



15 IEA IEF OPEC Symposium on Energy Outlooks

IEF Outlooks Comparison Report

February 2025

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Overview

- Key Messages
- IEA and OPEC Short-, Medium-, and Long-Term Outlooks
- IEA and OPEC Outlooks in Context
- Reducing Uncertainty to Increase Energy Investment
- Sector Spotlight on Transport and Electricity
- Concluding Observations

An outlook is not a forecast

Feature	Scenario	Forecast
Definition	A hypothetical exploration of different possible futures	A prediction of the most likely future outcome
Purpose	Helps understand uncertainties and risks	Estimates a single or most probable outcome based on data and trends
Approach	Qualitative and quantitative; considers "what if" situations	Data-driven, using models, historical trends, and reasoned assumptions
Flexibility	Explores a range of potential futures governed by varied assumptions	Focuses on probable futures based on current conditions and evolving trends
Example	"What if total primary energy demand would decline?"	Prevailing trends show total primary energy demand grows

Outlooks have gained tremendous influence

Investment Decisions – Financial institutions use them to assess “stranded asset” risks

EU Green Deal & Fit for 55 – Incorporate aspects of net-zero outlook targets

Court rulings – Set a precedent for using scenario-based models in legal decisions

Outlook hypotheses influence real world events

Investment Decisions – **Defund**

EU Green Deal & Fit for 55 – **Deindustrialize**

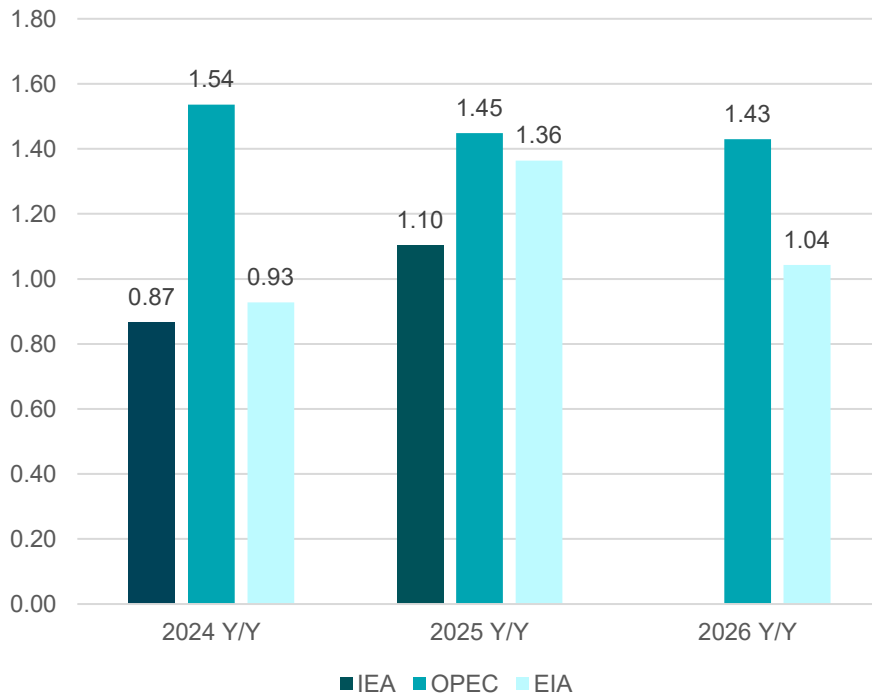
Court rulings – **Delegitimize**

IEA, EIA and OPEC Short-Term Forecast (February)

OPEC's global oil demand growth estimates remain highest but converge more in 2025. EIA is most bullish on 2025 supply

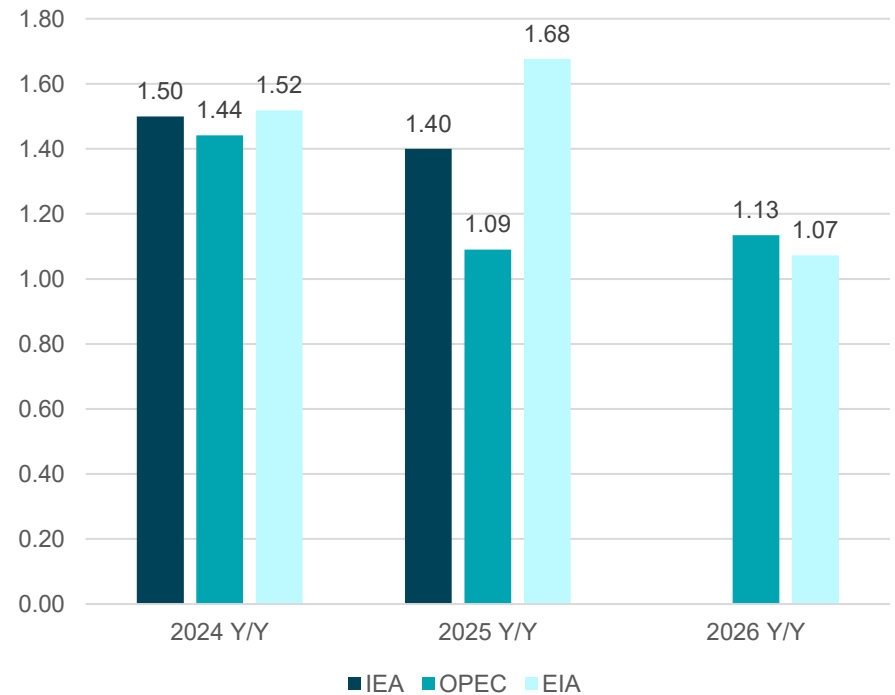
Global Demand Growth

y/y growth in million barrels per day



Non-DoC Supply Growth

y/y growth in million barrels per day



Source: IEF, IEA OMR Feb 2025, OPEC MOMR Feb 2025, EIA STEO Feb 2025.

Outlooks to 2030 Highlights (IEA and OPEC)

OPEC's Equitable Growth Scenario contrasts IEA's Net Zero Emissions and Announced Pledges Scenario assumptions on energy demand

IEA and OPEC Scenario Descriptions and Assumptions

IEA WEO 2024 Scenarios

Stated Policies Scenario (STEPS):

“This scenario provides a sense of the prevailing direction of travel for the energy sector based on a detailed reading of the latest policy settings in countries around the world.”

Announced Pledges Scenario (APS):

“This scenario starts from the same detailed reading of government policies but takes a different view on their implementation. The key difference is that this scenario assumes that all national energy and climate targets, including longer term net zero emissions targets and pledges in Nationally Determined Contributions, are met in full and on time.”

Net Zero Emissions by 2050 (NZE):

“This scenario portrays a pathway for the global energy sector to achieve net zero CO₂ emissions by 2050 which is consistent with limiting long-term global warming to 1.5 °C with limited overshoot (with a 50% probability).”

OPEC WOO 2024 Scenarios

Reference Case:

This scenario assumes the continued implementation of announced and enacted energy policies, to the extent that they are technically feasible and financially viable. In this scenario, all primary fuel types, except for coal, are expected to increase over the outlook period.

Technology-Driven Mitigation Scenario (TD):

This scenario presents an alternative approach to the prevalent emissions reduction narrative, which aims to limit the global temperature rise to well below 2°C. The scenario focuses on greater deployment of CCUS, hydrogen, and increased adoption of the Circular Carbon Economy (CCE). Within this framework, global oil demand is projected to stabilize at over 100 mb/d until around 2040, after which it is expected to taper to 96 mb/d in the final decade of the forecast period.

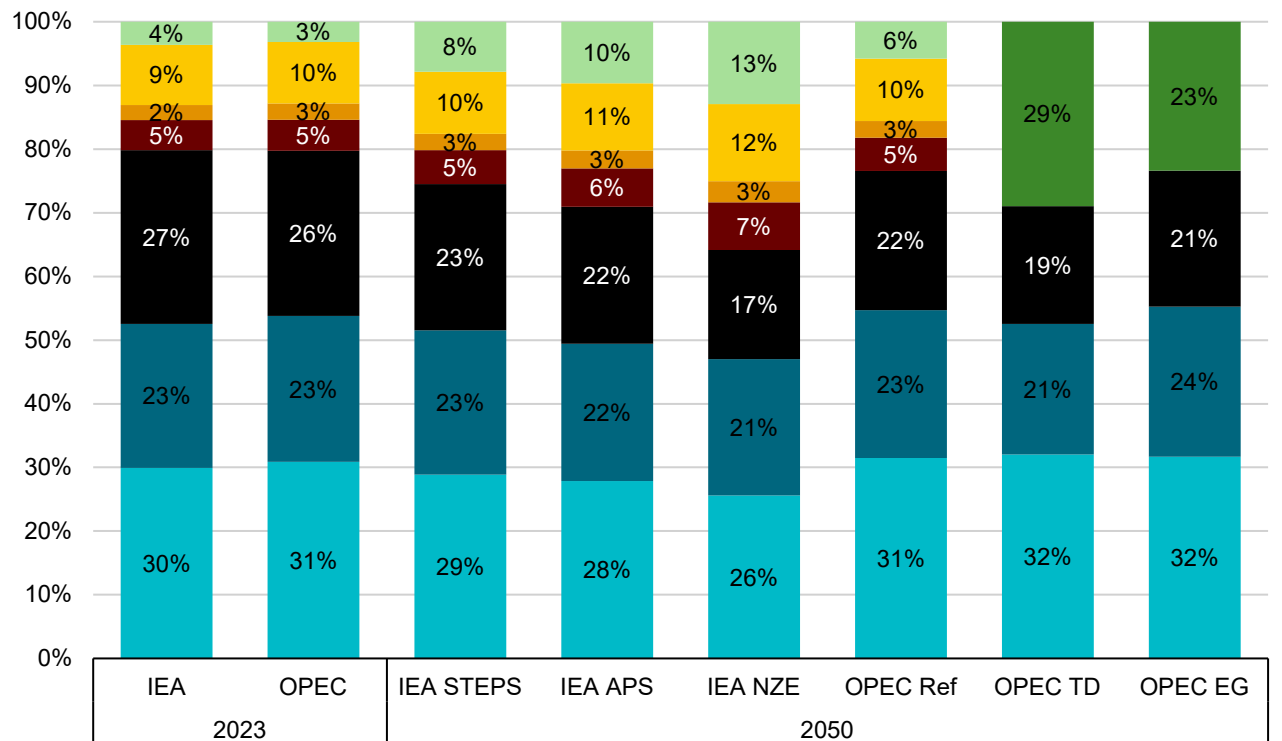
Equitable Growth Scenario (EG):

This scenario outlines a strategic framework aimed at fostering a fairer and more prosperous economic landscape for developing countries. It emphasizes a tailored approach to achieving emission reduction goals, considering the unique circumstances and timelines of each nation. Consequently, this framework anticipates an increase in overall energy consumption, with a specific rise in oil demand.

Fossil fuels' share of total primary energy demand projected to be between 64 and 77 percent by 2030

World Primary Energy Demand Outlook to 2030

Percent of total primary energy

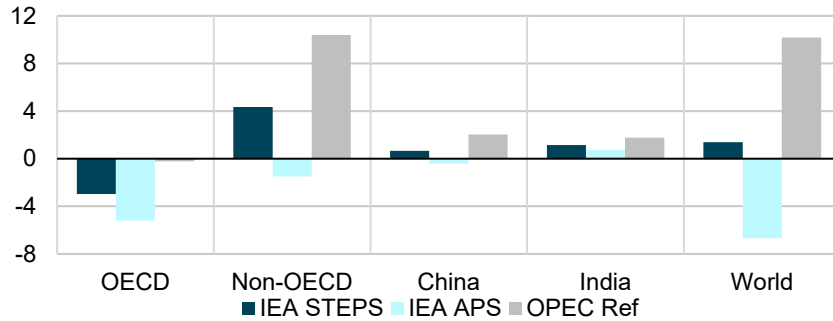


■ Oil ■ Gas ■ Coal ■ Nuclear ■ Hydro ■ Bioenergy ■ Other Renewables ■ Renewable and Nuclear (OPEC TD & EG)

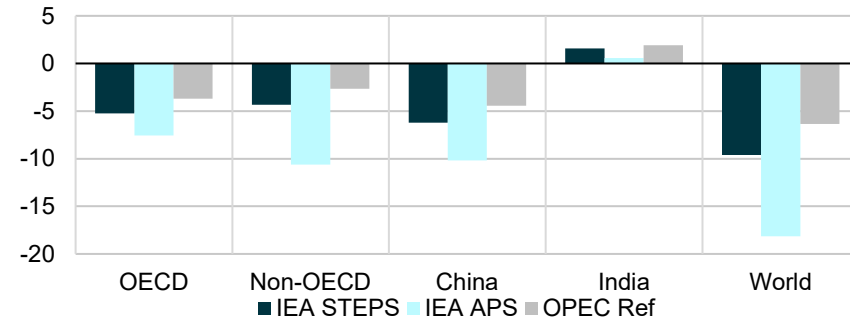
Reference and evolving policy scenarios show primary energy demand grows to 2030

All scenarios show declining OECD demand for oil, gas, and coal by 2030, while non-OECD oil and gas demand grows

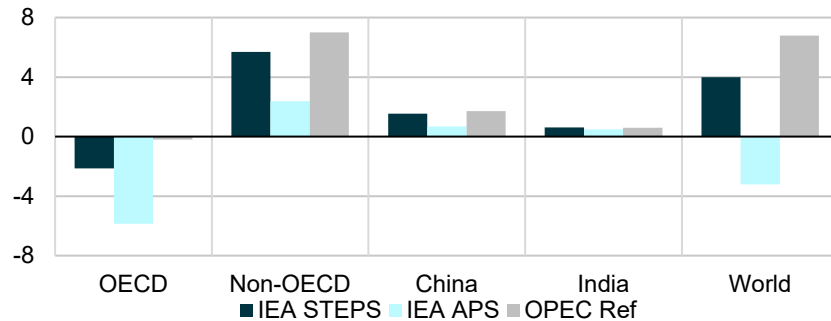
Change in Oil Demand: 2030 vs. 2023



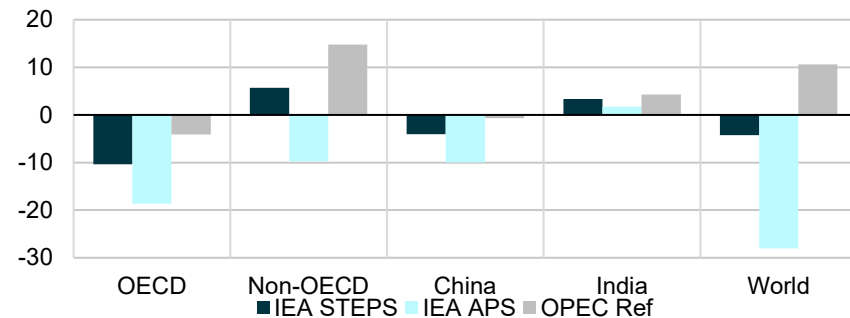
Change in Coal Demand: 2030 vs. 2023



Change in Natural Gas Demand: 2030 vs. 2023



Change in Fossil Fuel Demand: 2030 vs. 2023



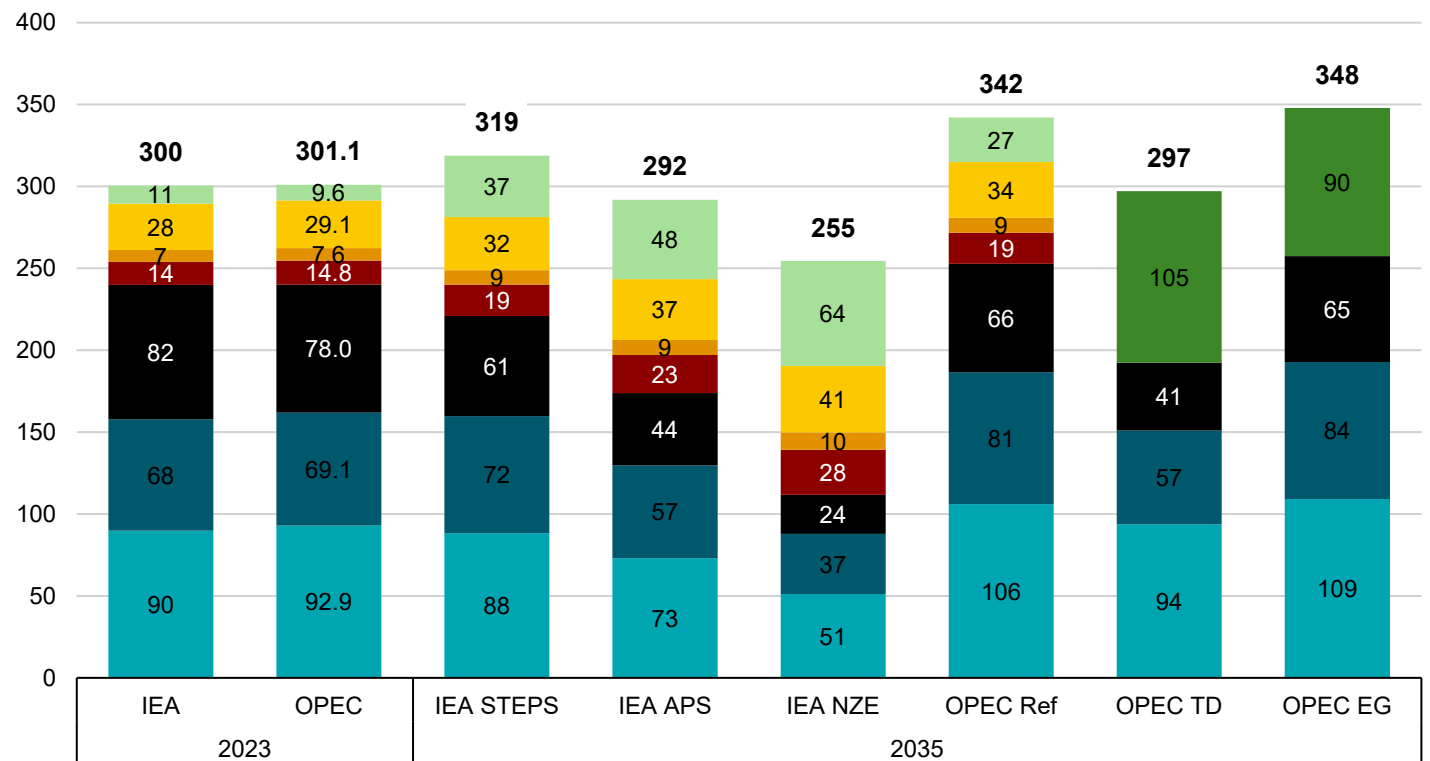
India's fossil fuel demand grows in all cases

Outlooks to 2035 Highlights (IEA and OPEC)

Global primary energy demand increases by 8 mboe/d on average across scenarios compared

World Primary Energy Demand Outlook to 2035

Million barrels of oil equivalent per day



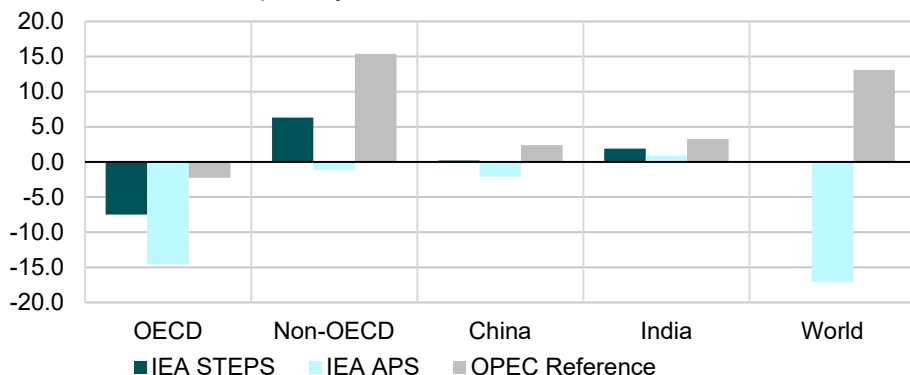
Oil Gas Coal Nuclear Hydro Bioenergy Other Renewables Renewable and Nuclear (OPEC TD & EG)

The OPEC EG scenario show the highest upward growth in contrast to the IEA's APS and NZE scenarios that show world primary energy demand to decline

OPEC sees growth in global fossil fuels by 2035, driven by oil and gas, despite a decline in the demand for coal

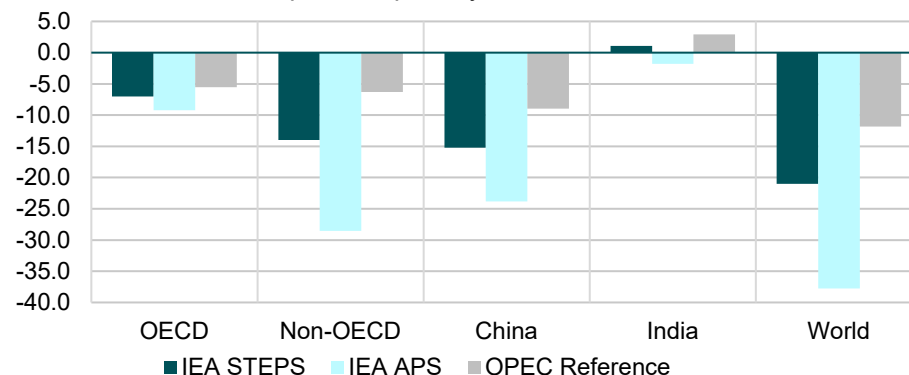
Change in Oil Demand: 2035 vs. 2023

Million barrels of oil per day



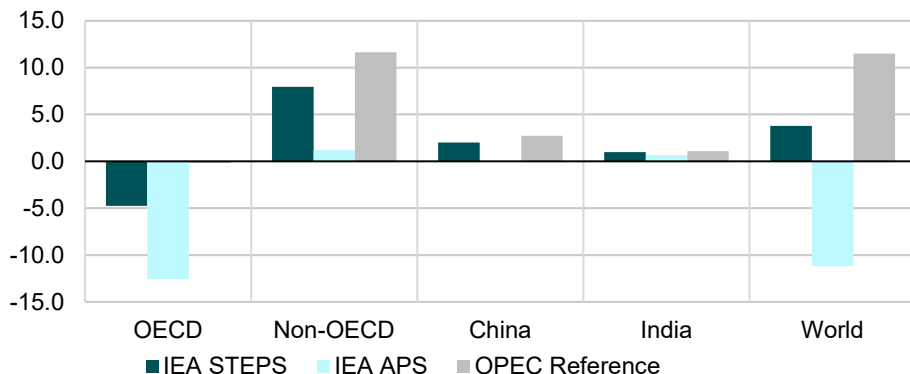
Change in Coal Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



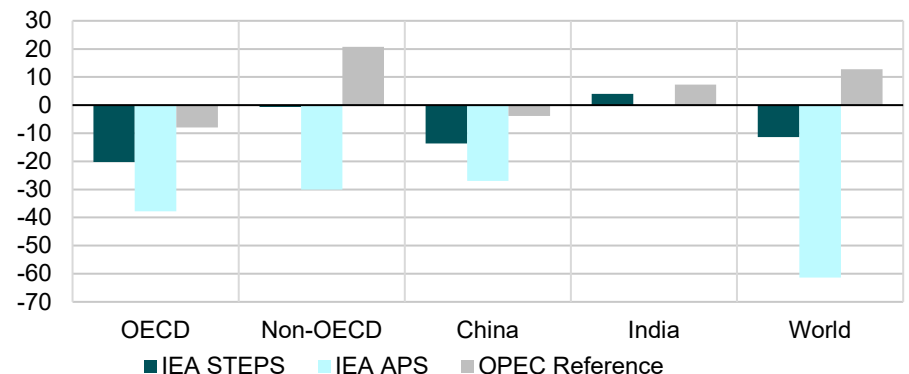
Change in Natural Gas Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



Change in Fossil Fuel Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



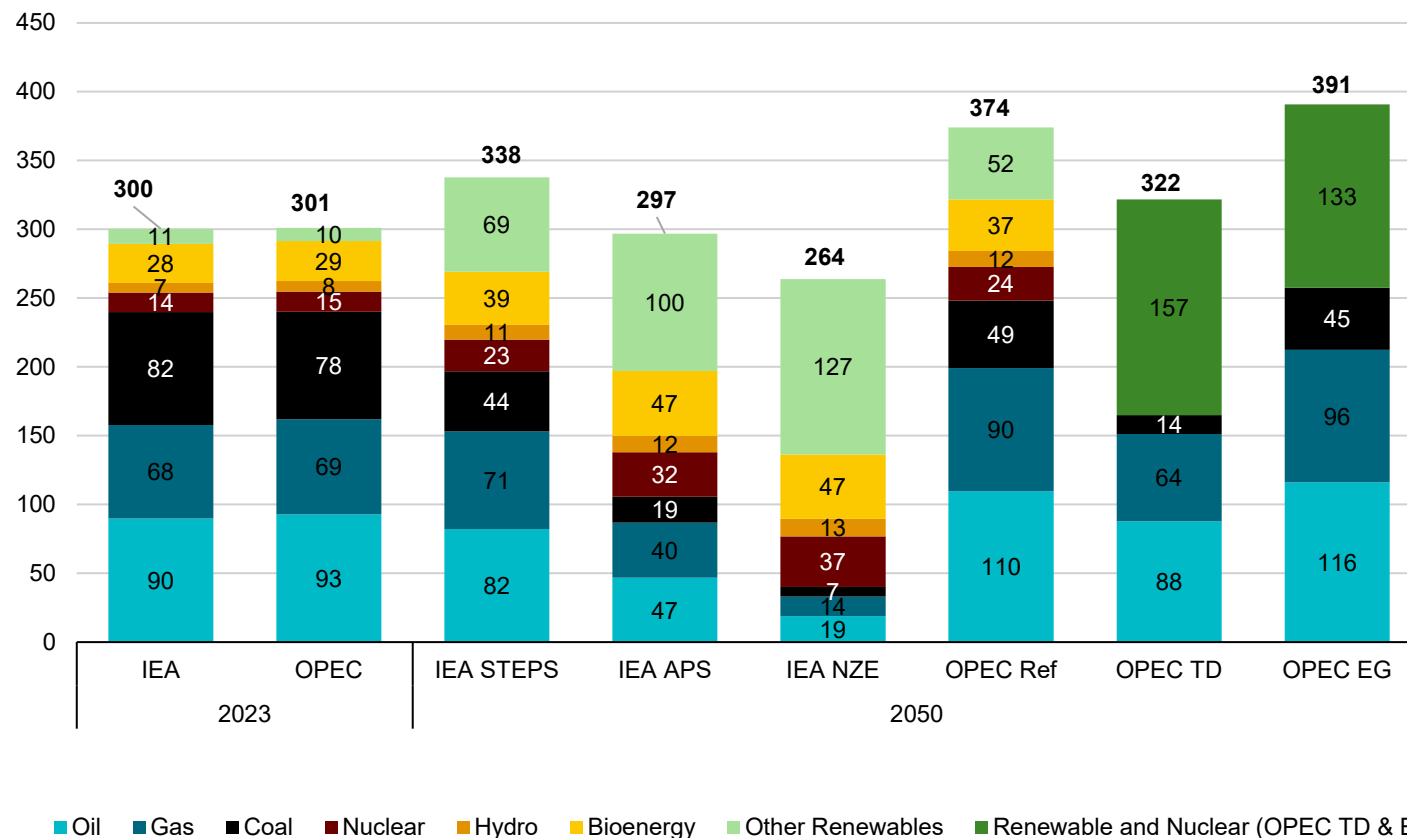
IEA STEPS and APS scenarios see large reductions in oil, natural gas, and coal demand

Outlooks to 2050 Highlights (IEA and OPEC)

Renewables and nuclear soar to meet global primary energy demand growth of up to 90 mboe/d by 2050

World Primary Energy Demand Outlook to 2050

Million barrels of oil equivalent per day

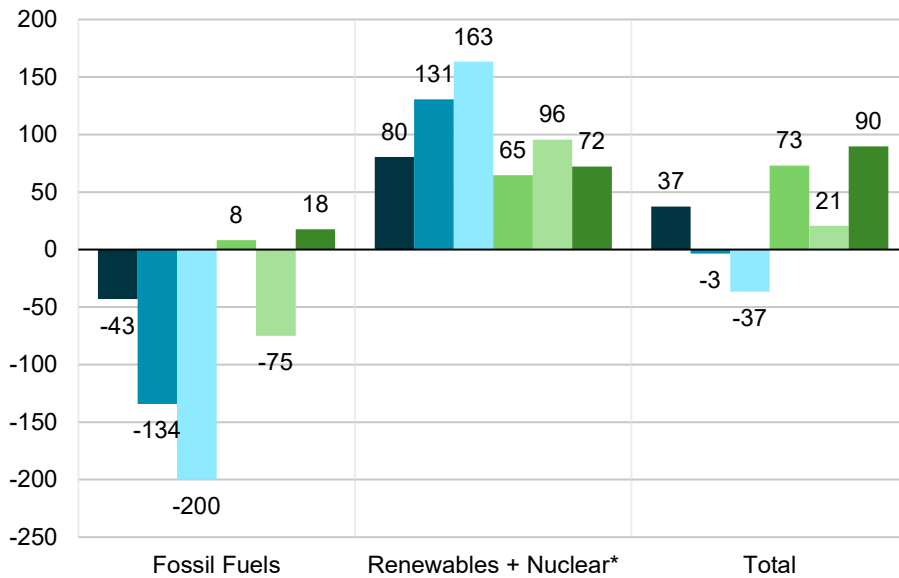


Coal demand is projected to decrease dramatically by 2050 compared to current demand in Paris aligned scenarios

The sharp reduction in coal consumption drives diminishing fossil fuel demand to 2050

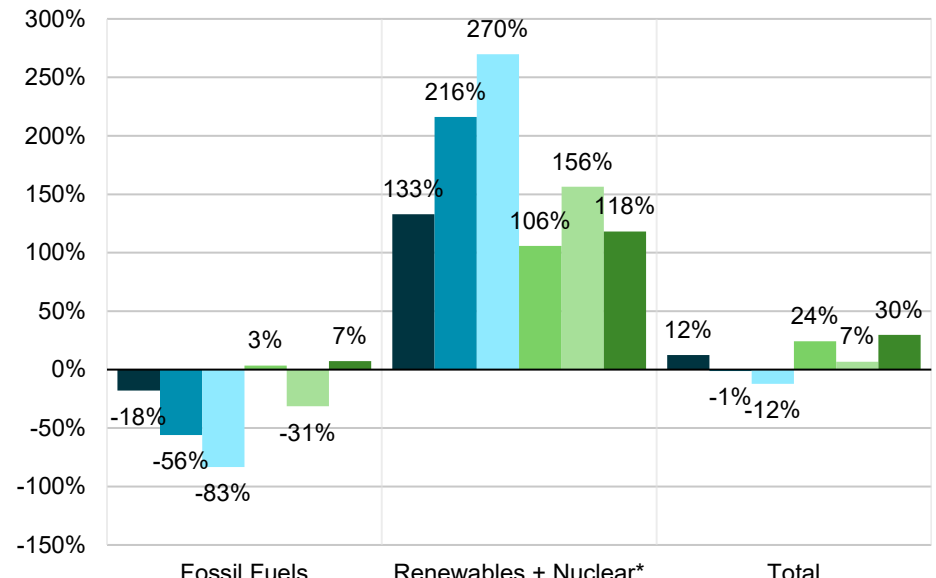
Change in World Primary Energy by Source: 2050 vs 2023

Million barrels of oil equivalent per day



World Primary 2050 vs. 2023

% change by energy source



■ IEA STEPS ■ IEA APS ■ IEA NZE ■ OPEC Ref ■ OPEC TD ■ OPEC EG

■ IEA STEPS ■ IEA APS ■ IEA NZE ■ OPEC Ref ■ OPEC TD ■ OPEC EG

Only the OPEC Reference and Equitable Growth Scenario see fossil fuel demand increase

IEA and OPEC Outlooks in Context of other Scenarios

The number and variety of outlooks has increased

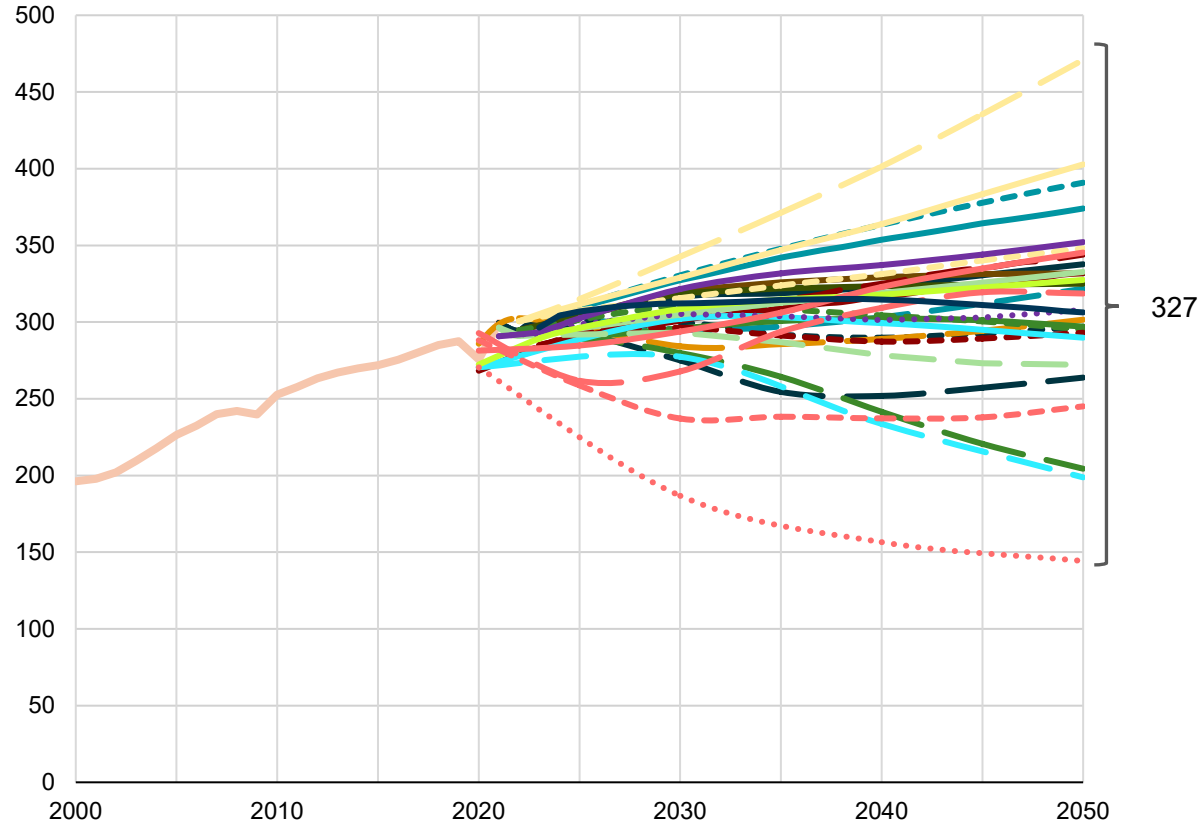
Additional Scenario Descriptions and Assumptions

Total	Trends**	The Trends scenario projects a global temperature increase of 2.6-2.7°C by 2100, incorporating current technological and policy trajectories.	GECF	Reference (RCS)**	Projects the most likely path for global energy and gas markets through 2050, based on current trends and assuming continuation of present economic and demographic patterns.
	Momentum**	Integrates decarbonization strategies of NZ50 countries and others' NDCs.		Sustainable Energy Scenario (SES)*	Emphasizes natural gas's potential to address energy poverty, promote economic growth, and contribute to environmental protection through decarbonization, highlighting its role as an affordable, reliable, and cleaner energy source.
	Rupture*	Aims to limit global temperature rise through aggressive global decarbonization efforts.			
BP	Current Trajectory**	In this scenario, greenhouse gas emissions, measured in carbon dioxide equivalents (CO ₂ e), reach their highest point in the mid-2020s and subsequently decrease to approximately 75% of 2022 levels by 2050.	IEEJ	Reference**	Mirrors historical patterns in technological advancements and existing energy strategies, without implementing bold initiatives for carbon reduction measures.
	Net Zero*	The Net Zero scenario envisions a substantial strengthening of environmental regulations.		Advanced Technology (ATS)*	Energy and environmental technologies are feasible and fully implemented.
EIA	Reference**	Reflects current energy trends and existing laws and regulations. Assumes global GDP growth averages 2.6% from 2022-2050.	IPCC AR6 WGIII	ModAct**	NDCs are implemented. Current trajectory leads to >2°C warming.
	High and Low Economic Growth**	The High Economic case assumes global GDP growth for 2022-2050 averages 3.4% while the low case assumes 1.8%.		IMP-Neg (2C)*	Limits warming to 2C with a higher reliance on net negative emissions.
				IMP-Ren (1.5)*	Limits warming to 1.5C with greater emphasis on renewables.
				IMP-LD (1.5)*	Limits warming to 1.5C with greater emphasis on demand reduction.
Equinor	Walls**	Current trends in the market, technology, and policies show that the energy transition is accelerating slowly but is not reaching climate goals.	IRENA	Planned**	Reference case based on planned targets and government policies.
	Bridges*	Broadly consistent with IPCC 1.5°C.		1.5-S*	Describes an energy transition pathway aligned with a 1.5C climate goal. It prioritizes readily available technology solutions that can be scaled up.
Exxon	Reference**	Current trends in market, technology and policies.	Shell	Archipelagos**	Global sentiment shifts away from managing emissions and towards energy security. Emissions fall throughout the century, but net zero is not achieved by 2100.
DNV	Reference**	Current trends in market, technology and policies.		Sky 2050*	Achieves net zero emissions by 2050 and limits global warming to 1.5C by 2100.
EnerData	Reference**	Current trends in market, technology and policies.			

The amplitude of energy demand projections increases each year as alternative views emerge and emission targets near

Total Primary Energy Demand Scenarios Through 2050

Mboe/d



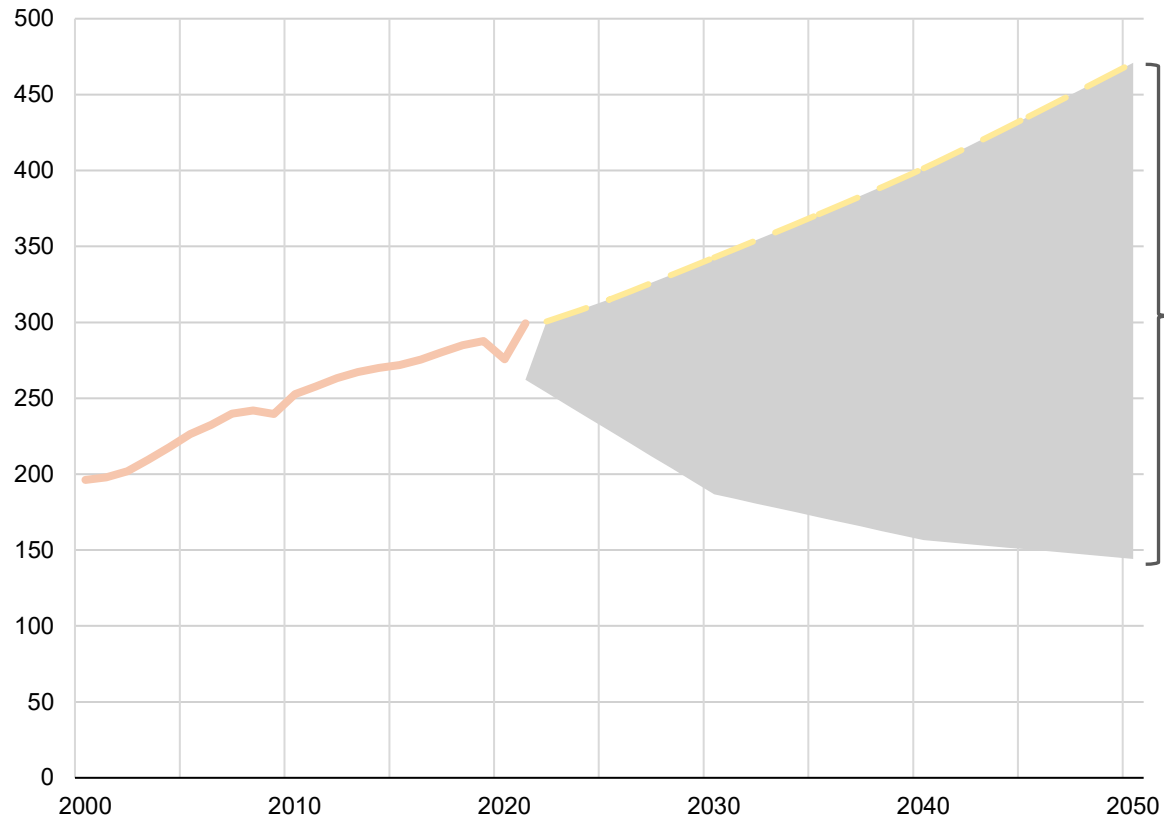
- History
- IEA STEPS
- IEA APS
- IEA NZE
- OPEC Reference
- OPEC TD
- OPEC EG
- IRENA 1.5-S
- BP Current Trajectory
- BP Net Zero
- Total trends
- Total momentum
- Total rupture
- GECF RCS
- GECF SES
- Enerdata
- Equinor Walls
- Equinor Bridges
- IEEJ Reference
- IEEJ ATS
- EIA Reference
- EIA High Econ Growth
- EIA Low Econ Growth
- Shell Archipelagos
- Shell Sky 2050
- Exxon
- IPCC ModAct (3C)
- IPCC IMP-Neg (2C)
- IPCC IMP-Ren (1.5C)
- IPCC IMP-LD (1.5C)
- DNV

Energy demand projections diverge by around ± 35 percent of current global demand

Considering that outlooks frame energy policy and market sentiment, this opens a widening uncertainty gap

Total Primary Energy Demand Scenarios Through 2050

Mboe/d



- History
- IEA STEPS
- IEA APS
- IEA NZE
- OPEC Reference
- OPEC TD
- OPEC EG
- IRENA 1.5-S
- BP Current Trajectory
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- IPCC ModAct (3C)
- IPCC IMP-Neg (2C)
- IPCC IMP-Ren (1.5C)
- IPCC IMP-LD (1.5C)
- DNV
- Average

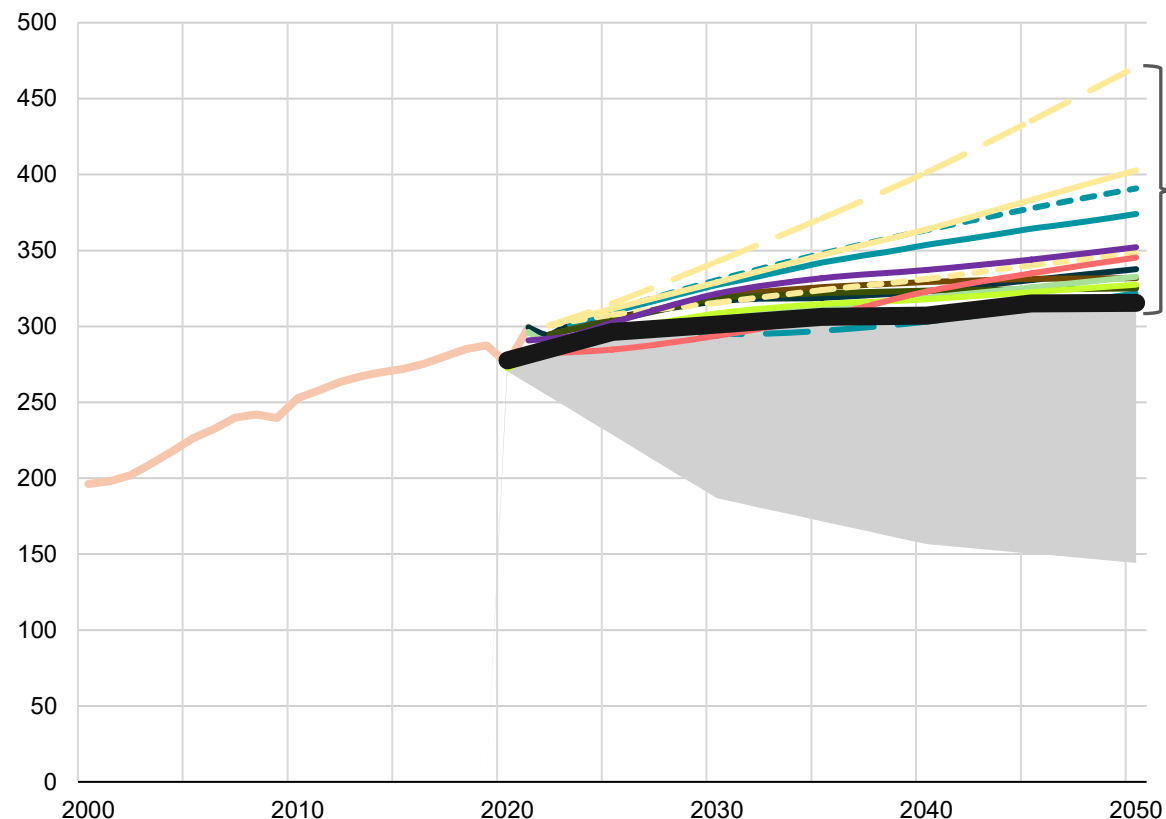
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Energy sector investment and trade opportunities, avoided or lost

Discounting scenarios with highly improbable assumptions narrows the uncertainty gap and improves predictability

Total Primary Energy Demand Scenarios to 2050

Mboe/d



- History
- IEA STEPS
- IEA APS
- IEA NZE
- OPEC Reference
- OPEC TD
- OPEC EG
- IRENA 1.5-S
- BP Current Trajectory
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- IEEJ ATS
- EIA Reference
- EIA High Econ Growth
- EIA Low Econ Growth
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- Shell Sky 2050
- Exxon
- IPCC ModAct (3C)
- IPCC IMP-Neg (2C)
- IPCC IMP-Ren (1.5C)
- IPCC IMP-LD (1.5C)
- DNV
- Average

Energy sector investment and trade opportunities gained

Reducing the widening uncertainty gap between scenarios improves energy security and benefits all

1. Today's **wide array of scenario projections** reflects **stakeholder preferences** and more **polarized views** on energy and climate policy objectives
2. **Dueling hypotheses** or “out of the box” trends **grab headlines** and **frame real world decisions** impacting energy investment and technology choices as well as energy prices and resiliency.
3. **Unprecedented levels of cooperation among governments and across sectors is vital** to secure affordable and clean energy access and safeguard inclusive and sustainable growth.
4. **Dialogue on assumptions and relating outcomes to prevailing trends** enhances **the utility of outlooks to reduce uncertainty and remove hurdles** for global energy needs.

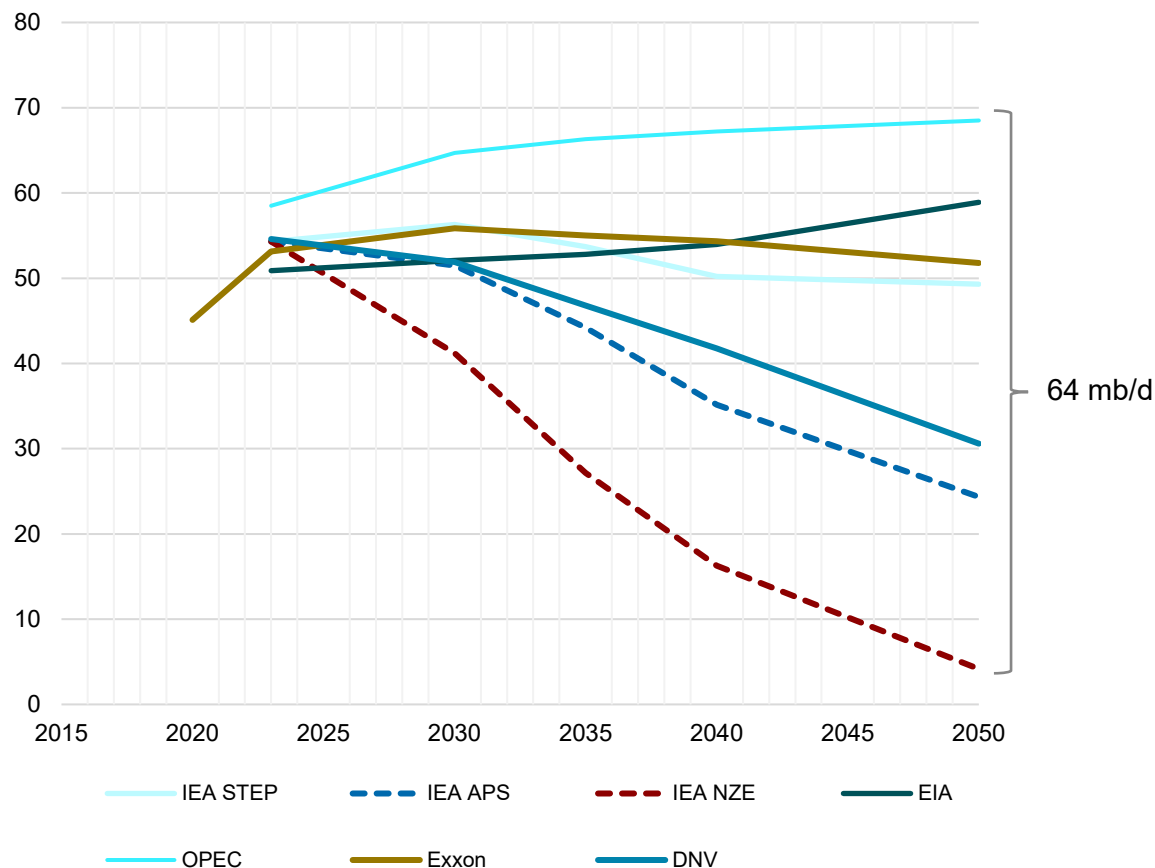
Sector Spotlight

Transport

Transportation is the key sector that will influence oil demand in the future

Global Oil Demand in the Transportation Sector

Million barrels of oil per day



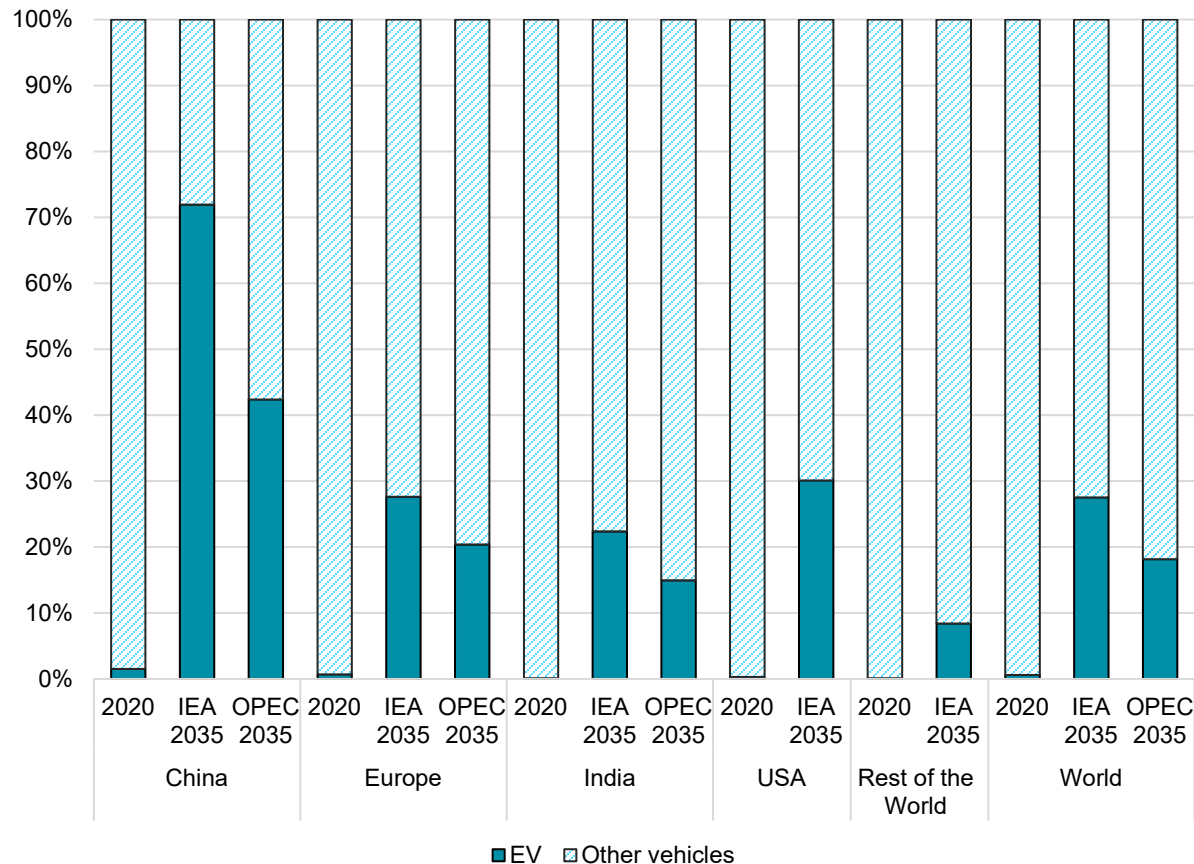
- The uncertainty surrounding transportation demand projections is evident, as the expected variance by 2050 surpasses 60 mb/d, which is almost equivalent to the current consumption within this sector.
- Only the EIA, Exxon and OPEC Reference Cases show transport sector oil demand increase and or plateau relative to the average levels of 2023, while others show oil demand trajectories decline.

Source: IEF, IEA WEO 2024, OPEC WOO 2024, EIA IEO 2023, DNV's Energy Transition Outlook 2024, and ExxonMobil Global Outlook 2024. Note: OPEC statistics, including liquid fuels.

Electrification within the transport sector

Electric Vehicle Penetration per 1000 Inhabitants

Percentage of total cars in use



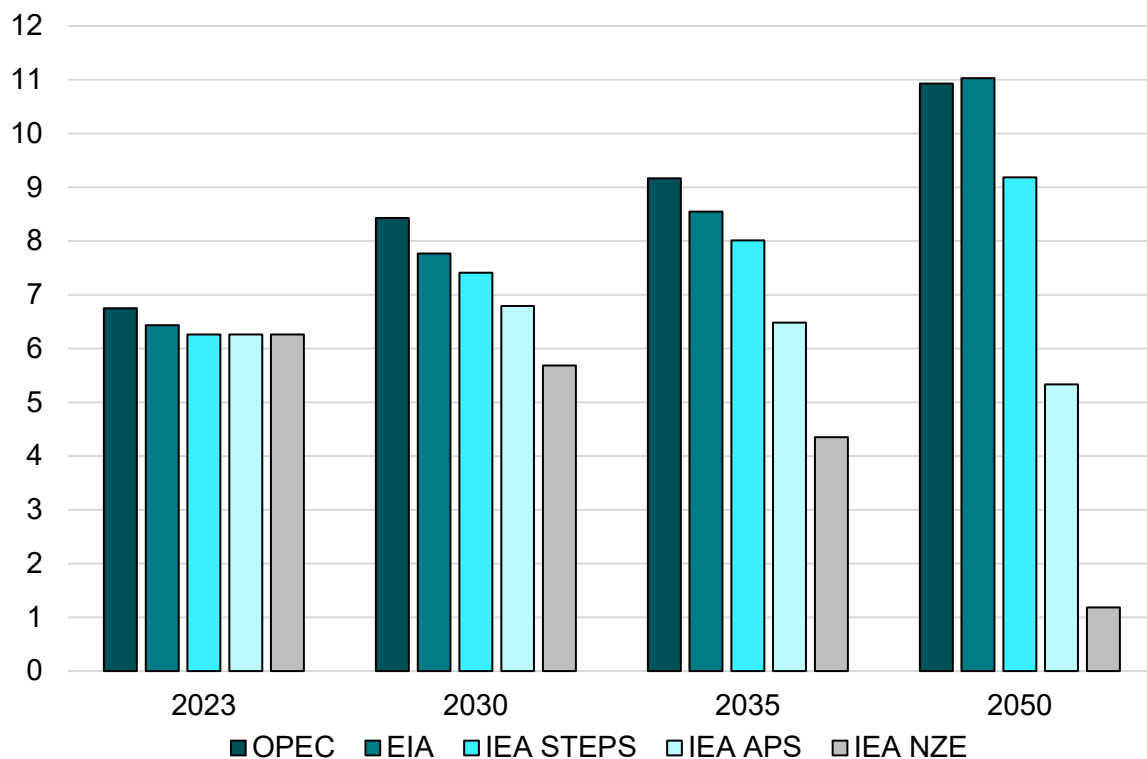
- The penetration of Electric Vehicle (EV) is projected to reach, on average, approximately 23 percent of global cars in use by 2035, but this growth will be concentrated in a limited number of countries and regions.
- EV penetration will largely be concentrated in China (on average, 57 percent of passenger cars in use per 1000 inhabitants), the US (30 percent), and the EU (28 percent).
- In countries experiencing the most significant economic and population growth, EV penetration will range from less than one percent in 2020 to less than 8 percent in 2035.

Sources: IEF, IEA – Stated Policies Scenario-EV sales, OPEC World Oil Outlook 2024, International Organization of Motor Vehicle Manufacturers (OICA), and UN population statistics.
 Note: IEA's EV category refers to all electric vehicles, including battery electric vehicles, fuel cell electric vehicles, and plug-in hybrid electric vehicles. The estimates assume that all electric vehicles sold before 2035 will still be in use. Projected EV data disaggregated for the US and the rest of the world is not available from OPEC.

Oil demand within the transportation sector

Aviation Demand

Million barrels of oil per day



- Projections from the IEA, OPEC, and EIA indicate sustained oil demand growth in the aviation sector.
- Despite converging oil demand trends between reference and evolving policy scenarios, gaps widen. The difference between the highest and lowest forecasts by 2050 is 1.6 times current aviation sector oil demand.

Note: The IEA presents data for aviation and shipping together. To enable comparison proportions from the world's final consumption, data by transport mode have been used to disaggregate these statistics. Note: OPEC statistics, including liquid fuels.

Source: IEF, IEA WEO 2024, OPEC WOO (Reference Case) 2024, and EIA IEO 2023.

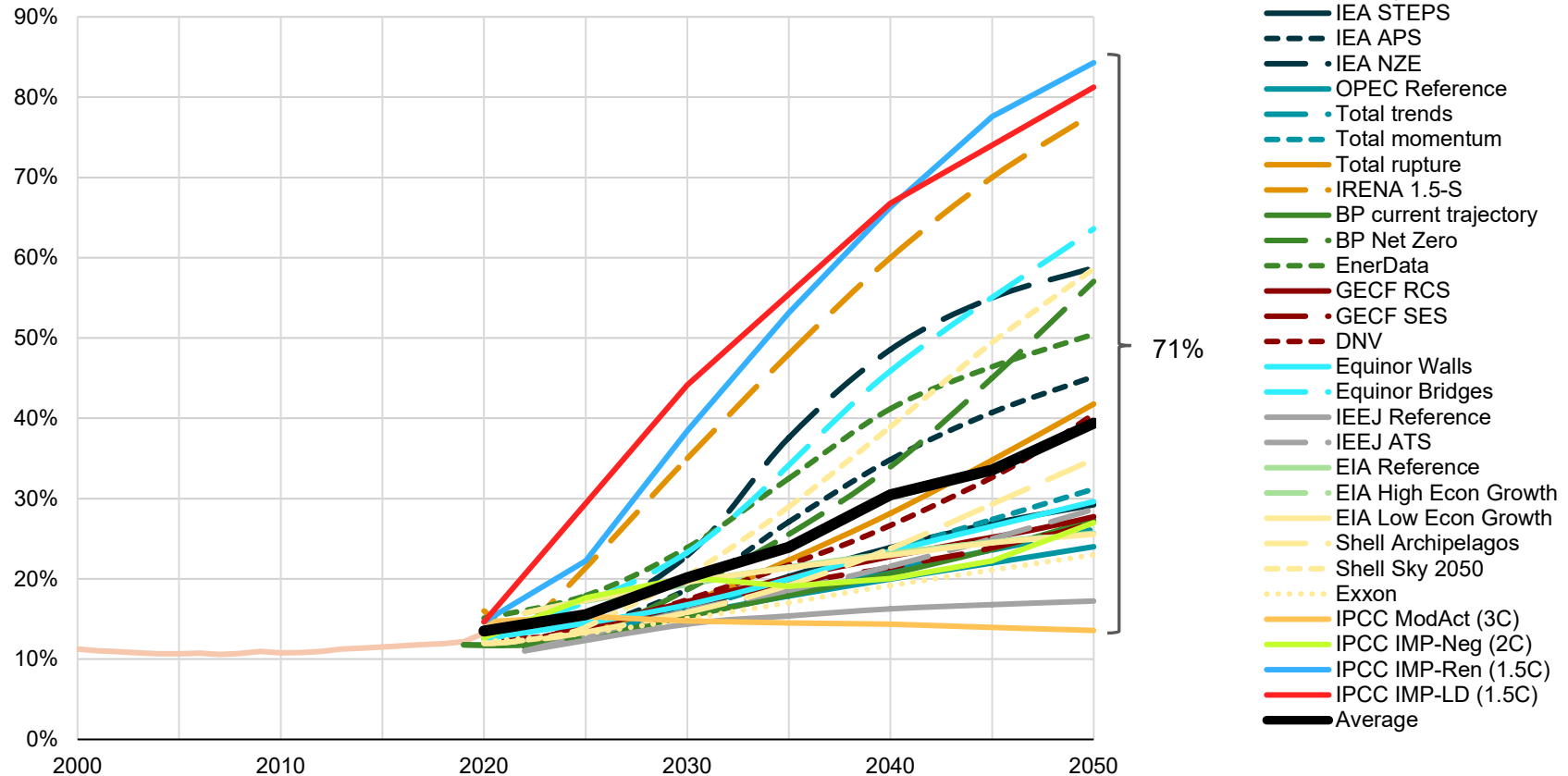
Sector Spotlight

Electricity

Ambitious projections show renewable energy demand doubling by 2050 compared to other scenarios

Renewable Demand Share of Total Primary Energy Demand Scenarios to 2050

Share of Primary Energy Demand

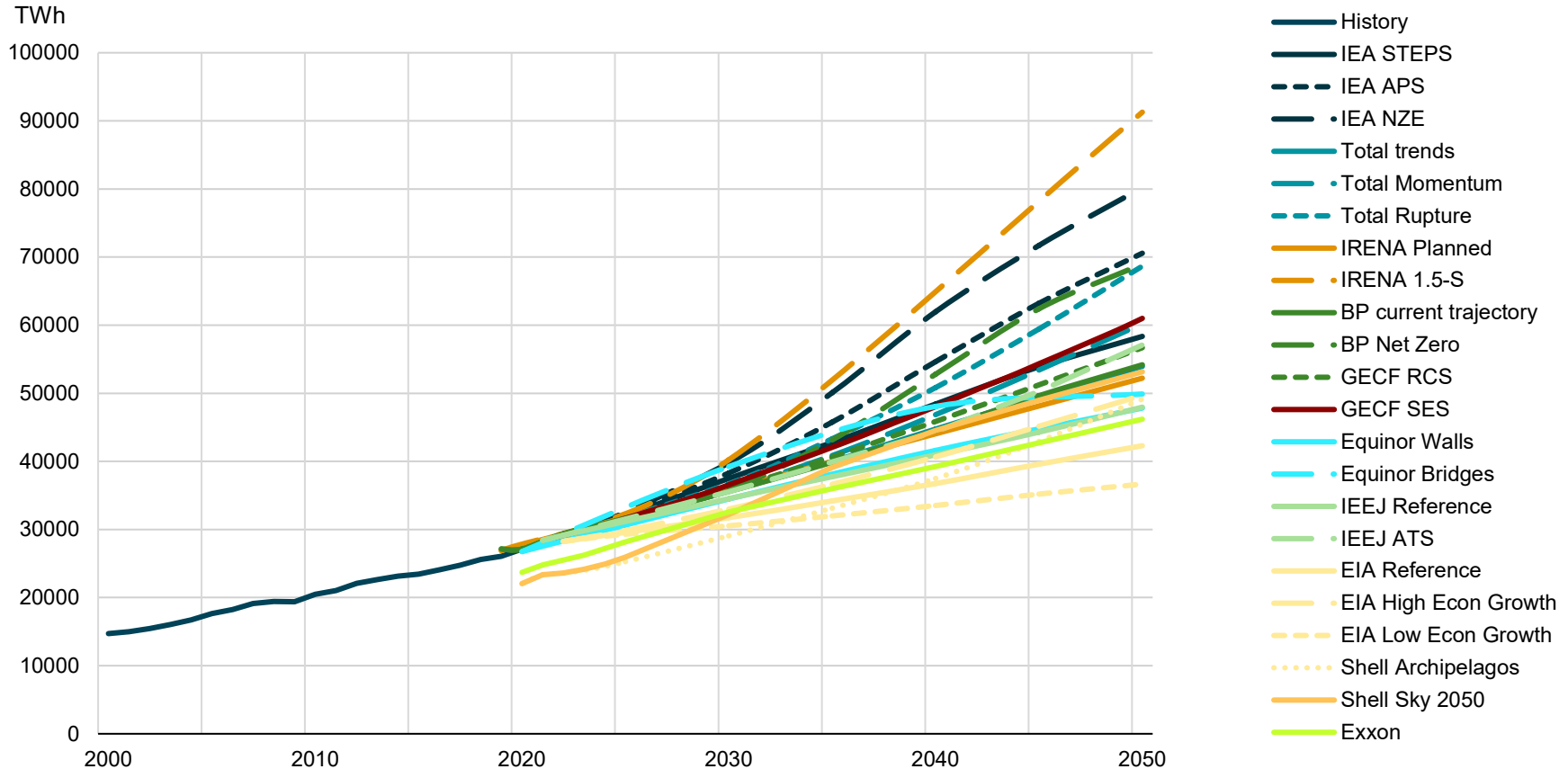


Notes: Renewables includes wind, solar, geothermal, modern and traditional bioenergy. EIA includes hydro.

Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, EnerOutlook 2050, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and IPCC AR6.

Electricity generation is expected to double by 2050, relative to 2023 levels

Electricity Generation Scenarios Through 2050



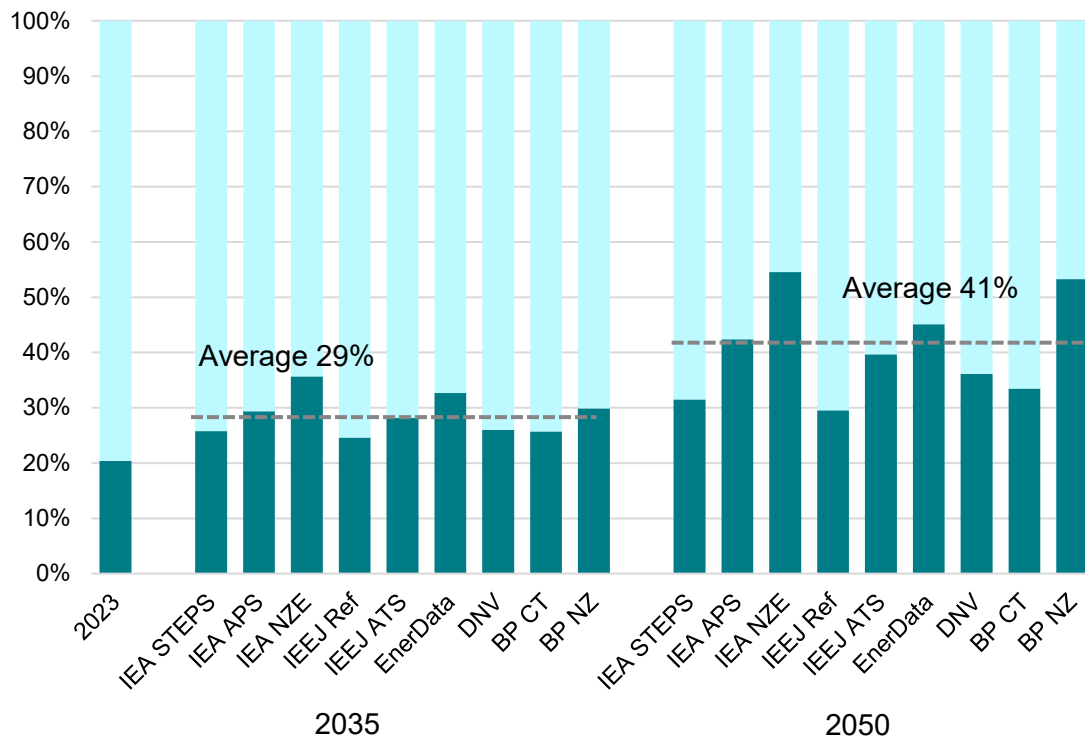
Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, and ExxonMobil Global Outlook 2024.

Electricity consumption may account for more than 40 percent of the total final energy consumption by 2050

Electricity Consumption

% of total final energy consumption

■ Electricity ■ Others



- The share of electricity in total final energy consumption globally is projected to nearly double by 2050, driven by several factors, including growing power demand for data centers, cooling and electrification.
- Ambitious climate scenarios project a significant increase in electricity's share of total final energy consumption, reaching more than 50 percent by 2050, while reference scenarios expect this rise from 20 to around 30 percent.

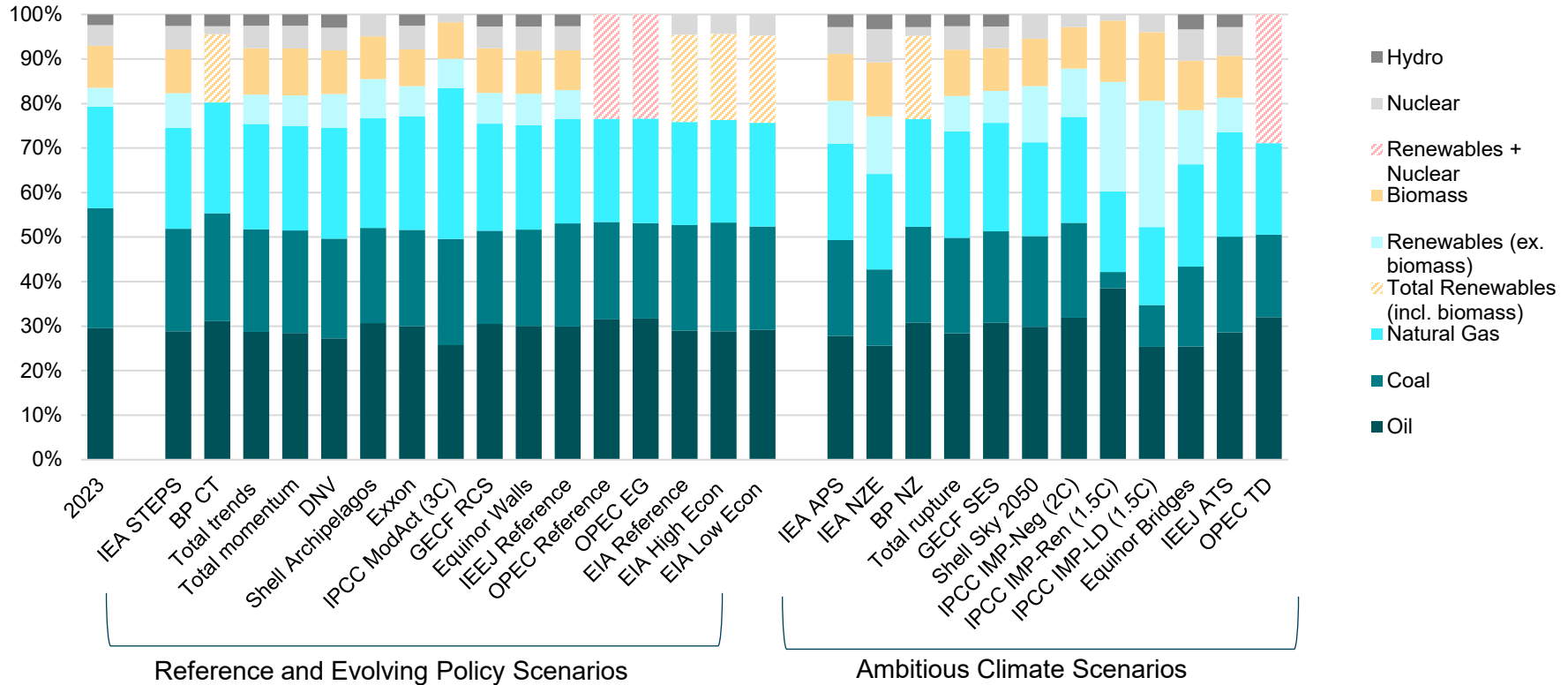
Source: IEF, IEA WEO 2024, IEEJ Outlook 2024, EnerOutlook 2050, DNV's Energy Transition Outlook 2024, and BP Energy Outlook 2024.

Concluding Observations on Scenario Projections

Ambitious scenarios project a ~10 percent increase in the share of renewables in total primary energy demand within 5 years

Primary Energy Demand Mix in 2030

% of total primary energy demand

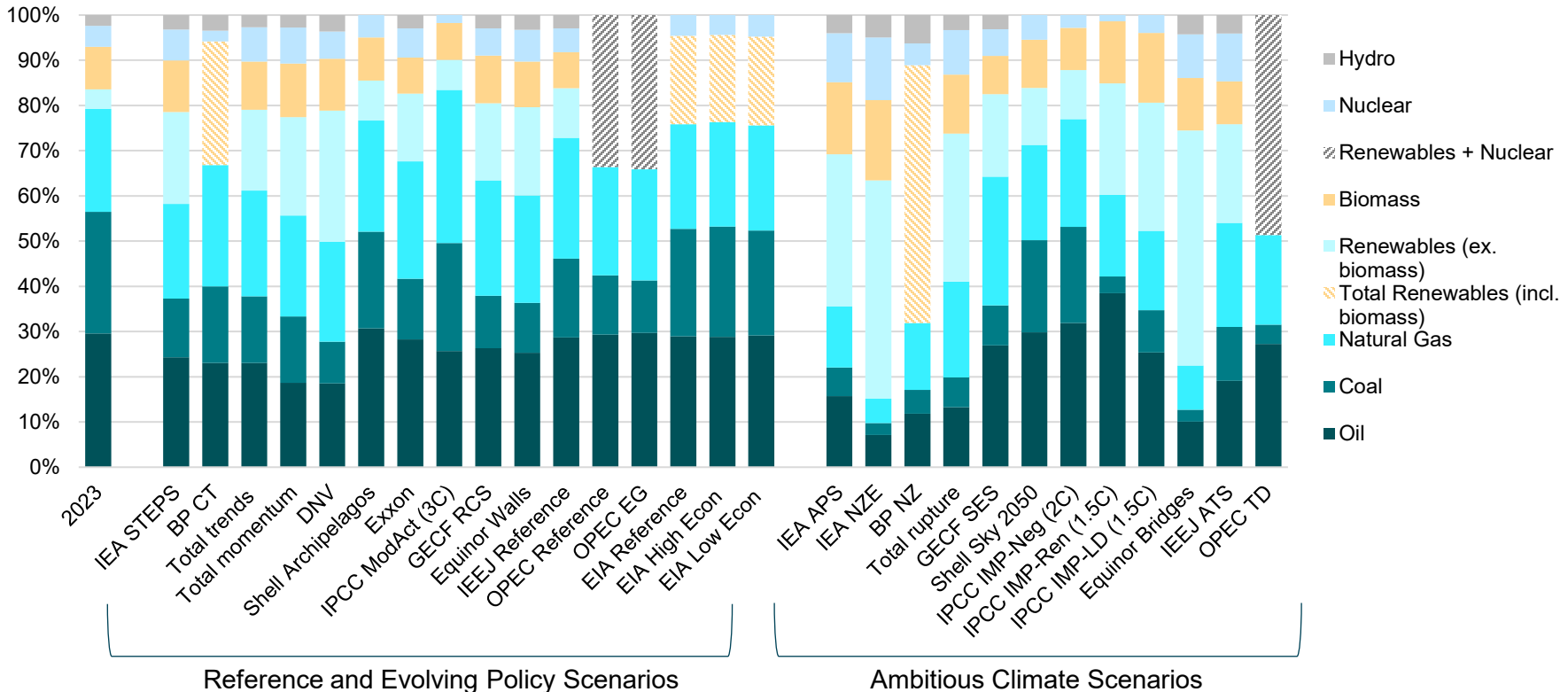


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Fossil fuels account for ~70% of total energy demand in evolving scenarios while ambitious outlooks predict around 50% by 2050

Primary Energy Demand Mix in 2050

% of total primary energy demand

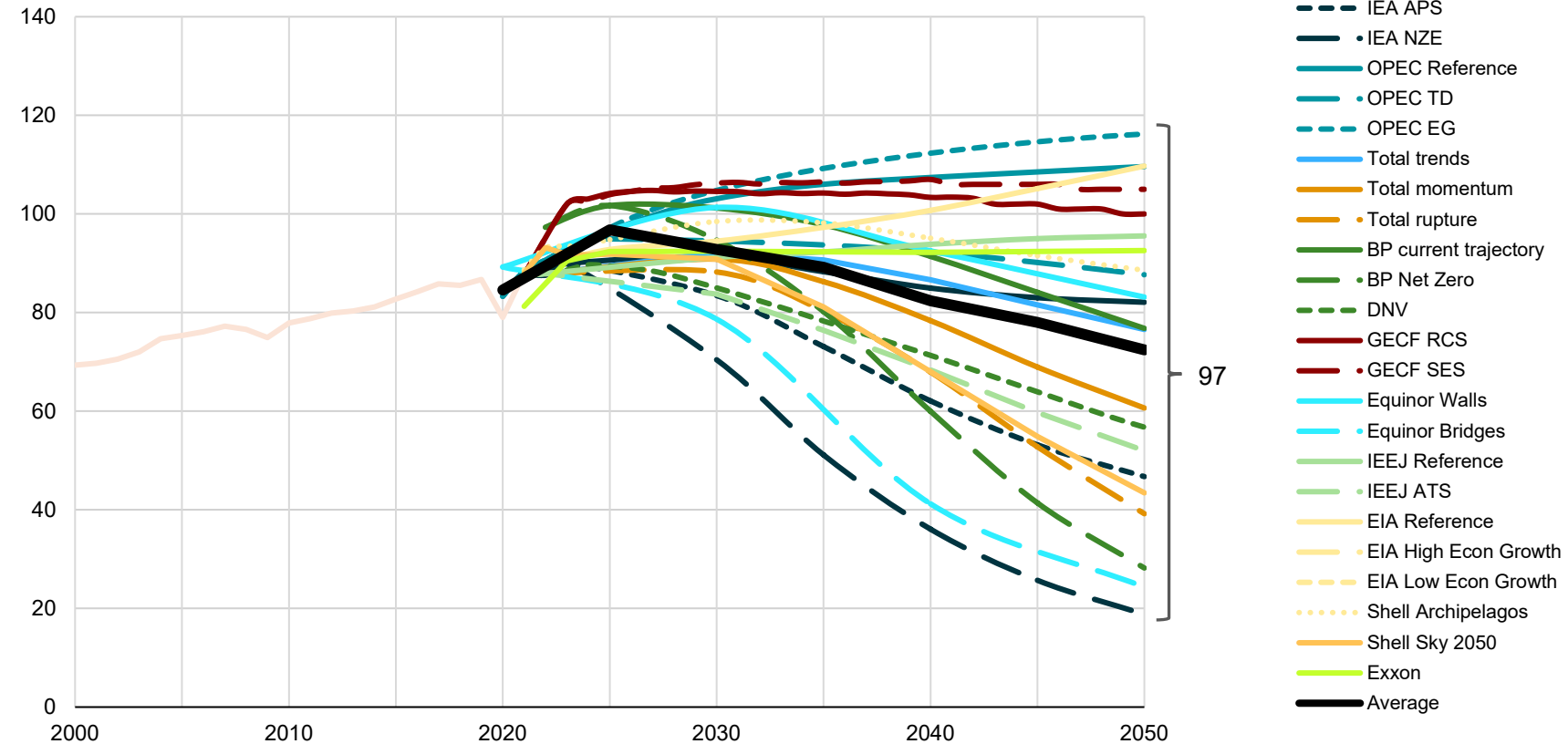


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and IPCC AR6.

The range in global oil demand forecasts reveals a gap that exceeds current demand and increases market risk

Oil Demand Scenarios Through 2050

MBOE/d

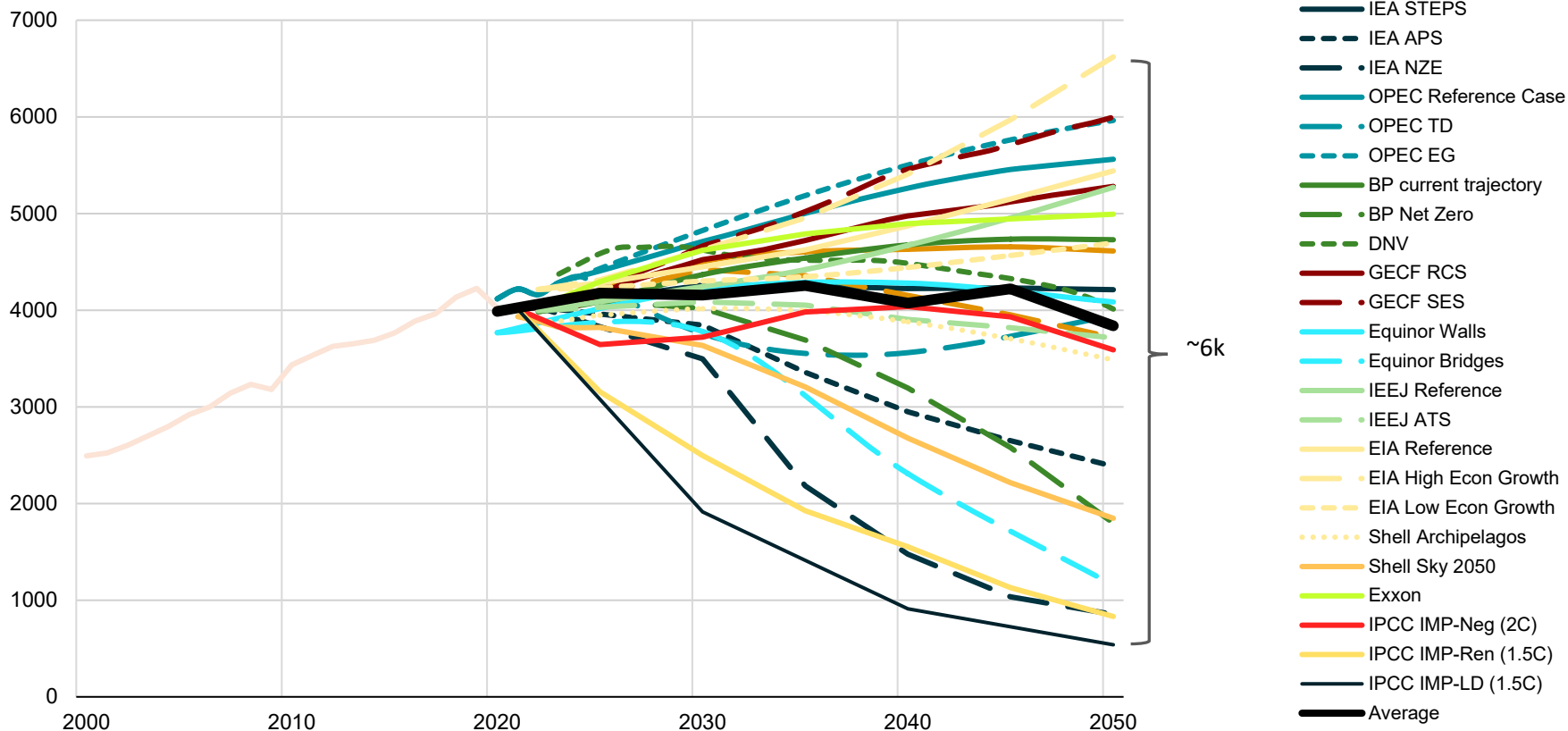


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More than half of the scenarios show sustained natural gas demand growth over the coming decades

Natural Gas Demand Scenarios Through 2050

Billion cubic metres

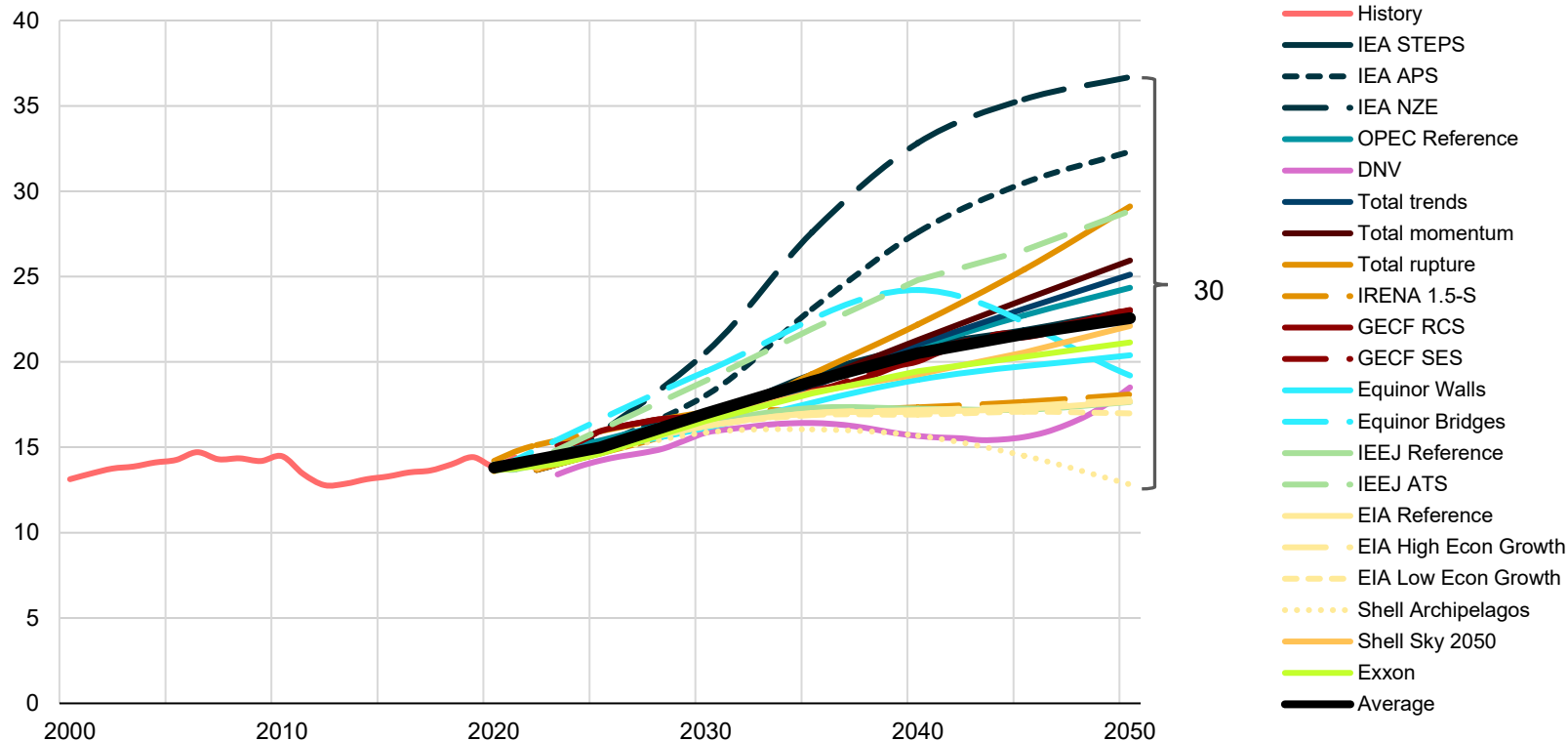


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and IPCC AR6.

Nuclear demand growth is projected to be slower than that of other renewable sources, but still doubles current demand by 2050

Nuclear Demand Scenarios Through 2050

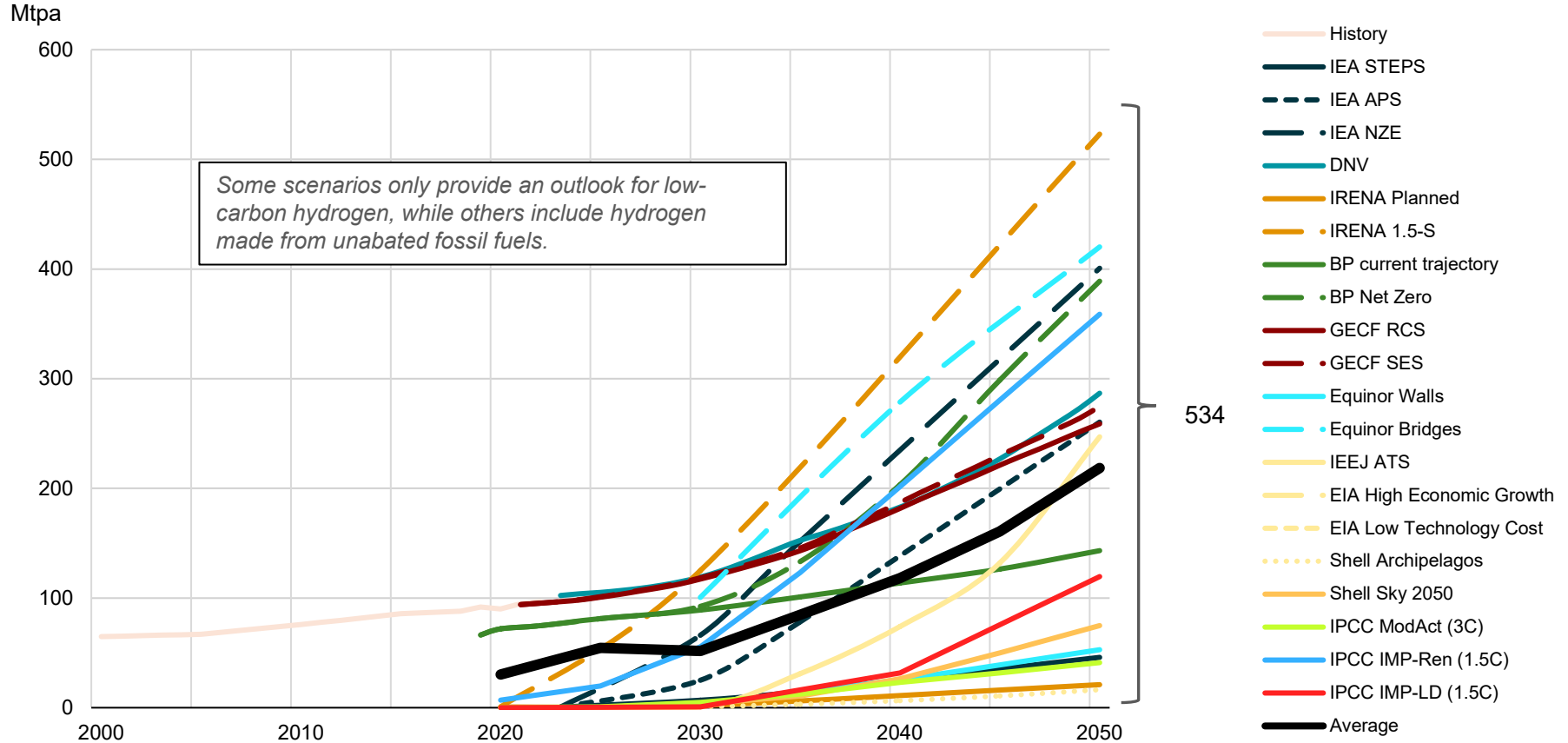
Mboe/d



Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, Shell Energy Security Scenarios 2023, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EIA IEO 2023, IRENA World Energy Transition Outlook 2024, Total Energy Outlook 2024, and ExxonMobil Global Outlook 2024.

Scenarios project a ~300-fold increase in hydrogen production by 2050, raising questions about baselines and assumptions

Hydrogen Demand Scenarios Through 2050

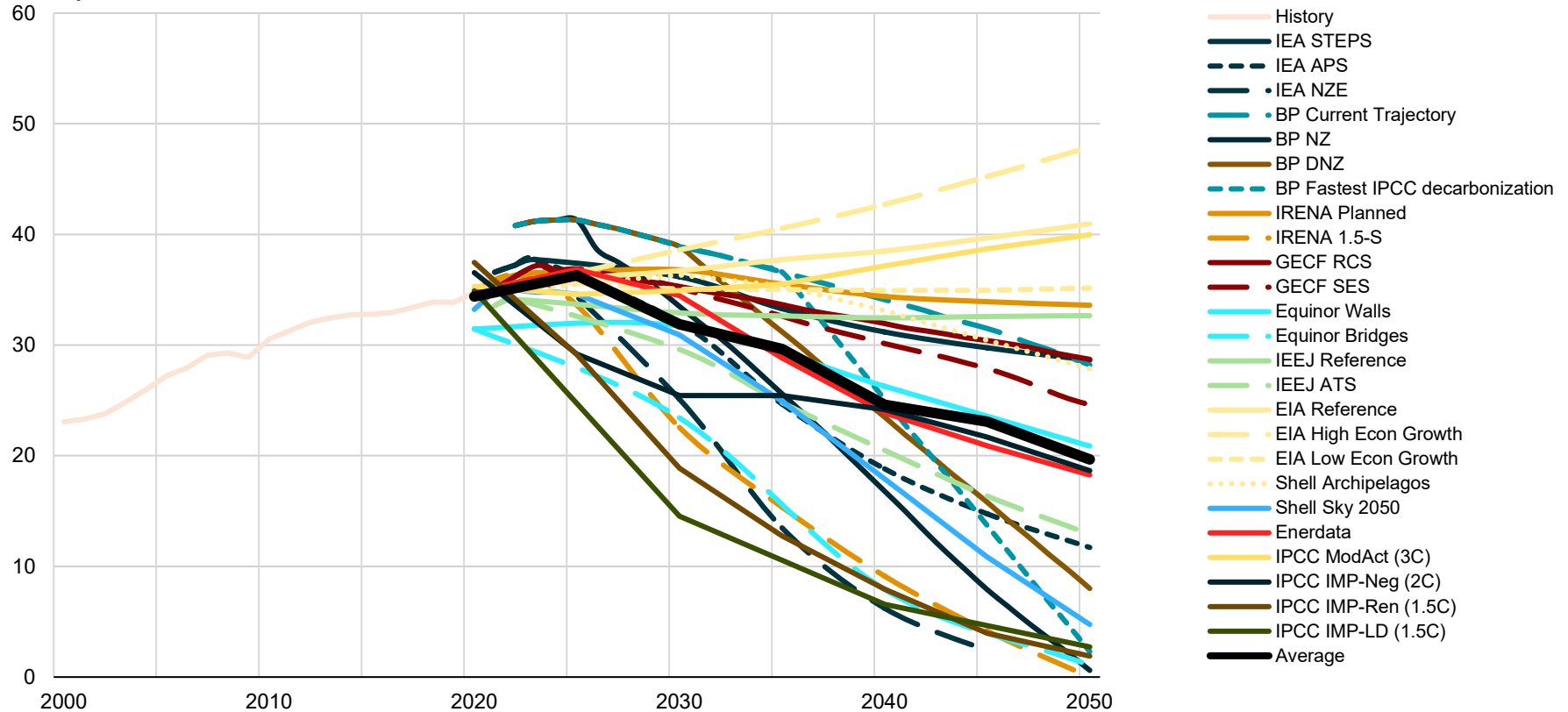


Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, GECF Global Gas Outlook 2025, BP Energy Outlook 2024, and IPCC AR6.

CO₂ emissions are projected to reach an average of 20 Gt CO₂/year by 2050, which is more than 40% of current emissions

CO₂ Emissions Scenarios Through 2050

Gt CO₂/year

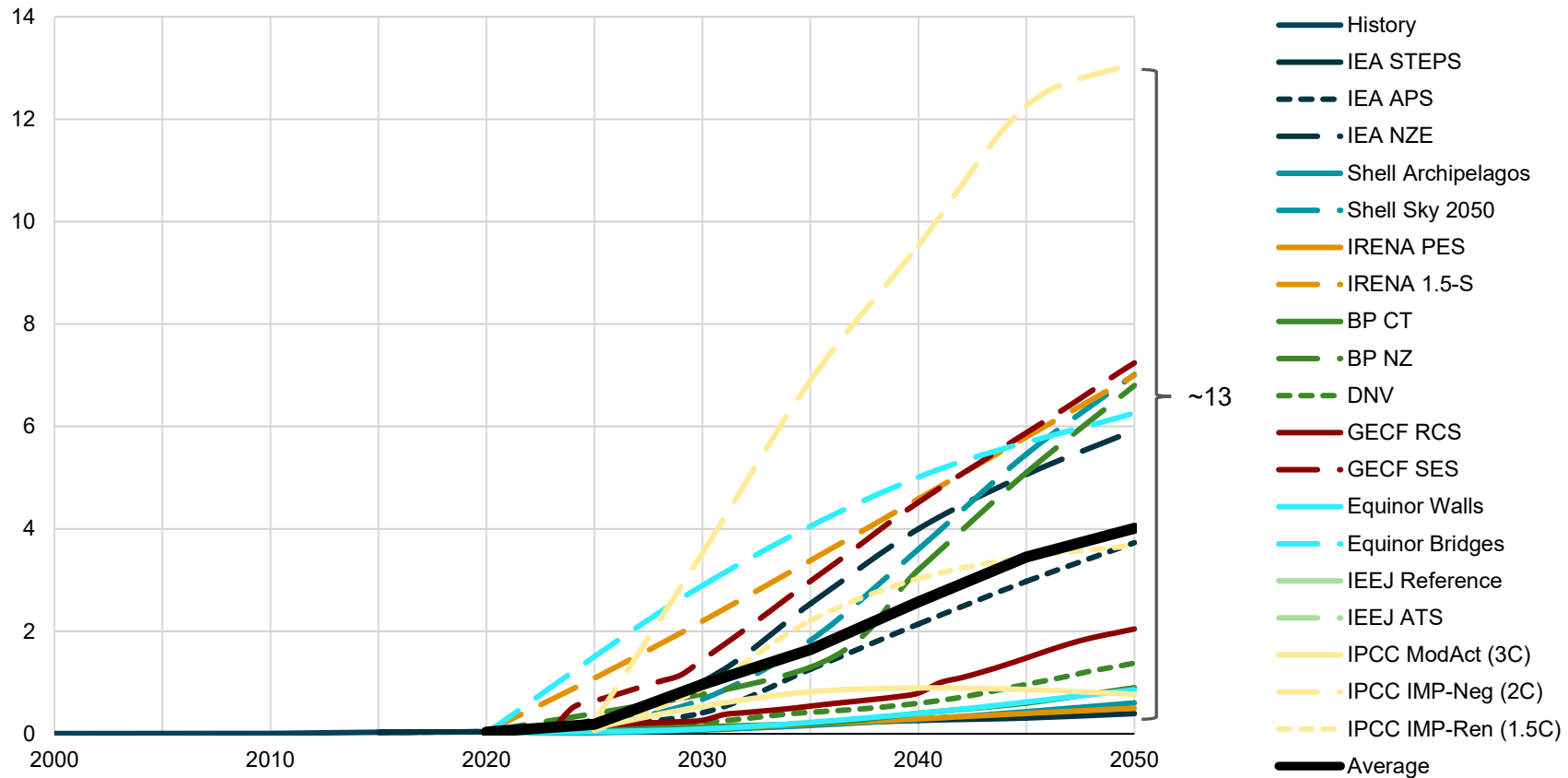


Source: IEF, IEA WEO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, EnerOutlook 2050, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, and IPCC AR6

Though CO₂ abatement scenario outcomes vary widely, on average 4 Gt of CO₂ is expected to be captured by 2050

Carbon Capture (CCUS, CCS, BECCS, Industrial)

Gt CO₂/year

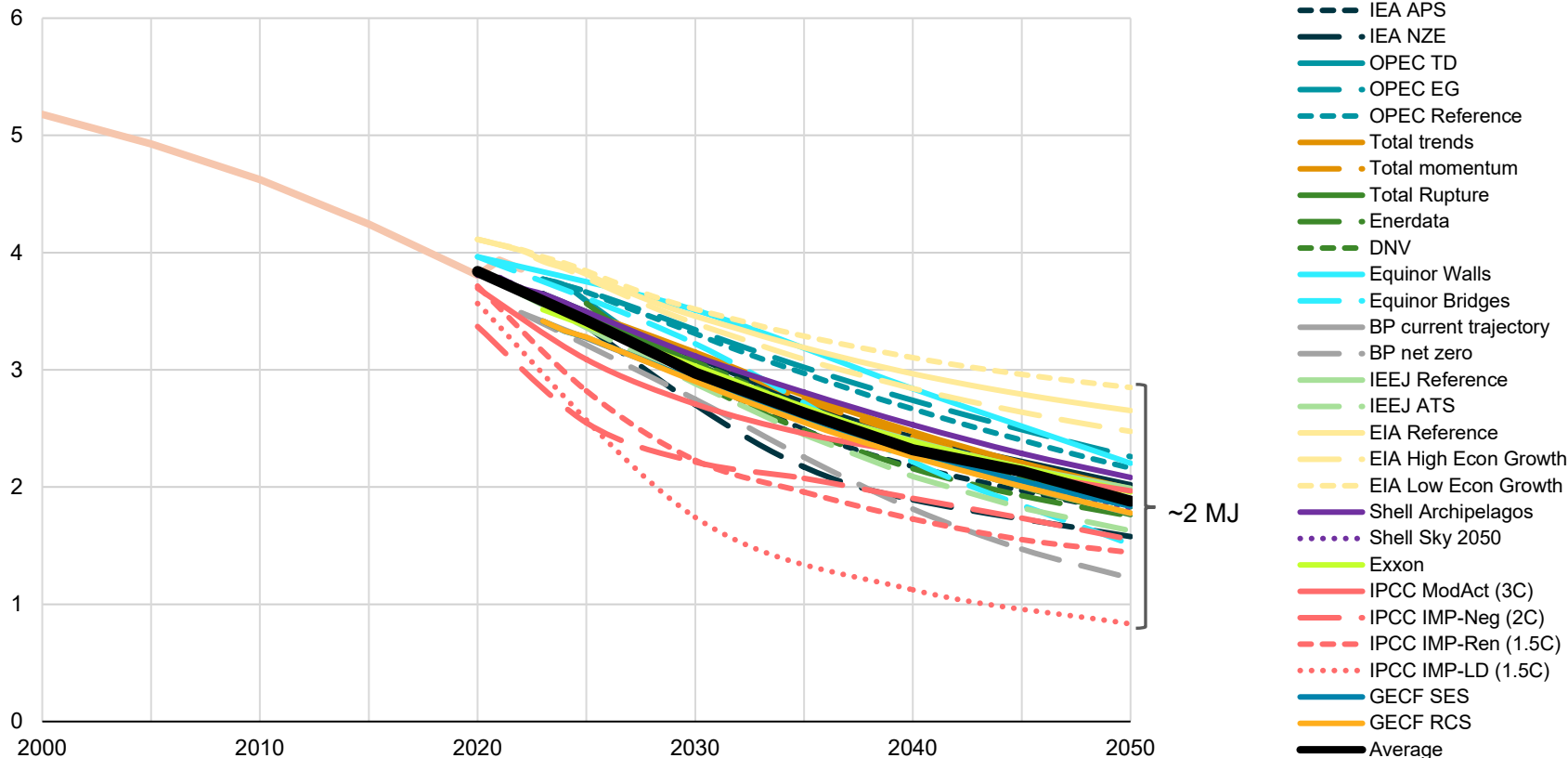


Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, Shell Energy Security Scenarios 2023, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, BP Energy Outlook 2024, and IPCC AR6.

Global energy intensity of GDP is on a sustained downward trend across all projections

Energy Intensity: Global Primary Energy Demand Per GDP

MJ per 2023 USD PPP

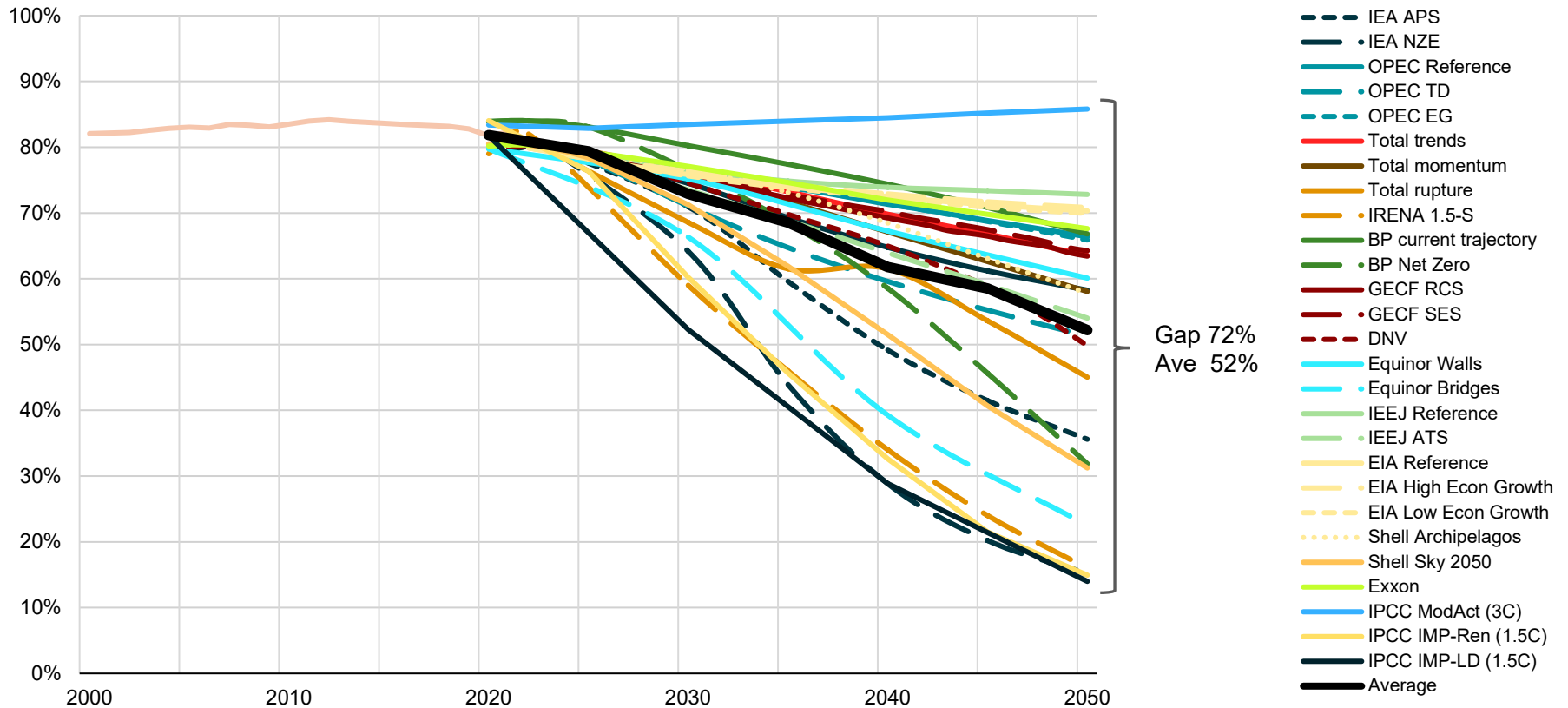


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EnerOutlook 2050, BP Energy Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

The “transition away from fossil fuels” that scenarios model contrast with the steady state of fossil fuels’ share of demand

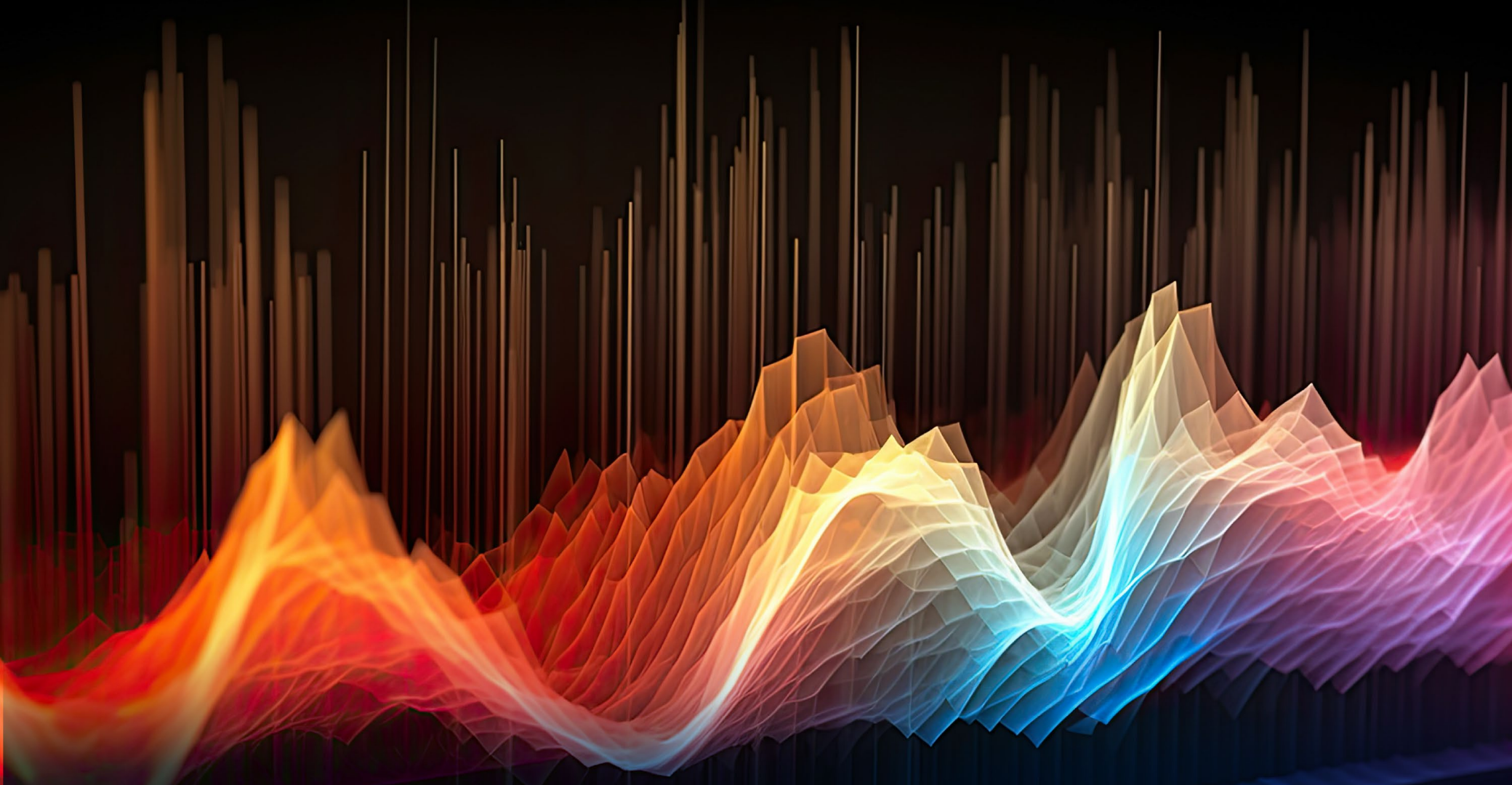
Fossil Fuels Share of Primary Energy Scenarios Through 2050

% of Primary Energy



Gap 72%
Ave 52%

Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV’s Energy Transition Outlook 2024, IRENA World Energy Transition Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and IPCC AR6.



This report was prepared in support of the 15th IEA IEF OPEC Symposium on Energy Outlooks

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