



15

IEA IEF OPEC  
Symposium on  
Energy Outlooks



# Outlooks Comparison Report

February 2025

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# Introduction: IEF Comparative Analysis of Energy Outlooks Decodes Global Energy Futures Enhances Decisions Worldwide

- Energy outlooks published annually by the IEA and OPEC play a leading role in shaping global perspectives and informing producer-consumer policy and investment decisions. Comparing these outlooks and clarifying underlying scenario assumptions through inclusive dialogue deepens understanding of their findings, enhancing decision-making processes worldwide.
- The Cancun IEF Ministerial Declaration (2010) called for the IEA, IEF, and OPEC to organize an annual symposium on energy outlooks. Producer-consumer dialogue in the IEF trilateral work programme on energy outlooks has gained in importance overtime. Geoeconomic shifts, new market realities, rapidly evolving clean energy technologies and energy security, affordable access, and climate policies all affect market stability and achievement of shared climate and sustainable development goals.
- This report informs the 15<sup>th</sup> IEA-IEF-OPEC Symposium by comparing the key scenarios and underlying methodologies of the most recent outlooks published by the IEA and OPEC and by placing them in the broader spectrum of scenario outlooks that other public and private sector stakeholders publish annually.
- Peer review of energy outlooks helps align historical baselines, clarify methodologies and makes assumptions that shape energy supply and demand trends over the short-, medium-, and long-term better understood. This allows stakeholders to decode the global energy futures they project and better evaluate their findings against real world market fundamentals, technology advances and policy dynamics.
- Produced to improve predictability and boost investor confidence, outlooks scenarios have increased in number, provide more varied outcomes, and serve as a public engagement tool. Though the growing diversity of findings may reflect stakeholder preferences and more polarized views on general trends, the wider array of projections also amplify risks and uncertainty delaying energy sector investment and clean energy technology transformations.
- Good baseline data comparability, clear model assumption descriptions anchored in reasonable expectations, or allocating a probability ranking to reflect the confidence in scenario outcomes can make energy dialogue more constructive and inclusive, improving the utility of outlook narratives for real world policy and investment decisions.

# Energy outlooks underscore the need for a collaborative approach to energy sector transformations on interconnected markets

- This report compares the short-, and long-term energy outlooks from the IEA and OPEC and subsequently analyzes a broader spectrum of scenarios published by intergovernmental energy organizations, industry, and think tanks.
- Outlooks comprise a range of scenarios for global energy consumption to 2050. They can be broadly categorized into three types:
  1. *Reference and evolving policy scenarios assume that current trends, policies, and technology advances continue with pathway dependent changes. These scenarios generally project energy demand to grow as a function of demographic and economic growth with gradual transitions to low-carbon energy sources.*
  2. *Accelerated scenarios envision stronger policy efforts on decarbonization and energy access including faster adoption of clean and more efficient technologies. These scenarios typically project more moderate energy demand growth and an accelerated roll out of renewable, carbon abatement, and nuclear technologies as well as energy efficiency gains and other demand side measures*
  3. *Ambitious climate scenarios prioritize achieving net-zero emissions by 2050 to limit global warming to 1.5°C. These scenarios are the most ambitious and involve significant changes in energy consumption patterns, such as a reduction in global energy demand, rapid renewable energy deployment, substantially increased rates of electrification and energy efficiency gains, as well as faster deployment of negative emissions technologies. These also include scenarios associated with a temperature increase of 1.7 °C in 2100.*
- As in previous years, the divergences in energy projections remain large and continue to grow. These differences reflect varied approaches to modeling and the complexity of global energy system interactions, which depend on diverse assumptions about economic growth, technology adoption, costs, and efficiency gains, among other factors. Moreover, assumptions that govern projections maybe implicit and are not always made clear.
- The most ambitious scenarios use back-casting; starting from a desired end-goal, such as achieving net zero emissions by a specific date and then model trajectories back to the present historical baseline. Reference and evolving scenarios take a bottom-up approach with forward looking trajectories governed by different assumptions on key factors and policy settings.
- Taken together outlook scenarios underscore that energy and climate policy choices to reach climate and sustainable development goals, including access to affordable, reliable, sustainable and modern energy for all, are exposed to growing uncertainties.
- OPEC's Equitable Growth scenario predicts the highest amount of primary energy demand by 2050 and almost the lowest share of non-fossil fuels. This contrasts with the IEA's NZE scenario, which sees that non-fossil fuels will account for about 85% of total primary energy demand by 2050 and projects a substantial reduction in overall primary energy demand.
- Originally created to improve predictability and boost investor confidence, energy outlooks require more inclusive dialogue to enable more cohesive producer-consumer approaches to managing energy security and change.

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# Outlooks Highlights

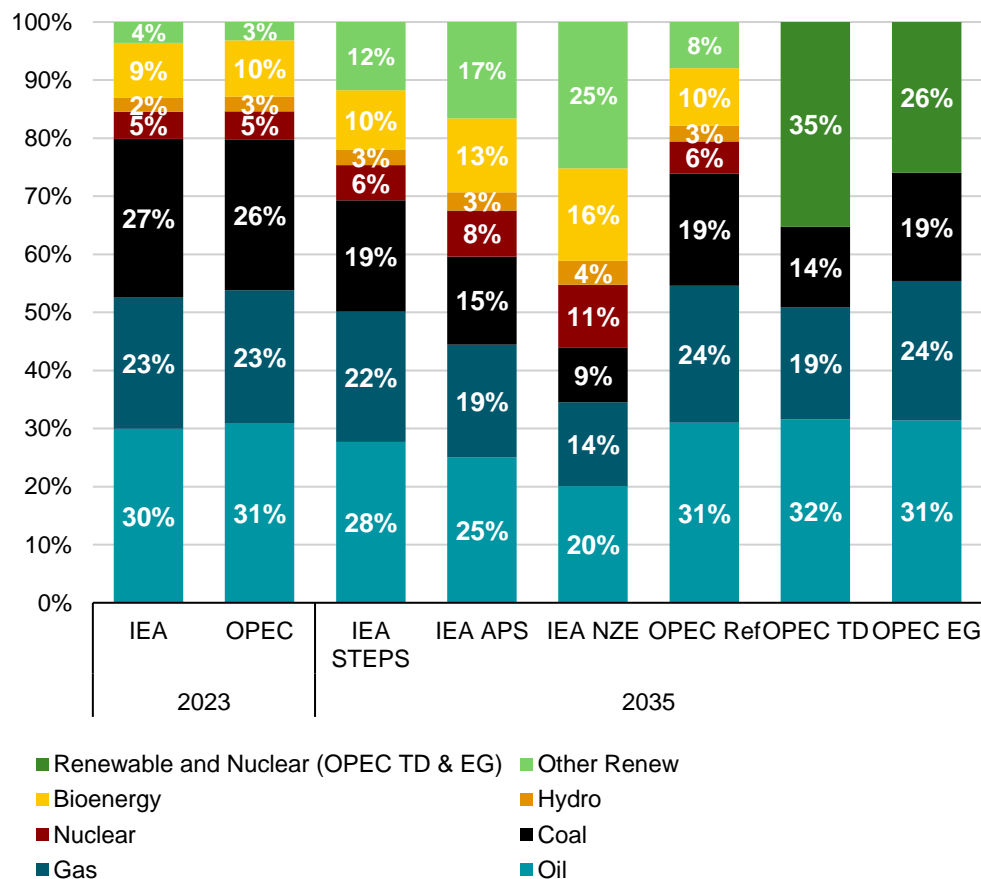
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# 2035 IEA & OPEC Outlook Highlights:

- Ambitious scenarios, including the IEA's NZE, IEA's APS and OPEC's TD, indicate more aggressive progress in renewable and nuclear sources compared to other scenarios. The share of these sources in global primary energy demand is projected to increase from around 20 percent in 2023 to a range of 35 percent to 55 percent by 2035.
- All renewable and nuclear sources are expected to show an increase by 2035, but at different rates. Solar and wind energy are projected to experience the most significant growth among renewable sources, with increases ranging from 1 to 8-fold. The share of nuclear energy in the total energy mix is expected to increase from 5% in 2023, up to 11% by 2035, while hydro is anticipated to maintain a stable or moderate trend.
- Coal is forecast to decline in all scenarios and is predicted to experience the steepest reduction among fossil fuel types during that period, with its share of total primary energy demand ranging from about 26 percent in 2023 to 19 percent in reference and evolving policy cases, while falling to 9 percent in the IEA's NZE scenario.
- Reference and evolving policy scenarios indicate a plateau in the share of crude oil in total primary energy demand for OPEC's EG and Reference case, or a modest decline in the IEA's STEPS scenario. For natural gas, OPEC's EG and Reference case show increasing trends by 2035 compared to 2023 levels, while IEA's STEPS shows a modest decline to about 22 percent.
- The demand for fossil fuels as a share of total primary demand is expected to range from around 45 percent in the most ambitious IEA NZE scenario to approximately 75 percent in reference and evolving policy scenarios.

## World Primary Energy Fuel Share Outlook to 2035

Percent of total primary energy



Source: IEF, IEA WEO 2024, OPEC WOO 2024

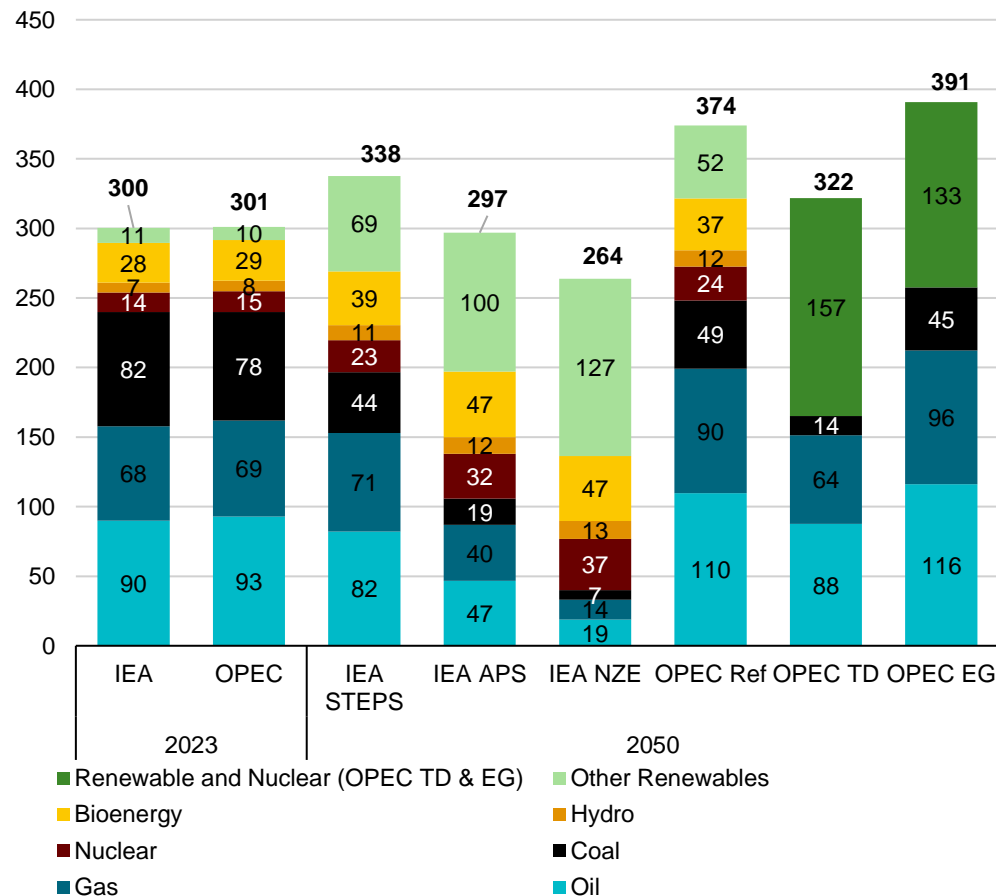


# 2050 IEA & OPEC Outlook Highlights:

- Four out of six scenarios indicate an increase in global primary energy demand by up to 90 mboe/d by 2050, relative to 2023 levels, while the IEA's APS and NZE see a decline in primary energy demand by up to 36 mboe/d.
- Consumption of renewable energy and nuclear power is expected to jump from around 60 mboe/d in 2023, reaching approximately 125 mboe/d according to OPEC's Reference Case, and up to 224 mboe/d by 2050 according to IEA's NZE, which would account for more than two-thirds of the world's primary energy demand.
- OPEC's Reference Case and OPEC's EG predict an increase in natural gas demand of more than 30% by 2050 compared to 2023 levels, while the IEA's STEPS indicates that demand will plateau.
- By 2050, all scenarios see a reduction in coal demand, with a range spanning from 37 percent (OPEC Reference case) to 90 percent (IEA NZE).
- Reference and evolving policy scenarios, including IEA's STEPS, OPEC's Reference, OPEC's EG and OPEC TD, indicate that fossil fuels will account for more than 50 percent of global primary demand by 2050.

## World Primary Energy Demand Outlook to 2050

Million barrels of oil equivalent per day



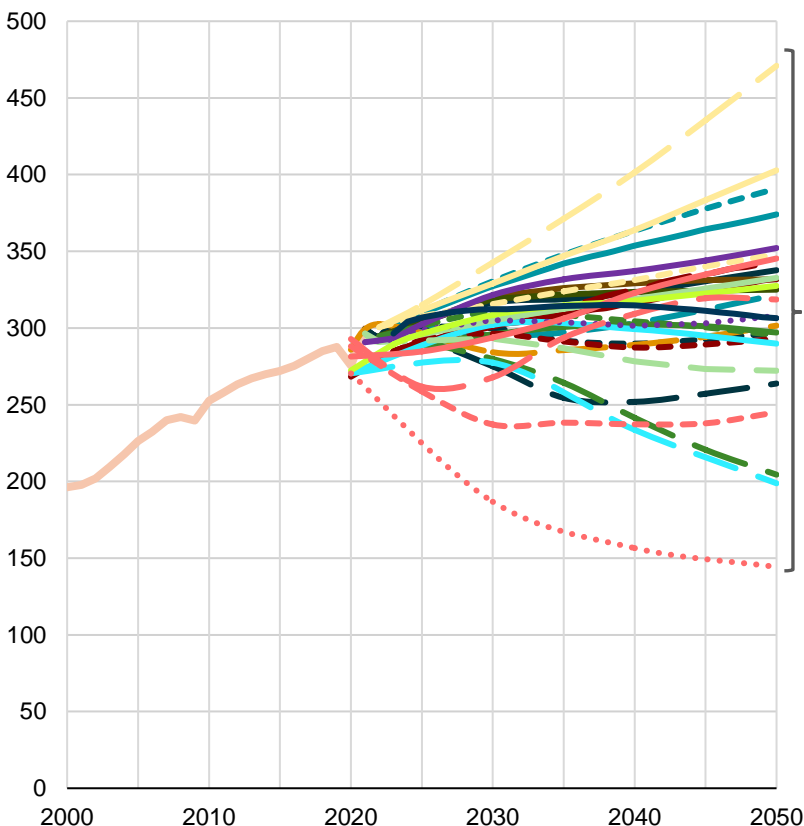
Source: IEF, IEA WEO 2024, OPEC WOO 2024

# IEA and OPEC Scenarios and Other Long-Term Energy Outlooks:

- To clarify how the projections from the IEA and OPEC align with other prominent energy forecasts, we compiled data from 24 additional scenarios from 12 sources.
- The divergence across energy forecasts by 2050 is approximately  $\pm 35$  percent of current global demand across most scenarios.
- Two-thirds of the scenarios show an increase in the total primary energy demand needed by 2050.
- Almost one-third of the scenarios indicate a plateau or an increase in oil demand by 2050.
- Approximately half of the scenarios project a 50 percent decline in coal demand by 2050.
- More than half of the scenarios predict an increase in natural gas demand by 2050, ranging from 1% to 50%.
- More than half of the scenarios show that fossil fuels will account for more than 60% of the total primary energy demand by 2050.

**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

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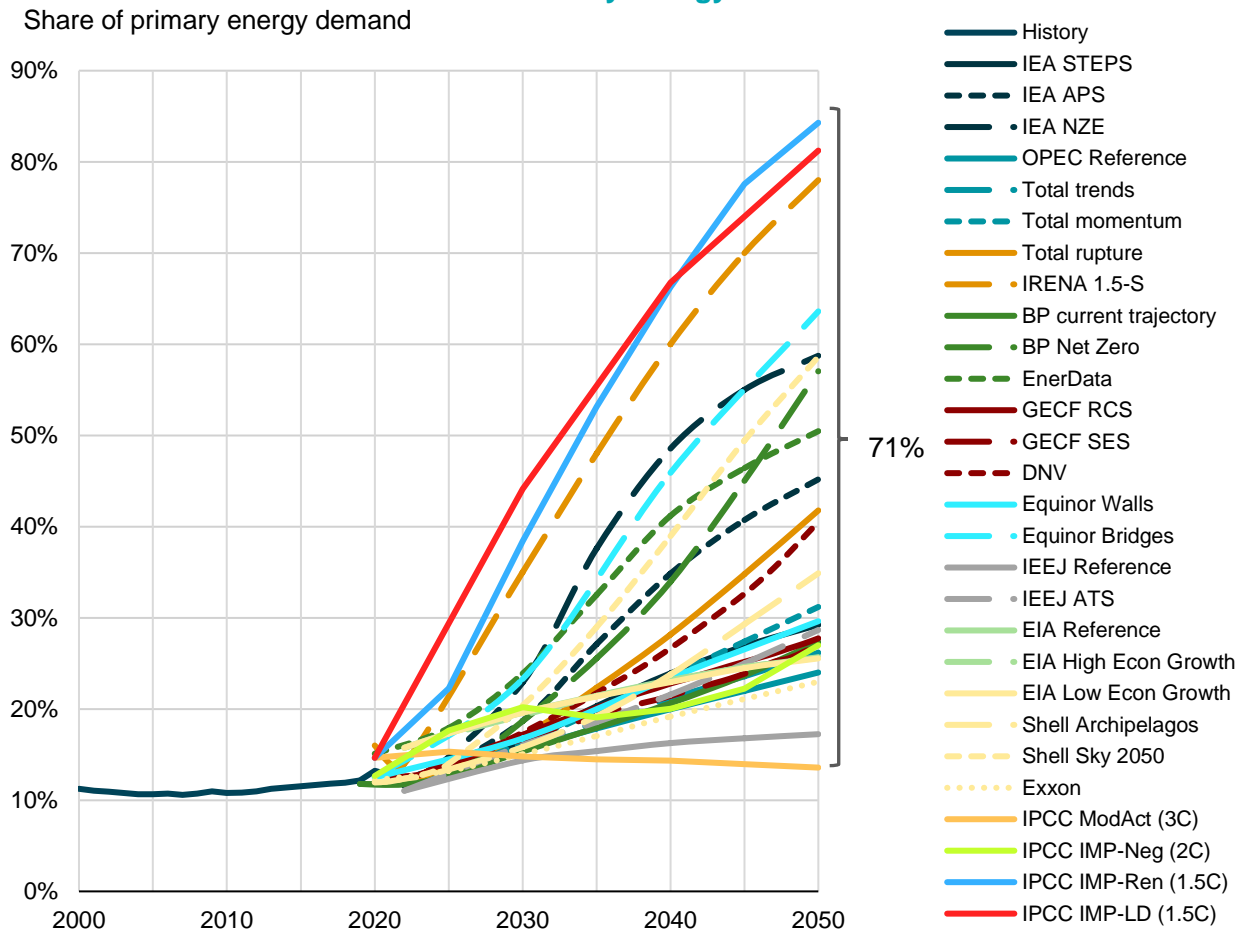
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, EnerOutlook 2050, ExxonMobil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



# IEA and OPEC Scenarios and Other Long-Term Energy Outlooks:

- The variations in different scenarios for renewable energy demand highlight significant uncertainties regarding its potential role in future primary energy consumption.
- The average increase in renewable energy demand by 2050, under ambitious projections, is almost twice that of the reference and evolving policy scenarios.
- Less than one-third of the scenarios predict that renewable demand will exceed half of the total primary energy demand by 2050, while more than half of the scenarios indicate that the share will not exceed 30 percent.
- A projected annual increase of 2.8 million barrels of oil equivalent per day in renewable energy demand is anticipated across multiple sources.
- By the year 2050, various forecasts anticipate a surge in the demand for renewable energy, projecting an increase of at least 100% compared to current consumption levels.

**Renewable Demand Share of Total Primary Energy Demand Scenarios to 2050**



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.

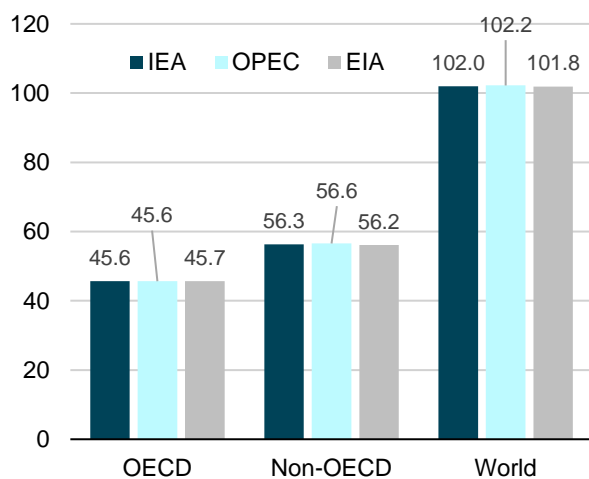
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## **Baseline 2023 Liquids Data (IEA OMR, OPEC MOMR, and EIA STEO as of January 2025)**

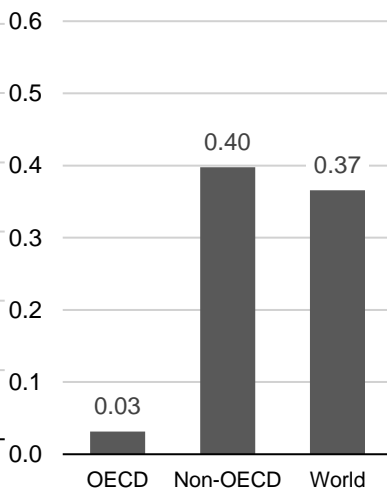
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# Range in global liquid demand estimates shows a decline of approximately 150 kb/d, compared to last year

**2023 Liquid Demand Estimates by Agency**

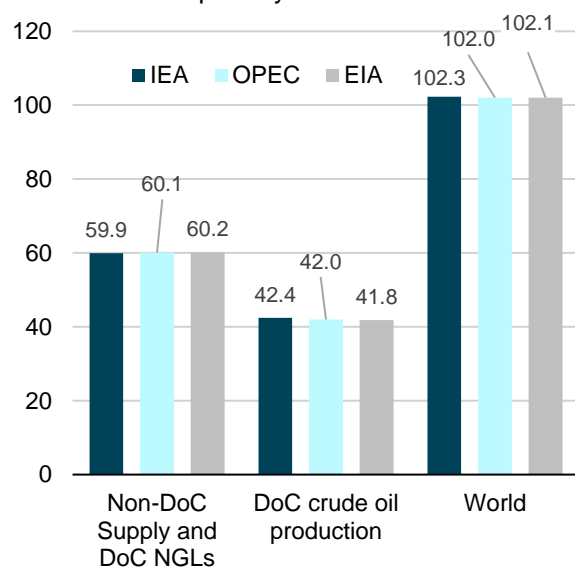


**Estimate Range**  
Million barrels per day

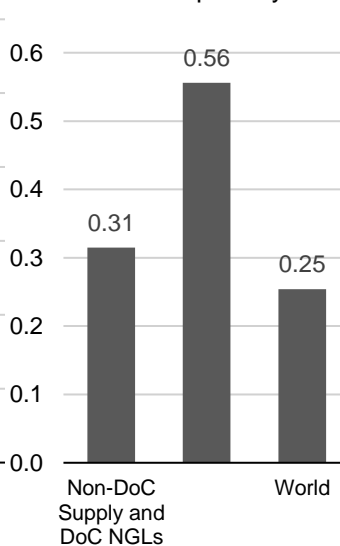


**2023 Liquid Supply Estimates by Agency**

Million barrels per day



**Estimate Range**  
Million barrels per day

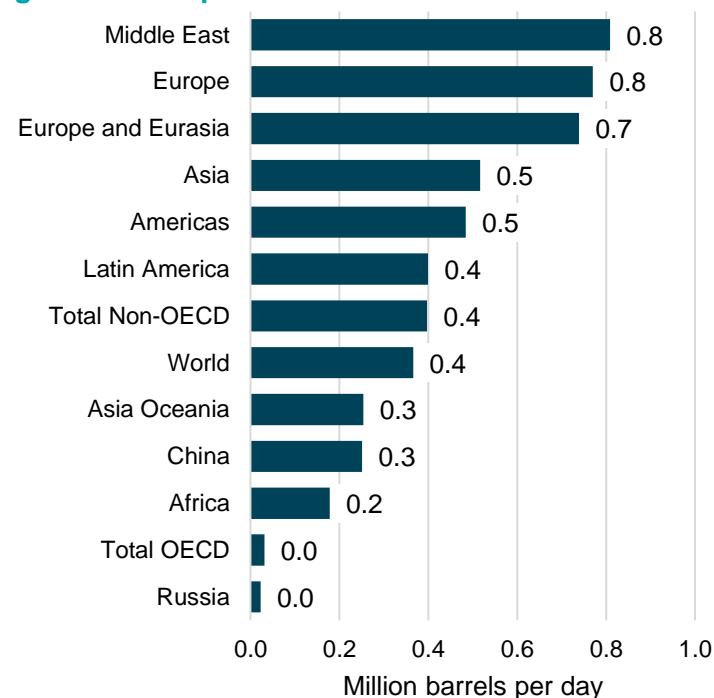


Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025.

# Largest variations in baseline liquid demand projections originate from the Middle East, Europe, and Eurasia

2023 Total Liquid Demand Estimates by Agency				
million barrels per day	IEA	OPEC	EIA	Range (high-low)
<b>Total OECD</b>	<b>45.65</b>	<b>45.65</b>	<b>45.68</b>	<b>0.0</b>
Americas	24.95	24.96	24.47	0.5
Europe	13.45	13.45	14.22	0.8
Asia Oceania	7.24	7.24	6.99	0.3
<b>Total Non-OECD</b>	<b>56.32</b>	<b>56.56</b>	<b>56.16</b>	<b>0.4</b>
Asia	30.82	30.98	30.46	0.5
China	16.44	16.36	16.19	0.3
Middle East*	9.07	8.63	9.44	0.8
Latin America	6.29	6.69	6.68	0.4
Europe and Eurasia	5.81	5.80	5.07	0.7
Russia	3.84	3.84	3.86	0.0
Africa	4.33	4.46	4.51	0.2
<b>World</b>	<b>101.97</b>	<b>102.21</b>	<b>101.84</b>	<b>0.4</b>

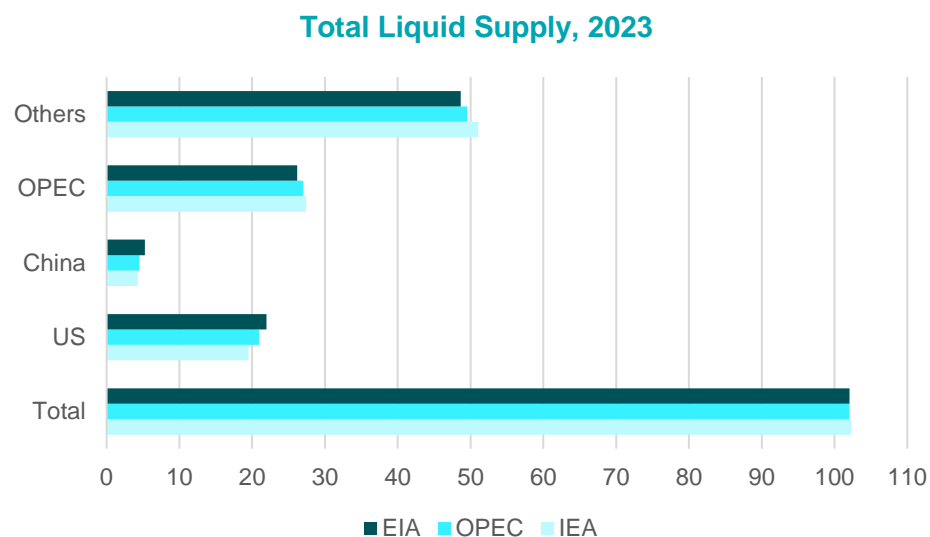
Range in 2023 Liquid Demand Estimates



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

\*The differences between the IEA and OPEC Middle East baselines relate to data sources. OPEC Secretariat's figures sources are national sources, as well as direct communication with OPEC Member Countries.

# Global liquid supply aligns across agencies, despite regional variations



2023 Total Liquid Supply Estimates by Agency				
	IEA	OPEC	EIA	Range
<b>Total</b>	102.3	102.0	102.1	0.2
<b>US</b>	19.5	21.0	22.0	2.5
<b>China</b>	4.3	4.5	5.3	1.0
<b>OPEC crude</b>	27.4	27.0	26.9	0.5
<b>Others</b>	51.1	49.5	47.9	3.1

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

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# Short Term Liquids Outlook

## (IEA OMR, OPEC MOMR and EIA STEO 2024-2025 as of January 2025)

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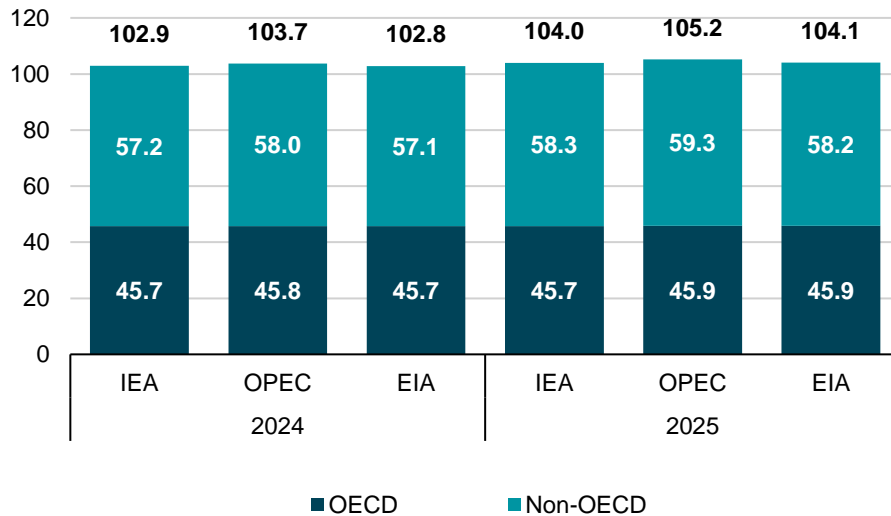


# Demand forecast for 2024 & 2025 diverge by 1.0 mb/d on average

## OPEC demand growth projections stand out in relation to the IEA and EIA

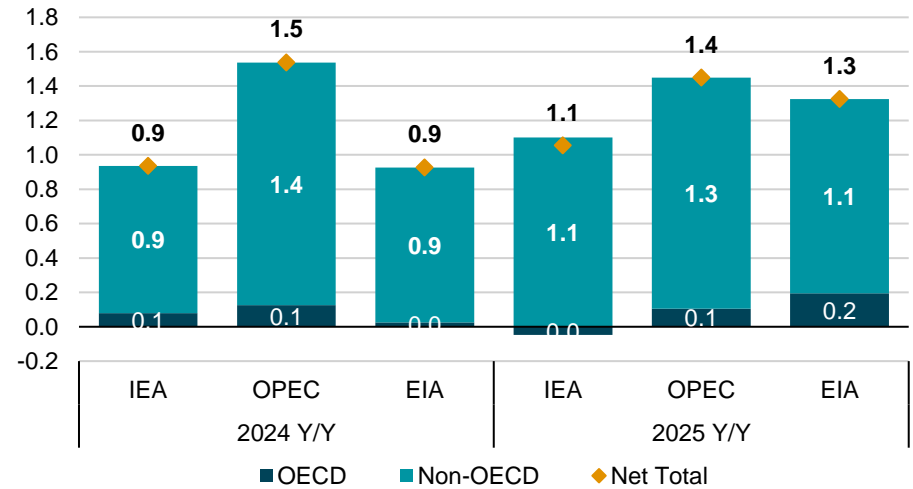
### 2024 & 2025 Liquid Demand Forecast By Agency

Million barrels per day



### 2024 & 2025 Liquid Demand Growth By Agency

Million barrels per day

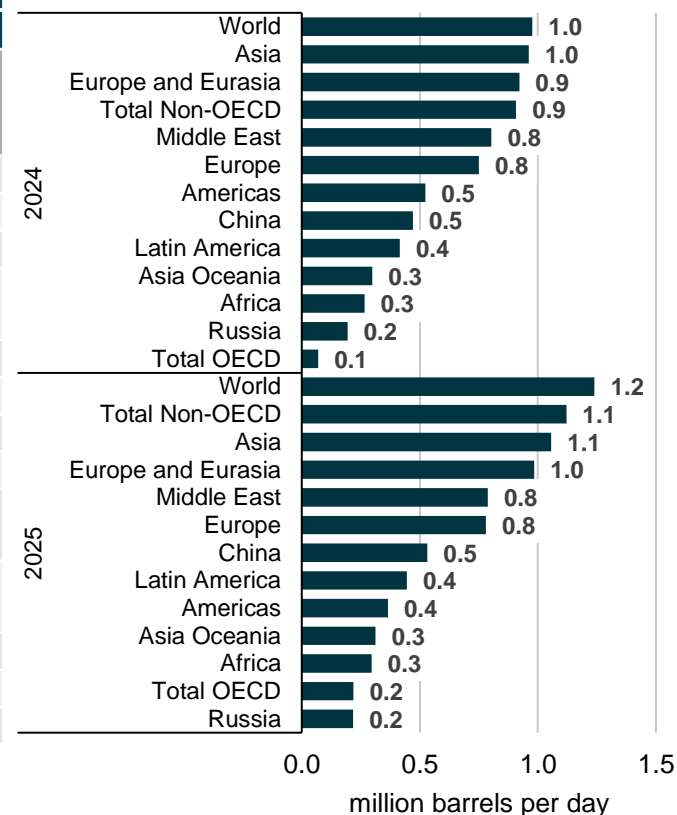


Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025.

# Contrasting demand estimates for Asia are among the largest discrepancies in regional outlooks

2024-2025 Liquid Demand Forecast by Agency								
million barrels per day	2024				2025			
	IEA	OPEC	EIA	Range (high-low)	IEA	OPEC	EIA	Range (high-low)
<b>Total OECD</b>	<b>45.7</b>	<b>45.8</b>	<b>45.7</b>	<b>0.1</b>	<b>45.7</b>	<b>45.9</b>	<b>45.9</b>	<b>0.2</b>
Americas	25.0	25.0	24.5	0.5	25.0	25.1	24.7	0.4
Europe	13.5	13.5	14.2	0.8	13.4	13.5	14.2	0.8
Asia Oceania	7.2	7.2	6.9	0.3	7.3	7.3	6.9	0.3
<b>Total Non-OECD</b>	<b>57.2</b>	<b>58.0</b>	<b>57.1</b>	<b>0.9</b>	<b>58.3</b>	<b>59.3</b>	<b>58.2</b>	<b>1.1</b>
Asia	31.5	31.9	30.9	1.0	32.1	32.8	31.7	1.1
China	16.6	16.7	16.3	0.5	16.8	17.0	16.5	0.5
Middle East*	9.2	8.8	9.6	0.8	9.3	8.9	9.7	0.8
Latin America	6.4	6.8	6.8	0.4	6.5	6.9	6.9	0.4
Europe and Eurasia	5.8	6.0	5.1	0.9	5.9	6.1	5.1	1.0
Russia	3.8	4.0	3.9	0.2	3.8	4.0	3.9	0.2
Africa	4.3	4.5	4.6	0.3	4.4	4.6	4.7	0.3
<b>World</b>	<b>102.9</b>	<b>103.7</b>	<b>102.8</b>	<b>1.0</b>	<b>104.0</b>	<b>105.2</b>	<b>104.1</b>	<b>1.2</b>

Range in Agencies' 2024-2025 Demand



Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025. \*The differences between the IEA and OPEC Middle East baselines relate to data sources. OPEC Secretariat's figures sources are national sources, as well as direct communication with OPEC Member Countries.

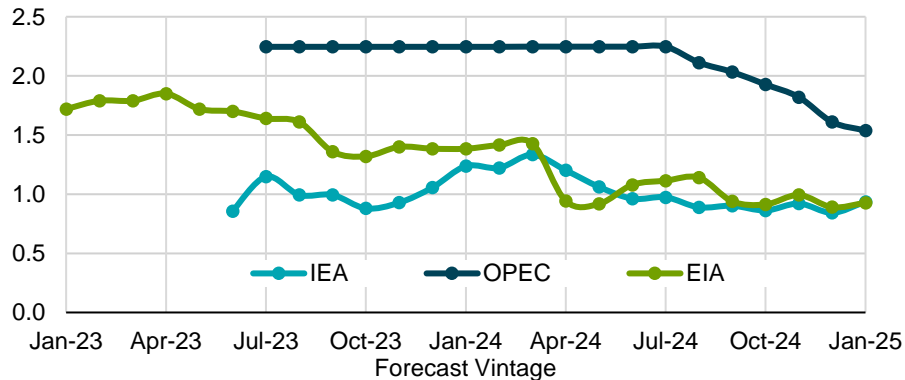
# 2024: OPEC sees 0.6 mb/d stronger global growth than IEA and EIA

Non-OECD demand growth accounts for 93-97 percent of global demand growth

## Global Demand Growth

Evolution of 2024 Forecasts

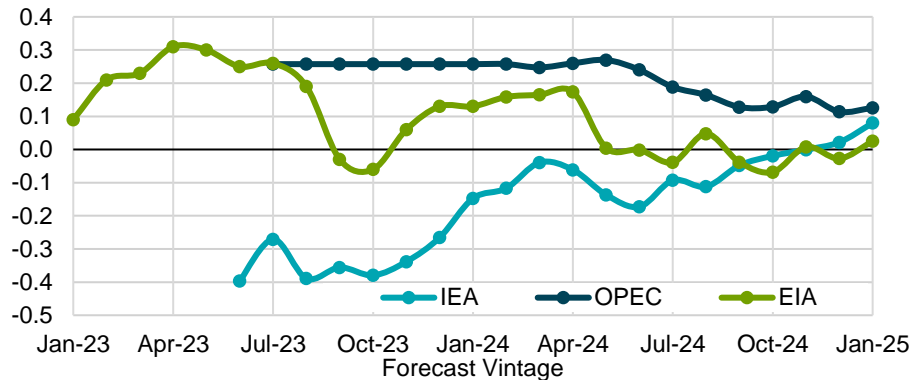
y/y growth in million barrels per day



## OECD Demand Growth

Evolution of 2024 Forecasts

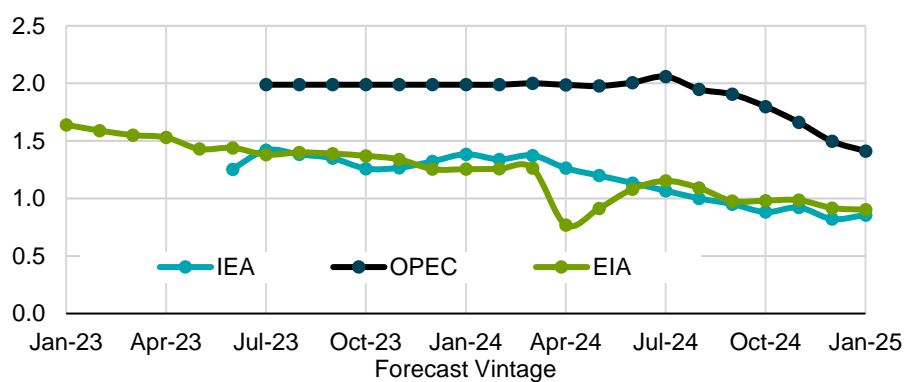
y/y growth in million barrels per day



## Non-OECD Demand Growth

Evolution of 2024 Forecasts

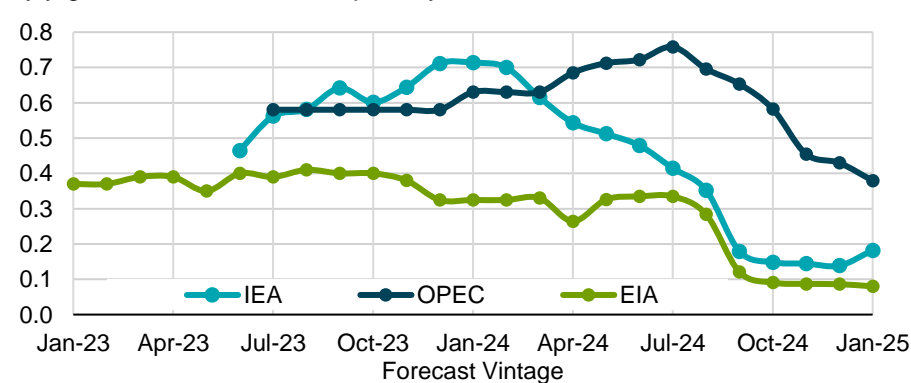
y/y growth in million barrels per day



## China Demand Growth

Evolution of 2024 Forecasts

y/y growth in million barrels per day



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

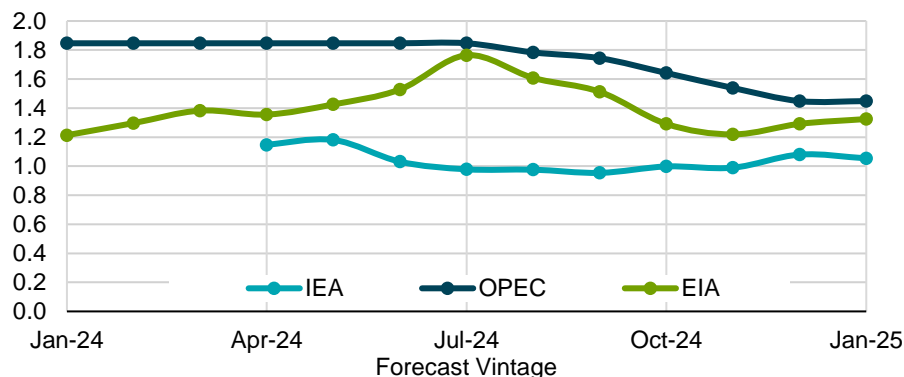
# 2025: Global demand growth forecasts see stable trends in recent months, although the gap exceeded 0.4 mb/d

The divergence in Non-OECD demand growth shrinks from around 0.7 mb/d to 0.2 mb/d

## Annual Global Demand Growth

Evolution of 2025 Forecasts

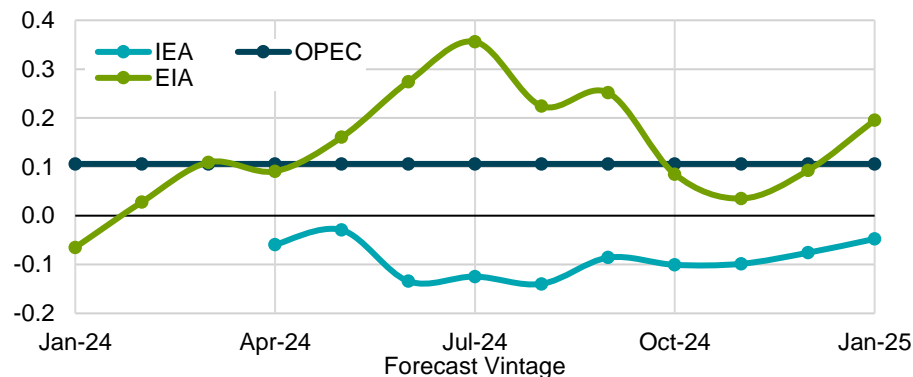
y/y growth in million barrels per day



## Annual OECD Demand Growth

Evolution of 2025 Forecasts

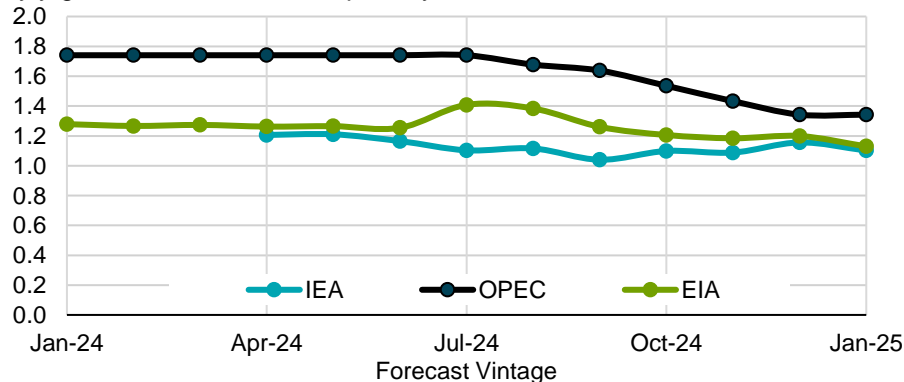
y/y growth in million barrels per day



## Non-OECD Demand Growth

Evolution of 2025 Forecasts

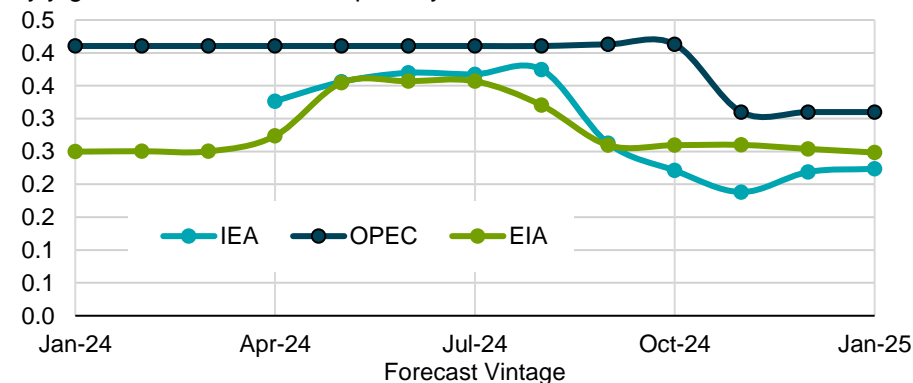
y/y growth in million barrels per day



## Chinese Demand Growth

Evolution of 2025 Forecasts

y/y growth in million barrels per day

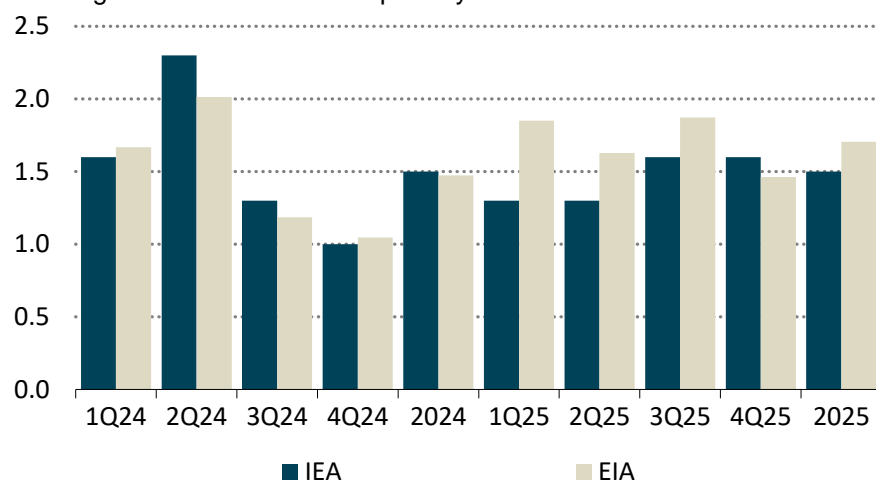


\* IEA first published a 2025 forecast in April 2024. Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025.

# Quarterly differences in liquids supply across agencies are double the yearly average of 2025 and 2026

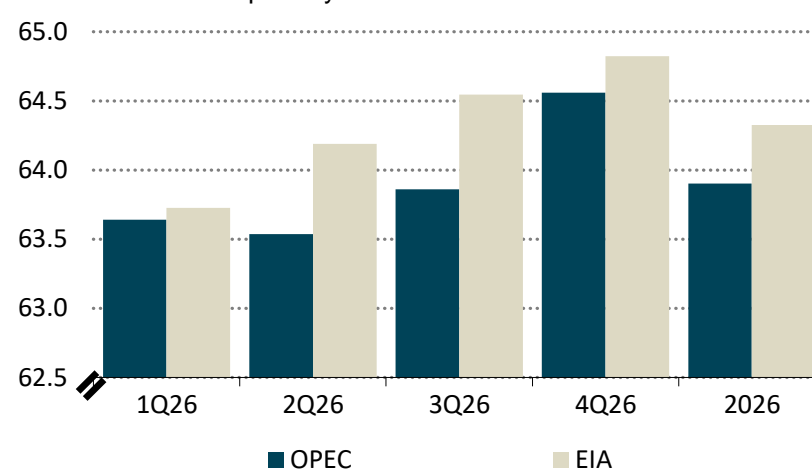
**Total Non-DoC liquids and DoC NGLs Supply Growth (2024 & 2025)**

Y/Y growth in million barrels per day



**Total Non-DoC liquids and DoC NGLs Supply (2026)**

million barrels per day



Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025. Datasets are selected based on available statistics.

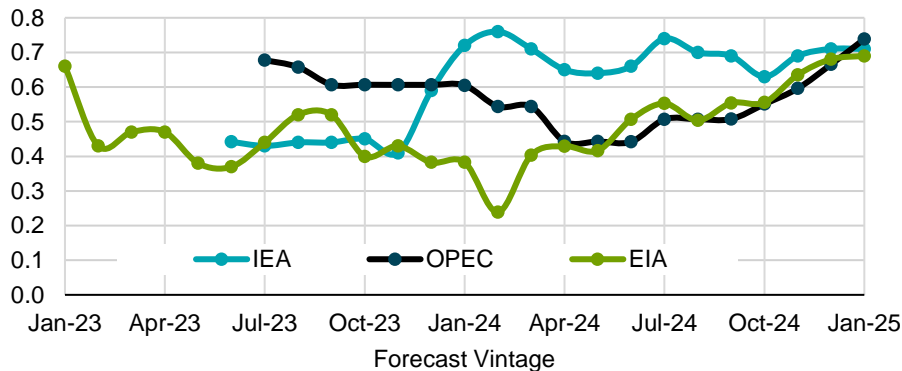
# Agencies continue to show more alignment on US supply growth forecasts

- US supply growth drives growth in non-OPEC.
- Russian oil production declined by approximately 0.25-0.37 mb/d y/y, compared to only 0-0.11 mb/d a year ago.

## Annual US Supply Growth

Evolution of 2024 Forecasts

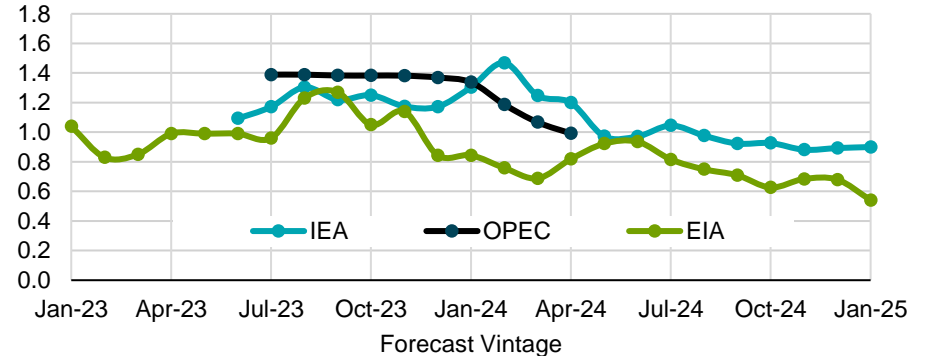
y/y growth in million barrels per day



## Annual Non-OPEC Supply Growth

Evolution of 2024 Forecasts

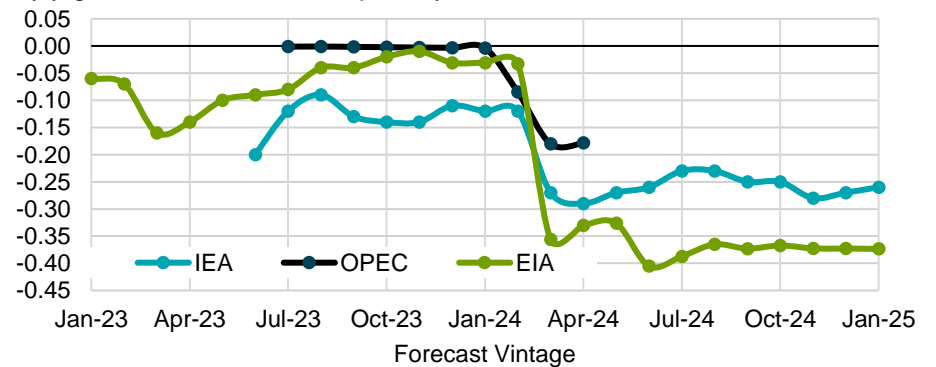
y/y growth in million barrels per day



## Annual Russia Supply Growth

Evolution of 2024 Forecasts

y/y growth in million barrels per day



Note: Beginning in May 2024, OPEC stopped publishing supply forecasts for non-OPEC members of the Declaration of Cooperation (DoC or commonly known as OPEC+). Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025.



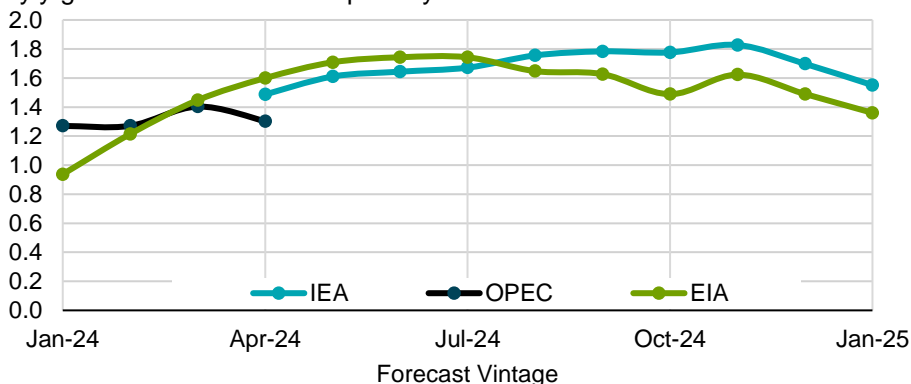
# Divergent views on Non-OPEC supply growth in the US drive forecast variations

- The IEA and EIA maintain comparable growth forecasts for non-OPEC supply, despite notable divergences.
- Forecasts of US supply growth from the three agencies align in recent months, compared to six months ago.
- EIA sees negative supply growth from Russia, while IEA projects growth, with more than a 0.1 mb/d difference.

## Annual Non-OPEC Supply Growth

### Evolution of 2025 Forecasts

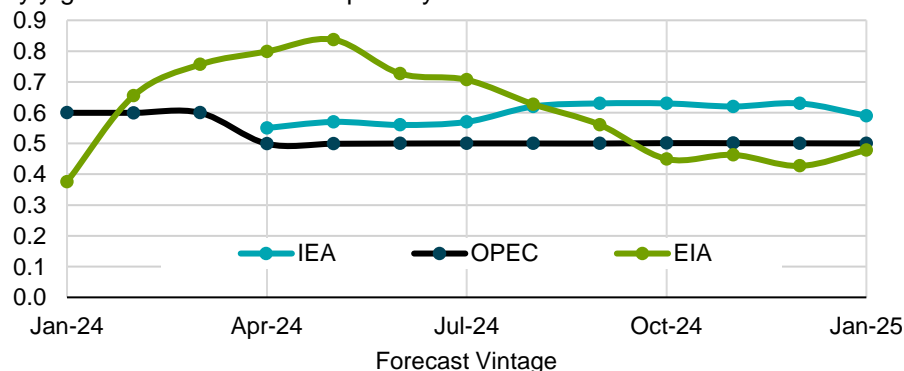
y/y growth in million barrels per day



## Annual US Supply Growth

### Evolution of 2025 Forecasts

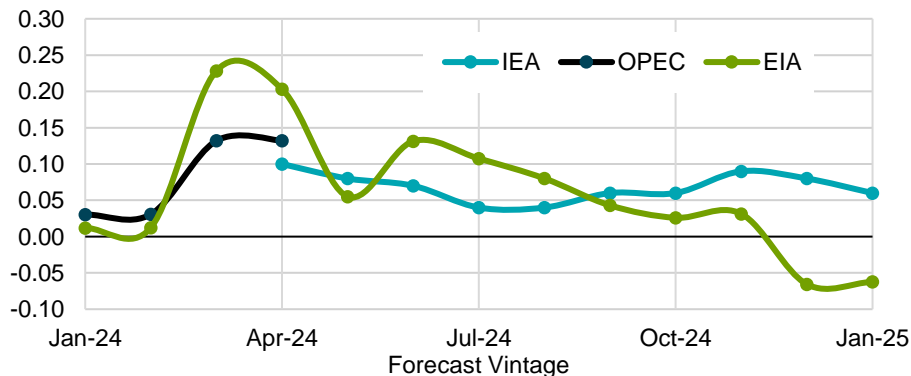
y/y growth in million barrels per day



## Annual Russia Supply Growth

### Evolution of 2025 Forecasts

y/y growth in million barrels per day

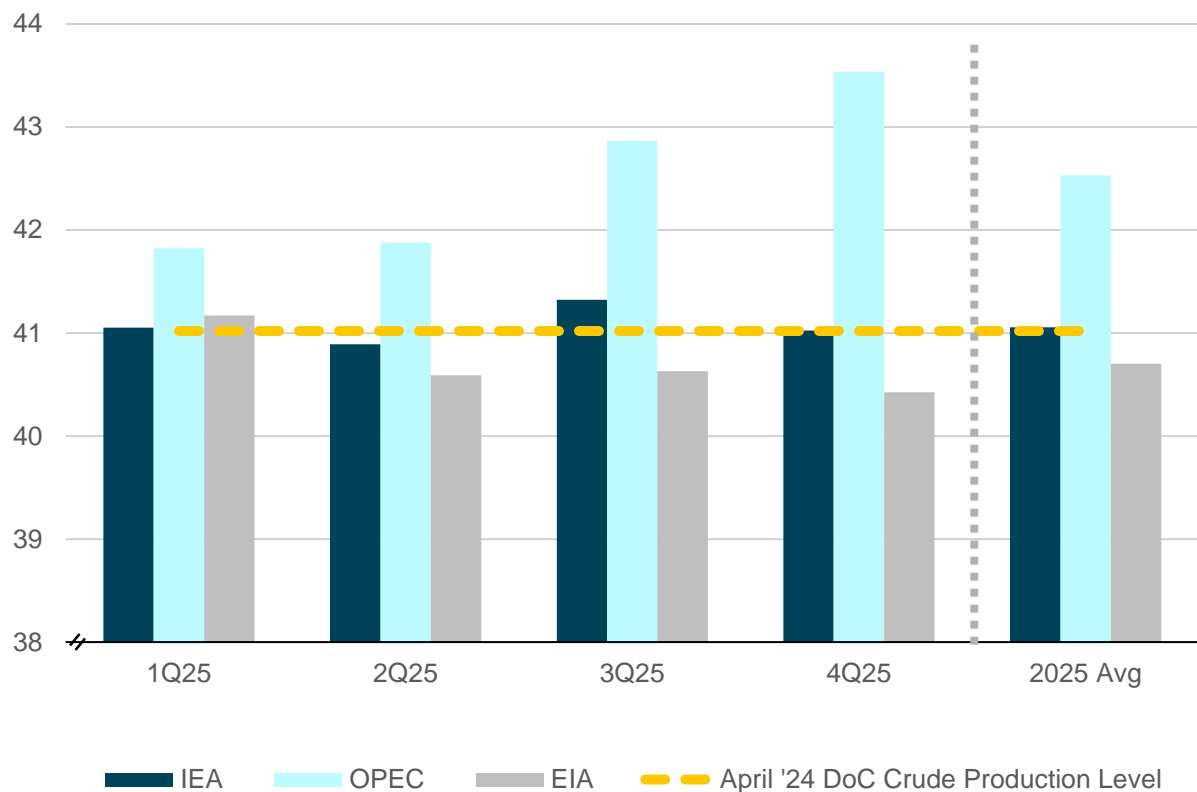


Note: Beginning in May 2024, OPEC stopped publishing supply forecasts for non-OPEC members of the Declaration of Cooperation (DoC or commonly known as OPEC+). IEA first published a 2024 forecast in April 2024; Source: IEF, IEA OMR Jan 2025, OPEC MOMR Jan 2025, EIA STEO Jan 2025.

# The average OPEC 'call on DoC' for 2025 surpasses EIA estimates by 1.8 mb/d

## 2025 Call on DoC and Recent DoC Production Levels

Million barrels per day



- The “call on DoC crude” is a calculation and not a forecast of actual production.
- The “call on DoC” estimates what OPEC+ would need to produce to balance global supply and demand.
- It is estimated by subtracting a forecast for non-DoC production and DoC NGLs from global demand.

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

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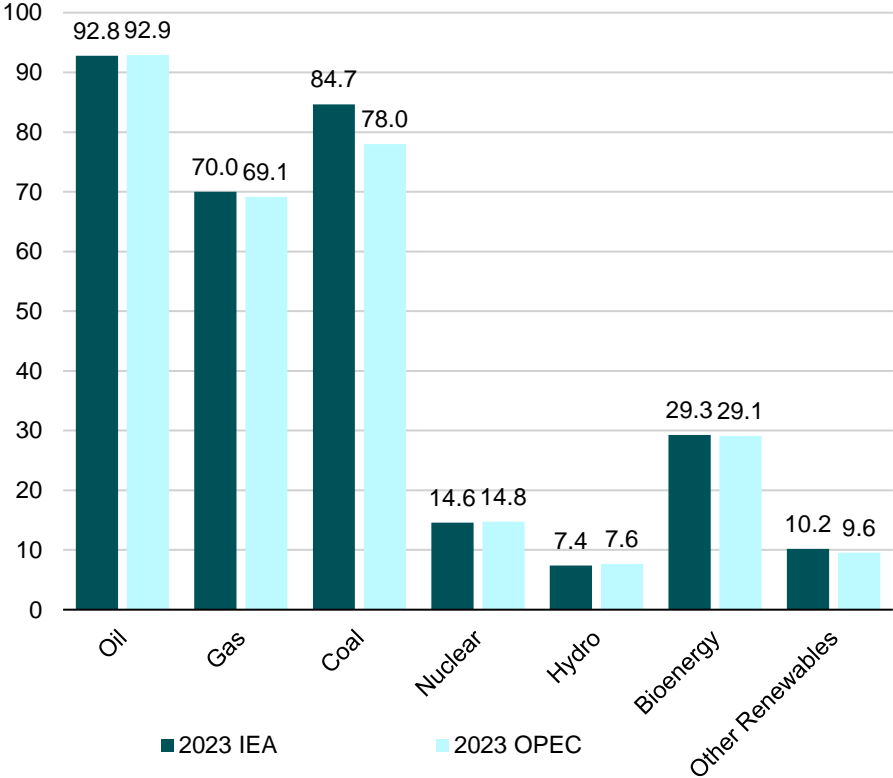
## Baseline Energy Data (IEA WEO and OPEC WOO)

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# Divergence in baseline data between the IEA and OPEC centers on coal accounting for around 80% of the total

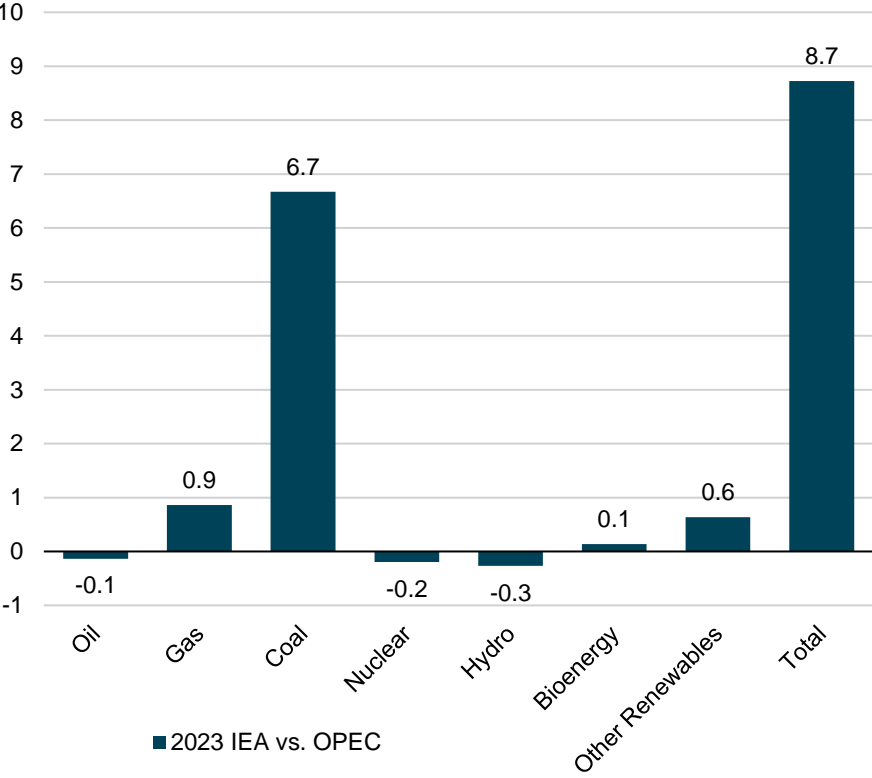
## 2023 World Primary Energy Demand

Million barrels of oil equivalent per day



## IEA vs. OPEC: 2023 World Primary Energy

Million barrels of oil equivalent per day

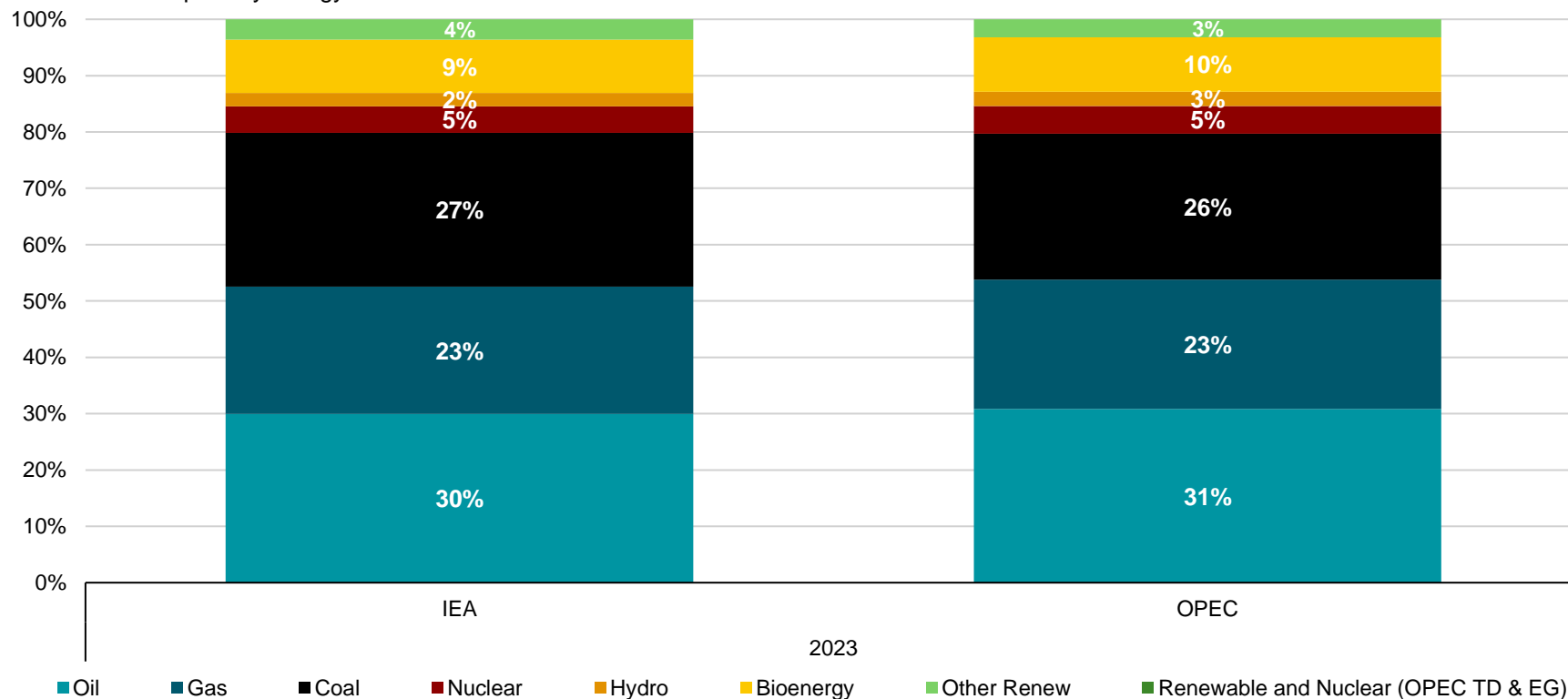


Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# Non-fossil fuels account for around 20% of global primary energy demand in 2023, according to both the IEA and OPEC

## 2023 World Primary Energy Demand Fuel Share

Percent of total primary energy demand



Source: IEF, IEA WEO 2024 and OPEC WOO 2024. OPEC TD is OPEC Technology-Driven Scenario and OPEC EG is OPEC Equitable Growth Scenario.

# Non-OECD fossil fuel demand baselines differ across types

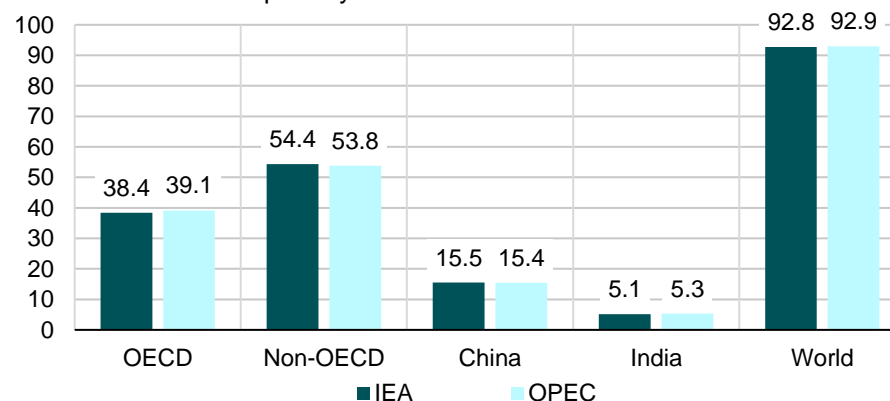
2023 IEA and OPEC Non-OECD coal and oil demand differ by 8 mboe/d and 2 mboe/d

The causes of these differences mostly relate to:

- Baseline data classifications and presentation make it difficult to harmonize statistics into a unified format.
- There is no single conversion key available for data presented in different units.
- Bunkering fuels are accounted differently in global and regional categories by the IEA and OPEC.

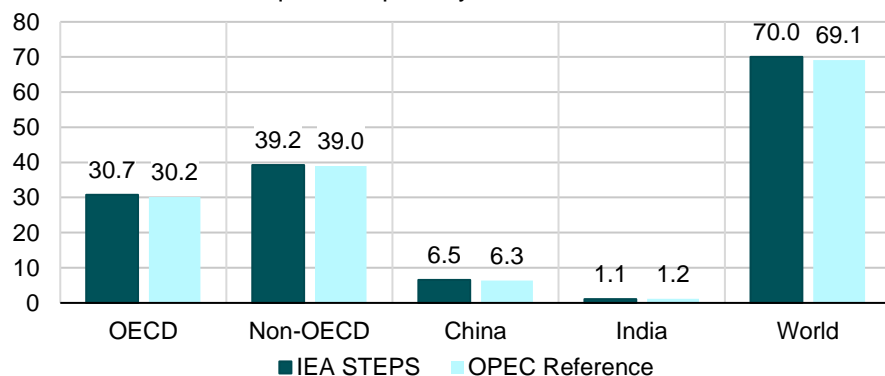
## 2023 Oil\* Demand

Million barrels of oil per day



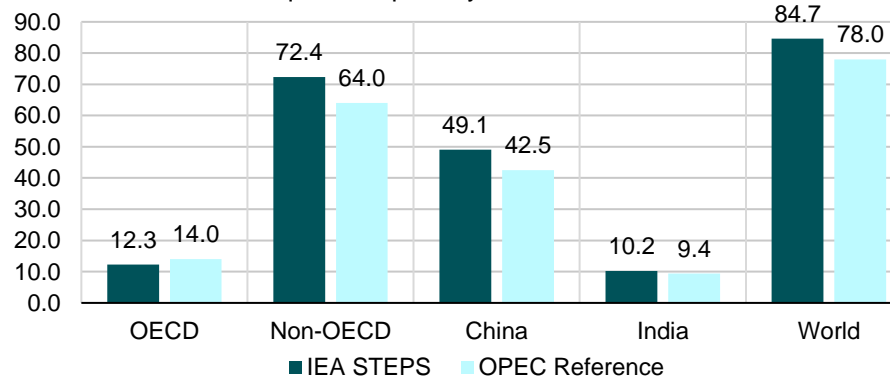
## 2023 Natural Gas Demand

Million barrels of oil equivalent per day



## 2023 Coal Demand

Million barrels of oil equivalent per day



\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

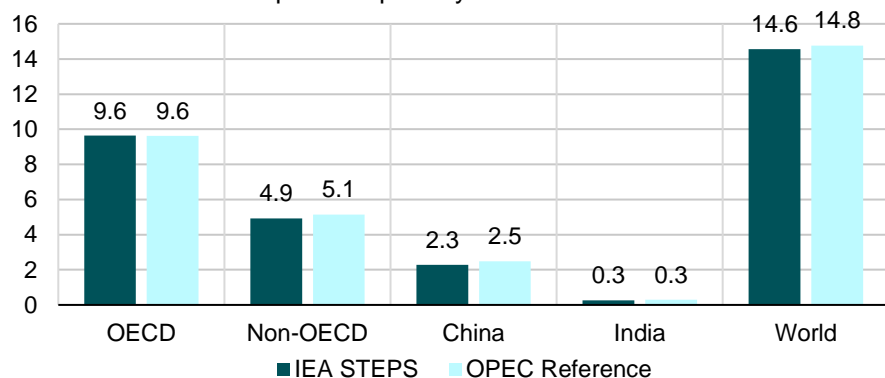
Source: IEF, IEA WEO 2024, OPEC WOO 2024.



# OPEC's reference scenario and the IEA's STEPS are more aligned regarding non-fossil fuel demand, with only minor differences

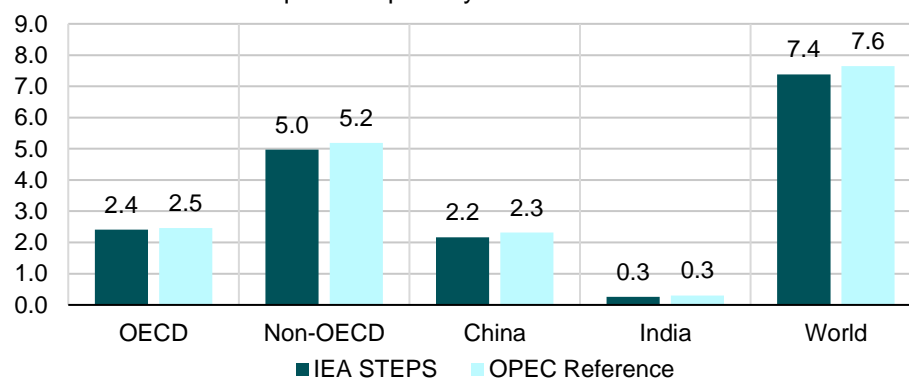
## 2023 Nuclear Demand

Million barrels of oil equivalent per day



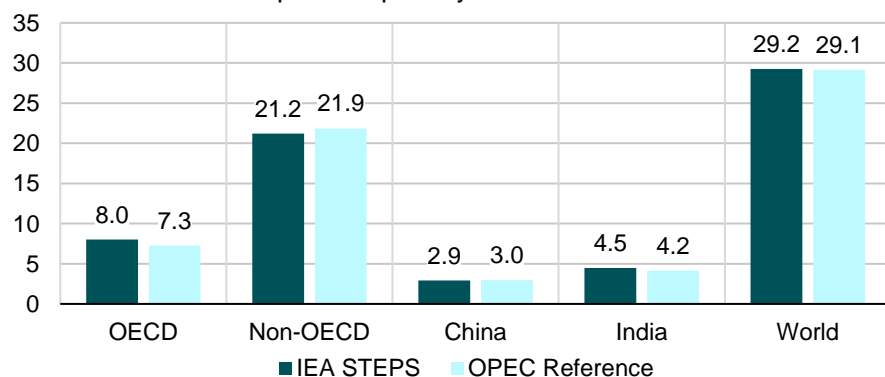
## 2023 Hydro Demand

Million barrels of oil equivalent per day



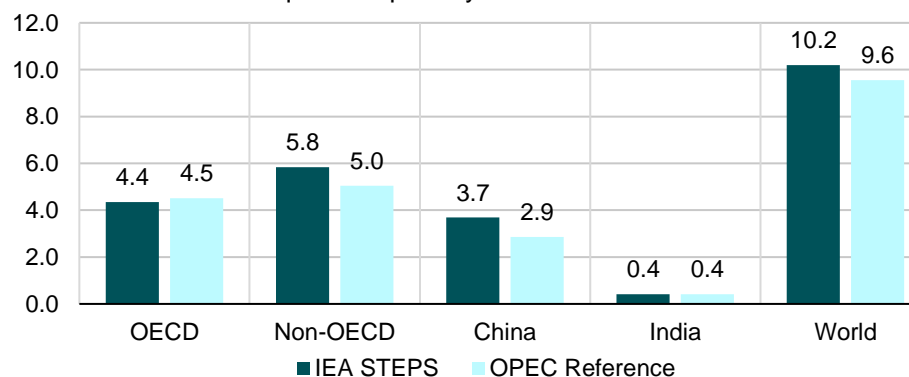
## 2023 Biomass Demand

Million barrels of oil equivalent per day



## 2023 Other Renewables Demand

Million barrels of oil equivalent per day



Source: IEF, IEA WEO 2024, OPEC WOO 2024.

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## Outlooks to 2030 (IEA and OPEC)

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## 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 CO<sub>2</sub> 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):

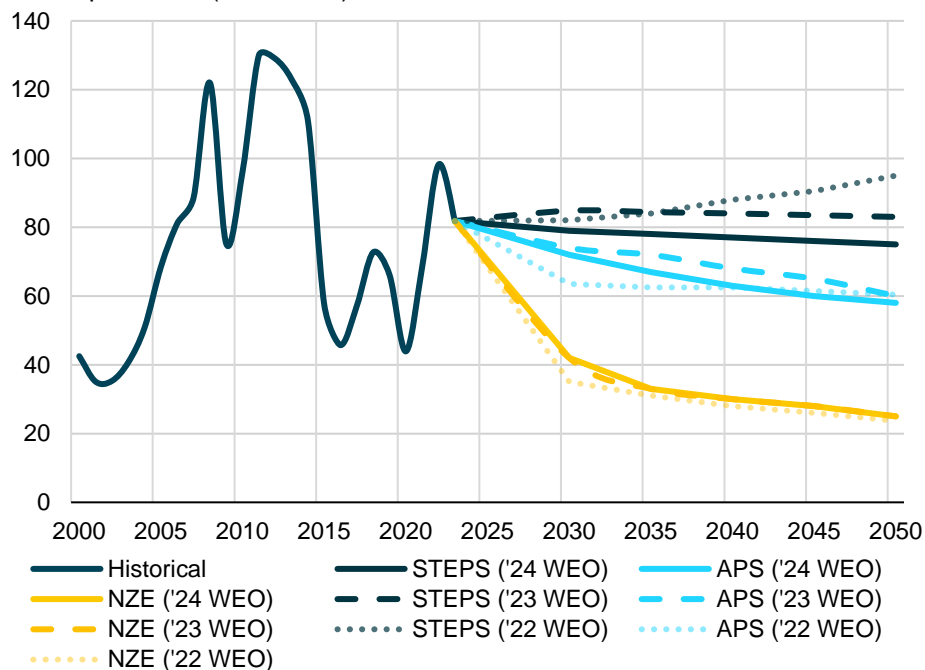
This scenario outlines a strategic framework aimed at fostering a fairer and more prosperous economic landscape for developing countries. It emphasizes a tailored approach to achieving emission reduction goals, considering the unique circumstances and timelines of each nation. Consequently, this framework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

# IEA and OPEC project global real GDP growth to reach 3.1%, a modest increase from last year's assessment of 3.0%

IEA projects crude oil prices to further decline in STEPS and APS scenarios

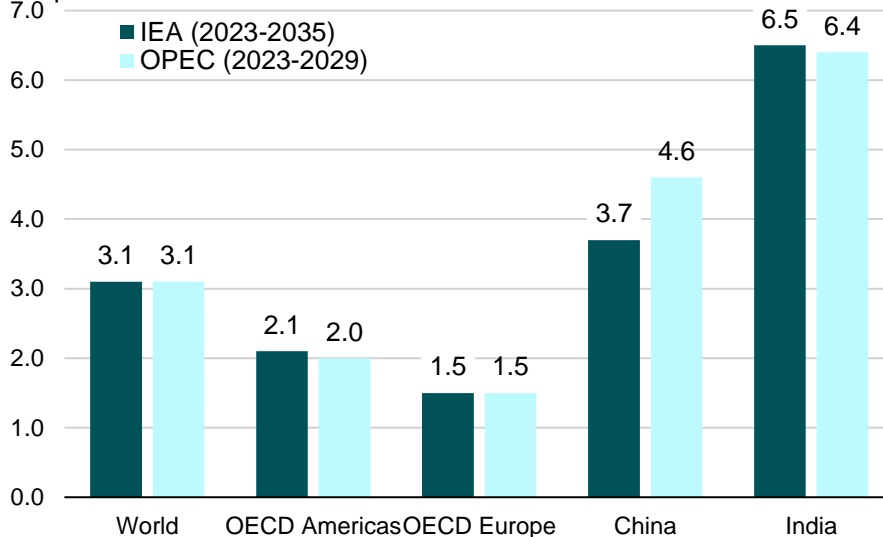
## IEA Crude Oil Price Assumptions by Scenario

USD per barrel (USD 2023)



## Compound Average Annual Real GDP Growth Rate

% per annum

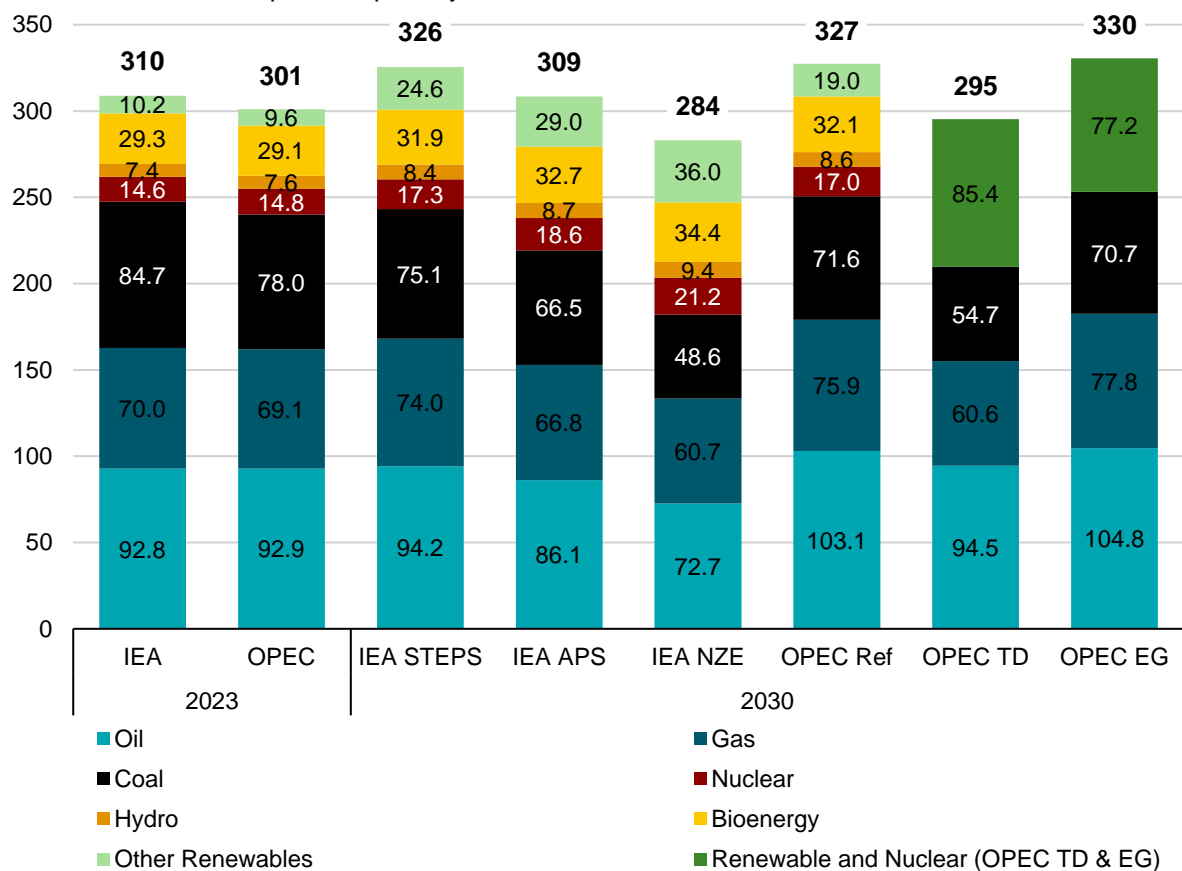


Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# Reference and evolving policy scenarios show primary energy demand growing between 2023 and 2030

## World Primary Energy Outlook to 2030

Million barrels of oil equivalent per day



- IEA NZE and OPEC TD show a decline in the total primary energy demand of 8% and 2% respectively, while IEA APS indicates a slight decrease between 2023 and 2030.
- IEA predicts oil demand to decline in IEA NZE and APS scenarios by 20.1 and 6.7 mb/d respectively.
- OPEC sees gas demand increasing in both Reference and EG scenarios by 10%-13%, while the IEA estimates approximately 6% growth in the STEPS scenario.
- Coal demand is falling in all scenarios. The size of the decline ranges from 8% (in the OPEC Reference scenario) to 43% in the IEA's NZE scenario

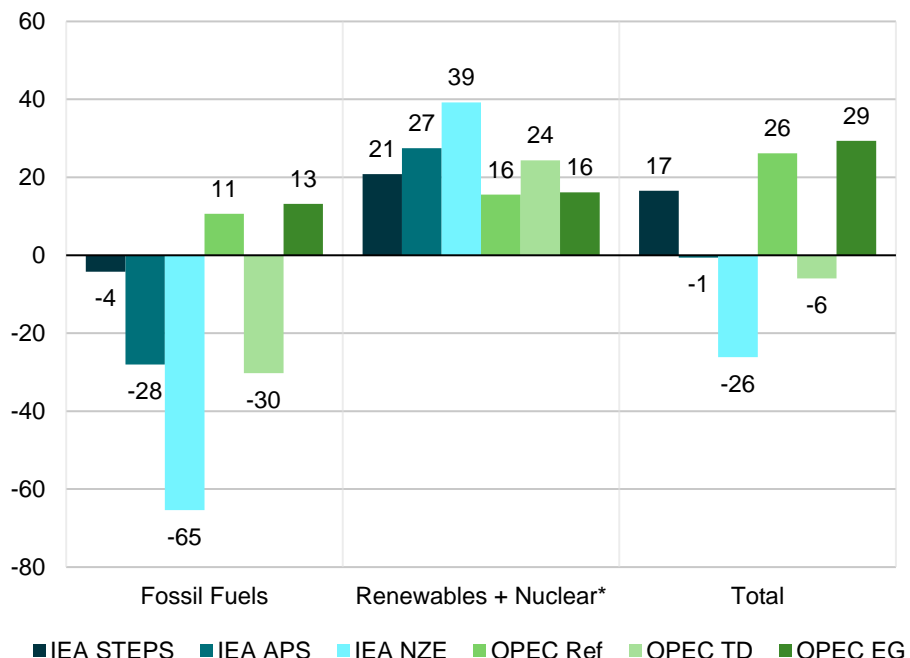
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# Across all scenarios, renewables and nuclear grow by 26% to 65% between 2023 and 2030

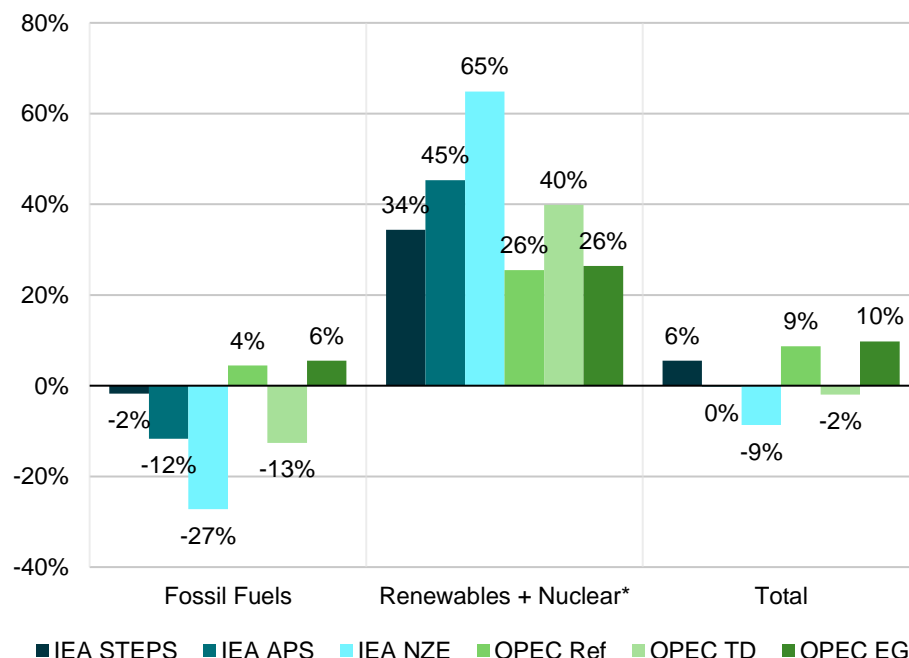
## Change in World Primary Energy by Source: 2030 vs 2023

Million barrels of oil equivalent per day



## World Primary 2030 vs. 2023

% change by energy source



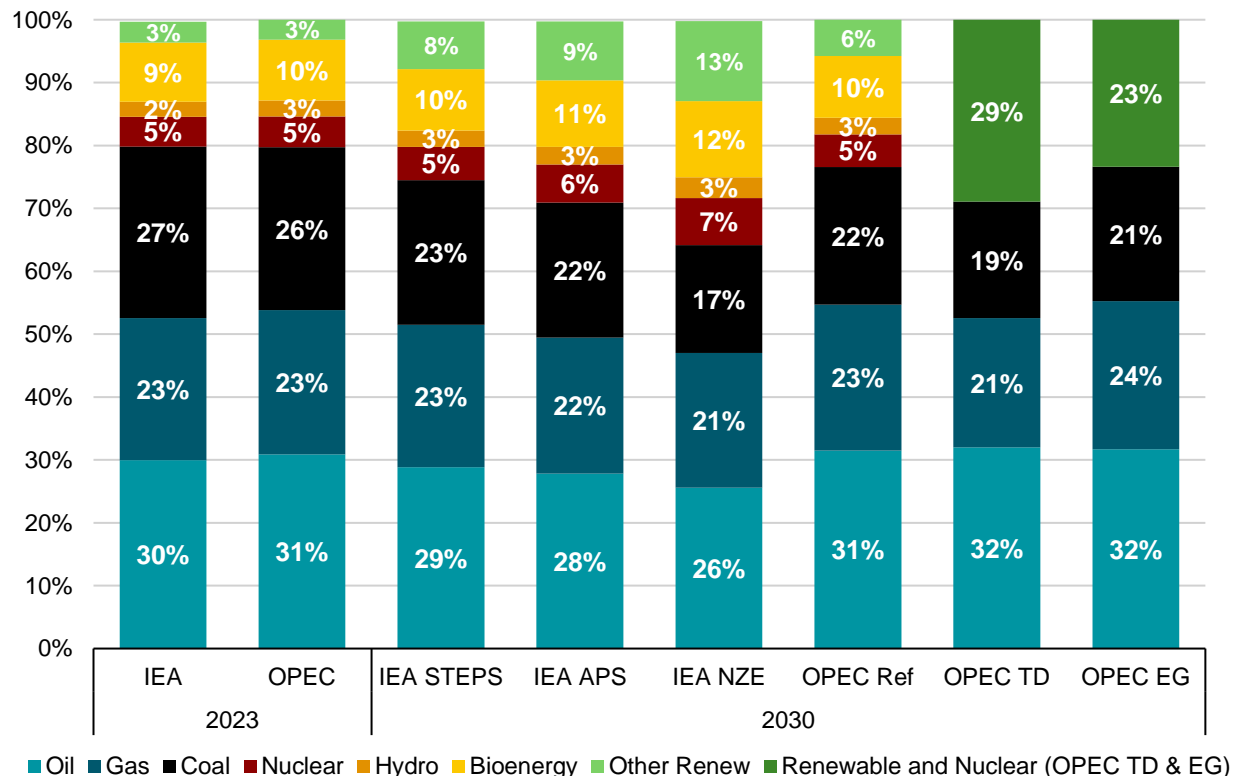
Renewables + Nuclear includes nuclear, hydro, biomass, and other renewables. Renewables are grouped with nuclear to be able to compare all scenarios. OPEC's DT and EG only report the aggregate and not components for renewables and nuclear.

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# By 2030, fossil fuels continue to power most global energy needs, and account for around 64-77% of primary energy demand

## World Primary Energy Fuel Share Outlook to 2030

Percent of total primary energy



- Oil's share of total primary energy demand sees a moderate decline or increase in reference and evolving policy scenarios (IEA STEPS and OPEC Ref).
- The nuclear share of primary energy demand grows in the IEA's ambitious scenarios, while remains flat in the Reference and evolving policies of OPEC and IEA.
- Global renewable energy demand (excluding hydro and bioenergy) is projected to dramatically increase across all IEA scenarios, with potential for doubling in OPEC's Reference Case projection

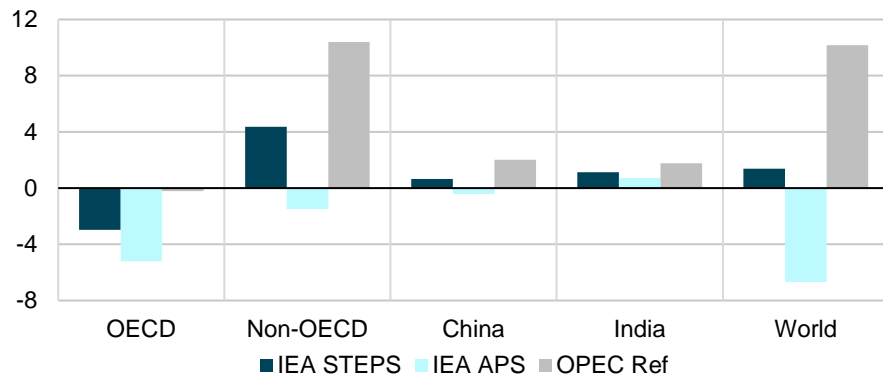
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# All scenarios show declining OECD demand for oil, gas, and coal by 2030, while India's fossil fuel demand grows in all cases

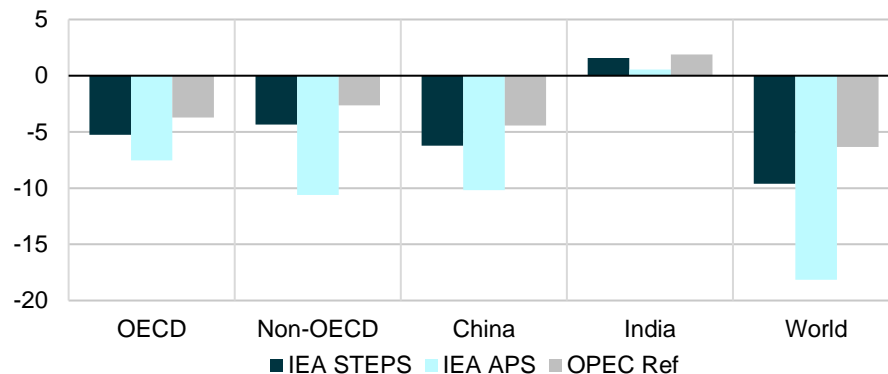
## Change in Oil Demand: 2030 vs. 2023

Million barrels of oil per day



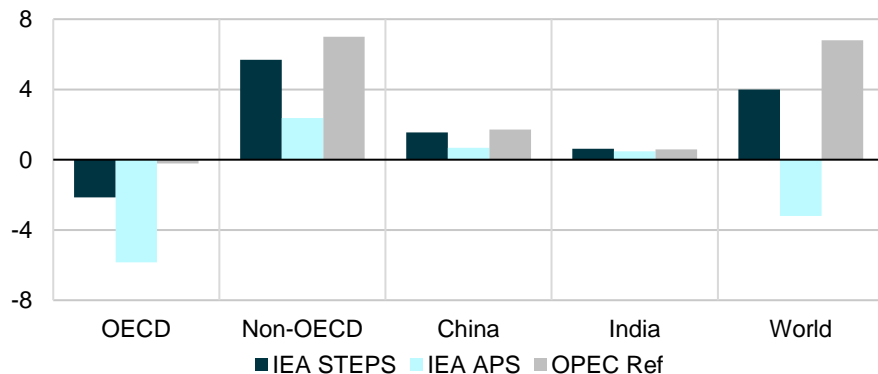
## Change in Coal Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



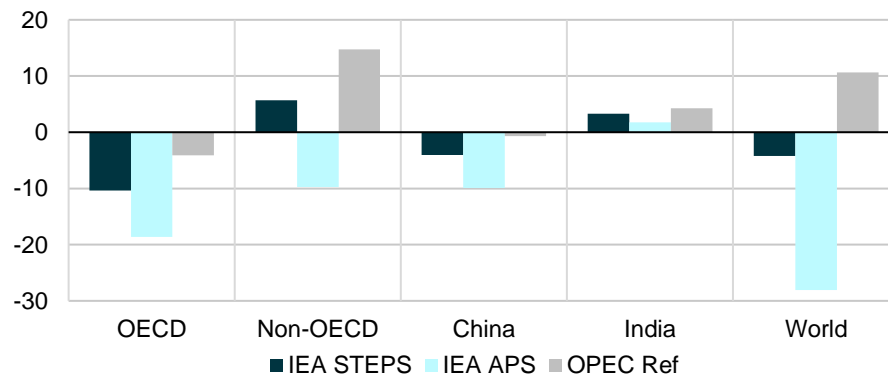
## Change in Natural Gas Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



## Change in Fossil Fuel Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



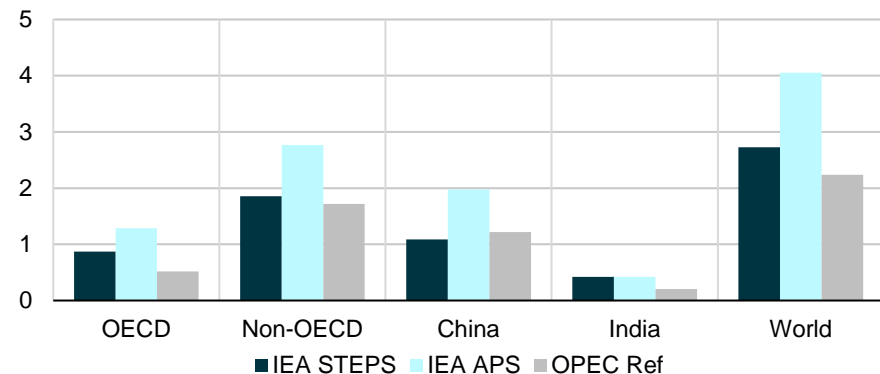
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).  
Source: IEF, IEA WEO 2024, OPEC WOO 2024



# 60%-65% of global growth in other renewables is being driven by non-OECD countries, relative to 2023

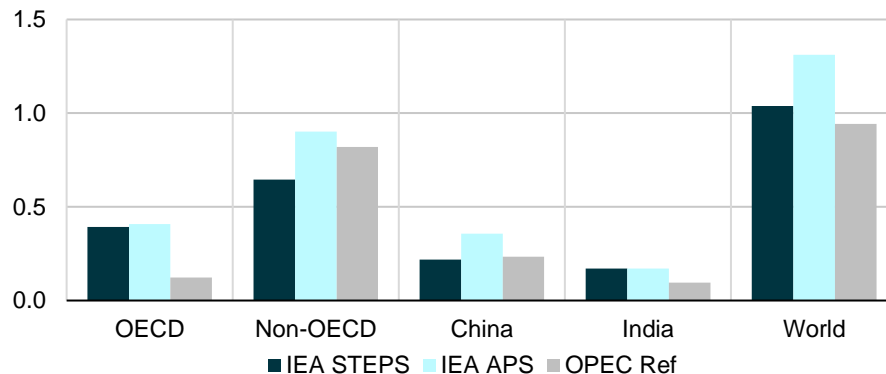
## Change in Nuclear Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



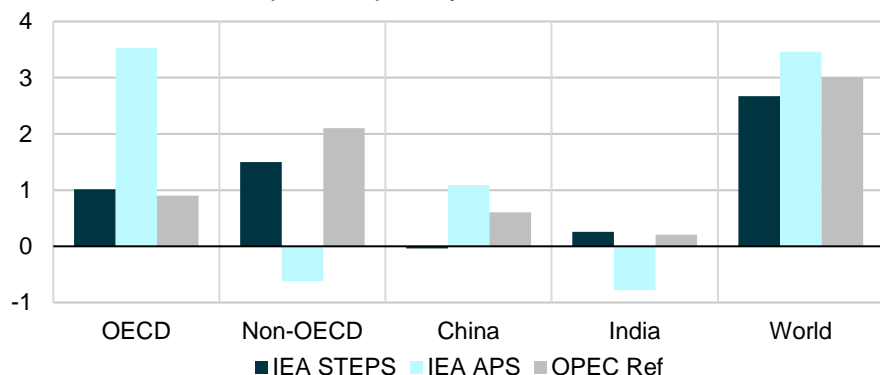
## Change in Hydro Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



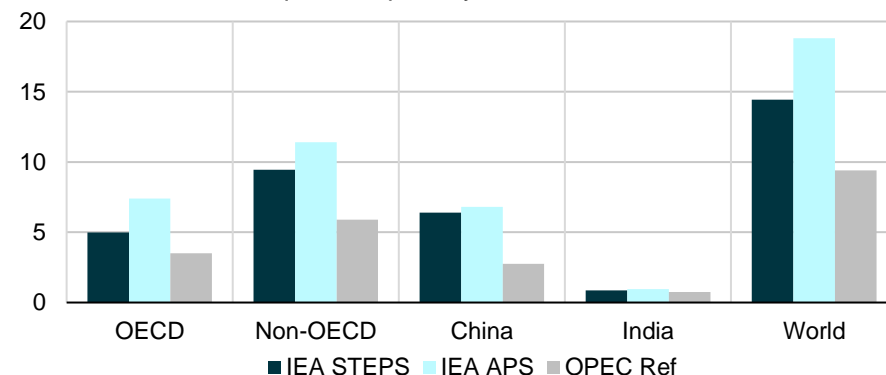
## Change in Biomass Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



## Change in Other Renewables Demand: 2030 vs. 2023

Million barrels of oil equivalent per day



Source: IEF, IEA WEO 2024, OPEC WOO 2024

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## Outlooks to 2035 (IEA and OPEC)

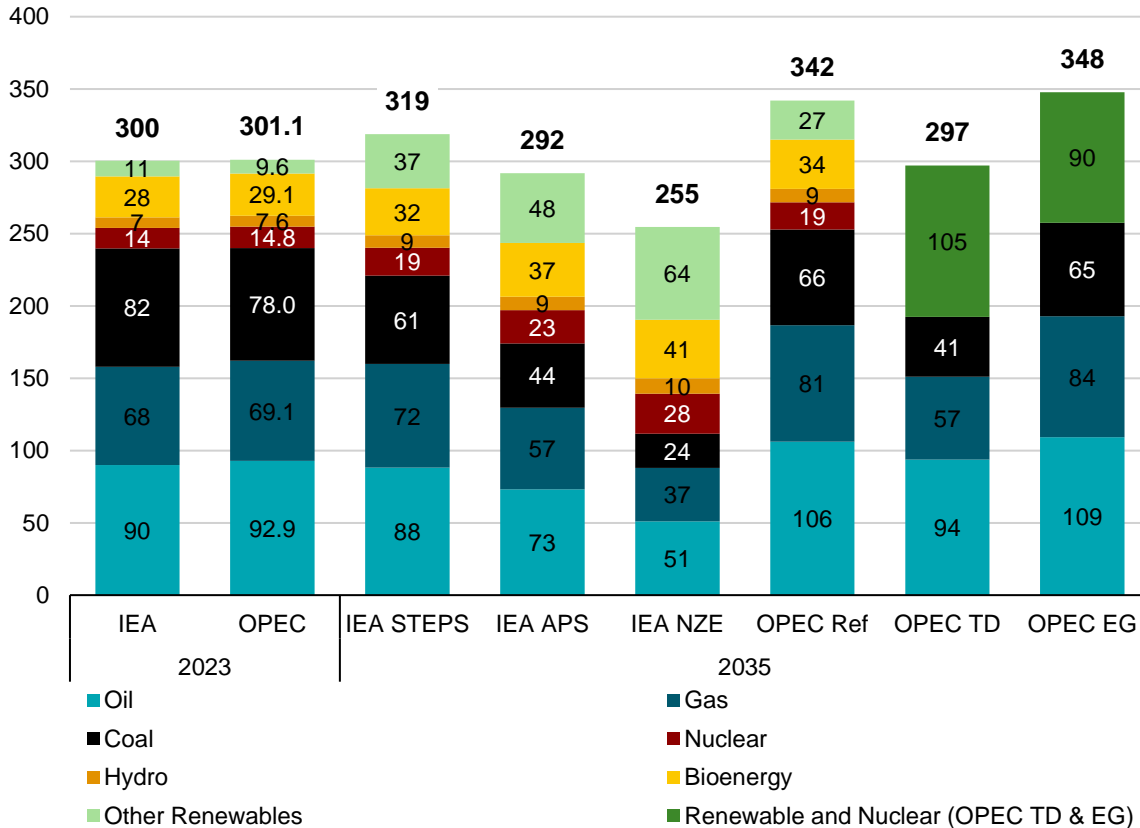
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# Global primary energy demand increases by 8 mboe/d on average across scenarios compared

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

## World Primary Energy Demand Outlook to 2035

Million barrels of oil equivalent per day



- OPEC's Reference Case and Evolving Policies scenarios predict the largest primary energy demand in 2035, with an average of 90 mboe/d difference compared to the IEA's NZE scenario.
- Wind, solar, and bioenergy are expected to experience the highest increase during the period between 2023 and 2035, while coal declines in all scenarios
- Natural gas sees an increase in both the IEA STEPS and OPEC Reference Case by 2035.

\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

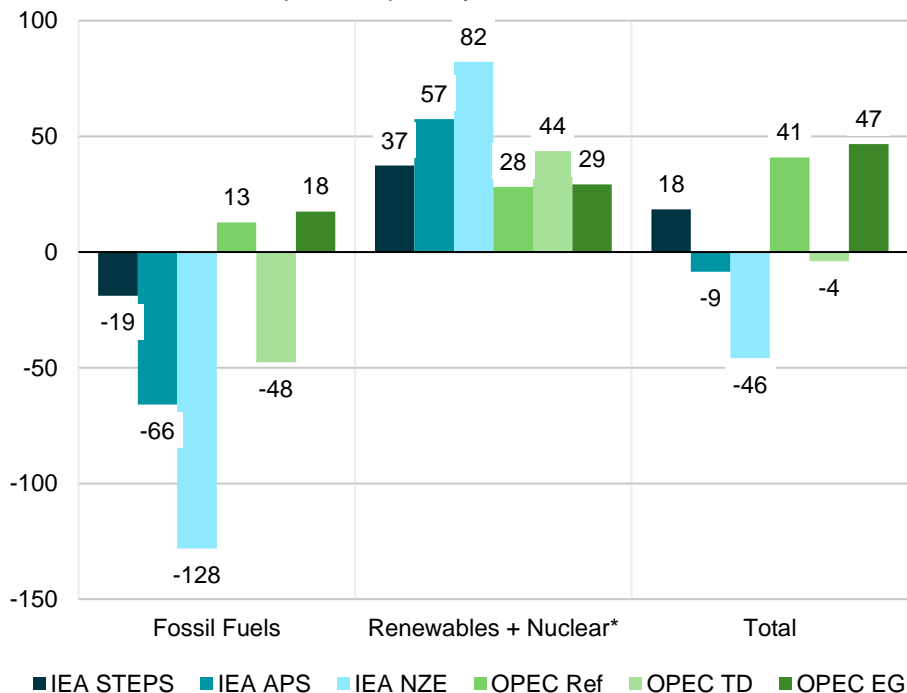
Source: IEF, IEA WEO 2024, OPEC WOO 2024.

# Renewables and nuclear energy are expected to increase across all scenarios, but at very different growth rates

In the net-zero scenario, the increase is approximately double the average of other scenarios

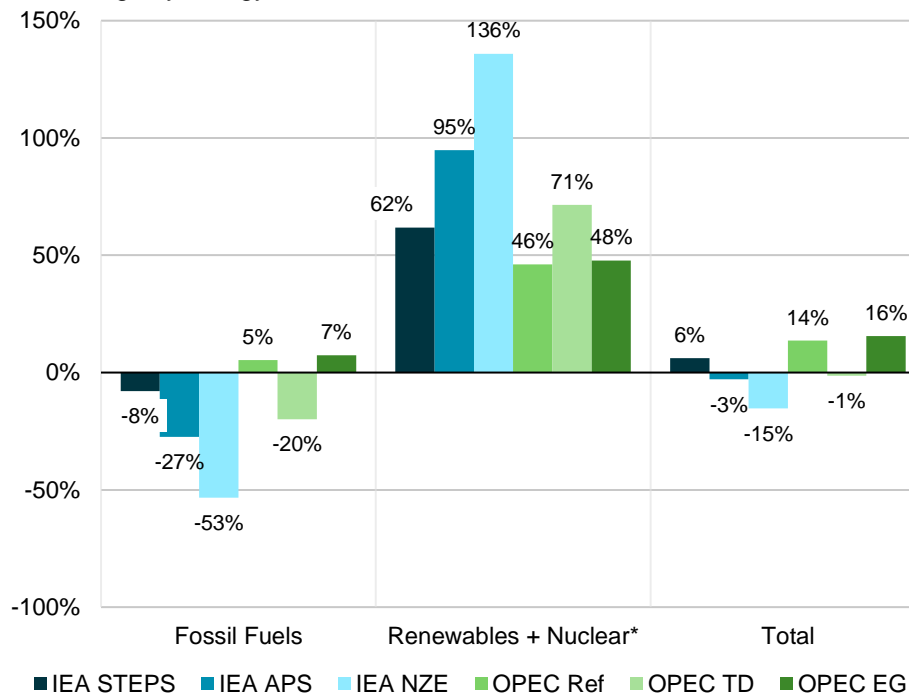
### Change in World Primary Energy by Source: 2035 vs 2023

Million barrels of oil equivalent per day



### World Primary 2035 vs. 2023

% change by energy source

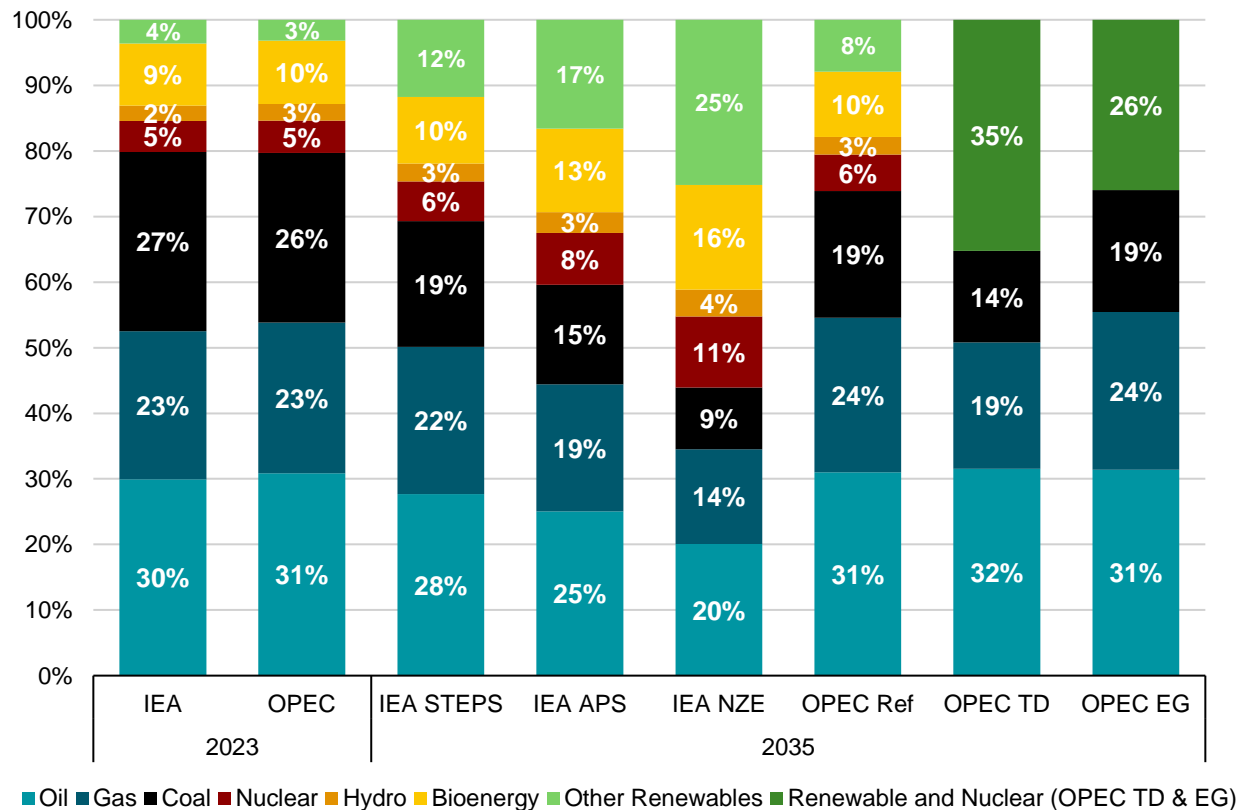


\* Renewables + Nuclear includes nuclear, hydro, biomass, and other renewables. Renewables are grouped with nuclear to be able to compare all scenarios. OPEC's EG and TD only report the aggregate and not components for renewables and nuclear.  
Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# Shares of nuclear, bioenergy, and other renewables increase by around 10% in reference and evolving policy scenarios

## World Primary Energy Demand Fuel Share Outlook to 2035

Percent of total primary energy demand



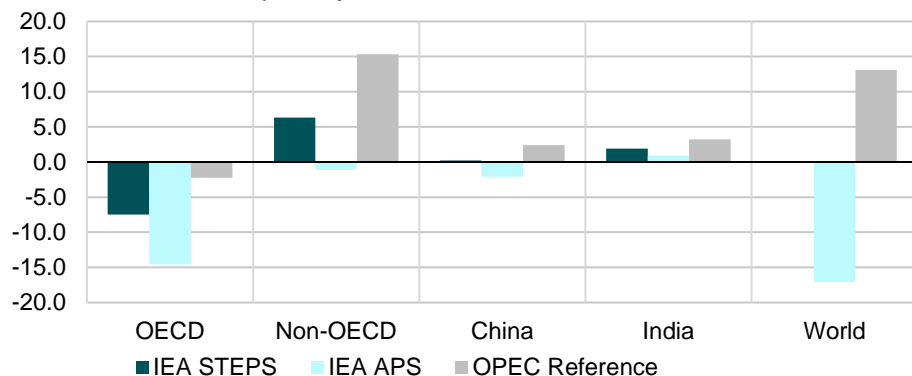
- Oil and natural gas demand in reference and evolving policy cases shows a plateau or an increase in forecasts by 2035.
- Demand for non-fossil fuels is expected to more than double by 2035 in a net-zero scenario, relative to 2023 levels.
- Solar and wind in the 'Other renewables' fuel types are expected to see the largest increase, ranging from 1 to 8-fold.

\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).  
Source: IEF, IEA WEO 2024, OPEC WOO 2024.

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

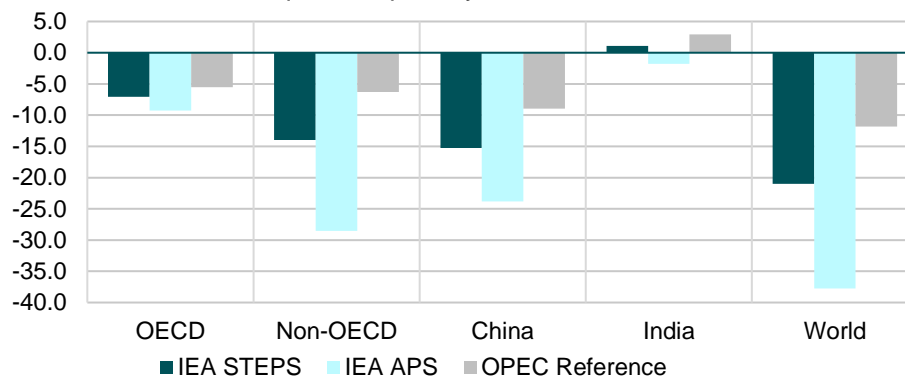
## Change in Oil Demand: 2035 vs. 2023

Million barrels of oil per day



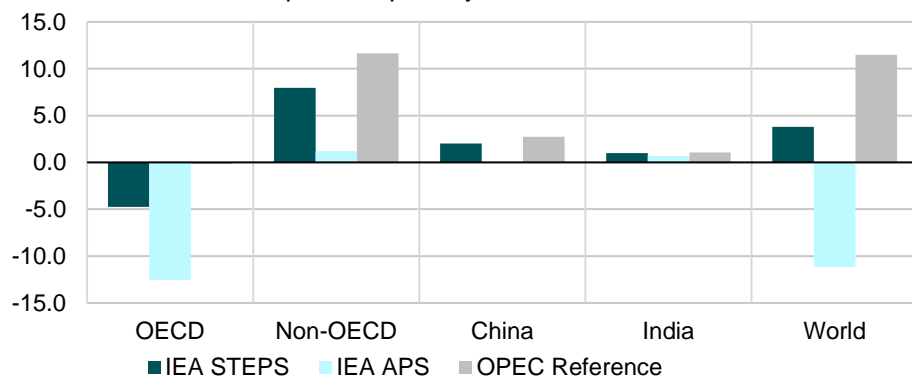
## Change in Coal Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



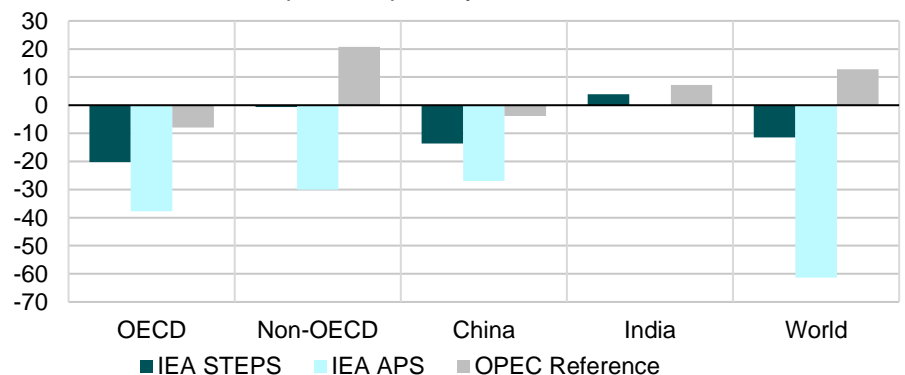
## Change in Natural Gas Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



## Change in Fossil Fuel Demand: 2035 vs. 2023

Million barrels of oil equivalent per day

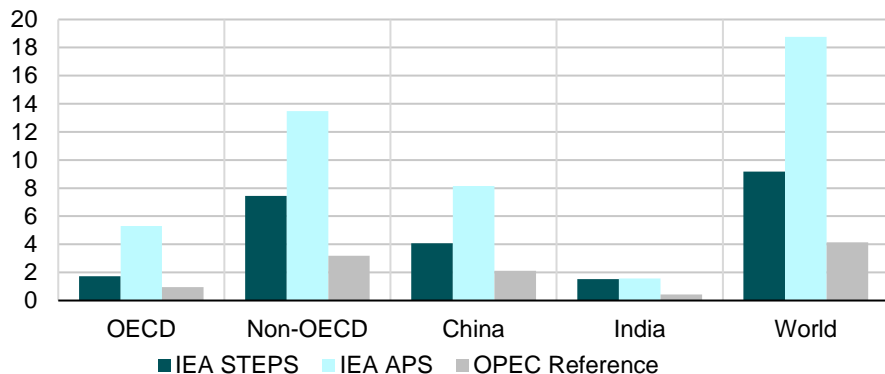


Source: IEF, IEA WEO 2024, OPEC WOO 2024.

# Across all scenarios and fuel sources, non-OECD demand drives global energy demand growth

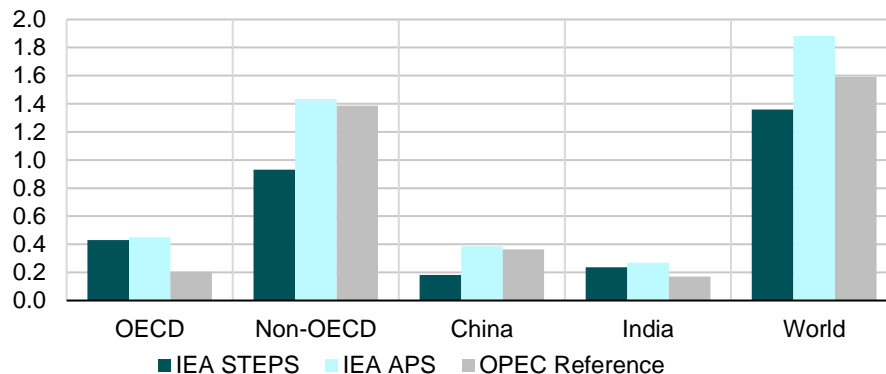
## Change in Nuclear Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



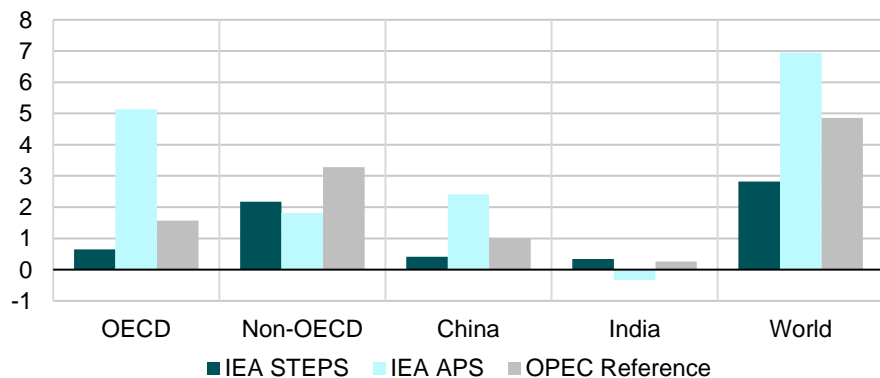
## Change in Hydro Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



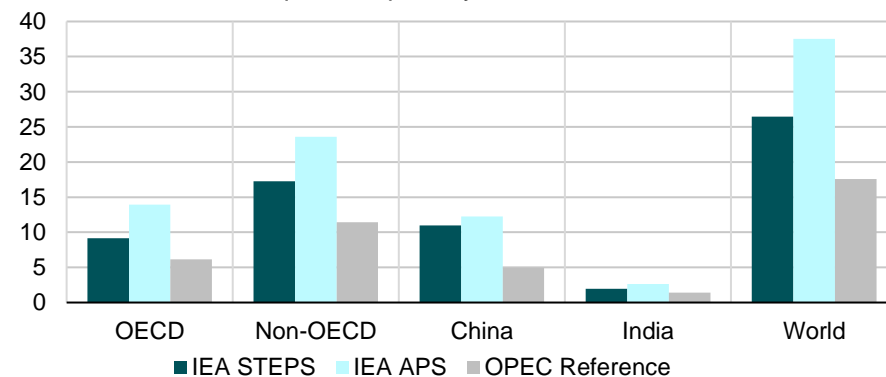
## Change in Biomass Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



## Change in Other Renewables Demand: 2035 vs. 2023

Million barrels of oil equivalent per day



Source: IEF, IEA WEO 2024, OPEC WOO 2024.

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## Outlooks to 2050 (IEA and OPEC)

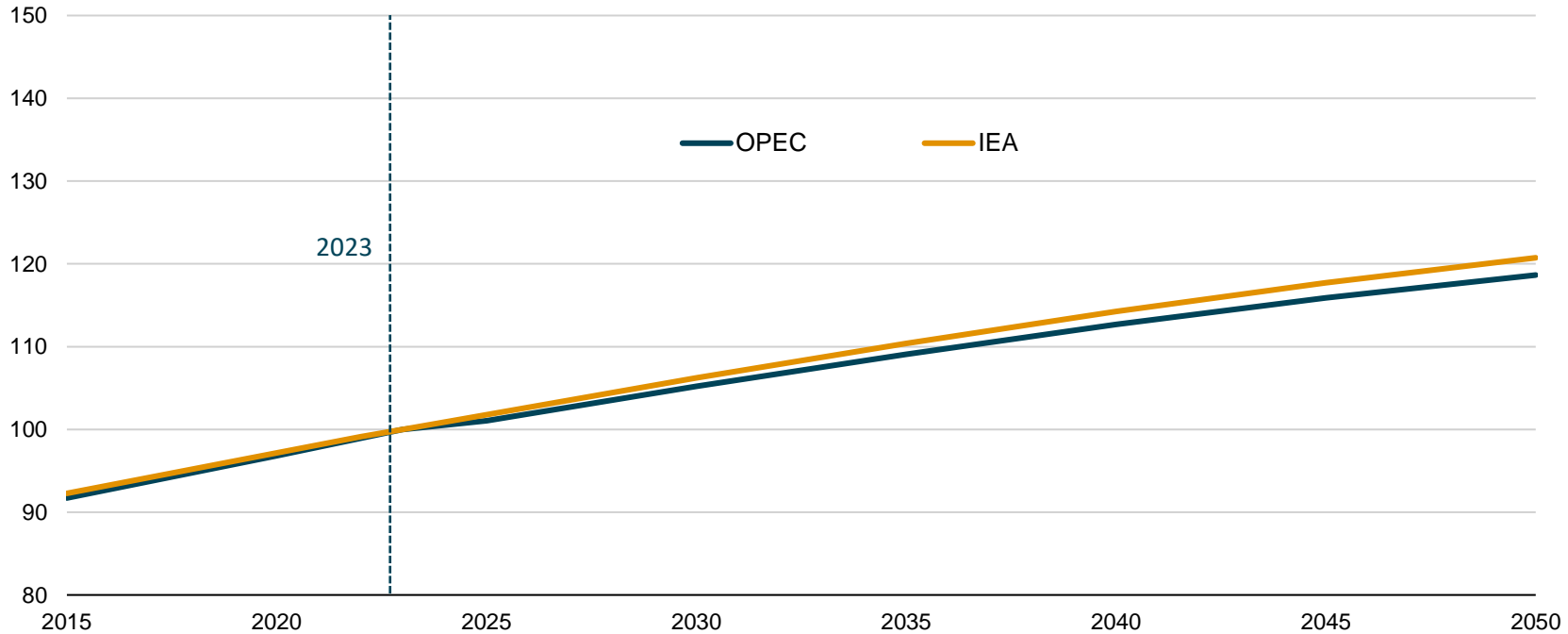
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# The global population is set to increase by 1.5 billion by 2050 relative to 2023 levels

## Global Population Growth

Index 2023=100

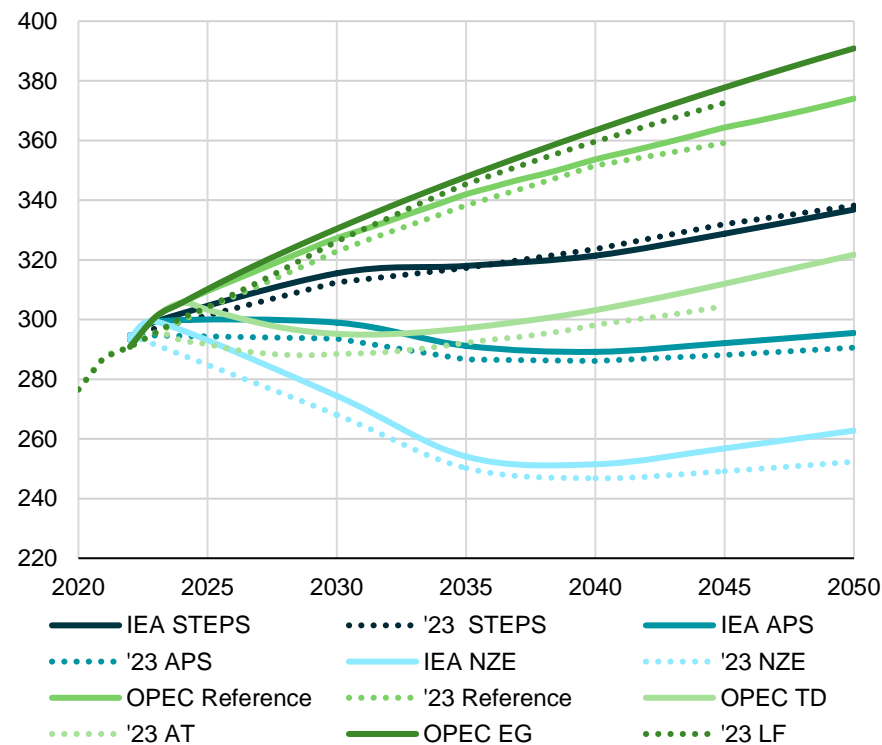


Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# Comparing to 2023 editions, global primary energy demand increases: IEA's NZE shows the largest upward revision in 2050

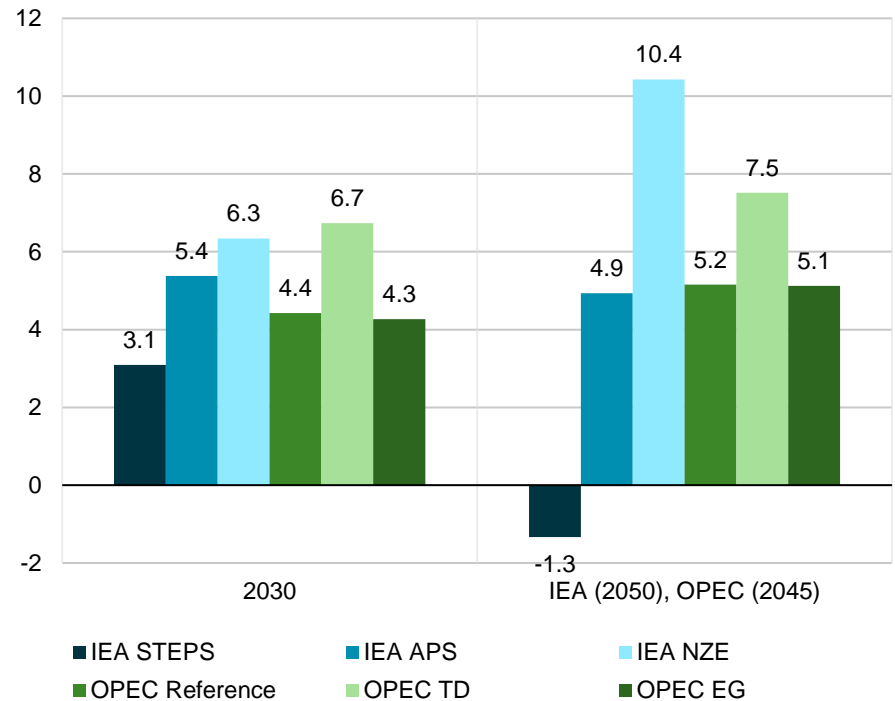
## Global Primary Energy Demand Outlook

Million barrels of oil equivalent per day



## Global Primary Energy Outlook: Revisions to 2023 Scenarios

Million barrels of oil equivalent per day

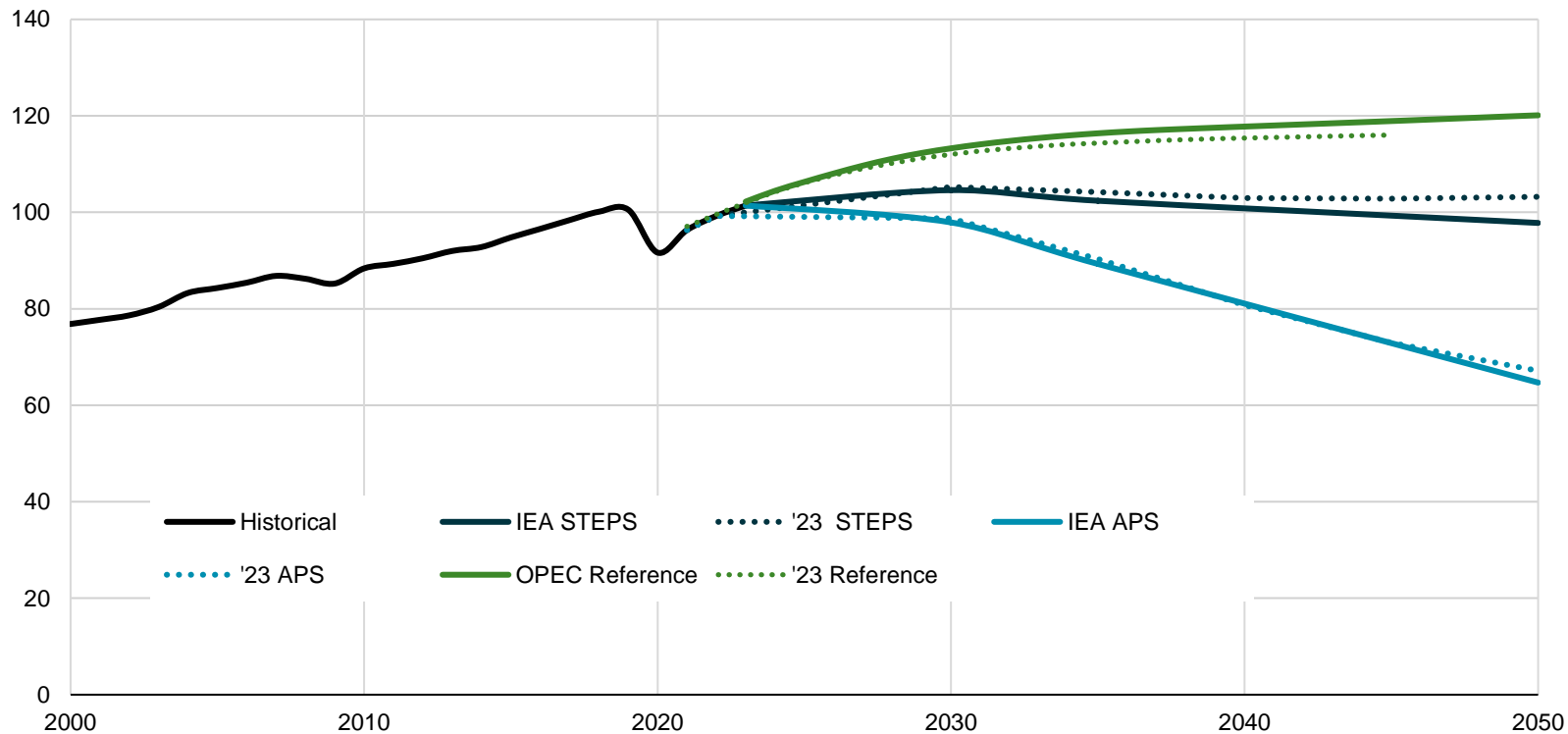


Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# OPEC shows global liquids demand increase while IEA made downward revisions compared to last year's assessments

## Global Liquids Demand

Million barrels of oil per day

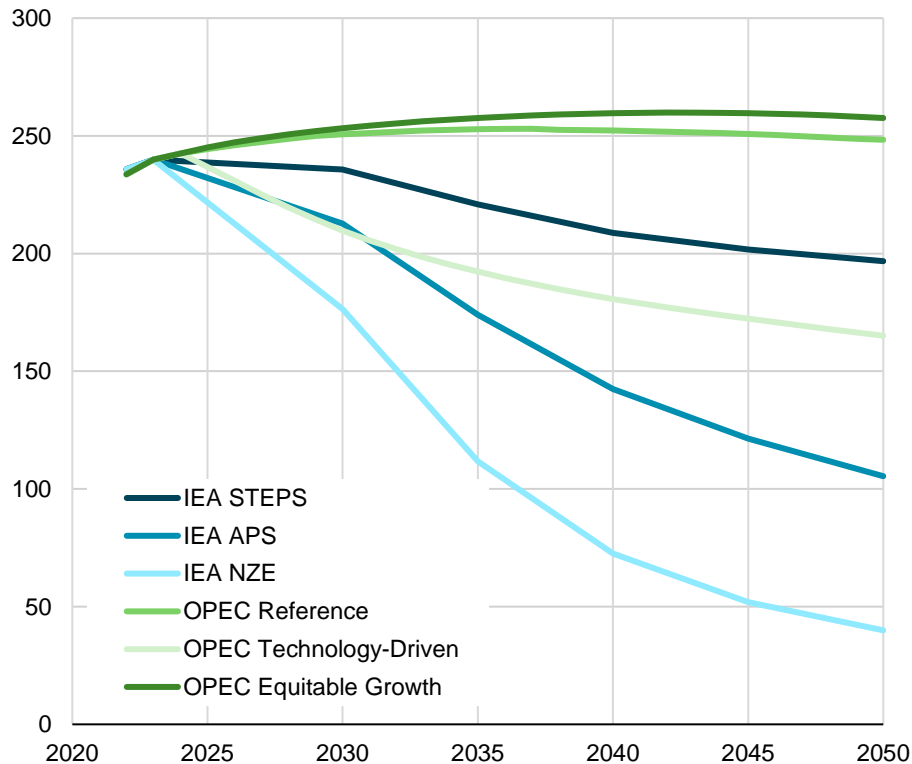


Source: IEF, IEA WEO 2024, and OPEC WOO 2024.

# Non-fossil fuels demand may rise from 57 mboe/d to around 125-223 mboe/d, but not reach current fossil fuel demand by 2050

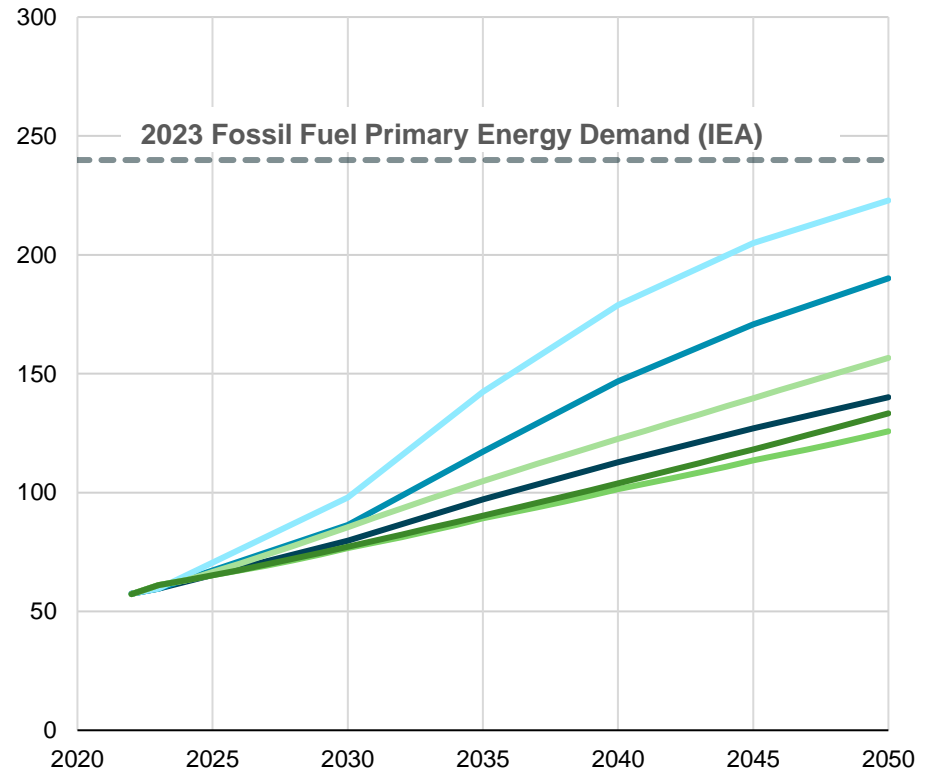
## Fossil Fuel Primary Energy Demand Outlook

Million barrels of oil equivalent per day



## Non-Fossil Fuel Primary Energy Demand Outlook

Million barrels of oil equivalent per day

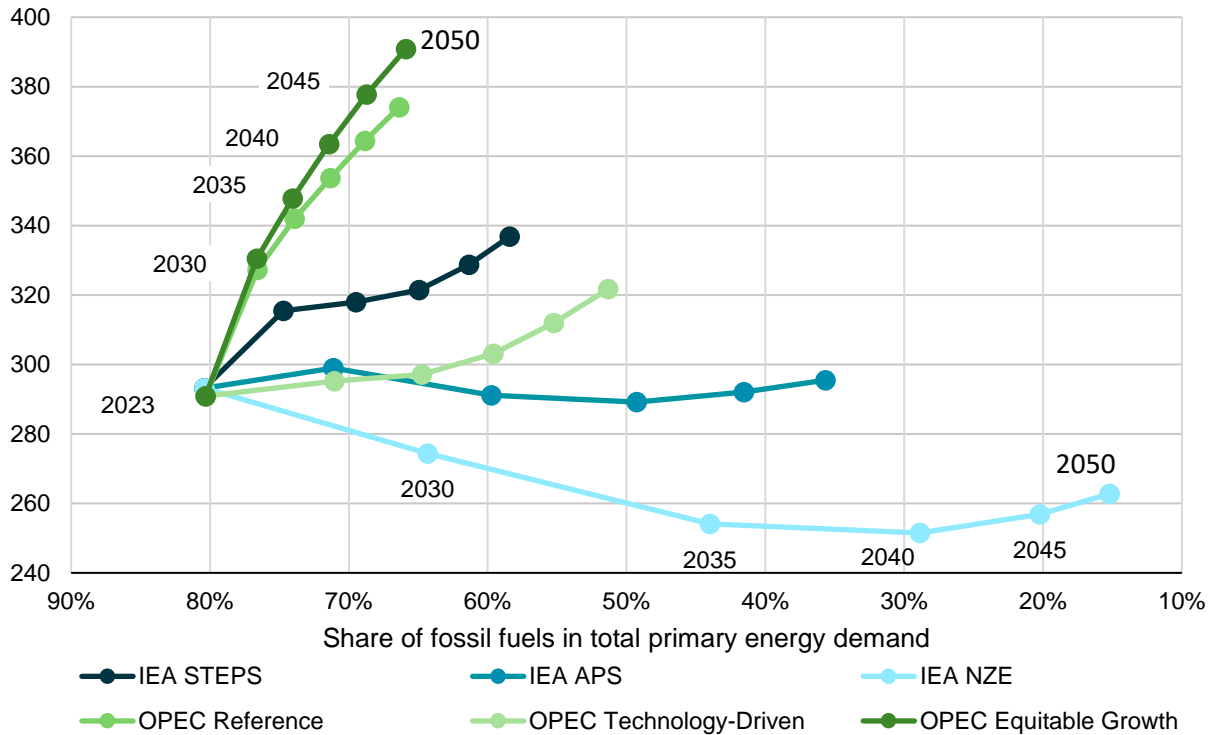


Source: IEF, IEA WEO 2024, and OPEC WOO 2024

# Fossil fuels' share in global primary energy demand declines from 80% to around 15% by 2050 in the most ambitious scenario

## Share Fossil Fuels in Total Primary Energy Demand

Total primary energy demand, million barrels of oil equivalent per day



- All scenarios reveal a decline in fossil fuels' share of total primary energy demand, although at vastly different paces.
- OPEC's Equitable Growth scenario contrasts with the IEA's Net Zero Emissions scenario.
- OPEC's EG predicts the highest amount of primary energy demand by 2050 and almost the lowest share of non-fossil fuels, while IEA's NZE scenario forecasts that non-fossil fuels will account for about 85% of total primary energy demand by 2050 with a substantial reduction in overall energy demand.

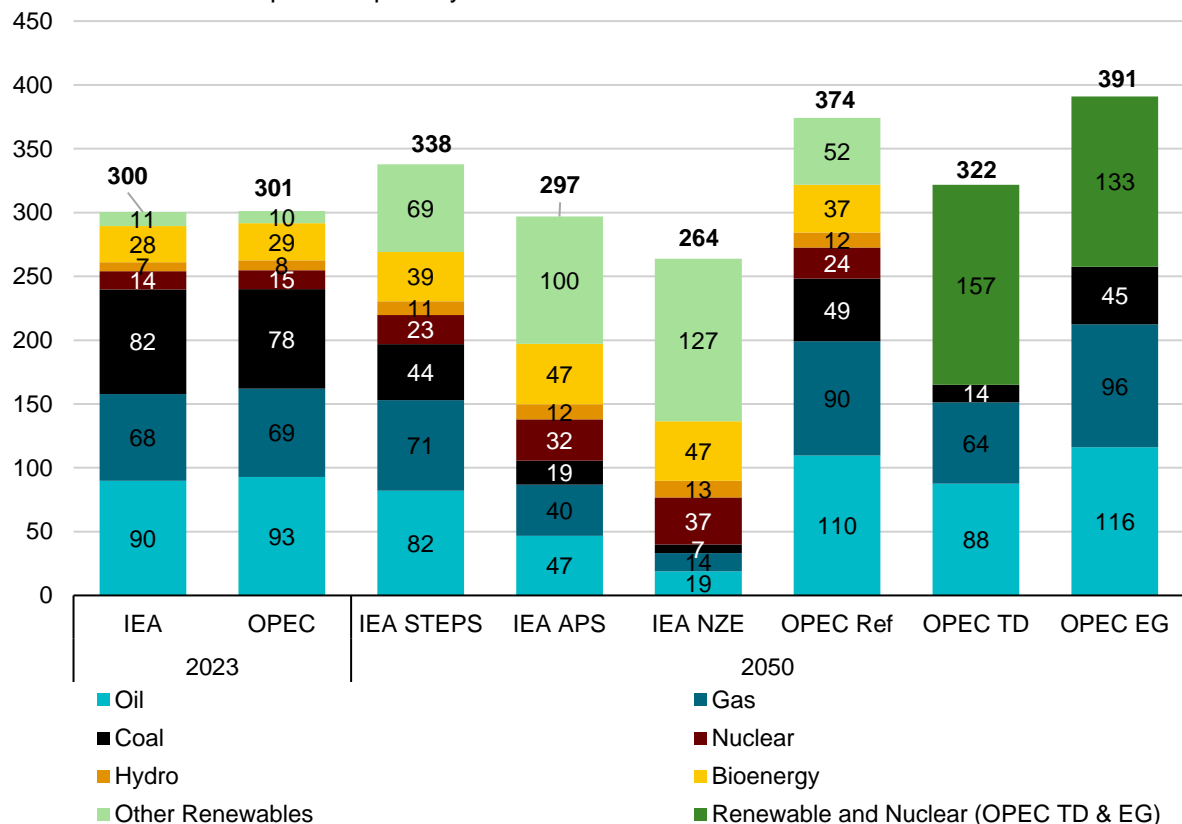
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# Renewables increase by 4 to 6 times by 2050, according to the reference and evolving policy scenarios

## World Primary Energy Demand Outlook to 2050

Million barrels of oil equivalent per day



- The IEA's STEPS reveals a small decline in oil demand by 2050, relative to 2023 levels, while OPEC shows an increase.
- Paris-compliant scenarios indicate that coal demand is projected to decrease by more than six times by 2050 compared to the demand in 2023.
- All reference and evolving policy scenarios show an increase in natural gas demand by 2050, with OPEC revealing an increase of approximately 30%.

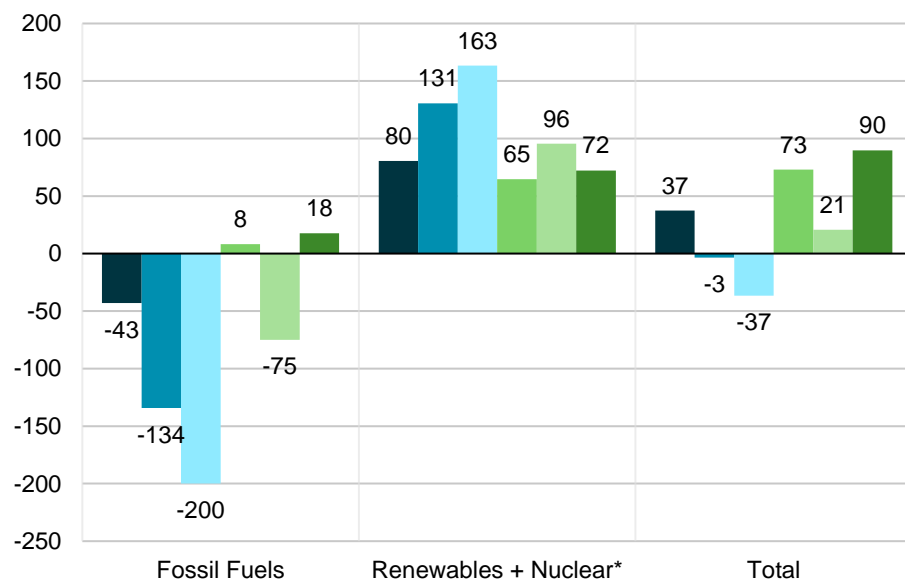
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# Sharp reduction in coal consumption serves as a primary driver in diminishing overall fossil fuel demand

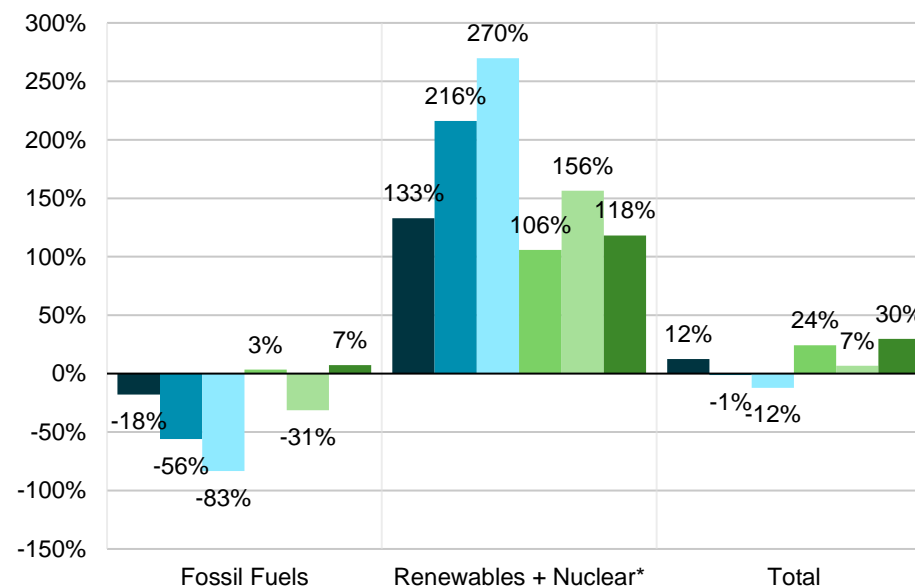
## Change in World Primary Energy by Source: 2050 vs 2023

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

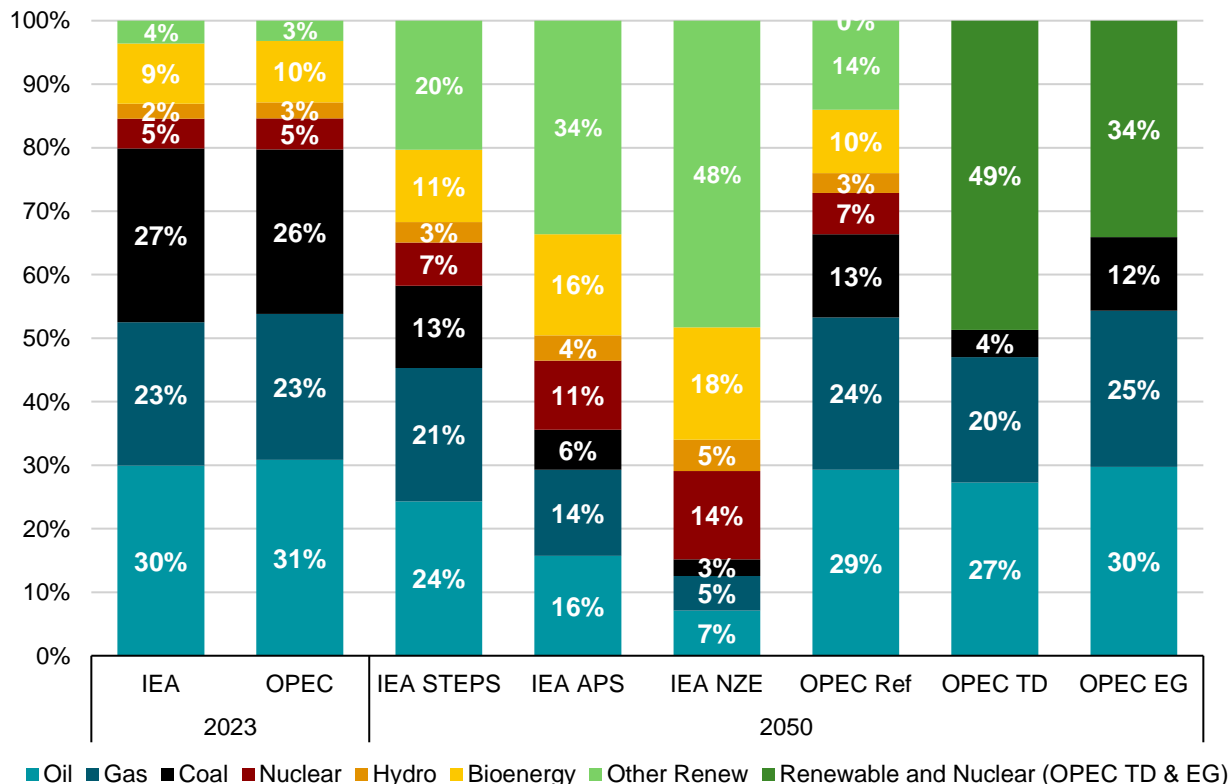
\* Renewables + Nuclear includes nuclear, hydro, biomass, and other renewables. Renewables are grouped with nuclear to be able to compare all scenarios. OPEC's EG and TD only report the aggregate and not components for renewables and nuclear.

Source: IEF, IEA WEO 2024, and OPEC WOO 2024

# The share of fossil fuels in global energy demand is projected to change from around 80% in 2023 to range at 15% to 67% by 2050

## World Primary Energy Demand Fuel Share Outlook to 2050

Percent of total primary energy



- Coal experiences the most significant reduction in its share of primary energy between 2023 and 2050. Its contribution to total primary energy demand decreases from 26-27% in 2023 to as low as 3% in IEA's NZE scenario, or up to 13% in the IEA's STEPS and OPEC's reference case.
- OPEC's Reference case and OPEC's EG projected a rise in natural gas demand compared to 2023 levels, while others predicted a decline.
- IEA's NZE scenario shows "other renewables" share of primary demand increasing from 3% in 2023 to 48% in 2050.

\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

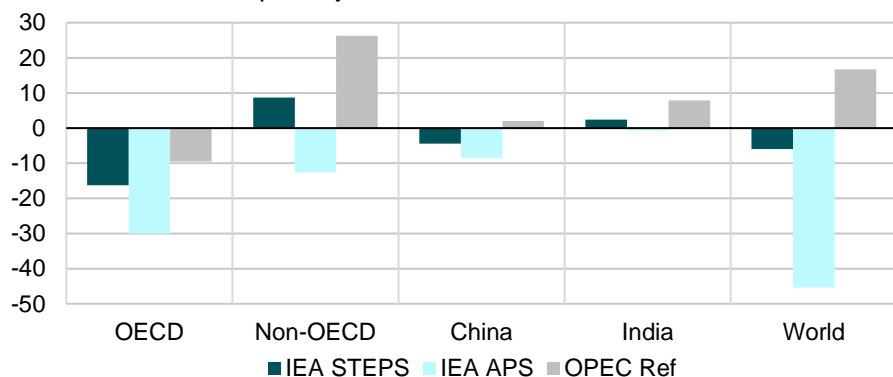
Source: IEF, IEA WEO 2024, OPEC WOO 2024



# Chinese coal demand declines by 2050, while natural gas and oil demand remains stable

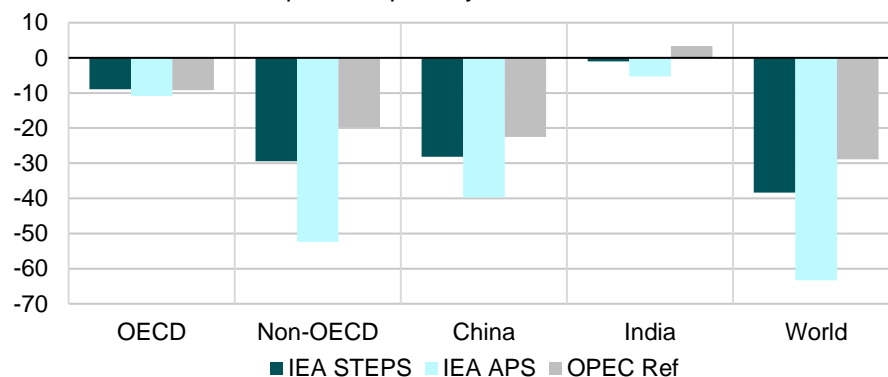
## Change in Oil Demand: 2050 vs. 2023\*

Million barrels of oil per day



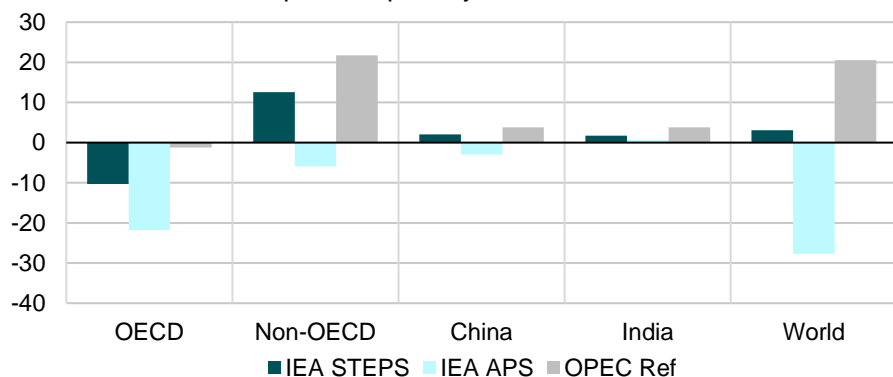
## Change in Coal Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



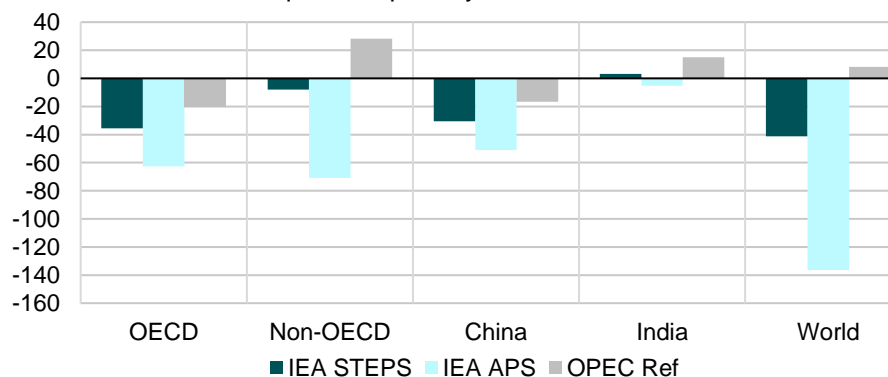
## Change in Natural Gas Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



## Change in Fossil Fuel Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



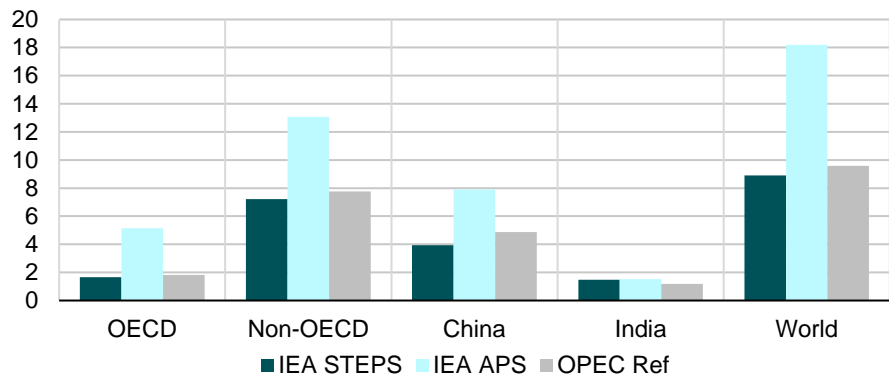
\*Oil excludes biofuels, coal-to-liquids, and gas-to-liquids (see appendix for more information).

Source: IEF, IEA WEO 2024, OPEC WOO 2024

# Changes in the world's projections for nuclear and biomass by IEA APS almost double figures from IEA STEPS and OPEC Reference

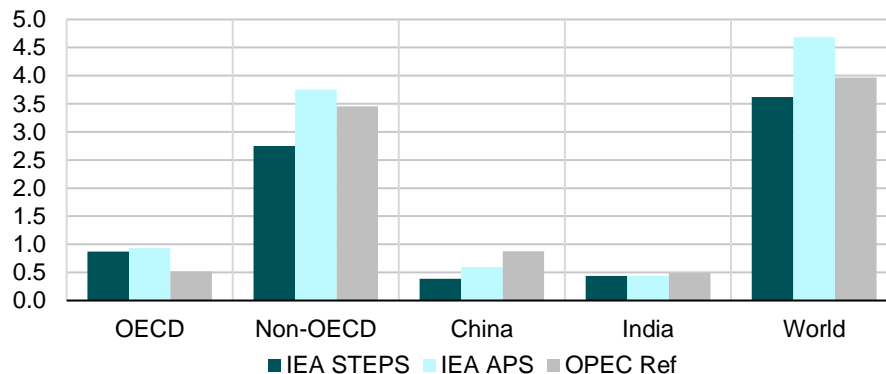
## Change in Nuclear Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



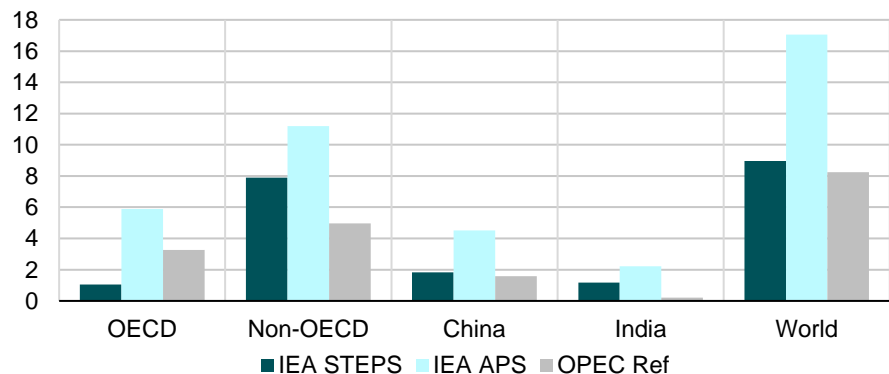
## Change in Hydro Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



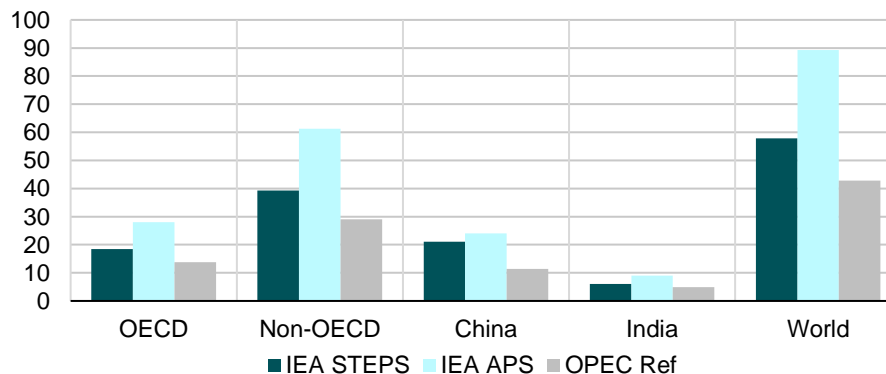
## Change in Biomass Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



## Change in Other Renewables Demand: 2050 vs. 2023

Million barrels of oil equivalent per day



Source: IEF, IEA WEO 2024, OPEC WOO 2024

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## **Additional Context: IEA and OPEC Scenarios Alongside Other Industry and Agency Outlooks**

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# Additional Scenario Descriptions and Assumptions

<b>Total</b>	Trends**	The Trends scenario projects a global temperature increase of 2.6-2.7°C by 2100, incorporating current technological and policy trajectories.	<b>GECF</b>	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.			
<b>BP</b>	Current Trajectory**	In this scenario, greenhouse gas emissions, measured in carbon dioxide equivalents (CO <sub>2</sub> e), reach their highest point in the mid-2020s and subsequently decrease to approximately 75% of 2022 levels by 2050.	<b>IEEJ</b>	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.
<b>EIA</b>	Reference**	Reflects current energy trends and existing laws and regulations. Assumes global GDP growth averages 2.6% from 2022-2050.	<b>IPCC AR6 WGIII</b>	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.
<b>Equinor</b>	Walls**	Current trends in the market, technology, and policies show that the energy transition is accelerating slowly but is not reaching climate goals.	<b>IRENA</b>	IMP-LD (1.5)*	Limits warming to 1.5C with greater emphasis on demand reduction.
	Bridges*	Broadly consistent with IPCC 1.5°C.		Planned**	Reference case based on planned targets and government policies.
<b>Exxon</b>	Reference**	Current trends in market, technology and policies.	<b>Shell</b>	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.
<b>DNV</b>	Reference**	Current trends in market, technology and policies.		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.
<b>EnerData</b>	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.

\*Included in "Ambitious Climate Scenarios" group in the following slides;

\*\*Included in the "Reference Cases and Evolving Policies" group in the following slides;

See descriptions of IEA and OPEC scenarios on page 32

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# Sector Spotlight

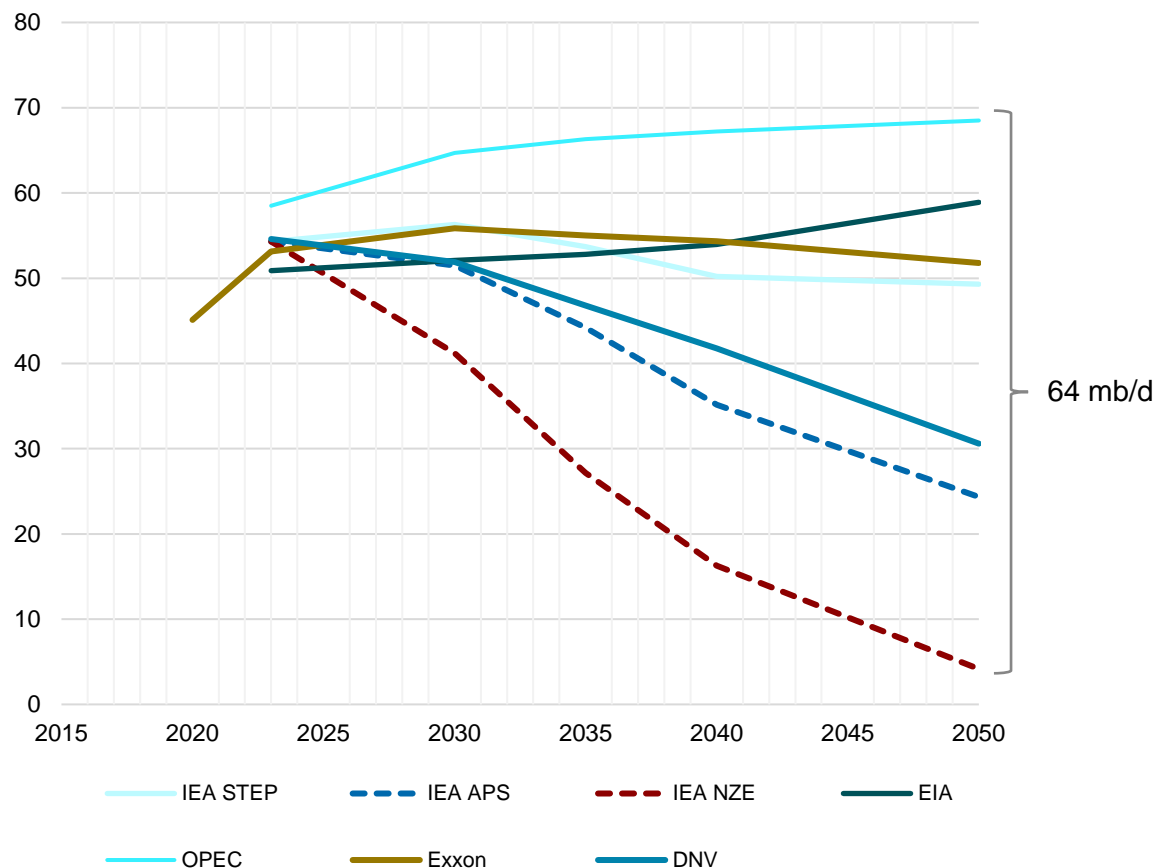
## Transport

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# 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



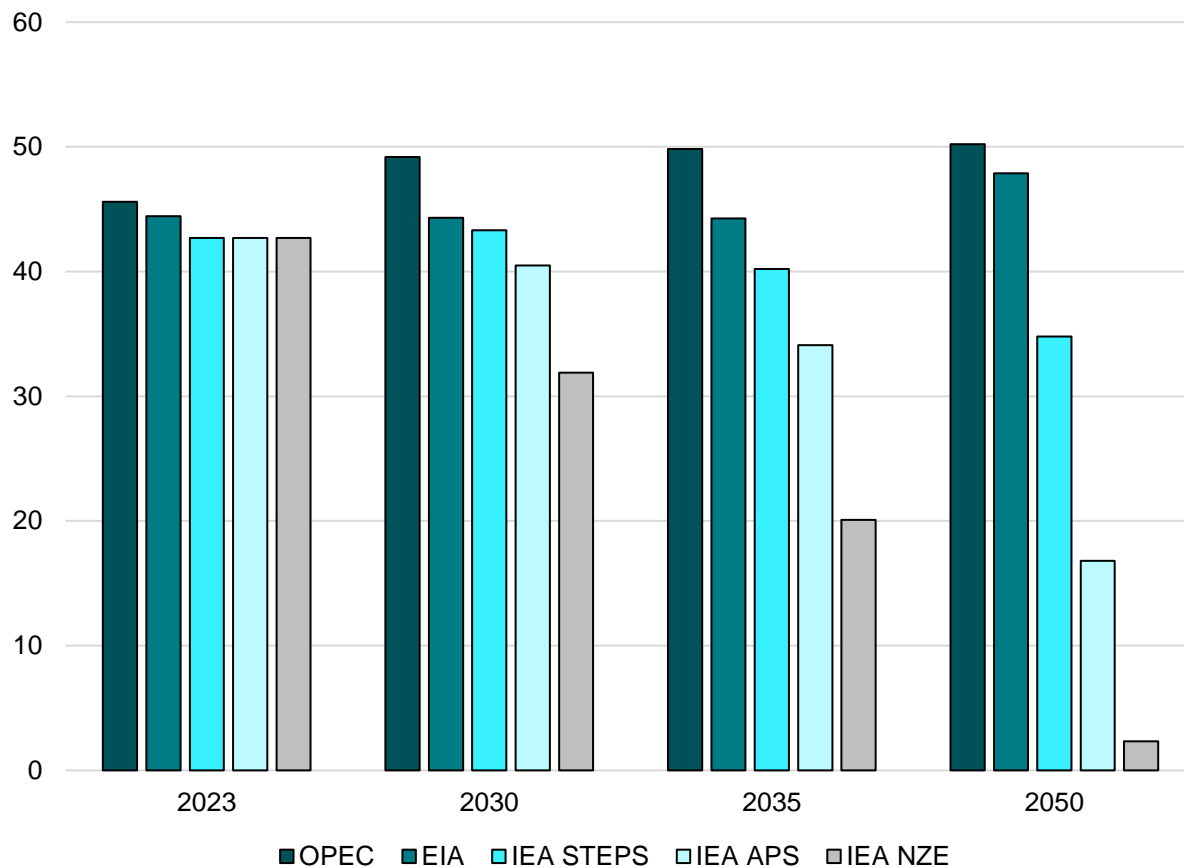
- The uncertainty surrounding transportation demand projections is evident, as the expected variance by 2050 surpasses 60 mb/d, which is almost equivalent to the current consumption within this sector.
- Only the EIA, Exxon and OPEC Reference Cases show transport sector oil demand increase and or plateau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

# Road transport is expected to account for an average of 70 percent of total transport demand by 2050

## Road Transport

Million barrels of oil per day



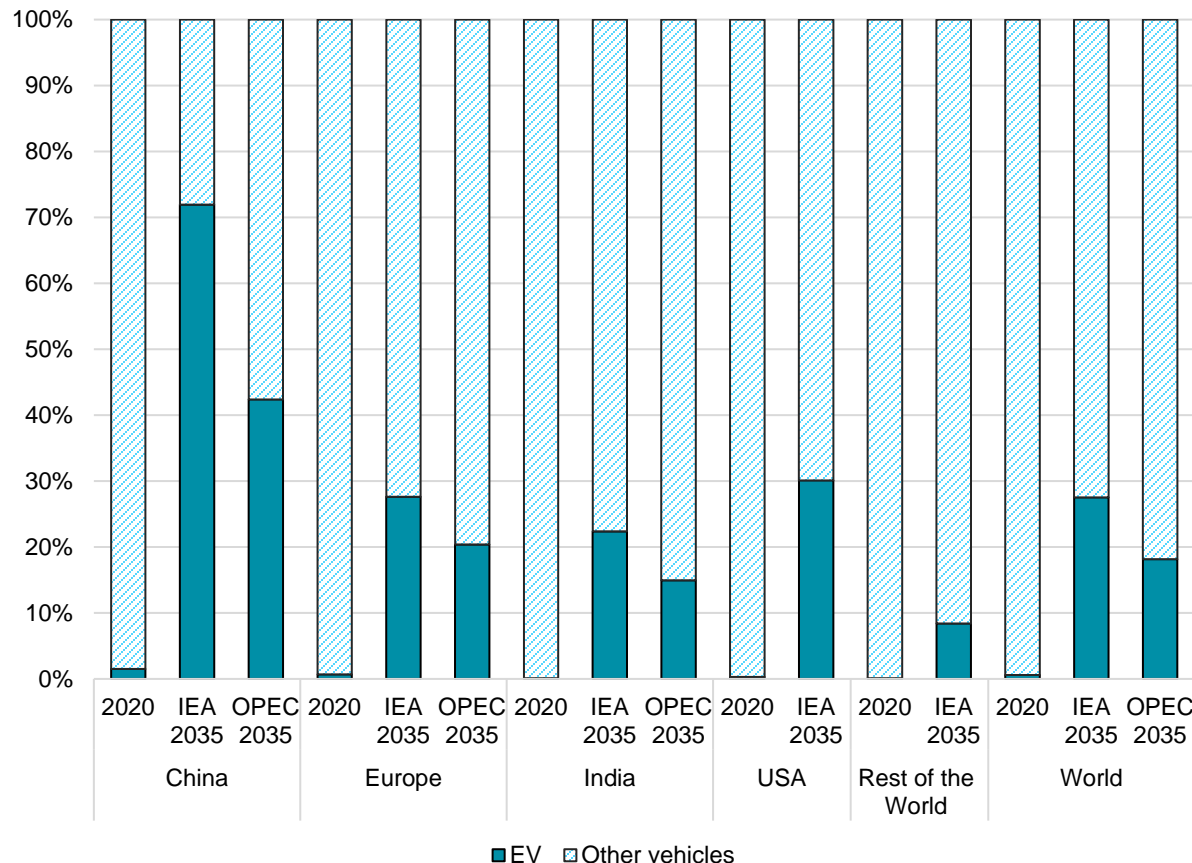
- OPEC's Reference Case projects an increase in oil demand for road transport over time, while the IEA's STEPS predicts a peak by 2030, followed by an eventual decline in demand.
- The uptake of Electric Vehicles, combined with improvements in energy efficiency and other factors, is projected to widen the gap between evolving and ambitious scenarios for road transport oil demand by more than 48 mb/d by 2050.

Source: IEF, IEA WEO 2024, OPEC WOO (Reference Case) 2024, and EIA IEO 2023. Note: OPEC statistics, including liquid fuels, and EIA statistics, which include data on other transportation (e.g., rail).

# 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.

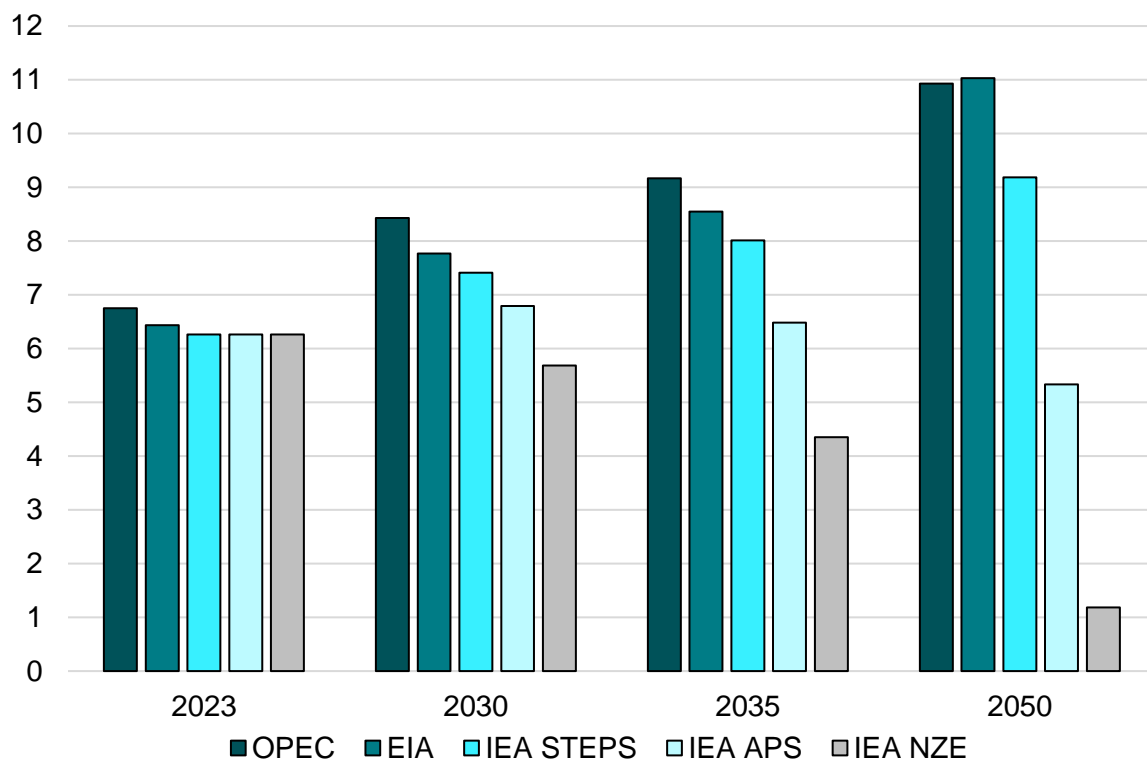
Sources: IEF, IEA – Stated Policies Scenario-EV sales, OPEC World Oil Outlook 2024, International Organization of Motor Vehicle Manufacturers (OICA), and UN population statistics.  
 Note: IEA’s EV category refers to all electric vehicles, including battery electric vehicles, fuel cell electric vehicles, 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.*

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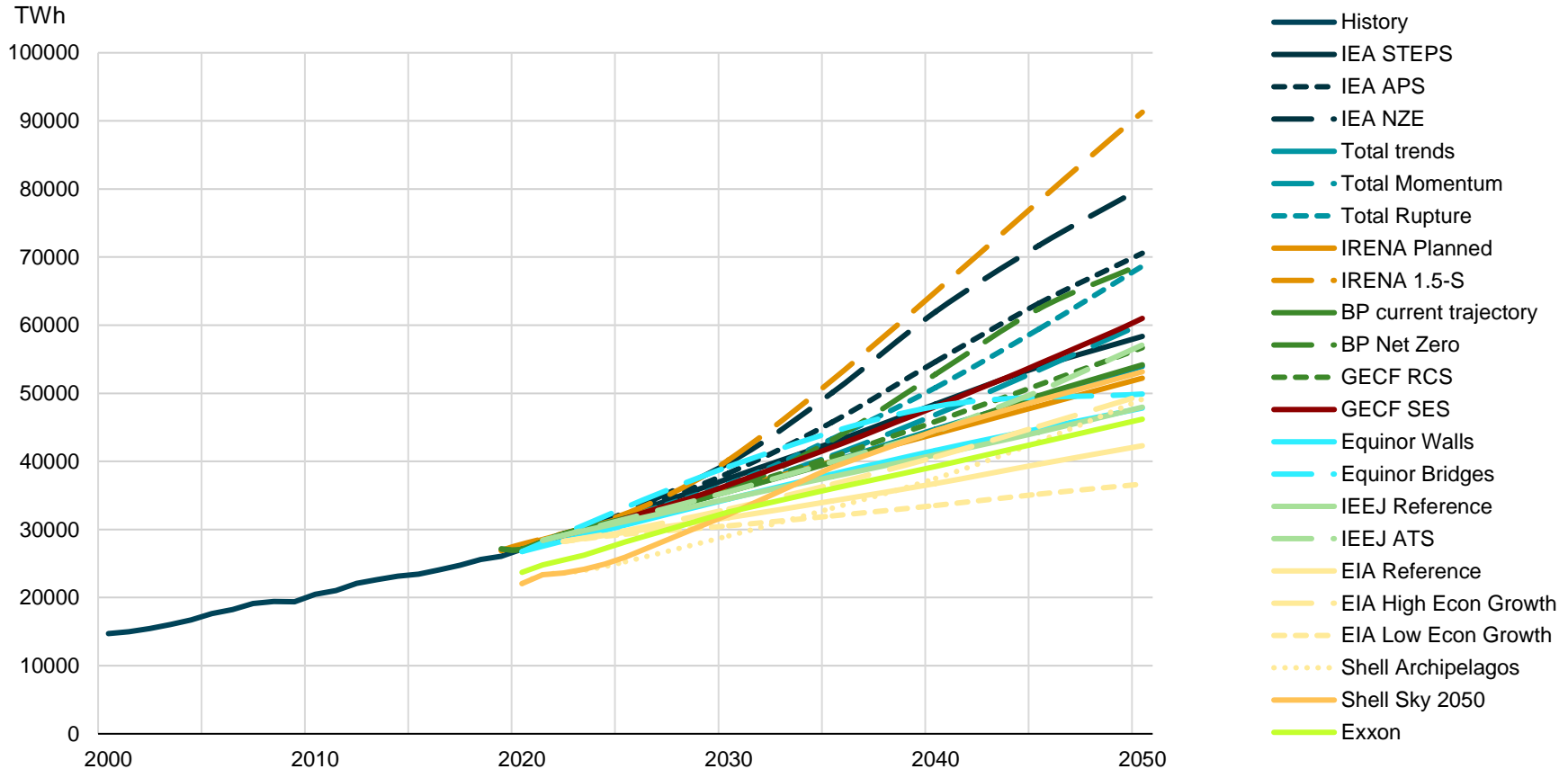
# Sector Spotlight

## Electricity

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

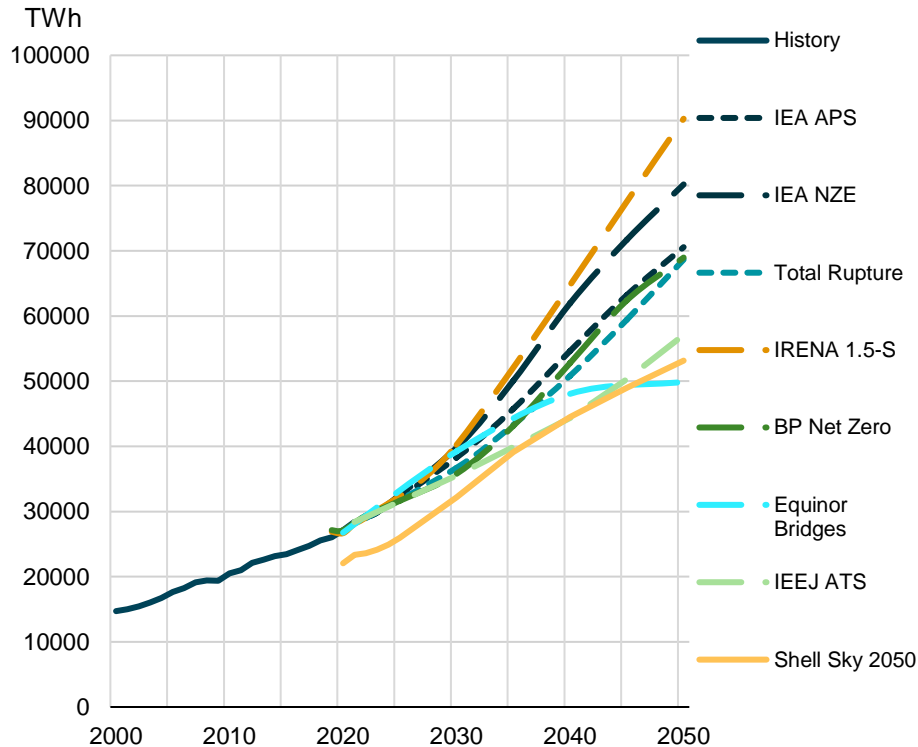
## Electricity Generation Scenarios Through 2050



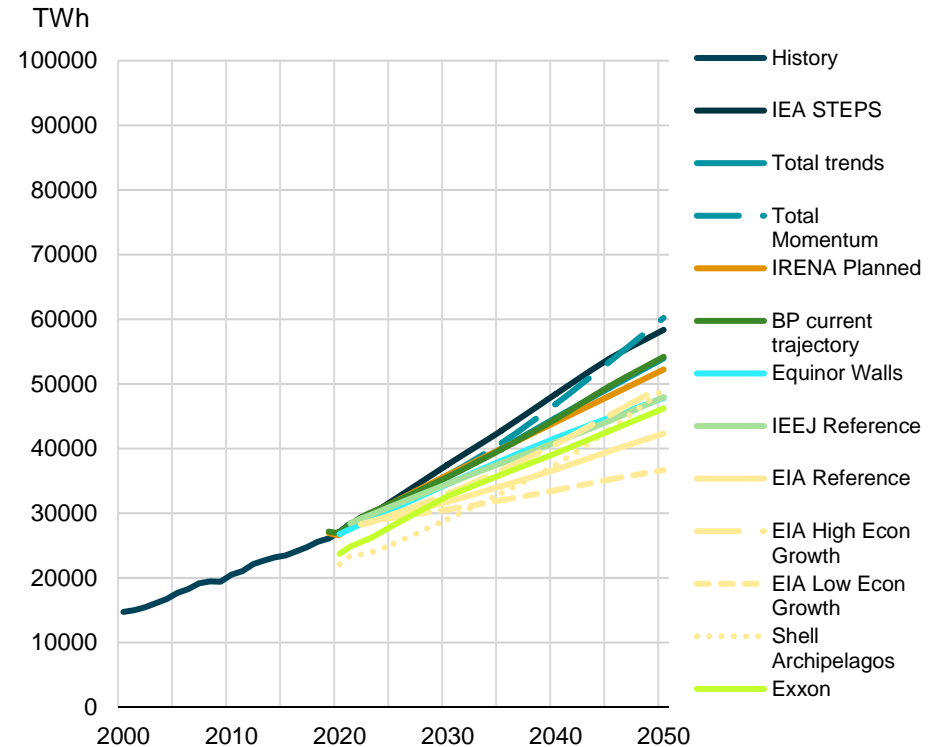
Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, and ExxonMobil Global Outlook 2024.

# Average electricity generation growth among Net Zero Scenarios is approximately 15,000 TWh higher than current trajectories

Electricity Generation: Across Alternative and Climate Scenarios



Electricity Generation: Reference Cases and Evolving Policies



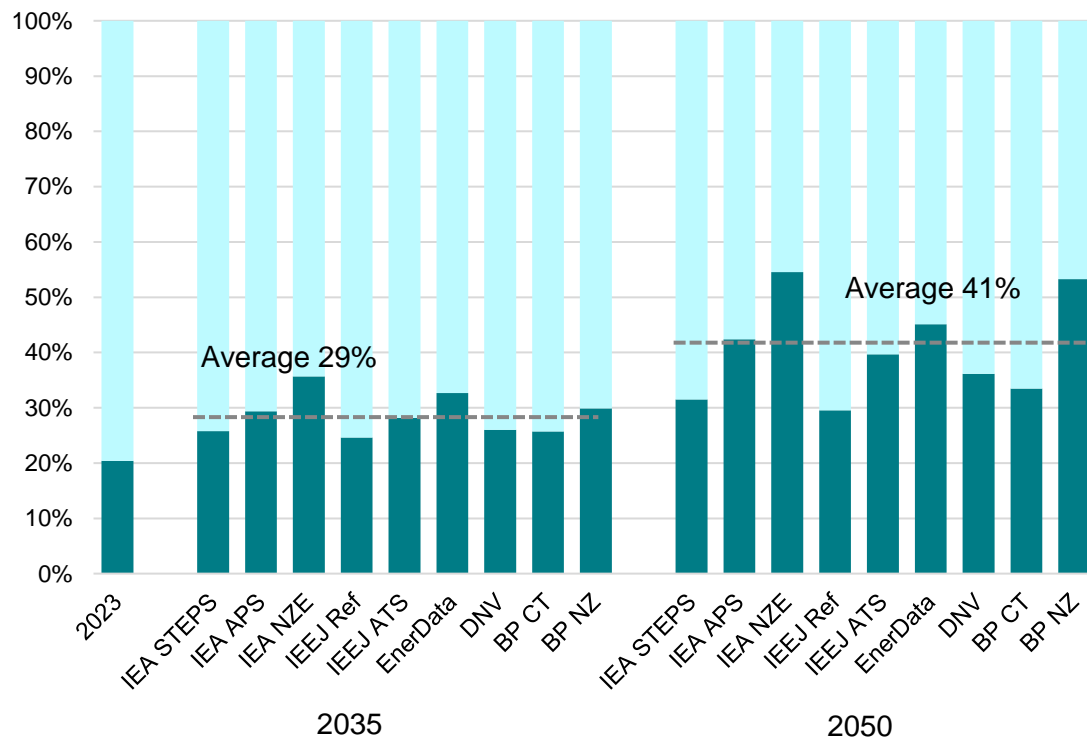
Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, and ExxonMobil Global Outlook 2024.

# 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



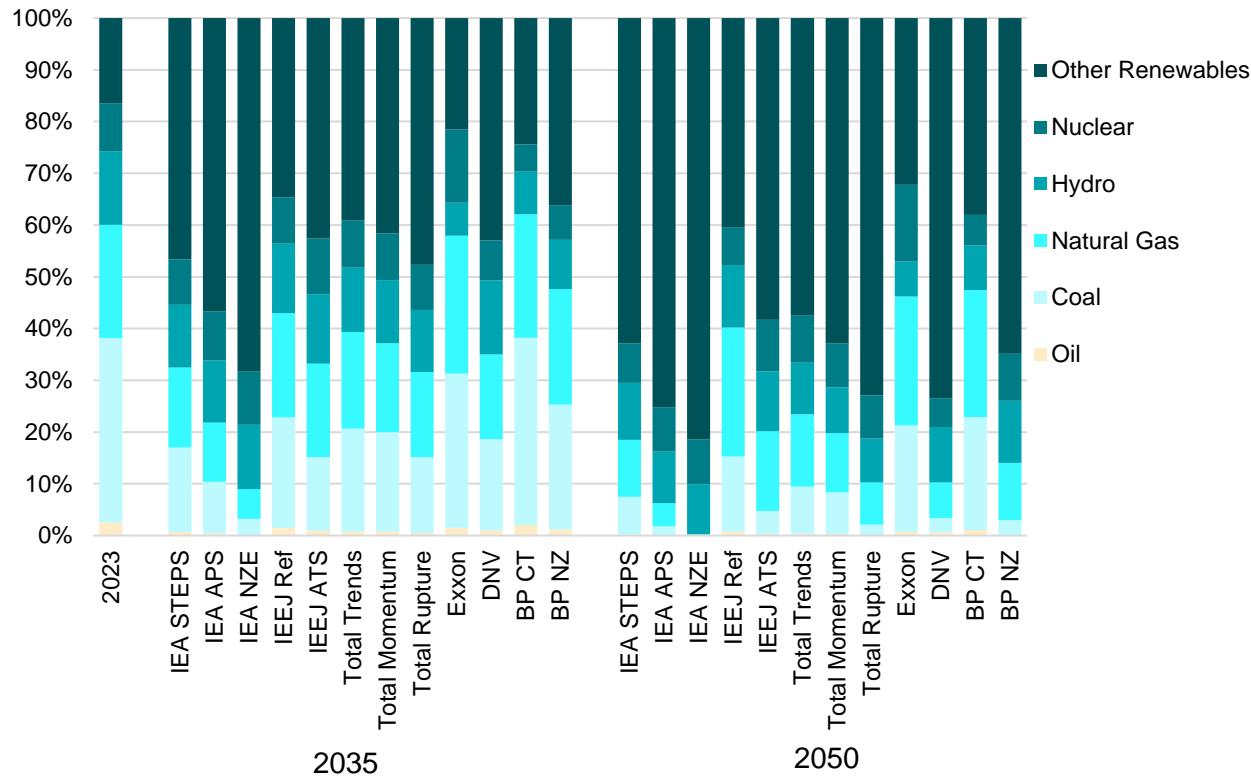
- The share of electricity in total final energy consumption globally is projected to nearly double by 2050, driven by several factors, including growing power demand for data centers, cooling and electrification.
- Ambitious climate scenarios project a significant increase in electricity's share of 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.

# Scenarios show a significant shift in electricity generation sources by 2050

## Electricity Generation by Type

% of total electricity generation



- By 2035, electricity generation from renewable sources is expected to increase from 16 percent in 2023 to an average of around 42 percent, while coal generation is projected to decrease from 36 percent in 2023 to 19 percent.
- An average of 60 percent of electricity generation is expected to come from renewable sources by 2050, driven by net zero scenarios.
- Reference and evolving policy scenarios still see more than 40 percent of electricity generated sourced from fossil fuel by 2050.

Source: IEF, IEA WEO 2024, IEEJ Outlook 2024, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, ExxonMobil Global Outlook 2024, and BP Energy Outlook 2024.

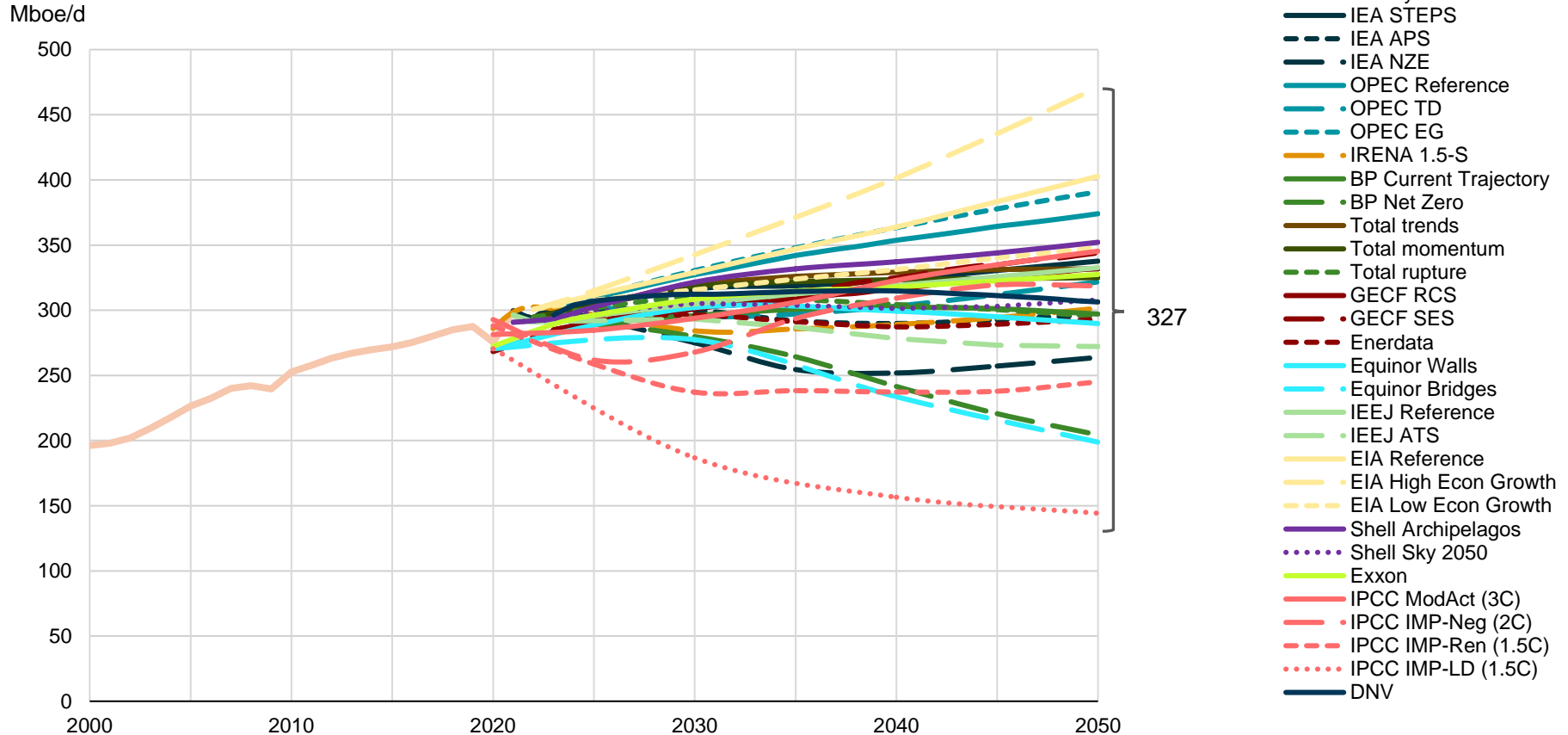
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## Concluding Observations on Scenario Projections

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# Most forecasts for global primary energy demand indicate demand will continue to grow at a lower rate, or plateau

Total Primary Energy Demand Scenarios Through 2050

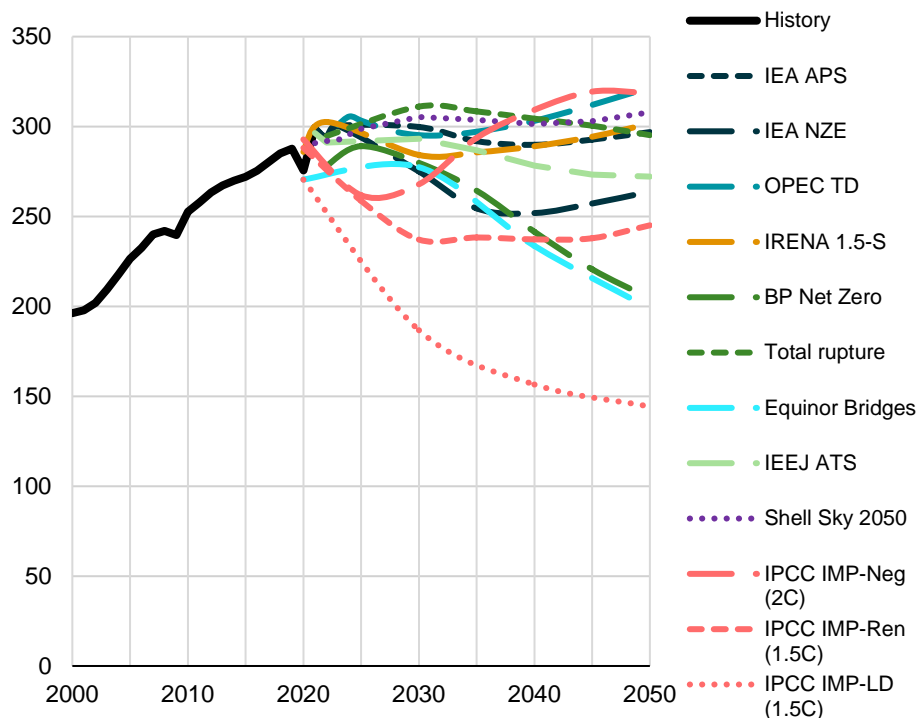


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, DNV's Energy Transition Outlook 2024, EnerOutlook 2050, GECF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

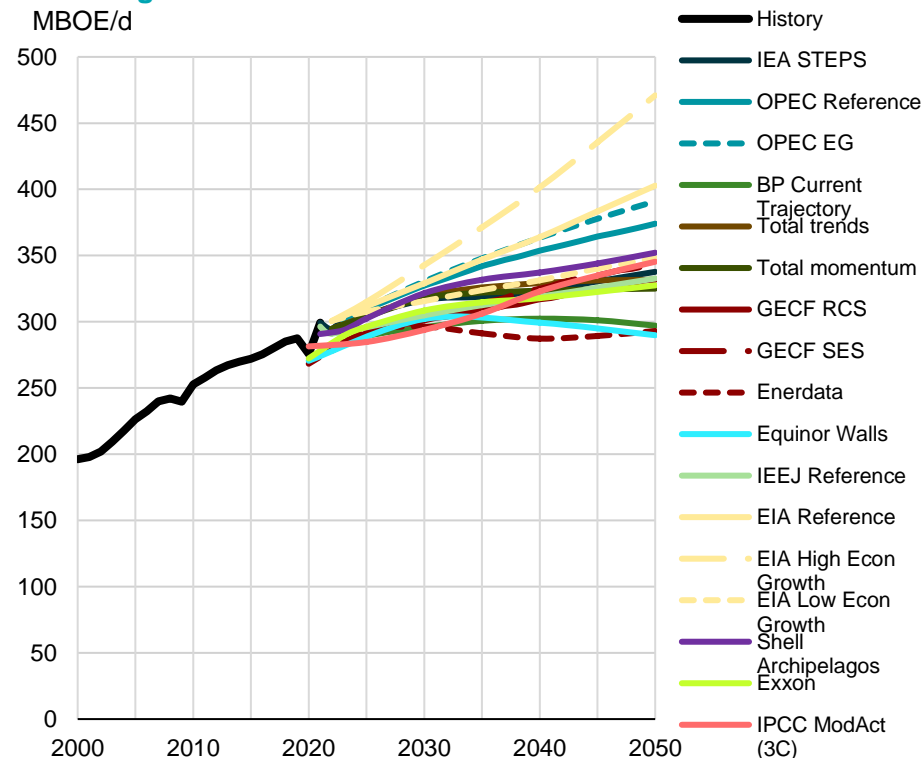


# Reference and evolving policy scenarios are more aligned with historical trends in global primary energy demand

**Total Primary Energy Demand: Ambitious Climate Scenarios**  
MBOE/d



**Total Primary Energy Demand: Reference Cases and Evolving Policies**  
MBOE/d

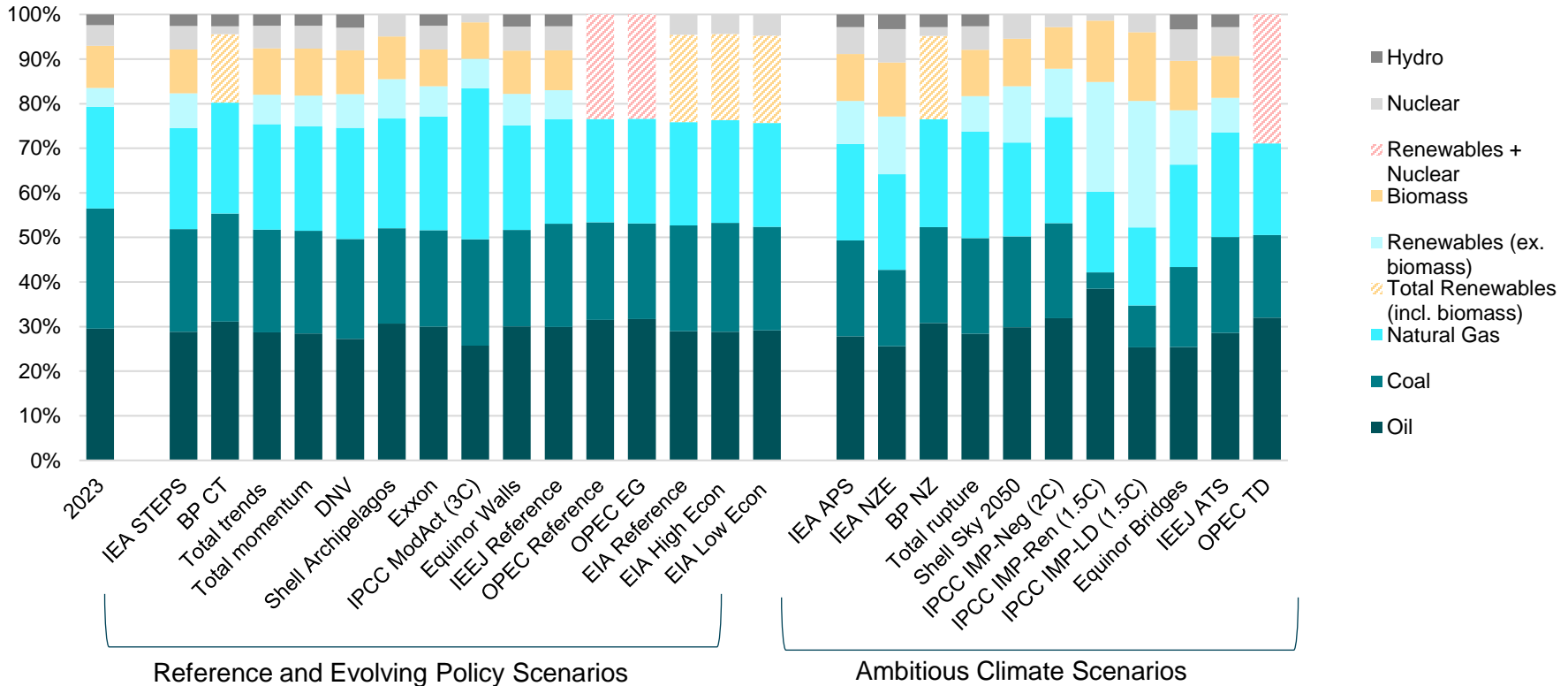


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, DNV's Energy Transition Outlook 2024, EnerOutlook 2050, GECF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

# An average of 25% of primary energy demand is projected to come from renewables by 2030 across all forecasts

## Primary Energy Demand Mix in 2030

% of total primary energy demand

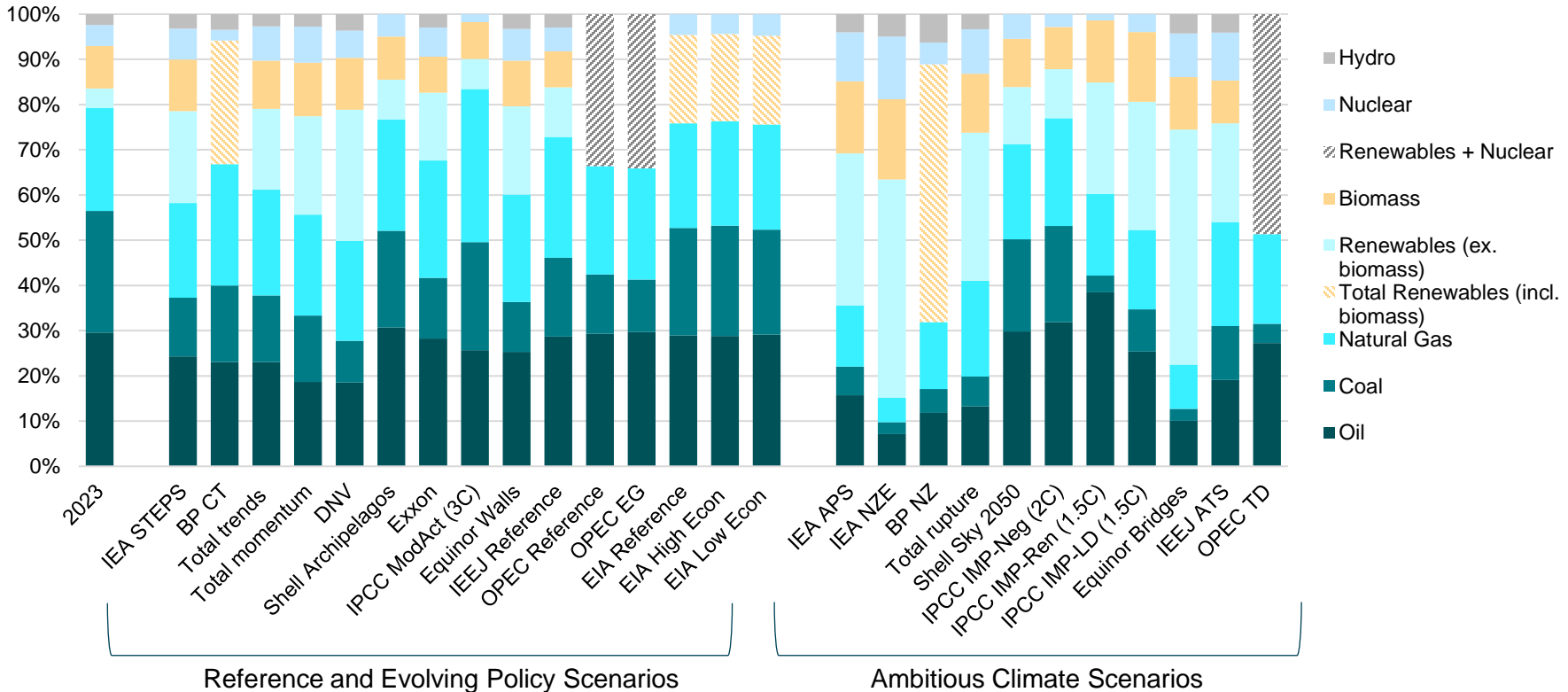


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, DNV's Energy Transition Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

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

## Primary Energy Demand Mix in 2050

% of total primary energy demand

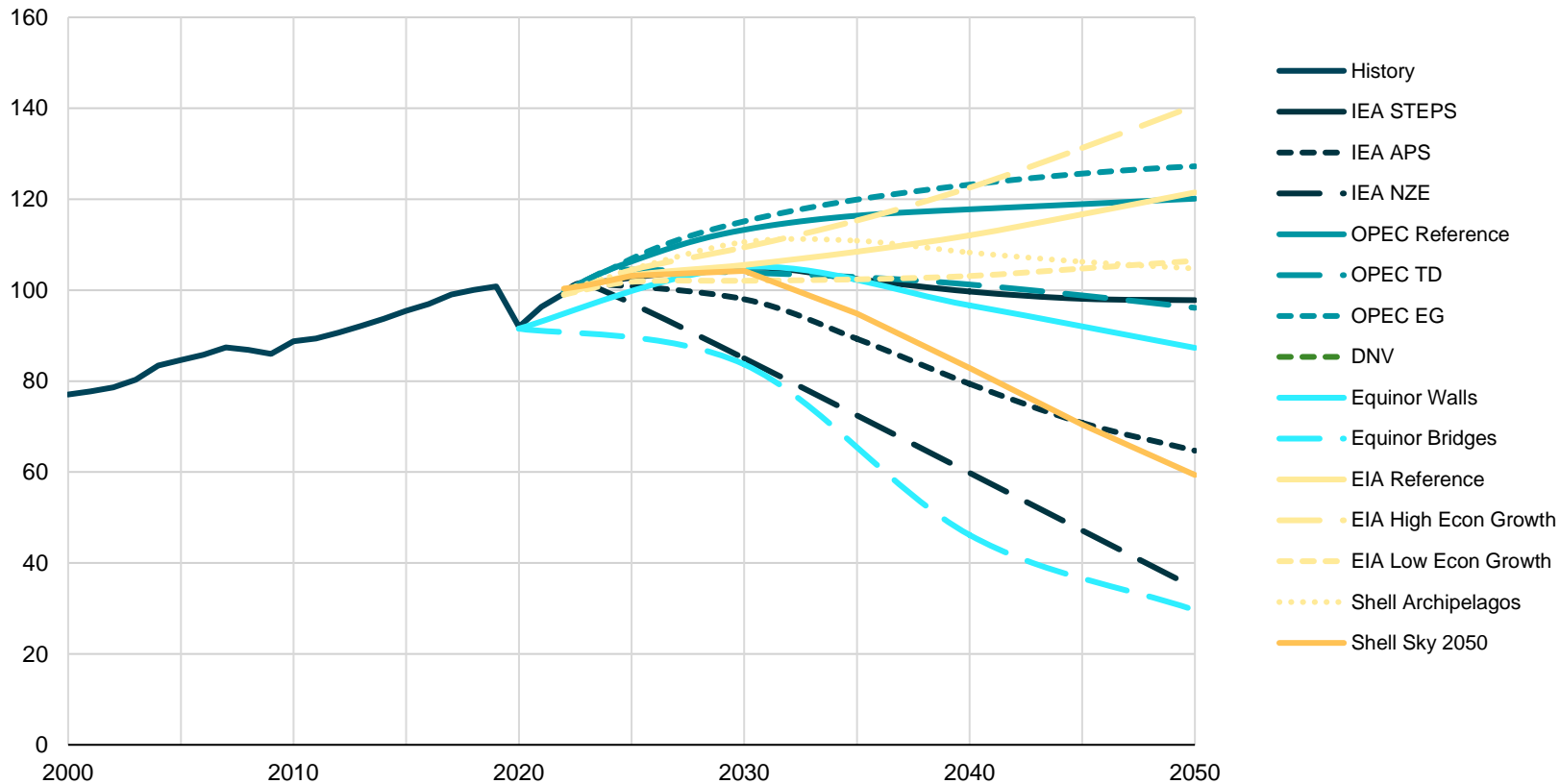


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, BP Energy Outlook 2024, DNV's Energy Transition Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

# The wide divergence across global liquid demand scenarios highlights growing uncertainty for investors

## Total Liquids Demand Scenarios Through 2050

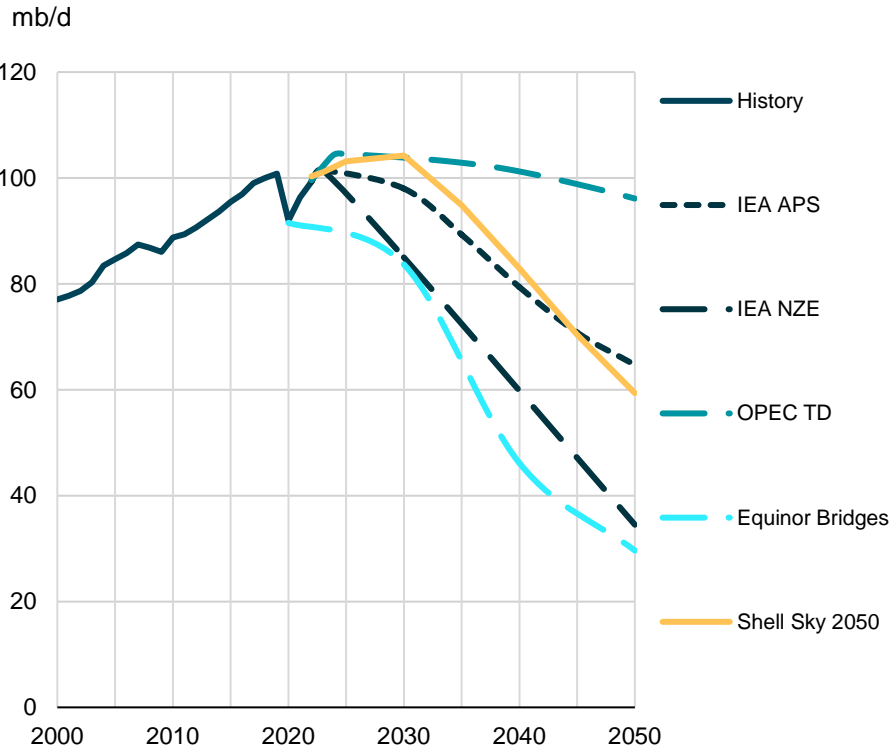
mb/d



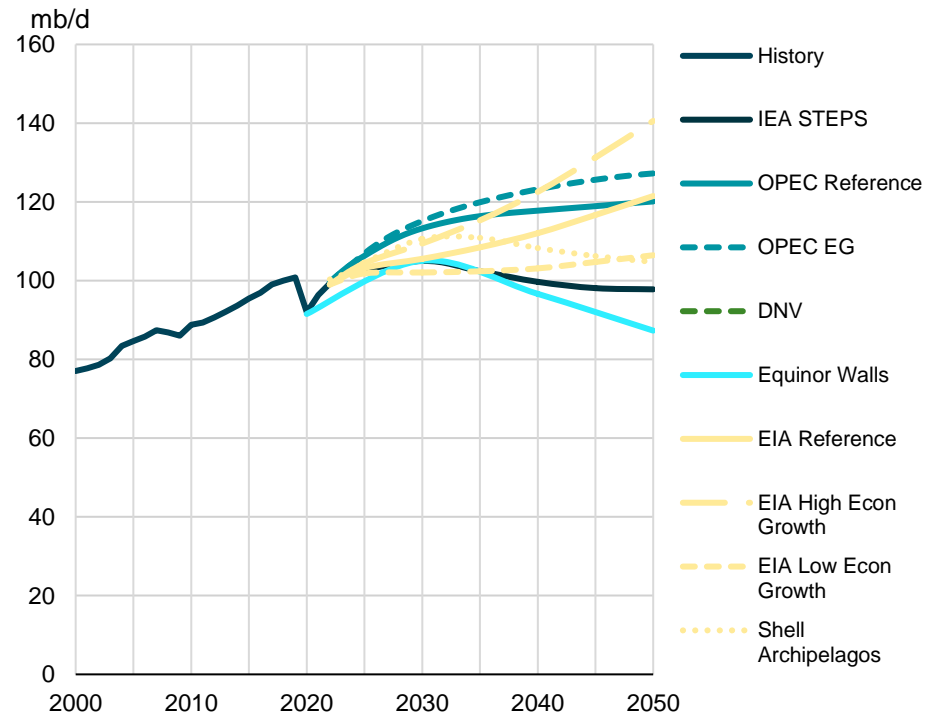
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, and DNV's Energy Transition Outlook 2024.

# Total liquids demand shows sustained growth in reference and evolving scenarios, ambitious scenarios sharp declines after 2030

**Total Liquids Demand: Ambitious Climate Scenarios**



**Total Liquids Demand: Reference Cases and Evolving Policies**

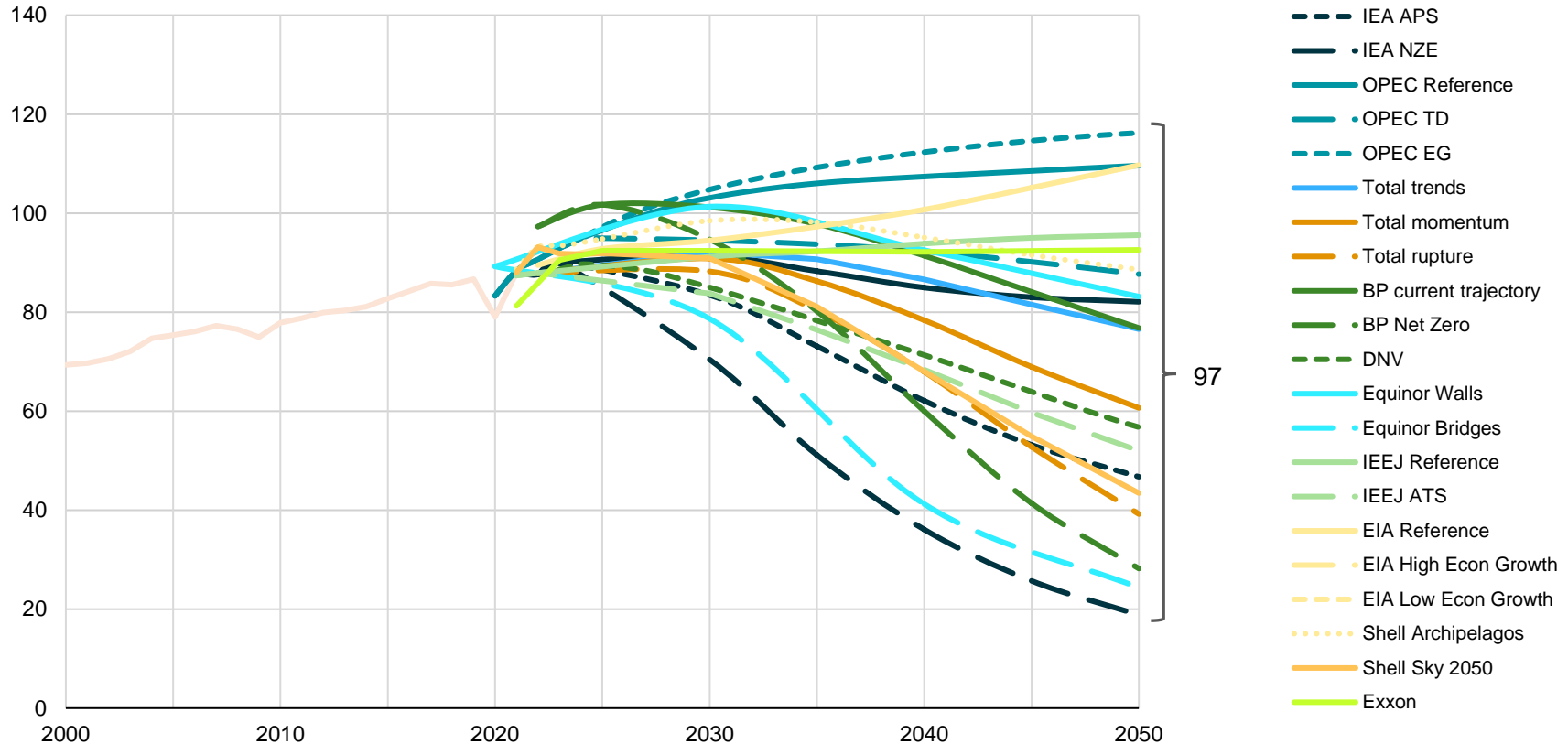


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, and DNV's Energy Transition Outlook 2024.

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

## Oil Demand Scenarios Through 2050

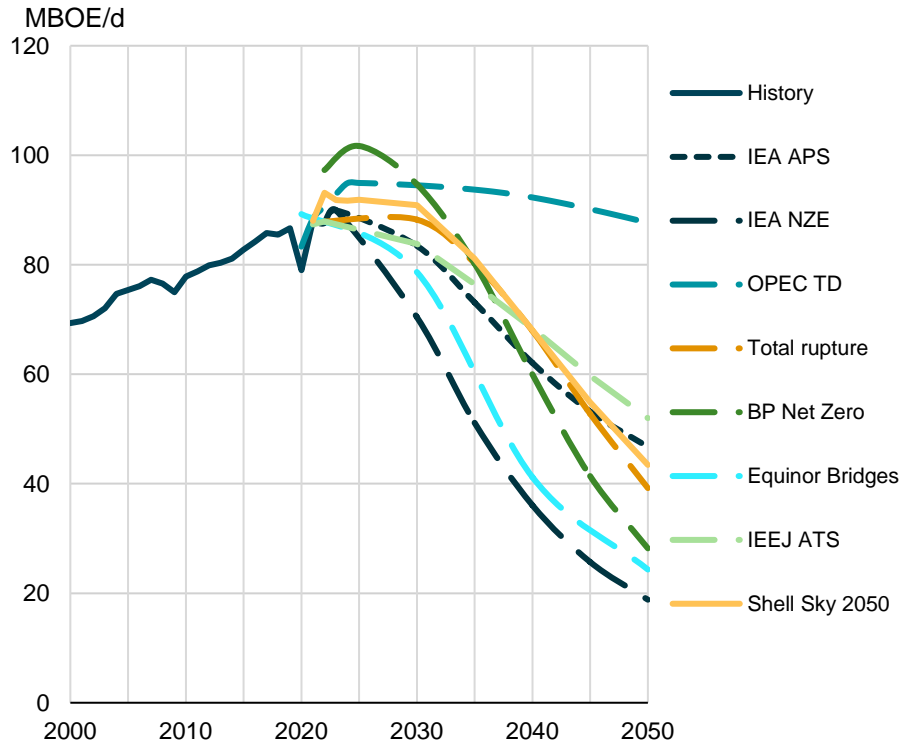
MBOE/d



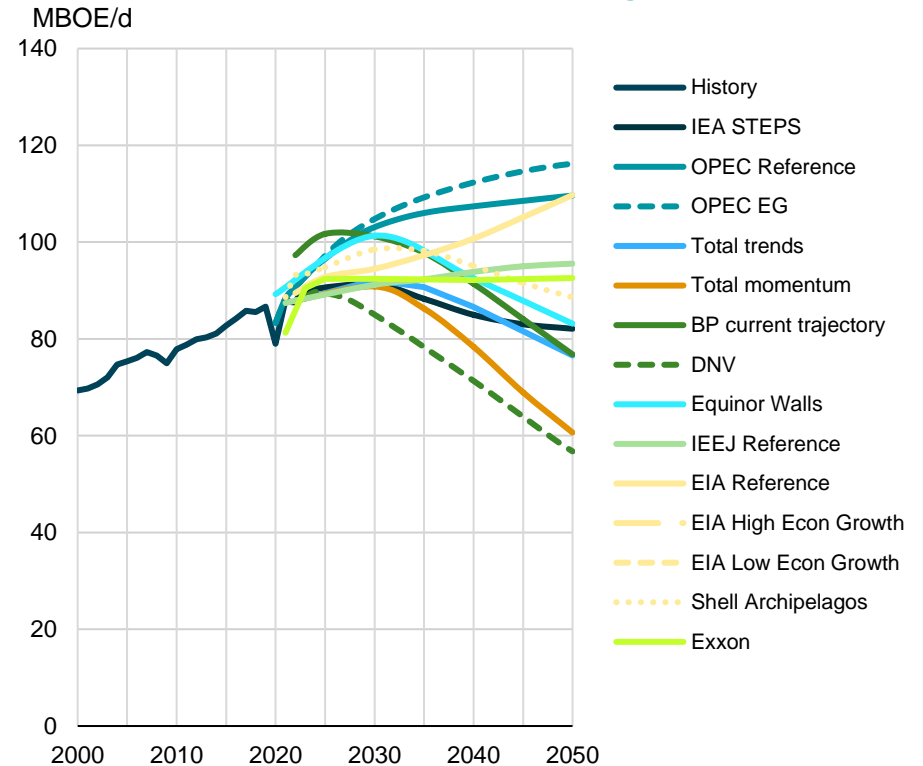
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, and ExxonMobil Global Outlook 2024.

# The average divergence of global oil demand between ambitious and evolving scenarios exceeds 40 mboe/d

## Oil Demand: Ambitious Climate Scenarios



## Oil Demand: Reference Cases and Evolving Policies

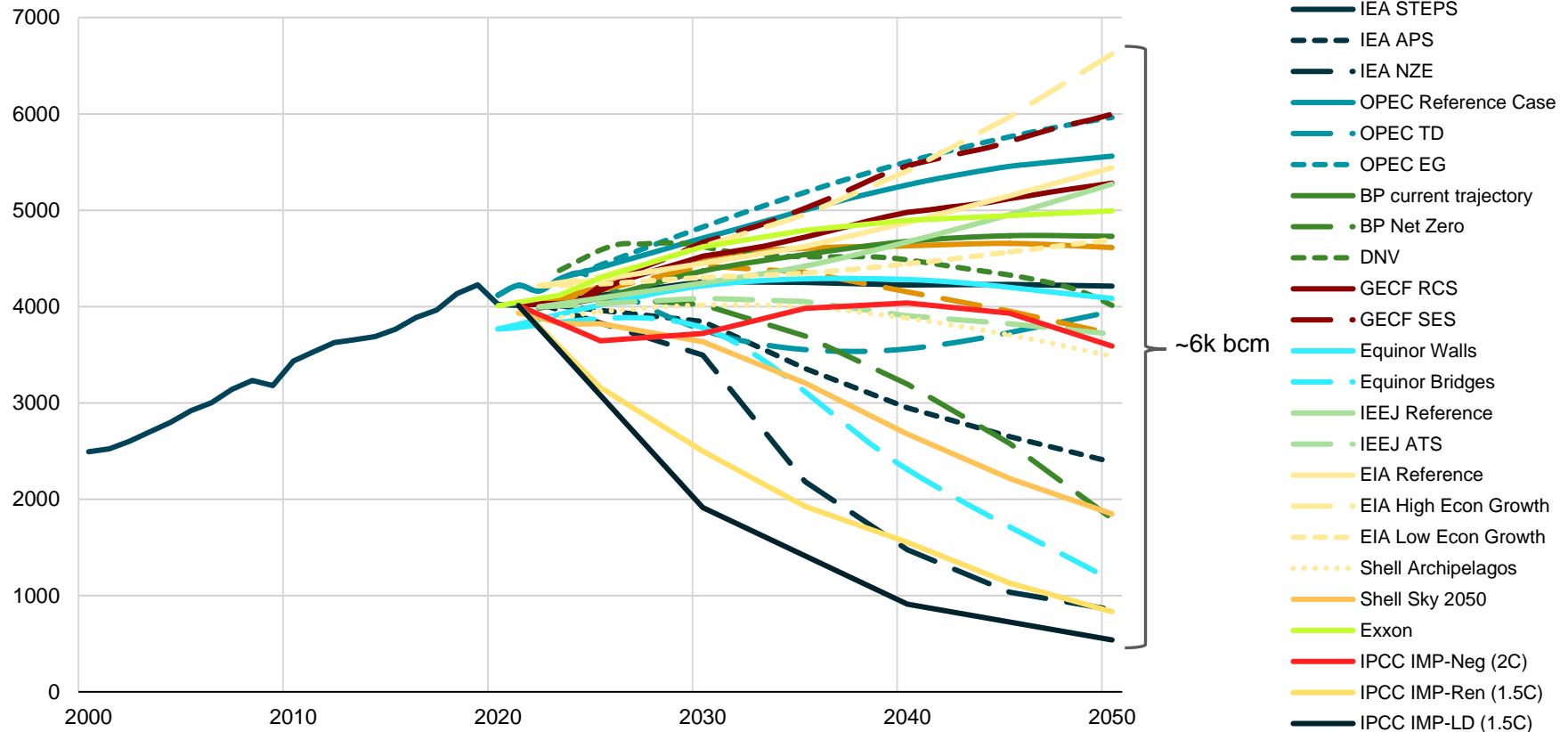


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, and ExxonMobil Global Outlook 2024.

# 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



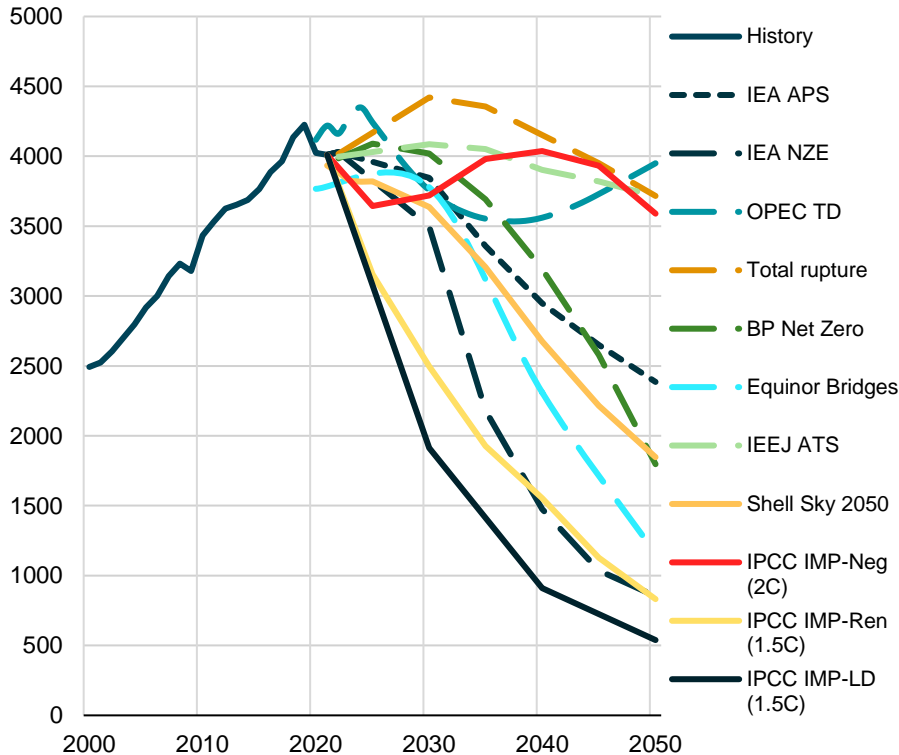
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and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



# Though few ambitious scenarios see gas demand grow or plateau reference and evolving scenarios align well with historical trends

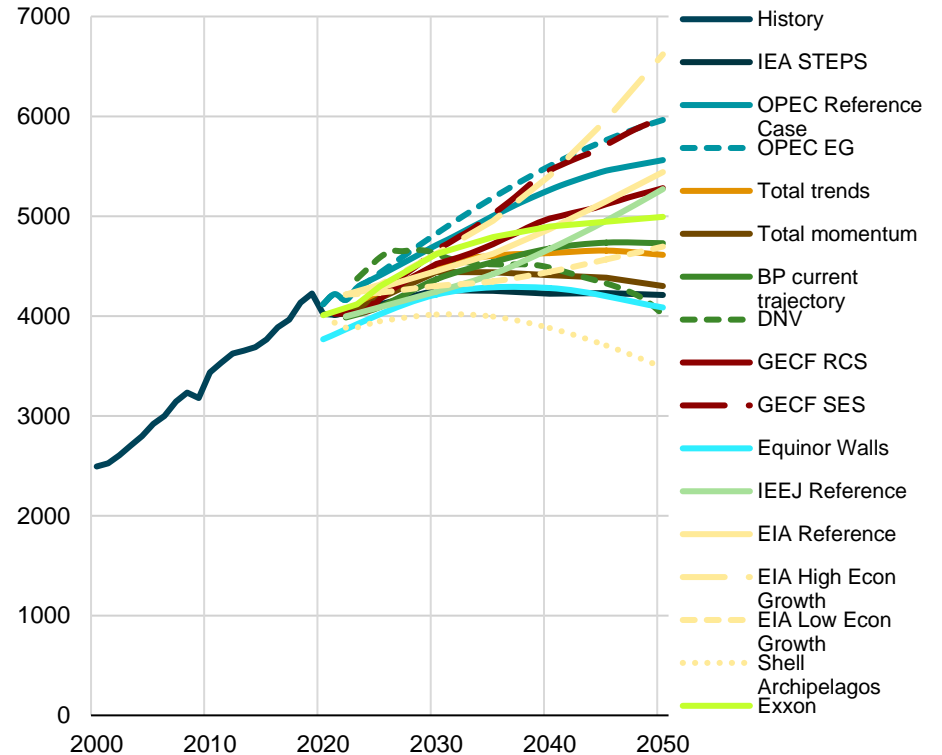
## Natural Gas Demand: Ambitious Climate Scenarios

Billion cubic metres



## Natural Gas Demand: Reference Cases and Evolving Policies

Billion cubic metres

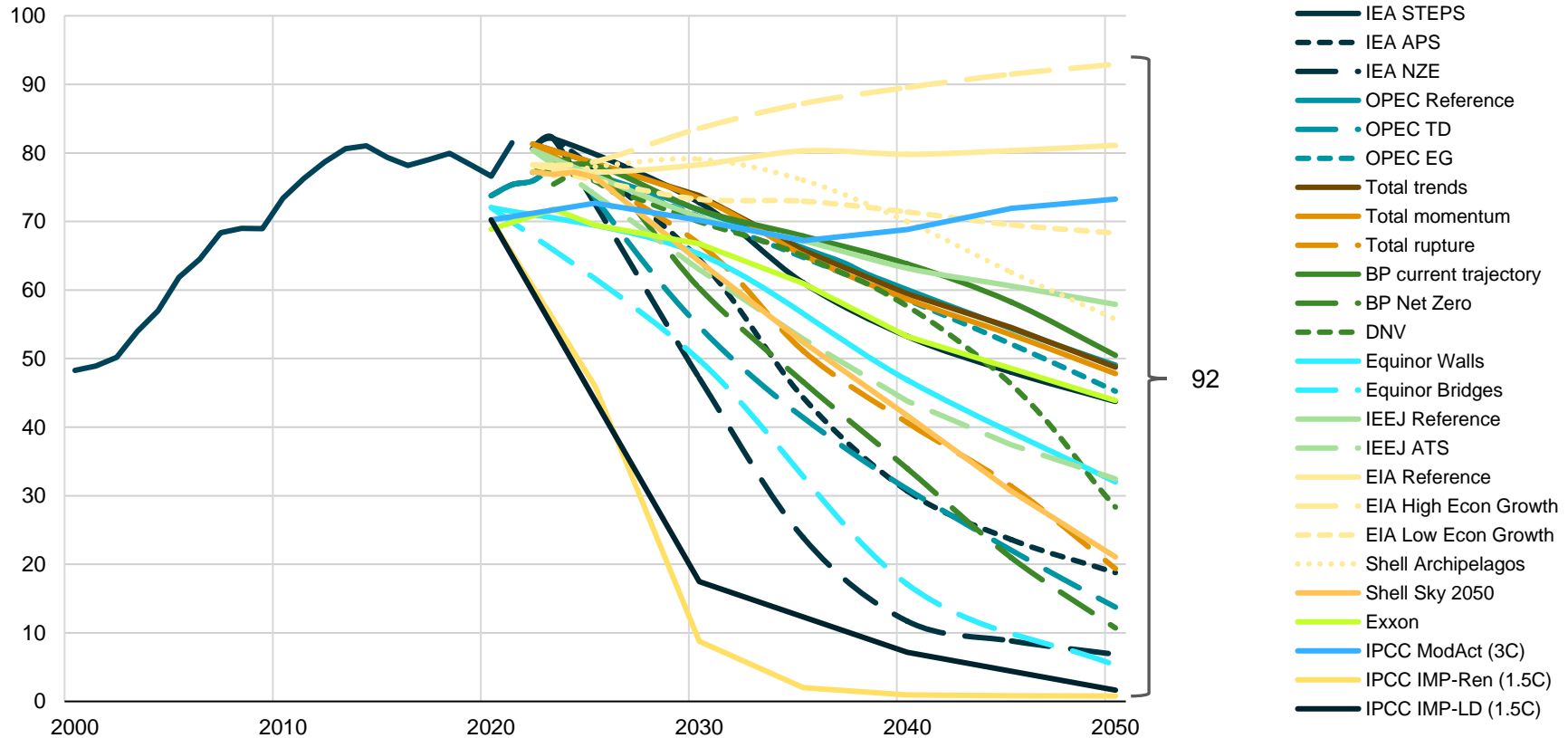


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook 2025, ExxonMobil Global Outlook 2024, and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

# A disparity of ~92 mboe/d exists among coal demand forecasts as early as 2040, raising diverse energy and climate issues

## Coal Demand Scenarios Through 2050

MBOE/D

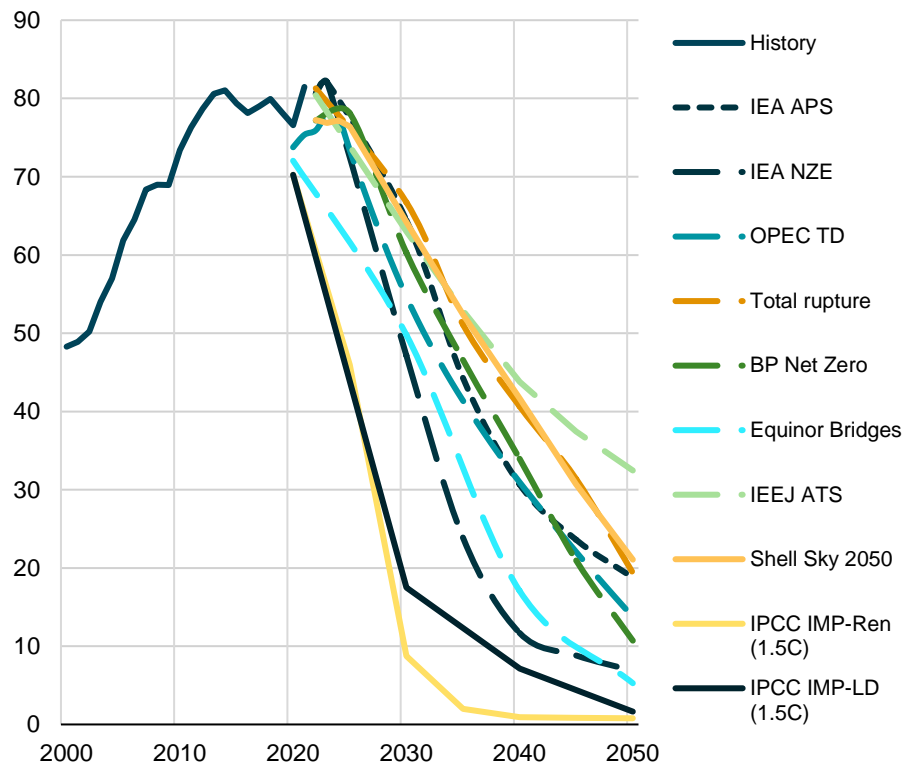


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

# As time goes by coal demand declines steeper to meet ambitious scenario targets and making other scenarios appear more likely

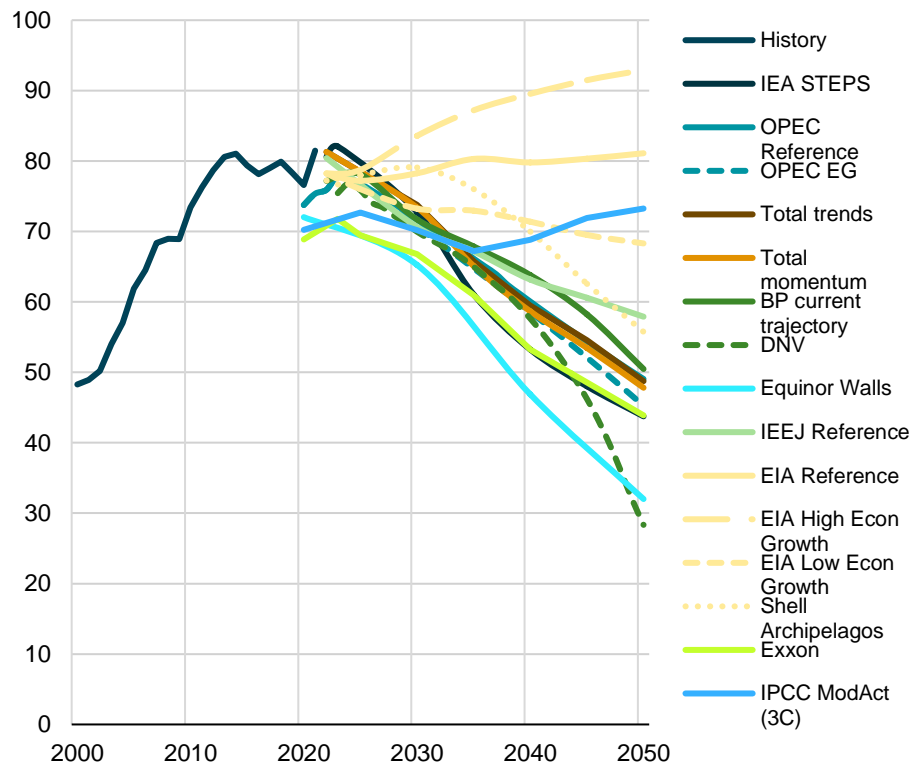
## Coal Demand: Ambitious Climate Scenarios

MBOE/d



## Coal Demand: Reference Cases and Evolving Policies

MBOE/d

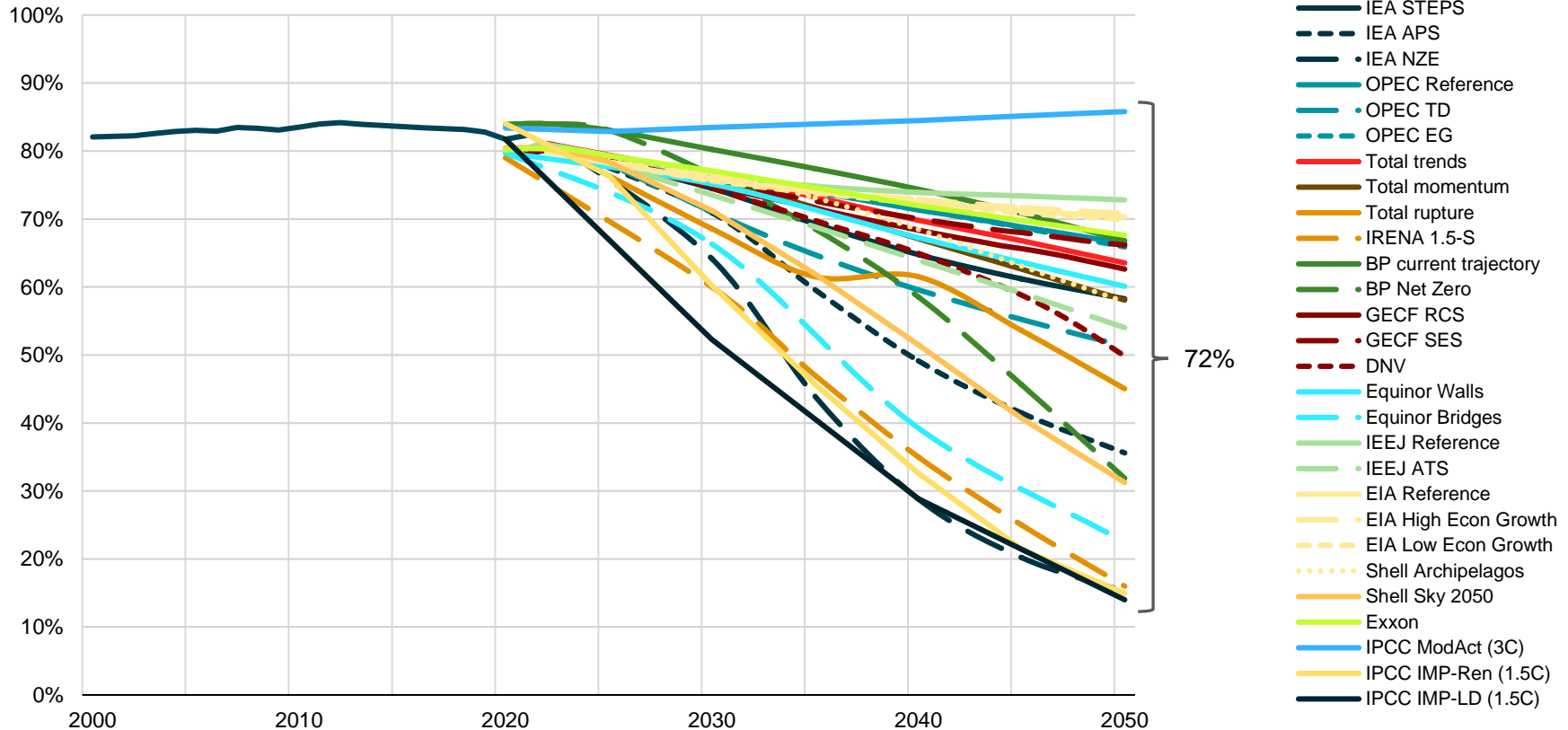


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

# 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 Demand Scenarios Through 2050

% of primary energy demand

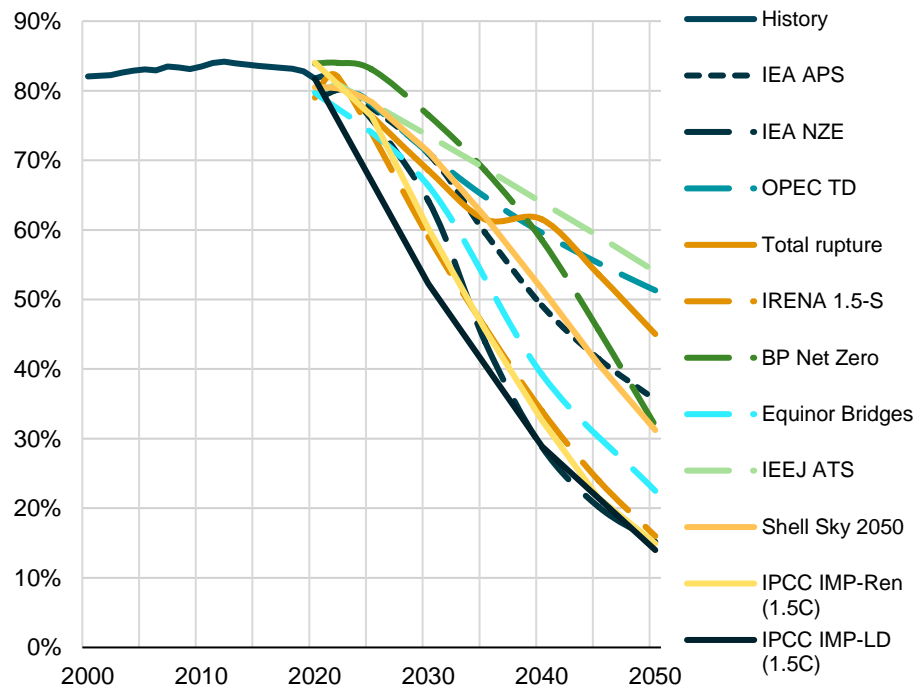


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, IRENA World Energy Transition Outlook 2024, BP Energy Outlook 2024, GECF Global Gas Outlook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

# Almost all current and evolving policy scenarios project that more than 60% of primary energy Demand by 2050 will come from fossil fuels

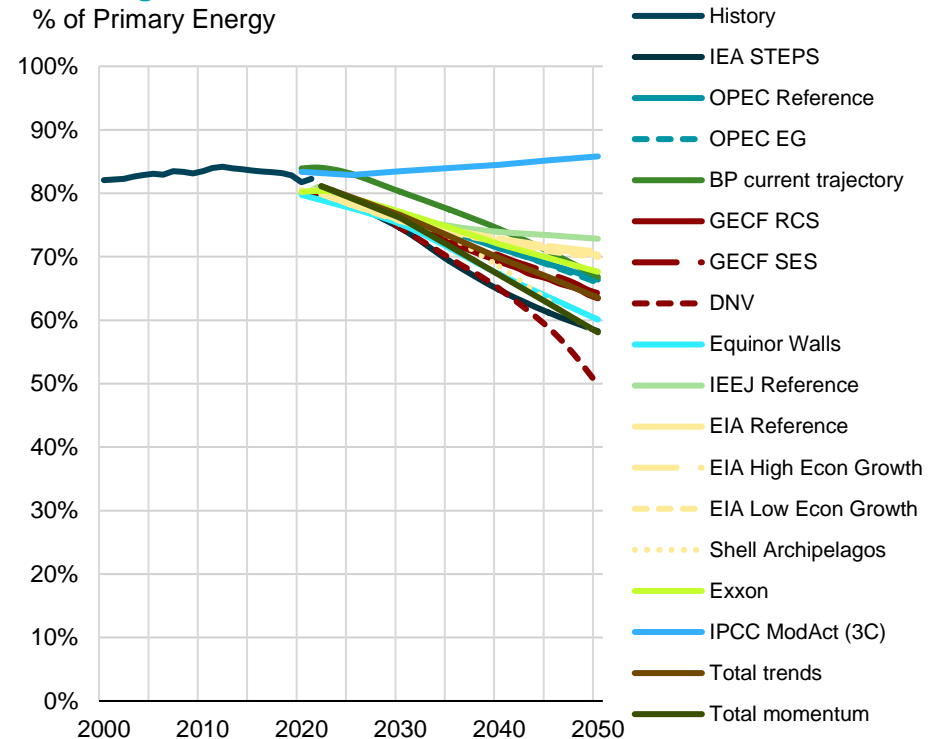
## Fossil Fuels Share of Primary Energy Demand: Ambitious Climate Scenarios

% of primary energy demand



## Fossil Fuels Share of Primary Energy: Reference Cases and Evolving Policies

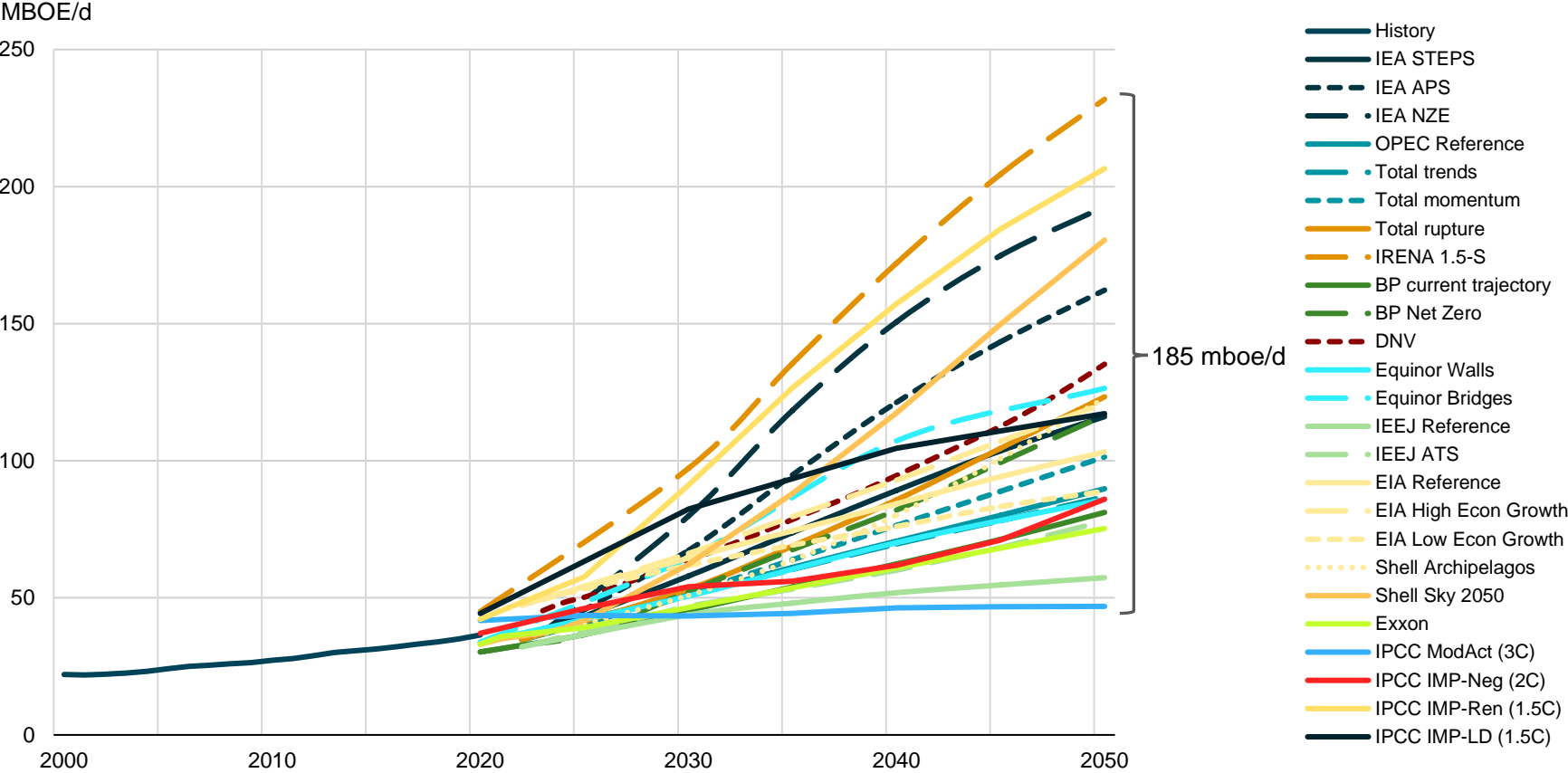
% of Primary Energy



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.

# An average annual growth of 2.8 mboe/d in renewable demand is forecasted among various sources

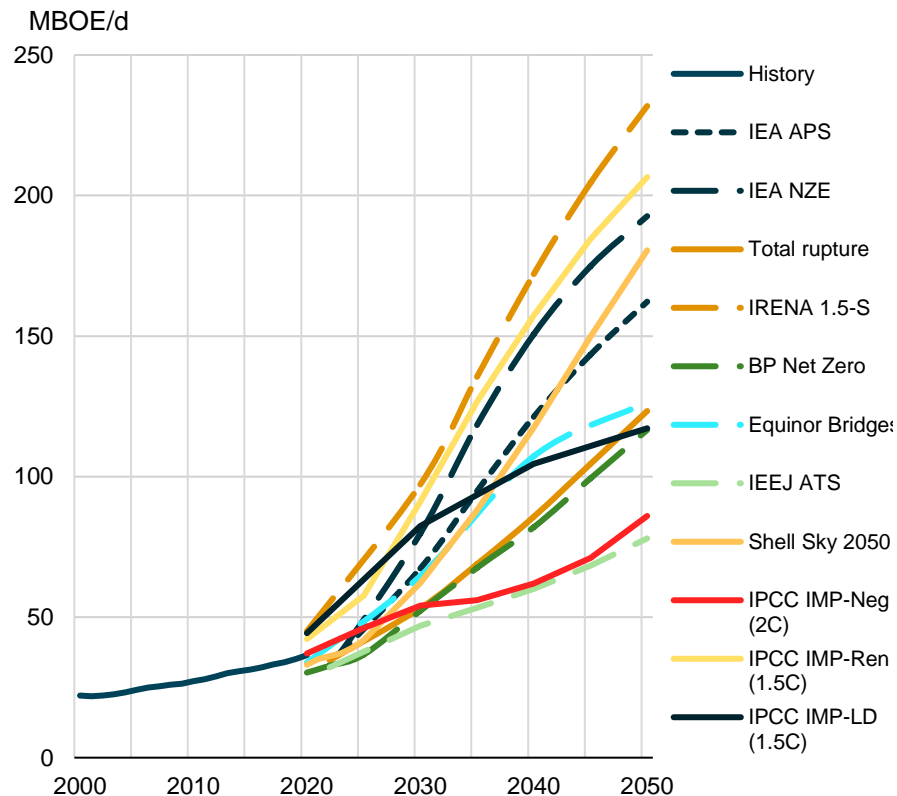
Renewable Demand Scenarios Through 2050 (includes wind, solar, geothermal, biomass, and biofuels)



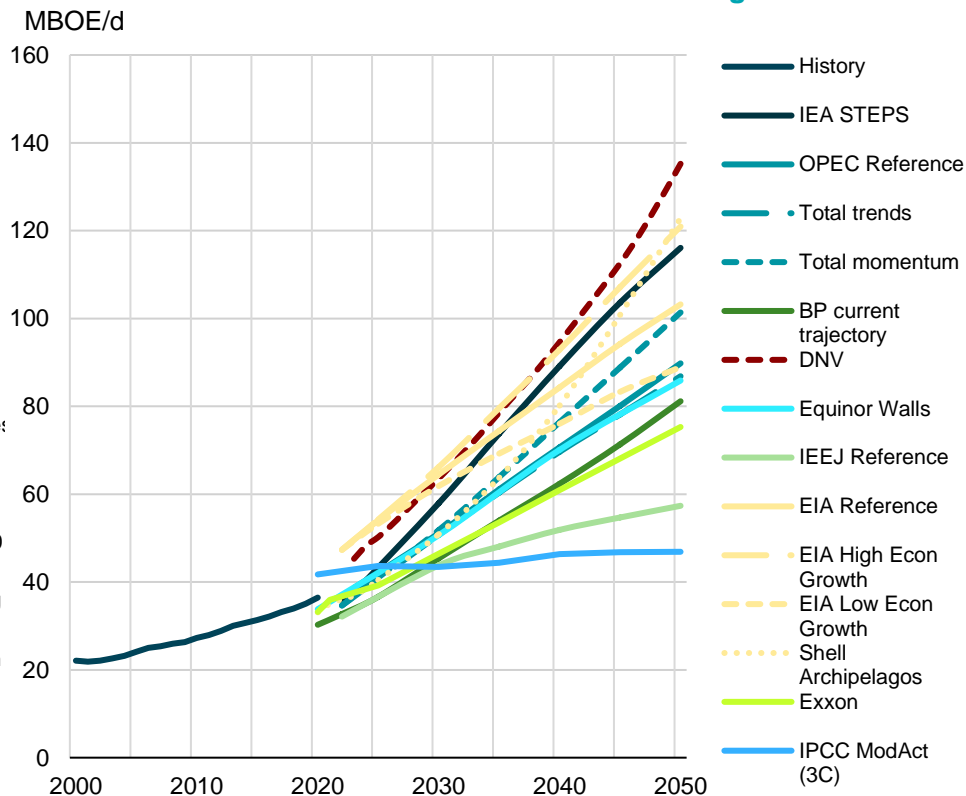
Notes: Renewables includes wind, solar, geothermal, modern and traditional bioenergy. EIA includes hydro.  
 Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, ExxonMobil Global Outlook 2024, and IPCC AR6.

# By 2050, most scenarios expect renewable demand to grow by at least 100% compared to current demand levels

## Renewable Demand: Ambitious Climate Scenarios



## Renewable Demand: Reference Cases and Evolving Policies



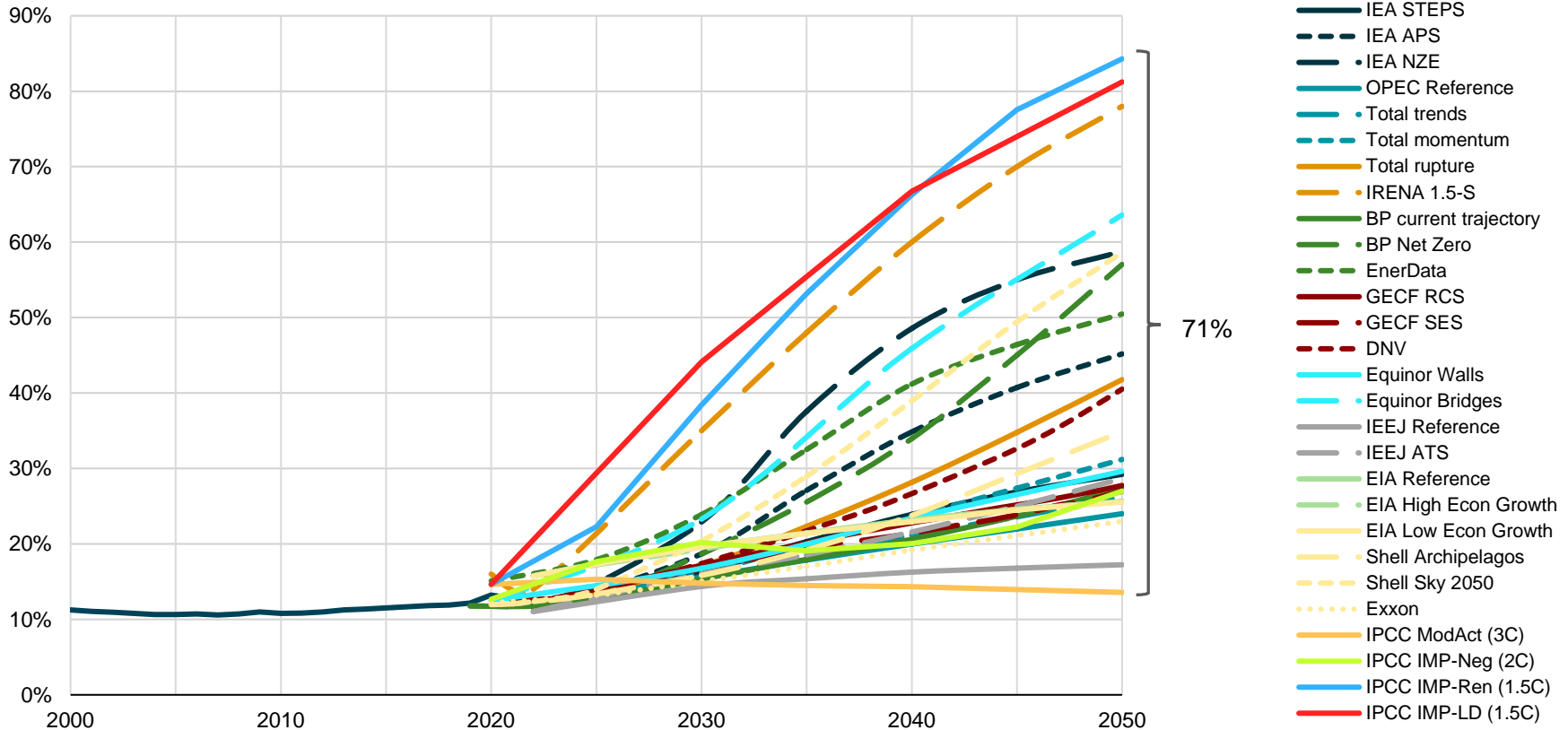
Notes: Renewables includes wind, solar, geothermal, modern and traditional bioenergy. EIA includes hydro.

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, ExxonMobil Global Outlook 2024, and IPCC AR6.

# Disparities among renewable energy demand outlooks raises questions about underlying assumptions

## 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.

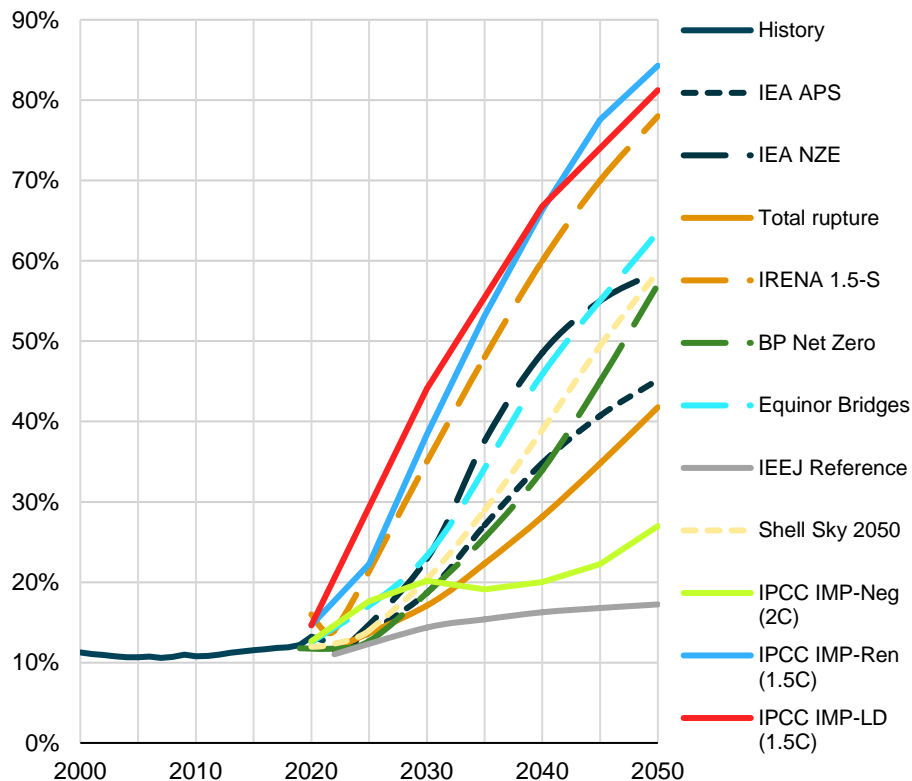
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, EnerOutlook 2050, GECF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



# The average of renewable demand growth in ambitious scenarios nearly doubles that of other scenarios by 2050

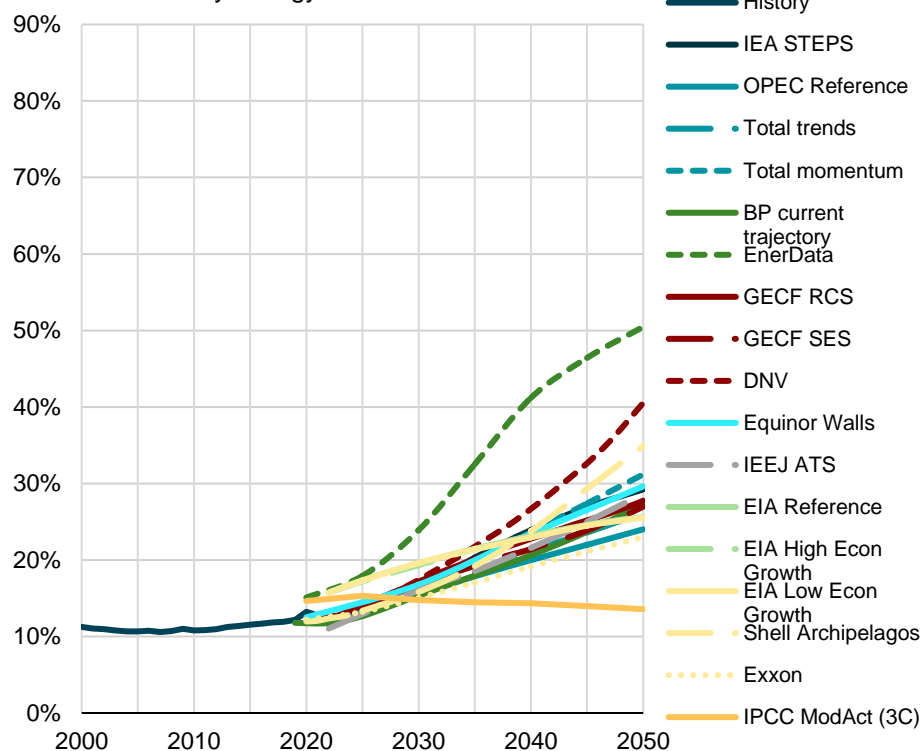
## Renewable Demand Share: Ambitious Climate Scenarios

Share of primary energy demand



## Renewable Demand Share: Reference Cases and Evolving Policies

Share of Primary Energy Demand



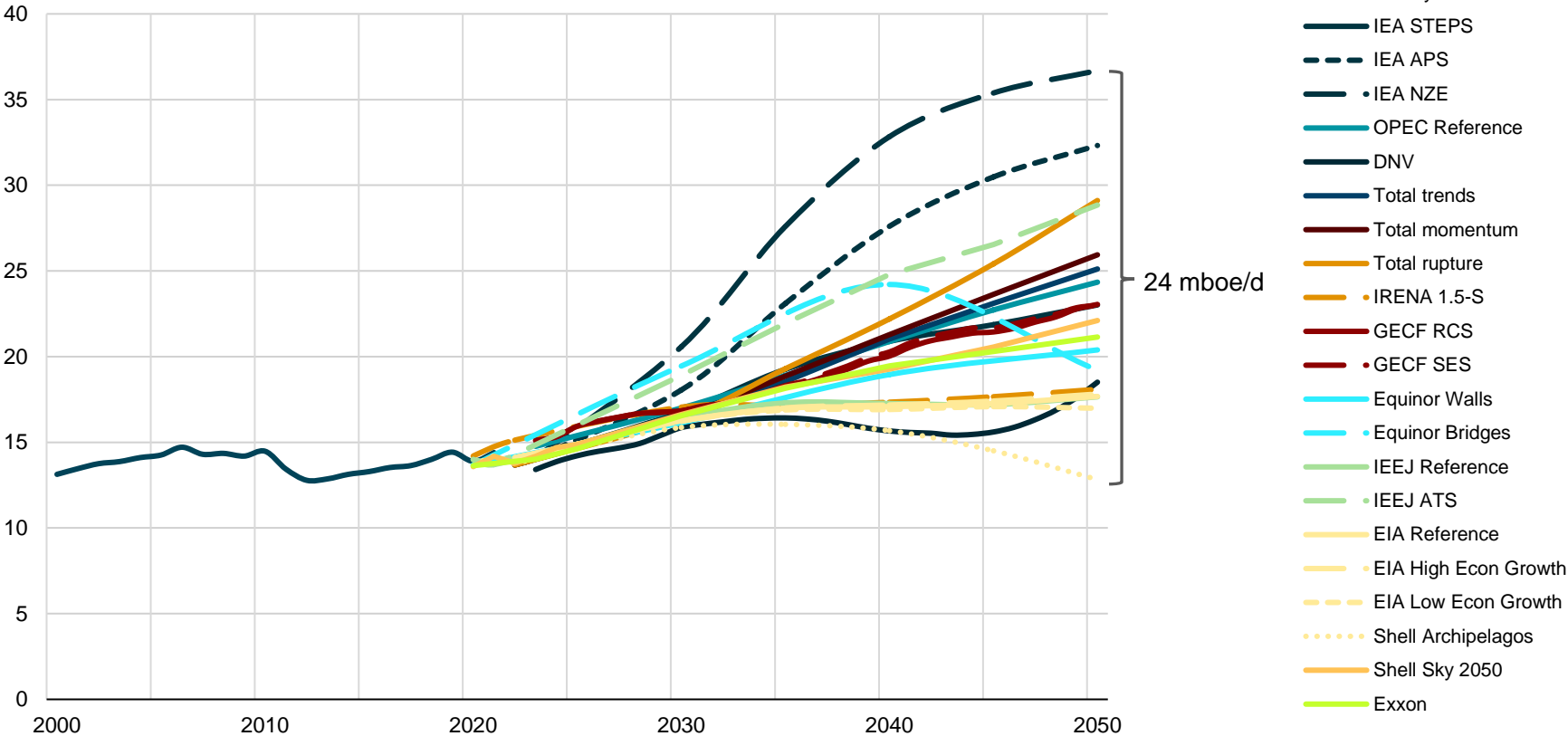
Notes: Renewables includes wind, solar, geothermal, modern and traditional bioenergy. EIA includes hydro.

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.

# 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 2020

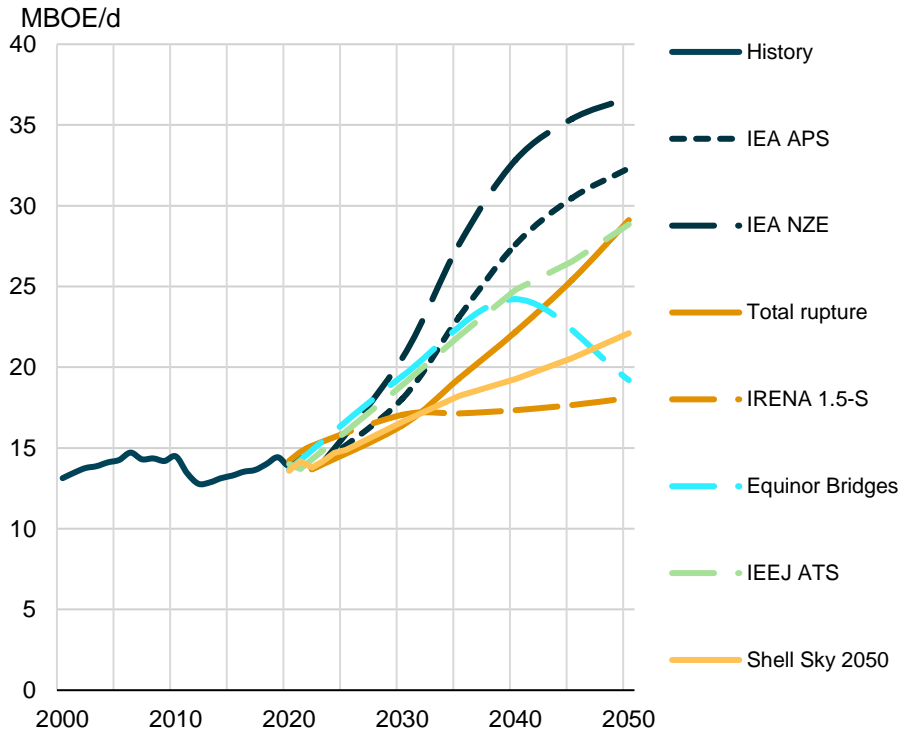
MBOE/d



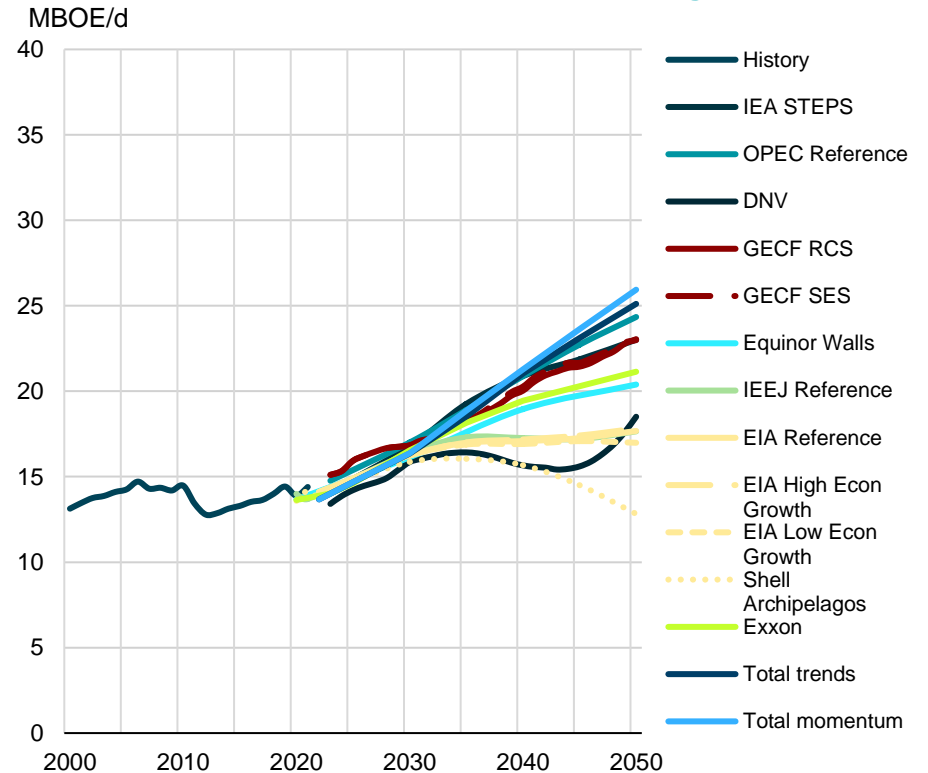
Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, Shell Energy Security Scenarios 2023, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EIA IEO 2023, IRENA World Energy Transition Outlook 2024, Total Energy Outlook 2024, and ExxonMobil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

# Ambitious and evolving scenarios converge on strong nuclear demand growth but reach different levels by 2050

## Nuclear Demand: Ambitious Climate Scenarios



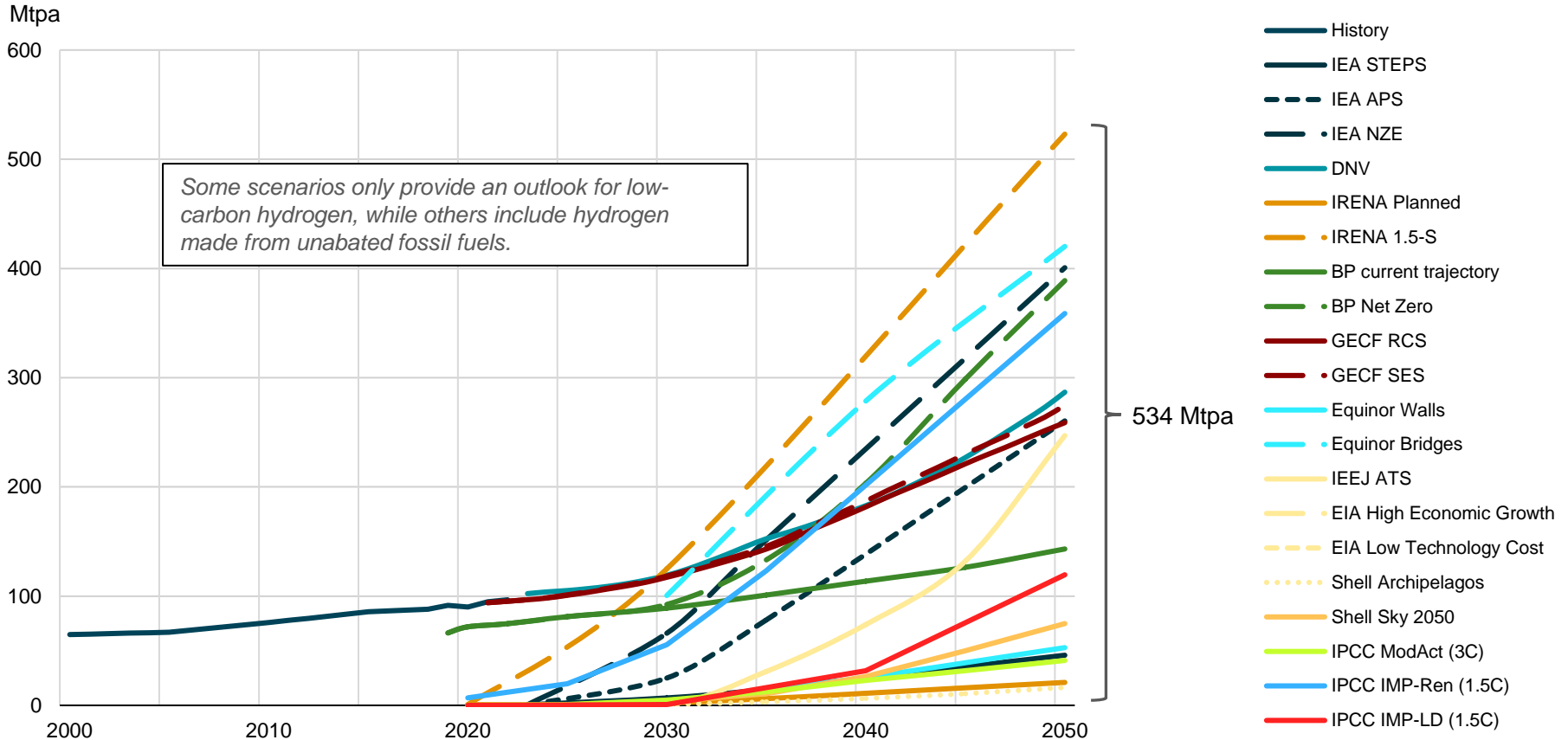
## Nuclear Demand: Reference Cases and Evolving Policies



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 the baselines and assumptions

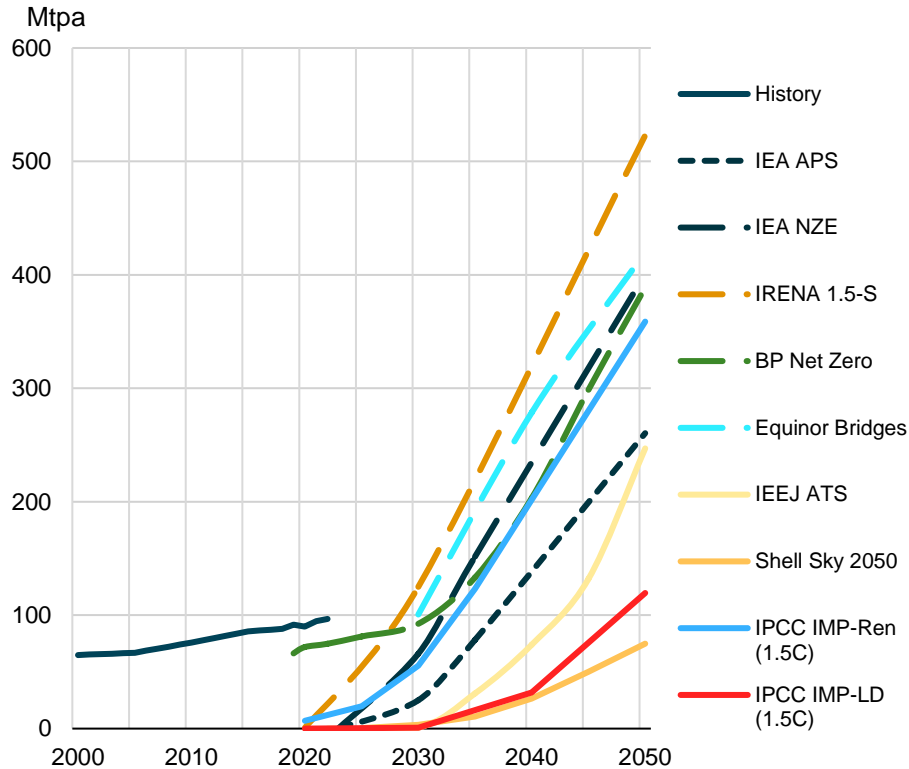
## Hydrogen Demand Scenarios Through 2050



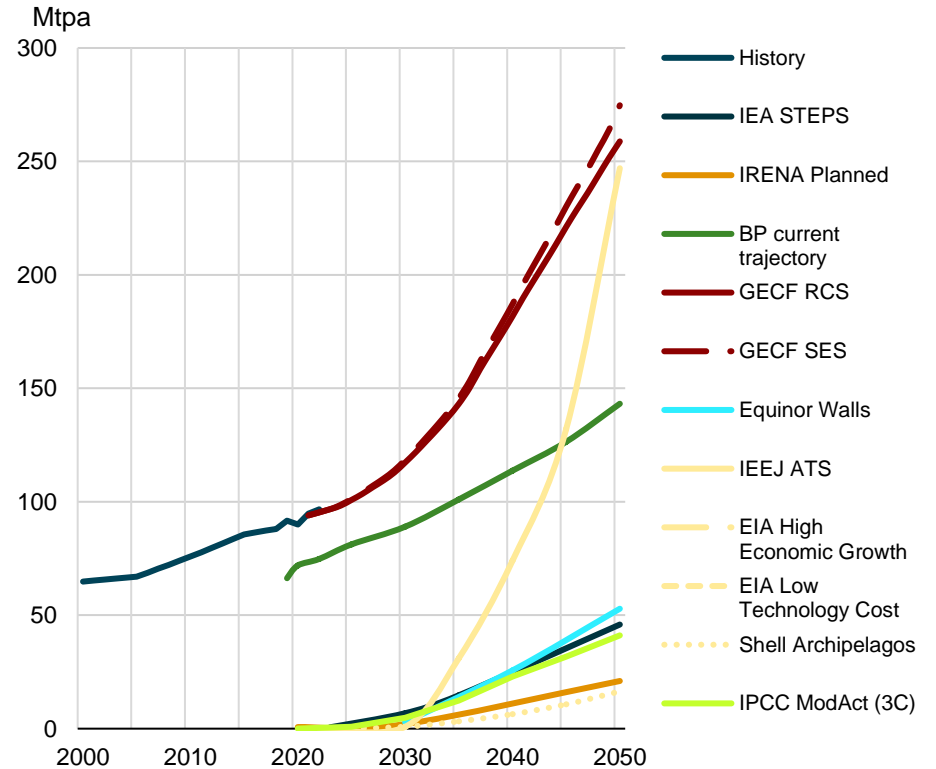
Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, GECF Global Gas Outlook 2025, BP Energy Outlook 2024, and IPCC AR6.

# Projections indicate a rapid increase in hydrogen demand, but the pace and scale of this increase differ across various scenarios

## Hydrogen Demand: Ambitious Climate Scenarios



## Hydrogen Demand: Reference Cases and Evolving Policies



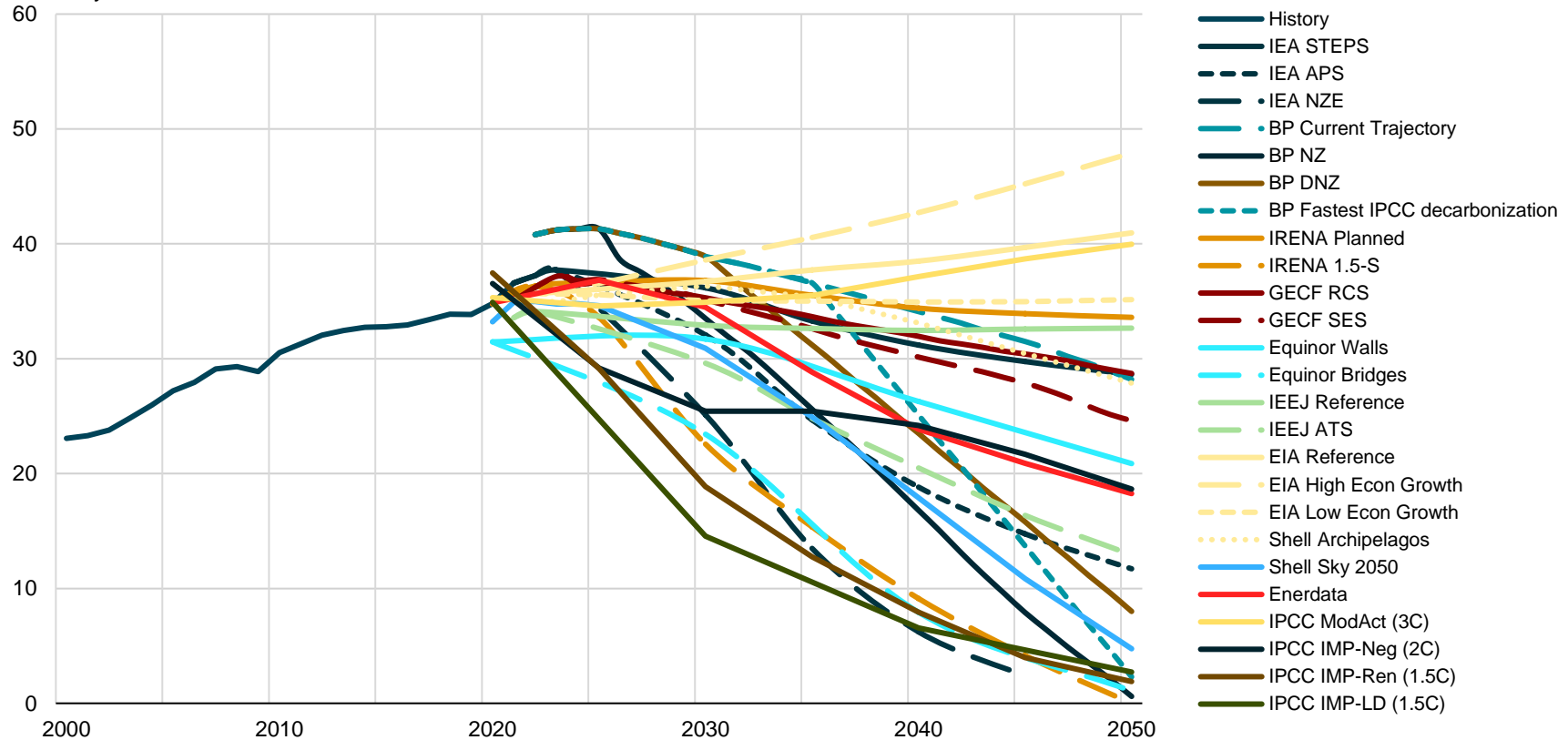
Some scenarios only provide an outlook for low-carbon hydrogen, while others include hydrogen made from unabated fossil fuels.

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.

# CO<sub>2</sub> scenarios vary widely, projecting changes from -1% to +30%, compared to 2022 levels

## CO<sub>2</sub> Emissions Scenarios Through 2050

Gt CO<sub>2</sub>/year

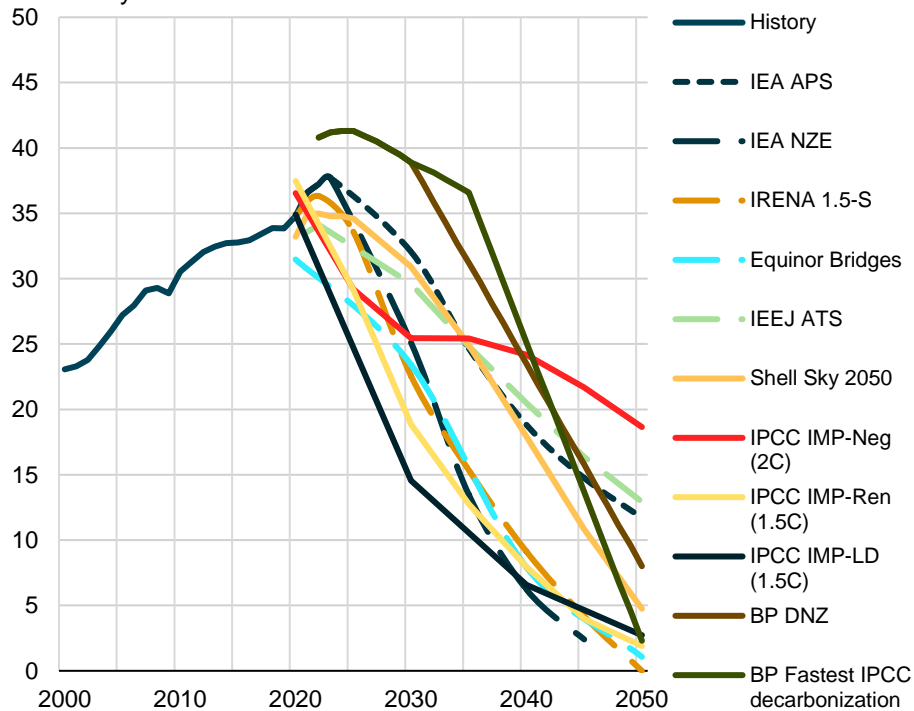


Source: IEF, IEA WEO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, EnerOutlook 2050, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, and IPCC AR6

# Ambitious scenarios show ~1 Gt of CO<sub>2</sub> on average reduction per annum, compared to 0.2 Gt in current and evolving policy scenarios

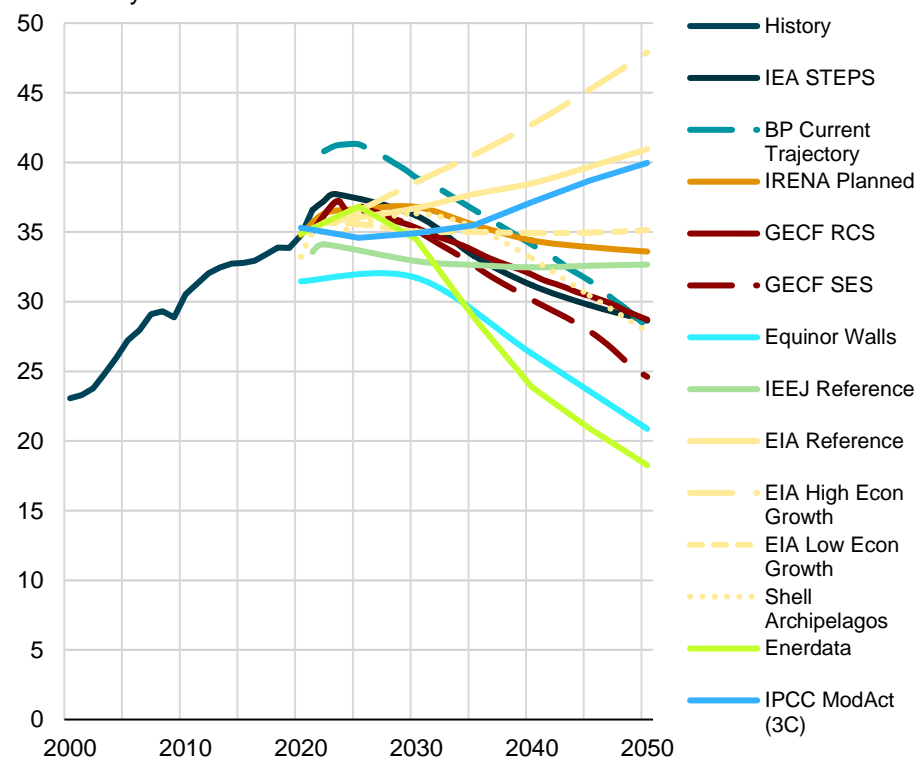
## CO<sub>2</sub> Emissions: Ambitious Climate Scenarios

Gt CO<sub>2</sub>/year



## CO<sub>2</sub> Emissions: Reference Cases and Evolving Policies

Gt CO<sub>2</sub>/year

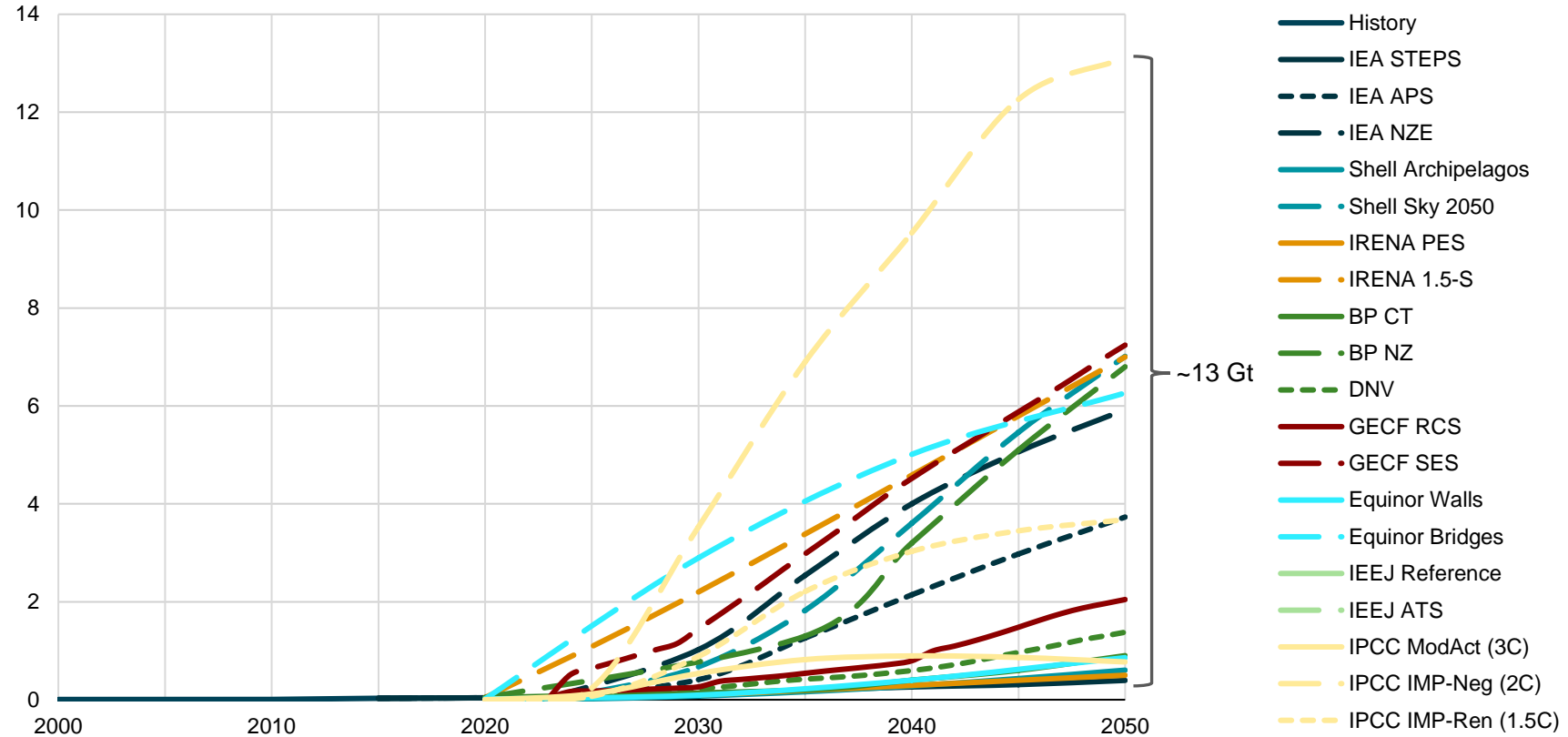


Source: IEF, IEA WEO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, EnerOutlook 2050, BP Energy Outlook 2024, IRENA World Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, and IPCC AR6

# Though CO<sub>2</sub> abatement scenario outcomes vary widely, on average 4 Gt of CO<sub>2</sub> is expected to be captured by 2050

## Carbon Capture (CCUS, CCS, BECCS, Industrial)

Gt CO<sub>2</sub>/year

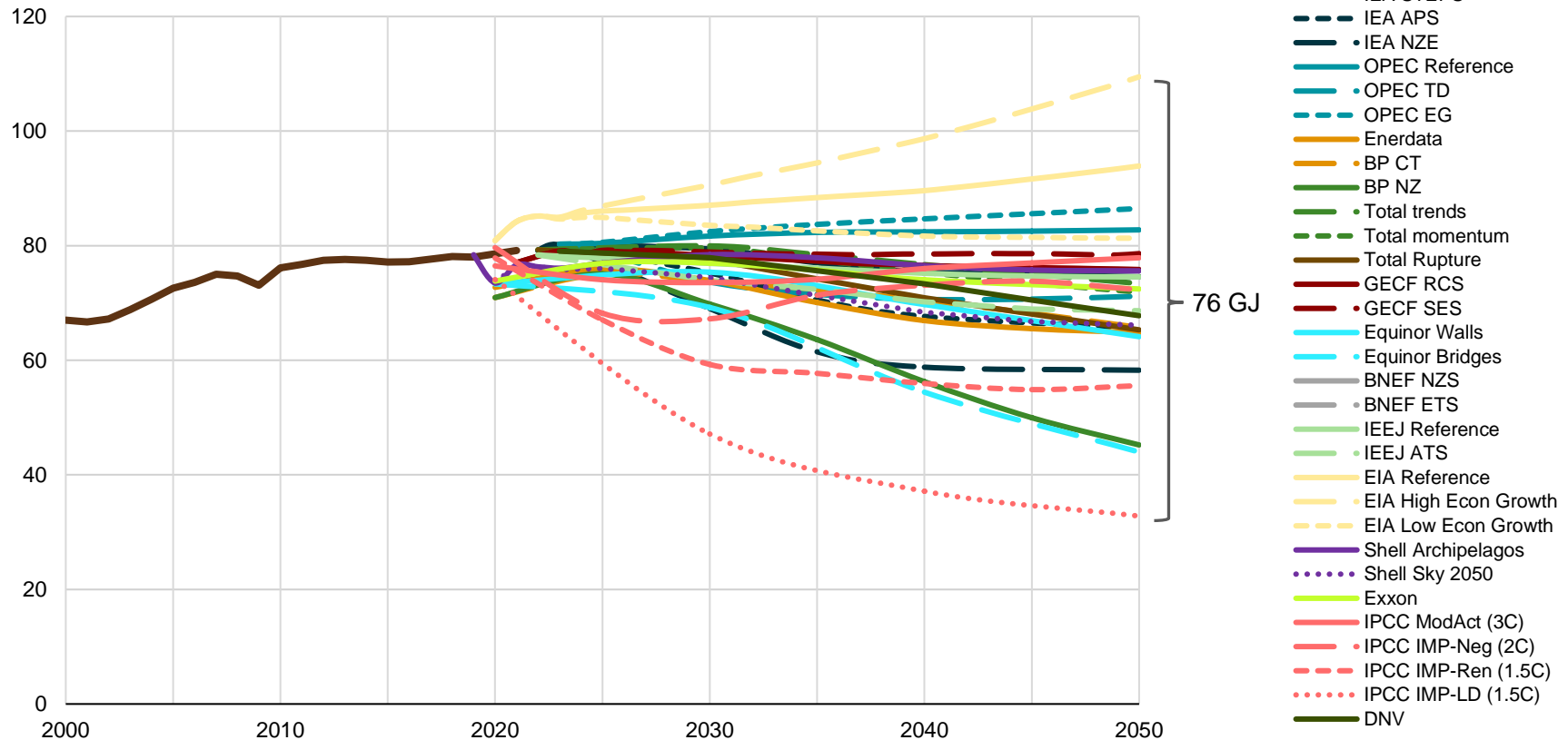


Source: IEF, IEA WEO 2024, IRENA World Energy Transition Outlook 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, Shell Energy Security Scenarios 2023, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, BP Energy Outlook 2024, and IPCC AR6.



# A 76 GJ per capita gap reflects divergent assumptions regarding energy access and productivity scenarios projected for 2050

**Primary Energy Consumption Per Capita**  
Gigajoules per capita

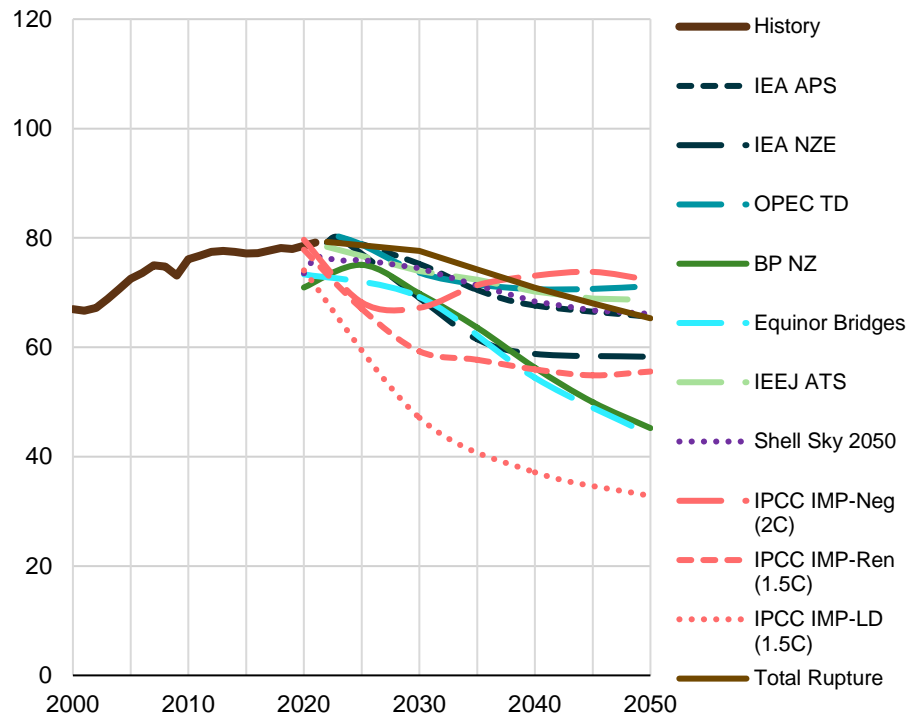


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EnerOutlook 2050, BP Energy Outlook 2024, ExxonMobil Global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

# The average per capita use of energy in evolving policy scenarios is higher than in ambitious climate mitigation scenarios

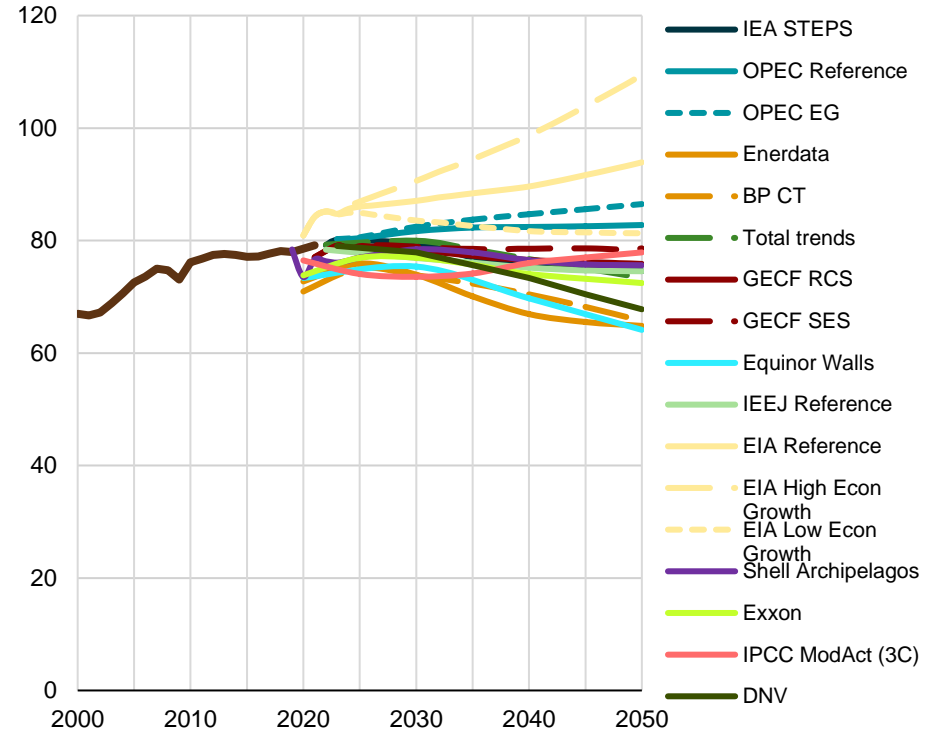
## Primary Energy Consumption Per Capita: Ambitious Climate Scenarios

GJ per capita



## Primary Energy Consumption Per Capita: Reference Cases and Evolving Policies

GJ per capita

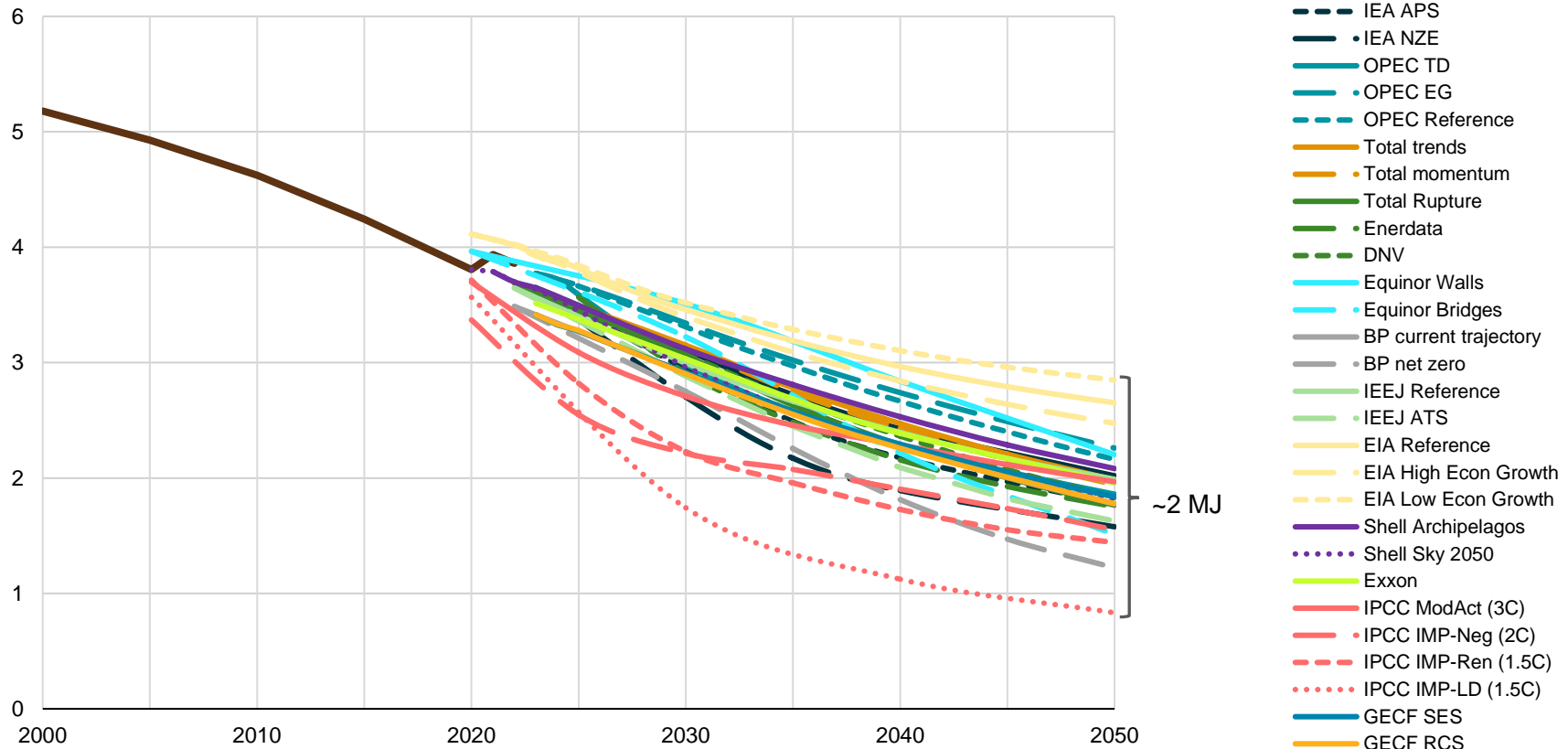


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EnerOutlook 2050, BP Energy Outlook 2024, ExxonMobil Global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

# 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

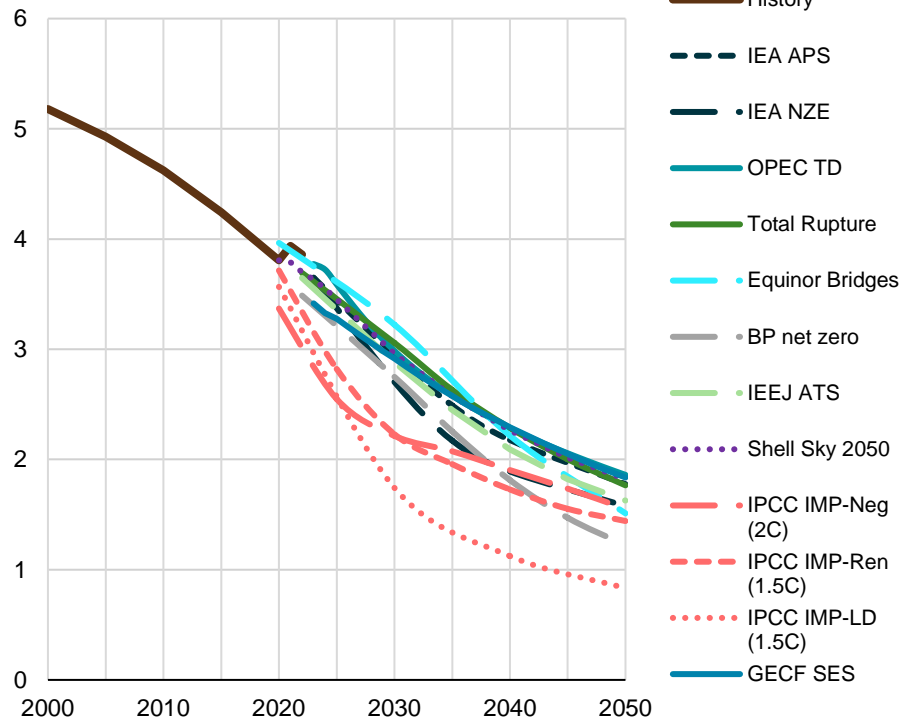


Source: IEF, IEA WEO 2024, OPEC WOO 2024, Equinor Energy Perspectives 2024, IEEJ Outlook 2024, EIA IEO 2023, Shell Energy Security Scenarios 2023, Total Energy Outlook 2024, DNV's Energy Transition Outlook 2024, GECF Global Gas Outlook 2025, EnerOutlook 2050, BP Energy Outlook 2024, ExxonMobil Global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

# By 2050, ambitious scenarios project an average energy intensity of 1.7 MJ/USD compared to 2.2 MJ/USD in current and evolving trends

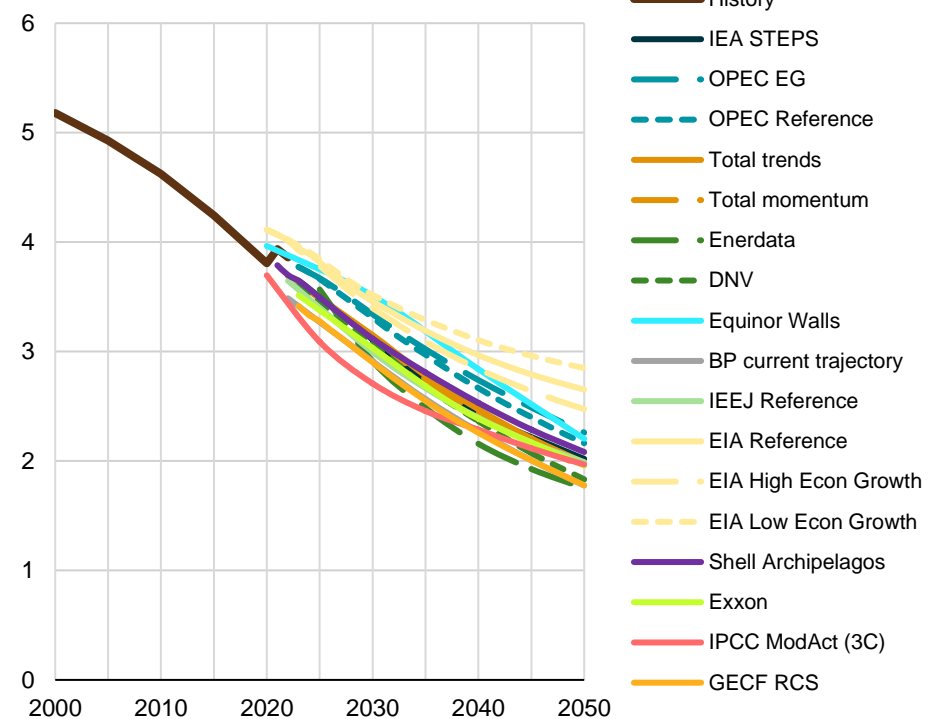
## Energy Demand Intensity of GDP: Ambitious Climate Scenarios

MJ per 2023 USD PPP



## Energy Demand Intensity of GDP: Reference Cases and Evolving Policies

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.

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# Appendix

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## Notes:

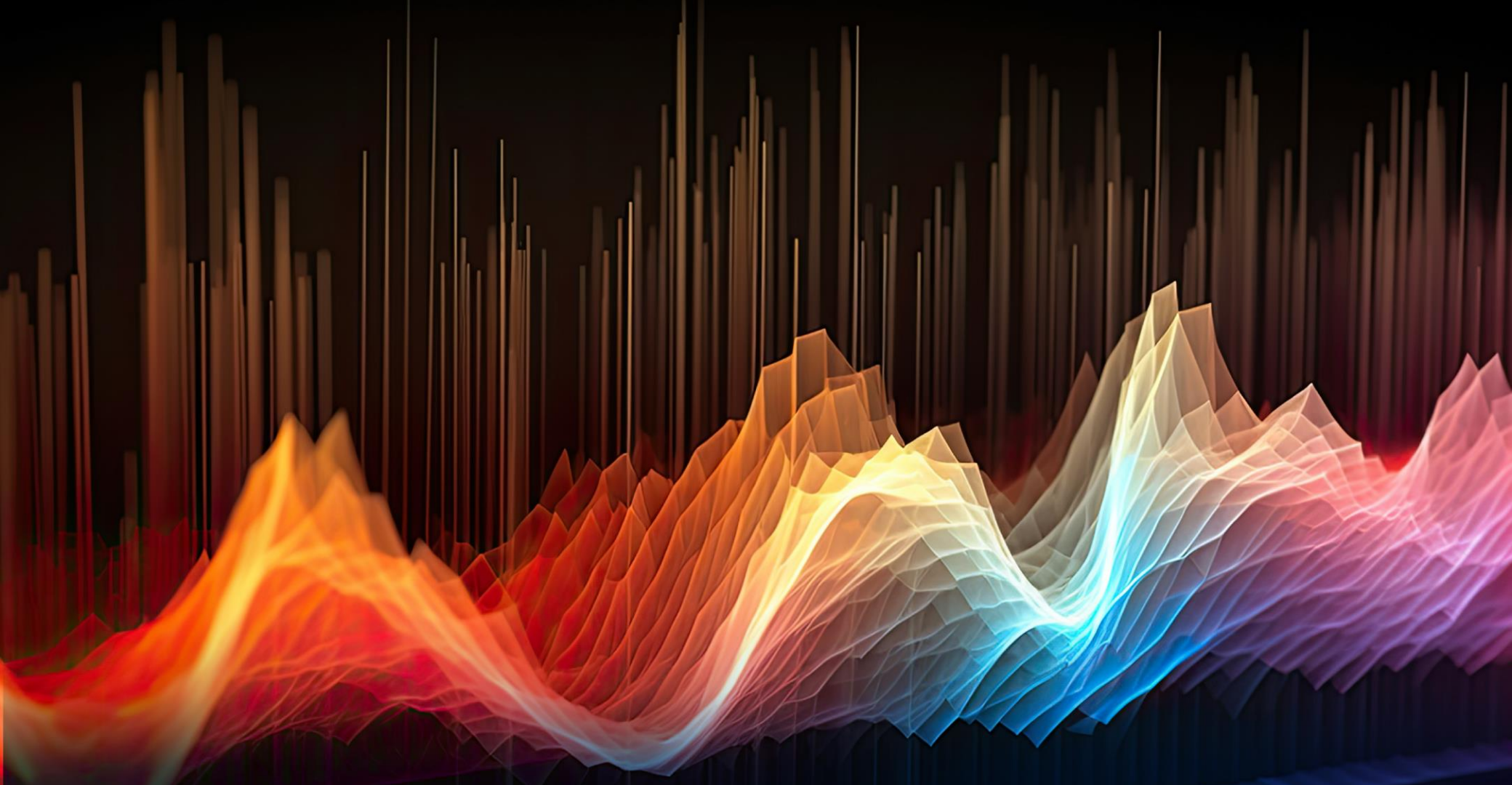
- Data in tables and charts may not sum due to rounding.
- Some divergences may be explained by different energy conversion efficiency assumptions.
- To enable comparability between agencies, biofuels (volumetric equivalent) were added to IEA regional oil supply data unless otherwise stated.
- Processing gains were subtracted from EIA regional oil supply data to enable comparability.
- In most instances in this report, when oil is reported in the context of primary energy demand it excludes biofuels, coal-to-liquids and gas-to-liquids and is reported in energy equivalent units (mboe/d) to allow for a comparison between different fuel types.

# Acknowledgements:

This report was prepared by the IEF, in consultation with the International Energy Agency, and Organization of the Petroleum Exporting Countries.

The IEF would like to thank the IEA and OPEC for their constructive comments and insights into this document and the on-going dialogue that underpins the trilateral program of work.

The IEF also thanks the GECF and IRENA and other organizations for sharing key data in support of the IEF producer-consumer dialogue.



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

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