



**APERC Annual Conference 2023**

**“Balancing Energy Security, Affordability, and  
Decarbonization”**

April 25, 2023  
Tokyo

***Session 1***  
***Role of Oil and Gas***

*Lucian Pugliaresi*  
*President*  
*Energy Policy Research Foundation*  
*Washington, DC*

**“ALL MODELS ARE WRONG, BUT SOME ARE USEFUL”**

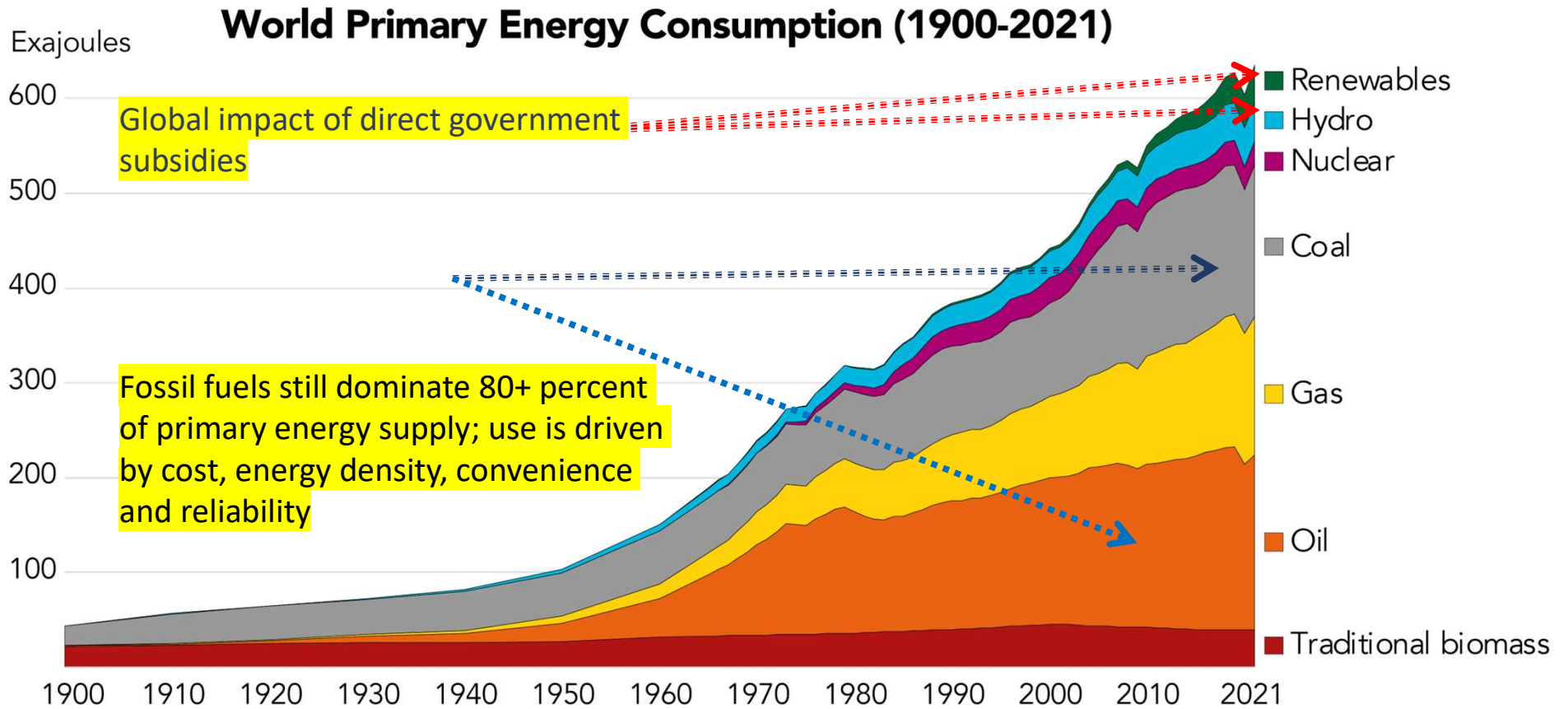
*George G.P. Box*

*British Statistician, 1919-2013*

**....Or Exactly How Hard is Net Zero When  
Balancing Energy Security, Affordability  
and Decarbonization?**



# Energy Transition is Hard & Rare

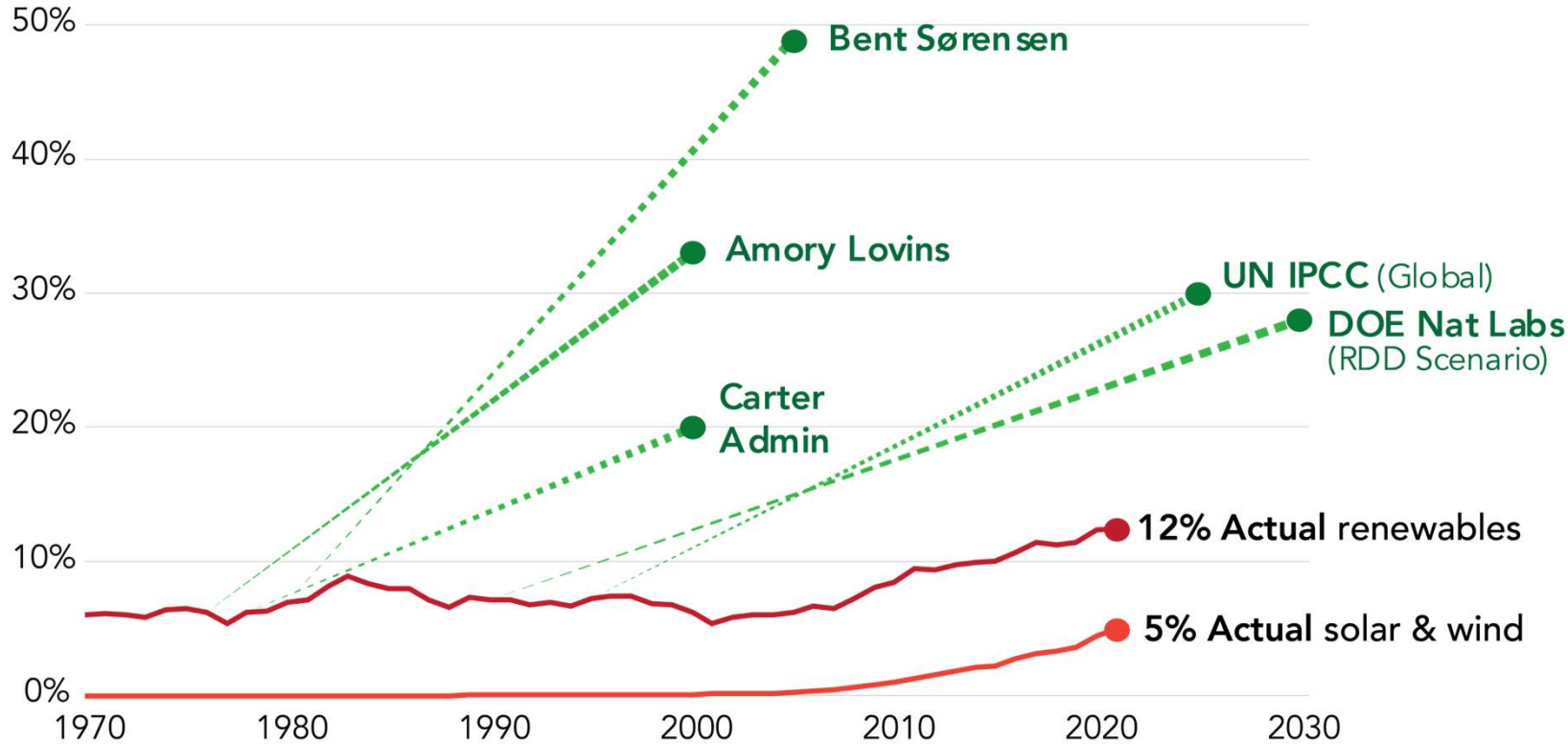


Source: EPRINC, Vaclav Smil, BP

# Ambition vs. Reality



Share of **Renewables** in U.S. Primary Energy Demand (1970-2021)



**Worldwide experience is similar:**

According to Bloomberg NEF, direct government subsidies and payments for wind, solar and other modern renewable fuels amounted to \$5 trillion over the last 20 years. It has yielded a total contribution to worldwide primary energy demand of approximately 5%.

Sources: Vaclav Smil (original chart from *JPMorgan 2021 Annual Energy Paper*); Amory Lovins, "Energy Strategy: The Road Not Taken?" (1976); "President Jimmy Carter's Remarks at White House Solar Panel Dedication Ceremony, 1979"; DOE, *The Potential of Renewable Energy: An Interlaboratory White Paper* (1990); IPCC *Second Assessment: Climate Change 1995*.

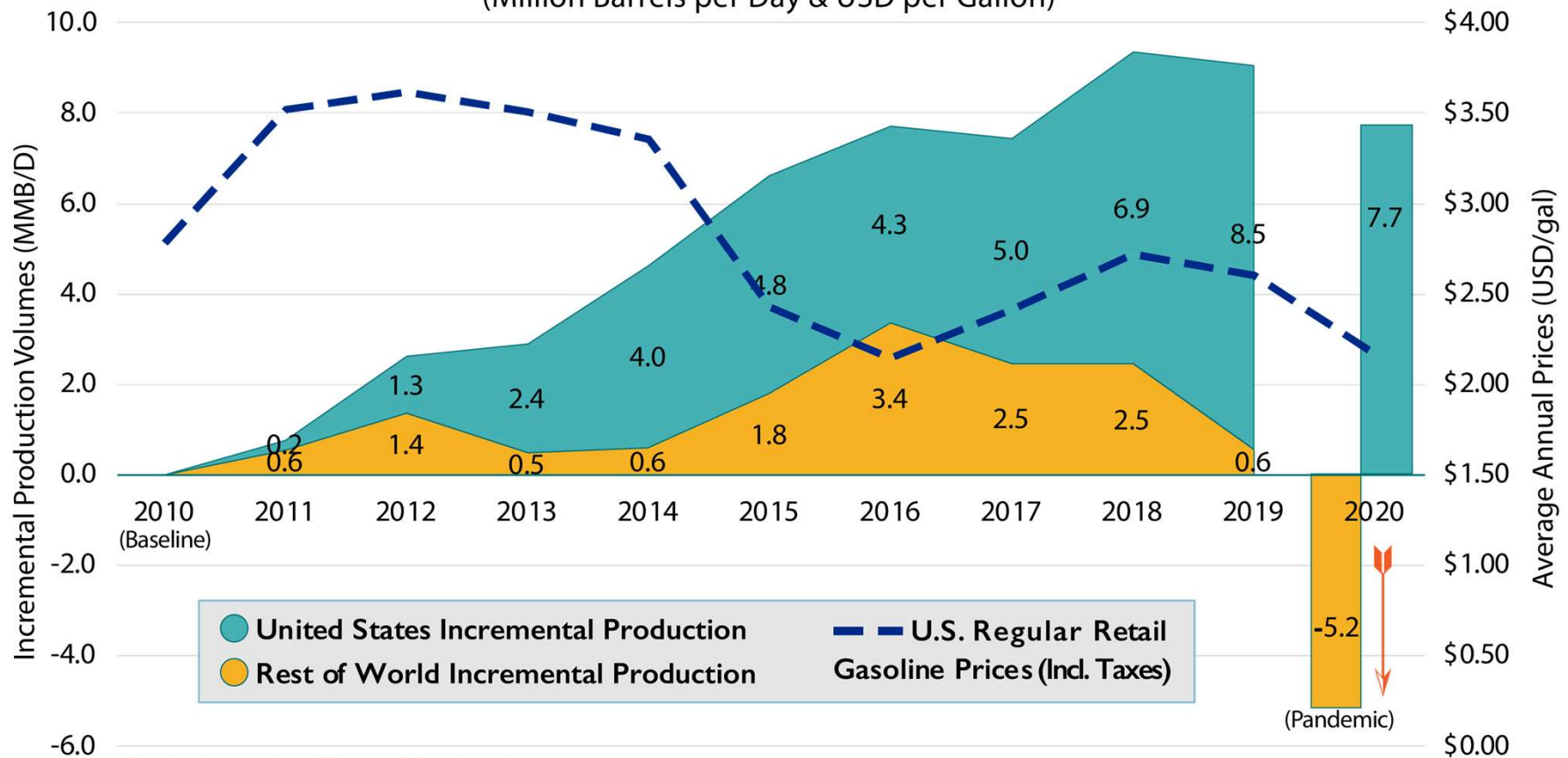
Note: Renewables include wind, solar, hydropower, geothermal, biomass.

# US Contributed 84% of Incremental Oil in 2010-2020



**Global Incremental Oil Production & U.S. Gasoline Prices (2010-2020)\***

(Million Barrels per Day & USD per Gallon)

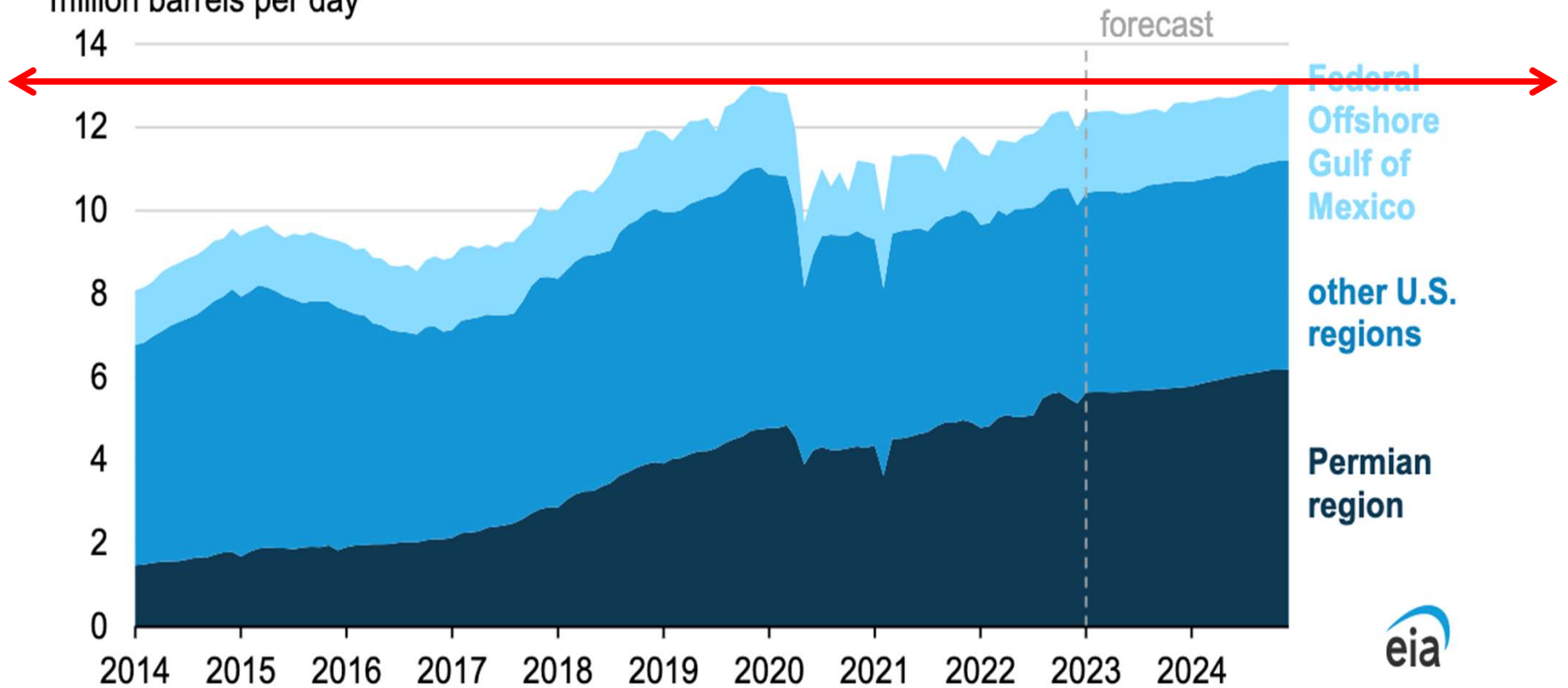


\*Includes crude, NGLs, and feedstocks  
EPRINC analysis based on data from IEA, EIA

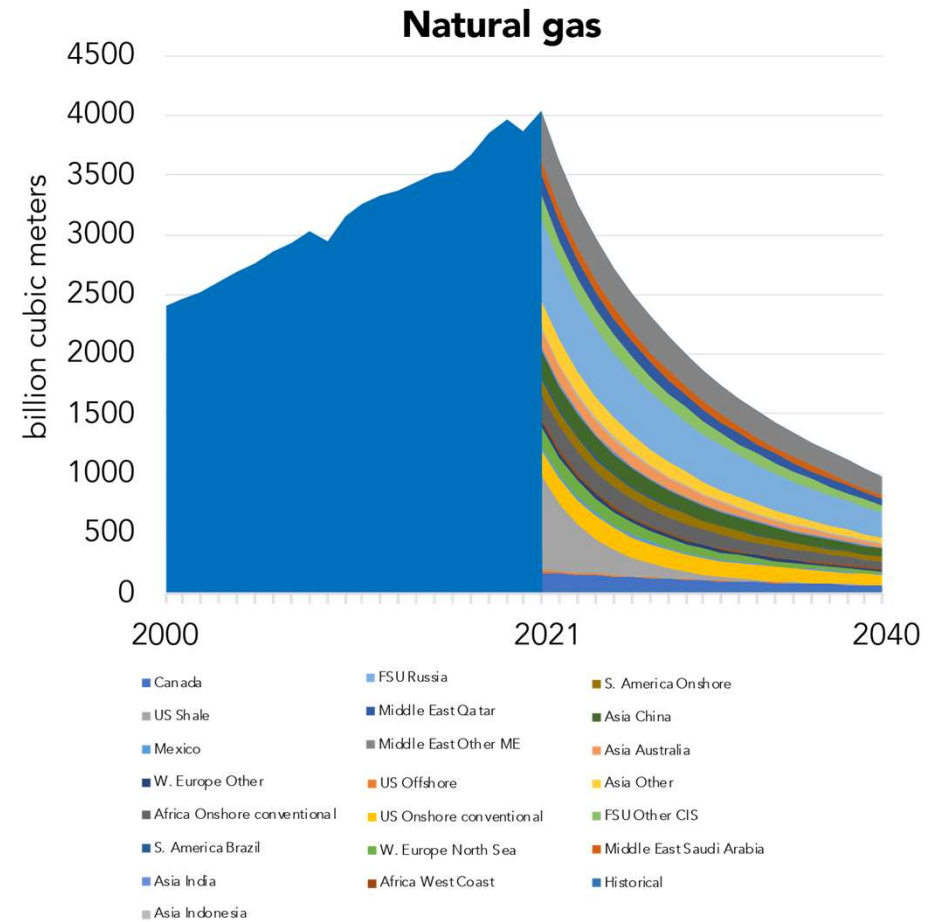
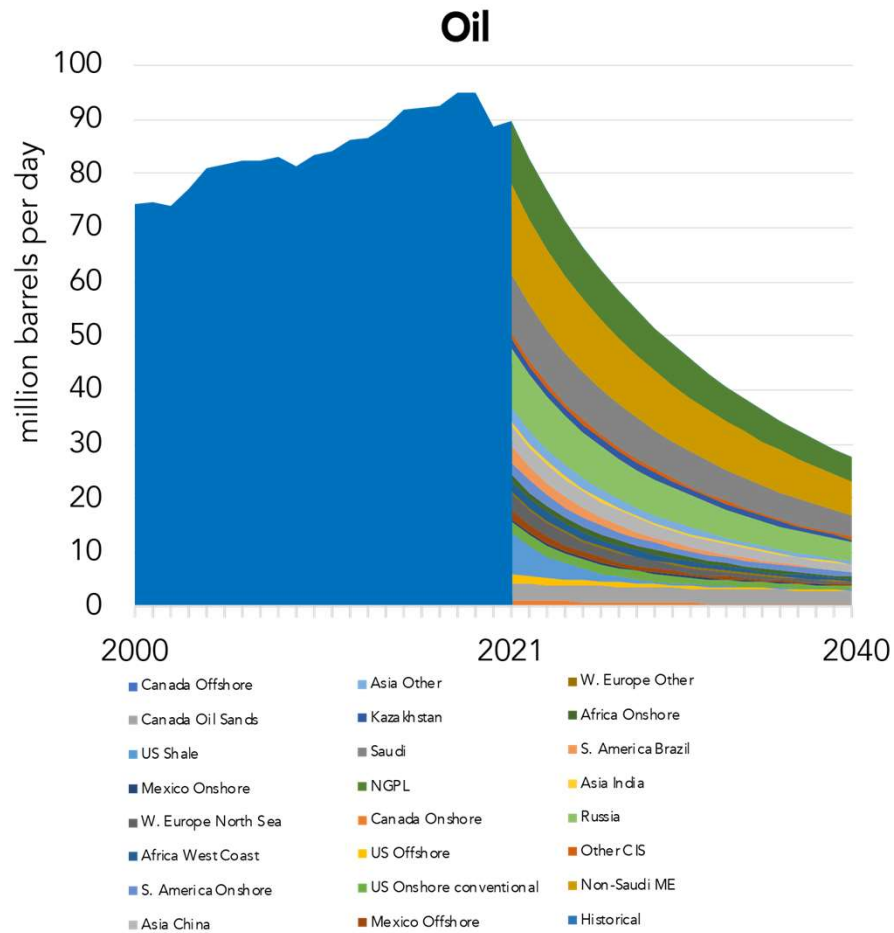
## EIA Expects US Crude Oil Production to Hit All Time High in 2024

Monthly U.S. crude oil production by region (Jan 2014–Dec 2024)

million barrels per day



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

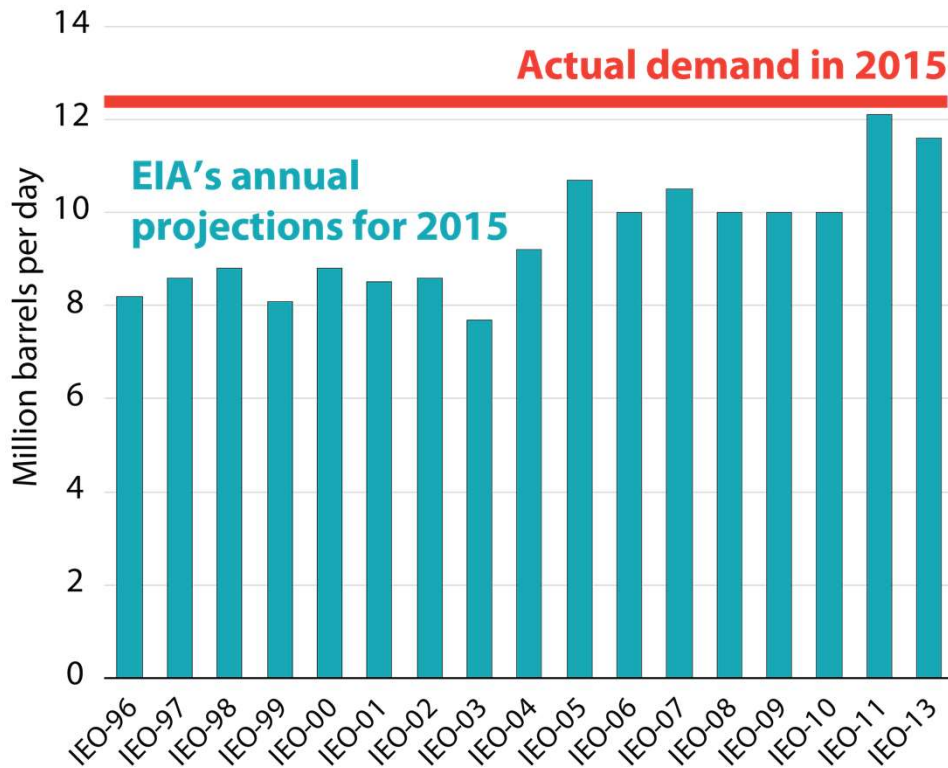


Source: EPRINC, Michael Lynch

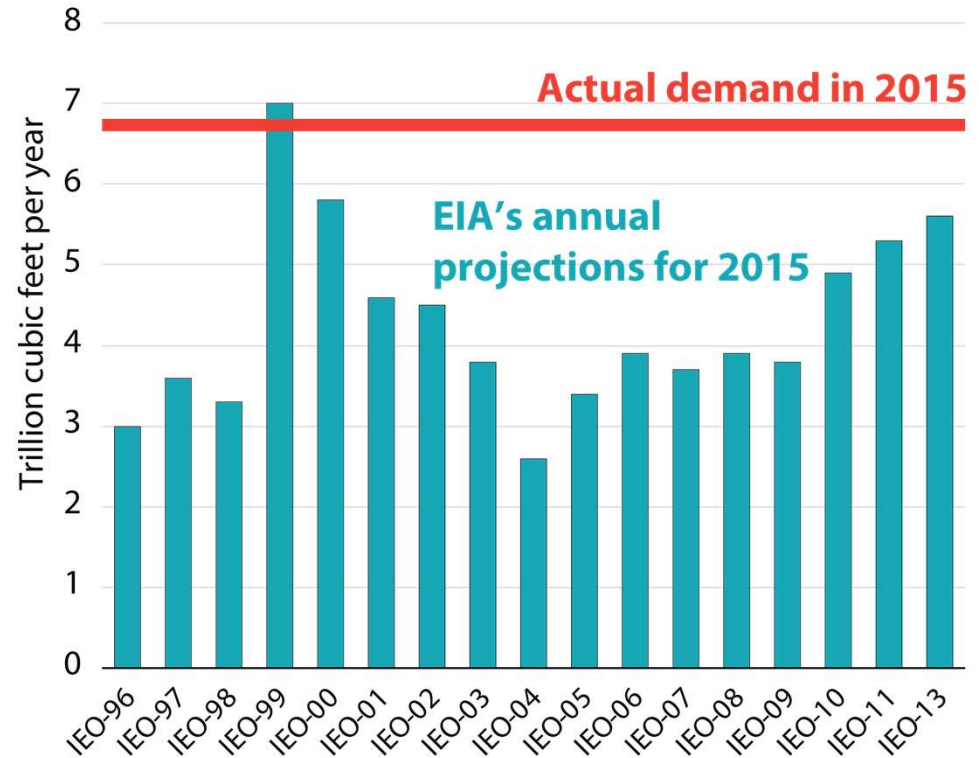
# It's Hard to Predict Non-OECD Demand: China Case



**China's Liquids Demand in 2015: Projected vs. Actual**



**China's Gas Demand in 2015: Projected vs. Actual**



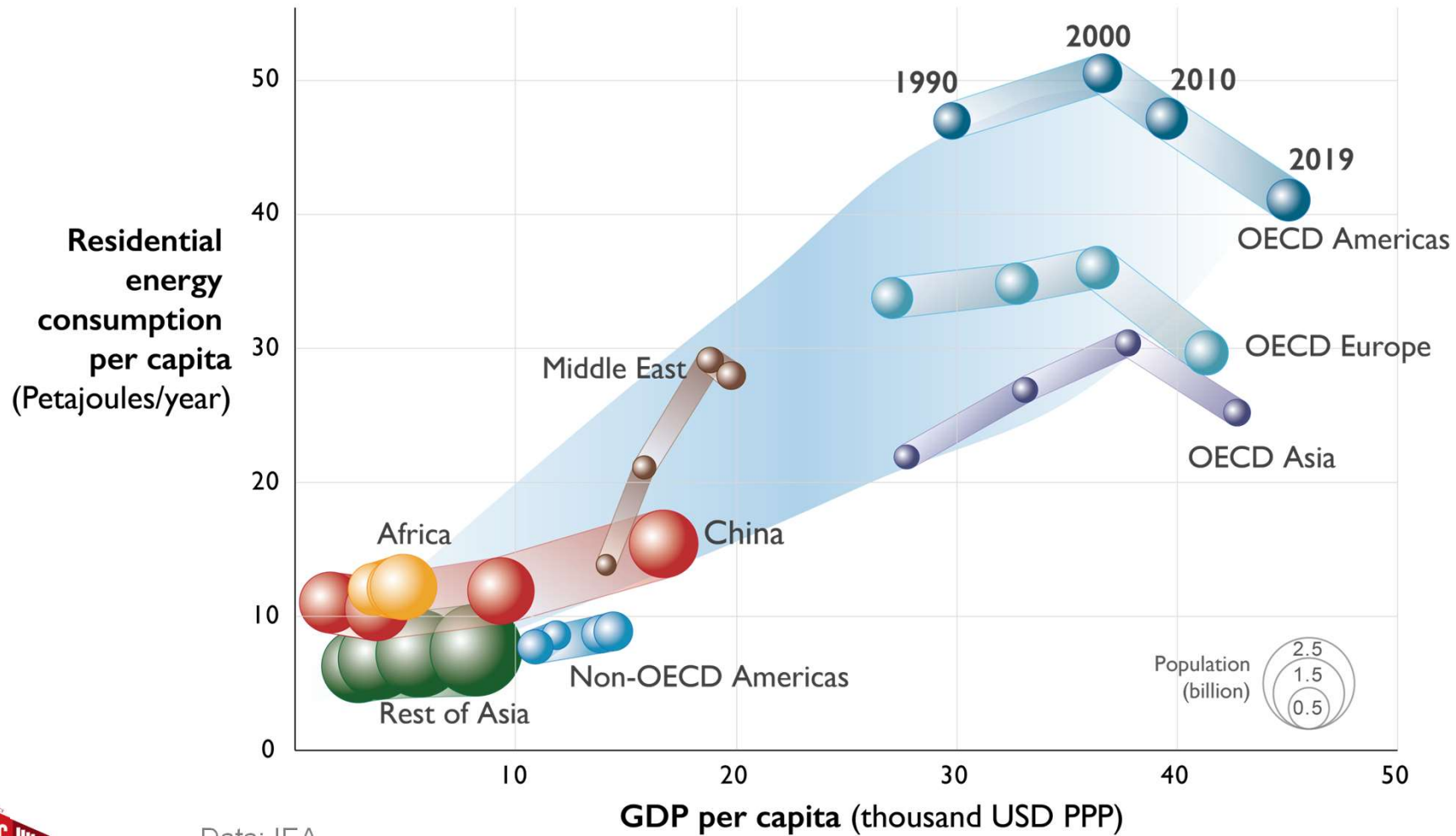
Source: U.S. EIA's International Energy Outlooks (IEO) 1996-2013, 2016, EPRINC.

**Note: On March 27, 2023, CNPC announced that 2023 petroleum demand would be 756 million metric tons (mt) . Earlier forecasts for 2023 were 690mt (2018), 705mt (2019) and 740mt (2020). Bloomberg**



# Household Energy to Grow in Non-OECD

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



Data: IEA



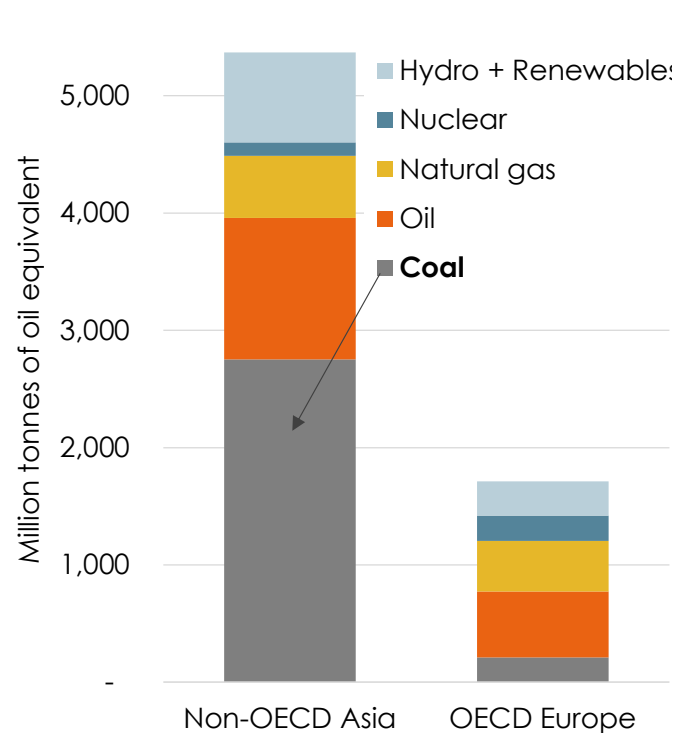
# Different Pictures Between Europe and Asia

**Primary coal supply in non-OECD Asia (incl. China and India) was 2,751 Mtoe, 60% higher than the entire primary energy supply of OECD Europe.**

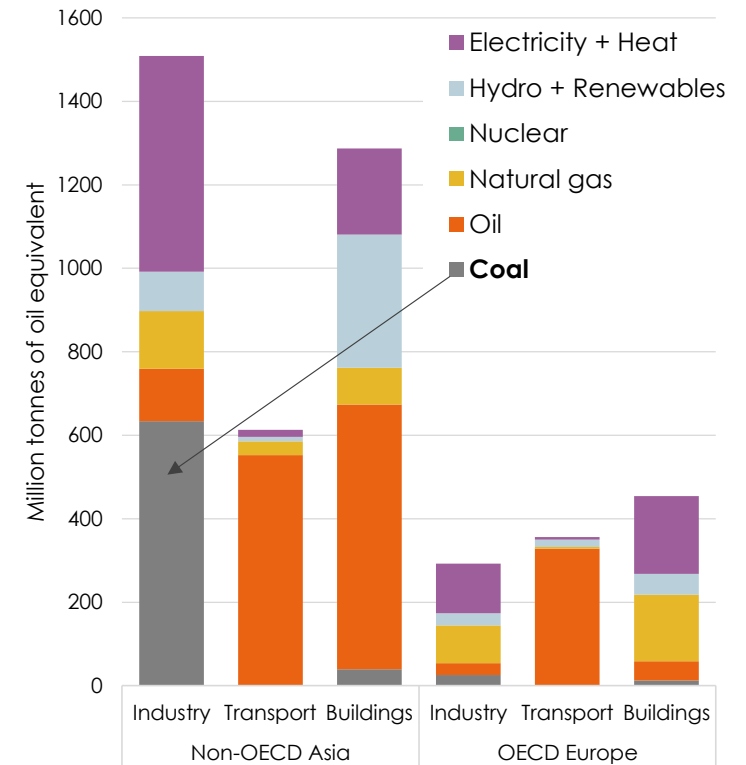
**In final consumption, 94% of non-OECD Asia coal use is consumed in industry, incl. “harder-to-abate” sectors like cement and steel.**

## Fuel Mix in Non-OECD Asia (incl. China) and OECD Europe

**Primary Energy Supply, 2019**



**Final Consumption, 2019**

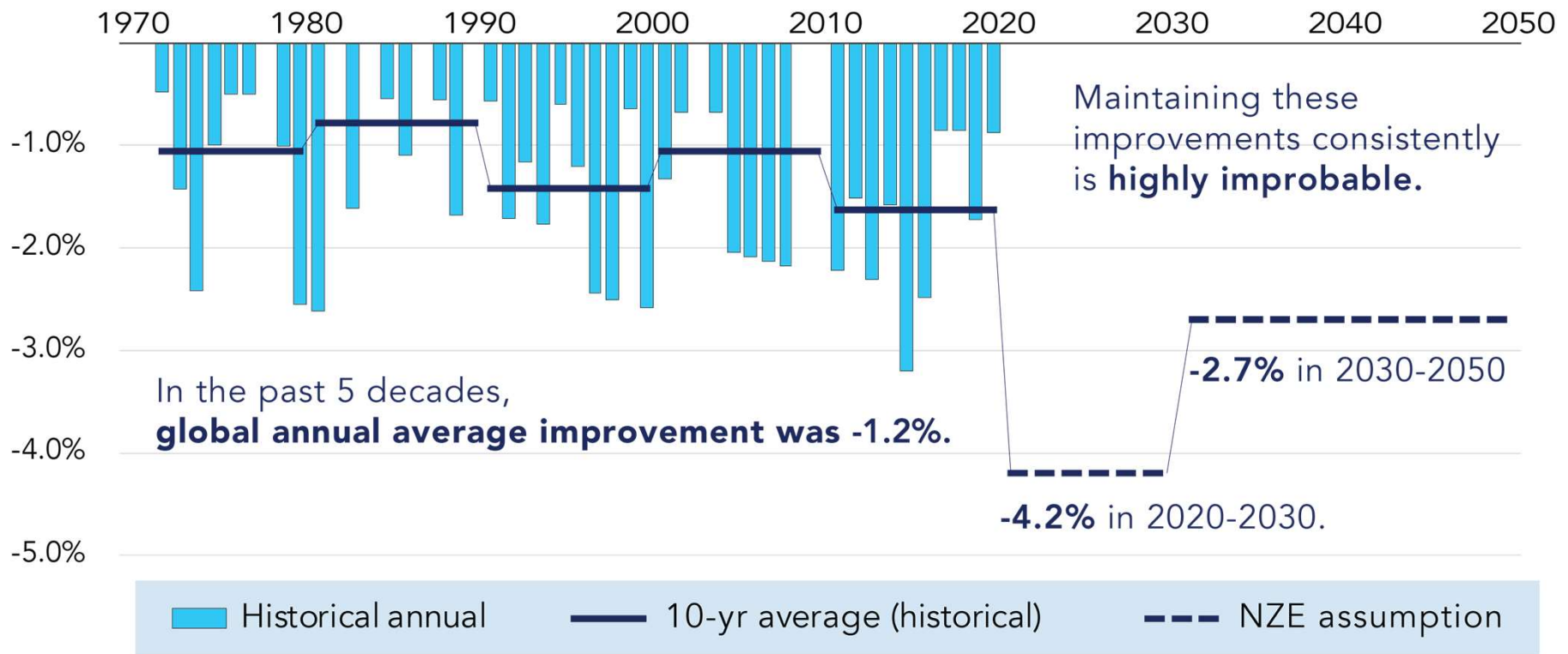


Source: EPRINC figures based on IEA data

# Historical Energy Intensity + Requirements under Net Zero



## Global Energy Intensity Improvements: Historical vs. IEA's Net Zero Scenario

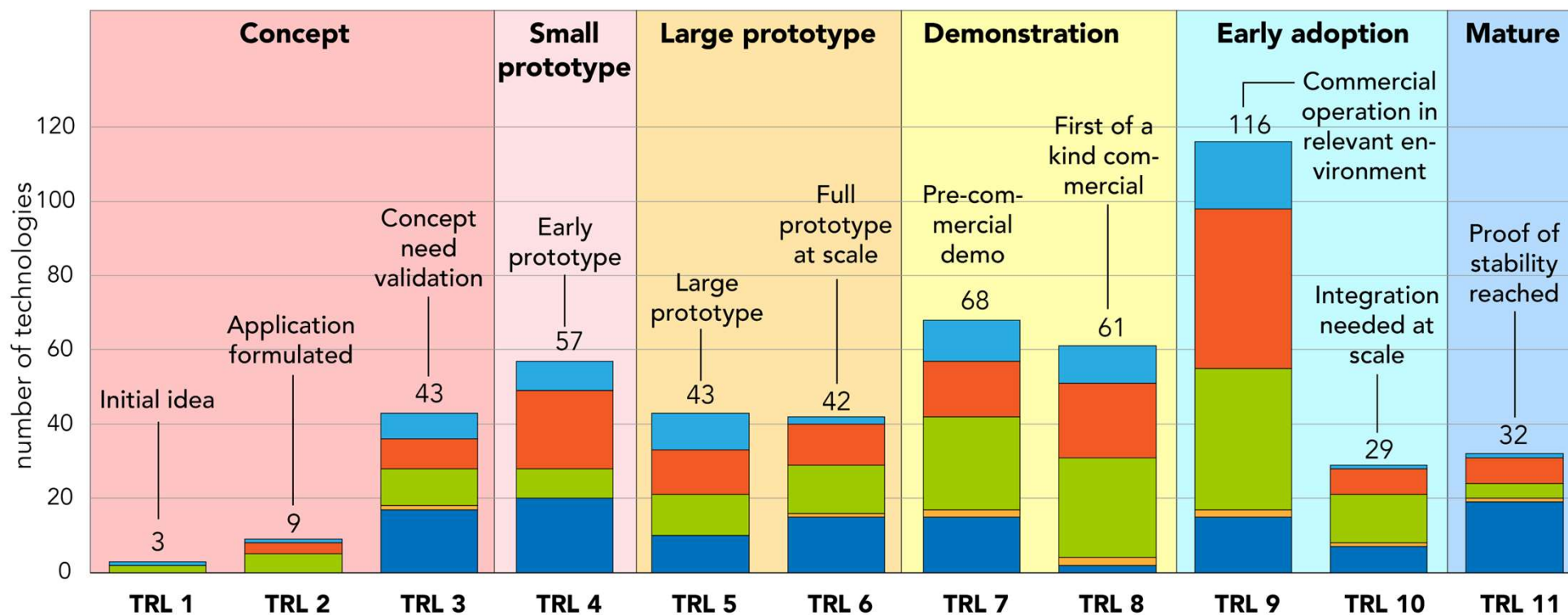


Source: EPRINC figures & calculations based on IEA WEB  
 Note: Primary energy / GDP (2019 USD PPP) is used for the calculation.

# Many Technologies Still in Early Stages of Readiness

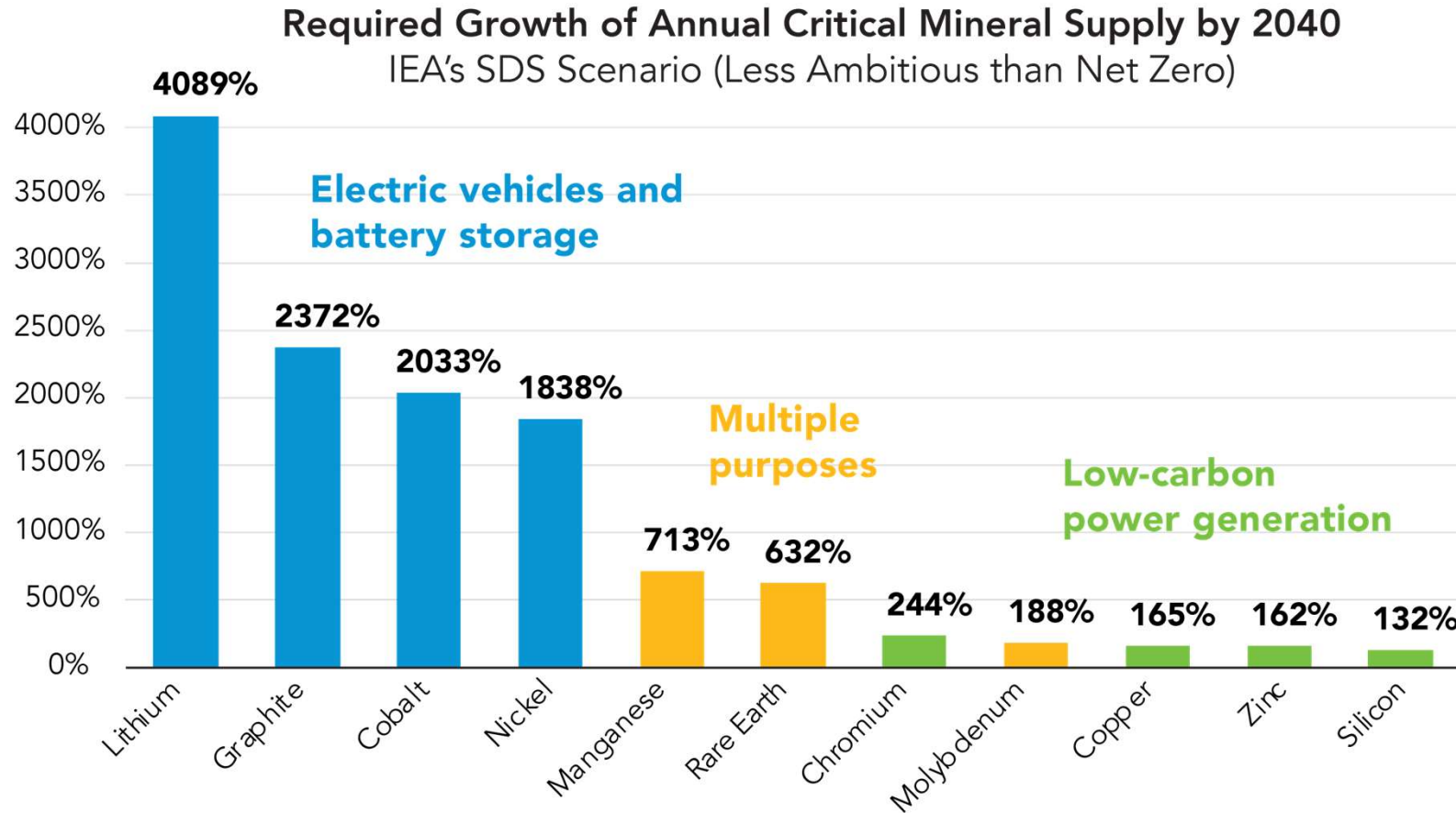
## IEA: Technology Readiness Levels of 500 Technologies Important for Net Zero Emissions

■ Buildings    
 ■ CO2 management    
 ■ Energy transformation    
 ■ Industry    
 ■ Transport



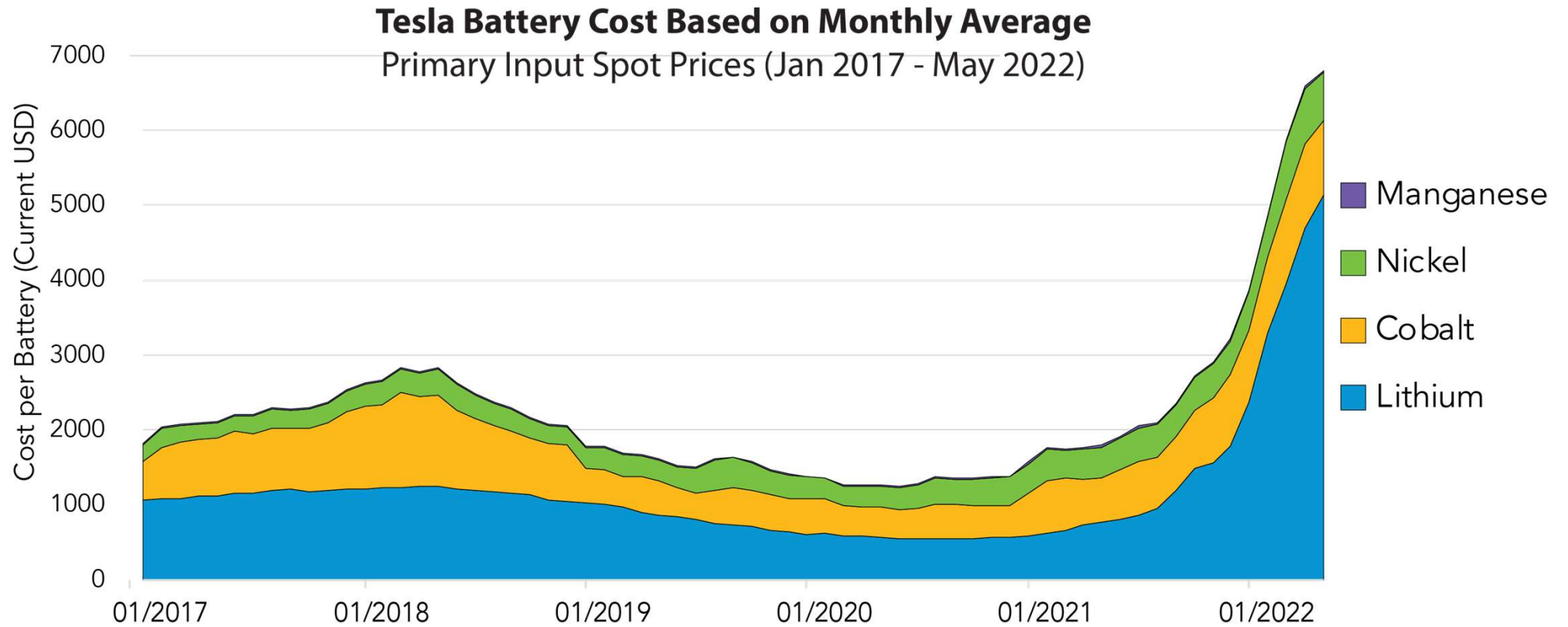
Source: EPRINC analysis based on IEA ETP

# Massive **Critical Minerals** Required in a Low-Carbon Future



Source: EPRINC analysis based on IEA Critical Mineral Report 2021

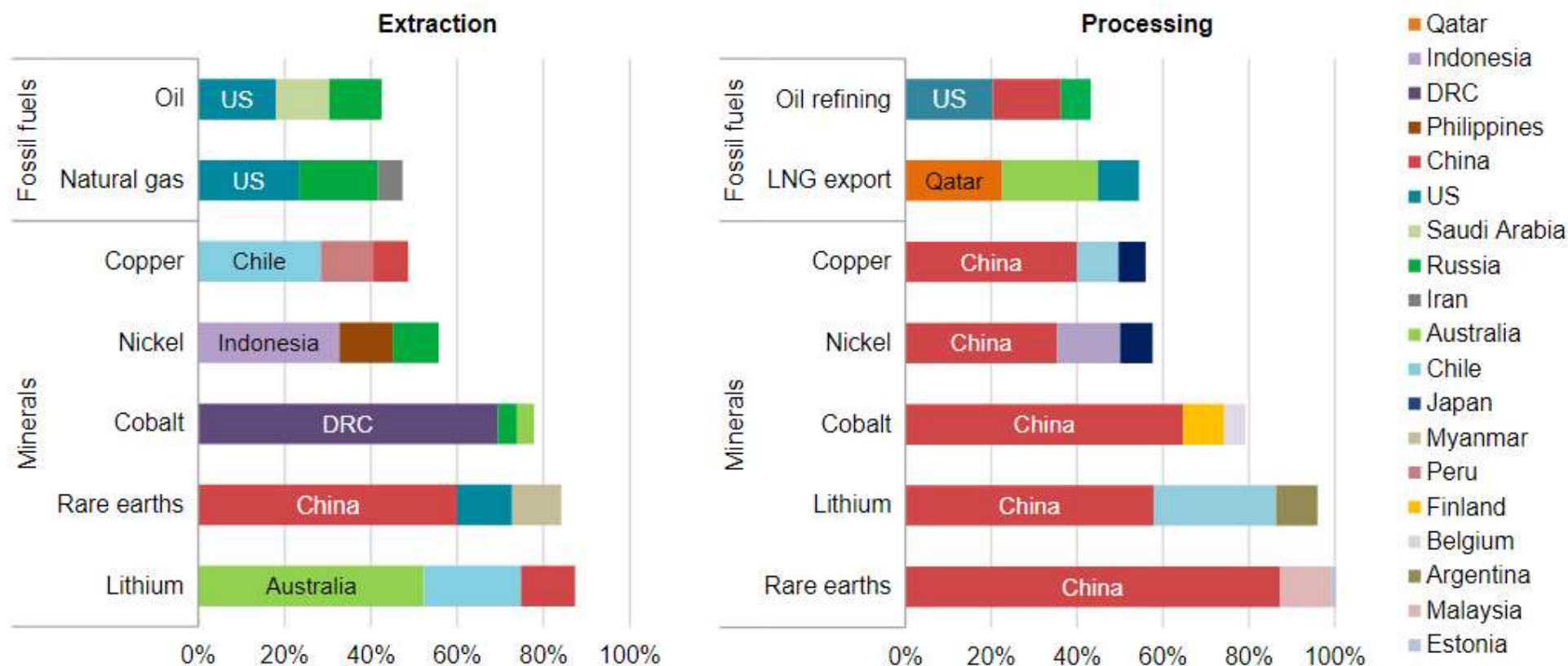
# Increased Vulnerability to Mineral and Metal Prices



Source: EPRINC analysis based on LME Monthly Data

# Dependence on China to Increase with Energy Transition

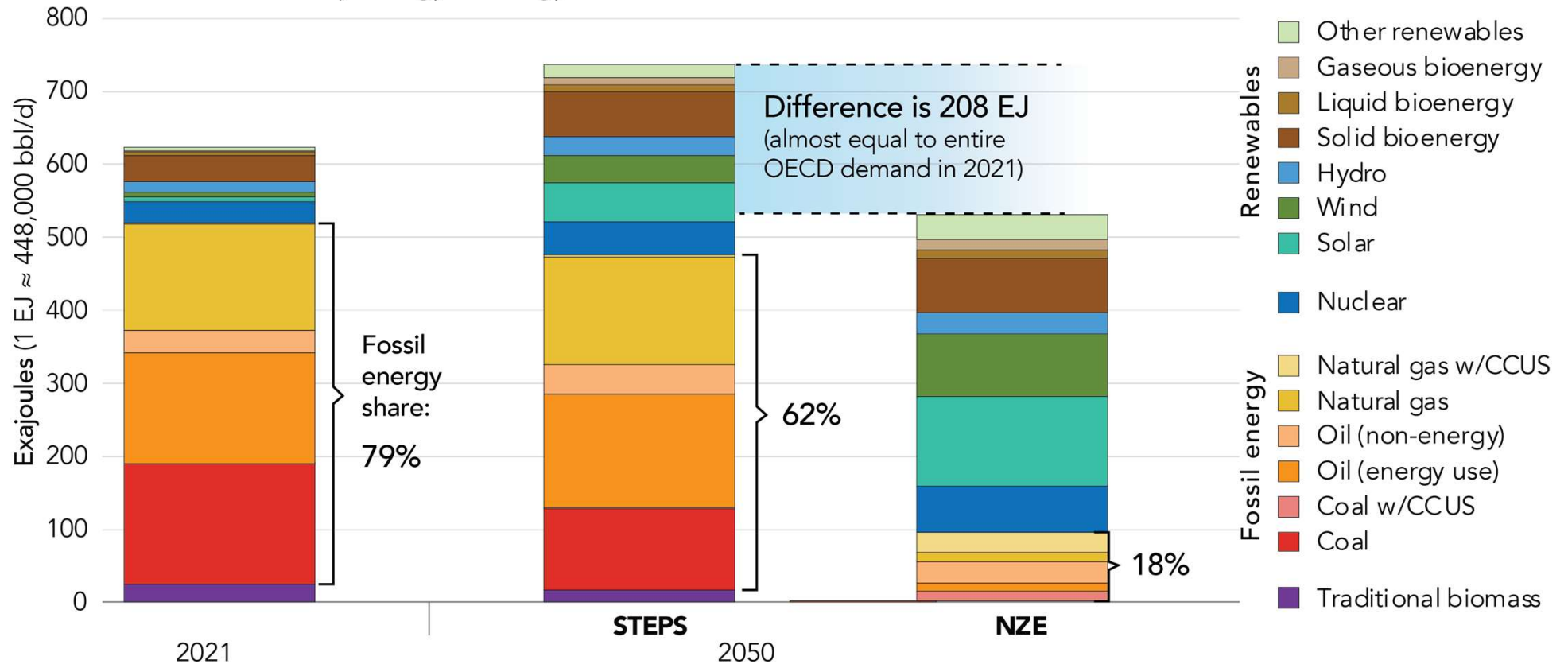
Share of top three producing/processing countries in *selected minerals and fossil fuels, 2019*



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

# Net Zero Assumptions: **Ambition** or **Delusion**?

Primary Energy & Energy Mix: IEA **Stated Policies** vs. IEA **Net Zero Scenarios**



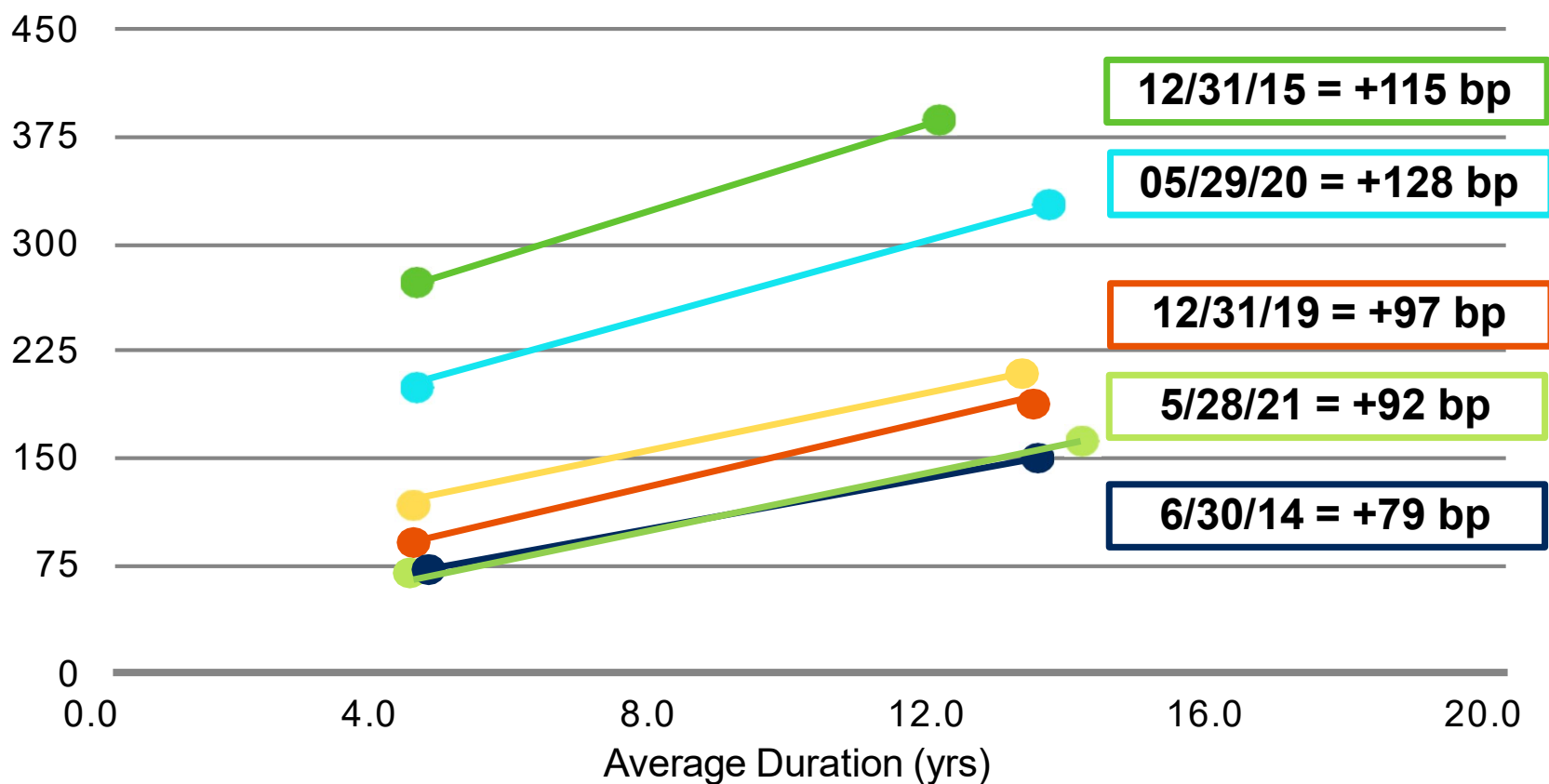
Source: EPRINC figures & calculations based on IEA World Energy Outlook 2022



# The Myth of **Stranded** Oil & Gas Assets

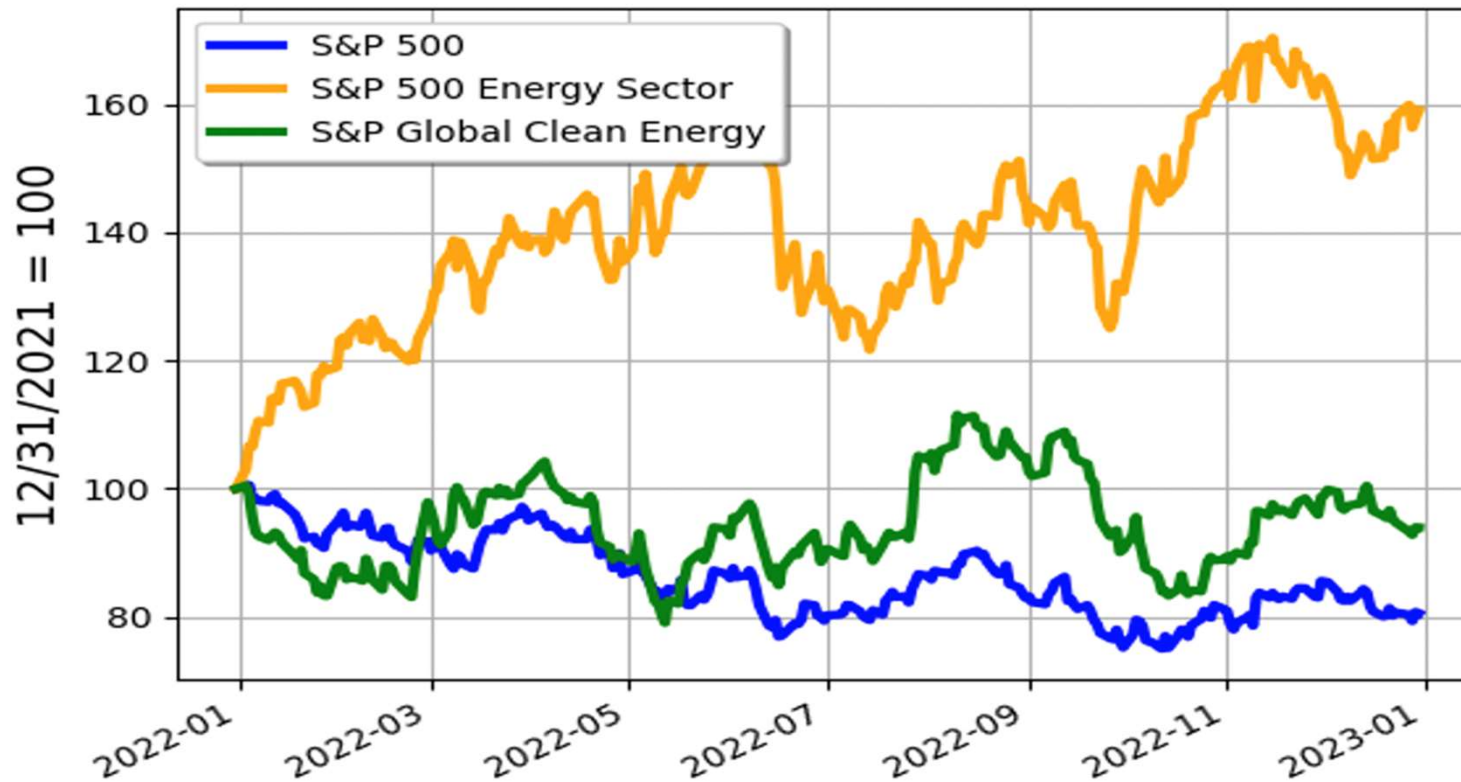


### U.S. Investment Grade Energy Bond Credit Spread Curves



Source: Bloomberg Barclays

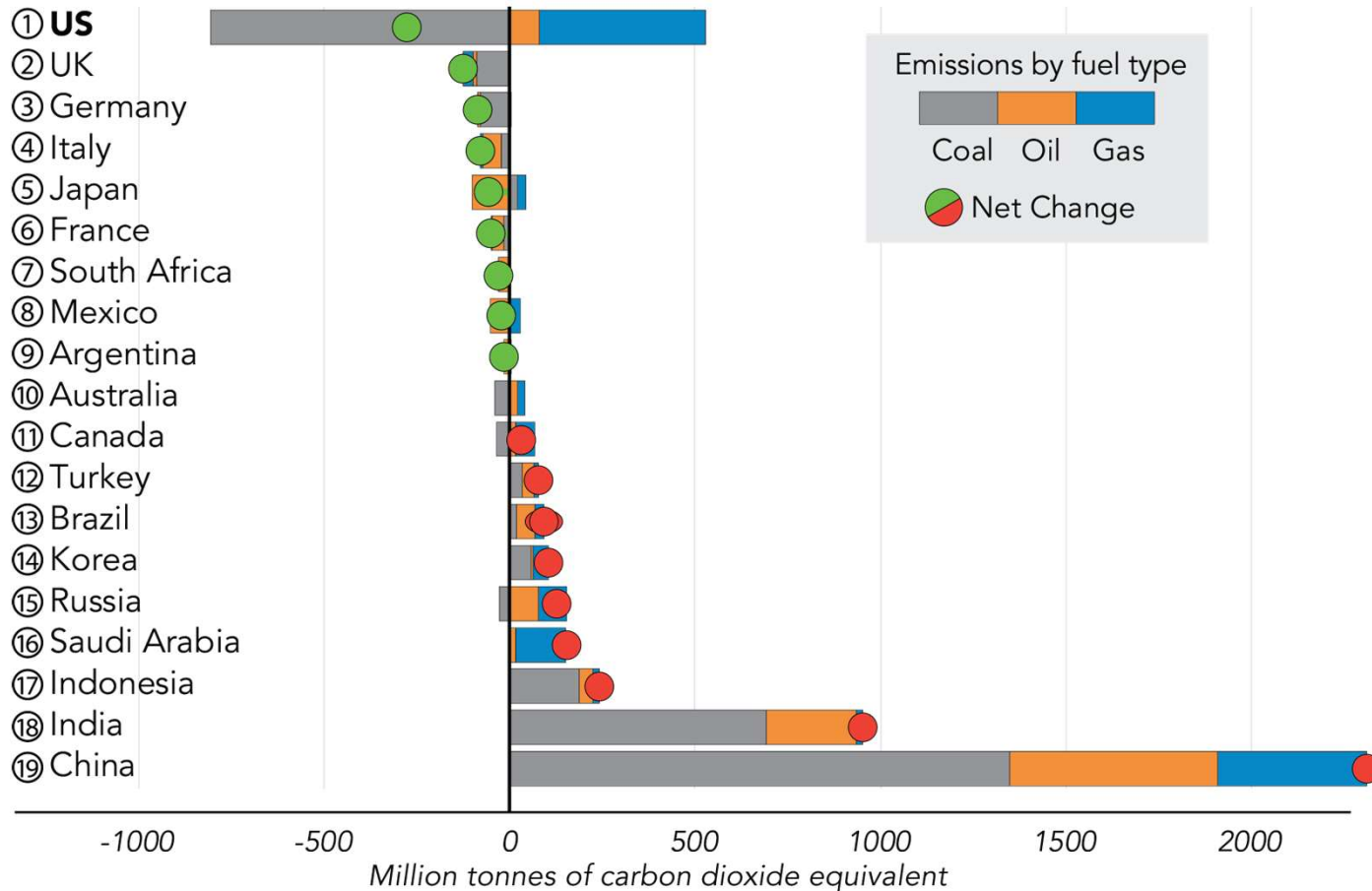
# Performance of Index Funds: S&P 500, S&P 500 Energy Sector and S&P Global Clean Energy



# Gas Remains the Most Cost-Effective Pathway for Rapid Carbon Reductions



2019 vs. 1999: Change in Annual **CO<sub>2</sub> Emissions** from Energy in G20



EPRINC analysis based on data from Global Carbon Atlas

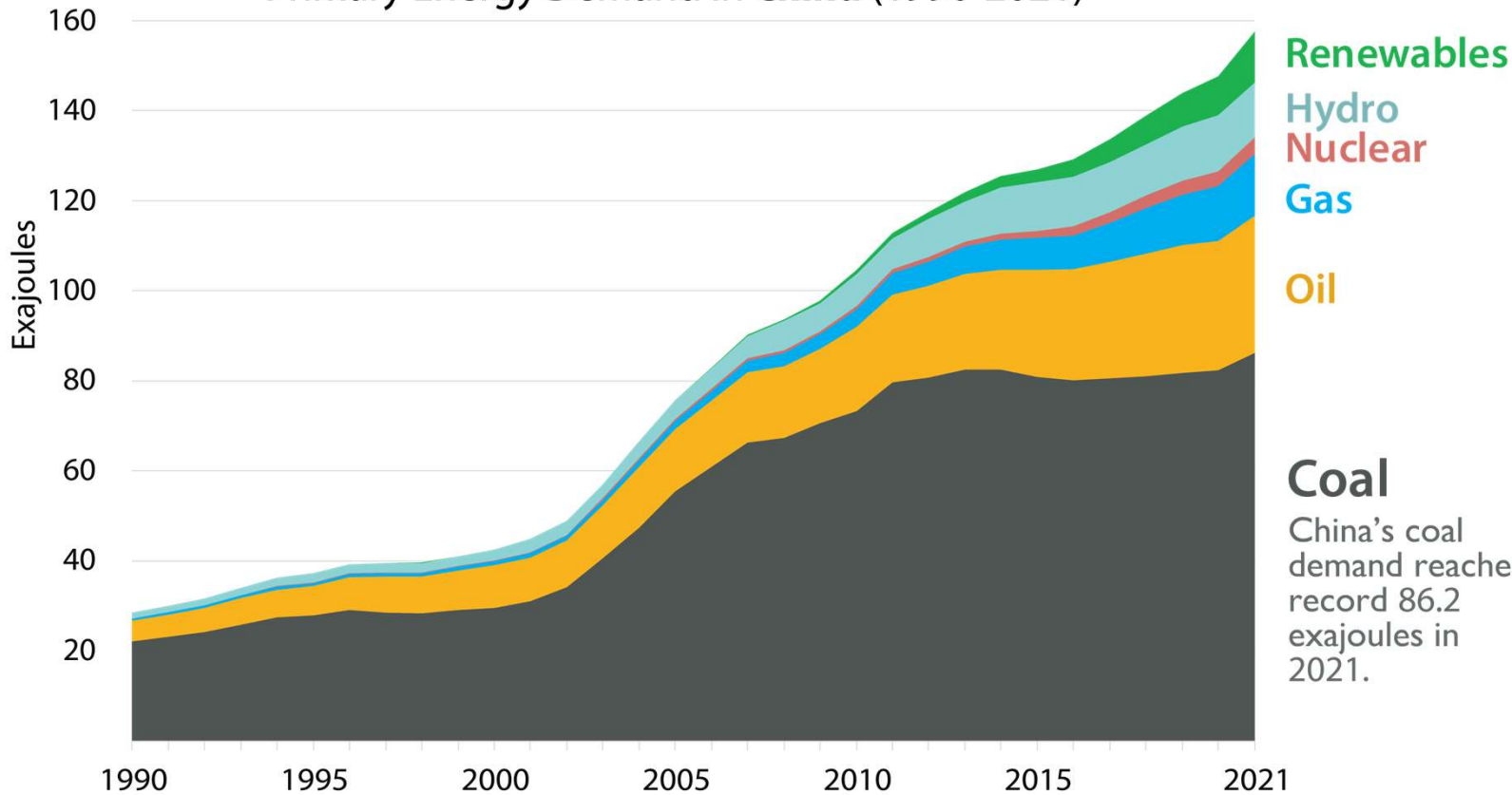
As G7 heads of government get ready for their annual meeting in May, there remains no consensus on the role of natural gas as a pathway to a lower carbon future.

But there is no low-carbon future without gas.

# China Runs on **Coal** and Keeps Consuming Record Volumes



Primary Energy Demand in **China** (1990-2021)



**Renewables**

**Hydro**

**Nuclear**

**Gas**

**Oil**

**Coal**

China's coal demand reached record 86.2 exajoules in 2021.

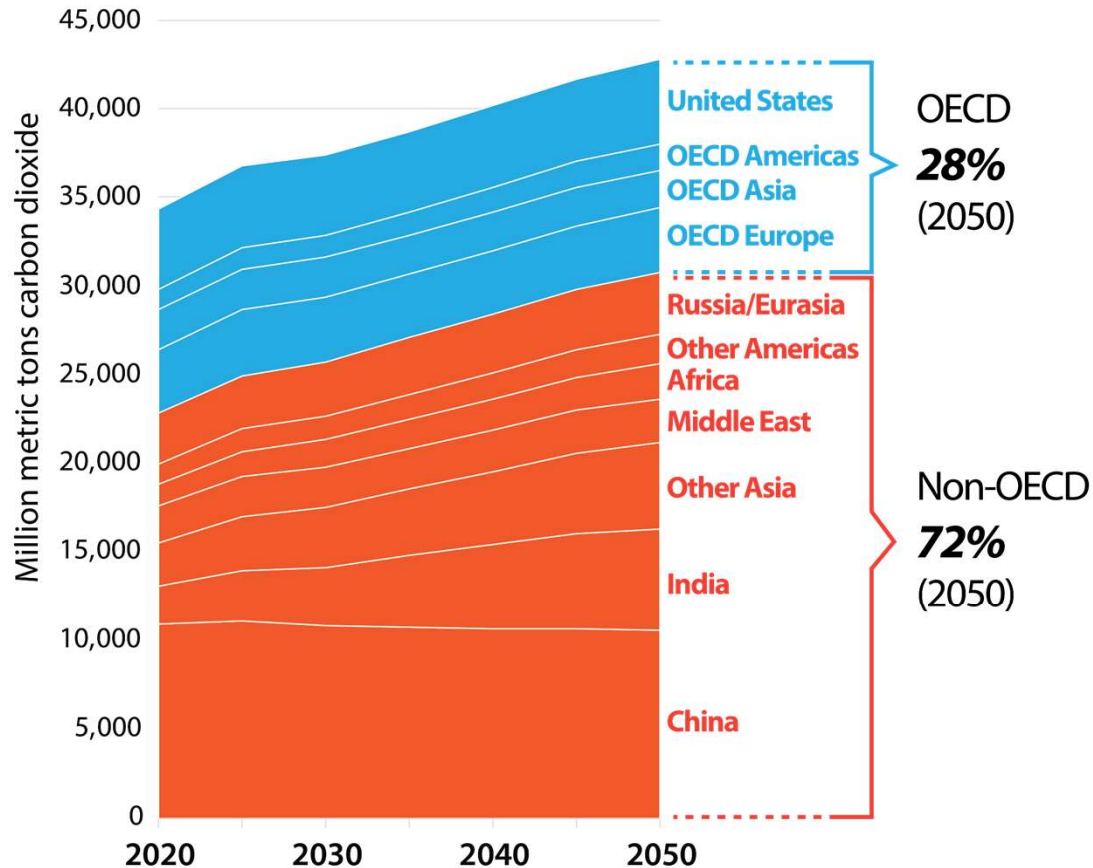
Managing natural gas demand is not easy. Many think the primary risk is the energy transition, but the real risk is coal.

Despite its carbon neutrality goals, China's coal consumption reached 86.2 exajoules (EJ) in 2021, surpassing its previous record of 82.5 EJ in 2014.

EPRINC chart based on BP Statistical Review of World Energy

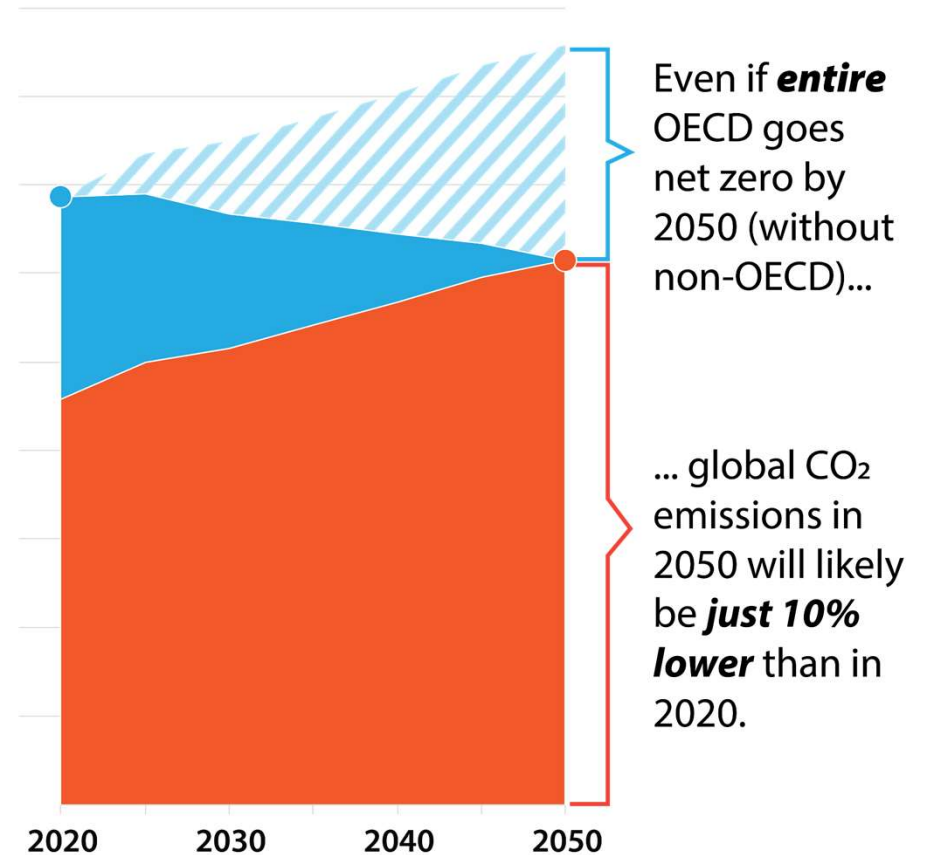
## Problem with **OECD**-Centered Worldview

EIA Reference Case: **Projected CO<sub>2</sub> Emissions**



EPRINC analysis based on EIA's International Energy Outlook 2021 (most recent)

Will **OECD Net Zero** Matter?



**Do Policy  
Makers  
Understand the  
Consequences  
of No New  
Investment in  
Oil & Gas  
Development?**



Source: EPRINC analysis

## **ADDITIONAL SLIDES**

# China's Existing Power Plants by Fuel Type

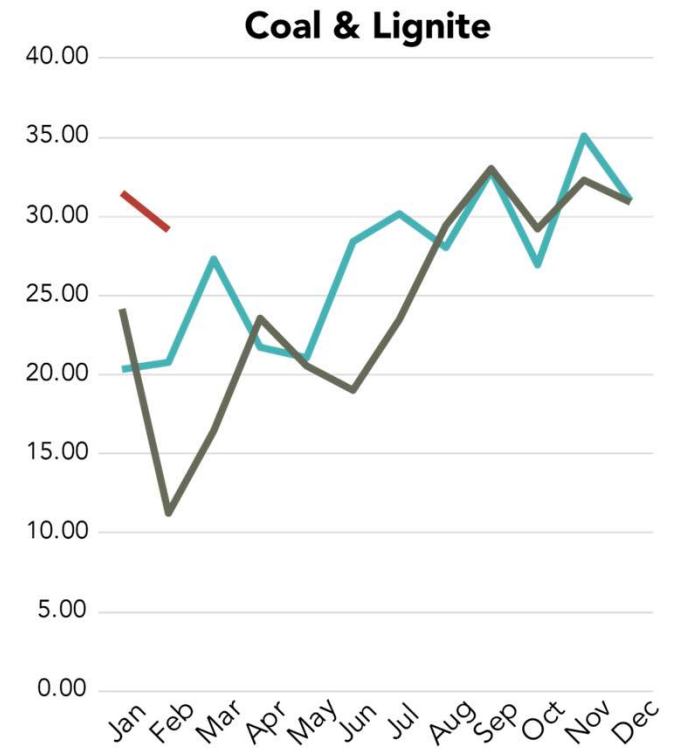
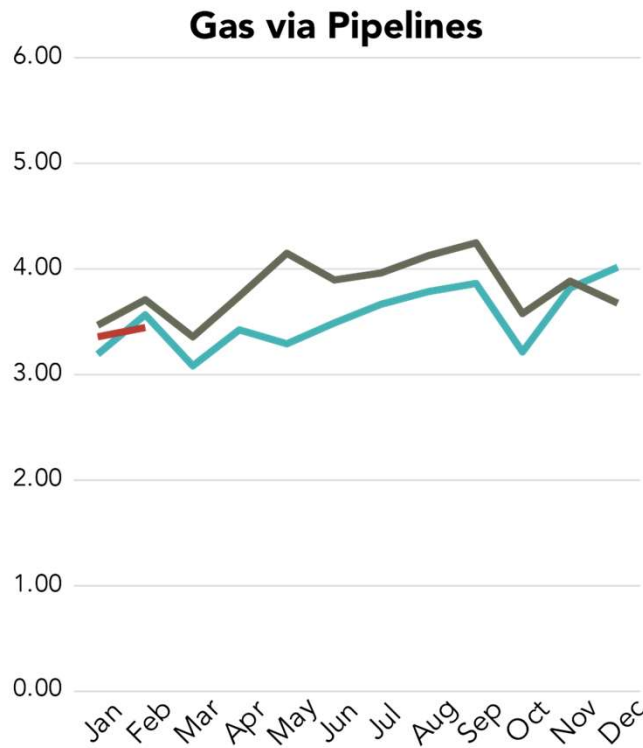
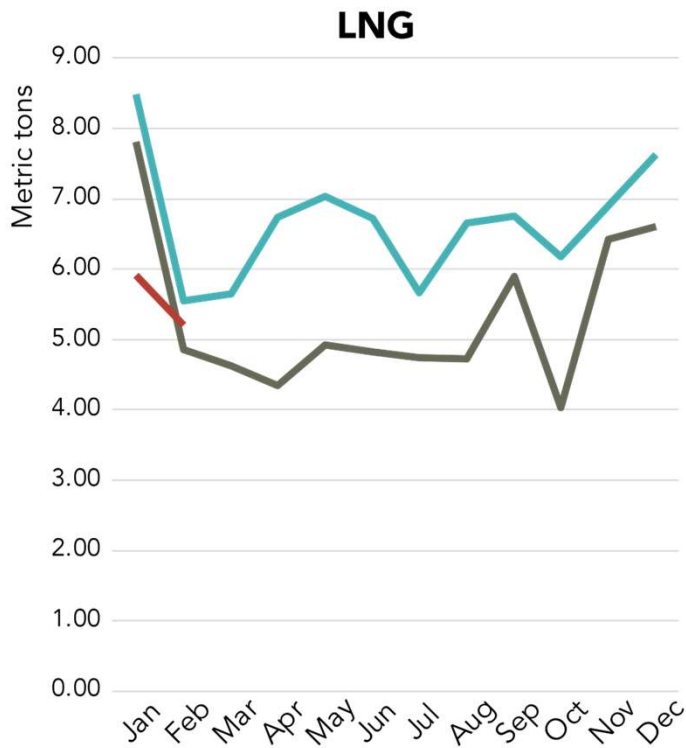




# China's Monthly Energy Imports: LNG Imports Below 2021 Levels, Short-term Outlook Remains Highly Uncertain



— 2021 — 2022 — 2023 (Jan-Feb)



Source: EPRINC, China Customs, NDRC

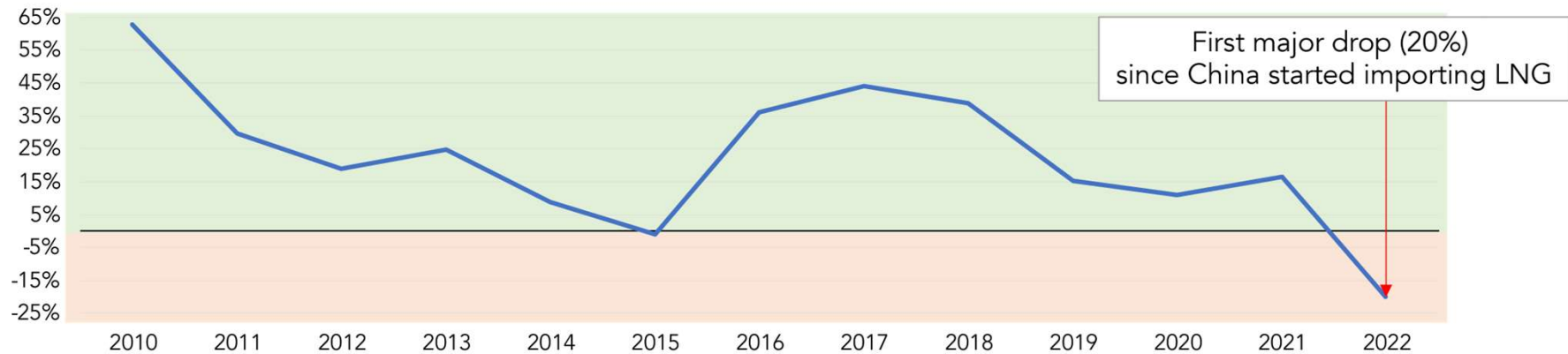
# 2022: A Historically Bad Year for China's Natural Gas Demand and LNG Imports



### Annual Natural Gas Consumption Growth Rates in China



### Annual LNG Import Growth Rates in China

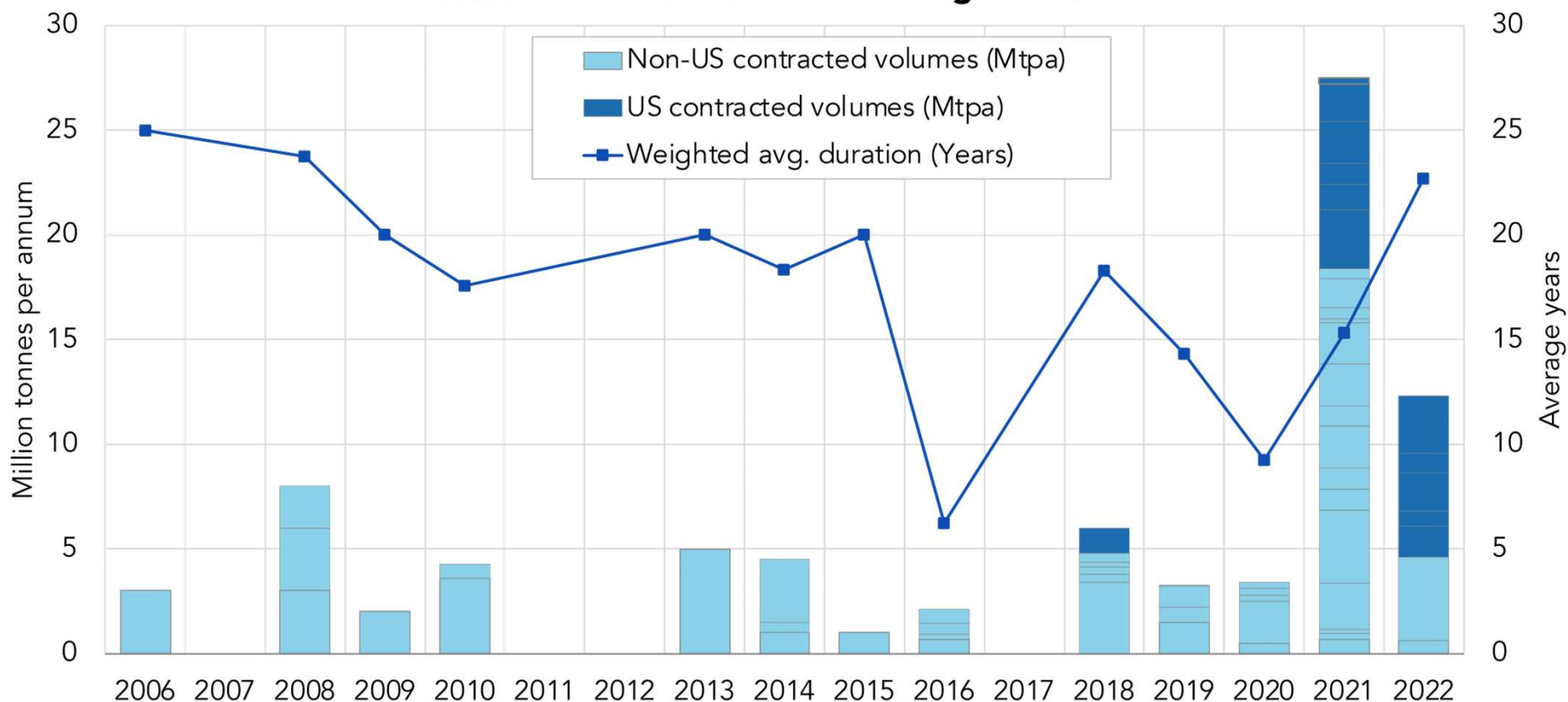


Source: EPRINC analysis based on data from BP, China Customs

# China Signed Record Number of Long-term Contracts in 2021 & 2022



## China's LNG Sale and Purchase Agreements



Each rectangle represents an SPA.

Source: 2006-2021 data from GIIGNL annual reports, 2022 data from various sources, press releases

## **Federal Onshore Oil & Gas Lease Sale Yielded \$468 Million for New Mexico in 2018**

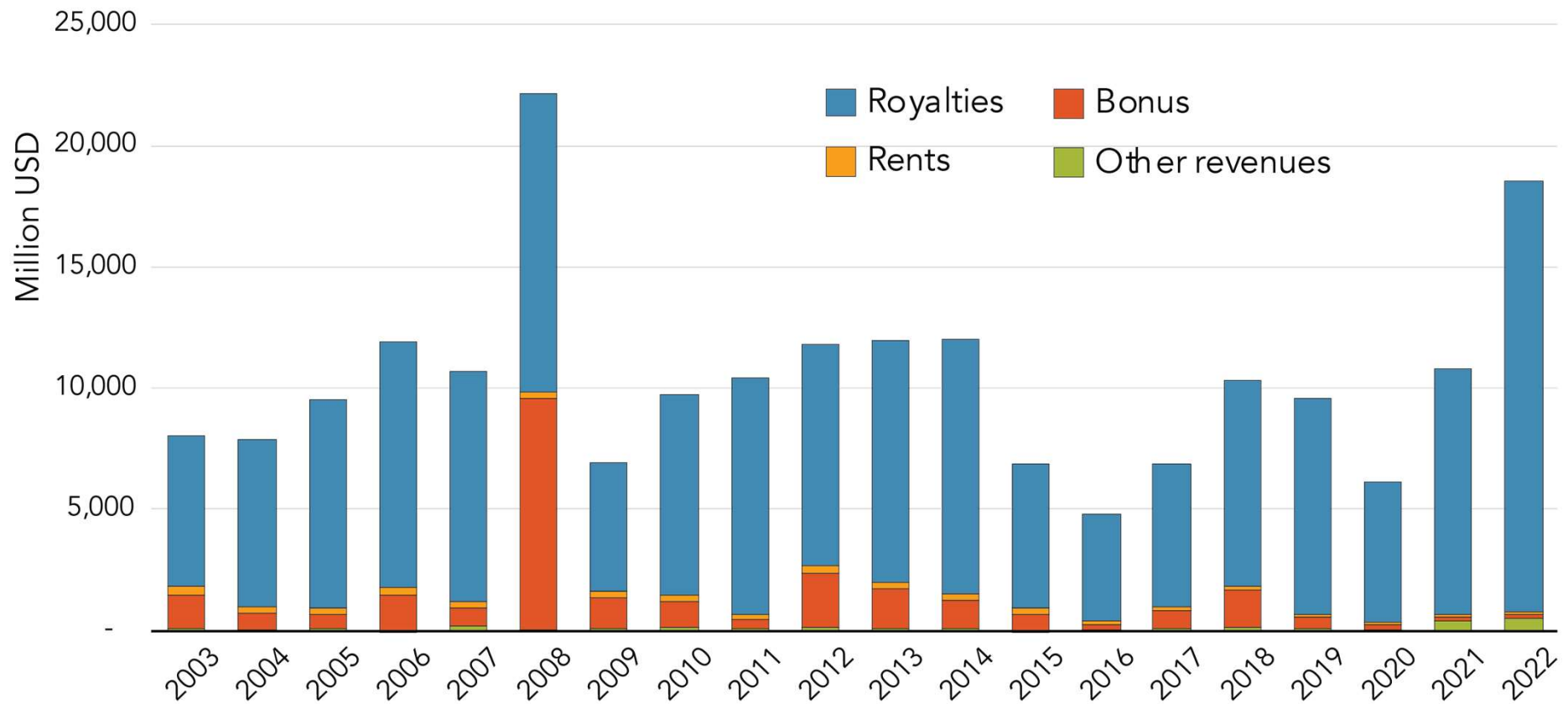


**In December 2018, Federal onshore Oil & Gas Lease Sale yielded \$972 million, of which \$486 million was distributed to New Mexico under U.S. Law**

**These funds will no longer be available should a successful ban on federal oil & gas development proceeds.**

**These funds (sometimes as high as 30% of the New Mexico state budget) fund education and health programs**

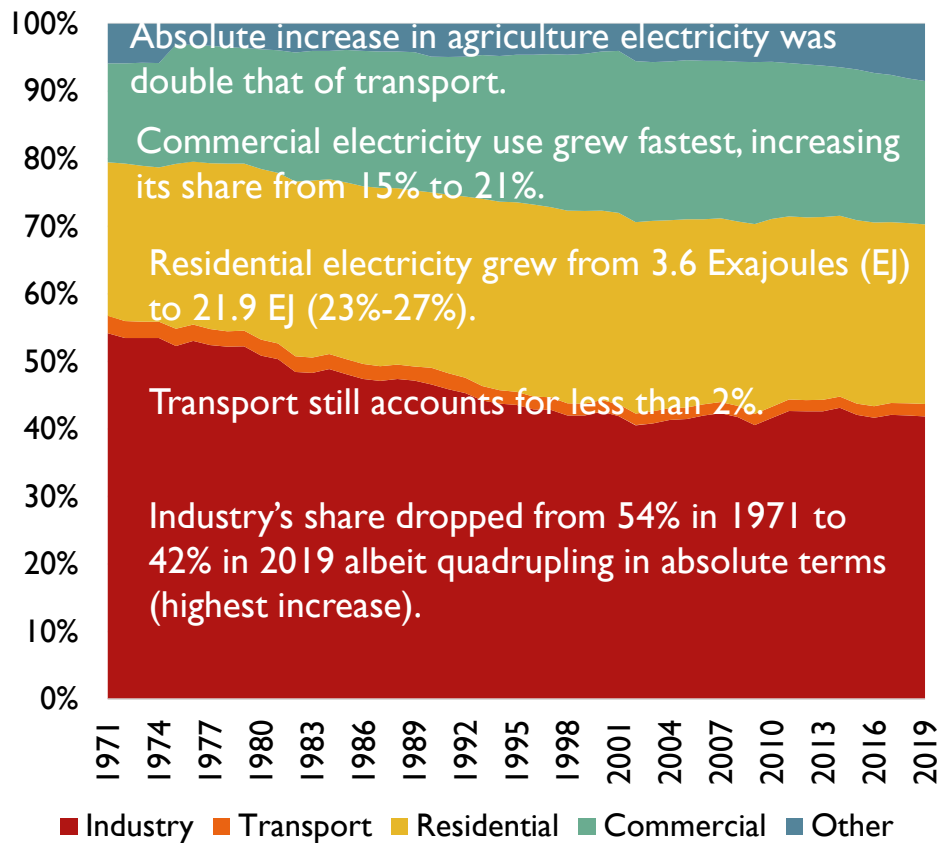
## U.S. Federal Oil and Gas *Revenues*



Source: EPRINC figures based on U.S. Department of Interior Natural Resources Revenue Data

# Worldwide Electrification Trends: Non-OECD Long Way to Go

## Global electricity consumption by end-use sector, 1971-2019



Data: IEA WEB

## Residential generation, kWh per capita

