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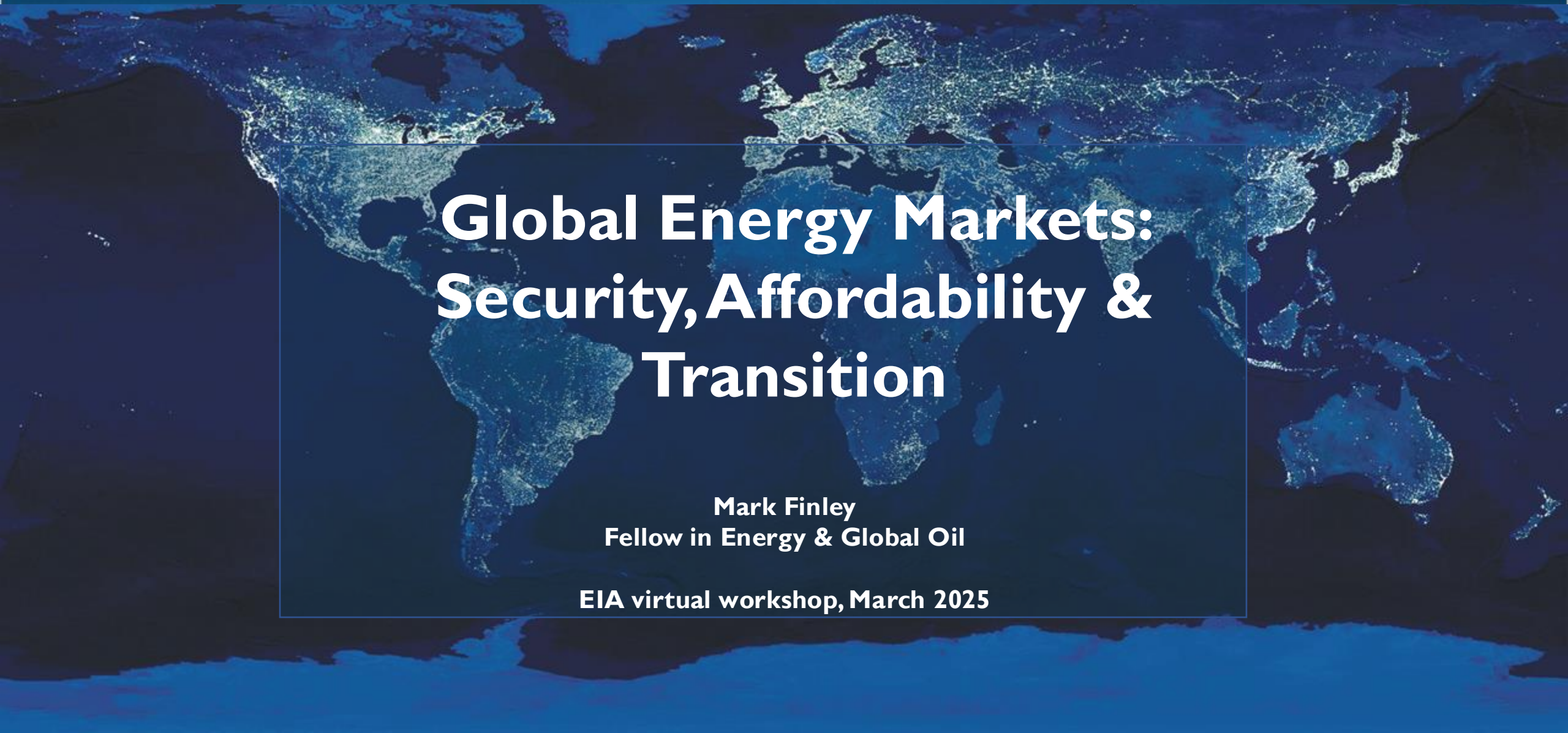

# Global Energy Markets: Security, Affordability & Transition

**Mark Finley**
**Fellow in Energy & Global Oil**

**EIA virtual workshop, March 2025**

# About Baker Institute/Center for Energy Studies

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Rice University's Baker Institute for Public Policy

- Baker Institute for Public Policy
  - Founded by former Secretary of State James A. Baker III (1993)
  - Non-partisan, independent public policy analysis
  - Top-rated university-affiliated think tank*

- Center for Energy Studies
  - Top-rated energy- and resource-policy program*
  - Programs: Global Oil & Natural Gas; Electricity Markets; Minerals & Materials; Environment & Sustainability; Transportation; and Energy Geopolitics
  - https://www.bakerinstitute.org/center-for-energy-studies/

* Global Go To Think Tank Index Report, Univ. of Pennsylvania Think Tanks and Civil Society Program

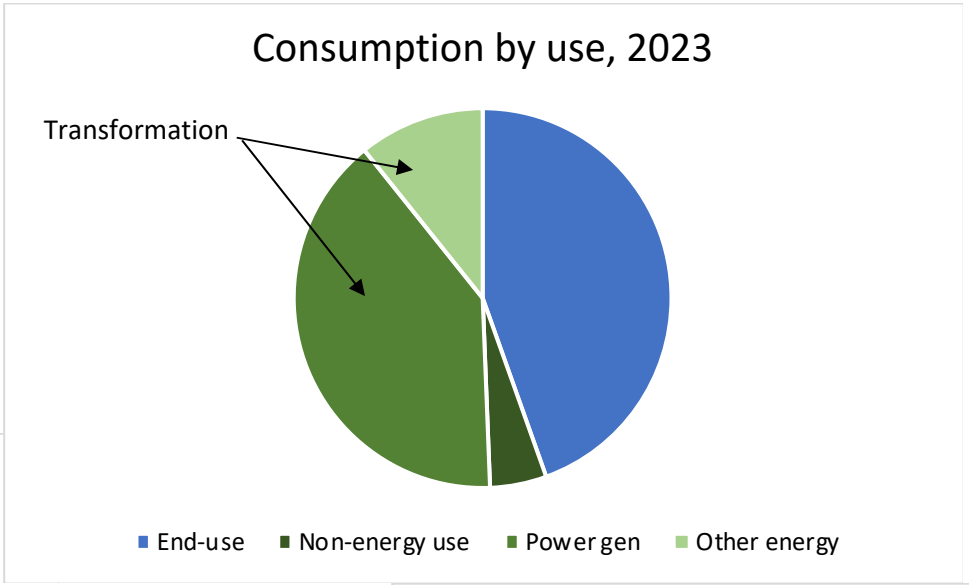
# Outline

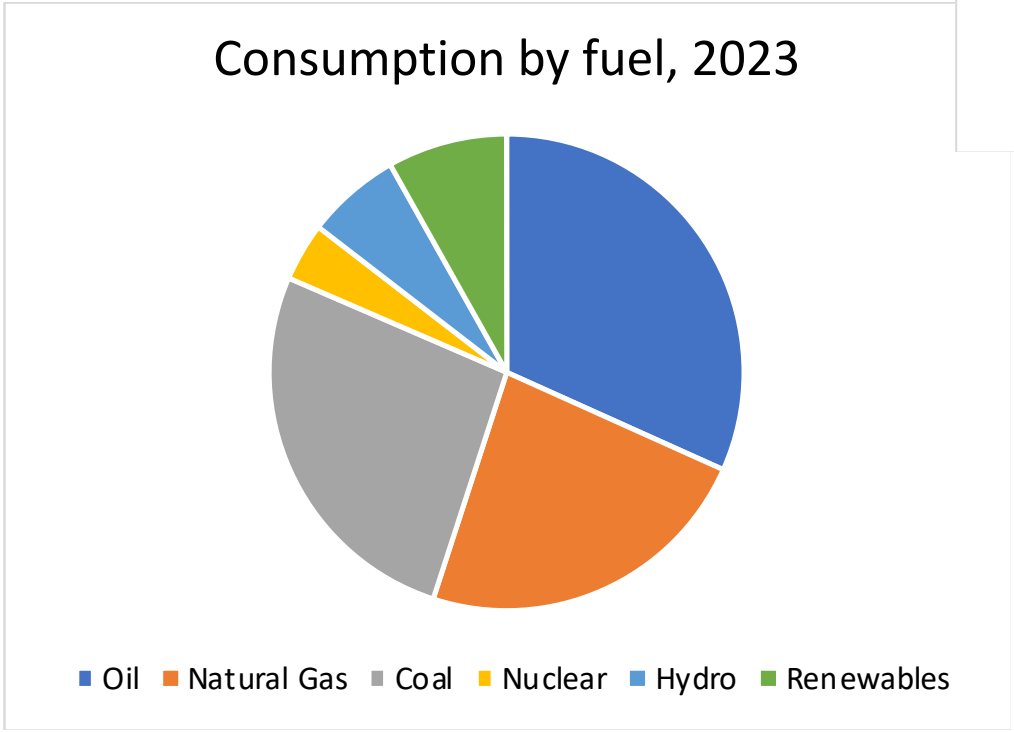


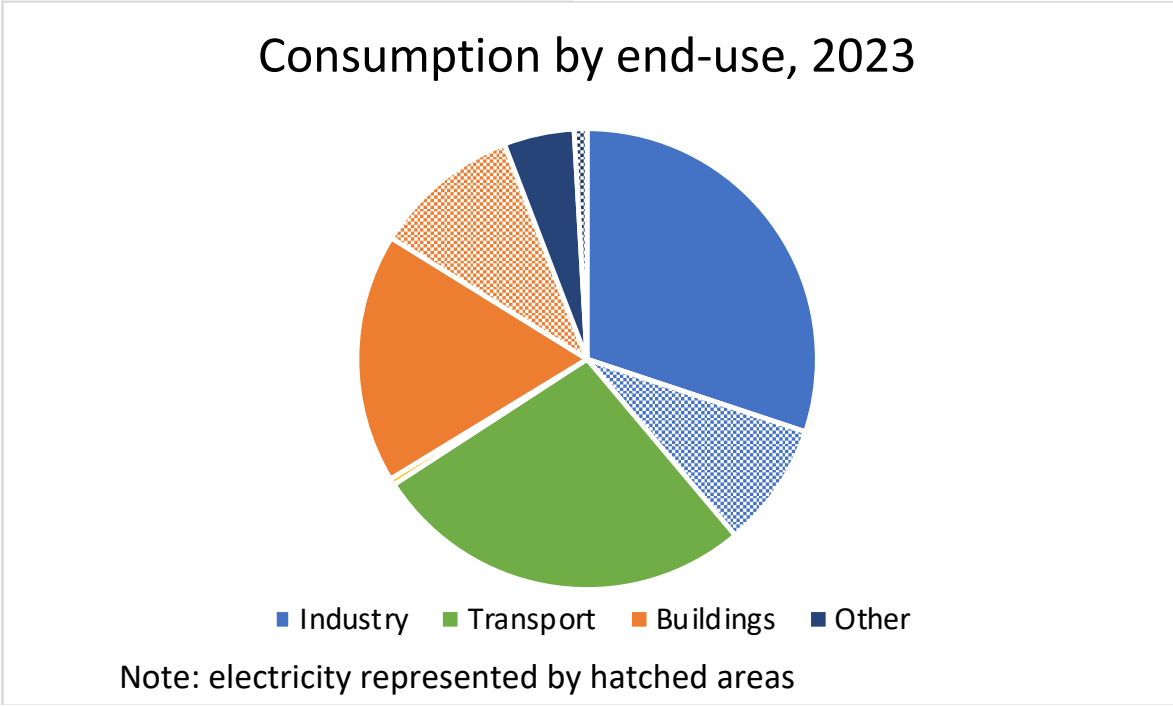
- The world of energy today
- Energy security and the transition
- Equity considerations
- The long-term energy transition
- Q&A/discussion

# The energy system today





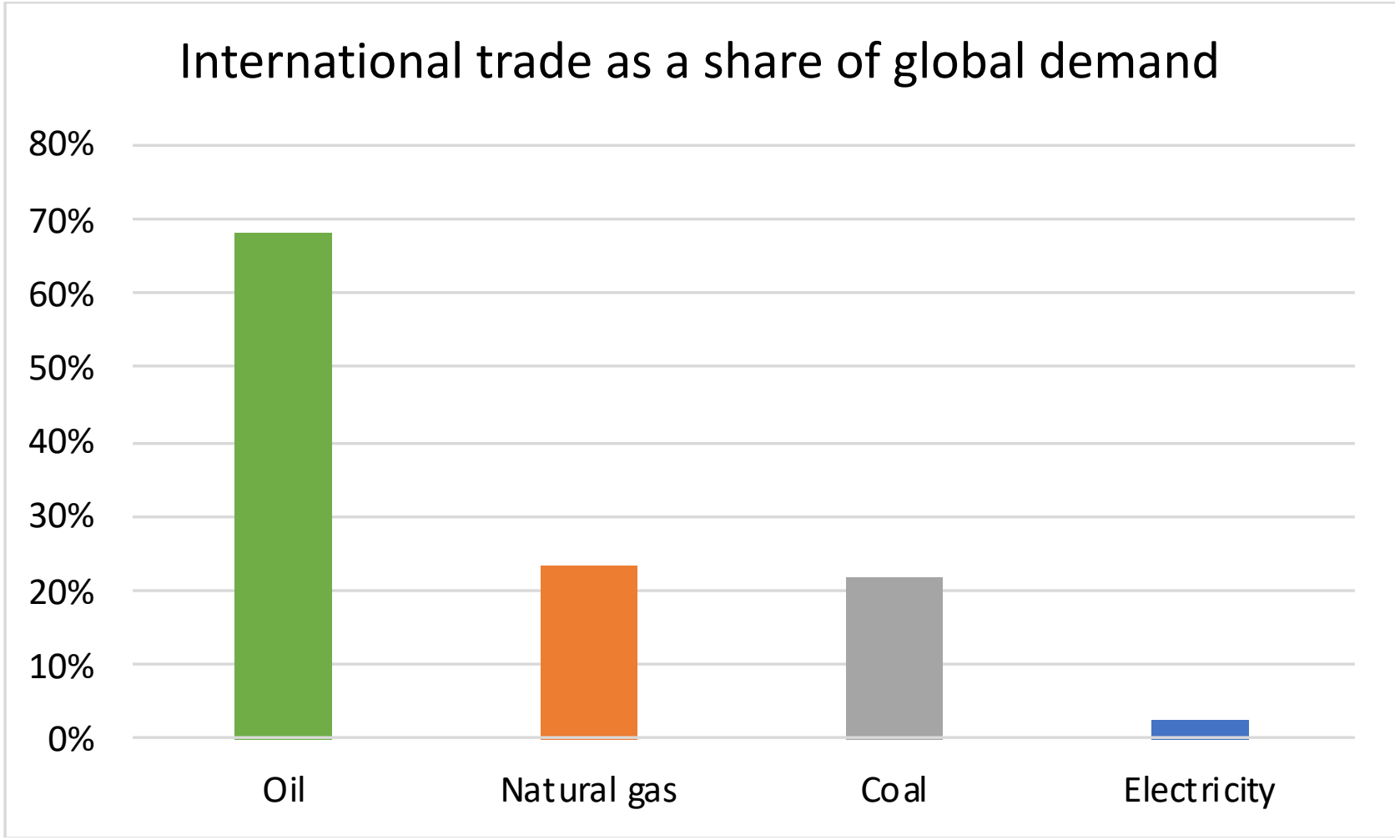




Sources: By fuel, Energy Institute (2024); by sector/end-use, IEA (2024)

Note: electricity represented by hatched areas

# The energy system today

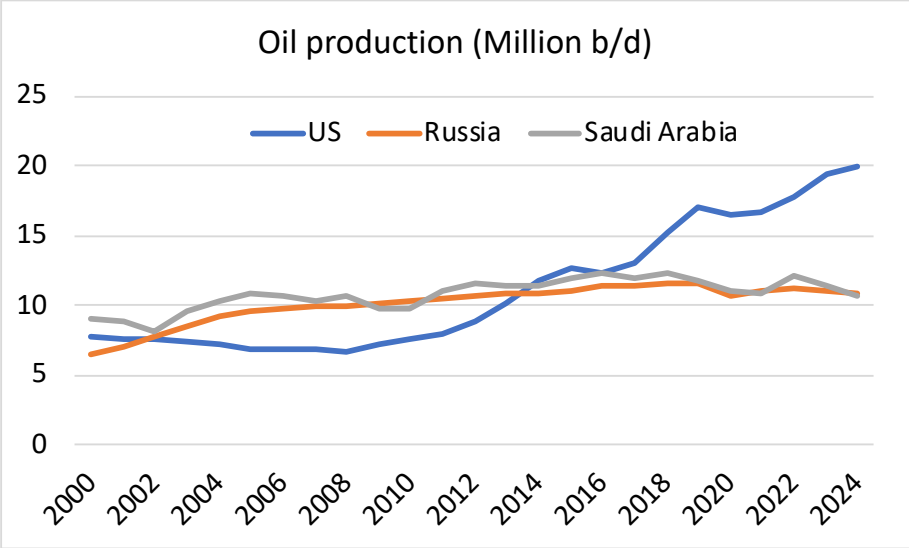


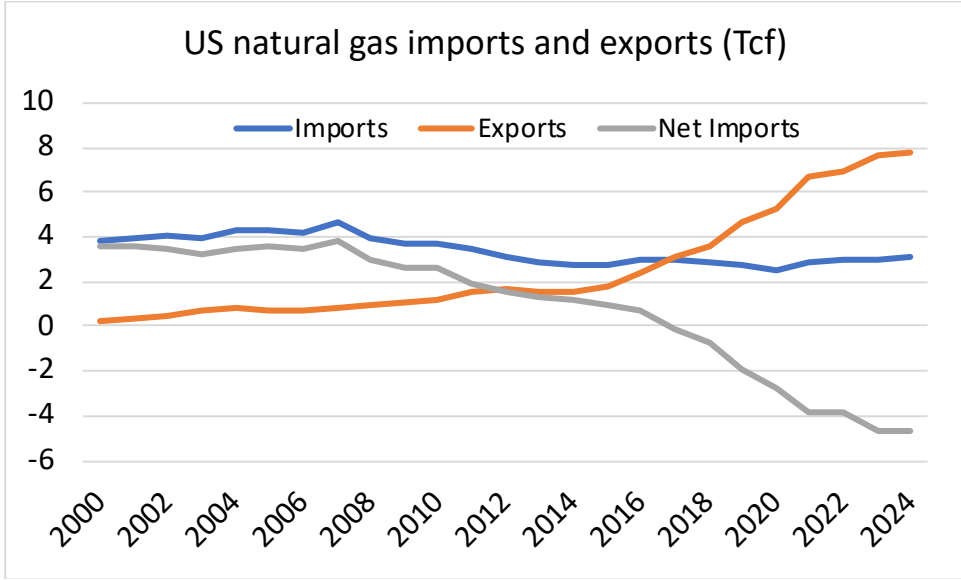


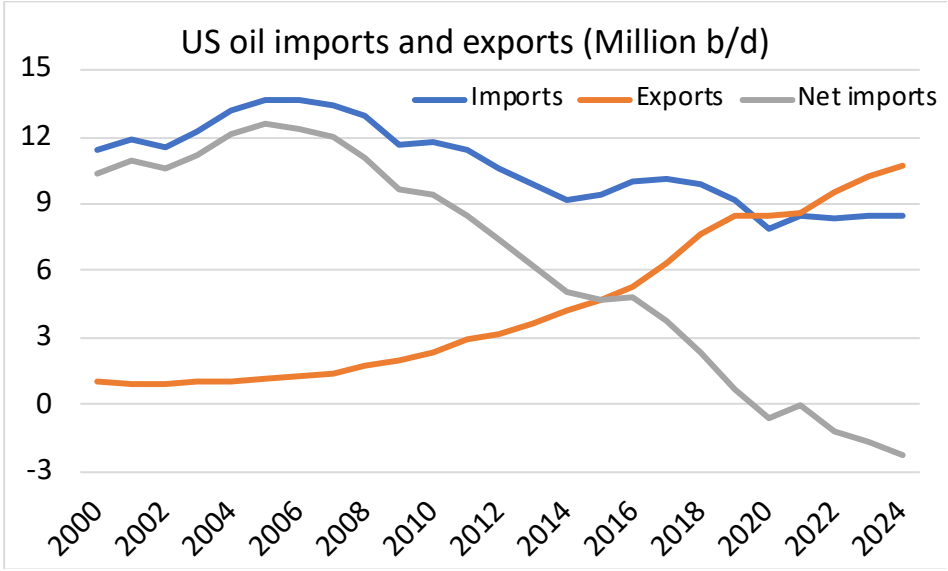

Source: Energy Institute for fossil fuels; IEA for electricity

# The energy system today: The US shale boom

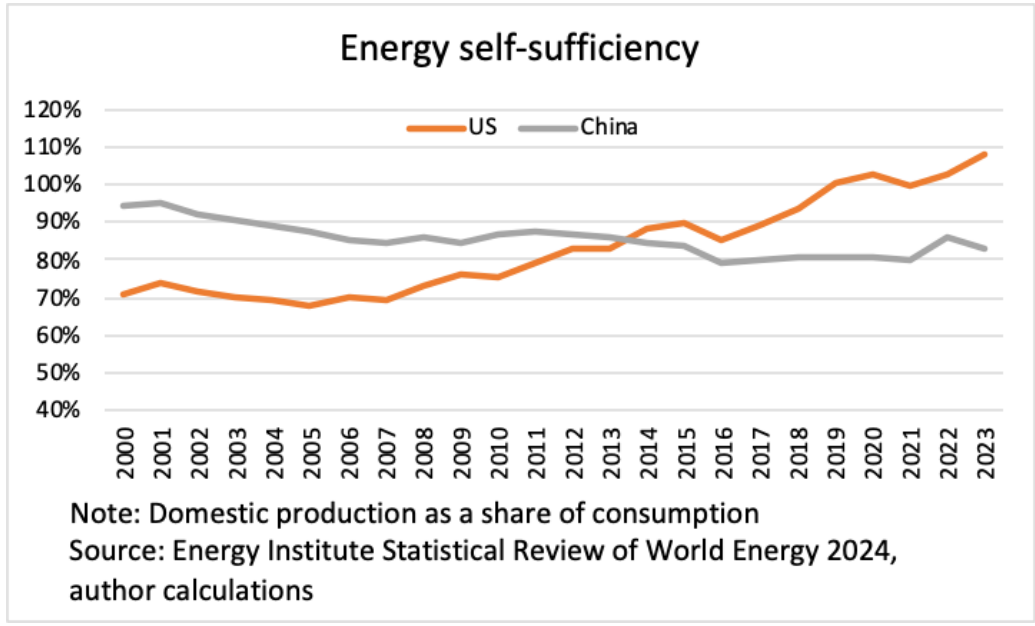




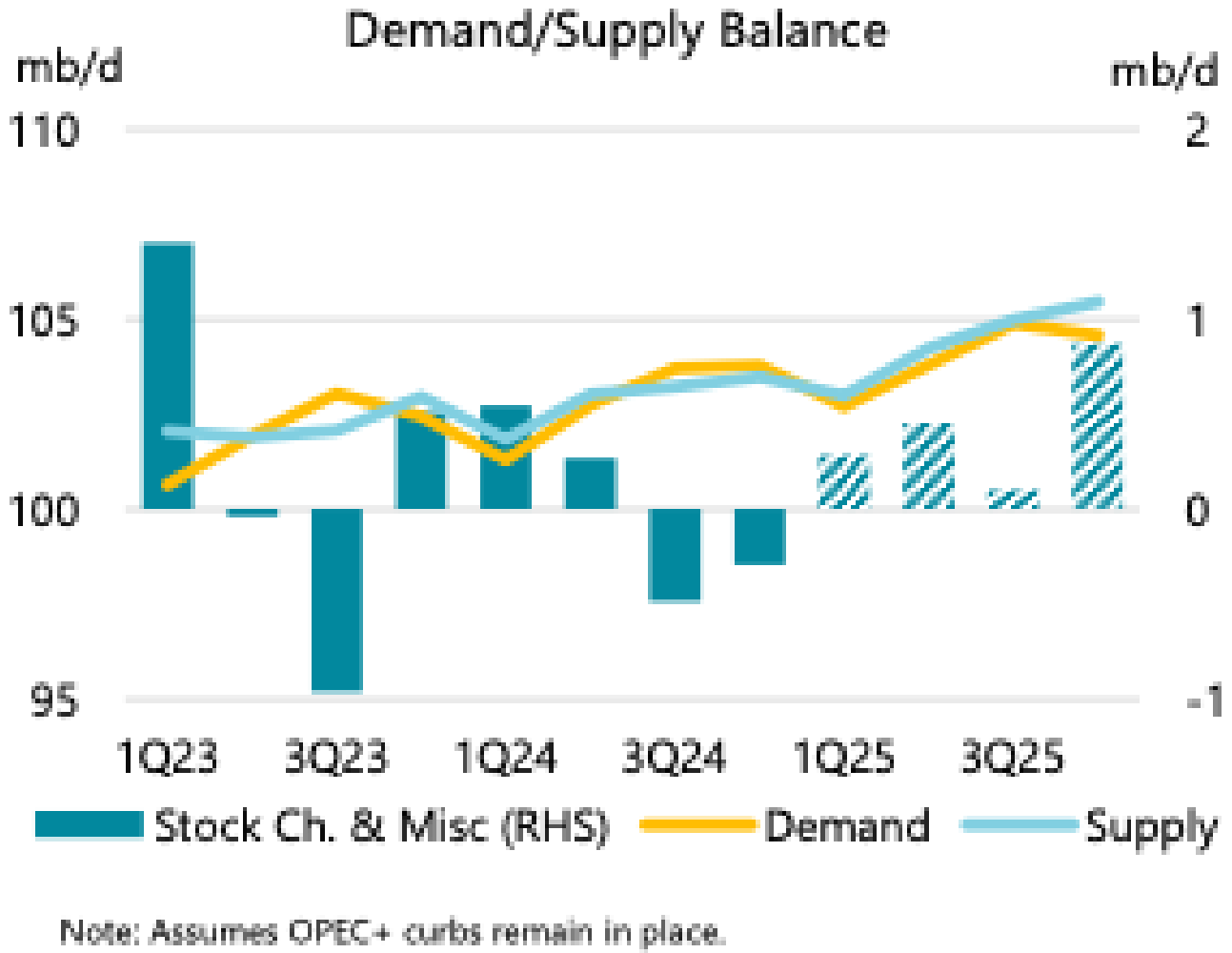




Source: Energy Institute, US EIA



# Oil market prospects in 2025



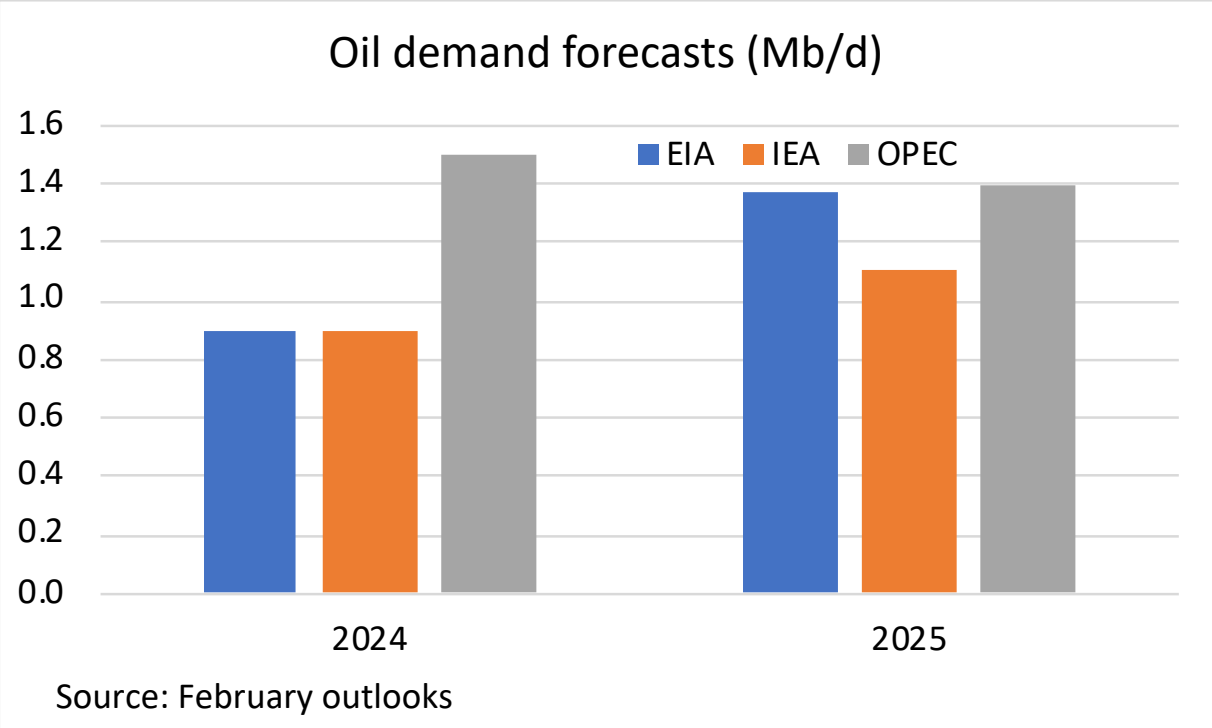



Source: IEA (Feb 25)

- Well-supplied – even IF OPEC cuts remain in place
- (That is, IF the IEA's demand forecast is correct…)
- Will US supply surprise again?
- Recession risks
- Signs of "peak" oil demand?

# BUT: Widely divergent demand forecasts!

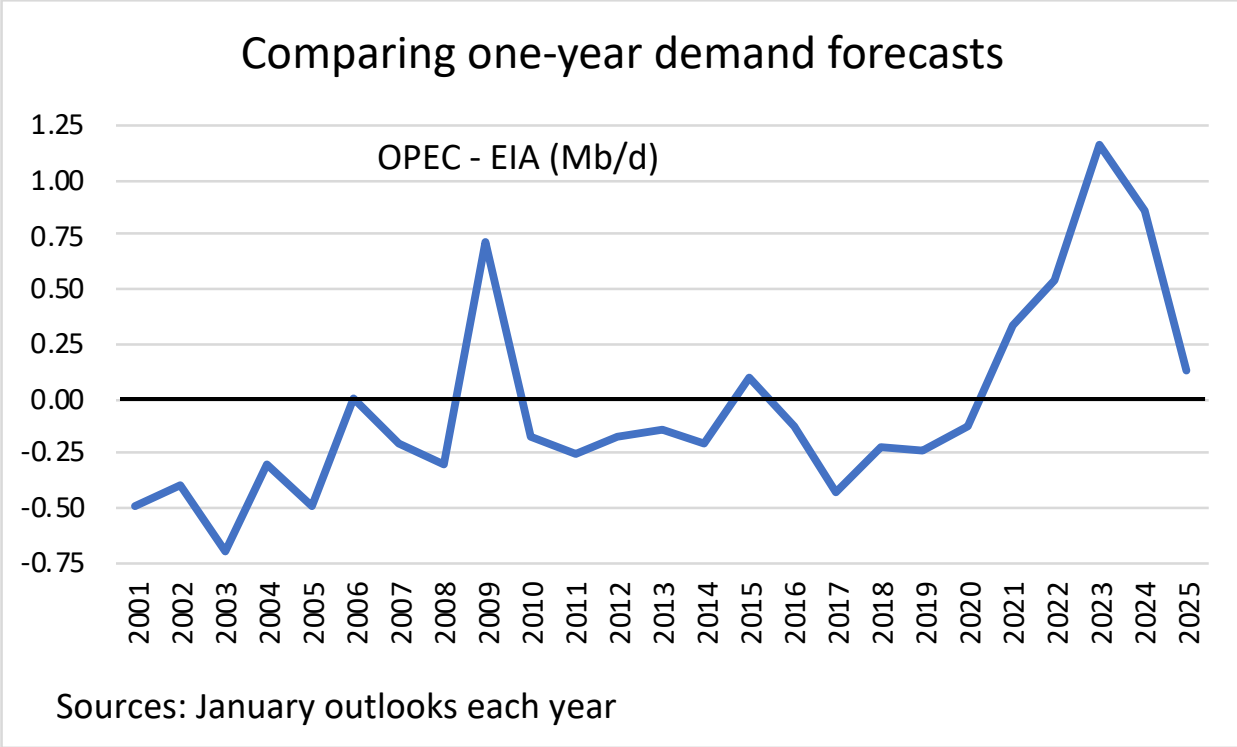





Source: February outlooks

- Unusually large range
- …in a pattern that doesn't match history
- Why? Shifting organizational priorities?

Add'l discussion: "What's Happening to Oil Market Forecasts?" Baker Institute, August 2024




Sources: January outlooks each year

# Oil outlooks: Analyst or advocate?



## Growing disparity in 2030 demand forecasts

| Global Oil Demand Projections for 2030 Year of Outlook | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| (Mb/d) | **2020** | **2021** | **2022** | **2023** | **2024** |
| IEA | 103.2 | 103.0 | 102.4 | 101.5 | 101.7 |
| OPEC | 103.6 | 102.7 | 103.4 | 107.9 | 109.1 |
| EIA | Not published | 105.0 | Not published | 101.9 | Not published |
| | | | | | |
| Sources: IEA WEO, OPEC WOO, EIA IEO | | | | | |
| Notes: IEA STEPS scenario | | | | | |
| Excludes biofuels and, where possible, small amounts of gas- and coal-to-liquids | | | | | |

## Growing tension between analysts

- "La La Land"
- Be "very careful"

## Importance of objective/unbiased analysis

# Houthis attacks: Oil and geopolitics mix…again!

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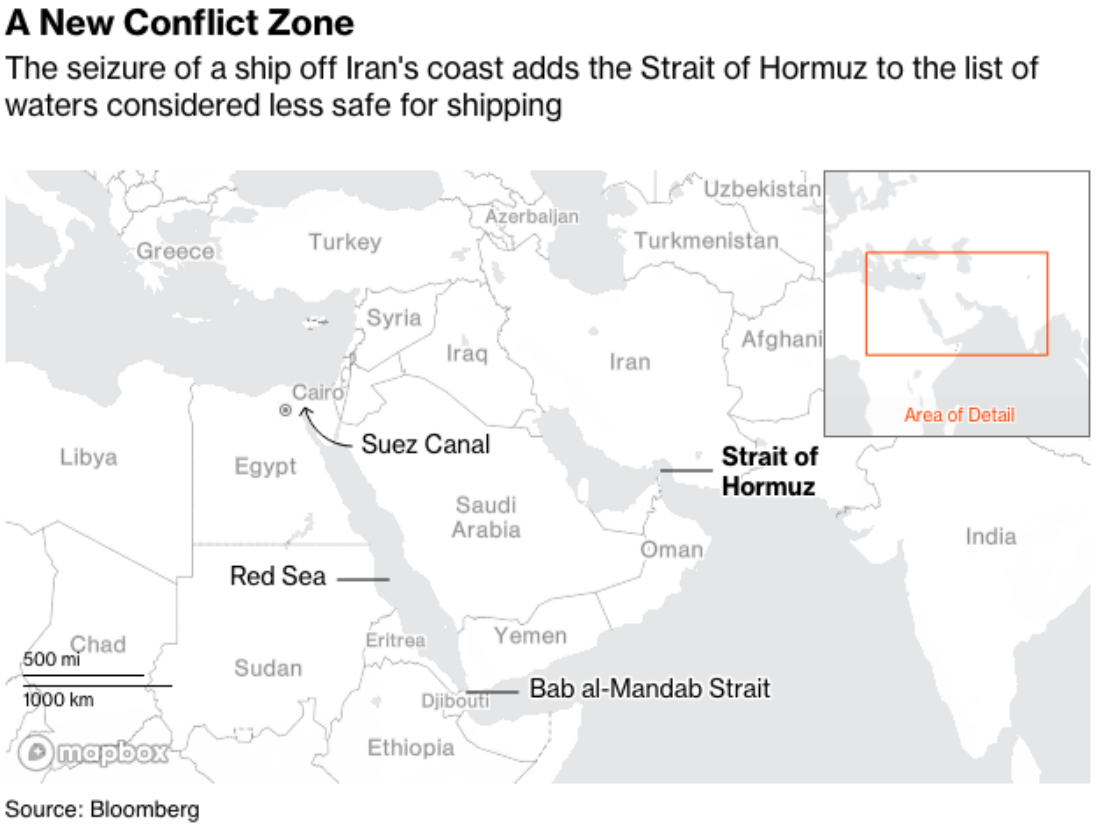
*Red Sea/Suez: Large energy flows, but you can sail around…unlike Hormuz*




Map source: Bloomberg

Bab el-Mandeb/Suez flows (1H23)

- Oil – 9 Mb/d, split between crude and refined products
  - 12% of global seaborne oil trade
- LNG – roughly 4 Bcf/d
  - 8% of global LNG trade

Strait of Hormuz (1H23)

- Oil – nearly 21 Mb/d; 2/3 of which crude
  - 27% of global seaborne oil trade
- LNG – roughly 11 Bcf/d
  - Roughly one-fifth of global LNG trade

Source: US EIA

# Energy security: Current (oil) system



- Let markets work
  - Then Saudi/OPEC spare capacity
  - Then IEA etc: Strategic stocks, but also demand restraint & fuel switching
- Oriented around oil supply outages. But what about:
  - Damage in the US Gulf Coast, where SPR sits? (Katrina, Ida)
  - Refineries & distribution system? (Heating oil reserve; Harvey, Ida)
  - Nat gas? (Saudi/UAE vs Qatar, 2017; Russia-Europe today)
  - Electricity grids, rare earths, etc?
  - Human nature? (Hoarding—every time!)
- And always:
  - When to rely on markets and when to intervene?
  - Free-riders

# Energy security and the energy transition



- Transition to a lower-carbon future would reduce traditional concerns about oil supply security
  - …but could introduce new vulnerabilities (other energy forms, minerals)

- 50 years of effort to build domestic and cooperative international systems for oil security – strategic stocks, spare capacity, IEA treaty, etc
  - …need to think about the same for new energy sources
  - New domestic and international capabilities to manage/mitigate
  - Data gathering is always a good place to start

# Energy security: Concentration of "new energy" materials

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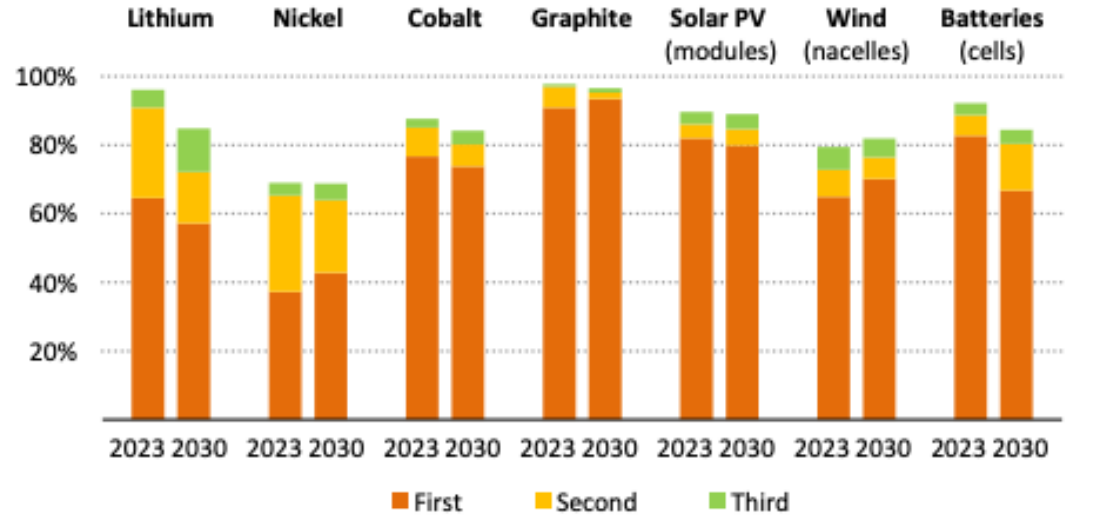
**Figure 1.7** ▷ Share of top-three suppliers of selected critical minerals and clean technologies based on announced projects, 2023 and 2030

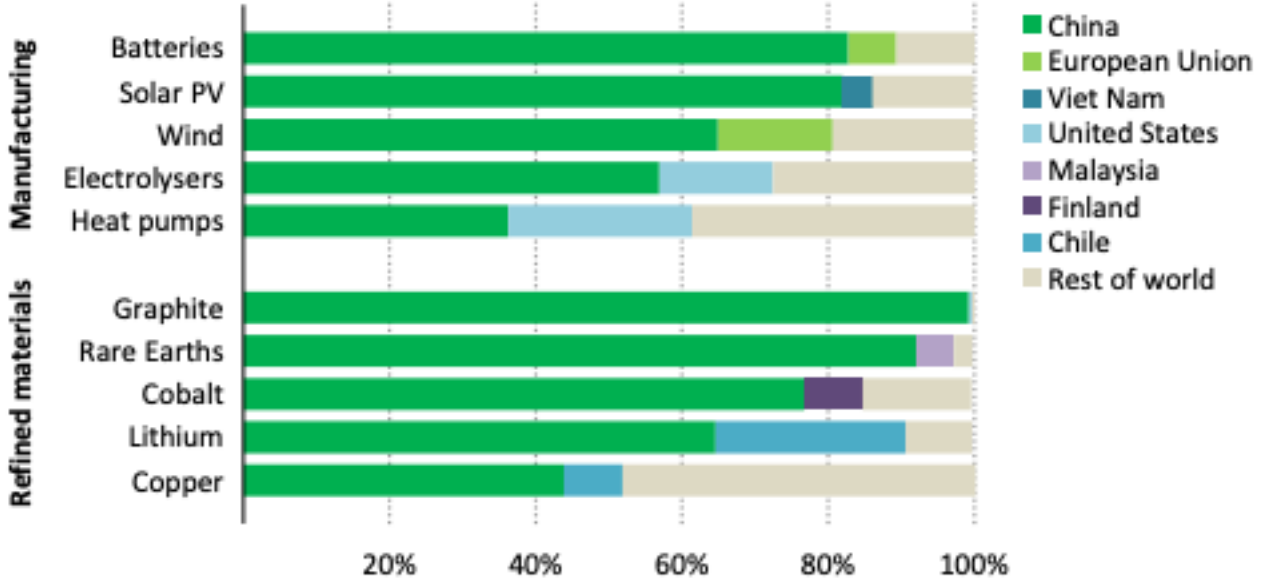



IEA. CC BY 4.0.

*Announced projects indicate that the geographic concentration of critical minerals and clean energy technology manufacturing is set to remain high through to 2030*

Note: Critical minerals data are refined material production.

**Figure 2.7** ▷ Share of clean energy technology supply chains, 2023




IEA. CC BY 4.0.

Source: IEA WEO 2024

# Energy security: De-globalization?



- Growing dissatisfaction with globalization
  - Much greater focus on supply chain resilience;
  - Domestic investment, production…and jobs
  - Trade war/tariffs

- How to juggle with cost/efficiency?
  - Higher cost = slower transition, slower (?) economic growth…
  - …but (potentially) greater public support/buy-in?

# Energy equity and the energy transition



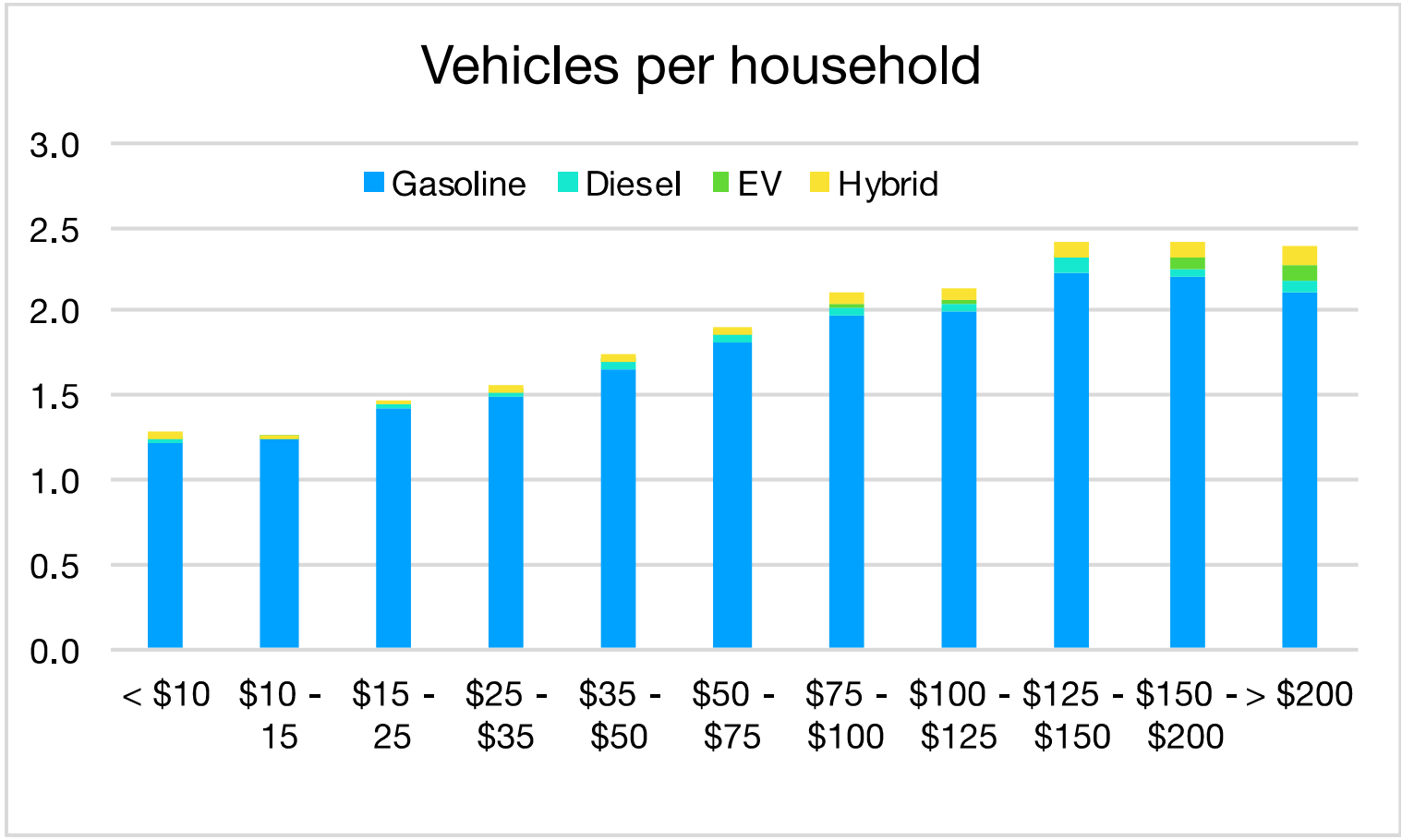
- Significant focus @ COP on rich vs poor countries

- …also an issue within the US
  - Poorer households spend a larger share of income on energy
  - Subsidies for EVs, solar panels benefit wealthier households

# Energy equity and the energy transition



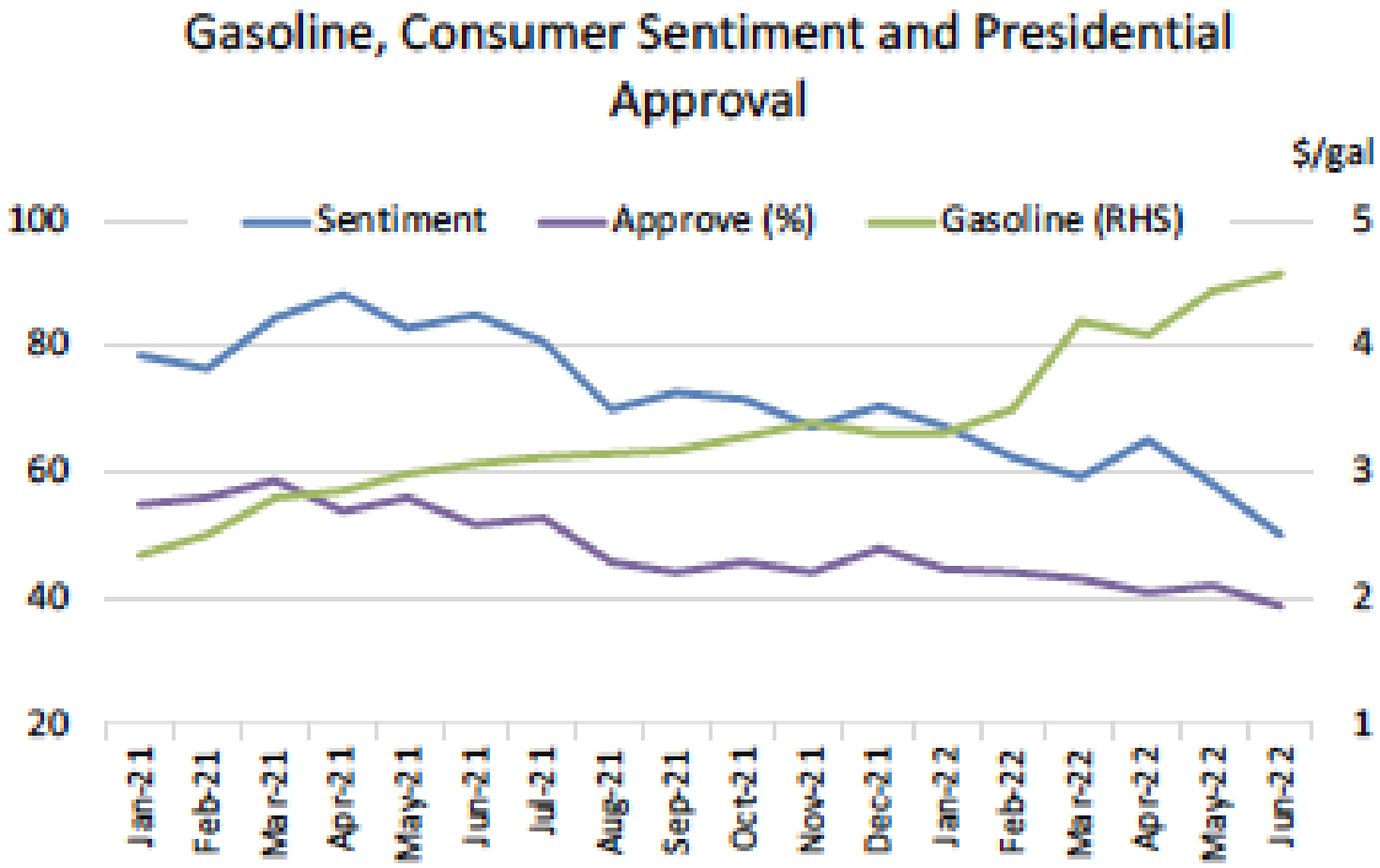
## US vehicles and family income, 2022




Source: ORNL National Household Travel Survey

# Pump prices: economic and political reality






Sources: University of Michigan, US Energy Information Administration, Reuters/IPSOS

# The long-term energy transition



- The future is uncertain!
- Moving from scarcity to surplus…but how quickly?
- What we know
- Key uncertainties

# The future is uncertain!



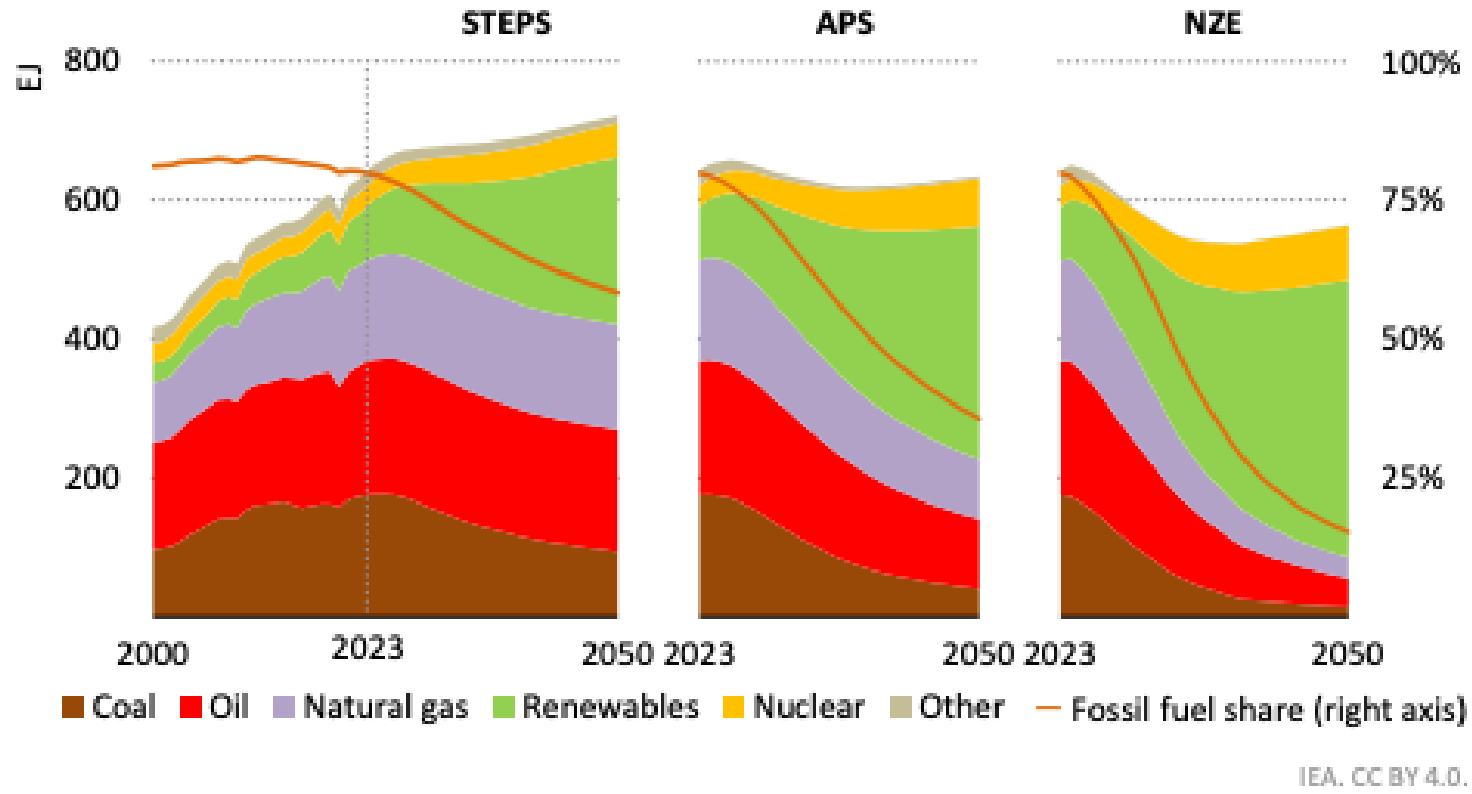
"It's tough to make predictions, especially about the future."
-Yogi Berra

# The future is uncertain!



## International Energy Agency World Energy Outlook scenarios

**Figure 3.1** ▸ **Global total energy supply by source and fossil fuel share by scenario, 2000-2050**

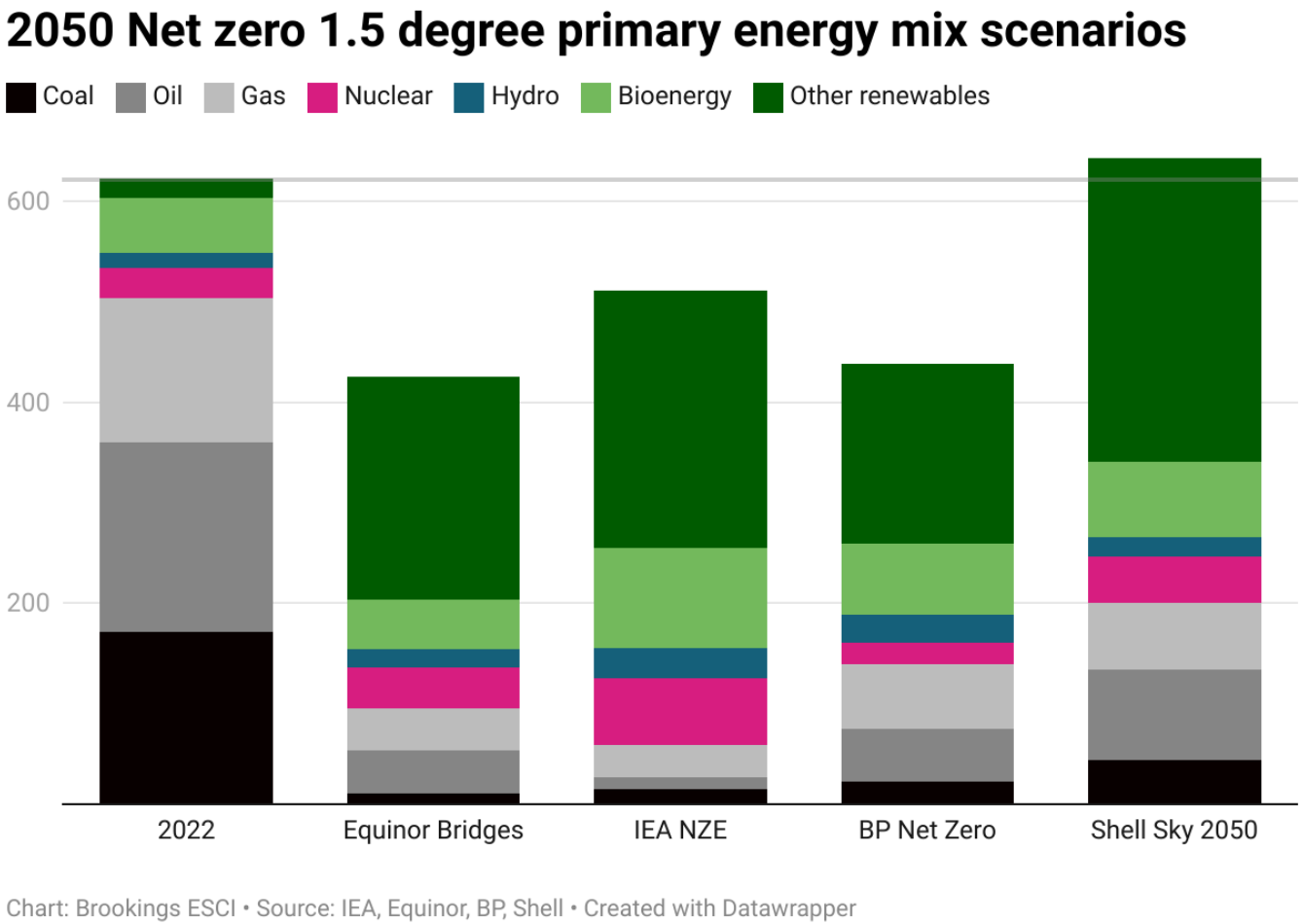



Source: IEA WEO 2024

# The future is uncertain!



## Range of outlooks 2-degree scenarios




Source: Gross and Finley (forthcoming), Brookings Institution

# From scarcity to surplus: Hotelling



- "The Economics of Exhaustible Resources" (1931) etc
  - Prices adjust over time to maximize economic rent via fully extracting a non-renewable natural resource
- In other words, a strategic producer will hold back some resource from development today…
  - …in the expectation that its price will rise as it is depleted
- Foundation for energy economics & politics in the 20th century
  - Rationale for oil strategies of key Mid East producers; creation of OPEC…
  - …and plays into "Energy Dominance"

- BUT:
  - NOT running out of hydrocarbons
  - More likely (?) to run out of demand with rapid growth of renewables

# From scarcity to surplus: Implications



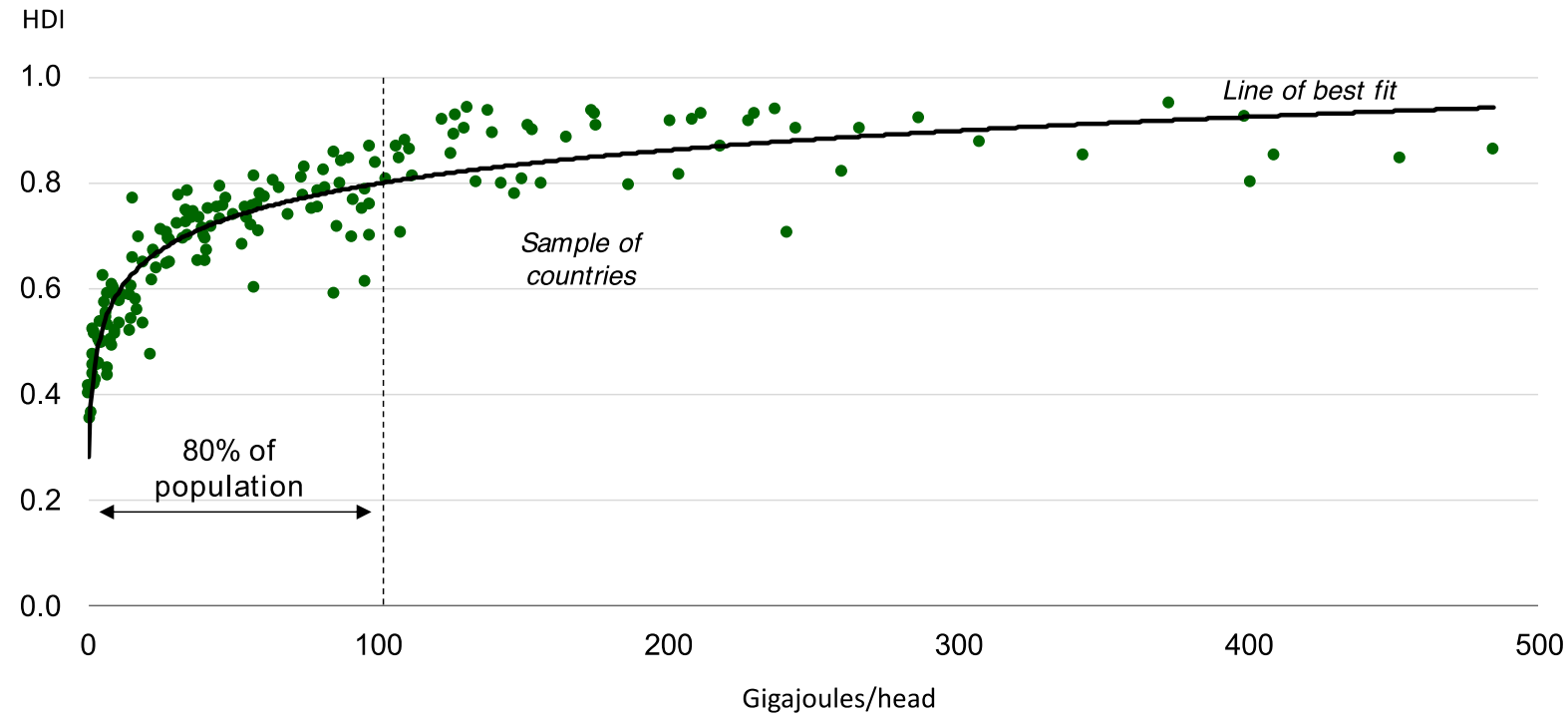
- Scarcity no longer the organizing principle for fossil fuels
  - Move from strategic producers "saving" scare resources for the future…
  - …to monetizing resources before "peak demand" strands them
- An urgent race to reform resource-dependent economies
  - Saudi Vision 2030/National Transformation Plan
  - Aramco IPO, UAE asset sales, etc
  - BUT: Not there yet!
  - ➔ Still need robust oil revenues
- Will we face the same questions for minerals???
  - De-globalization is NOT scarcity!

# What we know: Need for more energy



## Human development and energy consumption

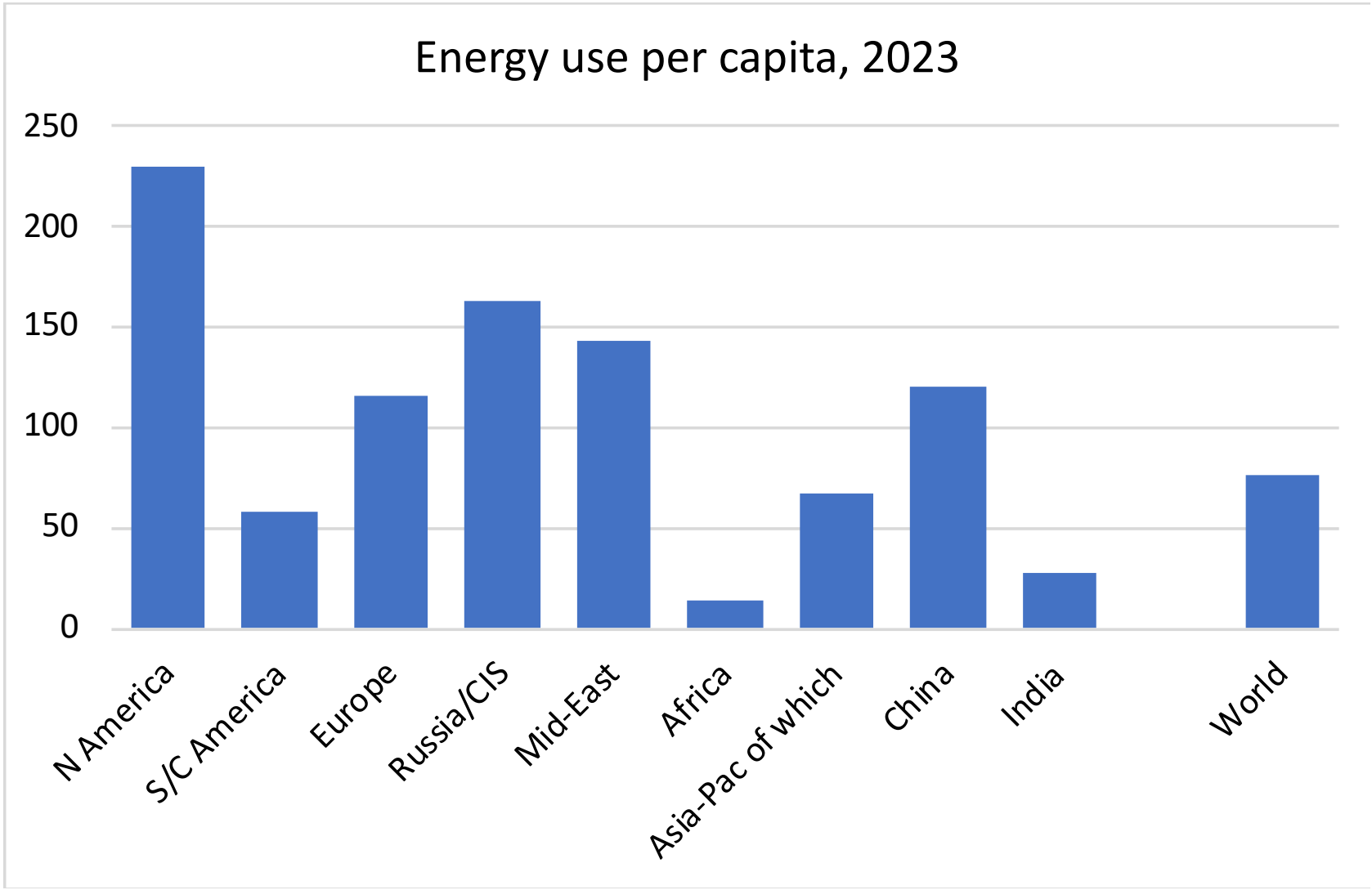
UN Human Development Index and energy consumption, 2017




Sources: BP (2019)

# What we know: Need for more energy

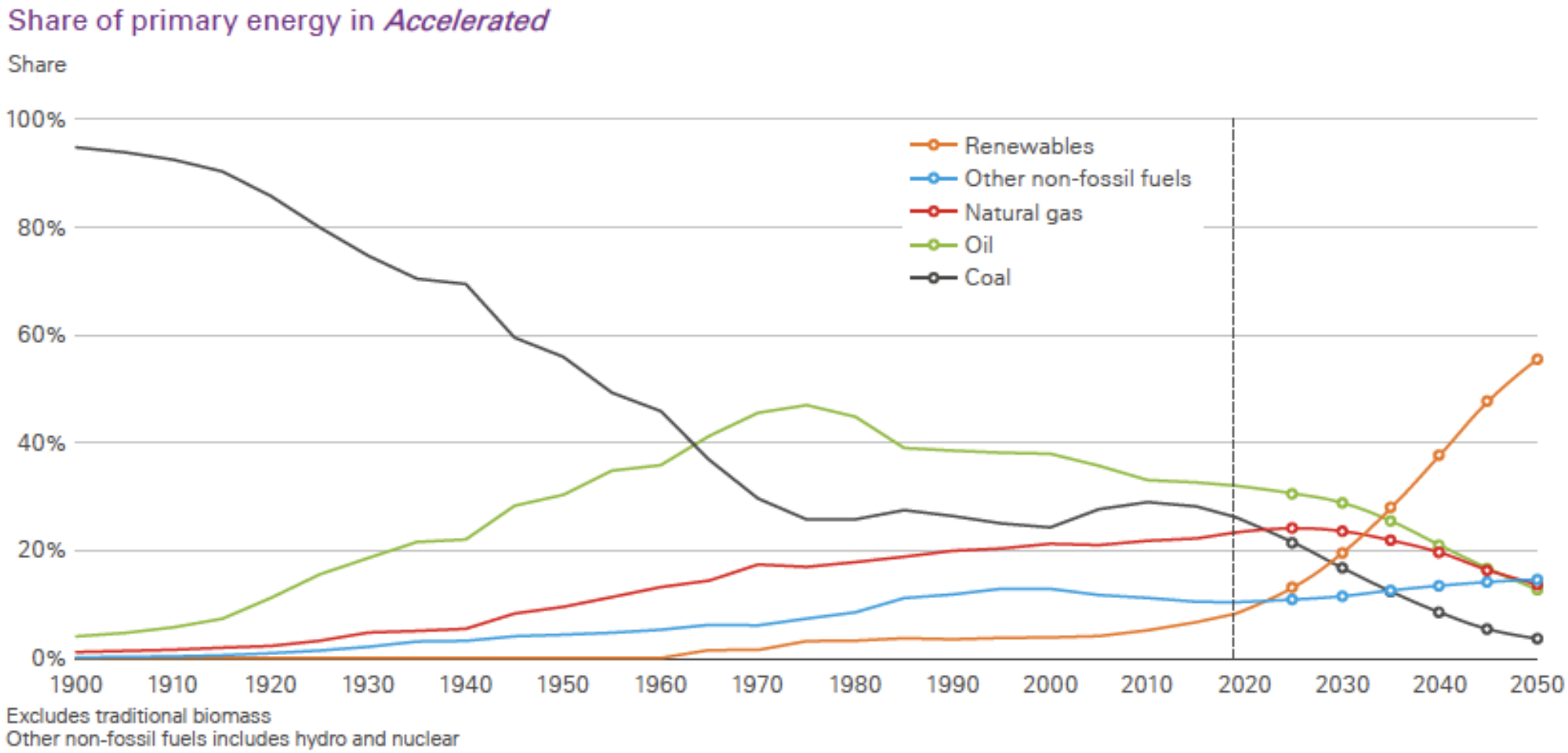





Source: Energy Institute (2024). Gigajoules per capita

# What we know: Transitions take time






Source: BP (2022)

# What we know: Scale of the energy sector



- About 1 million producing oil/gas wells in the US
- About 92,000 wind turbines in the US (2023)
- About 1 billion personal vehicles in the world

- Oil: 100 million barrels per day
  - In gallon jugs, would reach the moon in 8 hours

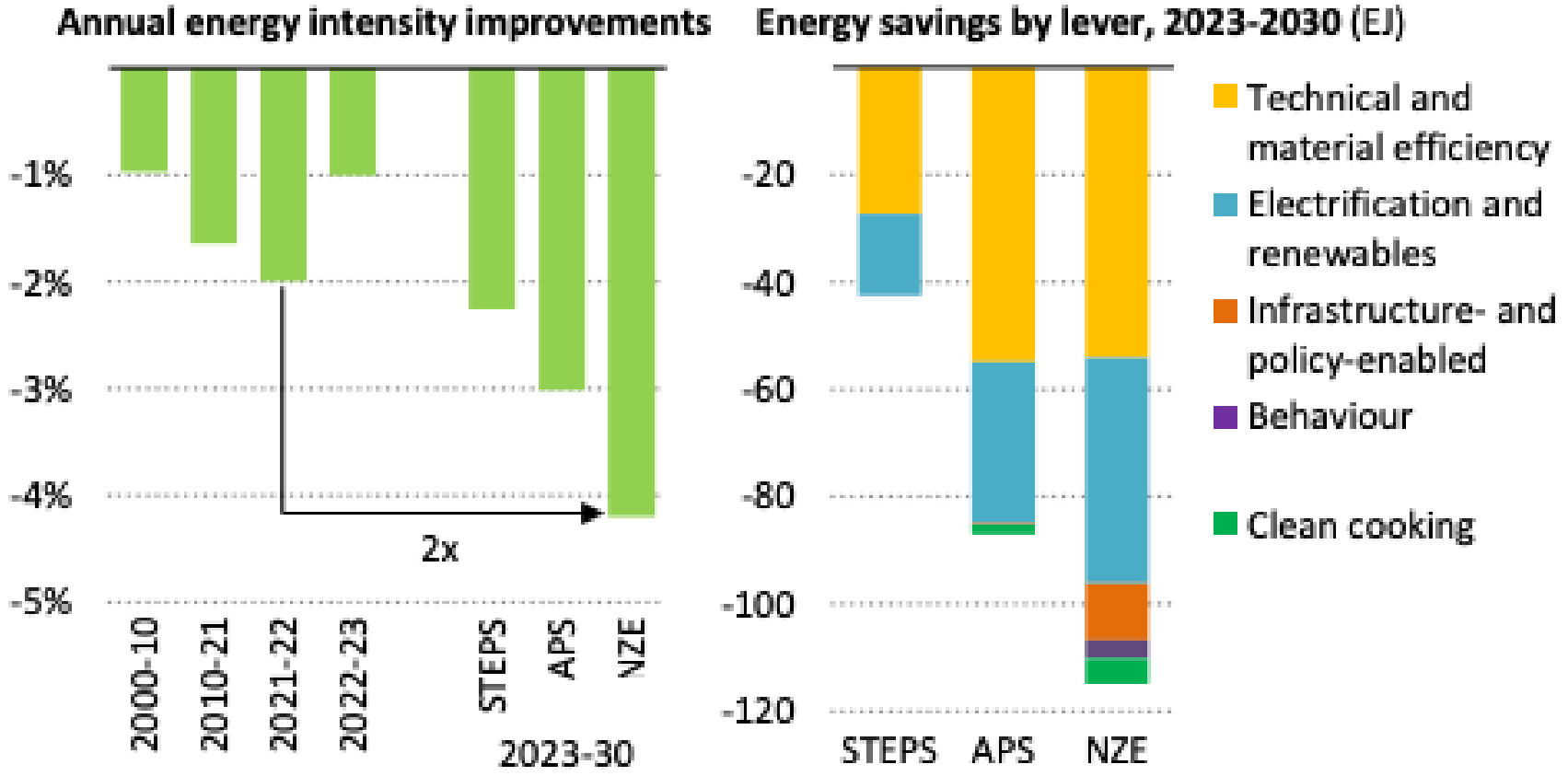
- Nat gas: 3.9 trillion cubic meters/yr
  - Over 1 million Goodyear blimps every day

- Biodiesel: 100% of global vegetable oil production needed to replace roughly 1/3 of jet fuel demand (8 million b/d)

# What we know: Efficiency gains, but need more



**Figure 3.2** ▷ Global annual energy intensity improvements, 2000-2030, and cumulative energy savings by lever and scenario, 2023-2030



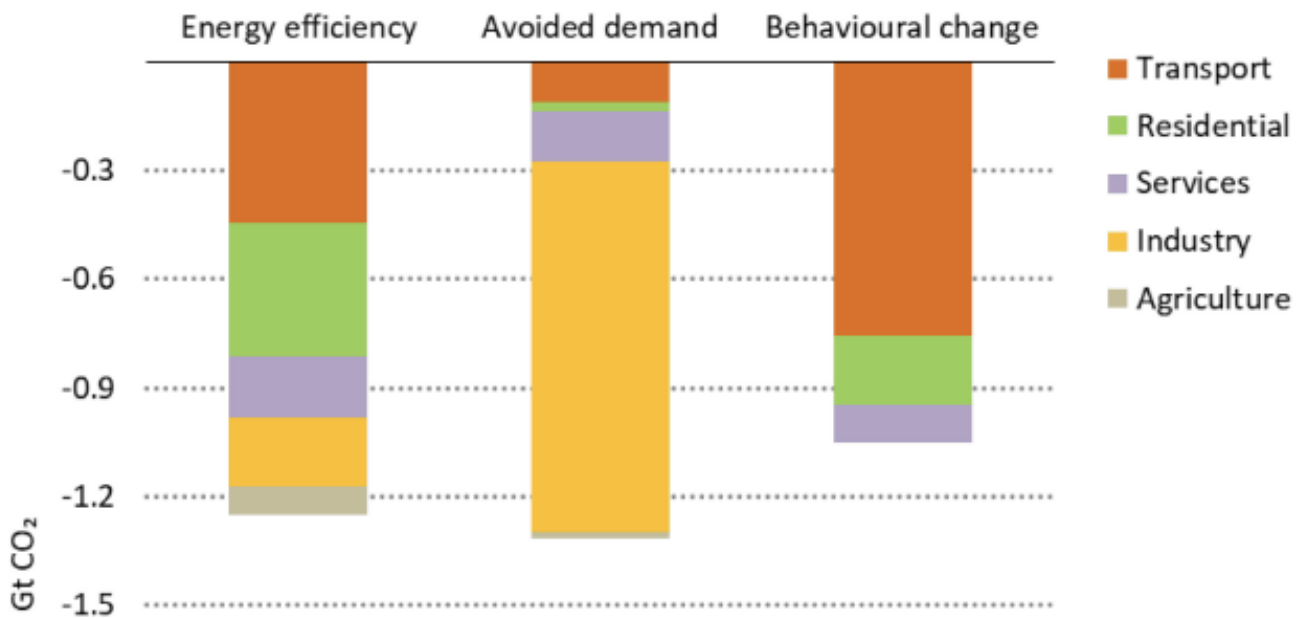



Source: IEA WEO (2024)

# What we know: No "silver bullet"…but "all of the above"



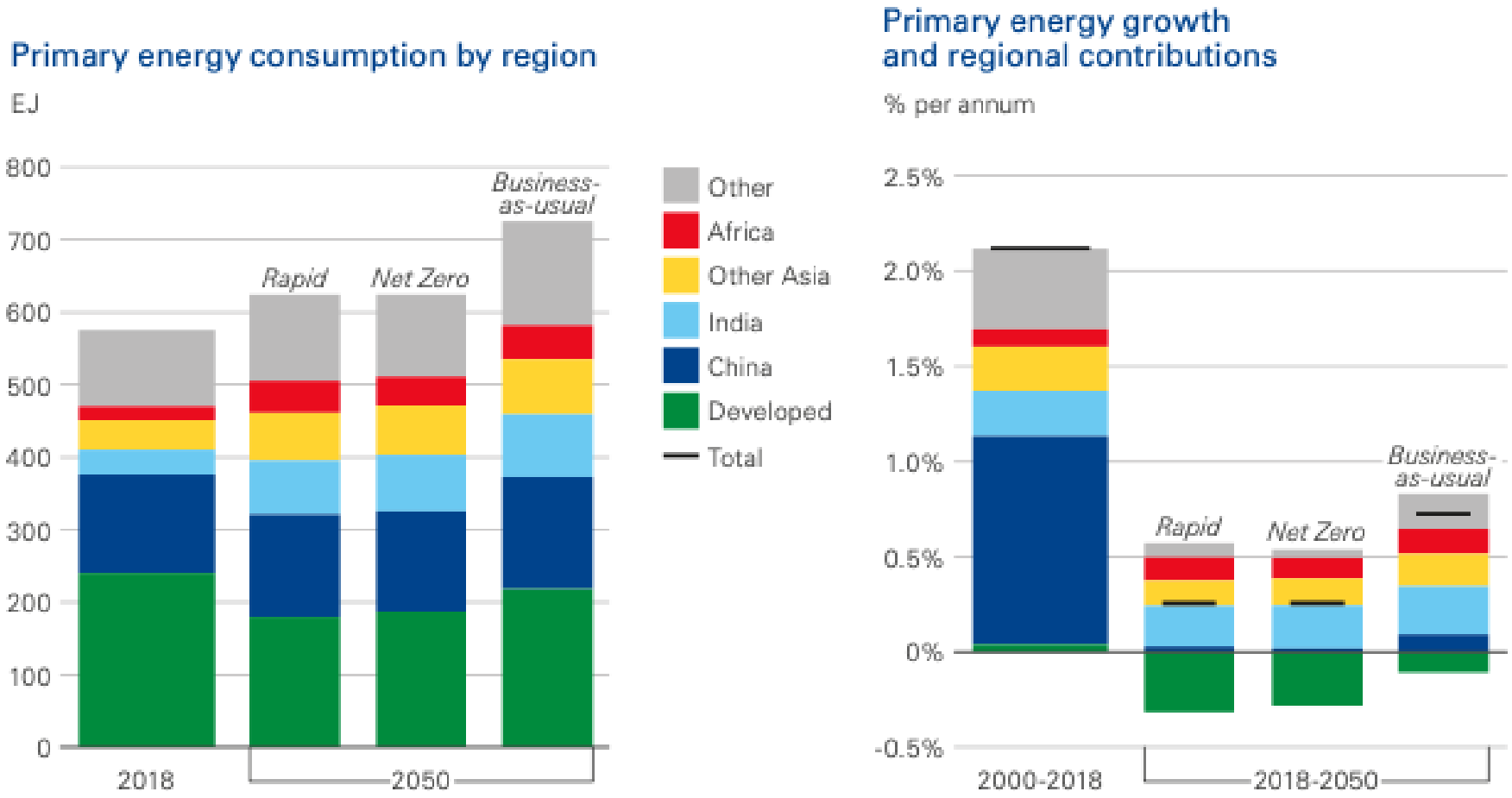
**Emissions reductions from end-use efficiency, avoided demand and behavioural change in 2030 between the Announced Pledges and Net Zero Emissions scenarios**




Source: IEA WEO (2021)

# What we know: Asian growth needs



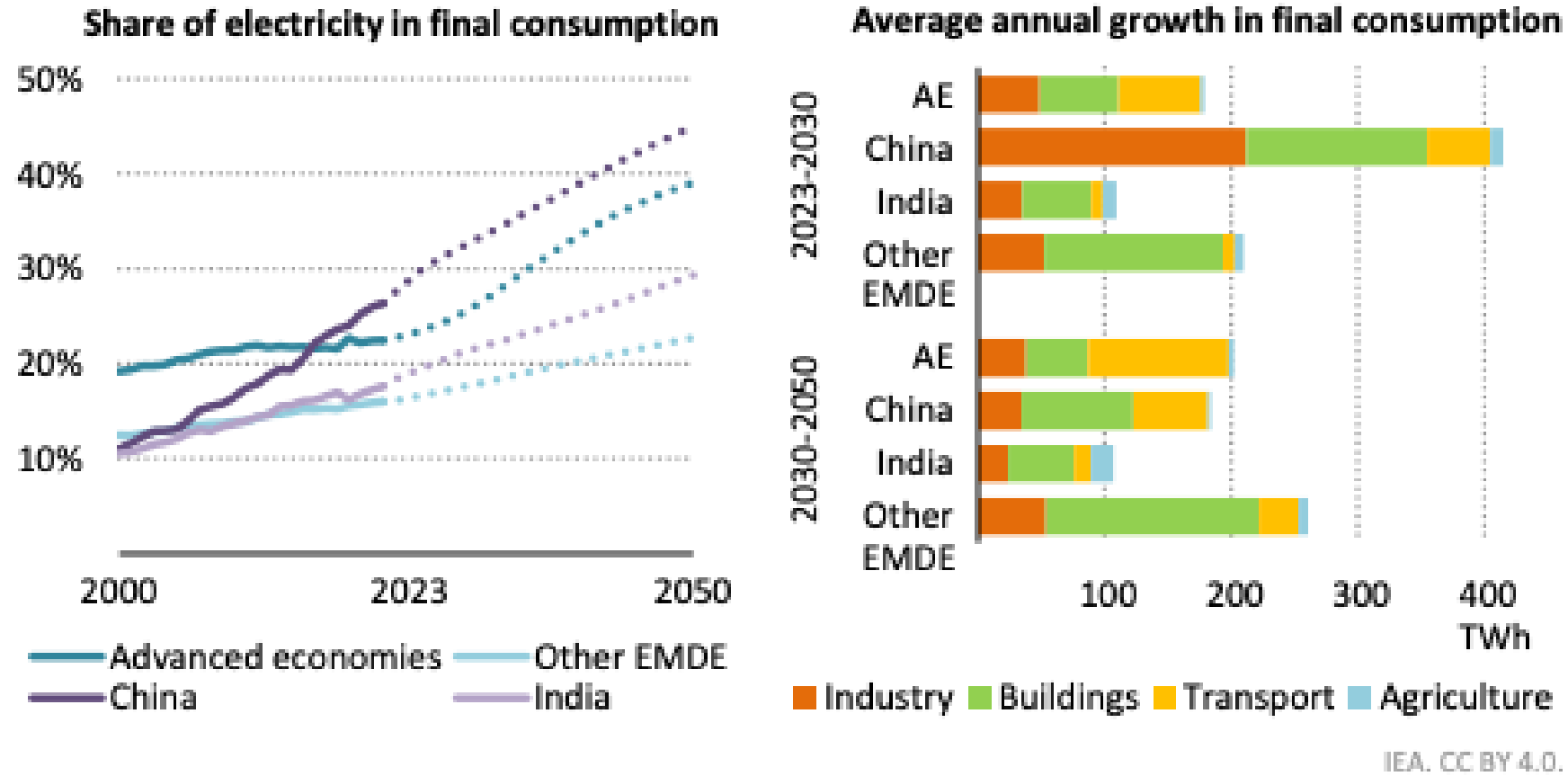



Source: BP (2020)

# What we know: The world electrifies



**Figure 1.10 ▻ Electricity in total final consumption and demand growth in the STEPS to 2050**




Source: IEA WEO (2024)

# What we know: Need (some) continued oil/gas investment

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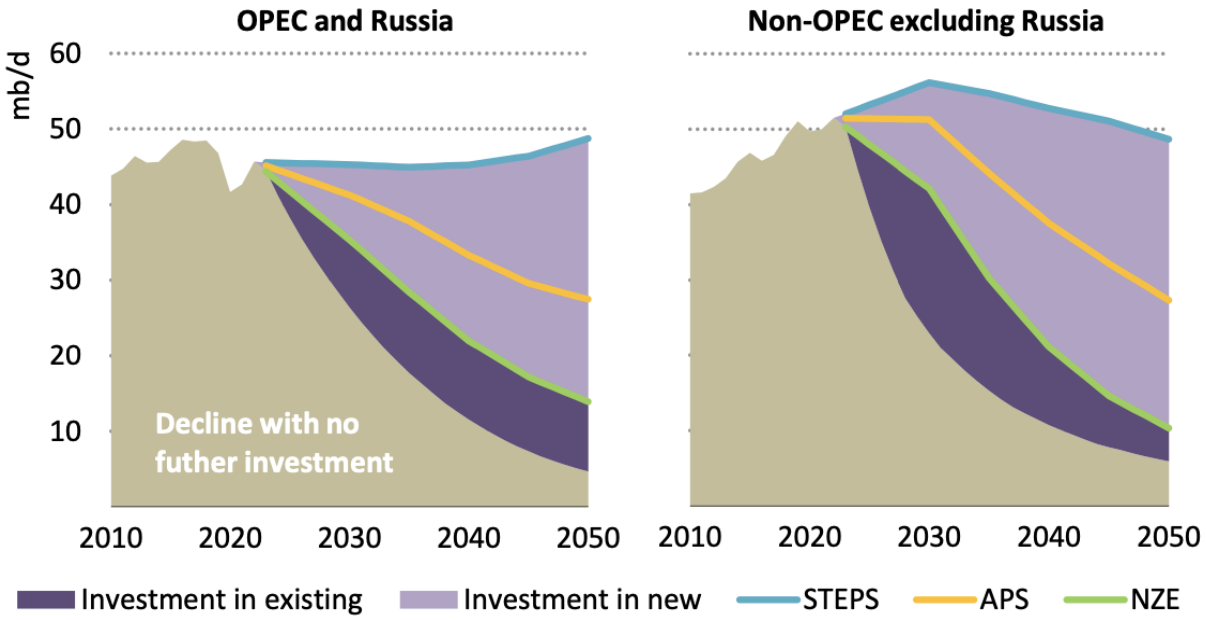
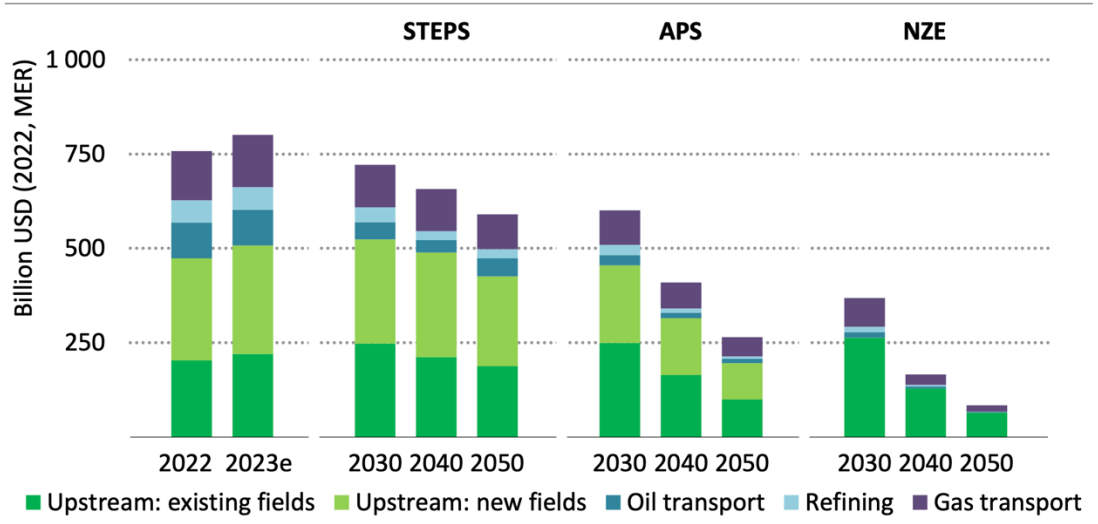
**Figure 3.21** ▷ Oil production by OPEC and Russia and other non-OPEC producers by scenario, 2010-2050




Source: IEA WEO (2023)

**Figure 3.22** ▷ Global oil and natural gas investment by scenario, 2022-2050



# Uncertainties: Policy



## International Energy Agency World Energy Outlook scenarios

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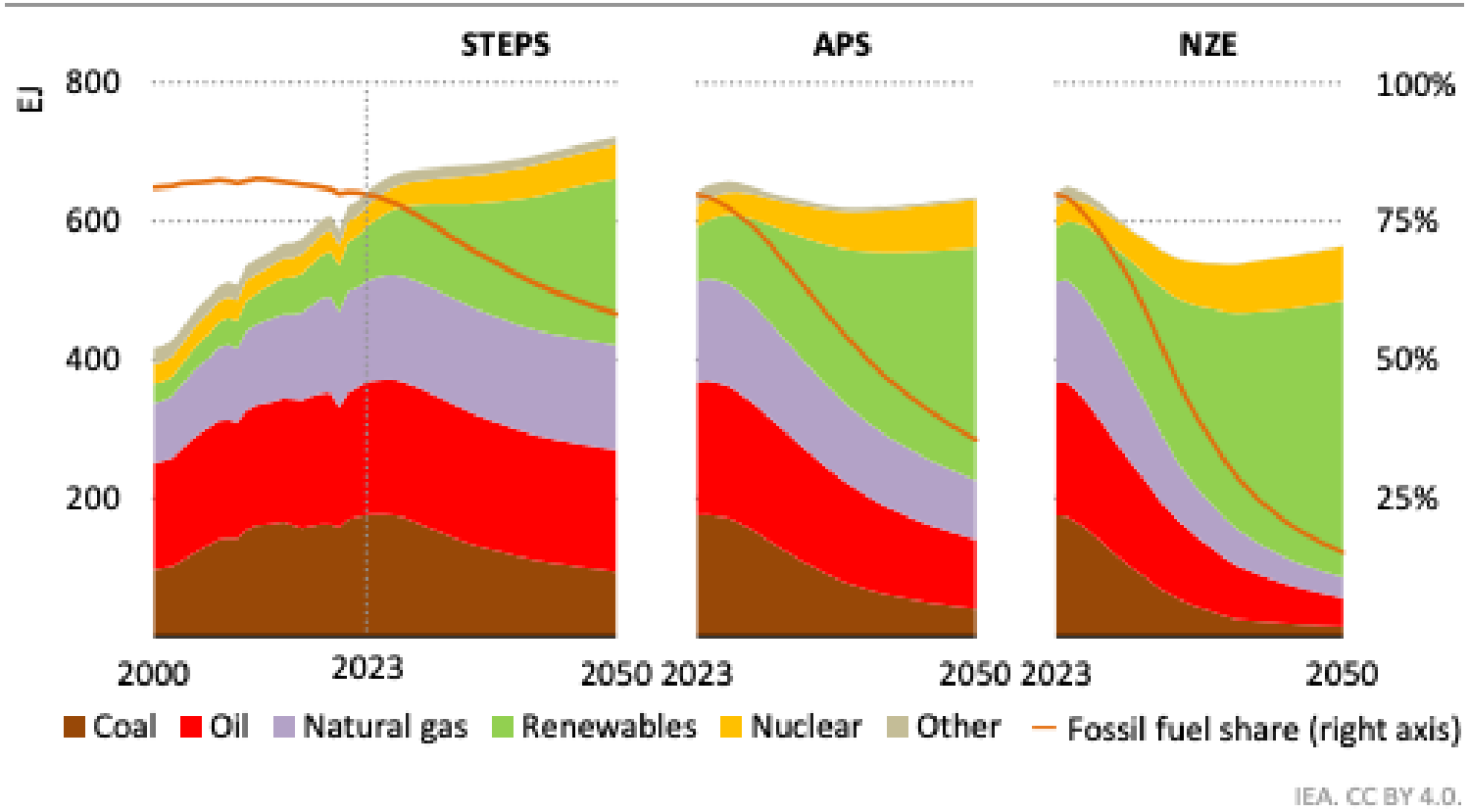


Source: IEA WEO 2024

# Uncertainties: Technology



Prepare to be surprised (shale revolution)

- Renewables:  Wind, solar
- Batteries/fuel cells:  EVs and electricity grid
- Hydrogen, ammonia, other energy carriers
- Nuclear
- Demand mgmt/efficiency:  Smart grids/buildings; EVs for load mgmt
- Non-energy: Crude to chemicals; CCUS; Land use
- Software/connectivity, AI, machine learning
- What else?!?

# Summary



- Energy remains profoundly strategic and essential to our economy and security
- The energy transition is here…
  - …but massive uncertainties about the pace…
  - …details—policy, technology…
  - …and the implications (domestically and internationally)
- How to manage, plan and invest?
  - Robustness, flexibility, agility, and humility
  - Anchored on what we know (or think we know!)
  - Focused on key drivers
- Important to understand and manage broader implications
  - Security, affordability, equity
- ➔ Need to ensure sufficient, secure, affordable energy today AND successful transition

# Appendix: Selected resources



- Baker Institute Center for Energy Studies: https://www.bakerinstitute.org/center/center-energy-studies
- IEA World Energy Outlook: https://www.iea.org/reports/world-energy-outlook-2024
- US DOE/EIA:
  - Annual Energy Outlook: https://www.eia.gov/outlooks/aeo/
  - Short-term Energy Outlook: https://www.eia.gov/outlooks/steo/
  - Also excellent source more generally for data & analysis: https://www.eia.gov/
- BP Energy Outlook: https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html
- Energy Institute Statistical Review of World Energy: https://www.energyinst.org/statistical-review
- What's Happening to Oil Market Forecasts? Baker Institute Issue Brief, August 2024: https://www.bakerinstitute.org/research/whats-happening-oil-market-forecasts

# Thank you!

# Stay connected…

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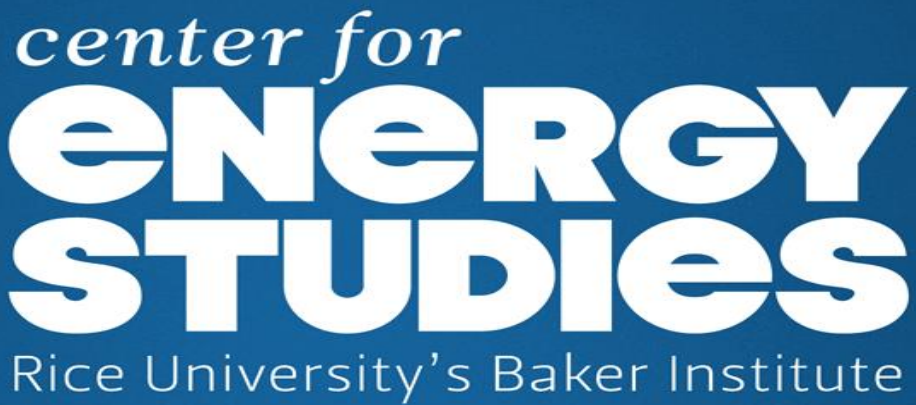
*Speaker: www.bakerinstitute.org/expert/mark-finley*

*Speaker email: mark.finley@rice.edu*

*Twitter: @finley_mark*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