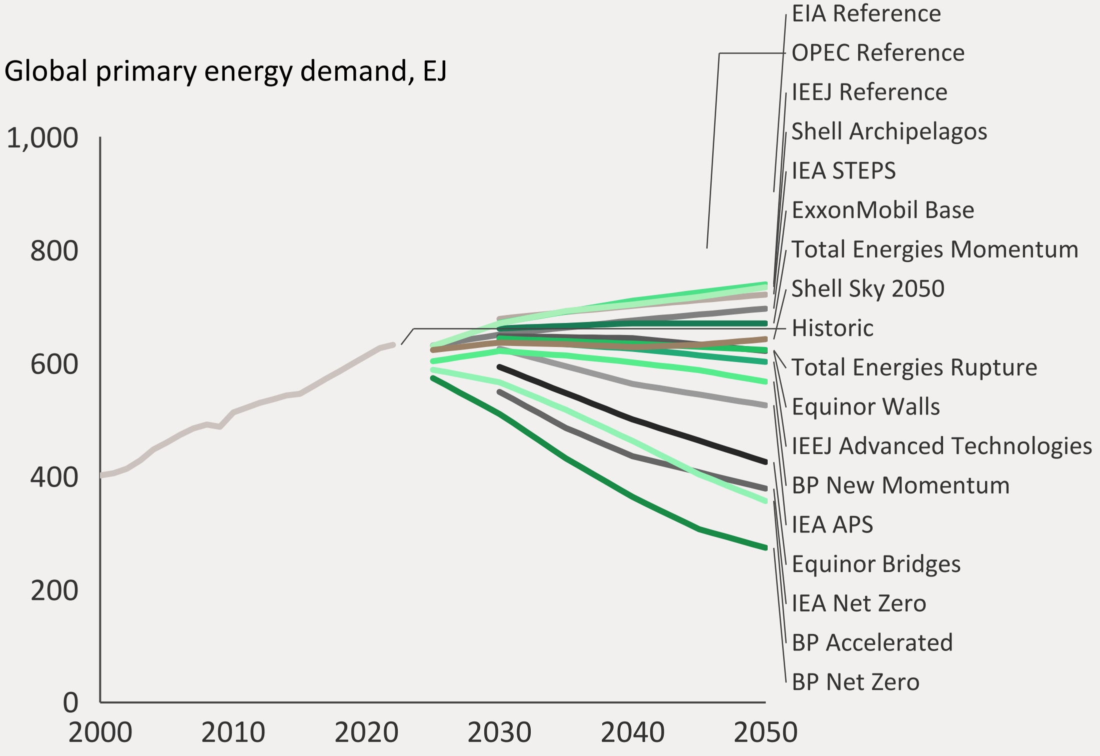
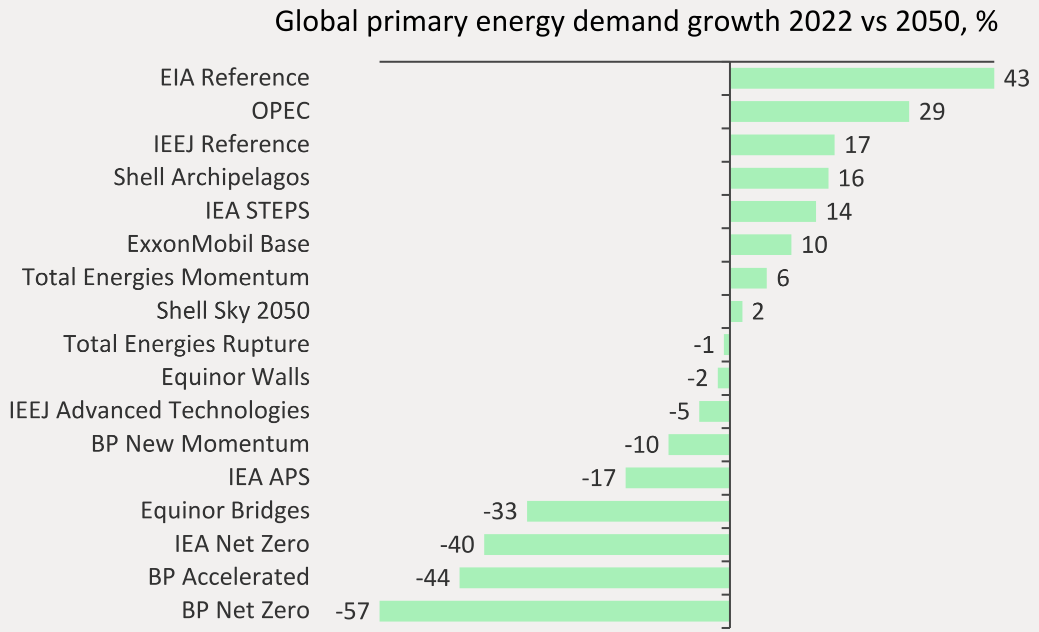
Energy demand grew by 58% over 20 years
Significant uncertainty to 2050 among scenarios

Global primary energy demand range of outcomes is almost as big as current energy demand



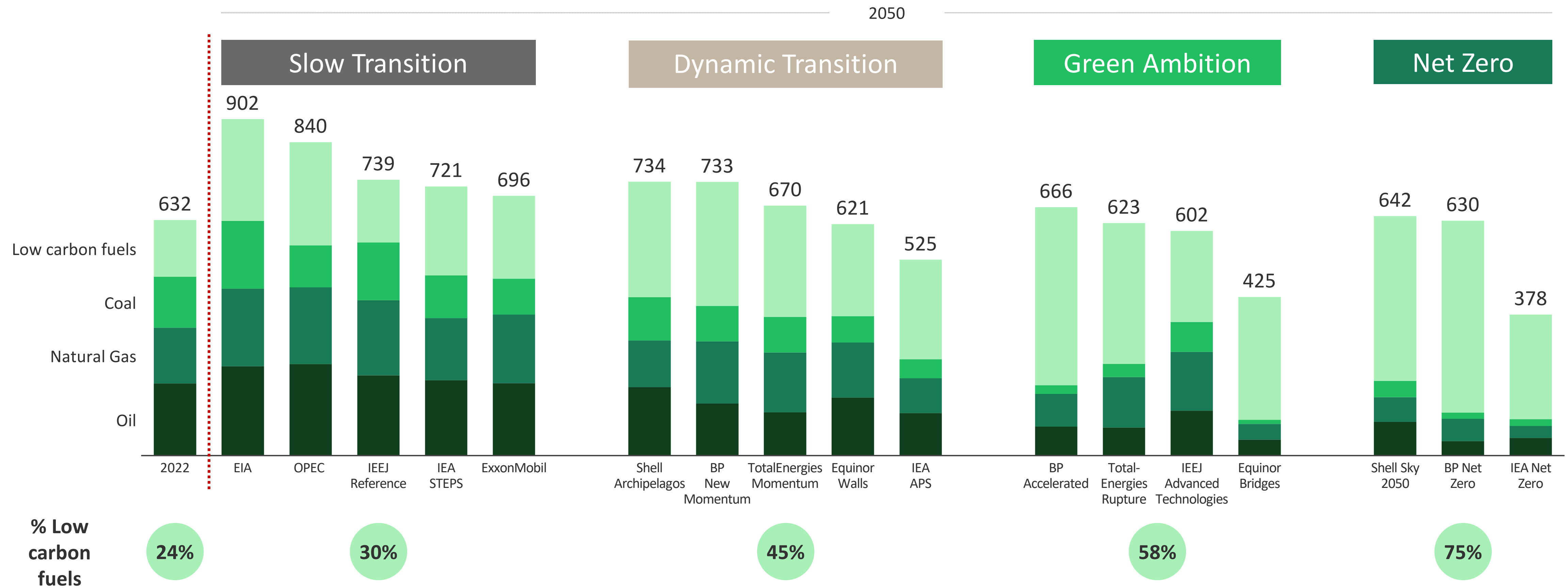
8 of the 17 scenarios (47%) project energy demand increases through 2050



Note: Gap between 2022-2025 to show the range of projection. OPEC's projection ends in 2045, estimated 2050 value
Source: Energy reports, BCG CEI

A look at the long-term scenarios: Green futures can increase global low carbon fuels share above 60%, and potentially cause a peak in total energy

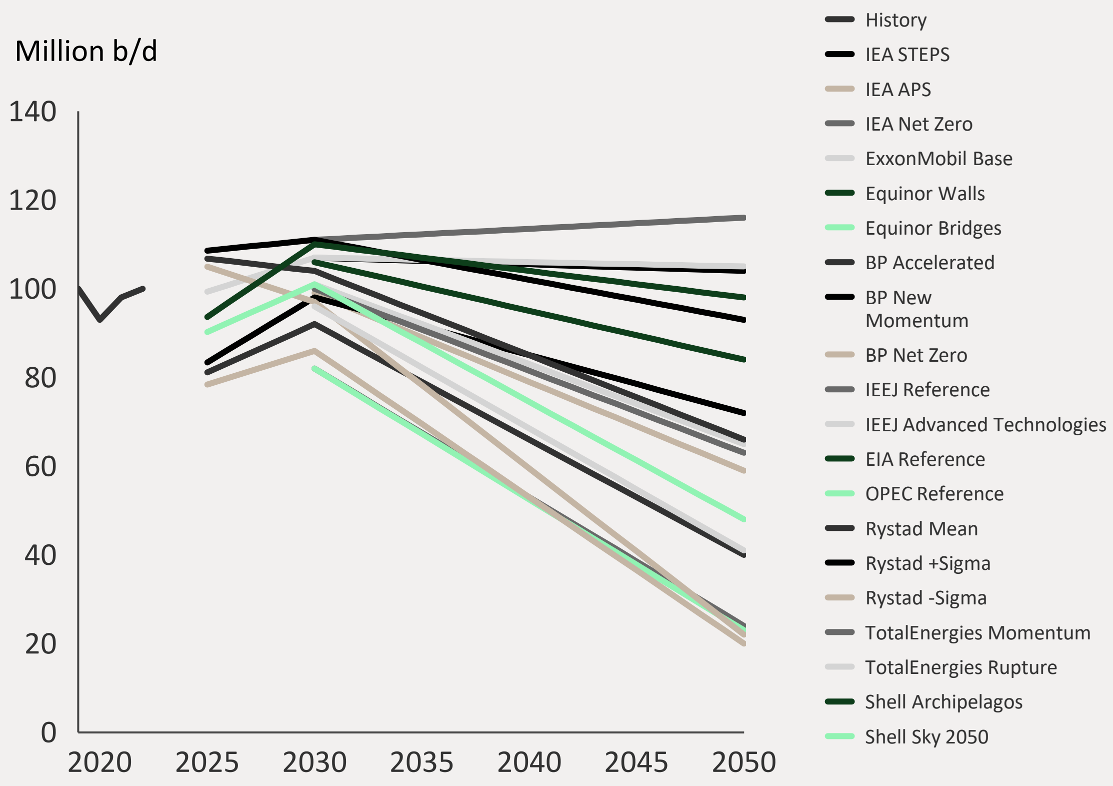
Global energy demand 2022 vs. 2050, by primary source (EJ)



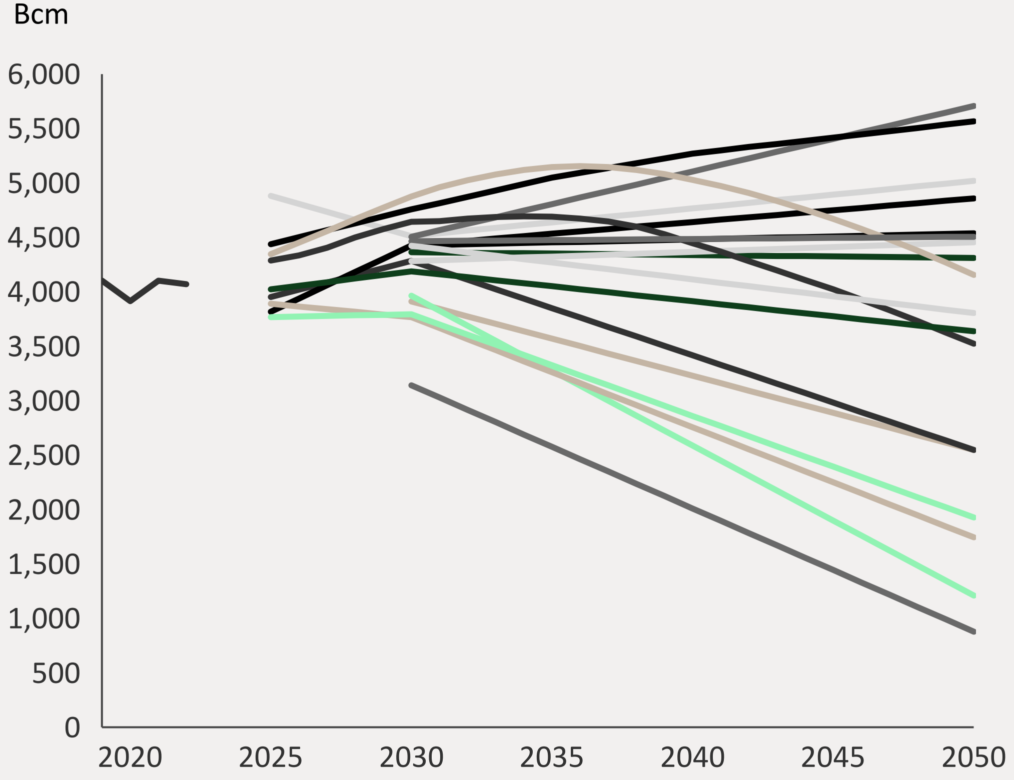
Note: Fossil fuels: oil, natural gas and coal. Low carbon fuels, nuclear, biofuels, hydro, geothermal, wind and solar
Source: IEA; IEEJ; Exxon, Equinor; BP; BCG Analysis

Oil demand up 9% since 2000- Current scenarios show high uncertainty through 2050, but most call for peak by 2030

Oil demand outcomes range equivalent to 2021 oil demand



Even greater uncertainty for natural gas demand



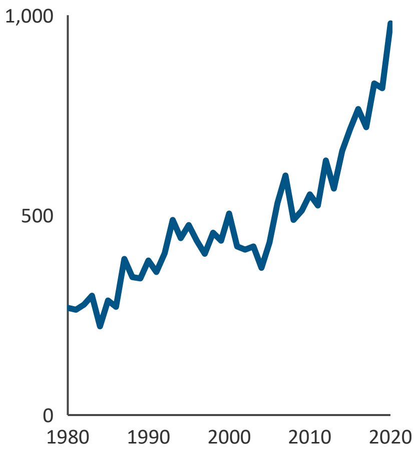
Note: Gap between 2022-2025 to show the range of projection. OPEC's projection ends in 2045, estimated 2050 value. Left chart: indexed to Rystad 2022 historic data
Source: Energy reports, BCG CEI

Rising geopolitical risks are correlated with other changes in energy system- complicating forecasting

Extreme weather

Extreme weather events drive **higher energy demand** and migration**,** contributing to an **increase in geopolitical risks**

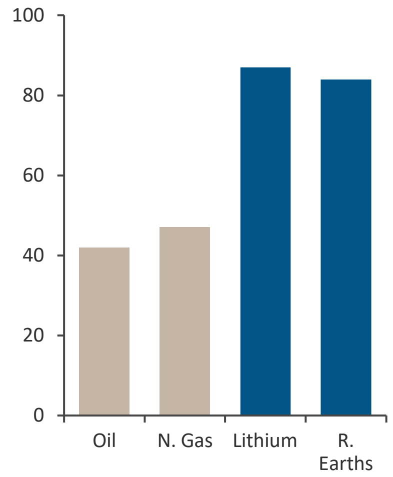
Number of extreme weather events



Transition to minerals

Transitioning to minerals in **highly concentrated** markets requires **geopolitical navigation**

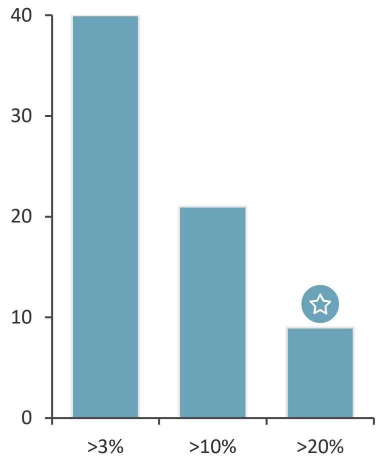
% supply of top 3 producers of different commodities



Stranded assets

Prices could **sharply drop** at hydrocarbon demand peak, **stressing countries** dependent on this industry

# of countries dependent on hydrocarbon revenues by level of GDP



Energy poverty

Increasing geopolitical risks **reduce affordable energy** availability

41
million people in EU unable to keep homes warm in 2022

Weaponization of energy

Risk of weaponizing resources increases as **power dynamics shifts**

Examples include:

- Russia cutting off gas to Europe
- China's minerals export license requirements

€300
MWh for natural gas August 2022

☆ *Libya, Iraq, Congo, Angola, Kuwait, Saudi Arabia, Oman, Guyana & Azerbaijan*

Source: UN, Yale Climate center, IEA, World Bank, Bloomberg, European Parliamentary Research Service, BCG analysis

Effective Signposts: identifying and solving data gaps

Category	Initial Signpost	Signpost status			Best available signpost and comments
	Note: all signposts to include global and regional cuts, project level detail when possible	Found support for identified signpost	Alternate signpost found	Alternate signpost not available	
CCS	Permits for CCS infrastructure (i.e., pipelines)		✓		• Data not available due to pipeline permits issued by different regulatory bodies; permitting process varies by jurisdiction • **Class VI well permits** in the US leading indicator
Wind	Permits for onshore/offshore wind projects			✓	• Permits either not available or not leading indicator • **Number of projects best available, but not ideal signpost** because this reflects current operational capacity
Solar	Permits for solar installations		✓		• Permits not available • Module shipments not available • **Module production capacity** seen as leading indicator
Advanced Nuclear	Permits/approvals for 4th generation nuclear projects		✓		• Permitting/licensing process varies greatly across geos; data availability inconsistent • **Project announcements** seen as leading indicator
Renewable Diesel	Operating plant capacities	✓			• **Operating plant capacities available** and can be updated regularly
Building Electrification	Rates at which buildings are being electrified			✓	• Available data either has significant time lag (GEM) or includes mobility electrification (IEA), **investigating alternatives**
Electricity Infrastructure Build-Out	Infrastructure build-out critical for solar/wind supply	✓			• Data on overall **Grid Capex** available at global and regional levels with very limited breakdown into T&D • Data on **Transmission Circuits** available, but no visibility into Distribution Circuits

Thank You.

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