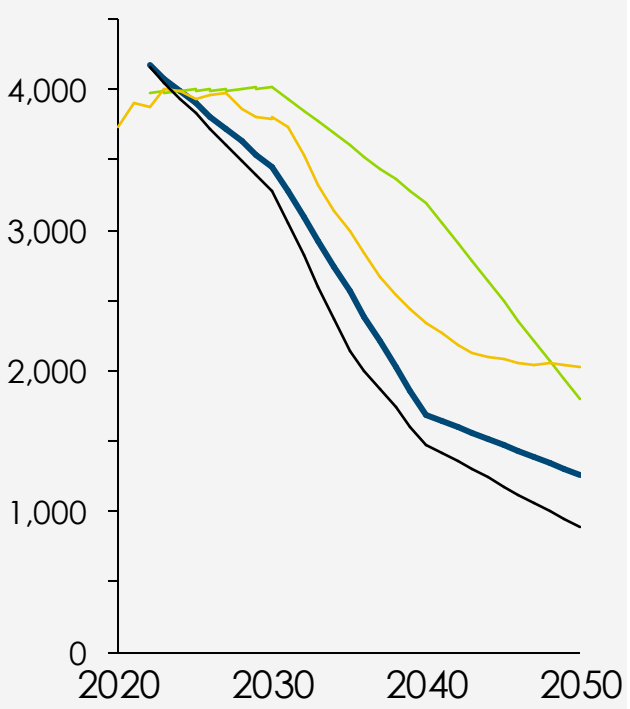
Global – normative net-zero scenarios

Oil consumption
Mb/d



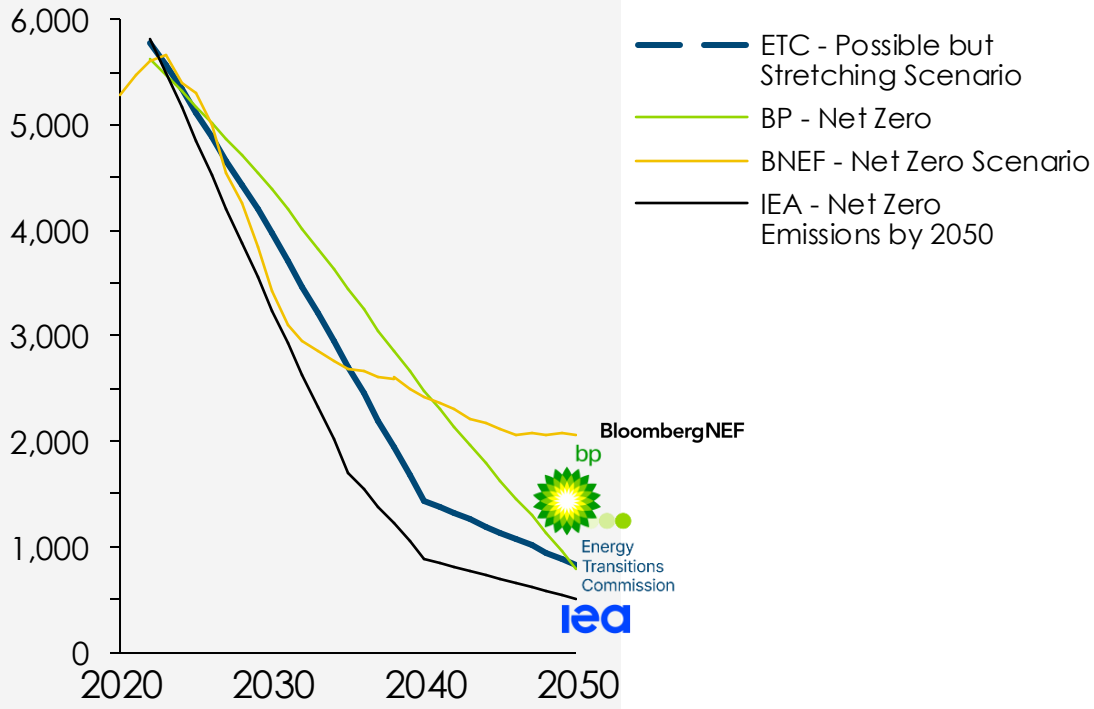
ETC's PBS is more ambitious than the net-zero targets of IEA, BNEF, and BP

Gas consumption
bcm



ETC's PBS is closely aligned which the even more ambitious IEA net-zero scenario.

Coal consumption
Mtce



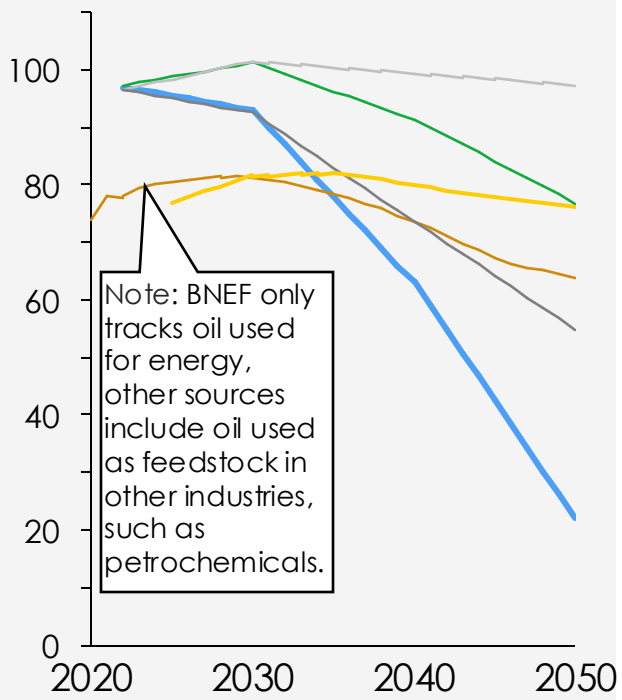
ETC's PBS scenario projects the same coal capacity in 2050 as BP's net-zero outlook, with only the IEA being more ambitious in its net-zero outlook.

Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

Descriptive scenarios agree coal will decline, but highlight much wider uncertainty around pace and levels of decline in all fuels

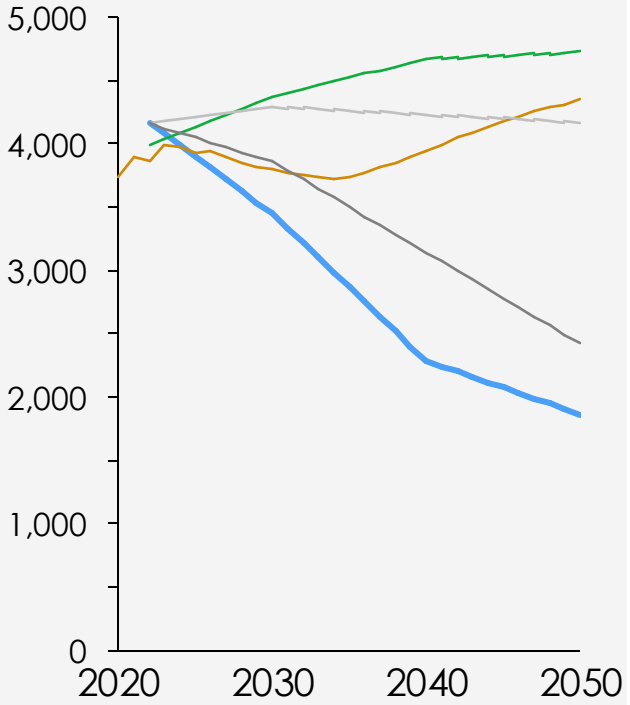
Global – Descriptive economic transition scenarios

Oil consumption
Mb/d



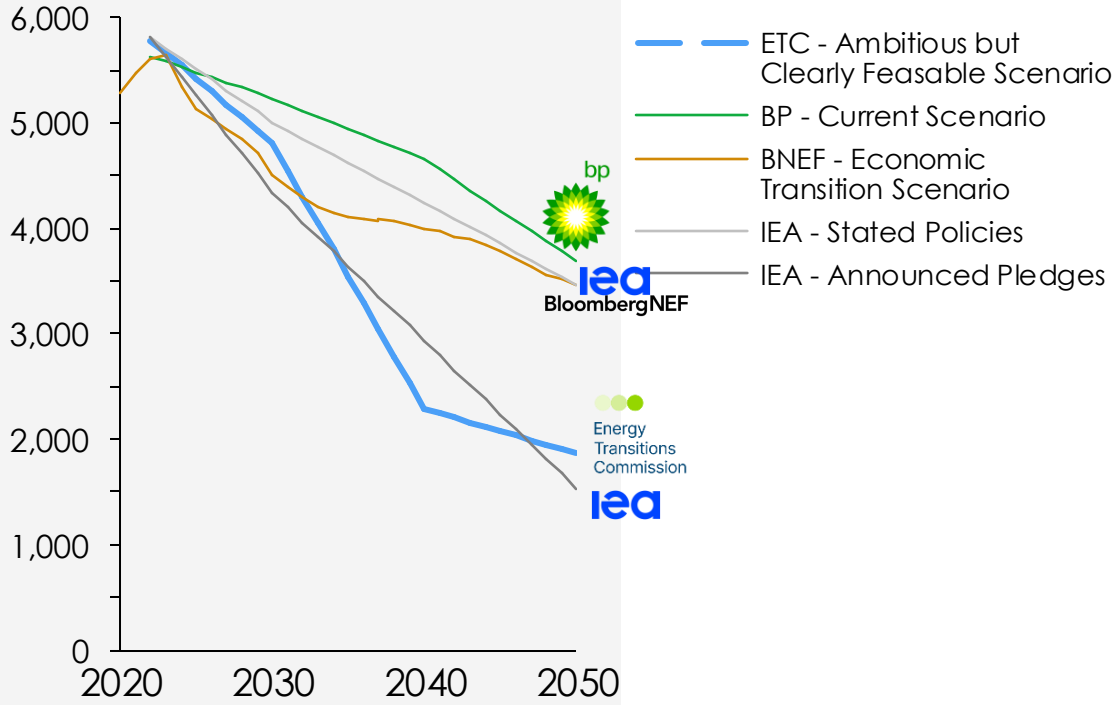
ETC's ACF is not aligned with other descriptive scenarios.

Gas consumption
bcm



ETC's ACF is not aligned with other descriptive scenarios.

Coal consumption
Mtce



ETC's ACF is only aligned with IEA announced pledges scenario.

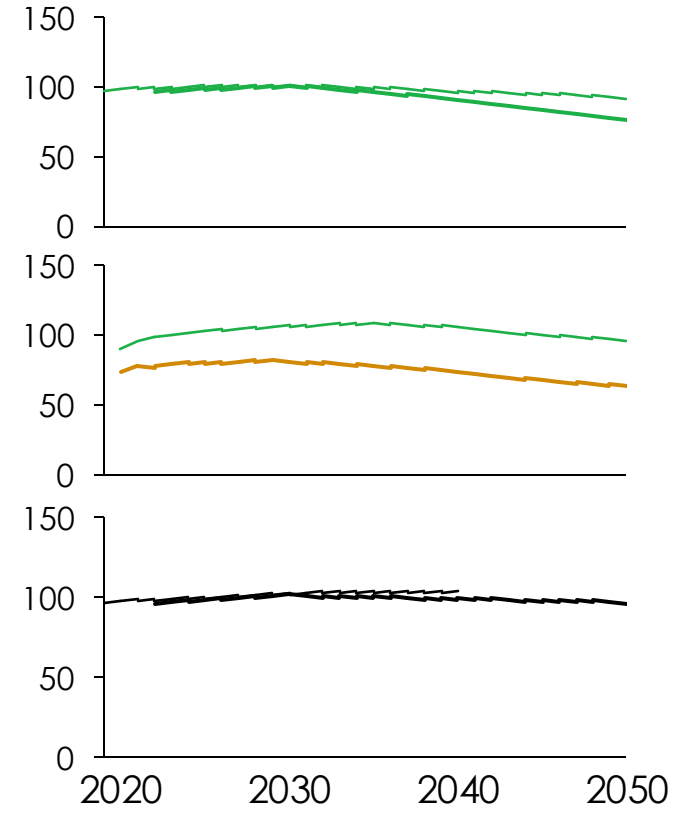
- ETC - Ambitious but Clearly Feasable Scenario
- BP - Current Scenario
- BNEF - Economic Transition Scenario
- IEA - Stated Policies
- IEA - Announced Pledges

Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

Fossil projections from 2020 to 2023 have seen minor revisions downwards

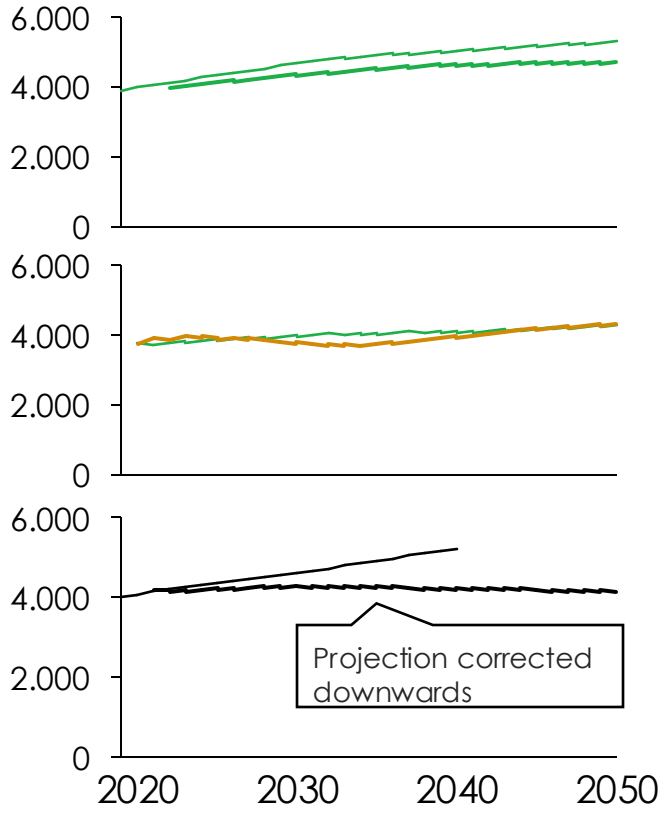
2020 vs 2023 Projections

Oil 2023 vs 2020 projections
Mb/d



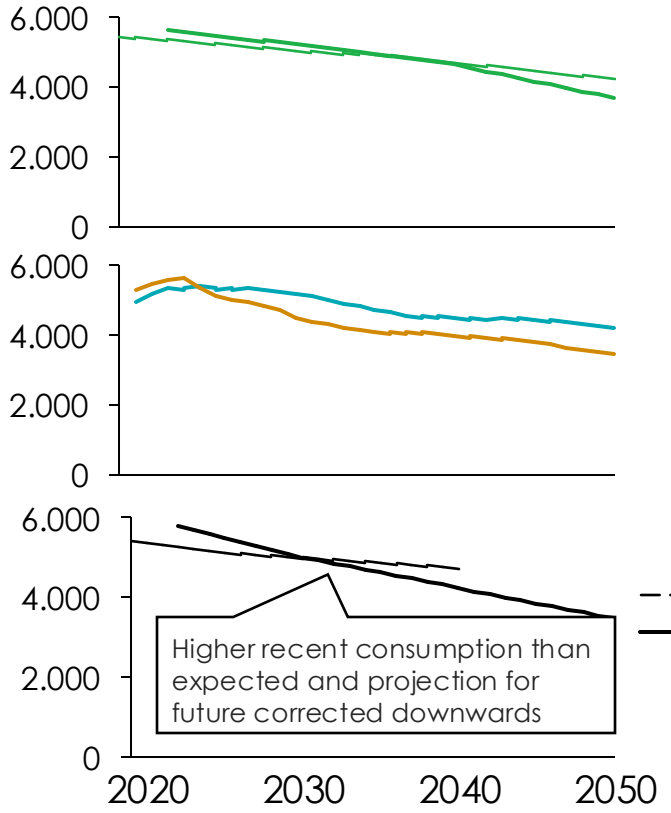
Some downward correction

Gas 2023 vs 2020 projections
bcm

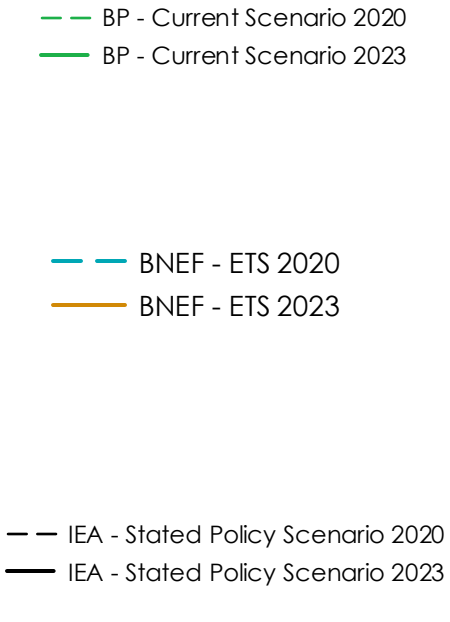


Some downward correction

Coal 2023 vs 2020 projections
Mtce



Stronger downward correction



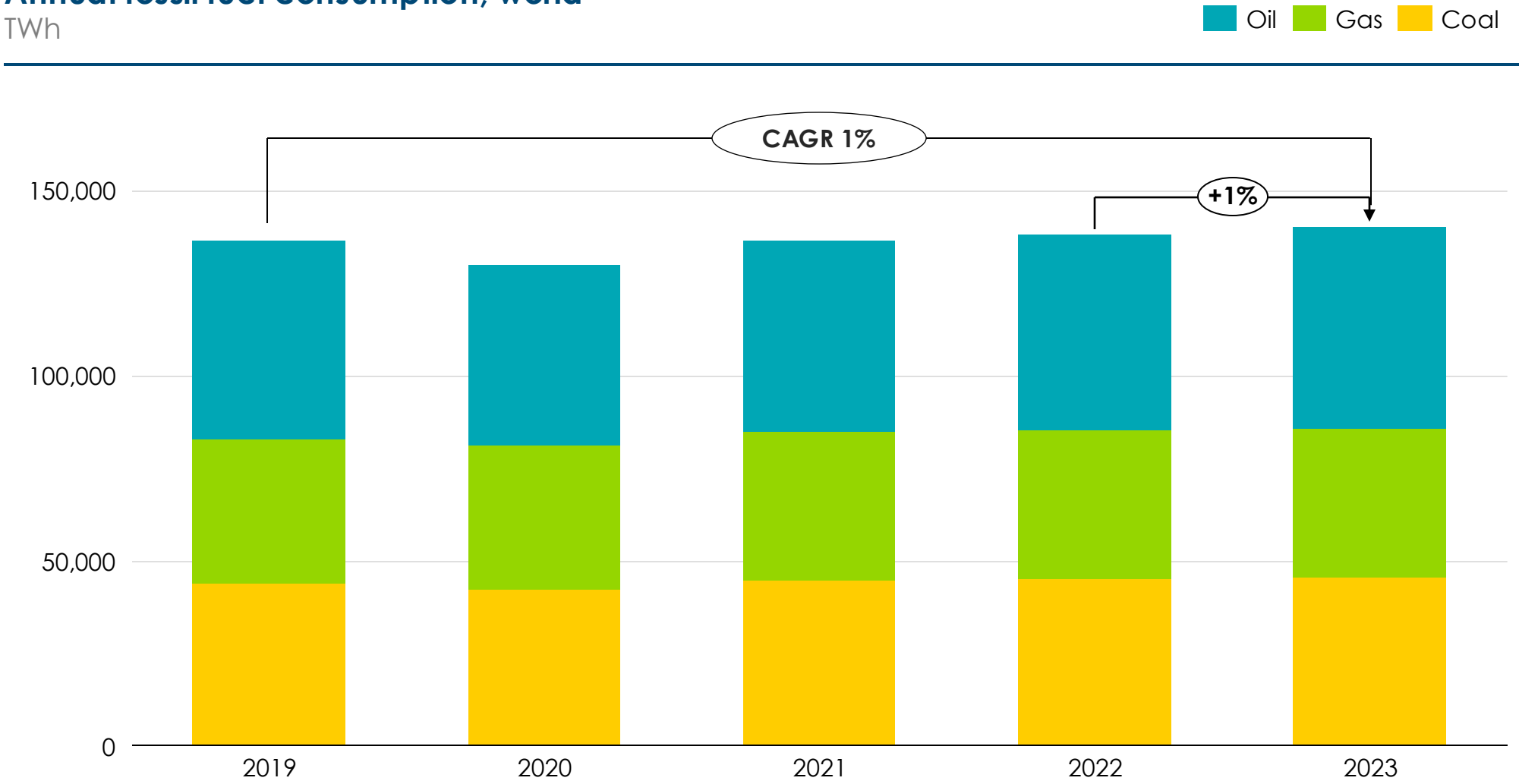
Source: BP (2020, 2023), *Energy Outlook;* IEA (2020, 2023), *World Energy Outlook;* BNEF (2020, 2023), *New Energy Outlook*
Note: BNEF 2023 excludes oil used in feedstock production

Fossil growth rate is constant across globe, as declines in the West are offset by rising demand in emerging markets

Global view
Fuel by Fuel

Annual fossil fuel consumption, world

TWh



2019-2023 (CAGR)	
Oil	1%
Gas	0%
Coal	1%

2022-2023	
Oil	3%
Gas	0%
Coal	2%

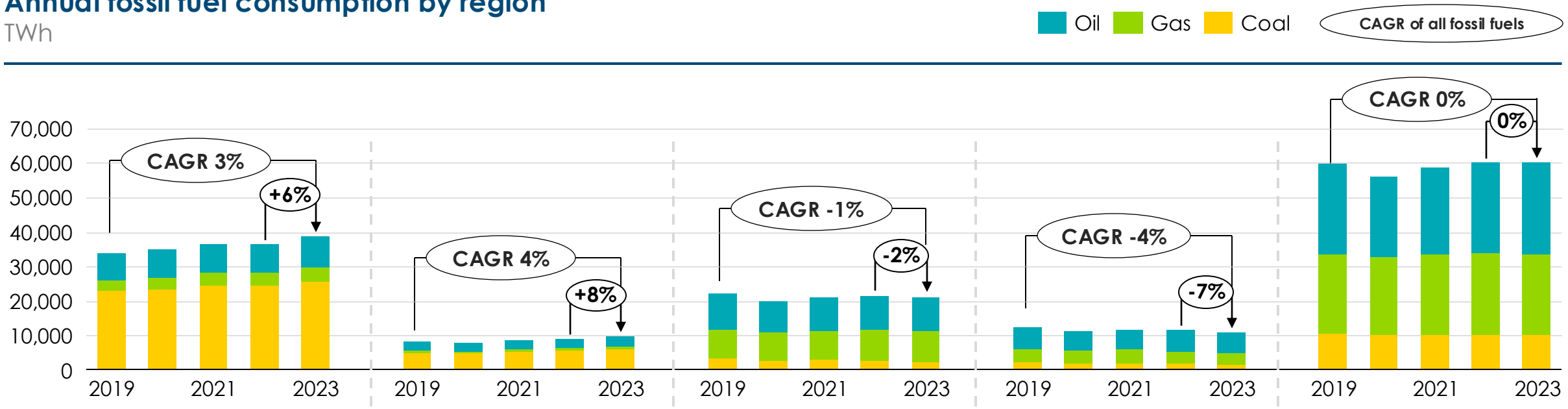
Source: Our World in Data (2024), *Fossil Fuels*

Rising fossil fuel consumption in China and India surged driven by strong gas growth, partly offset through fossil declines in US and EU

Regional view
Fuel by Fuel

Annual fossil fuel consumption by region

TWh



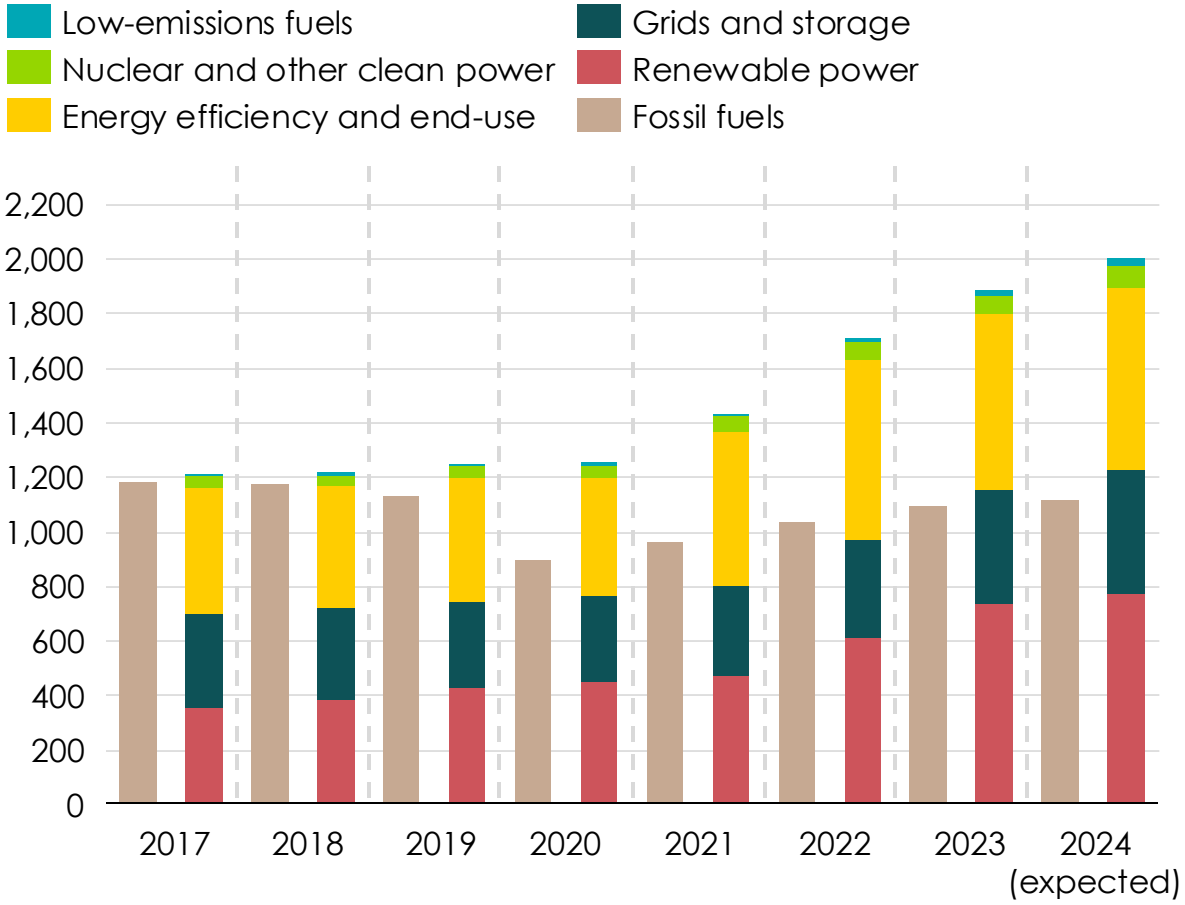
CAGR Fuel by Fuel	China	India	US	EU	RoW
2019-2023 (CAGR)					
Oil	8%	1%	- 1%	-2%	0%
Gas	7%	1%	1%	-5%	0%
Coal	3%	5%	- 6%	-6%	-1%
2022-2023					
Oil	**11%**	5%	0%	-2%	2%
Gas	**7%**	**7%**	1%	**-7%**	0%
Coal	5%	**10%**	**-17%**	**-20%**	0%

Source: Our World in Data (2024), *Fossil Fuels*

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

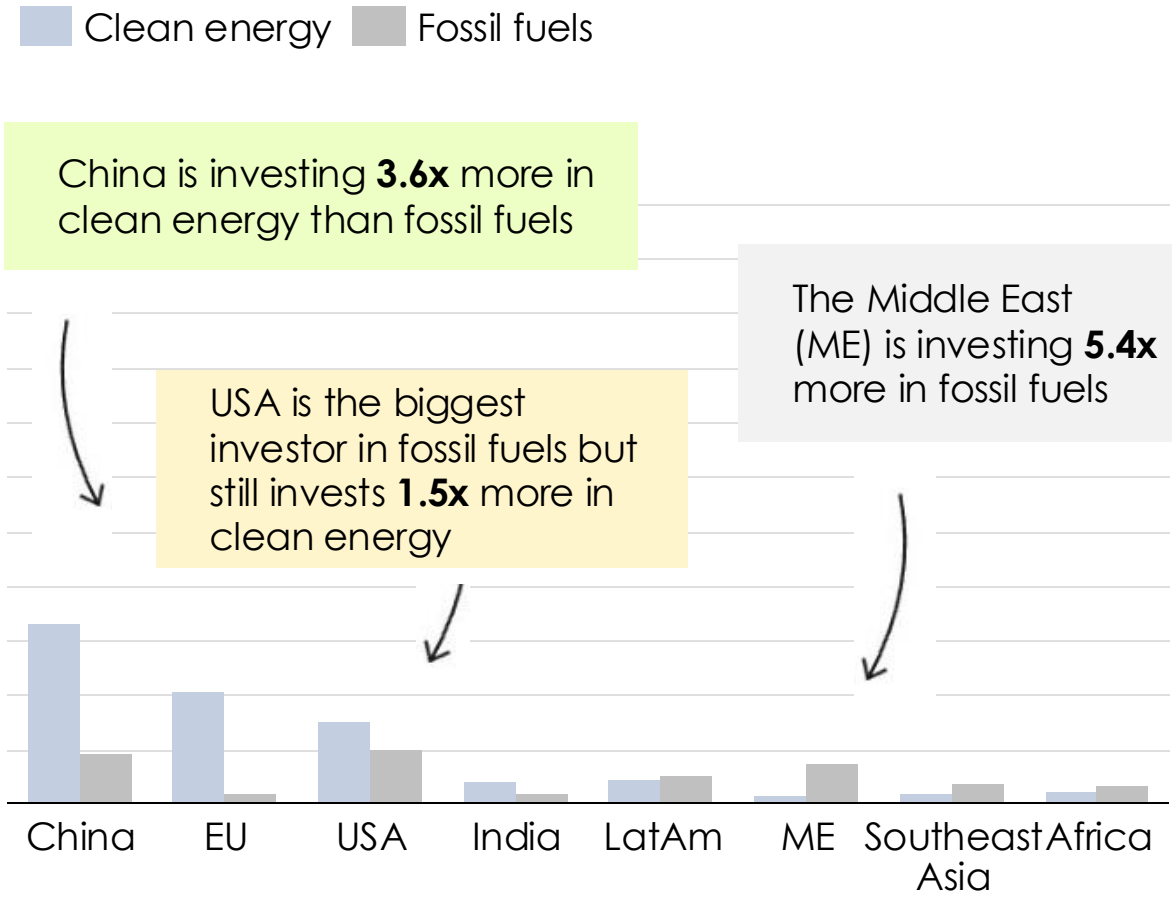
Global investment in clean energy and fossil fuels

Billion USD (2023); 2015–2024



Investment in energy by country or region in 2024

Billion USD (2023)



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

Coal

Global coal demand is expected to peak in 2023 and decrease thereafter

Global coal consumption, 2010-2023

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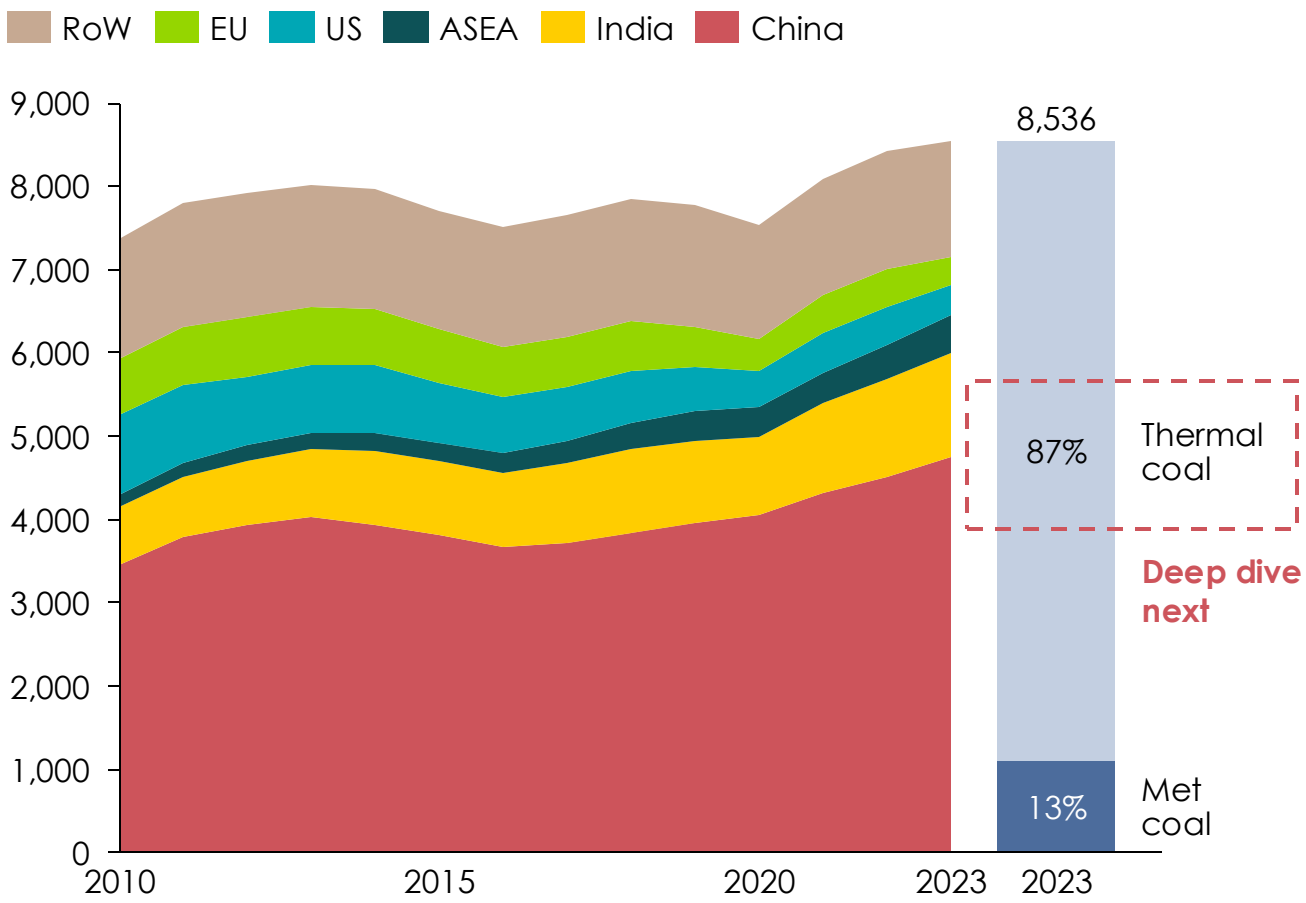

Despite recent increases, IEA expects coal demand expected to drop 2% to 2026

Source: IEA (2023), *Coal 2023: Analysis and forecast to 2026*

For coal, the transition story is clear: question is only over pace

Global view Industrial Coal Use – Net zero scenarios

Pre-read only

Power coal consumption – normative scenarios

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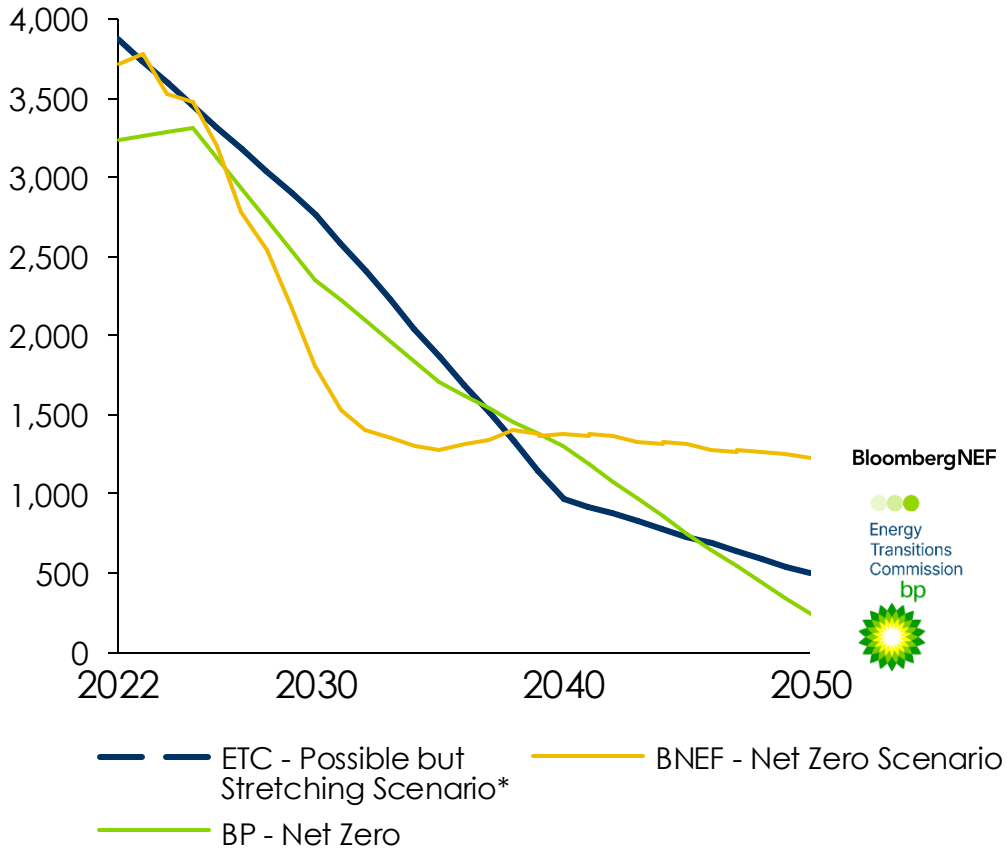

Power coal consumption – descriptive scenarios

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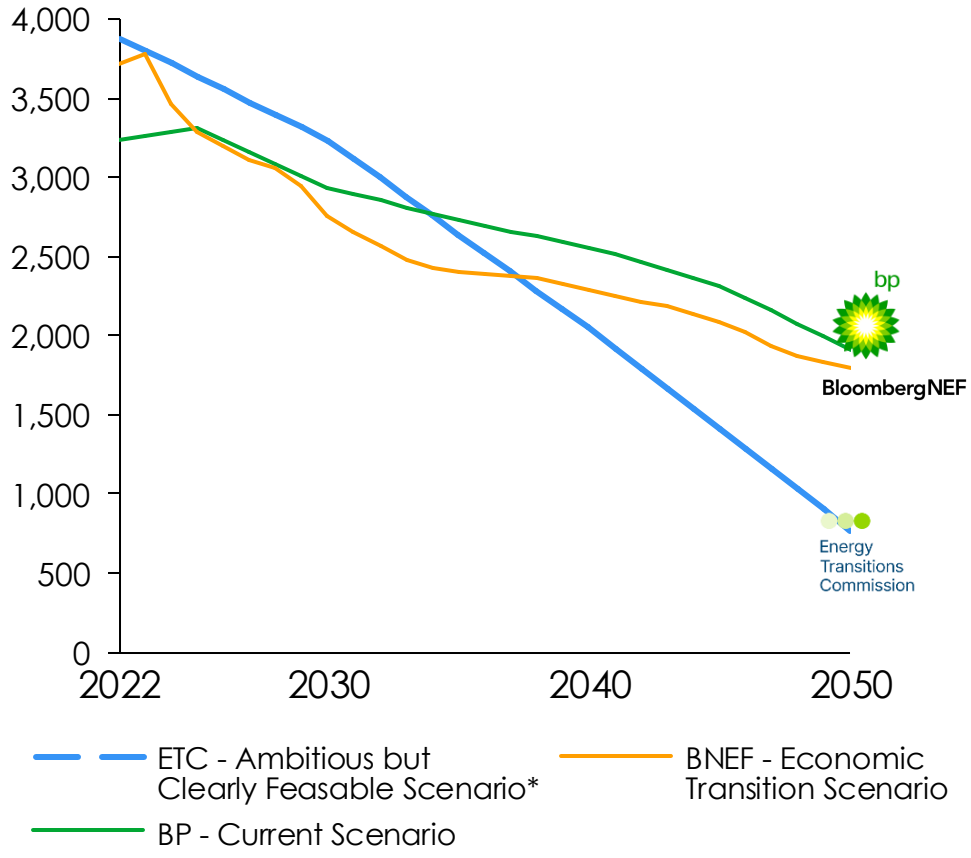


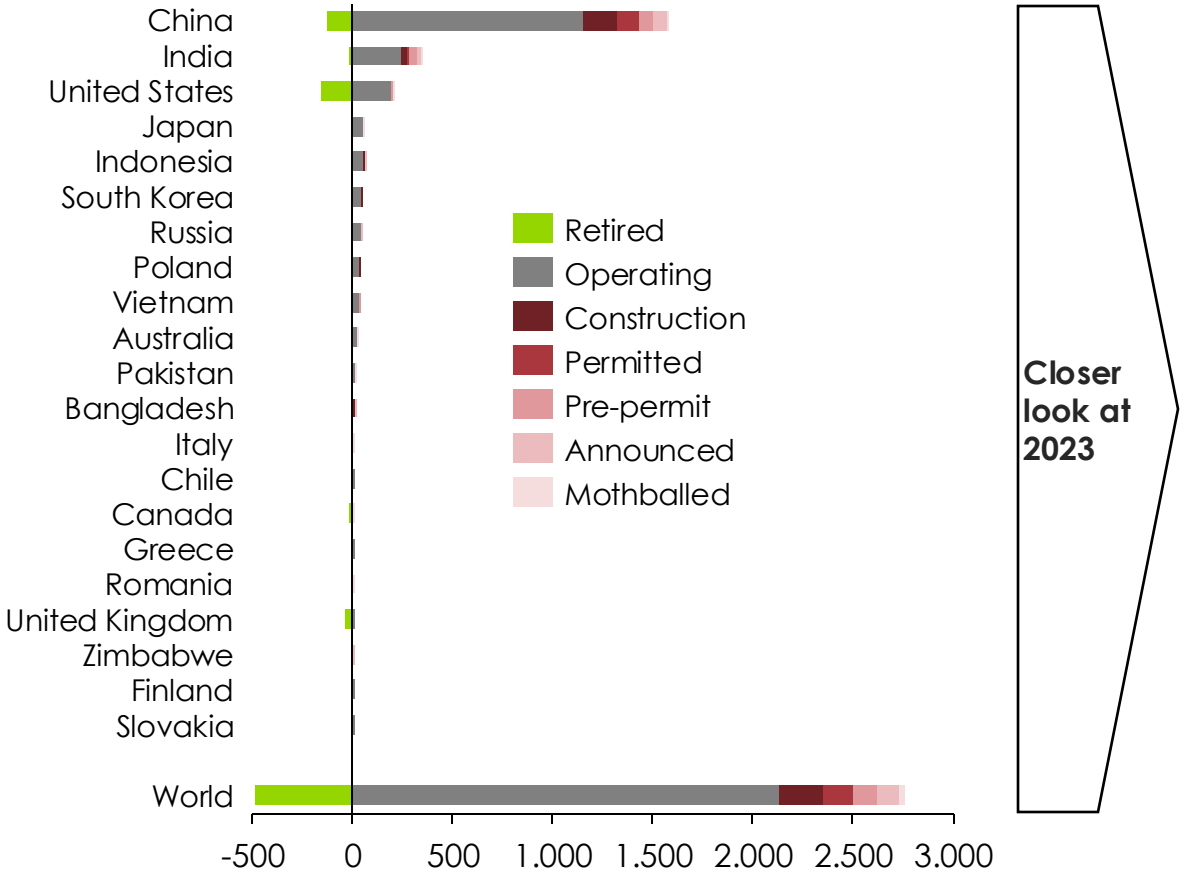
Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: ETC scenarios have been attributed to normative and descriptive given PBS is closer to net-zero scenarios and ACF closer to descriptive scenarios; only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

China continues to dominate new coal power additions, despite some retirements

Global view
Power coal
Use

Coal power plant fleet stocktake

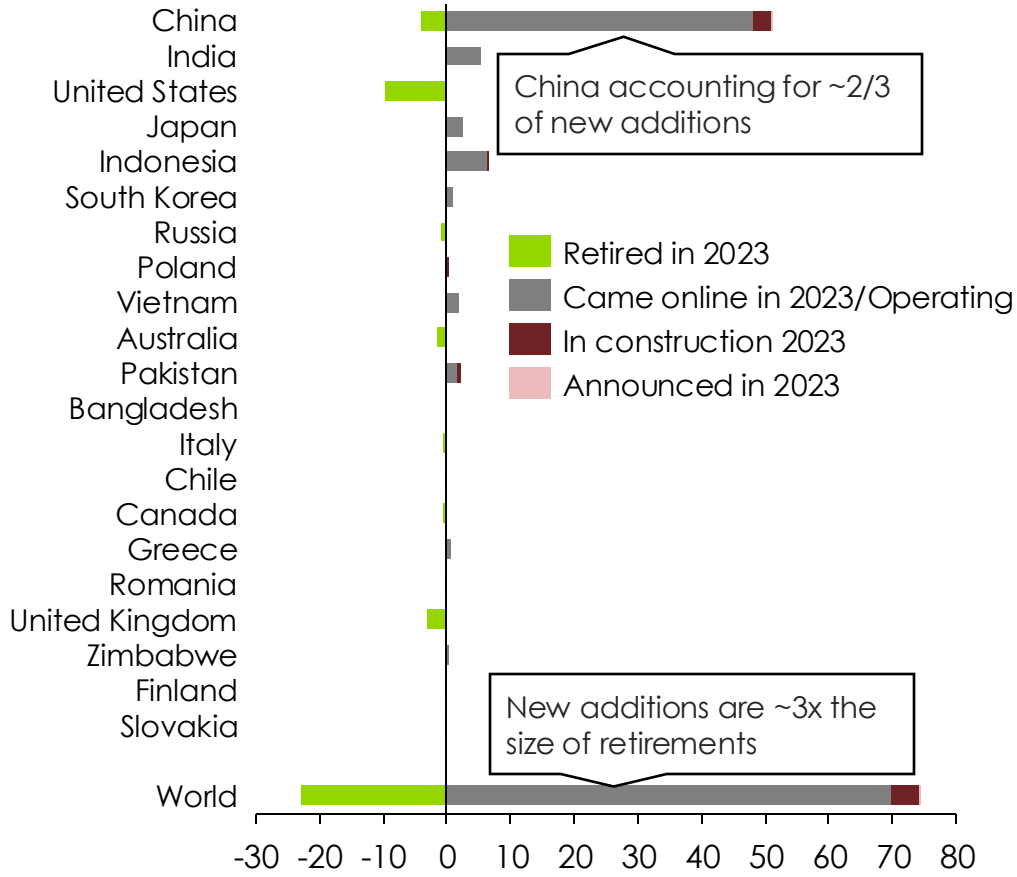
Total global capacity, GW



Closer look at 2023

Coal power plant fleet, 2023 retirements and additions

2023, GW



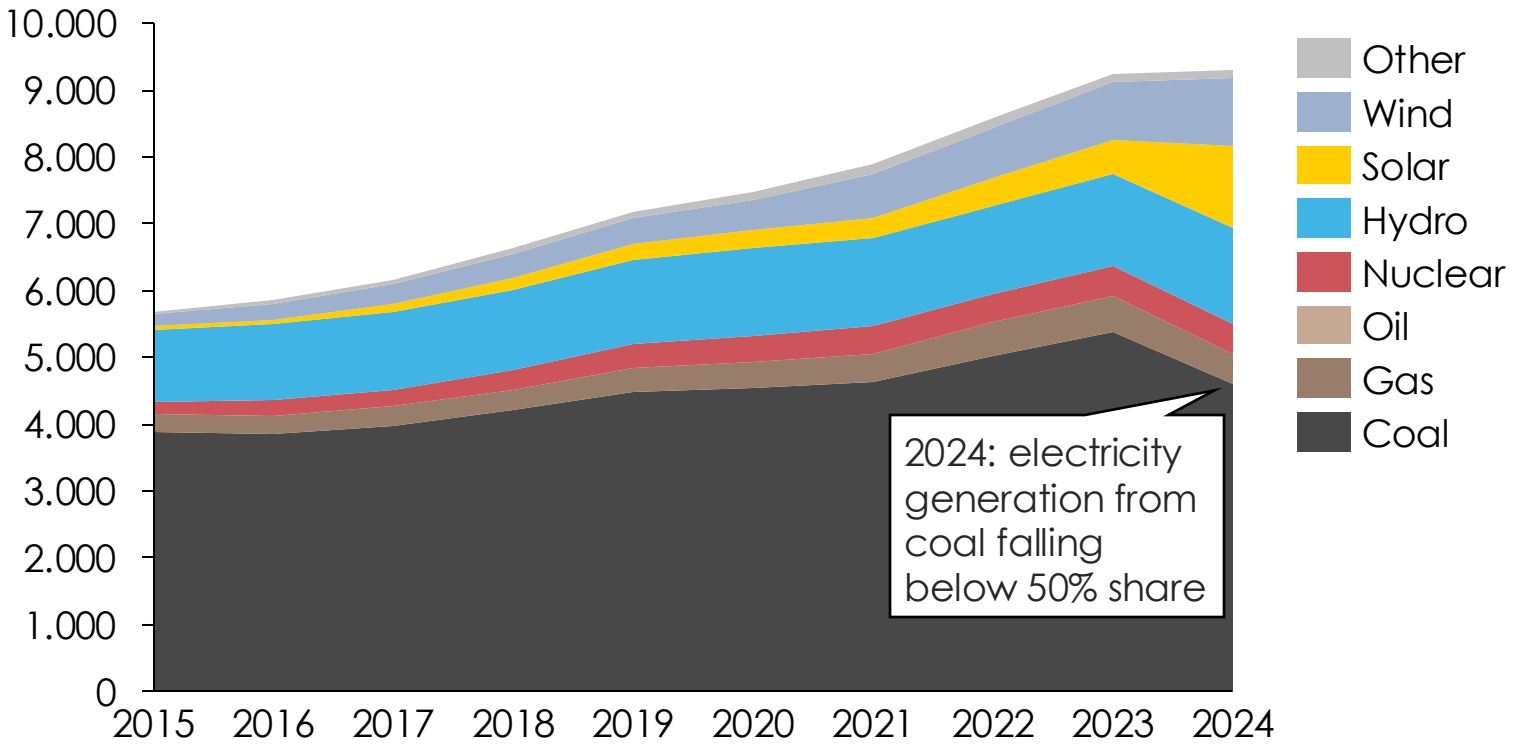
In 2023, only the United States, the United Kingdom, and Australia retired more than 1 GW of coal capacity without adding any new plants.

Source: Data for analysis from Global Energy Monitor (2024), *Global Coal Plant Tracker*

Coal use in Chinese power generation set to fall in 2024

Share of electricity generation

TWh



Despite growth in capacity, share of generation from coal in China is set to fall, with implications for global coal decline

Source: BNEF (2024), *NEO*

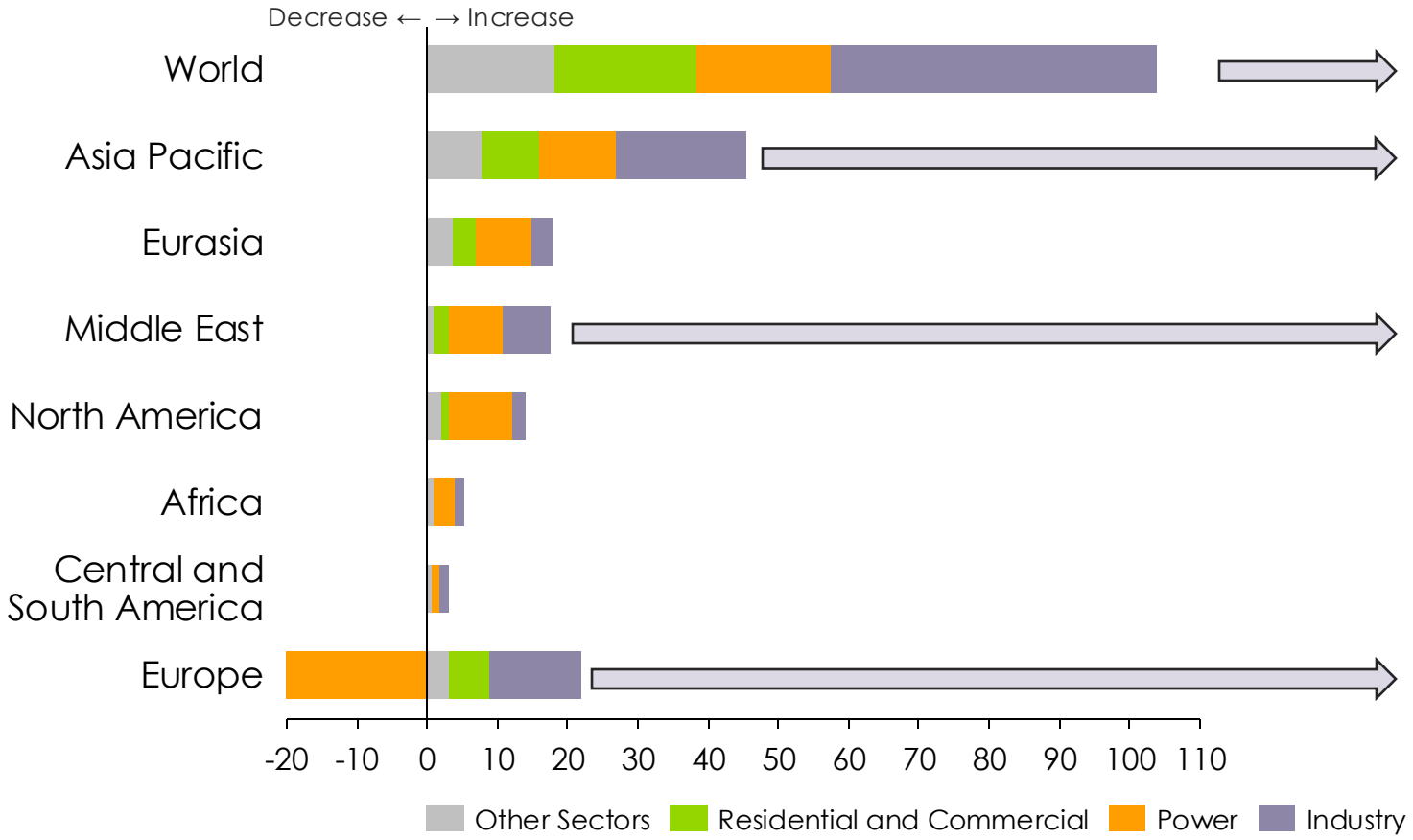
Gas & LNG

The IEA forecasts a global 2.4% growth in gas demand from 2023 to 2024, with most of it driven by industry in China and India

Global view
Gas Use

Forecast for natural gas consumption by region and sector, 2023 vs. 2024

bcm



Global gas consumption increase (2.4% compared to 2023) **primarily driven by spike in industry gas demand.**

Strongest industry gas demand increase in Asia-Pacific, within which **China** accounted for 60% of demand surge in 2024, followed by **India** (20%), South Korea (6%), and Japan (5%).

Middle East also shows disproportionate high gas use in industry.

Europe expects higher industrial gas consumption as facilities throttled or shut in 2022 due to Ukraine war-related price spikes are restarted.

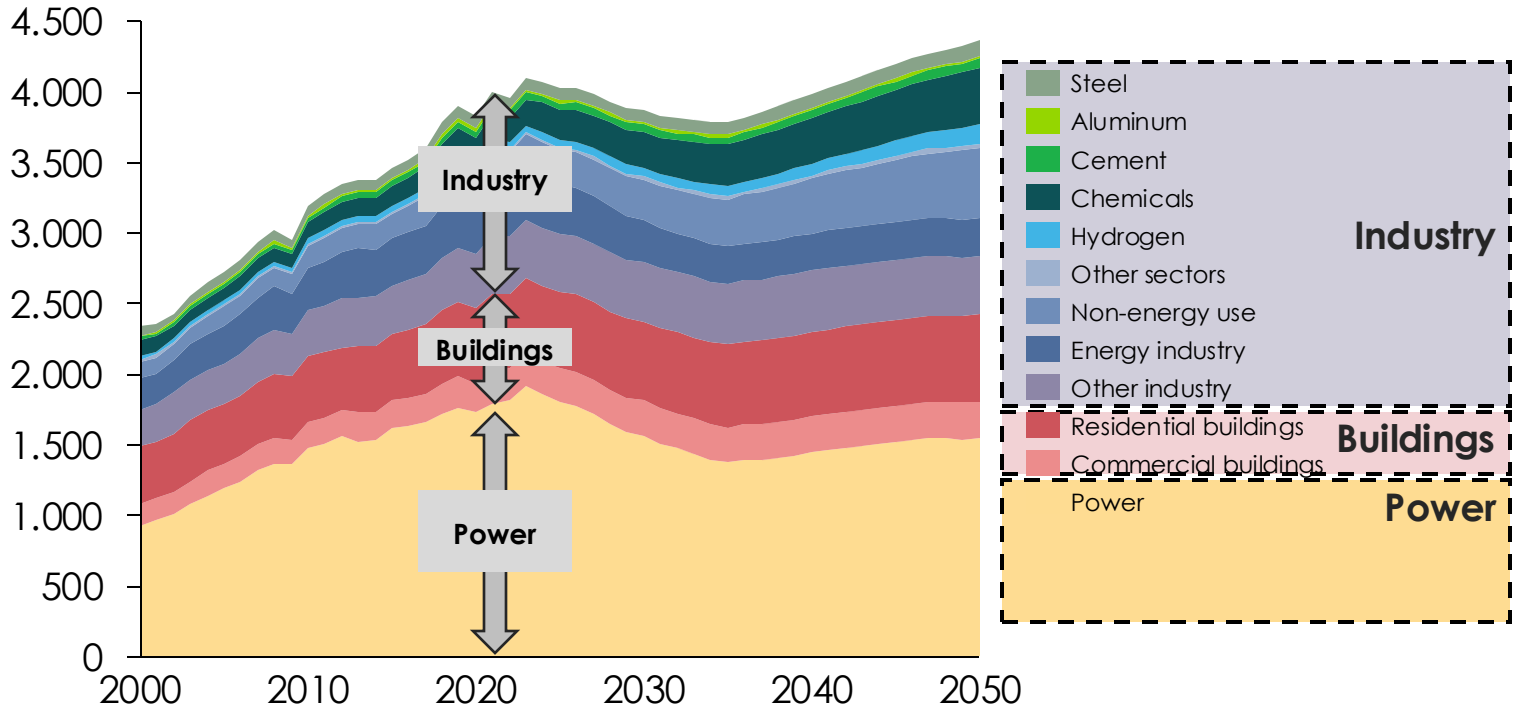
Source: IEA (2024) *Gas Market Report, Q3-2024*

Longer-term global gas demand forecasts show increase in industry andbuildings, but declines in power gas demand

Global view
Gas Use

Gas demand by sector – BNEF ETS

bcm



2022-2035 change		
BNEF view	ETC view	
ETS	PBS	ACF
+13%	-27%	0%
+10%	-35-40%*	
-26%	-35%	-32%

Comparing descriptive vs. normative scenarios highlights key policy gaps, particularly in industry and buildings

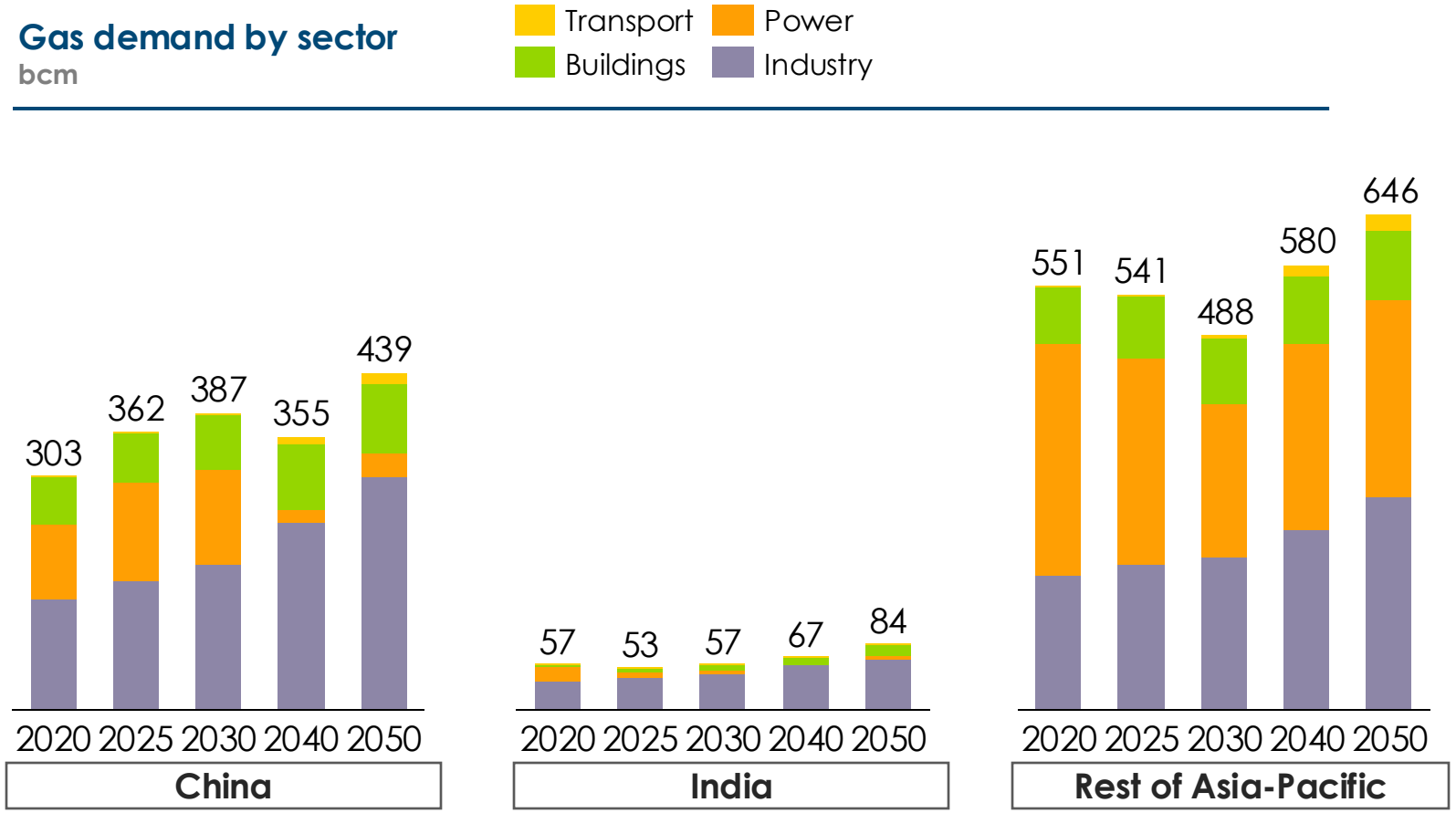
Source: BNEF (2024), *NEO – Economic Transition Scenario (ETS)*
*The new ETC Building Report updates the scenarios presented in the Fossil Fuels in Transition report
Note: Other sectors represent: agriculture, services, waste management; Other industry includes light manufacturing like: food and beverages, pulp and paper, textiles, electronics; Non-energy use: gas used as raw materials, e.g. In plastics; PBS and ACF 2035-2022 % change interpolated from trajectory towards 2030 and 2040 forecast

Gas demand is set to rise sharply in India, China, and the rest of Asia, led by industrial use in China and India, with declines in power smaller than global average

Asia view
Gas

Gas demand by sector

bcm



Industrial gas demand dominates gas demand in both China and India.

Industrial gas demand is expected to grow significantly in APAC.

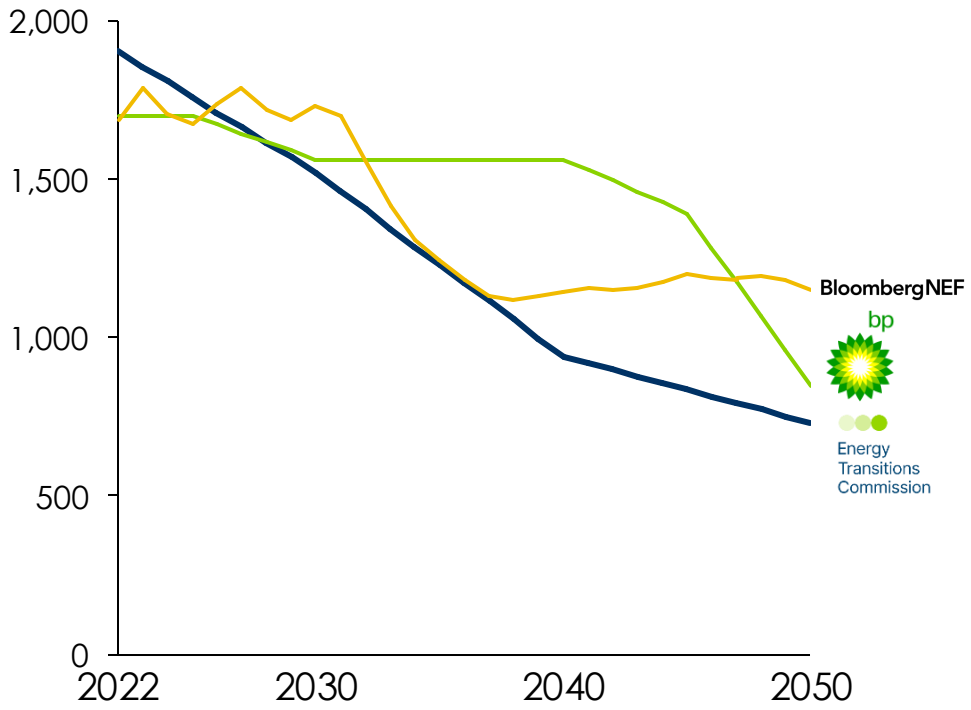
Source: BNEF (2024), *NEO - ETS*

Power: Descriptive scenarios highlight wider range of views on role of natural gas in power

Global view Power Gas Use – normative & descriptive scenarios

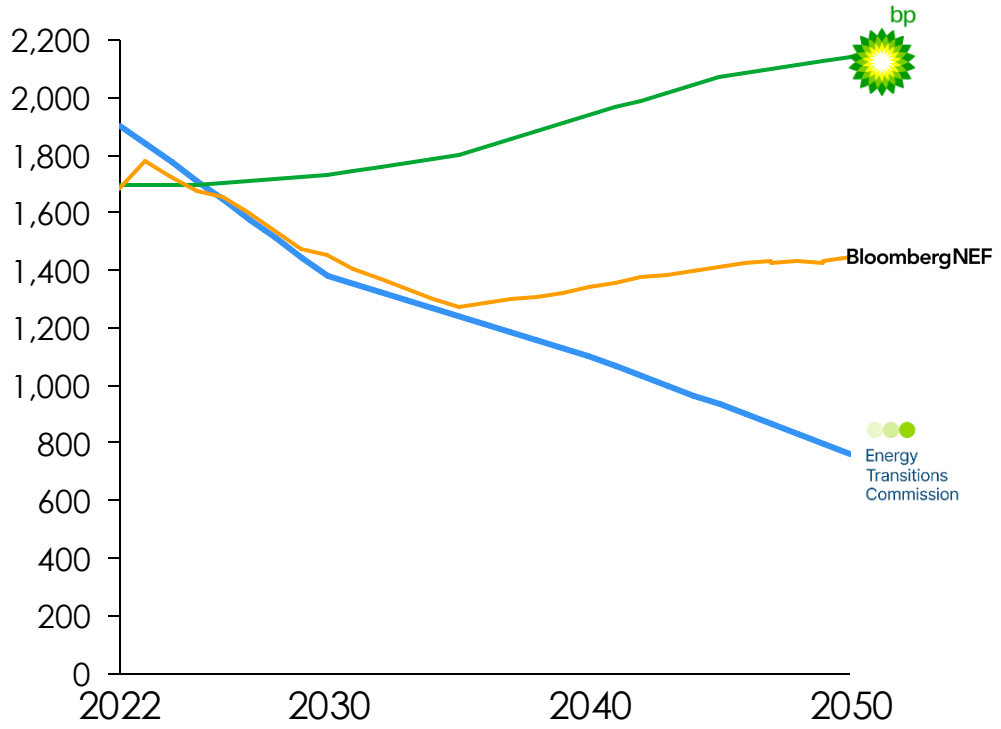
Power gas consumption – normative scenarios

Mtce



Power gas consumption – descriptive scenarios

Mtce



ETC - Possible but Stretching Scenario*

BP - Net Zero

BNEF - Net Zero Scenario

ETC - Ambitious but Clearly Feasable Scenario*

BNEF - Economic Transition Scenario

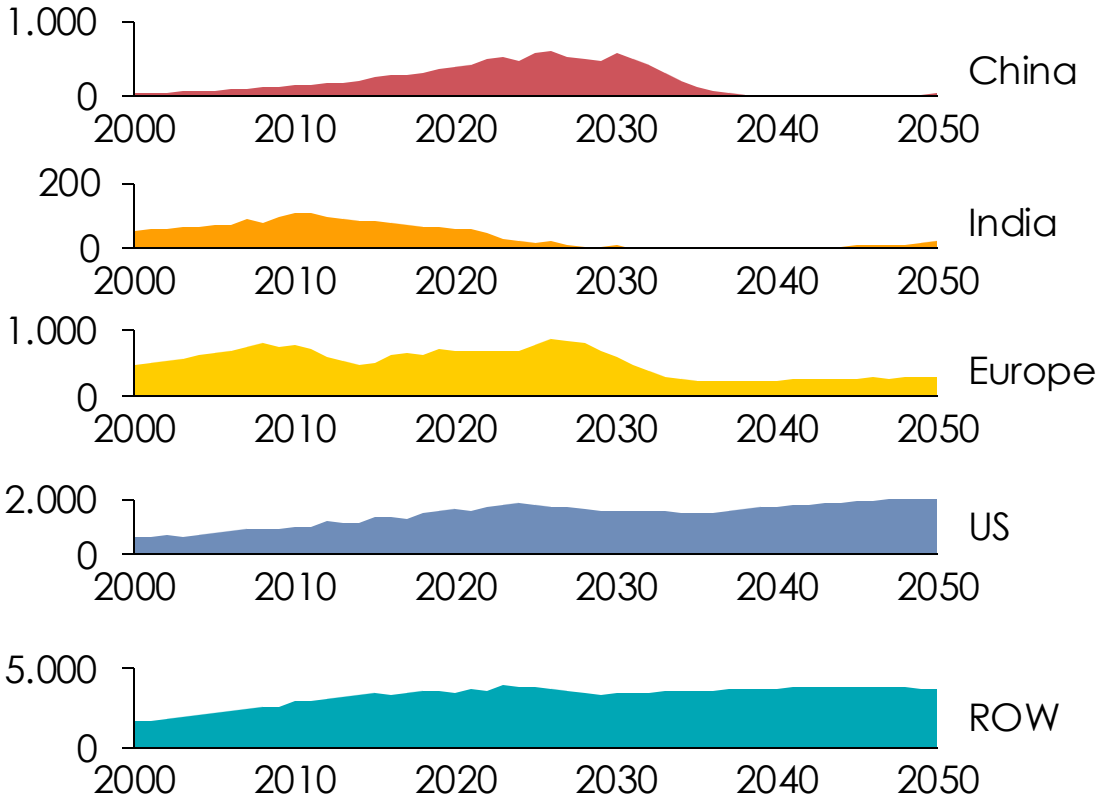
BP - Current Scenario

Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: ETC scenarios have been attributed to normative and descriptive given PBS is closer to net-zero scenarios and ACF closer to descriptive scenarios; only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

Power: Gas consumption projected to increase in some regions; is viability of projections challenged by falling solar + battery costs?

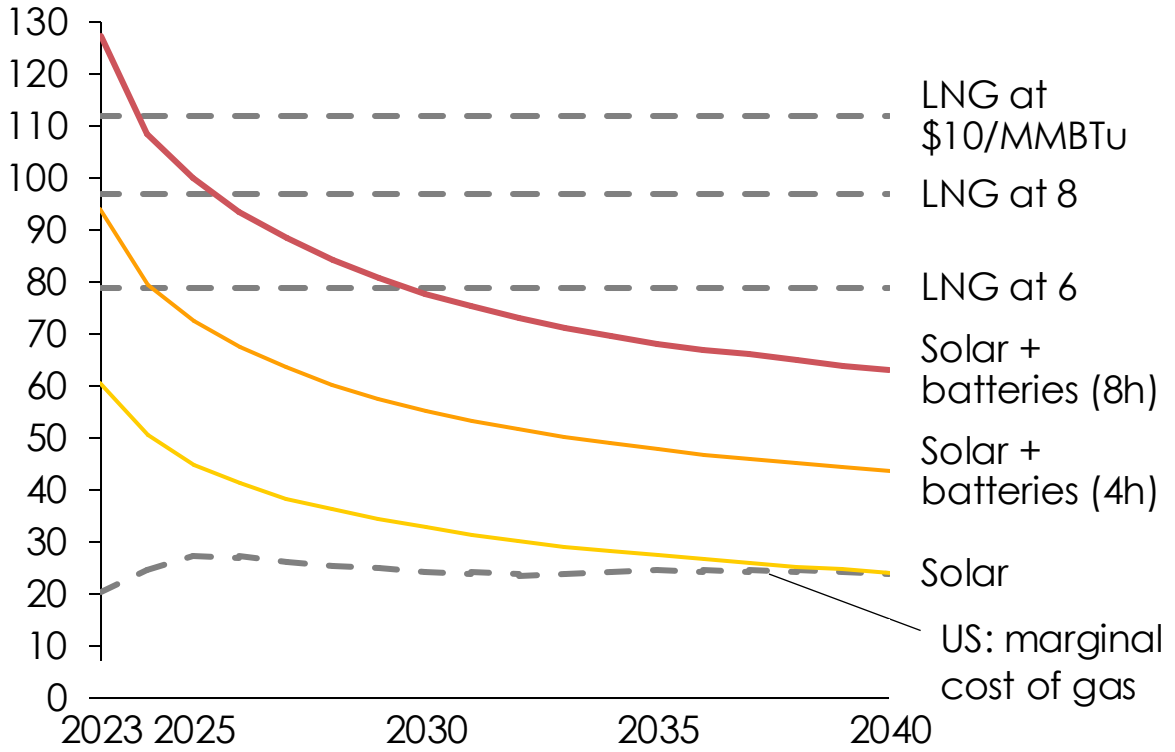
Gas demand for power generation per region

TWh



LNG is far more expensive than renewables – LNG data from RMI

USD/MWh

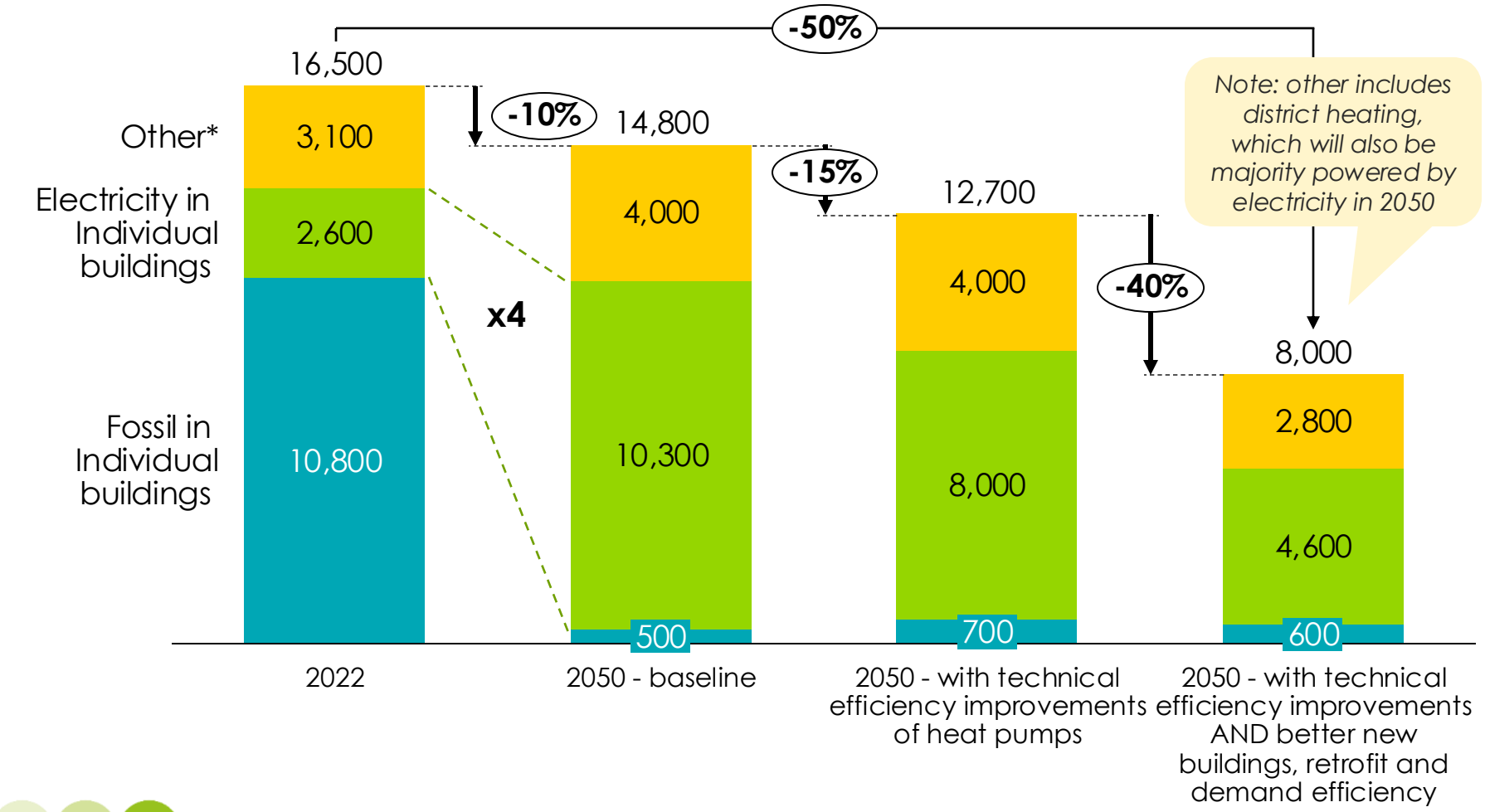


Source: BNEF (2024), *NEO;* LNG prices from RMI (2024); Solar, solar + battery, CCGT from BNEF (2023), *LCOE 2H 2023. RMI (2024) Powering up the global south.*
Notes: RMI estimates at different gas prices per MMBTU. Estimates for solar based on Vietnam. Battery cost estimates for China.

Buildings: ETC work highlights that falls in fossil possible, but requires strong policy

Global final energy demand for heating by fuel in 2050

TWh



- Buildings to become **increasingly electric**, and therefore low-carbon
- ETC global scenario sees:
  - Gas use fall 75-90% by 2050,
  - Oil demand fall 90-95% by 2050
  - Coal use entirely eliminated by 2040
- But cost and consumer adoption barriers mean **adoption of clean solutions at this level unlikely without strong policy**

*Other includes district heating and renewables.

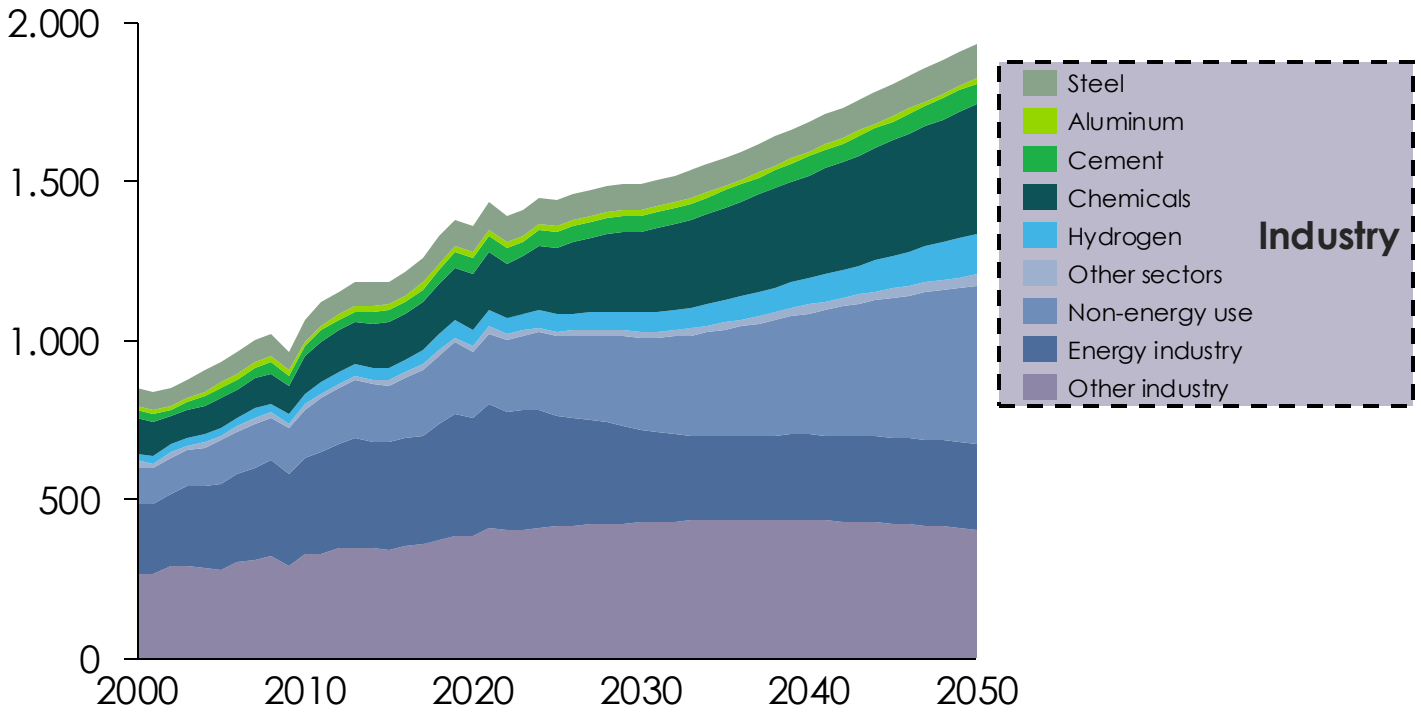
Sources: Systemiq analysis for the ETC (2024); IEA (2023), World Energy Outlook 2023; IEA (2021), Net Zero by 2050.

Industrial gas growth is a key driver of gas forecasts

Global view
Gas Use

Gas demand by sector – BNEF ETS

bcm



2022-2035 change		
BNEF view (ETS)	ETC view	
	PBS	ACF
+13%	-27%	0%

Source: BNEF (2024), *NEO*
Note: Other sectors represent: agriculture, services, waste management; Other industry includes light manufacturing like: food and beverages, pulp and paper, textiles, electronics; Non-energy use: gas used as raw materials, e.g. In plastics

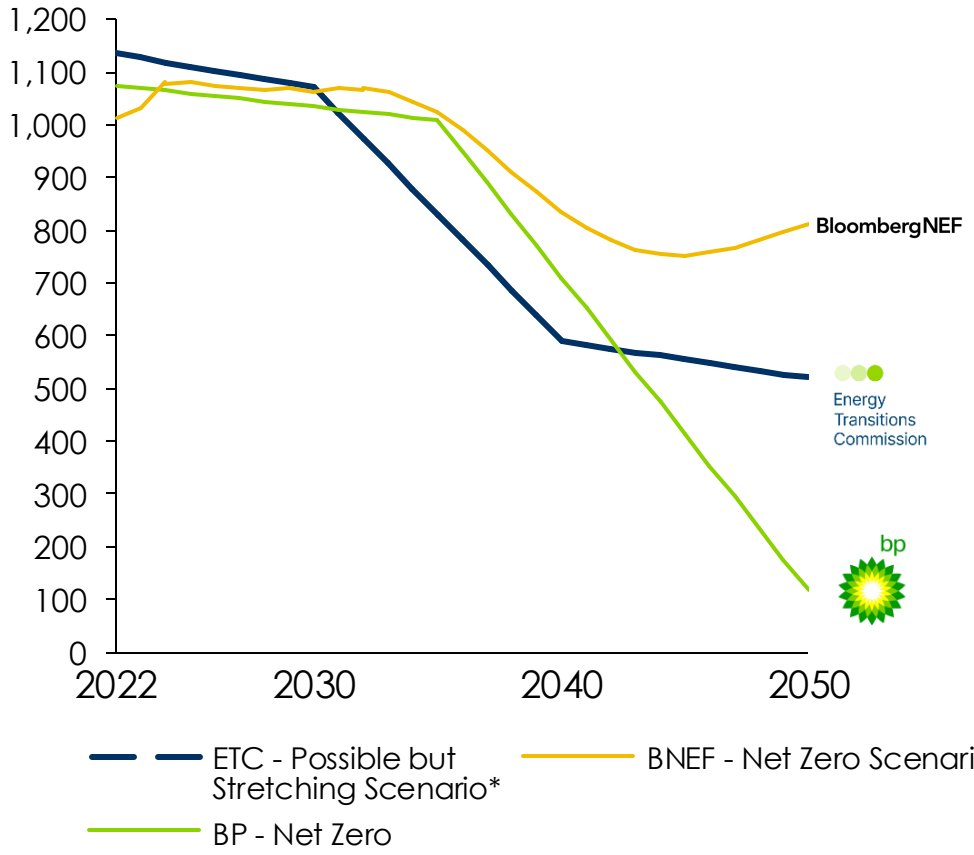
Both normative and descriptive scenarios highlight wider uncertainty around industrial gas outlook

Global view Power Gas Use – normative & descriptive scenarios

Pre-read only

Industry gas consumption – normative scenarios

bcm



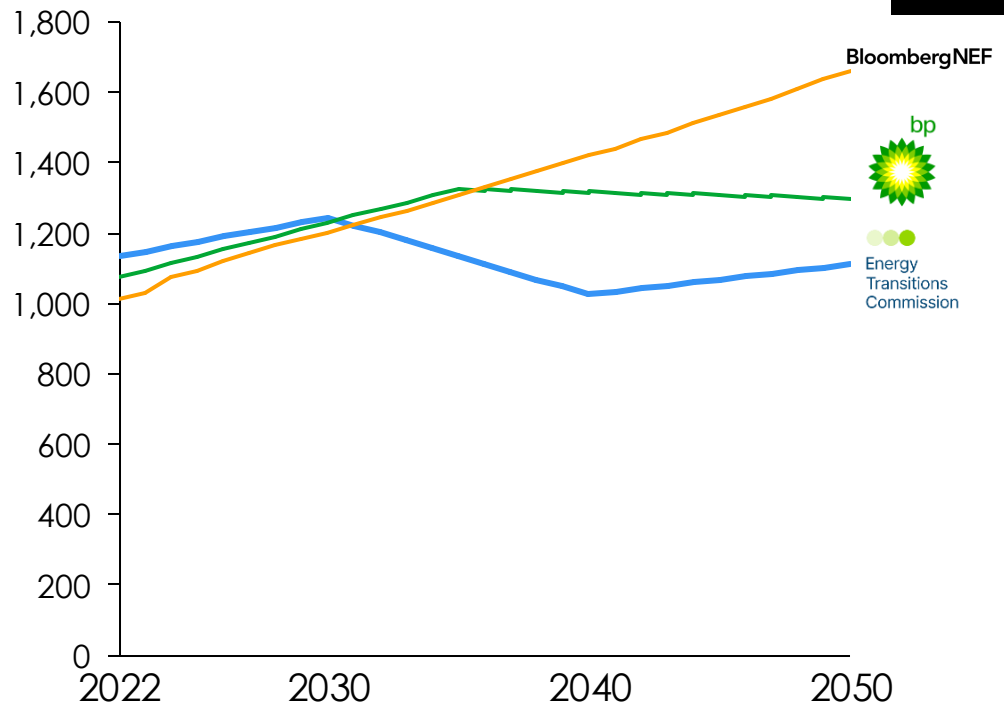
ETC - Possible but Stretching Scenario*

BNEF - Net Zero Scenario

BP - Net Zero

Industry gas consumption – descriptive scenarios

bcm



ETC - Ambitious but Clearly Feasable Scenario*

BNEF - Economic Transition Scenario

Source: ETC (2023), *Fossil Fuels in Transition;* BP (I2024), *Energy Outlook;* BNEF (2024), *New Energy Outlook;* IEA (2023), *World Energy Outlook;* Coal icon from Flaticon (2024), *coal*
Note: ETC scenarios have been attributed to normative and descriptive given PBS is closer to net-zero scenarios and ACF closer to descriptive scenarios; only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

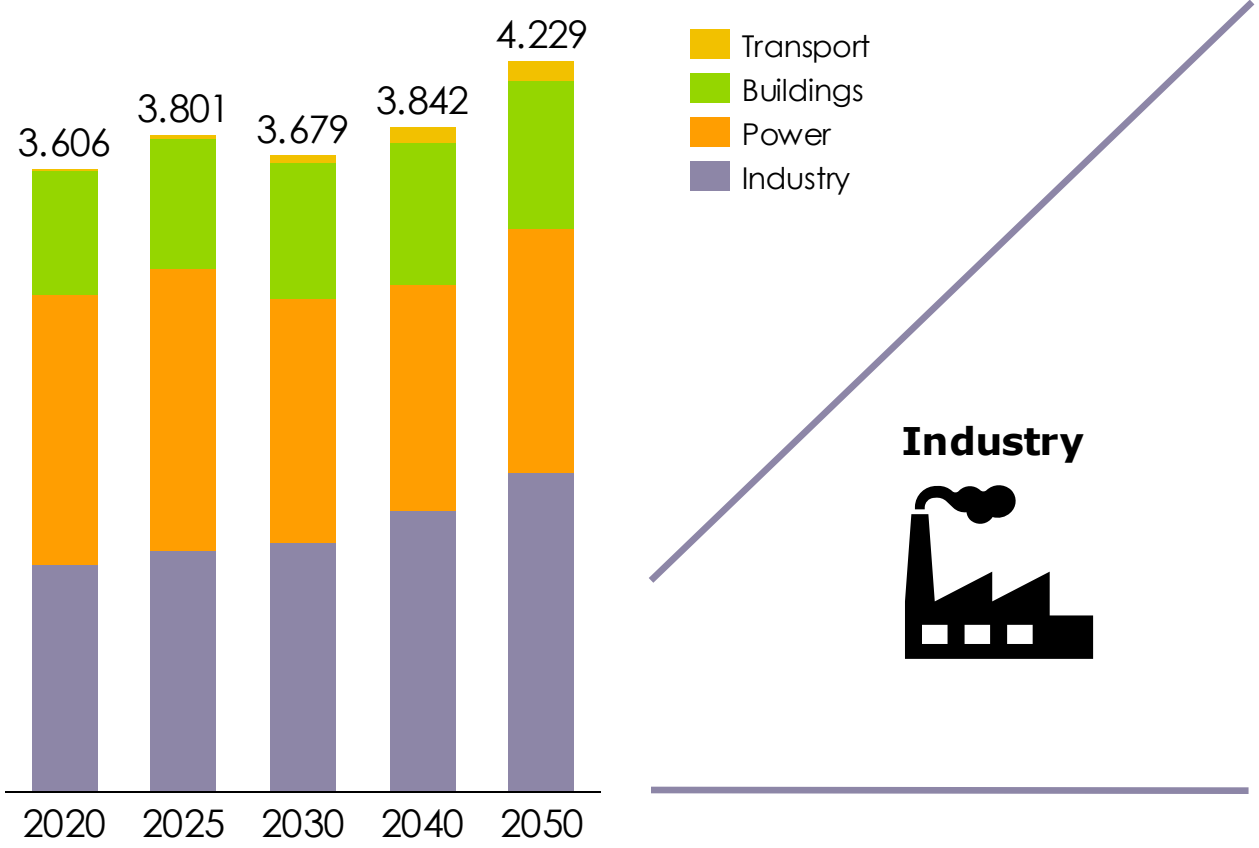
Industry – chemicals, manufacturing and metals drive gas demand

Global view
Gas

Pre-read only

Global gas demand by sector

bcm



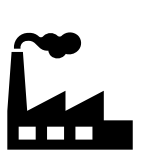
Use of natural gas in key industry sectors

Petrochemical and chemicals ~40-45%	**Gas is used as feedstock** for producing chemicals like ammonia, methanol, or hydrogen, as well as fertilizers and refinery.
Manufacturing ~30-35%	**Gas is used as a source of energy** for process heating, powering industrial equipment, and sometimes as a raw material for producing products like glass, pulp and paper, textiles, or ceramics.
Steel and Metals ~20-25%	**Gas is used as a fuel for furnaces** in processes like melting, heating, and annealing, as well as a reducing agent in direct reduction of iron (DRI) to produce steel.
Other Industries ~5-10%	**Gas is used at smaller scale in various industrial processes** - such as pharmaceutical production, food processing, textiles, pul and paper - using natural gas for precise heating, drying, and other processes.

Focus in further analysis

Source: Shell (2024), *Shell Energy Transition Strategy 2024;* International Council of Chemical Associations *(n.a.), 2022 Report;* U.S. Energy Information Administration (2022)

Industry contributes to ~40% of national gas demand, with rising demand, driven by gas use in chemicals, manufacturing, and steel making

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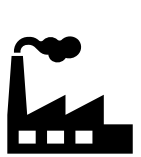
	Industry	Gas consumption in industry in 2022	Growth in 2023	Drivers
		~112 bcm	7.1%	**Across sectors, increasing coal replacement by gas and economic recovery from pandemic drive gas use.**
Key Sectors	**Petrochemical and chemicals**	**~34 bcm** **~30%** of industrial demand.	**8%**	▪ **Feedstock for chemicals:** rising demand for ammonia, fertilizers and other chemicals, both for domestic and export use. ▪ **Demand for plastics:** as key exporter, global post-Covid plastic demand led to rising input demand for production in China. ▪ **Gas replacing coal:** gas increasingly replaces coal in industrial production to reduce emissions.
	Manufacturing	**~22 bcm** **~20%** of industrial demand.	**6%**	▪ **Urbanization & Infrastructure Growth**: Rising urbanization and major infrastructure projects in China drive demand for gas-based manufacturing. ▪ **Gas replacing coal**: Environmental regulations encourage industries, especially ceramics and glass, to switch from coal to cleaner natural gas, boosting gas consumption. ▪ **Industrial Modernization & Efficiency**: Modernizing production processes and incentives for emission reductions further support the growing use of natural gas in industry.
	Steel and Metals	**~17 bcm** **~15%** of industrial demand.	**4%**	▪ **Gas replacing coal:** gas increasingly replaces coal as a reductant in steel-making to reduce emissions

Source: BNEF (2024), *China Gas Market Outlook 2040;* IEA (2024) *Gas Market Report, Q3-2024;* IEA (n.a.) *Chinese Natural Gas consumption by sector, 2005-2023;* BNEF (2024), *China Gas Market Outlook 2040);* India flag icon from FlagIcon (2024), *India.*

Industry contributes to ~60% of national gas demand, with rising demand, primarily driven by use in fertilizer production



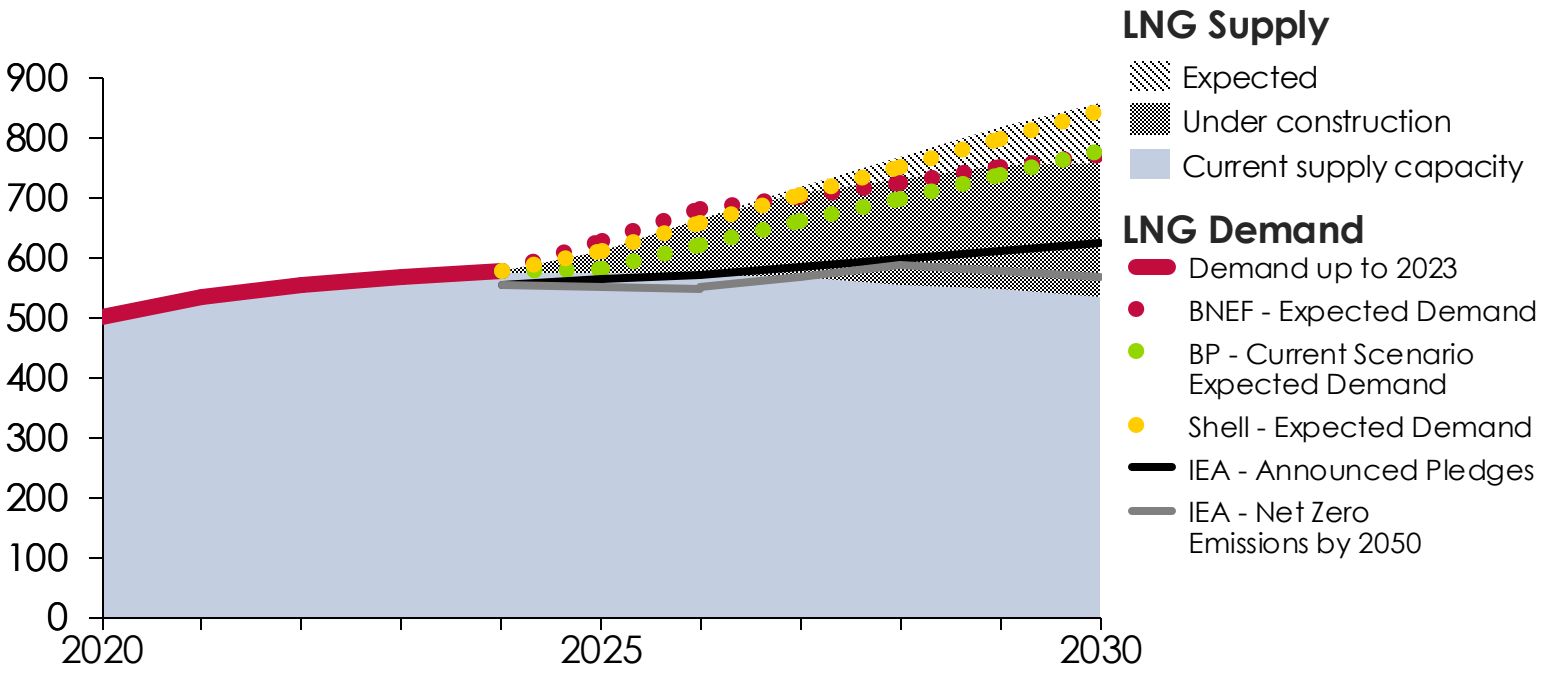
Pre-read only

	Industry	Gas consumption in 2022	Growth in 2023	Drivers
		~45 bcm	5.2%	**Across sectors, increasing coal replacement by gas drive gas use.**
Key Sectors	**Petrochemical and chemicals**	**~21 bcm** (18 bcm from fertilizer production) **~47%** of industrial demand.	**7.3%**	▪ **Feedstock for fertilizer production:** almost ½ of Indian industrial gas use driven by fertilizer production, which is growing based on increasing domestic demand and export, as well as government initiatives to expand production capacities. ▪ **Refinery:** as key exporter, global post-Covid plastic demand led to rising input demand for production in India. ▪ **Gas replacing coal:** gas starts to replace coal in industrial production to reduce emissions.
	Manufacturing	**~5 bcm** **~20%** of industrial demand.	**4%**	▪ **Gas replacing coal:** manufacturing industries, like ceramics, glass, and textiles, are turning to natural gas as a cleaner and more efficient energy source to replace coal
	Steel and Metals	**~1.1 bcm** **~2.4%** of industrial demand.	**1%**	▪ **Gas replacing coal:** gas increasingly replaces coal as a reductant in steel-making to reduce emissions

Source: India Energy (2024), *India Climate & Energy Dashboard;* IEA (2024) *Gas Market Report, Q3-2024*; GasOutlook (2024), *Indian gas consumption hits highest-ever annual level;* India (2024); *Natural Gas consumption;* India flag icon from FlagIcon (2024), *India.*

Growing gas demand is being met through growth in LNG supply, but divergence across normative and descriptive scenarios may mean long-term oversupply

Global LNG supply and supply additions against expected global demand
bcm



Increase in **LNG demand drives** global **supply capacity**

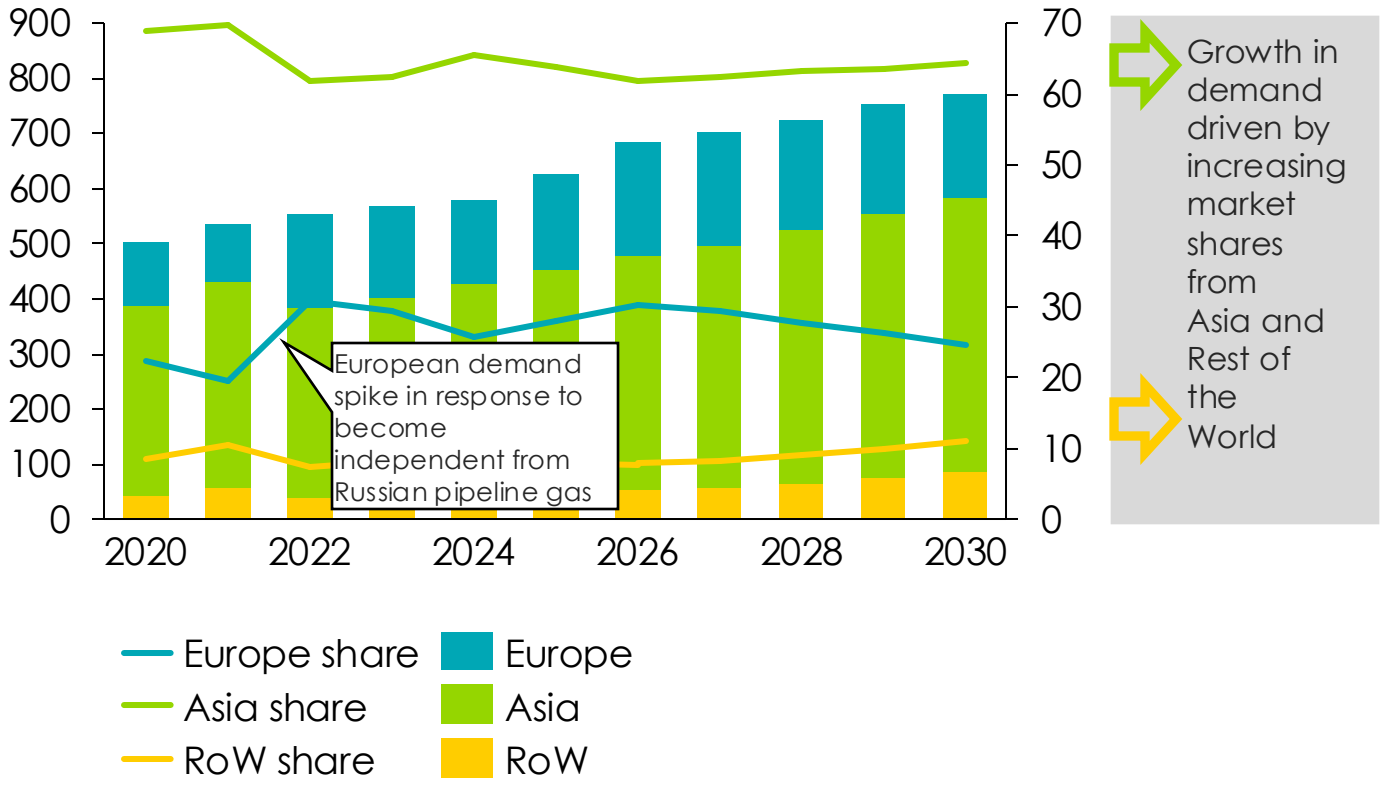
Shell's expected 2030 LNG demand is 9% higher than BP's current scenario projection

Key question is relative competitiveness against domestic gas and low-carbon alternatives

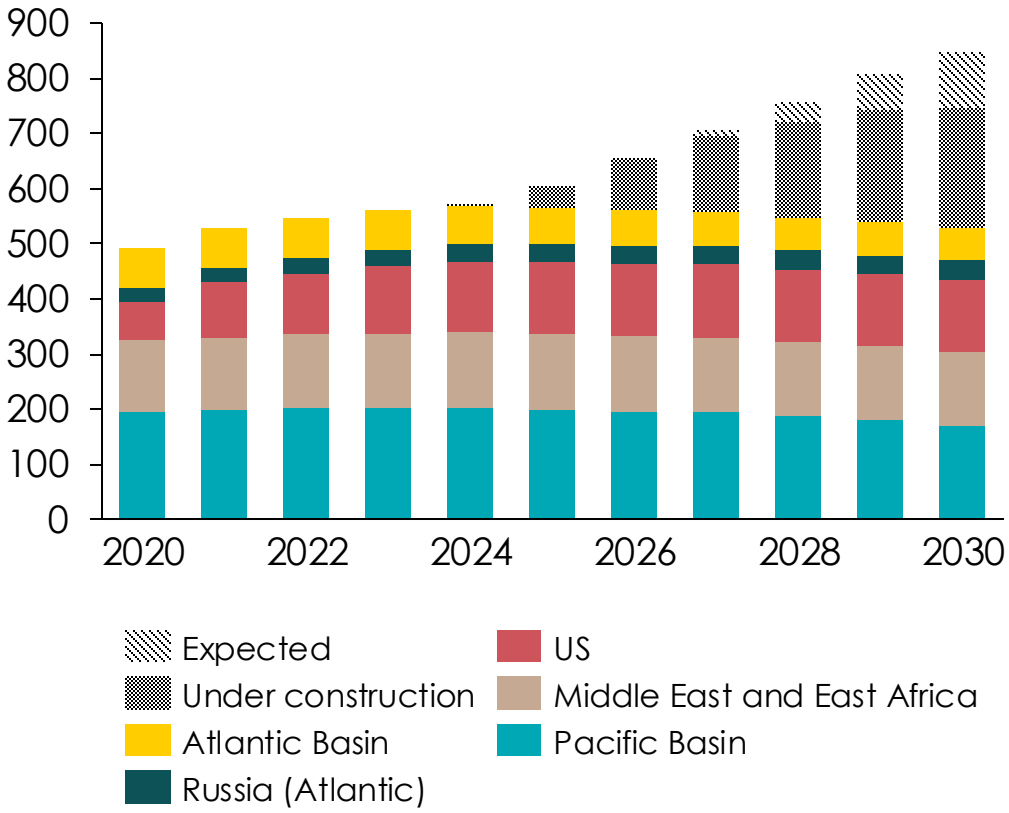
Source: BNEF (2022), *Global LNG Market Outlook 2030;* BP (2024), *Energy Outlook;* Shell (2024), *LNG Outlook 20204*

Largest recent growth from Europe to offset reduced Russian pipeline gas. However, Asian dominance of global LNG market is expected to be supplement by growth in RoW

Demand - LNG consumption per region
bcm on the left; market share in % on the right



Supply - LNG provision per region
bcm

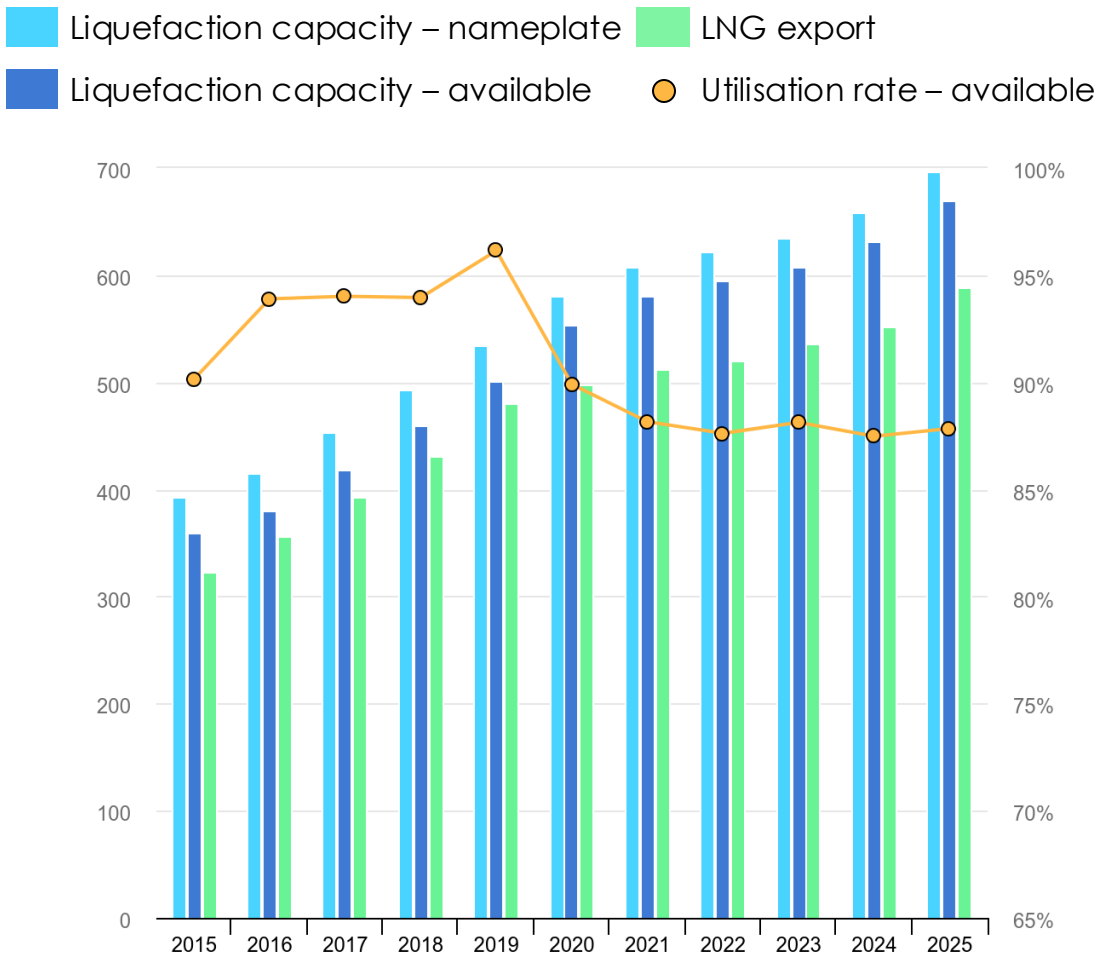


Source: BNEF (2022), *Global LNG Market Outlook 2030*

Risks of fossil fuel investment lock-in are inherent in the global LNG market, which seeing lower utilisation rates

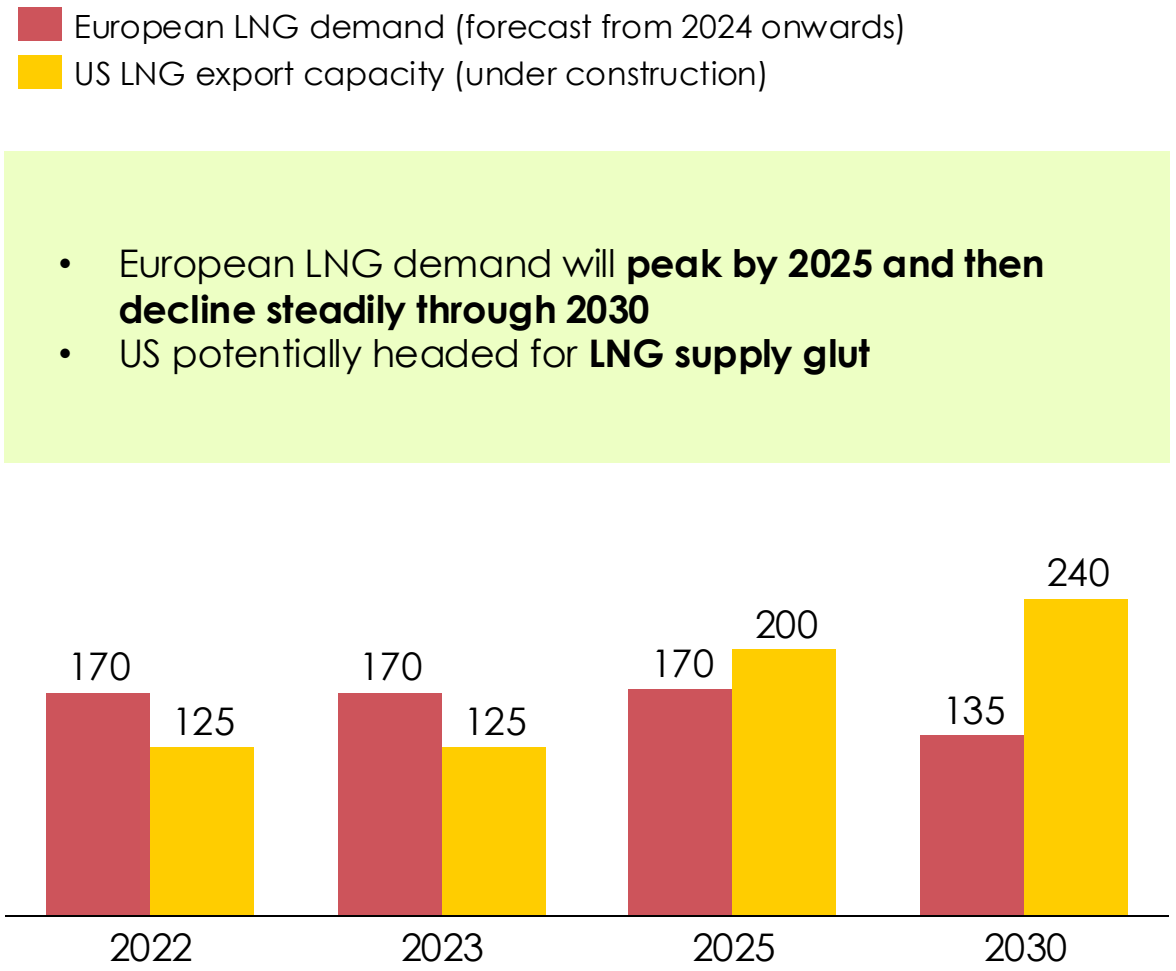
LNG trade and liquefaction utilisation rate

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



European LNG demand vs.US LNG export capacity

bcm; 2023 – 2030



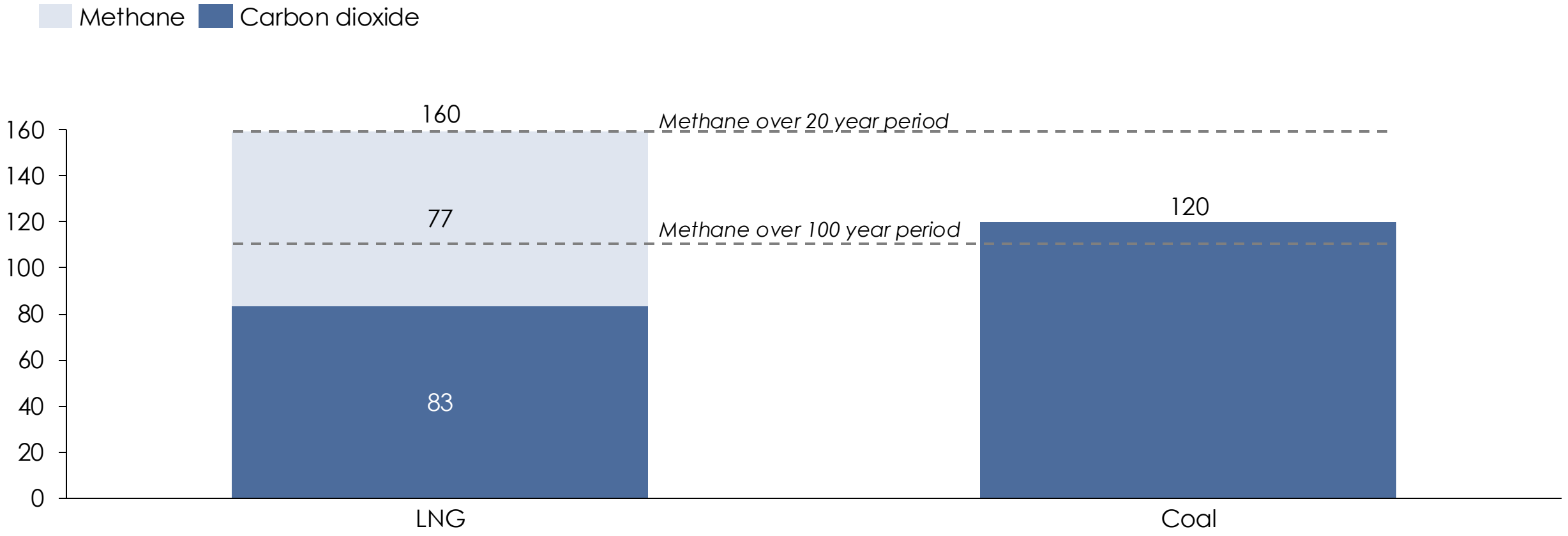
- European LNG demand will **peak by 2025 and then decline steadily through 2030**
- US potentially headed for **LNG supply glut**

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

Assessing global warming impacts over a 20-year lifetime suggests LNG can be worse for the climate than coal

GHG emissions for LNG exported from the US and coal produced domestically

g CO2e/MJ



Source: Howarth (2024), The greenhouse gas footprint of liquefied natural gas (LNG) exported from the United States
Notes: Coal in power generation at 45% efficiency.

In most markets, cost of LNG is not cheaper than domestic fuel production – availability, not price, key driver of use

Global view LNG

LNG value chain - breakdown of LNG cost per region

USD/MWh

	Exploration and processing	Liquefication Refrigeration	Shipping	Storage and Regasification	Distribution	Entire Value Chain	Sources of LNG
EU	10,2	13,0	7,8	6,8	5,5	43	EU imports mainly from US (~1/2), followed by Russia and Algeria
China	10,2	13,0	6,5	5,5	7,2	42	China imports mainly from Australia (~1/3), followed by Qatar and Russia
India	10,2	13,0	6,1	4,1	5,5	39	India imports mainly from Qatar (~1/2) followed by the US and Australia

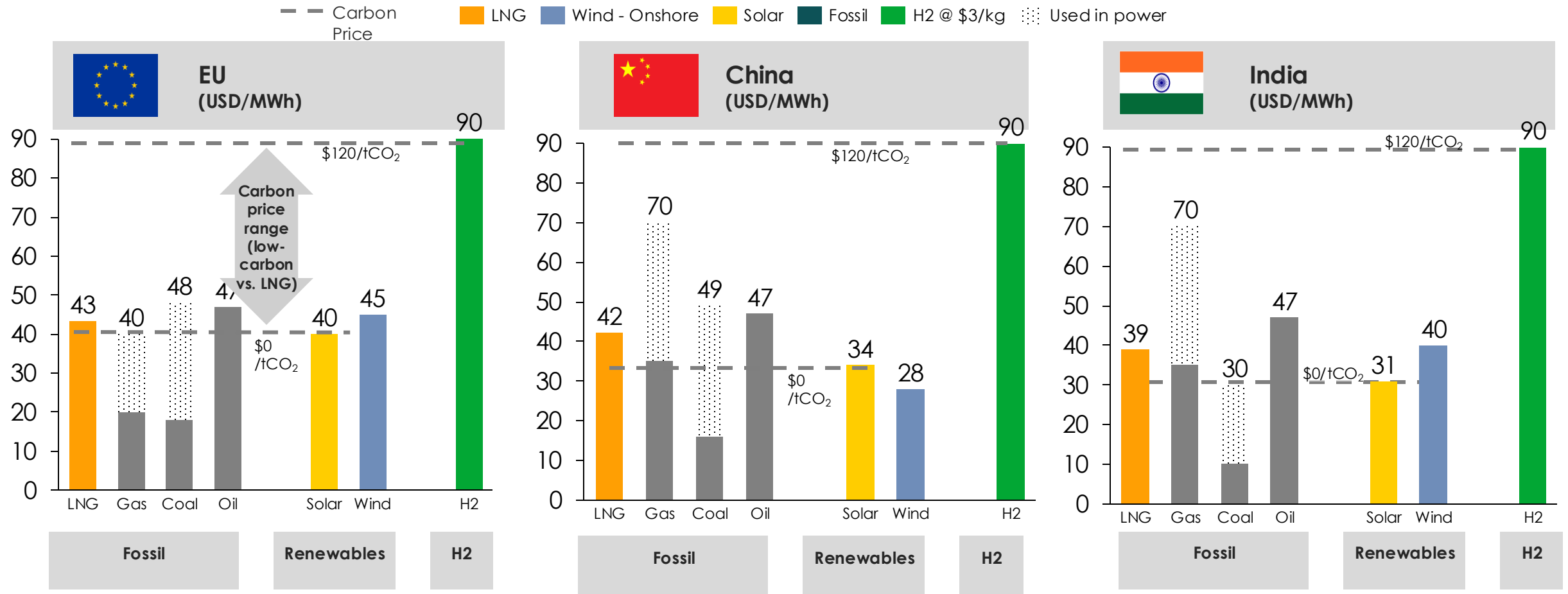
Cost of domestic production/alternative fuels

USD/MWh

	Gas	Coal (fuel, in power)	Oil
	In LNG price range	LNG costlier	LNG cheaper
EU	20-48	10-18 (35-63)	60-70
China	35-50	12-16 (42-56)	60-70
India	35-45	10-15 (35-53)	60-70

Source: Own analysis, data from S&P Global (2024), *Commodity Insights – LNG Analytics;* IEA (2024), *Price of US LNG;* Other fossil fuel data from World Bank (2024); *Monthly Prices;* Note: Prices have been converted from USD/MMBtu to USD/MWh. LNG price is average from 2024

Carbon prices or policy support required to make low-carbon industrial fuels like hydrogen competitive with LNG



Low-carbon alternatives cost-competitive at reasonable expectation of carbon price.

Strong carbon price/policy support required.

Strong carbon price/policy support required.

Sources: ETC (2022) *Bioresources technical annex*. Data from S&P Global (2024), *Commodity Insights – LNG Analytics;* IEA (2024), *Price of US LNG;* Other fossil fuel data from World Bank (2024); Monthly Prices; BNEF (2023*), 2H 2023 LCOE: Data Viewer v.1.0*; European Commission (2024), *Liquefied natural gas;*
Note: assuming a carbon intensity of 0.4 ton per MWh of coal used and 0.2 per ton of gas and oil used. Oil at 2024 avg. of $80/bbl.

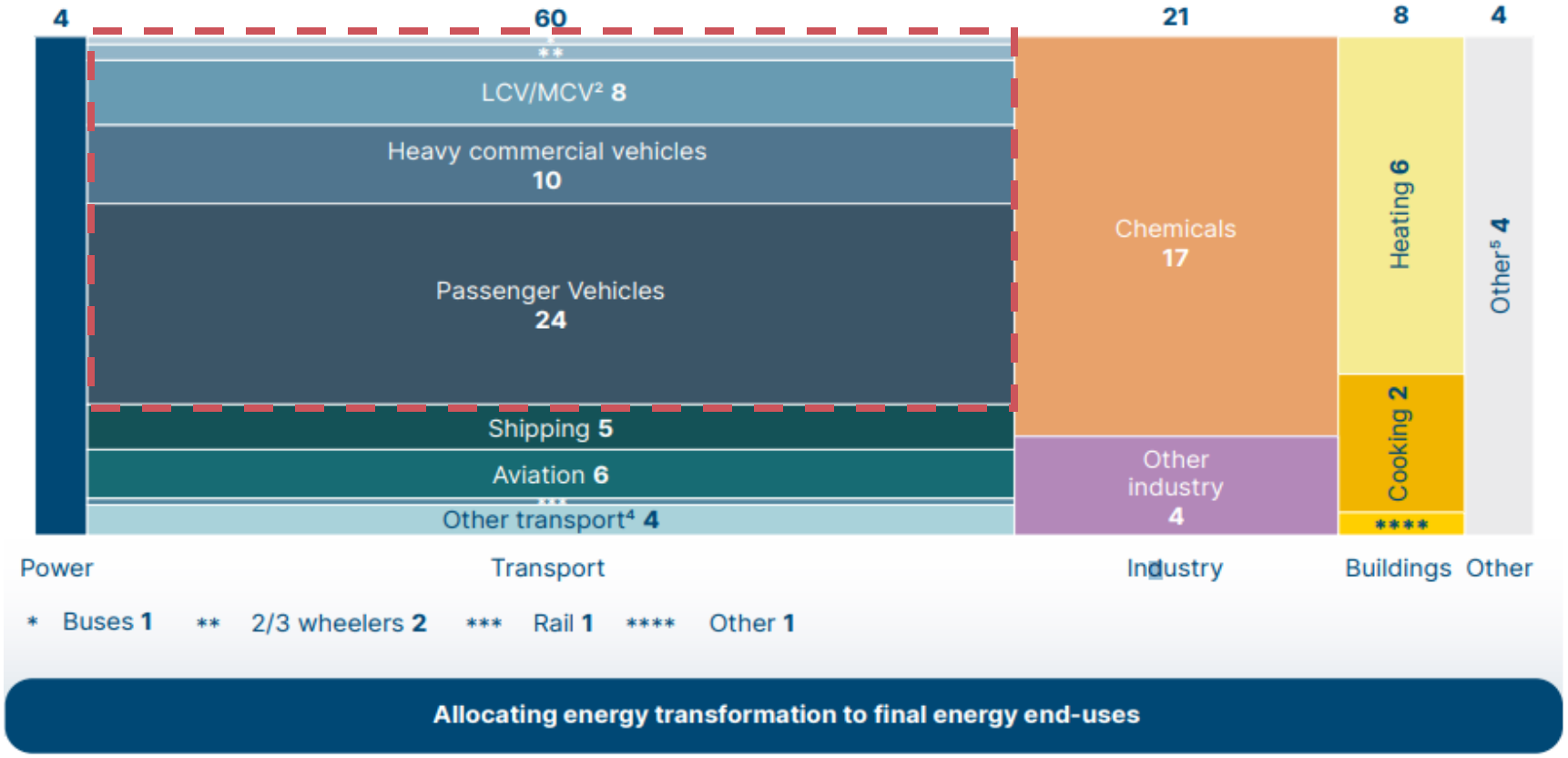
Without further policy push, risks of 'sticky' gas demand over long-term

- Gas demand in industry may be 'sticky' in some regions, but low carbon options exist at realistic ($100/$TCO_2$) levels of carbon price versus LNG.
- Emissions from methane/LNG important to remember: may be worse than coal over 20 year warming trimeframe
- Relative competitiveness of LNG is not a given, particularly in power but also in industry – raising questions around viability of demand growth
- BUT short-term growth in gas demand, including through long-term LNG contracts, and potential low prices through oversupply, may lead to long-term demand lock-in

Oil

Reminder: Road transport accounts for ~50% of total oil demand

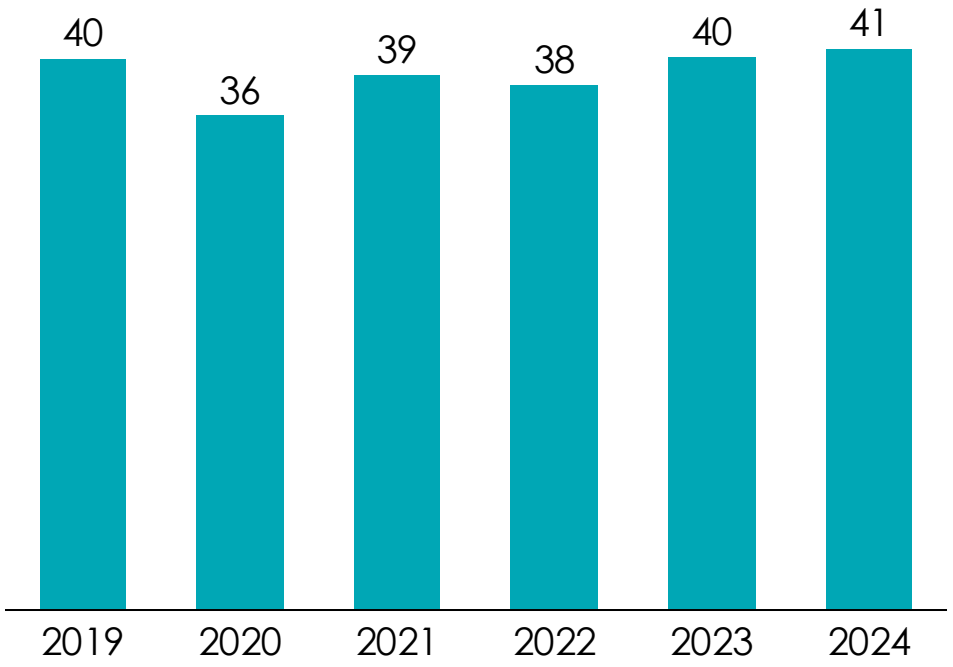
Sectoral breakdown of oil[1] consumption for 2022
Mb/d



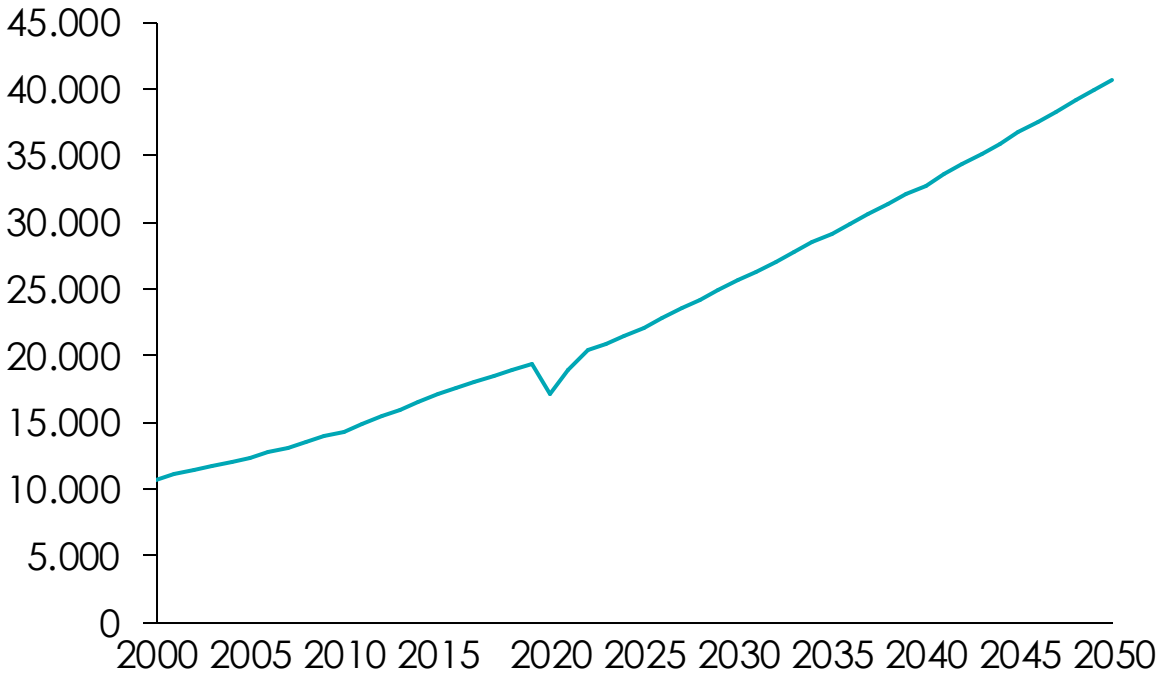
NOTE: All numbers are rounded. [1]Represents total liquids demand, including biofuels and processing gains from refineries; [2] Light and Medium Commercial Vehicles. [3] refining; [4] incl. Agriculture, mining etc; [5] incl. Non energy uses; assumed 90%/10% split for oil use in feedstock and energy for the petrochemicals sector, difference from bottom-up aggregation with reported total demand with IEA (2.8%) is equally allocated across sectors. Source: Systemiq analysis for the ETC; RystadEnergy (2022), Oil Market Transition Report 2022; IEA (2023), World Energy Outlook 2023; IEA (2023), Oil Market Report; IEA (2019), The Future of Petrochemicals.

Global oil consumption for road transport has been increasing, driven by overall increase in passenger kilometres travelled

Global oil consumption for road transport
Mb/d



Passenger vehicle km travelled per year - Shell
Billion passenger km



Source: BNEF (2024), *NEO;* Shell (2024), *Energy Security Scenarios*

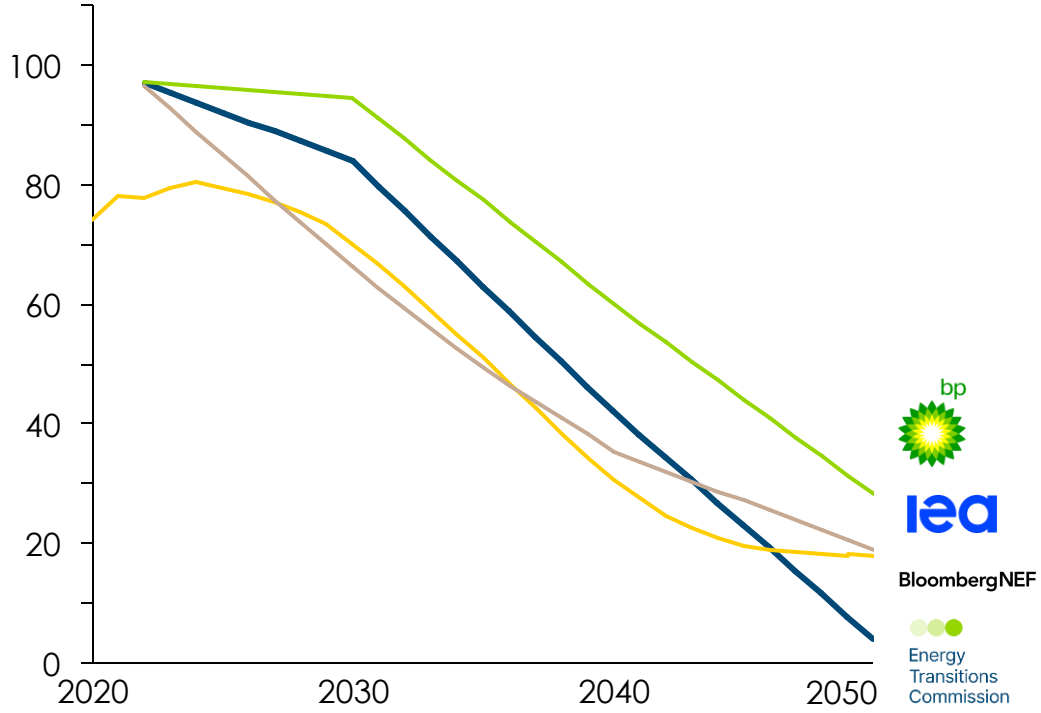
Descriptive scenarios highlight uncertainty around oil consumption outlook

Global view

Pre-read only

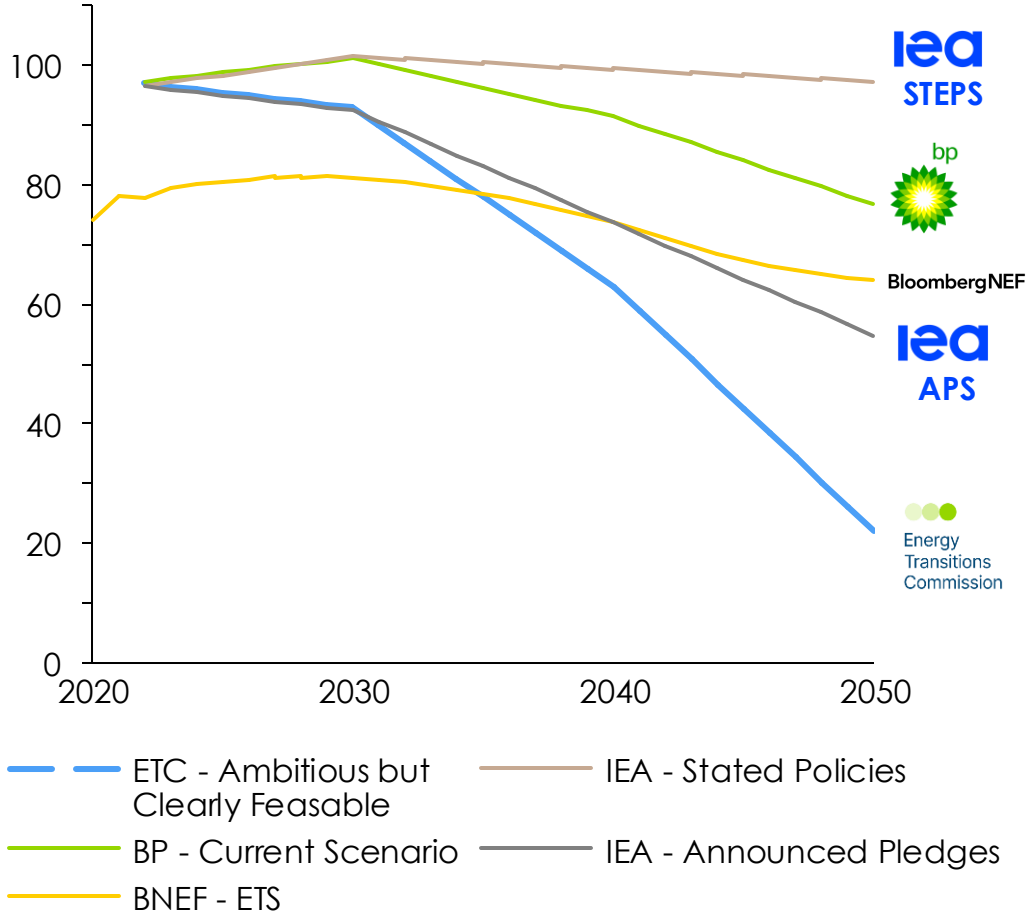
Oil consumption – normative scenarios

Mb/d



Oil consumption – descriptive scenarios

Mb/d

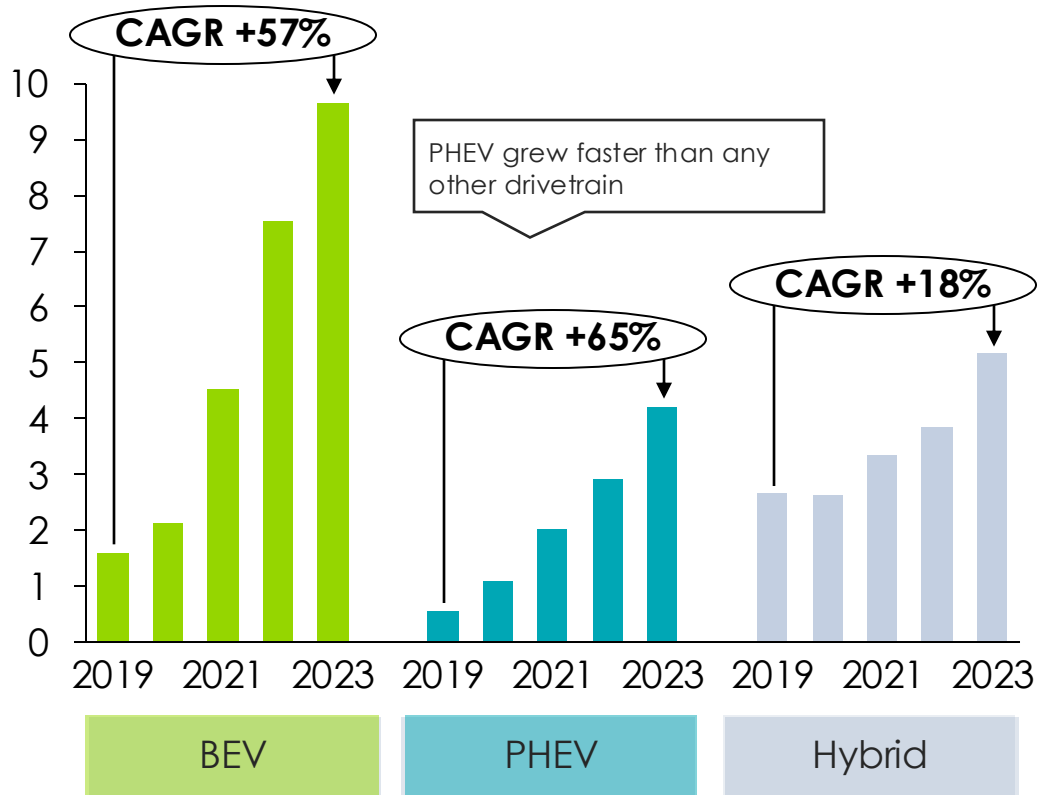


Source: ETC (2023), Fossil Fuels in Transition; BP (I2024), Energy Outlook; BNEF (2024), New Energy Outlook; IEA (2023), World Energy Outlook; Coal icon from Flaticon (2024), coal
Note: only BNEF data is on year-on-year basis, e.g. IEA goes from decade to decade.

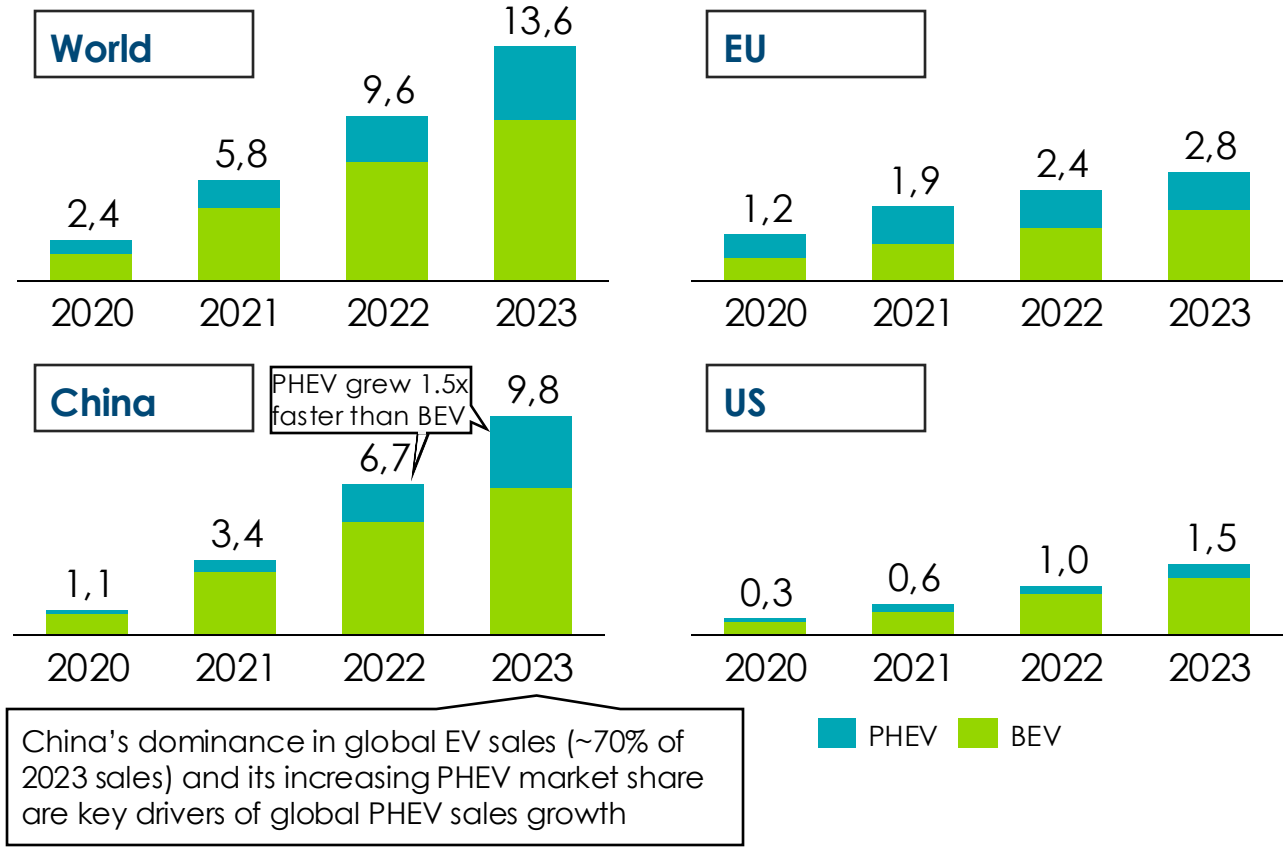
Plug-in hybrid EVs (PHEV) have been the fastest-growing segment, surpassing battery-electric EVs (BEV), driven by rising PHEV market shares in China

Global view
BEV vs PHEV growth

Global BEV, PHEV, and hybrid vehicle sales
Million vehicles sold



Share of new cars sold that are battery-electric and plug-in hybrid, 2020 to 2023
%



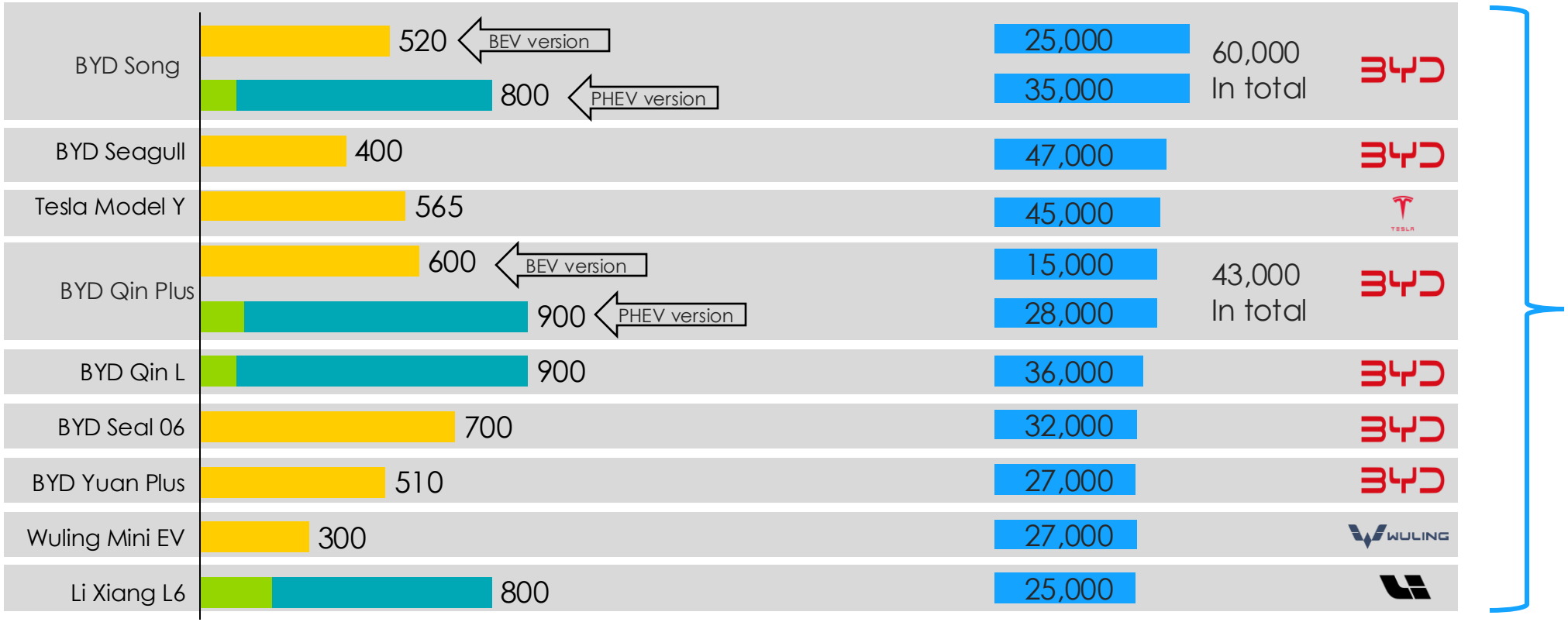
China's dominance in global EV sales (~70% of 2023 sales) and its increasing PHEV market share are key drivers of global PHEV sales growth

Source: BNEF (2024), *The Return of Plug-In Hybrids: Electric Mileage Is Key*; EV Volumes (2023), *Global BEV & PHEV Sales;* IEA (2024), *Global EV Outlook 2024*

PHEVs offer more versatile range utilization compared to BEV, but EV range increasingly close

Ranges of the most popular BEV and PHEV models
km

Sold models in August 2024
Number of sold vehicles x1000

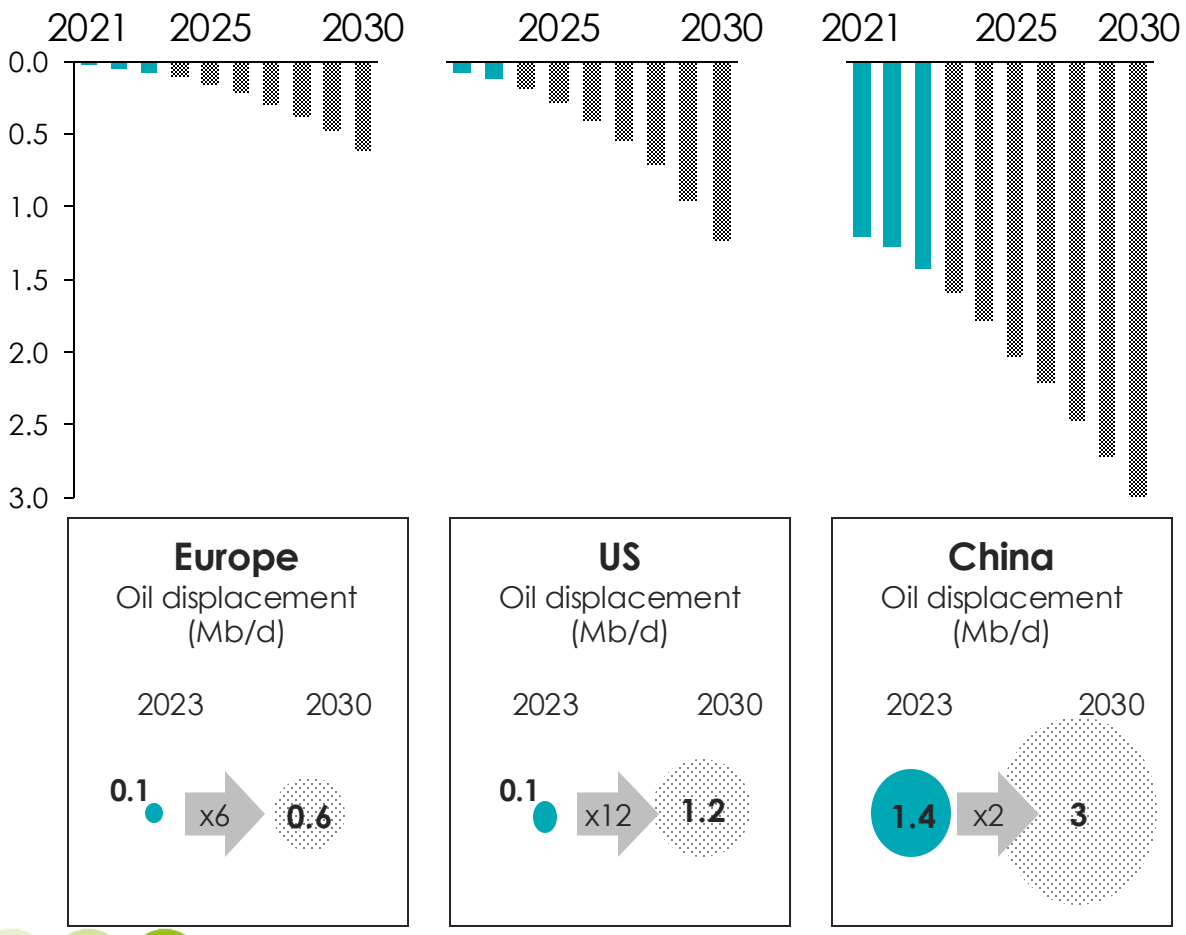


- 1/3 of all EVs sold in August 2024 in China

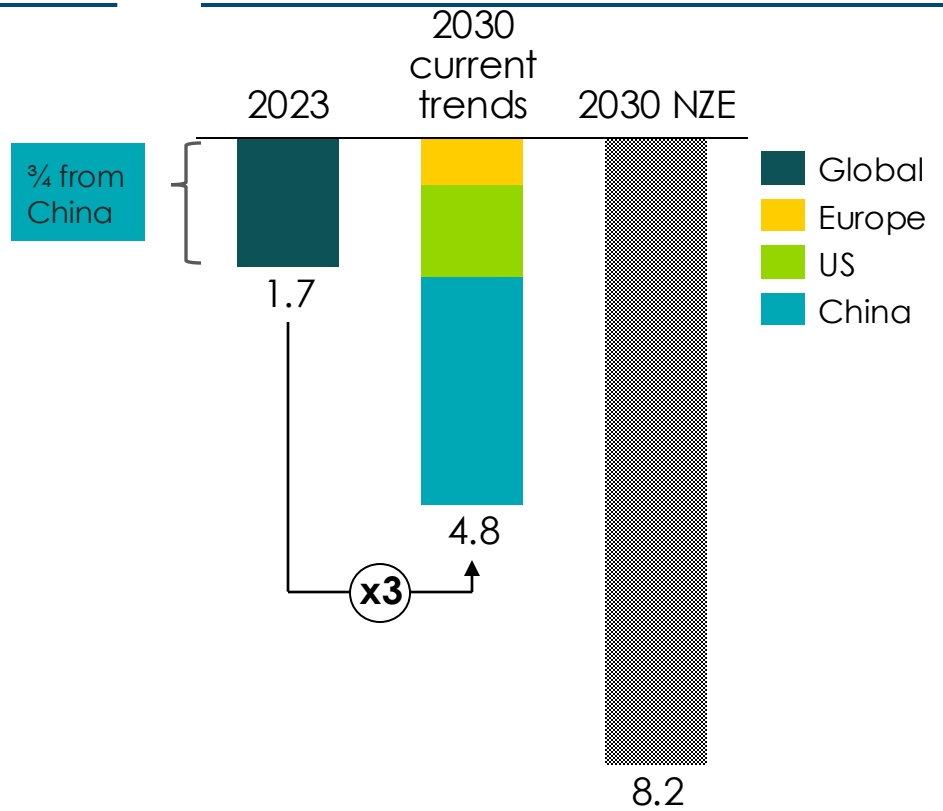
Source: BYD (2024); Tesla (2024); Wuling (2024), Li Xiang (2024); Photos from ML Truck (2023); Logos from company websites (2024)

Adoption of EVs already drive significant oil reduction, with China responsible for 75% of this shift

Regional: road fuel avoided by EV drivetrains per key regions, historic and expected
Mb/d



Global: road fuel avoided vs 2030 target
Mb/d



Source: BNEF (2024), *Long-Term Electric Vehicle Outlook 2024;* IEA (2024), *Electric Vehicles*

Long term trends continues to point light duty fully electric vehicles

- Even with small batteries – electric range of PHEVs, at ~100km, likely to satisfy most journey demand and lower emissions
- As battery costs continue to fall range and adoption of fuller/full EVs likely to increase, removing any remaining relative cost advantage of PHEV
- Innovation continues to focus on higher ranges and faster charging ranges, reducing consumer adoption barriers

Summary conclusions

Key Messages

- Despite strong pace of clean energy scale up – particularly solar and EVs – it is yet to reach some areas, with slow progress in heavy industry/mobility and low-carbon fuels like hydrogen and CCUS

- Fossil debate not won – despite agreement at COP, O&G sector not showing signs of phase-down. In short-term, increase in profitability and rush to LNG may suggest the opposite.

- Key regions such as EU and US are declining, not growing fossil use. However China, India showing ~5% growth.

- Convictions on coal point to decline – key data point will be China. Need to continue to phase out capacity in power / run flexibly.

- For gas, uncertainty remains about long-term role in power, buildings and industry.
  - Growing LNG market risks locking in uses where lower-carbon fuels may be cost competitive in the long terms (e.g. solar+batteries in power). In buildings and industry, policy will need to play a firmer role in reducing role for gas.
  - Risk of methane leakage, including in LNG, risks locking-in high emission fuel.

- For oil, passenger transport trend is clear: oil is already and will be displaced. Policy commitments should hold firm.