

Energy Transitions: Navigating the Trilemma

(Energy Security, Affordability and Decarbonization)

Fuellers' Duke of Edinburgh (DoE) Future Energy Conference 2023

November 29, 2023
London



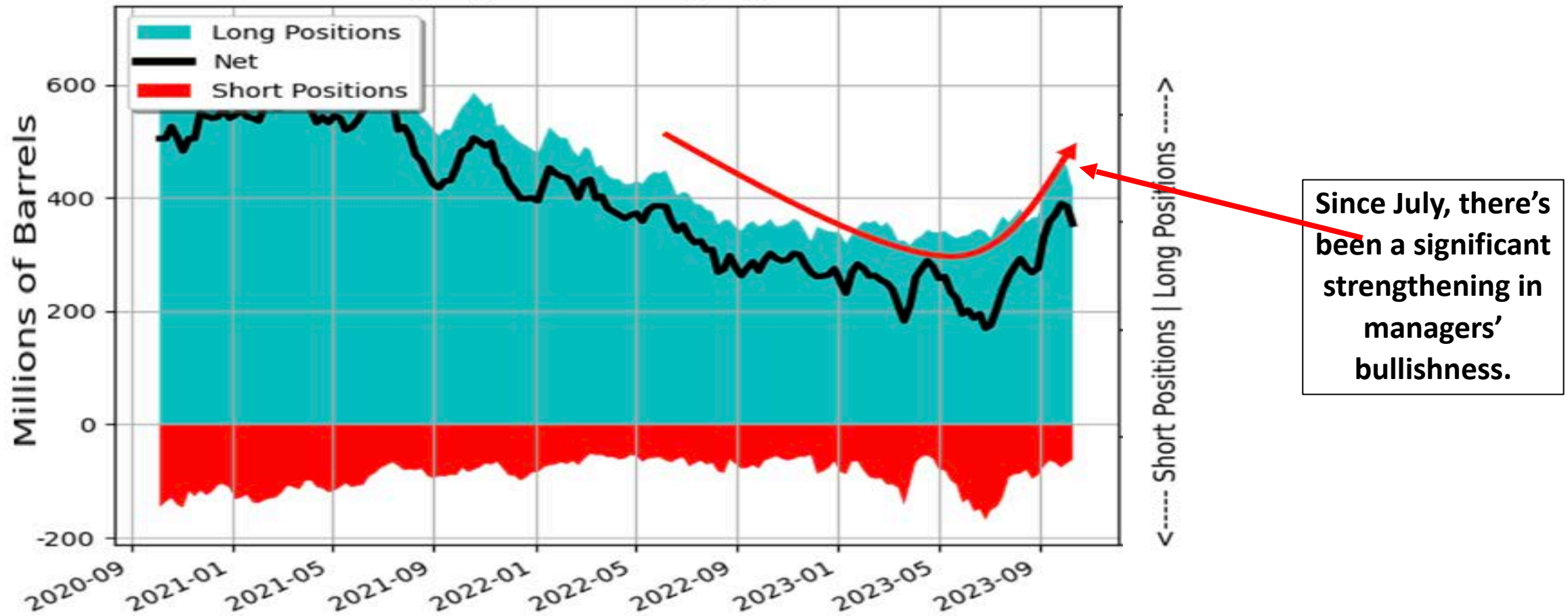
About Energy Policy Research Foundation



- Est. 1944
- Washington, D.C.
- Partnerships with domestic and international think tanks (especially IEEJ)
- Analysis of transition pathways, electrification, transportation issues
- Gaskins Center for Energy Security Studies (2023)
- www.eprinc.org

Money Managers Short and Long Positions (Net)

(Crude Oil and Options Contracts- 2020 to 2023)

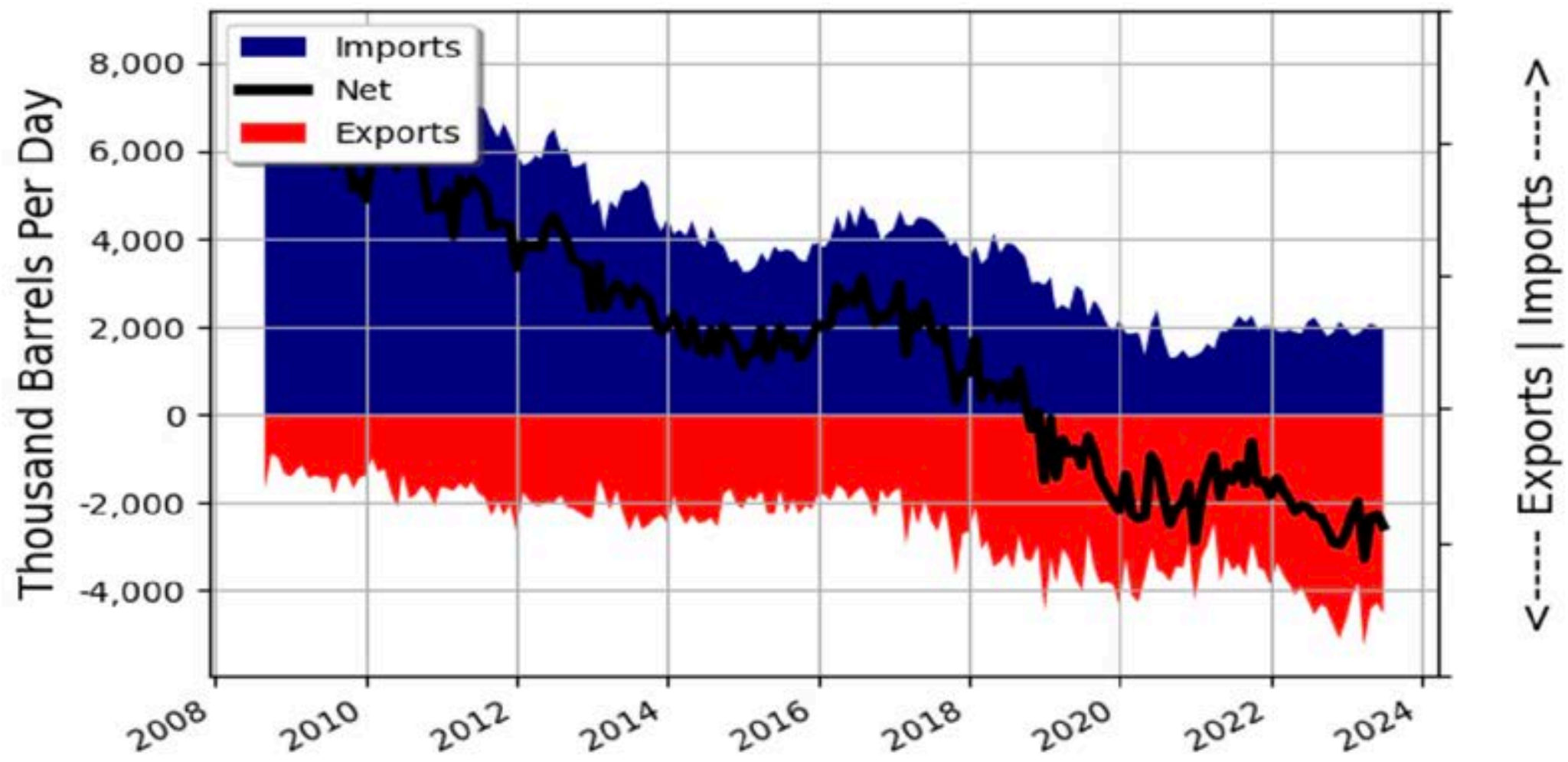


Since July, there's been a significant strengthening in managers' bullishness.

Source: Energy Policy Research analysis on CFTC data sets

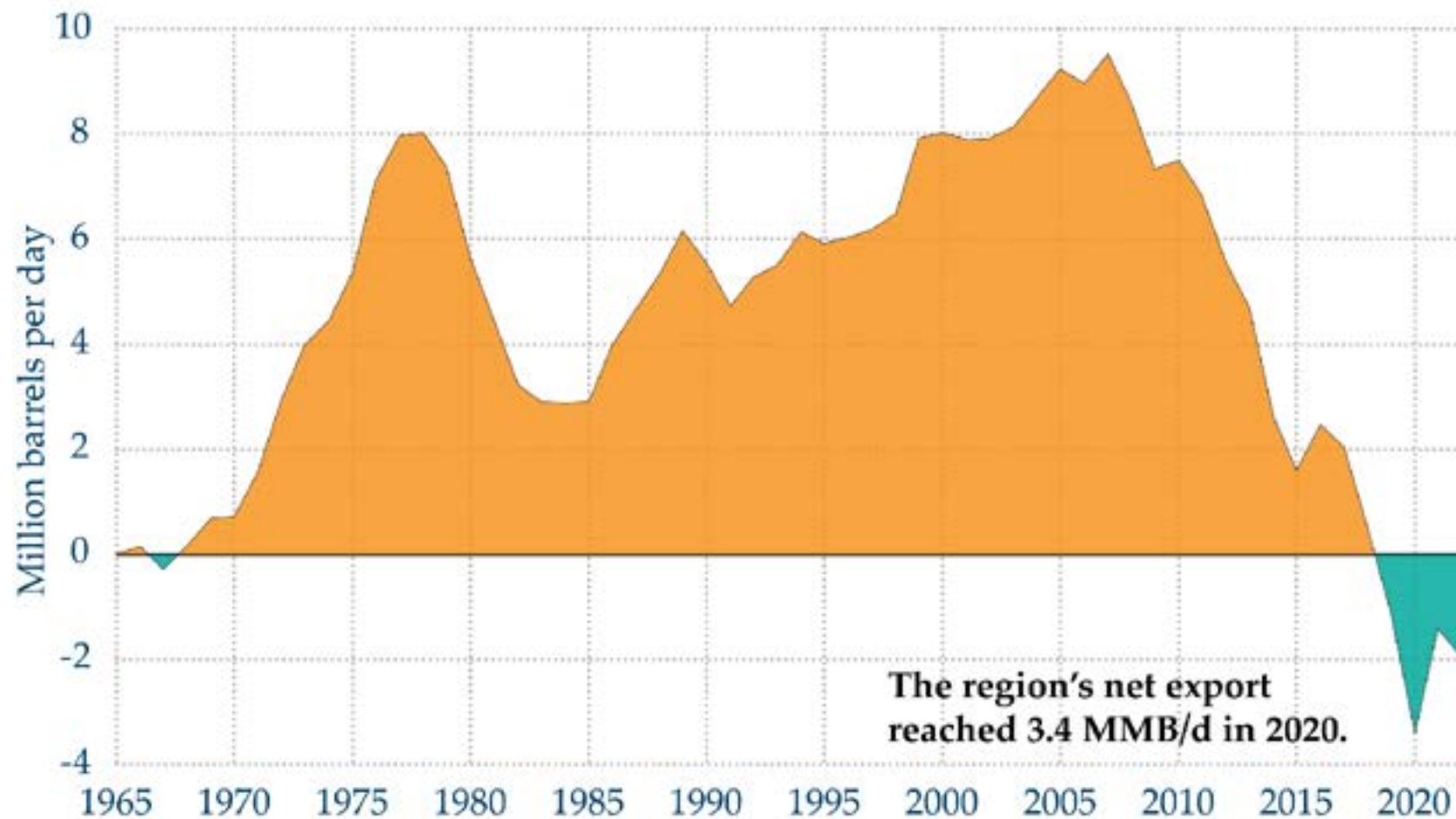
North American Crude Oil & Petroleum Products: Net Exports

(August 2008 through June 2023)



Source: Energy Policy Research analysis from monthly data sets; JODI, EIA, Statcan

Net Oil Imports of Western Hemisphere (North, Central, & South Americas)



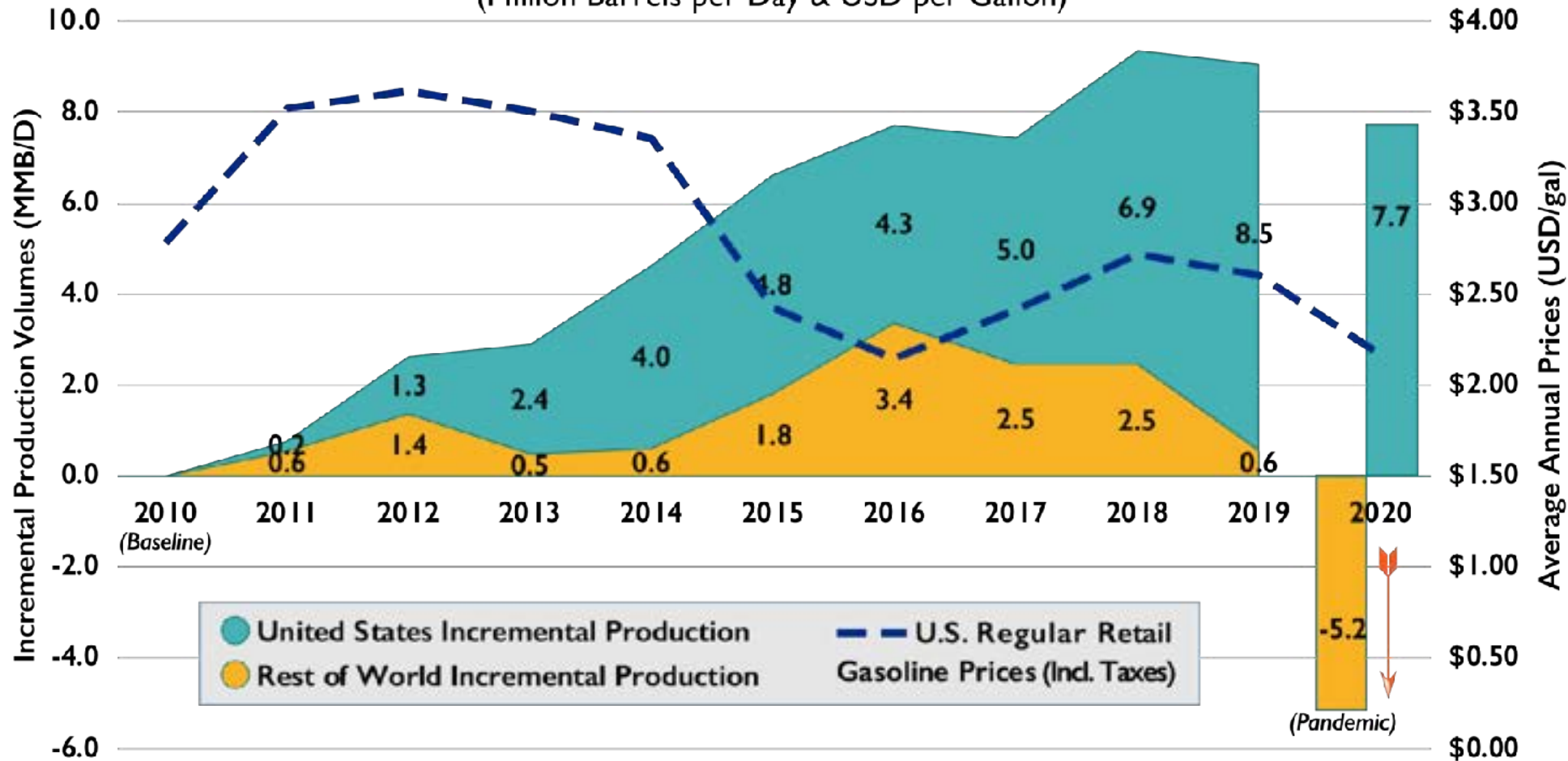
The region's net export
reached 3.4 MMB/d in 2020.

Data: *EI's Statistical Review of World Energy*

Expansion of US Production Kept Gasoline Prices Low

Global Incremental Oil Production & U.S. Gasoline Prices Since 2010*

(Million Barrels per Day & USD per Gallon)



U.S. supplied **84%** of incremental global liquids demand between 2010 and 2020.

*Includes crude, NGLs, and feedstocks
EPRINC analysis based on data from IEA, EIA

Why is the Energy Transition So Hard?

Does the Energy Transition Pose New Risks?

Major Technological Energy Transitions

Draft animals & fire

For agriculture and to produce metals and other durable materials



10,000 BC

6,000 yrs

Rivers & wind

Use waterwheels and windmills



4,000 BC

5,500 yrs

Coal, oil & natural gas

Led to Industrial Revolution & increased mobility



17th Century

250 yrs

Electricity

Beginning of widespread use of electricity



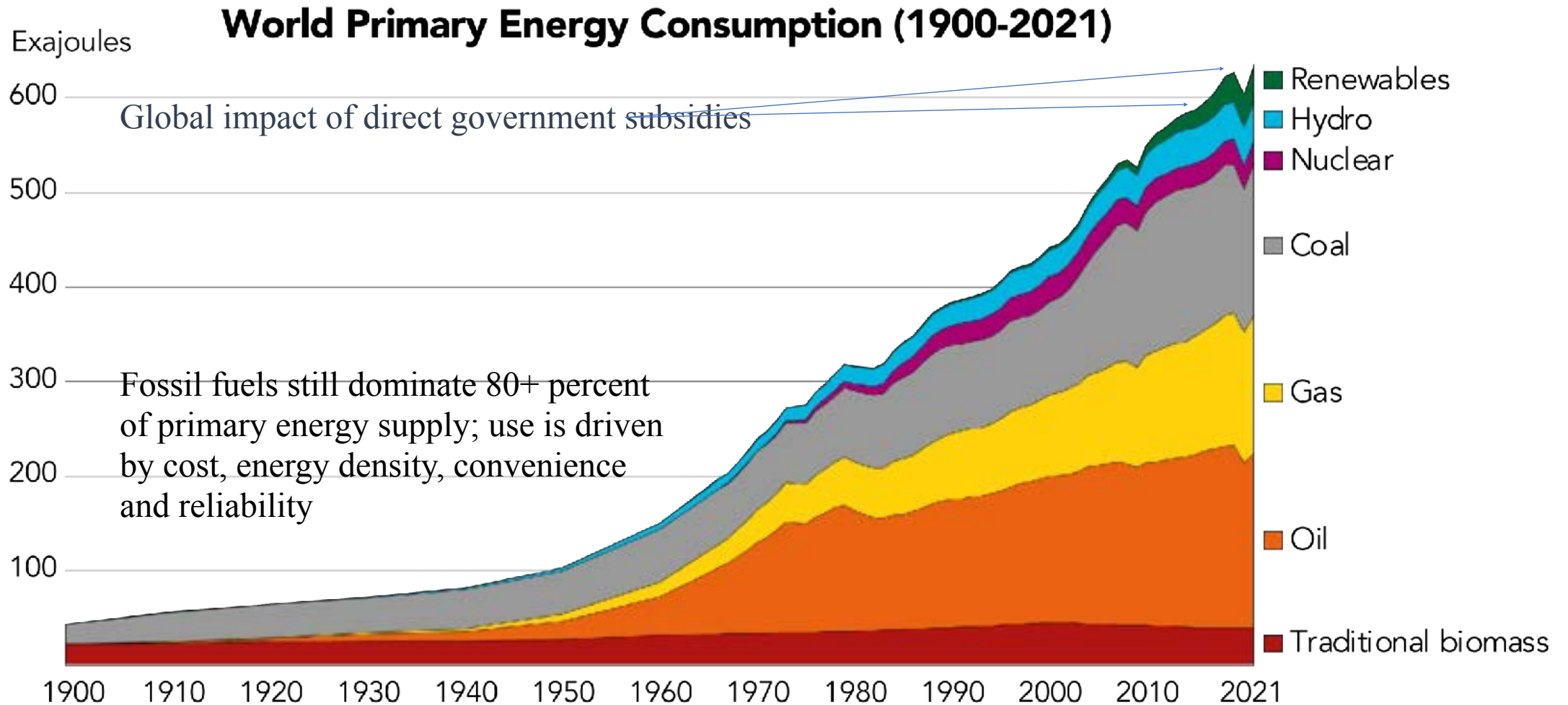
Late 19th Century

Nuclear, wind & PV



Mid-20th Century

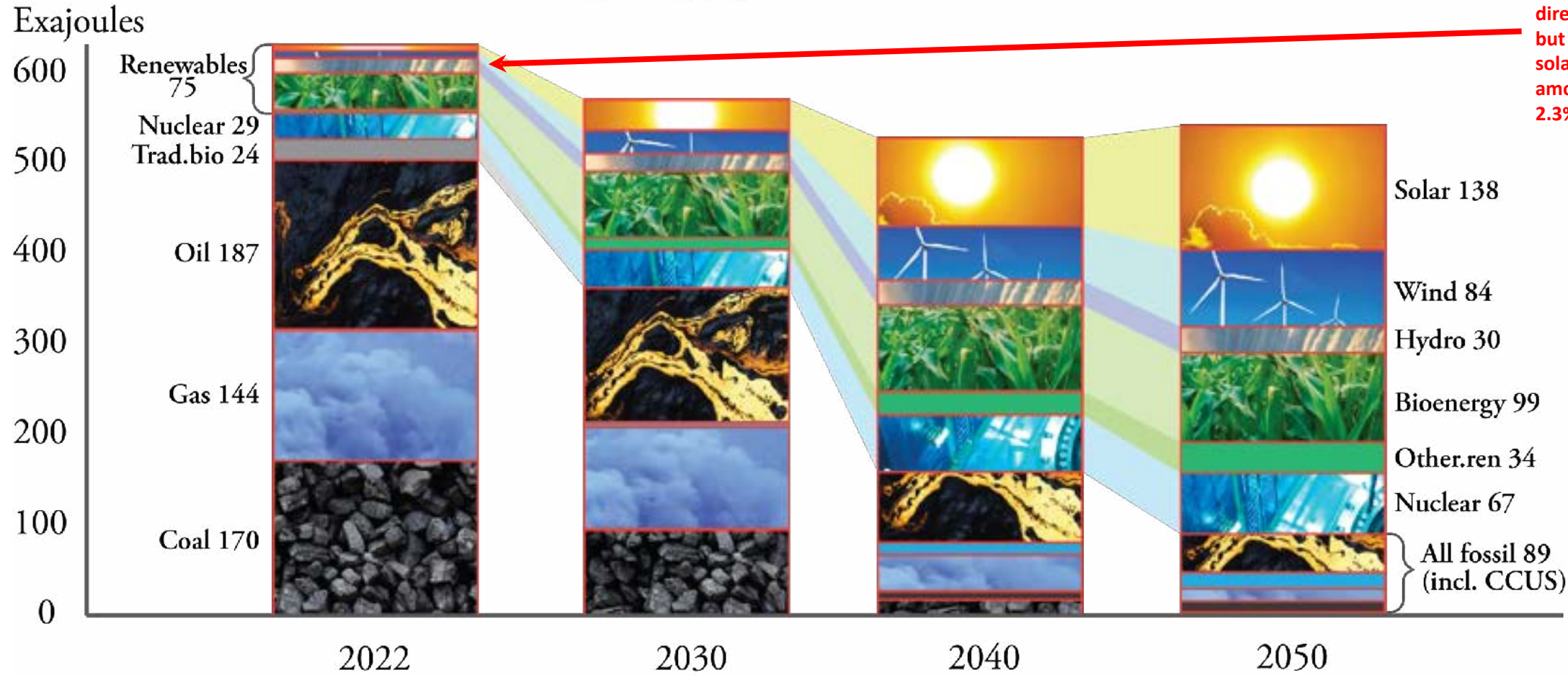
Energy Transition is Hard & Rare



Source: Energy Policy Research, Vaclav Smil, BP

Fossil's Share from 80% today to 16% in 2050

Global Primary Energy Supply under IEA Net Zero Scenario (2023)

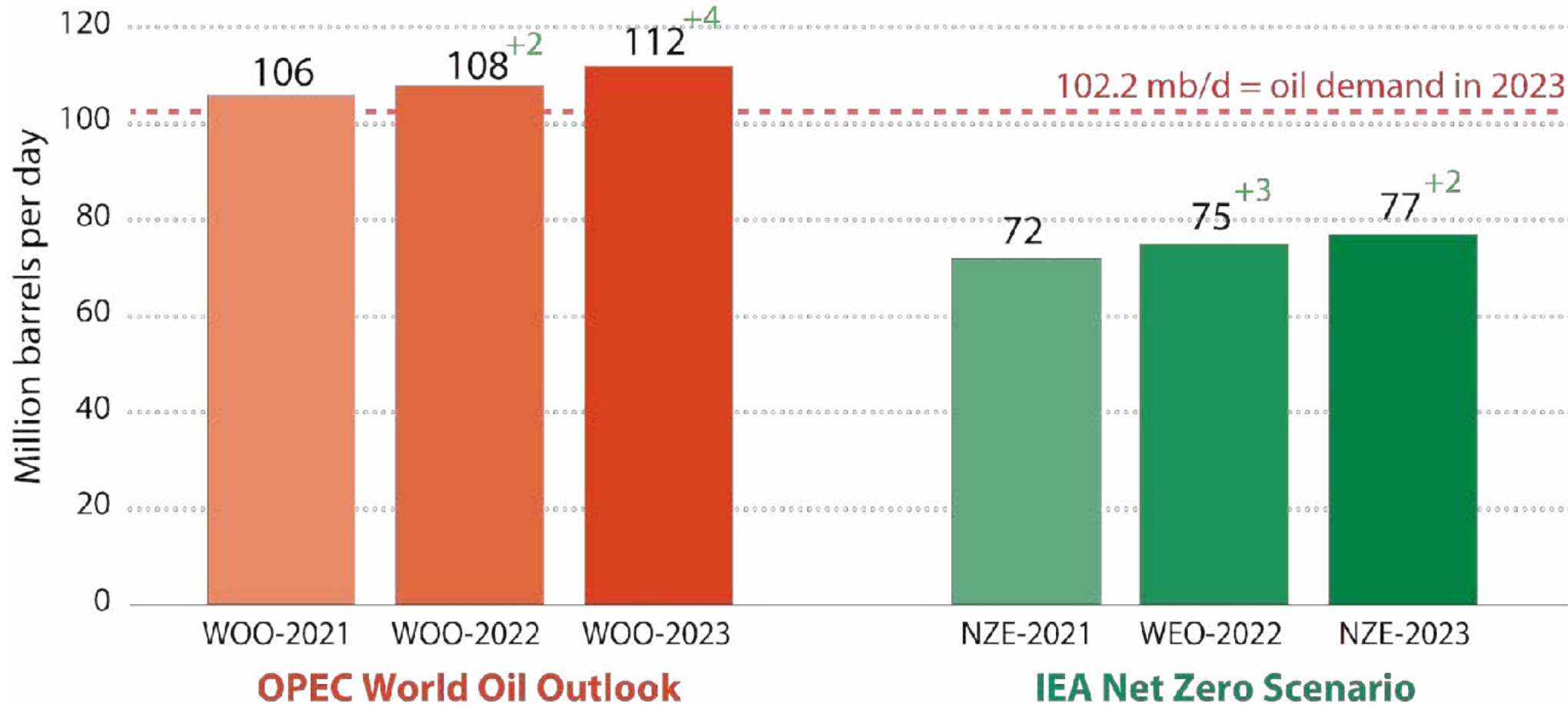


Over \$6 trillion in direct subsidies, but wind and solar amount to only 2.3%

Source: IEA Net Zero Update 2023

World Oil Demand in 2030

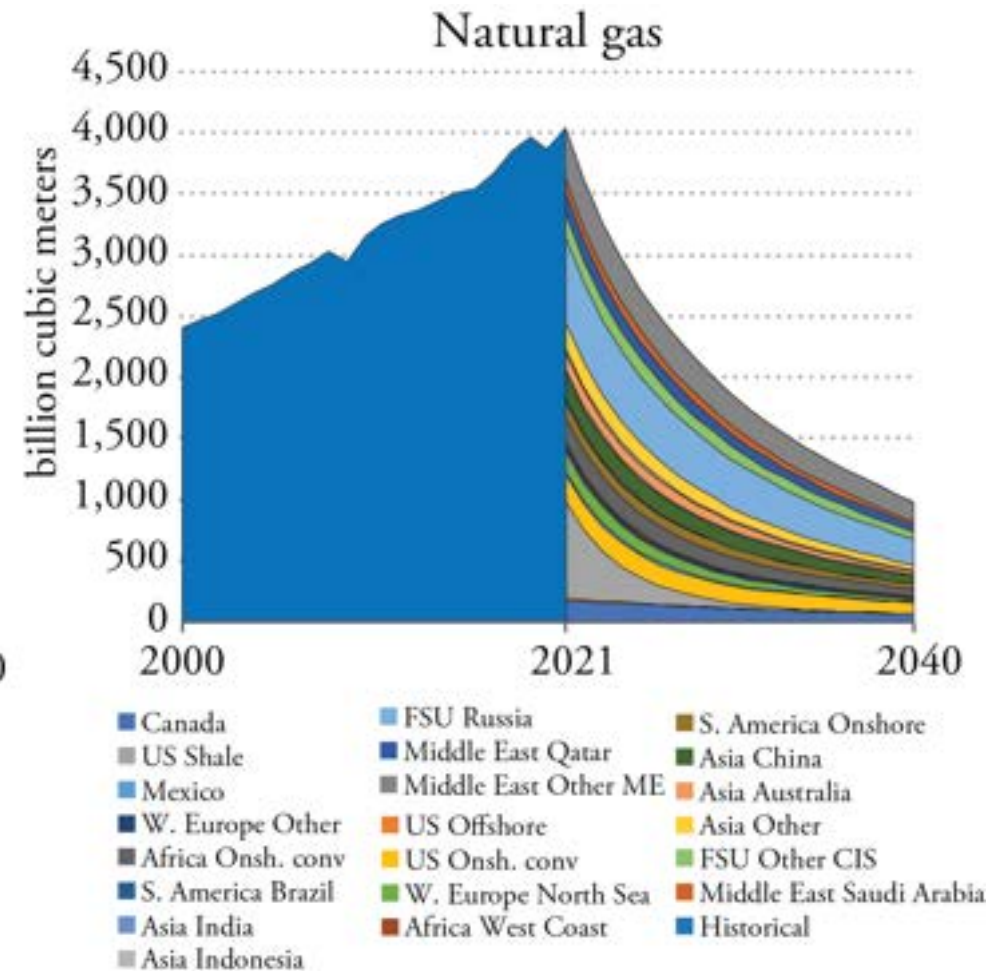
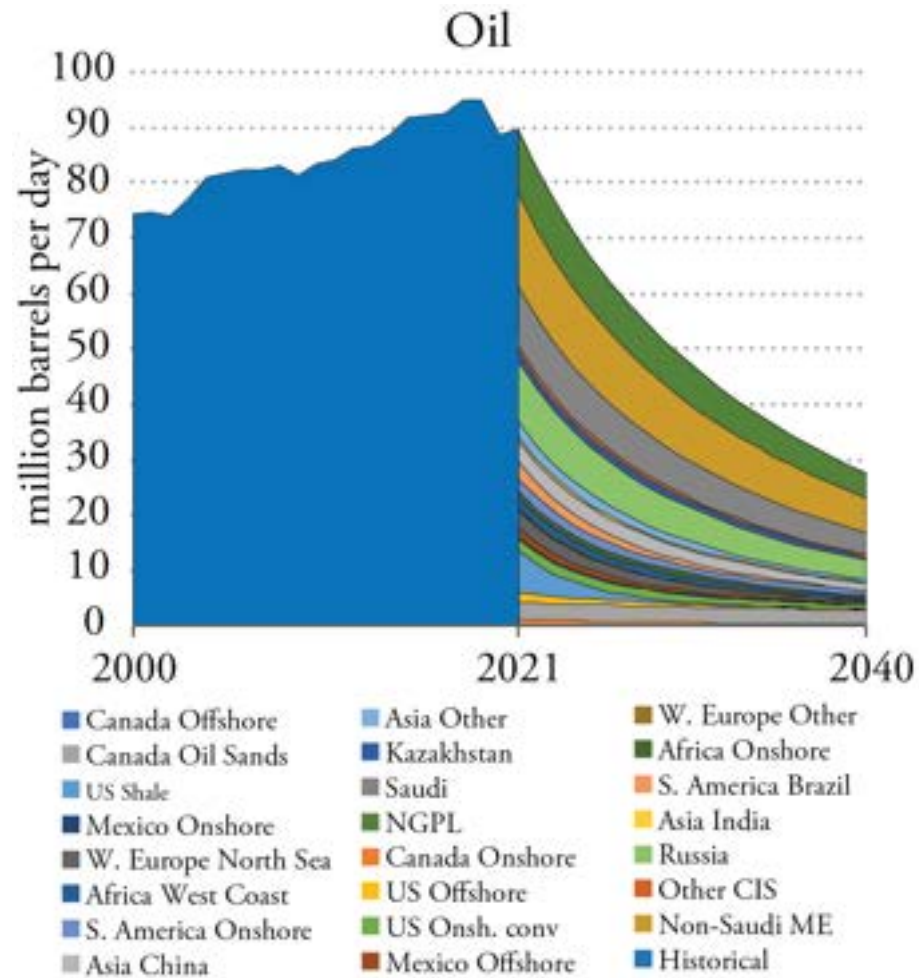
Two Opposite Scenarios  , Similar Upward Adjustments 



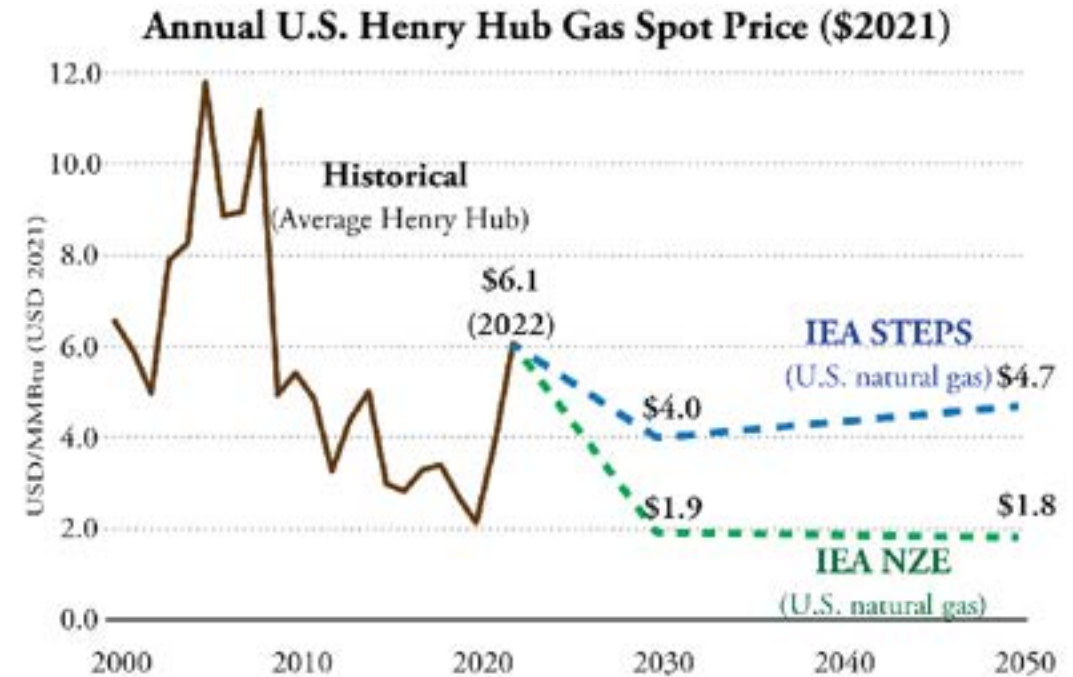
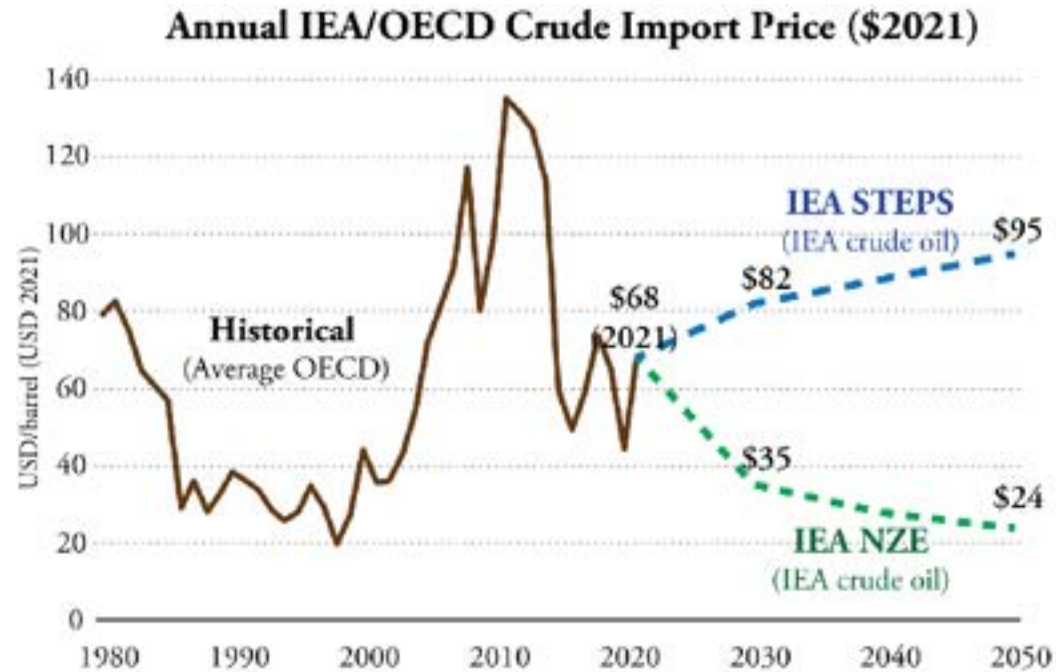
WOO = World Oil Outlook, NZE = Net Zero Roadmap, WEO = World Energy Outlook

Source: Energy Policy Research based on WOO 2021-2023, IEA NZ Roadmap 2021, NZ Update 2023, WEO-2022.

What Happens if Investment is Halted Worldwide for New Oil and Gas Development?

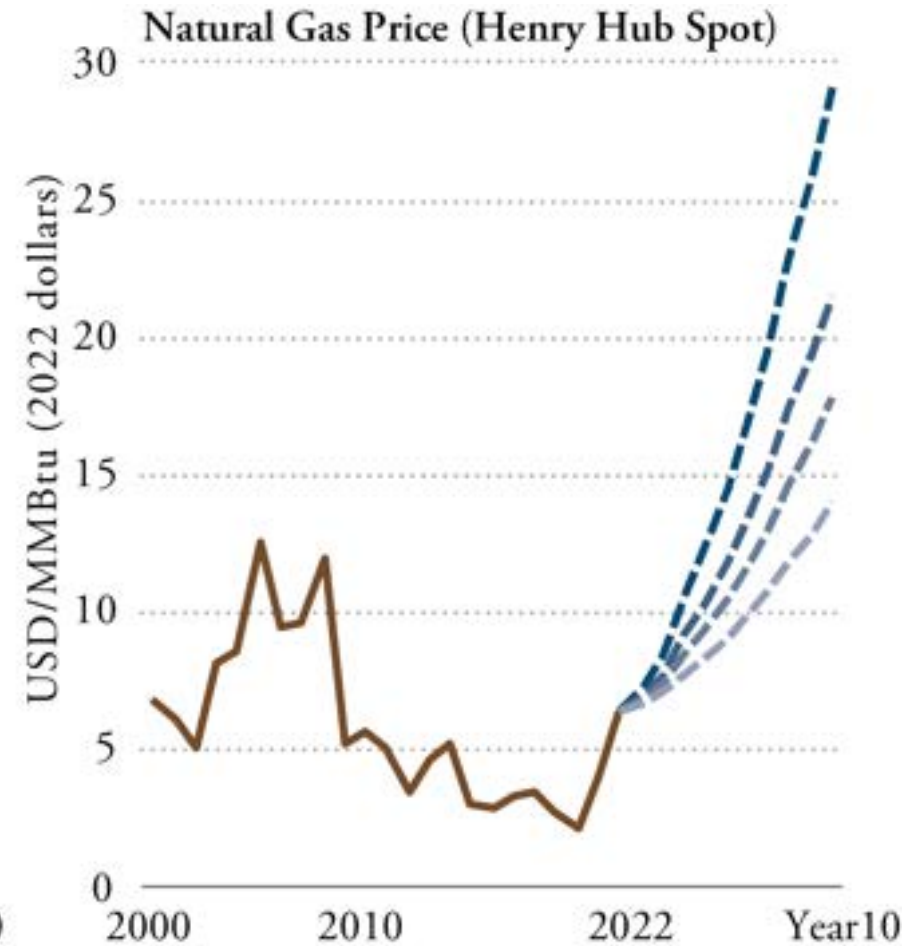
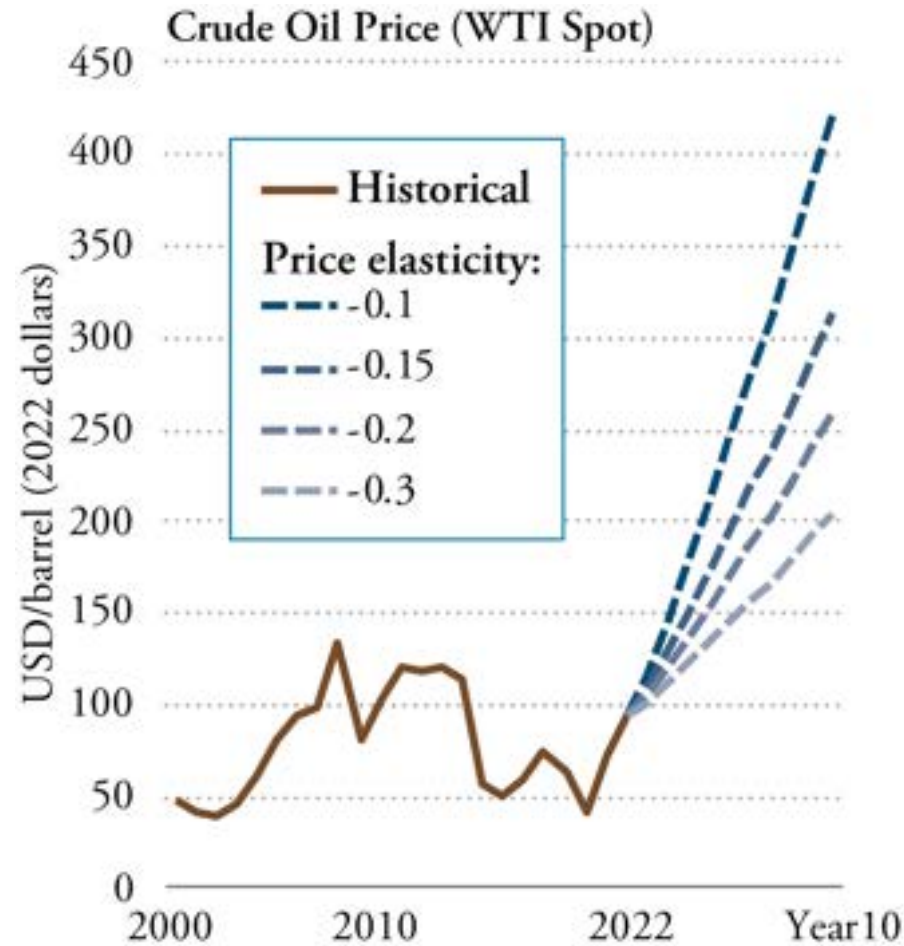


Oil and Gas Prices According to IEA



“If supply were to transition faster than demand, with a drop in fossil fuel investment preceding a surge in clean energy technologies, this would lead to much higher prices—possibly for a prolonged period—even if the world moves towards net zero emissions.” (IEA, WEO–2022, p. 134)

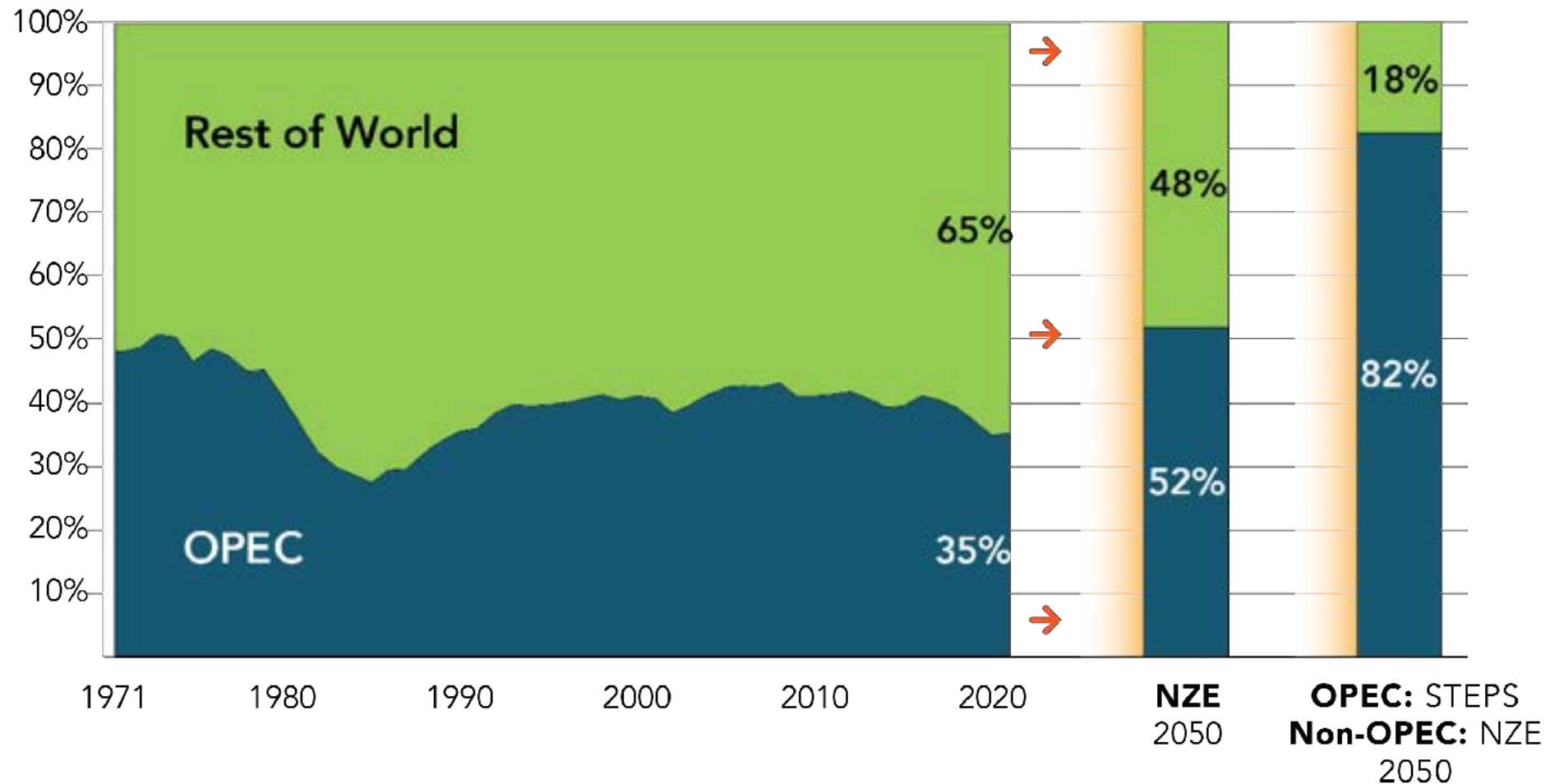
Oil and Gas Prices Under No New Investment Scenario (IEA-NZE) Based on Historic Price Elasticities of Demand



Source: Energy Policy Research

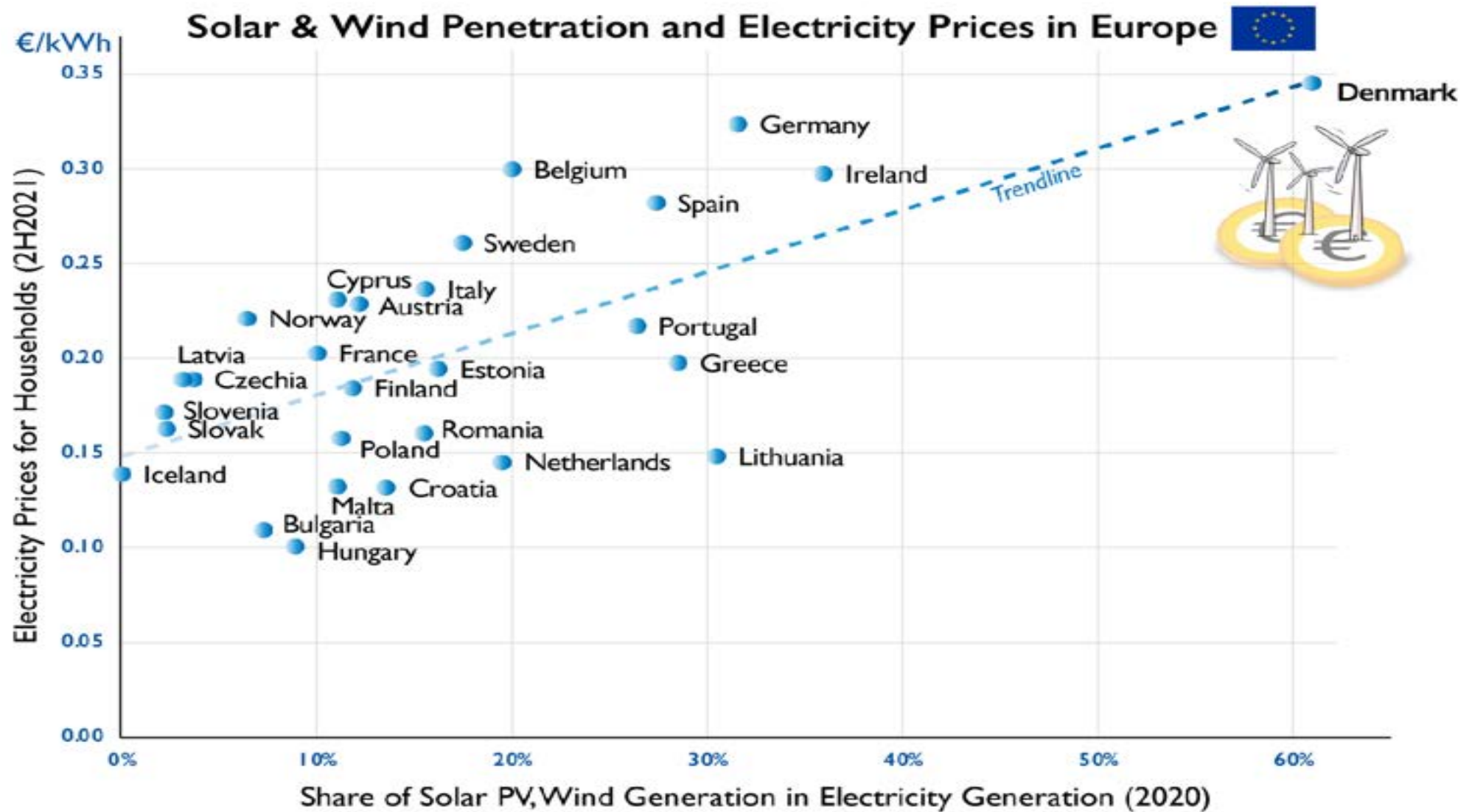
Oil Supply Concentration under Net Zero

OPEC Share of Global Oil Production

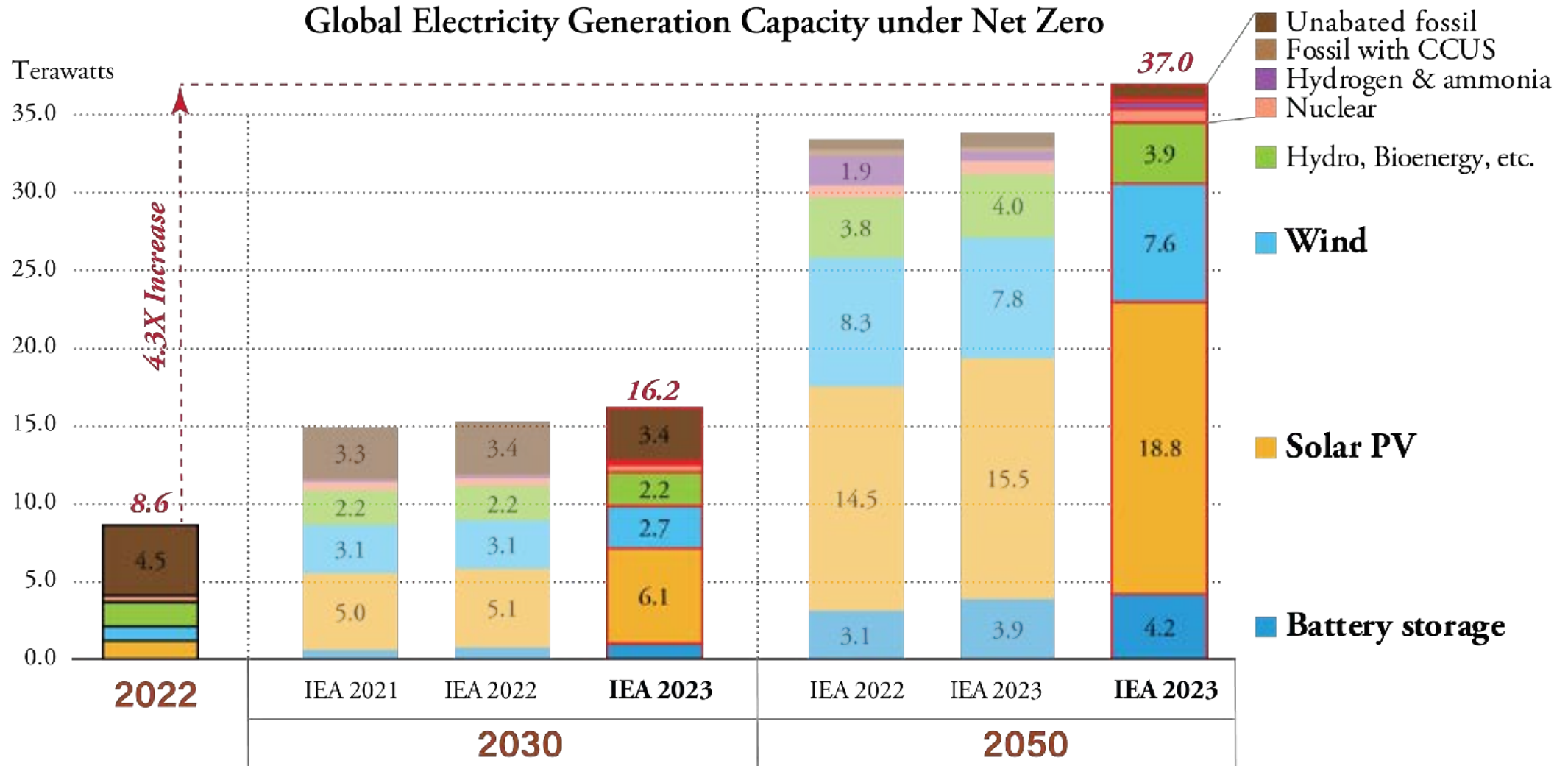


Source: EPRINC figure based on IEA World Energy Outlook 2022, WEB data

System Power Cost Rise with Intermittent Energy Sources

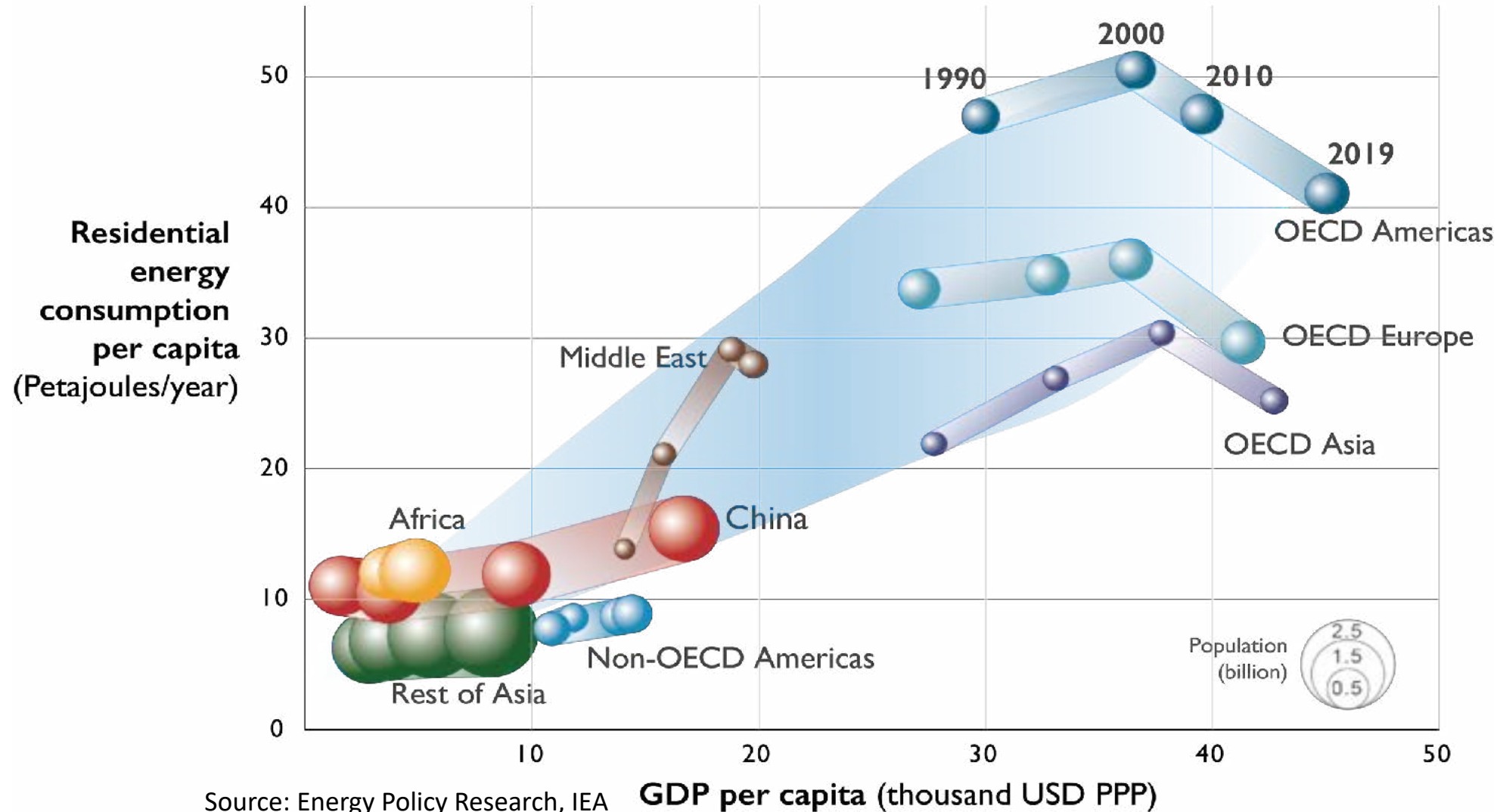


By 2050, Solar Capacity Alone Reaches 2.2x Current World Total Generation Capacity



Non-OECD: Energy Must Grow to Meet Economic Progress

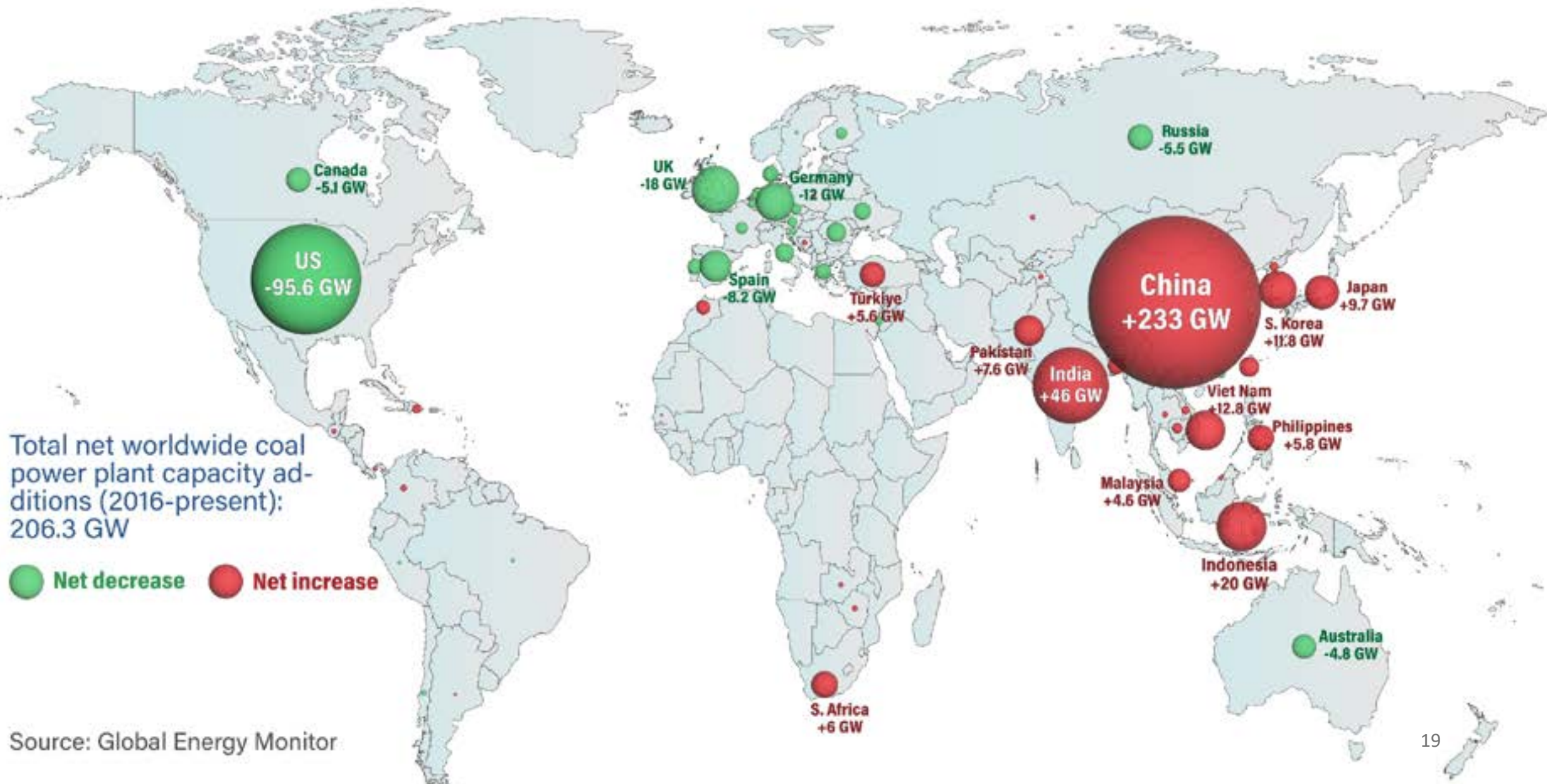
Primary Energy Requirements for Residential Consumption & GDP per Capita (1990-2019)



Source: Energy Policy Research, IEA

GDP per capita (thousand USD PPP)

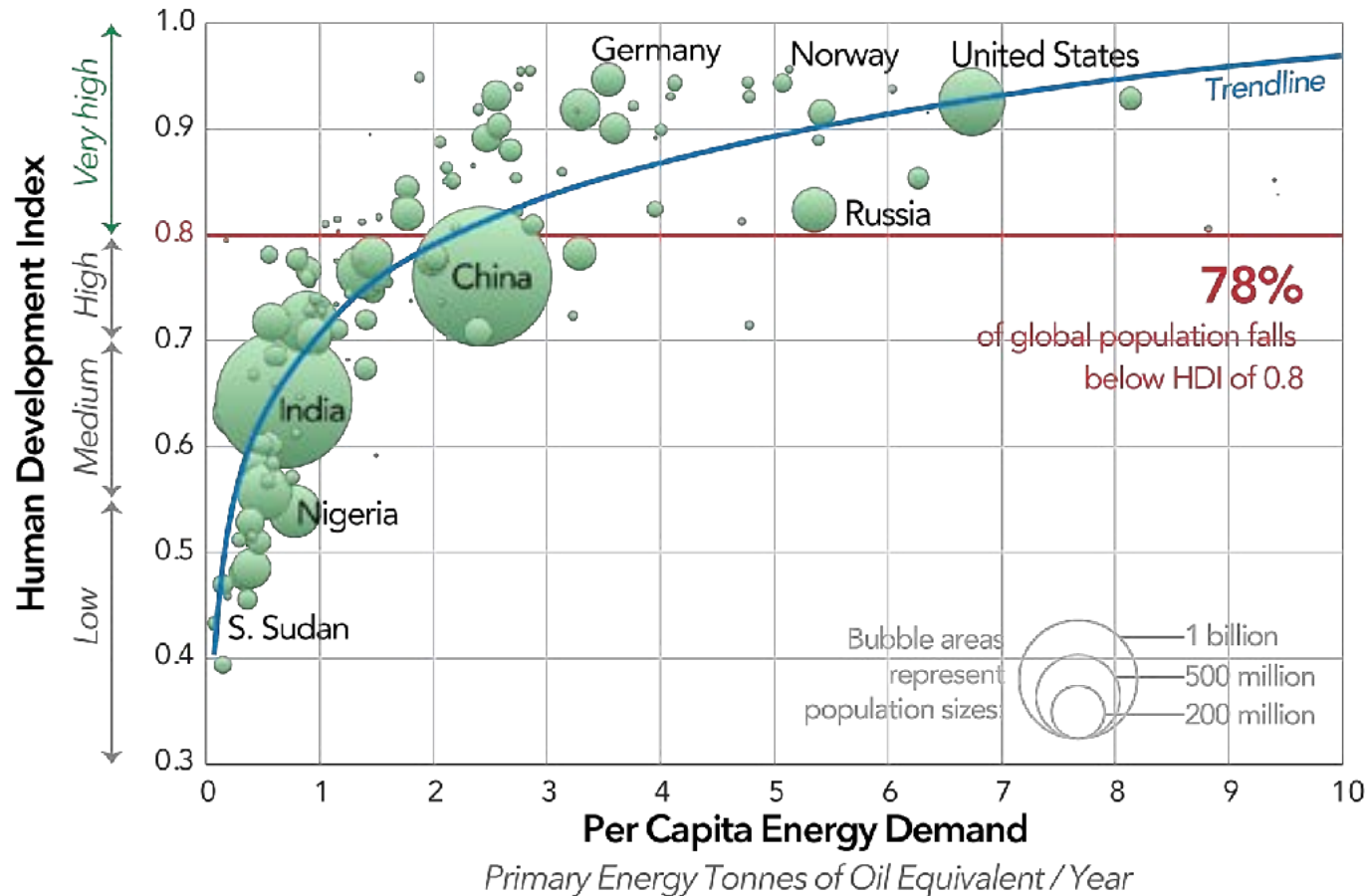
NET ADDITIONAL COAL PLANT CAPACITY SINCE 2015 PARIS AGREEMENT



Source: Global Energy Monitor

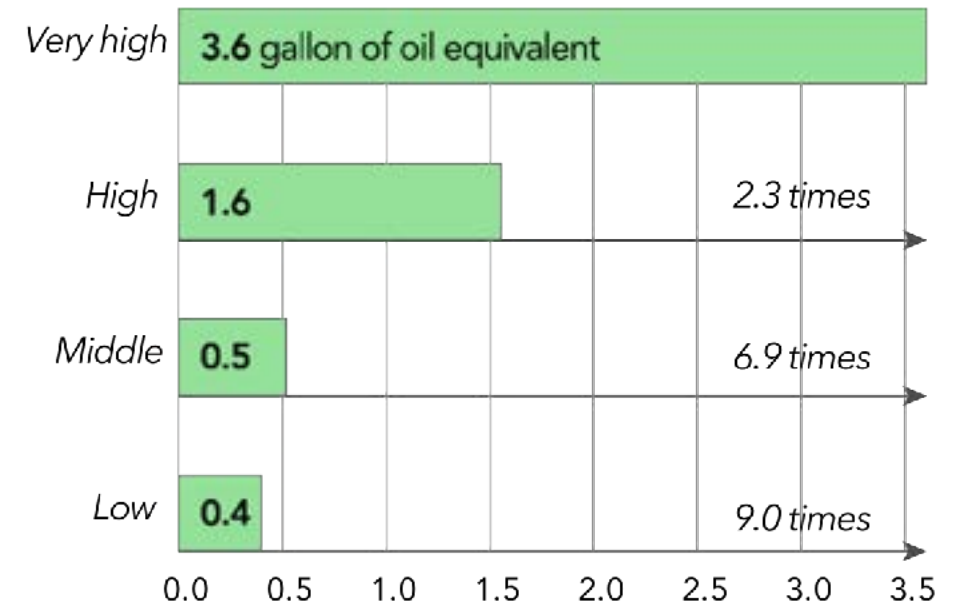
Energy Supply and Human Development Index

Per Capita Energy Demand and Human Development Index (2019)



Source: Energy Policy Research

Daily per Capita Energy Demand by Human Development Index (2019)

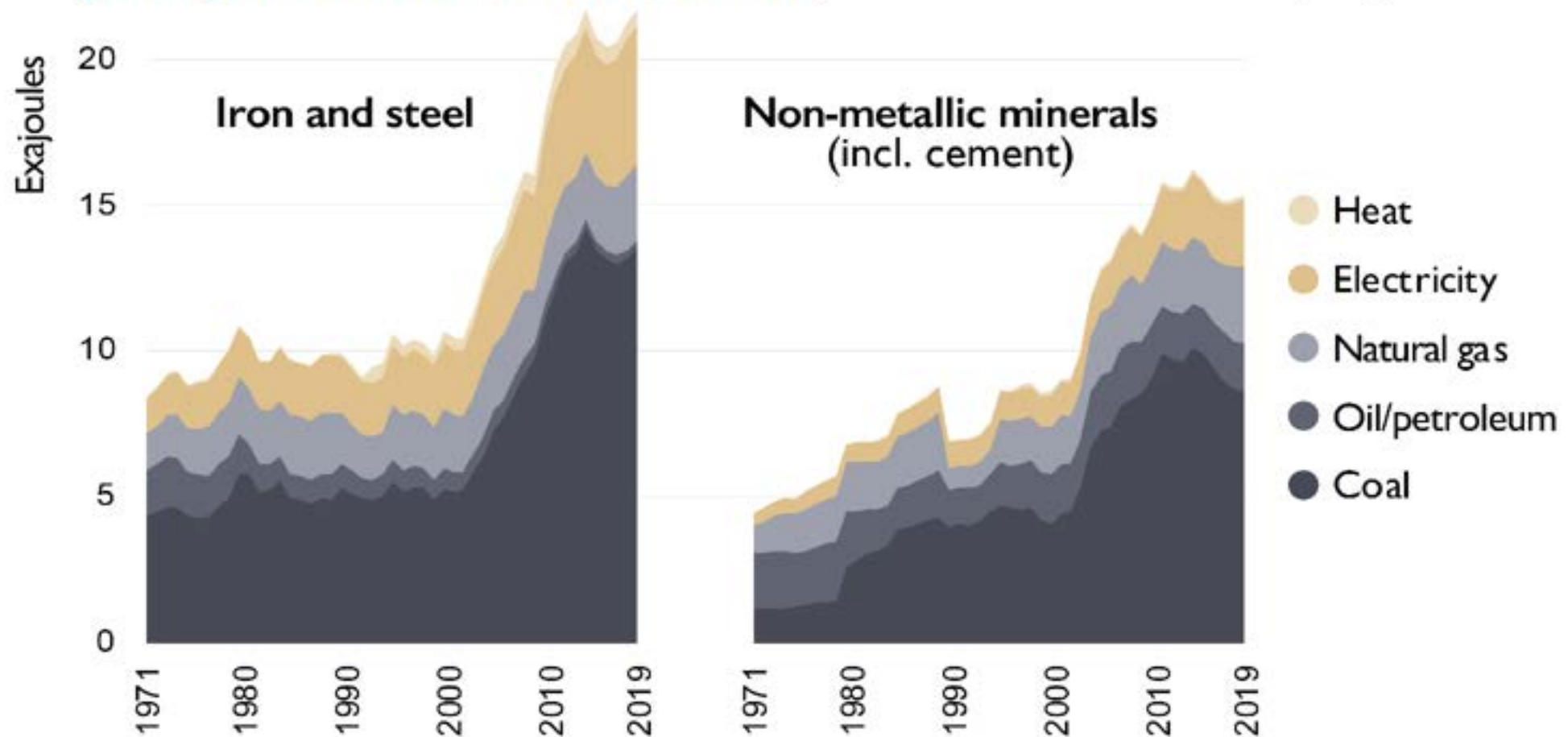


Power Gen Capacity (GW), 2021



MAIN PILLARS OF MODERN CIVILIZATION RELY ON FOSSIL FUELS

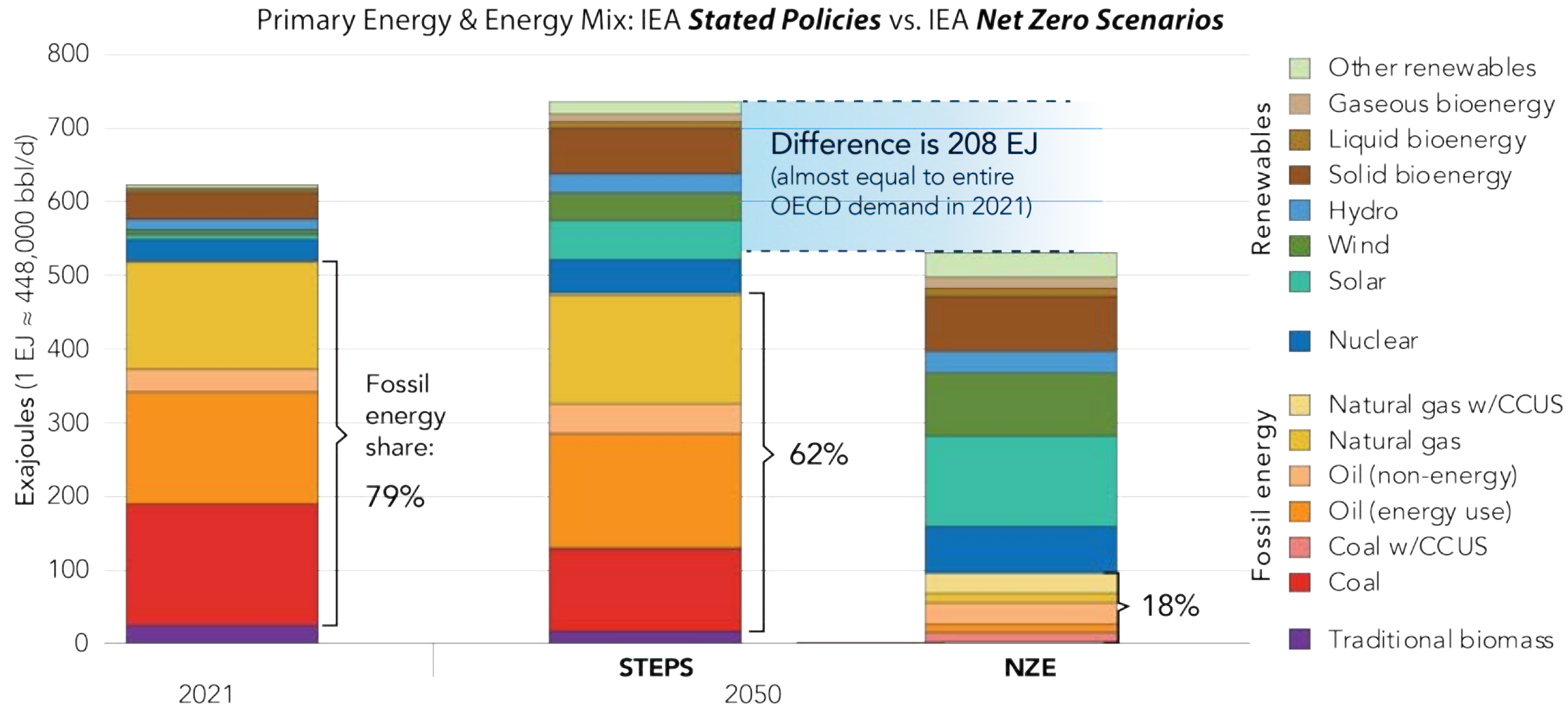
It's extremely hard to displace the direct use of coal (and other fossil sources) in the **global production of steel and cement**, which the modern society depends on.



An Exajoule/year equals 447,000 bbl of oil/day.

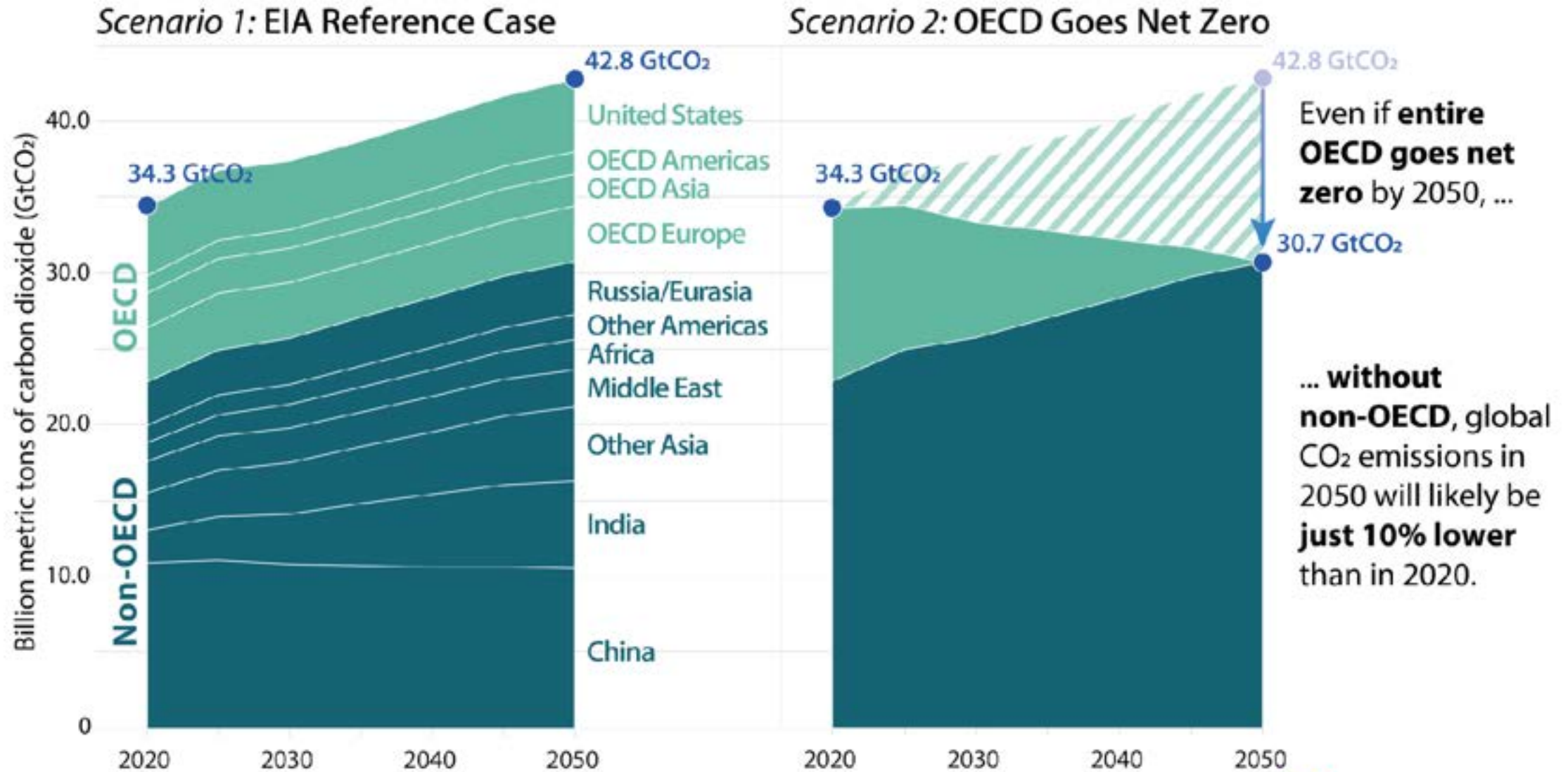
Source: EPRINC analysis, IEA data

Net Zero Goals: Ambition or Delusion?



Source: EPRINC figures & calculations based on IEA World Energy Outlook 2022

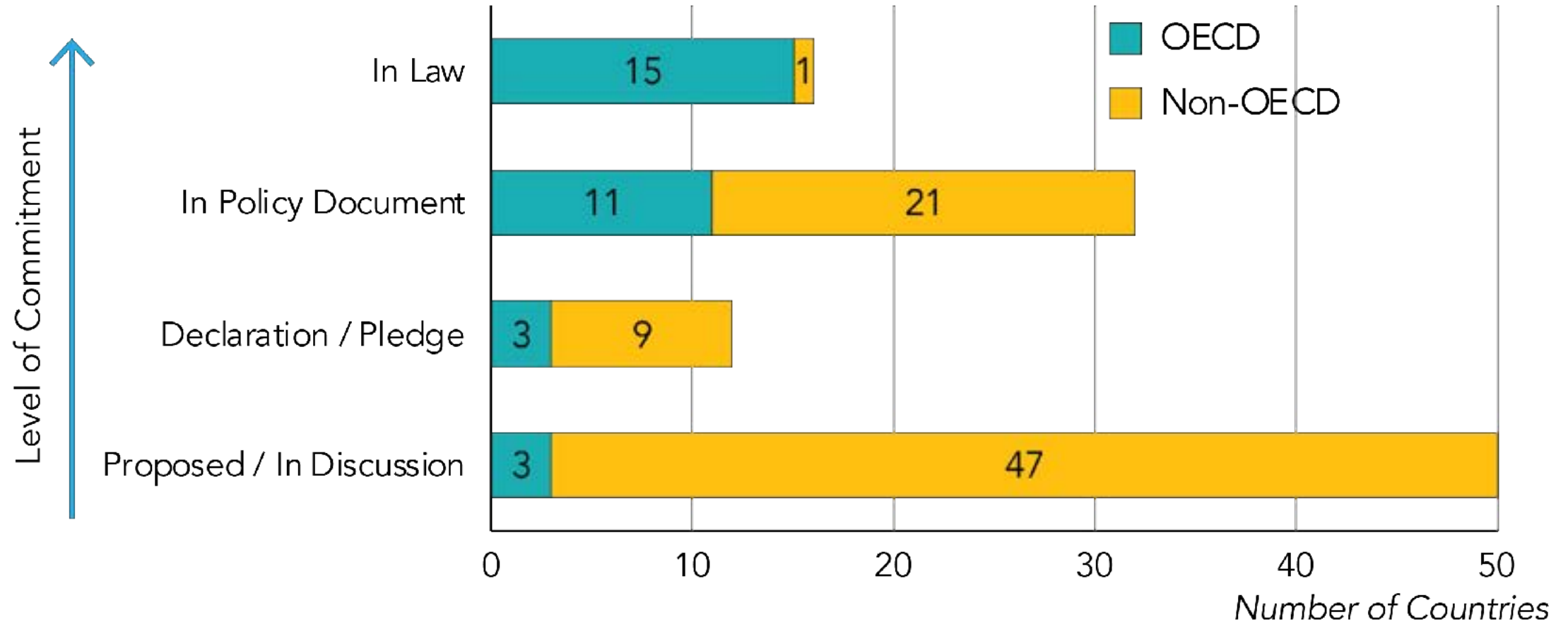
Global CO₂ Emissions: What If Only OECD Goes Net Zero by 2050?



Energy Policy Research analysis based on EIA's International Energy Outlook (Oct 2021)

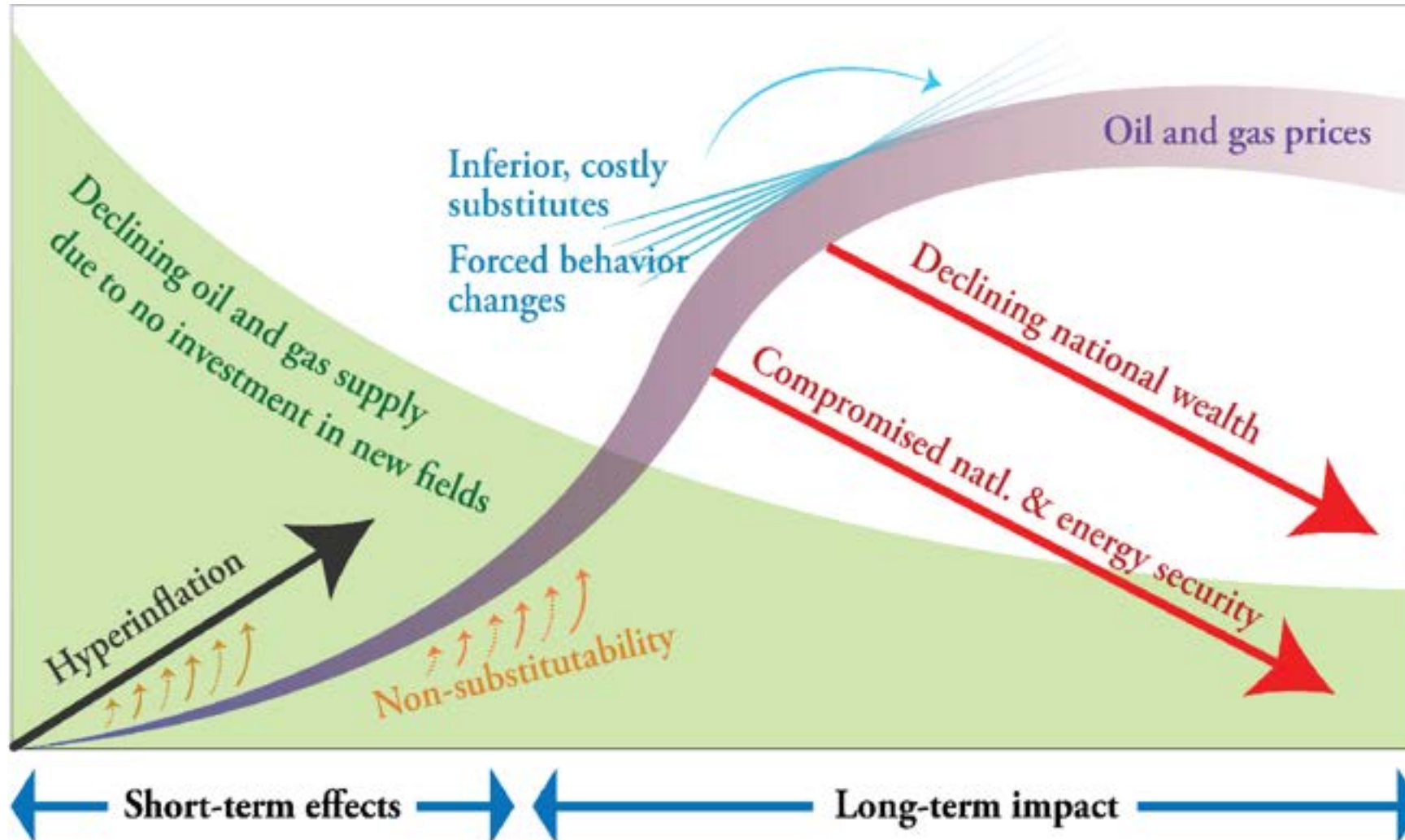
How Serious are the Commitments?

Two-Speed Transition: Net Zero by 2050 Level of Commitment

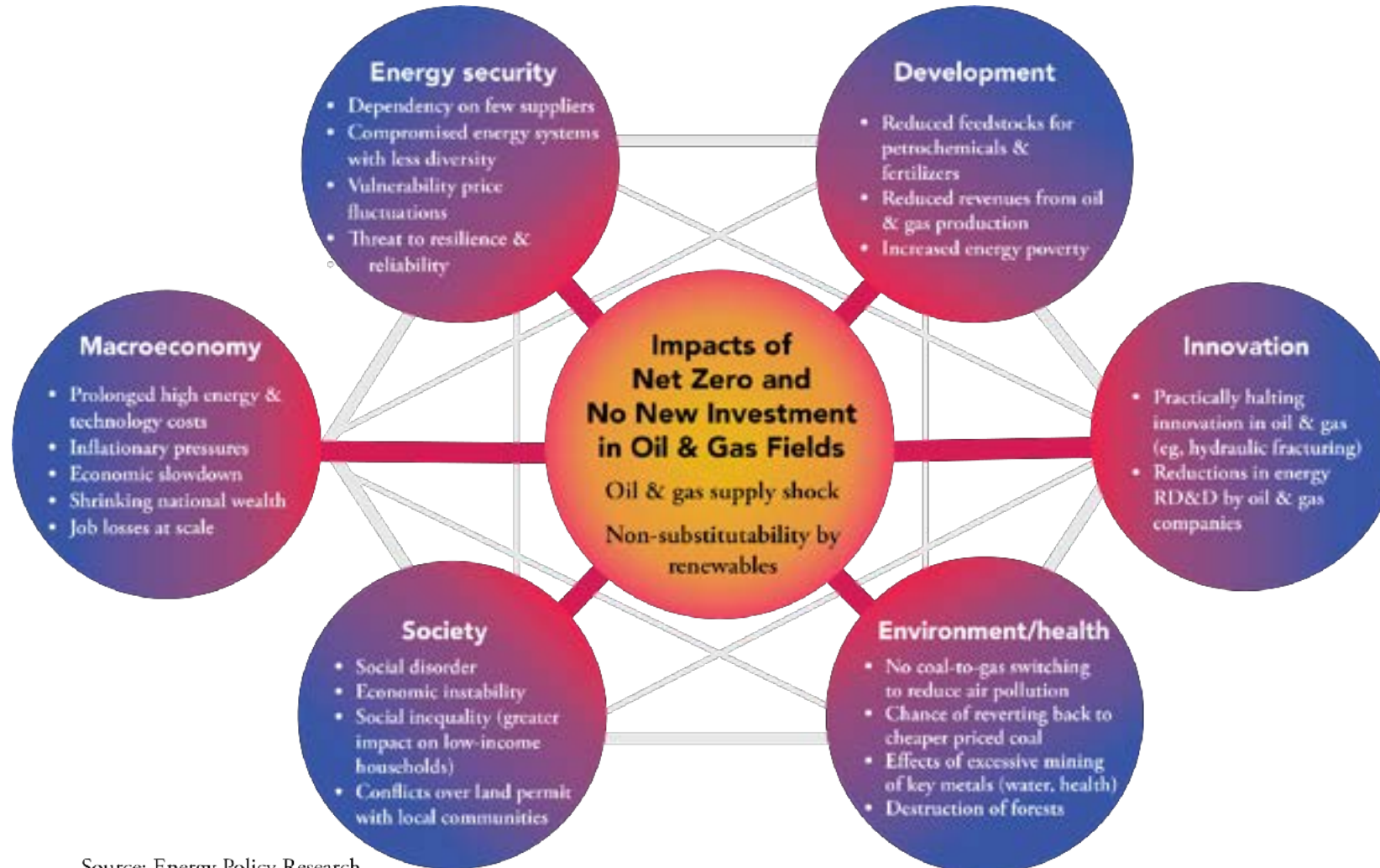


Sources: EPRINC figure based on data from Net Zero Tracker.

Implications of High Oil and Gas Prices Under No Investment Scenario



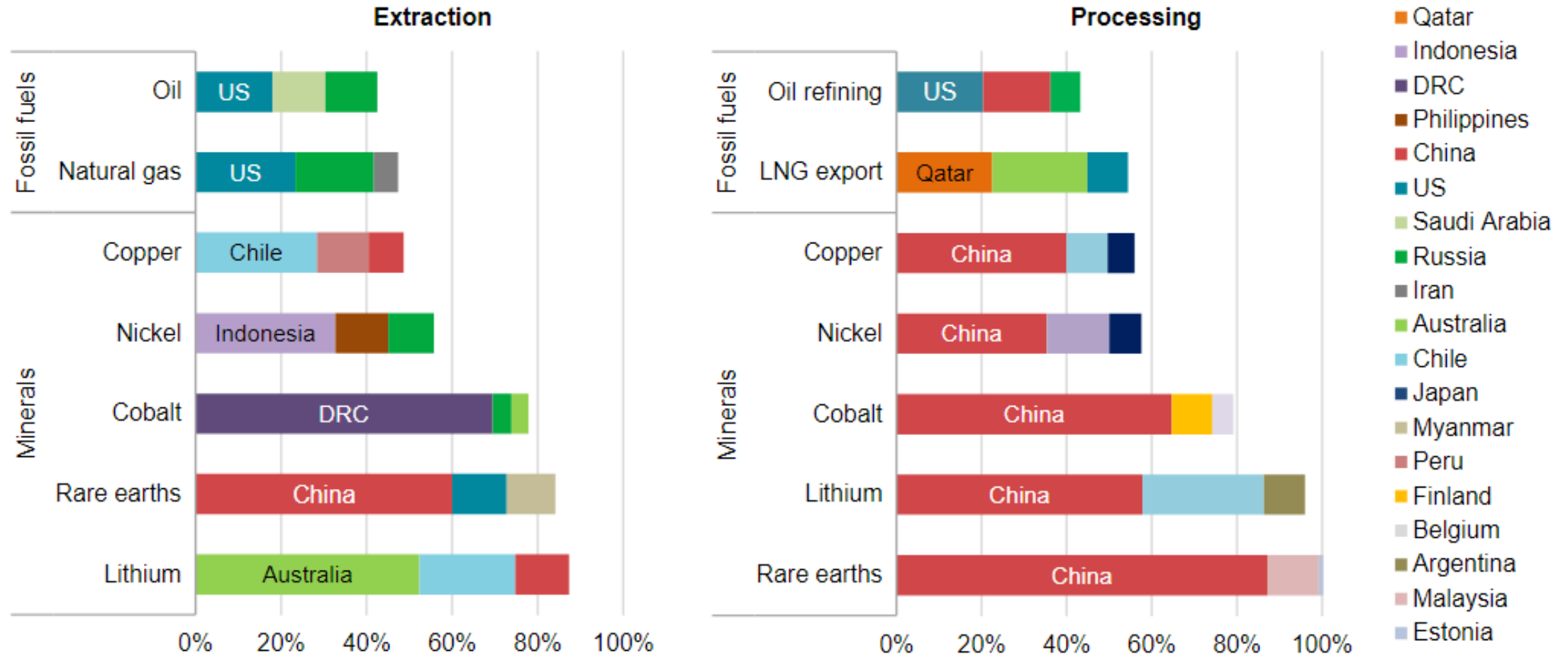
Do Policy Makers Understand the Consequences of the Net Zero Energy Transition?



Source: Energy Policy Research

Dependence on China to Increase with Energy Transition

Share of top three producing/processing countries in *selected minerals and fossil fuels*, 2019



Sources: IEA Report *The Role of Critical Minerals in Clean Energy Transition*; USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020)