

# Natural Gas in the U.S. in the Aftermath of Russia's Invasion of Ukraine

Presented to:  
Rocky Mountain GPA Luncheon

September 28, 2023



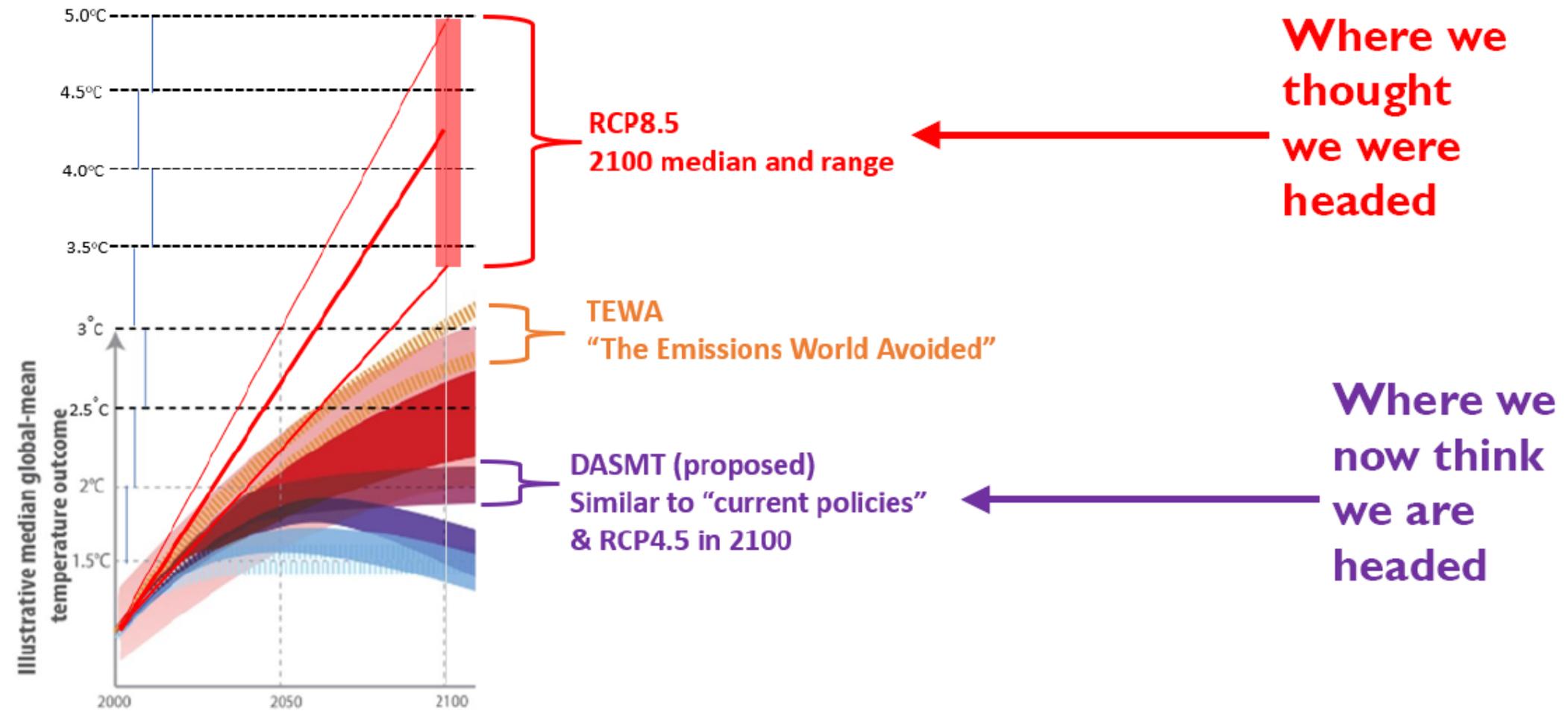
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U.N. Chief Antonio Guterres

“**Humanity has opened the gates to hell**’ by heating the planet, U.N. Secretary General Antonio Guterres told a one-day climate summit held alongside the general assembly, where he lamented the **‘naked greed’ of fossil fuel interests.**”

## Buckle up ...



## Judith Curry interview on Robert Bryce's Power Hungry podcast

**Deniers** – That's religion and not science

- The belief that all recent climate change is **exclusively man-made**.
- The belief that it's **catastrophic**.
- The belief that it's so serious that science and preferred policy solution **can't be questioned**.

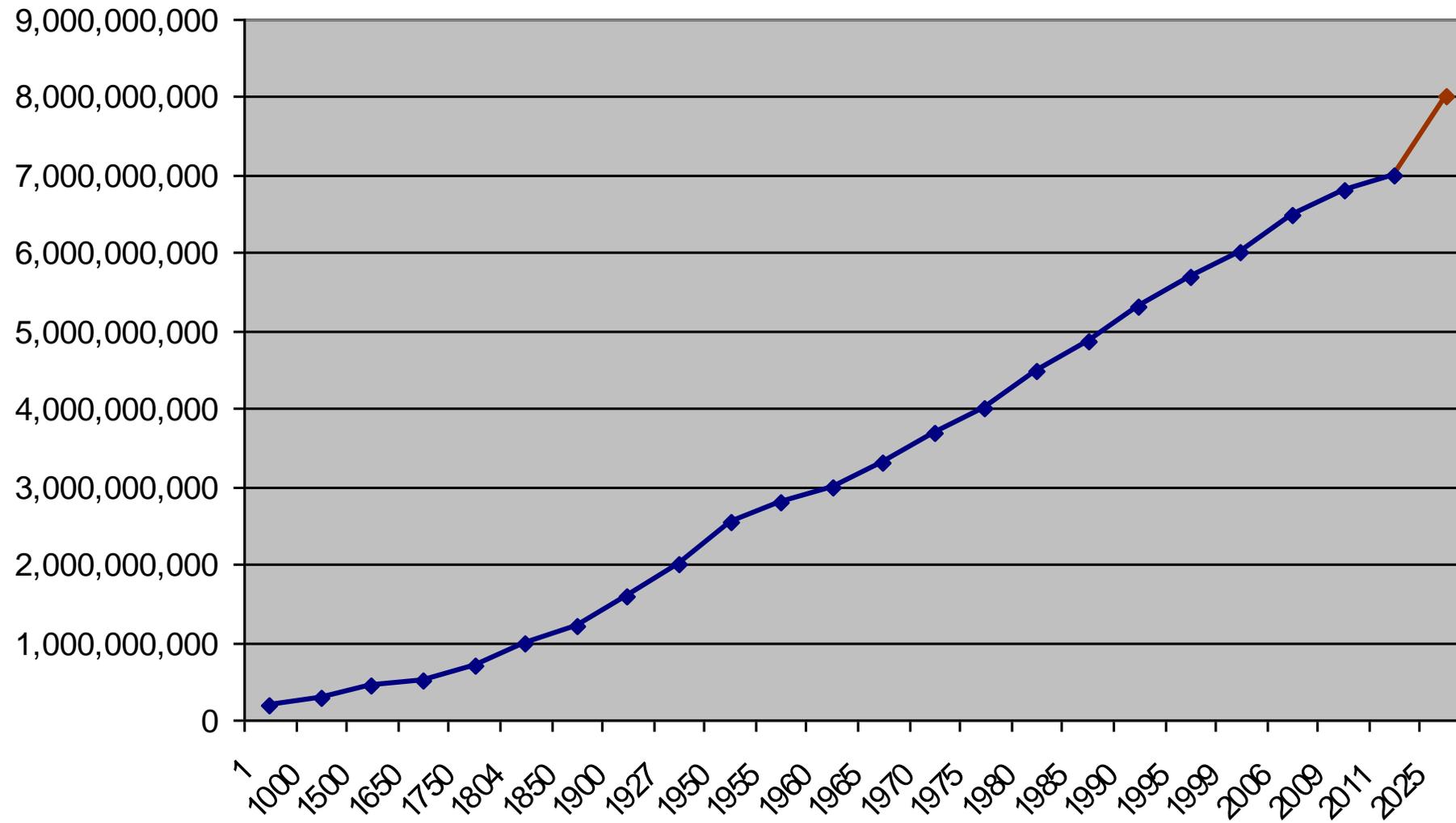
This is dogma, not science.

That's where Denier comes from.

“People may not remember exactly what you did,  
or what you said,  
but,  
they will always remember how you made them  
feel.”

“Fear” and “compulsion to act to avoid a  
catastrophe” is used to motivate

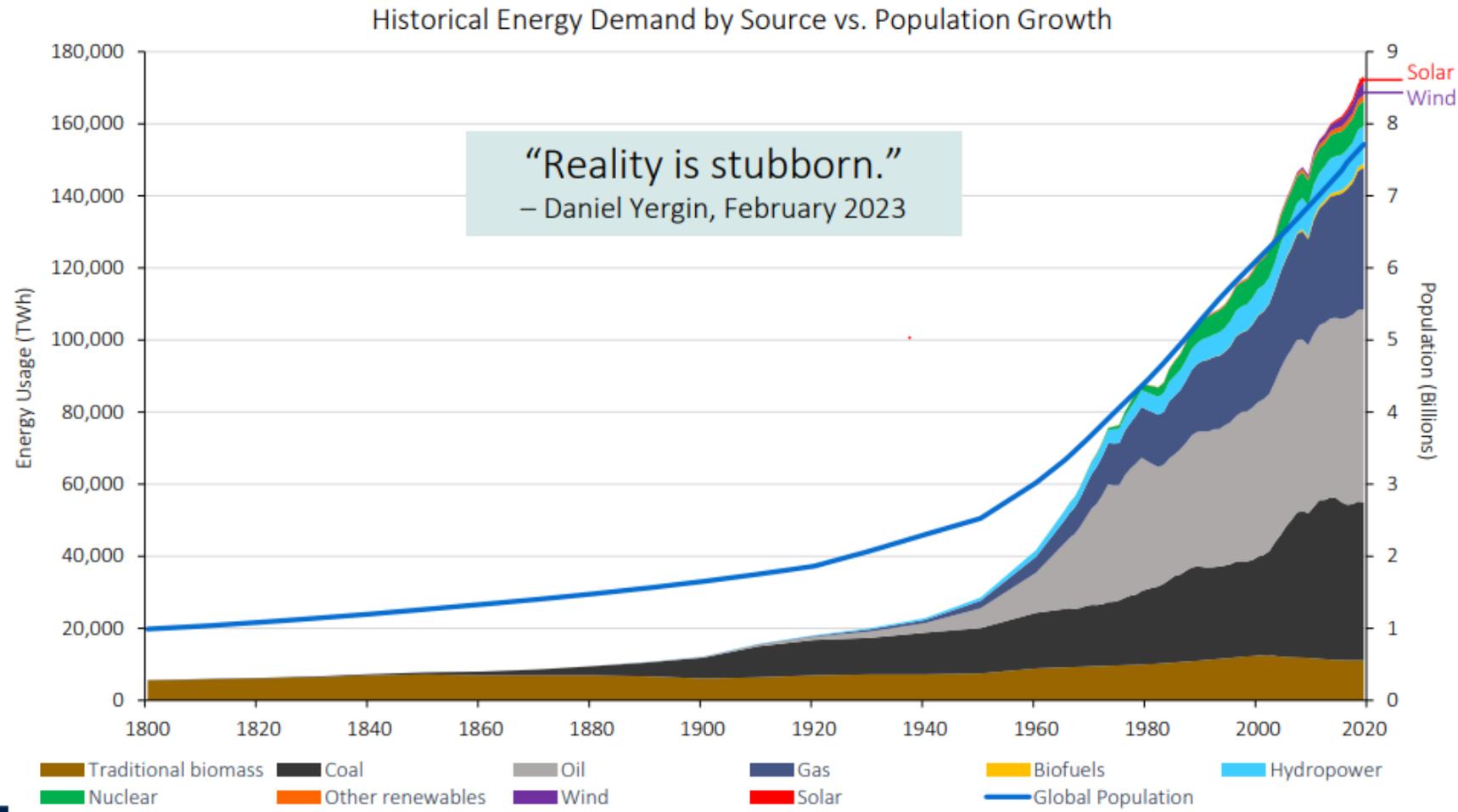
# World Population Growth



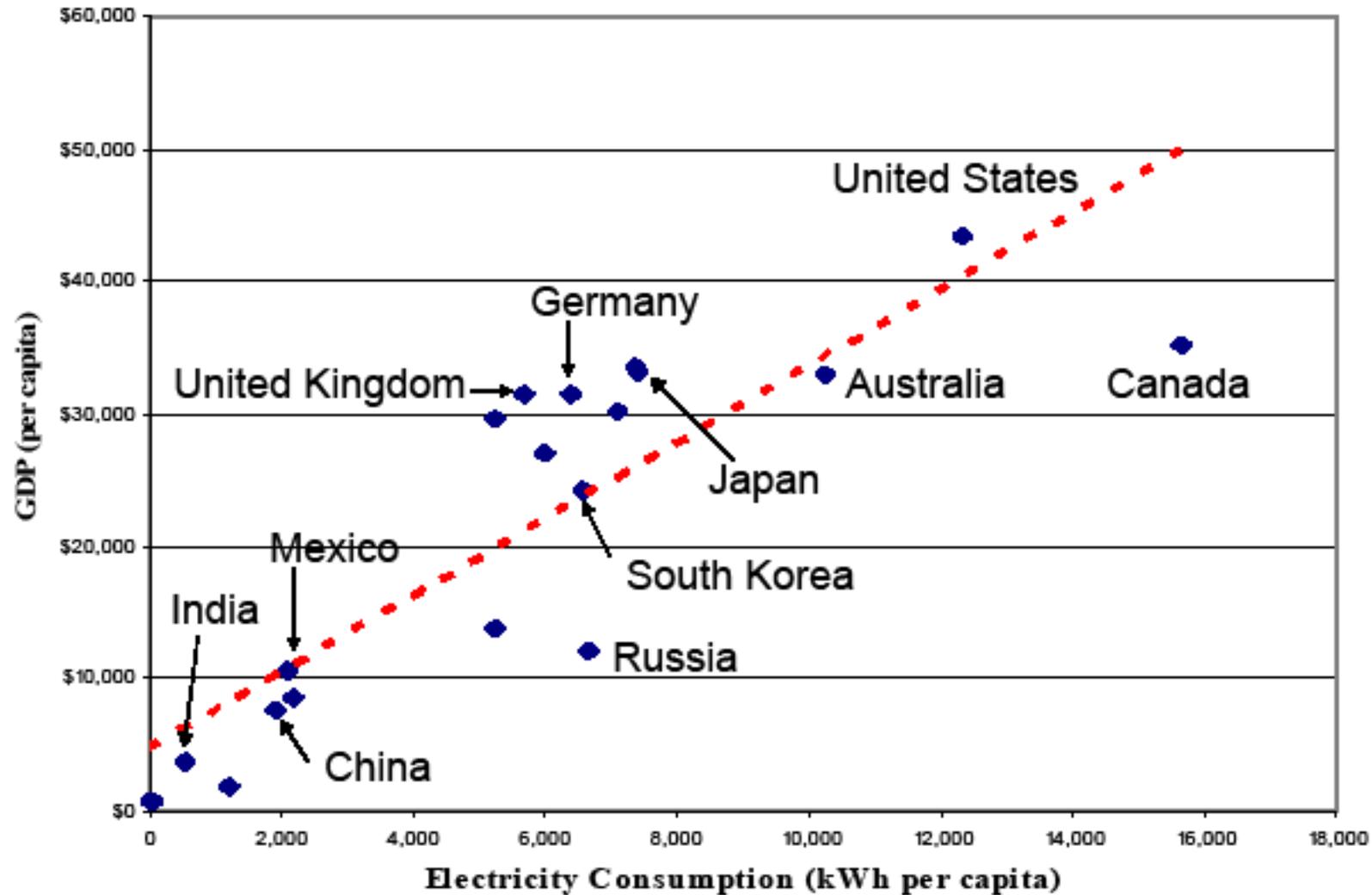
Source: About.com; <http://geography.about.com/od/obtainpopulationdata/a/worldpopulation.htm>

# Global Population Growth Drives Energy “Addition”

Over the past century, global energy usage increased rapidly in connection with industrialization and rising global population. Further, from 1965 to 2021, per capita energy consumption grew 61%.



# Quality of Life is Strongly Correlated with Electricity Consumption

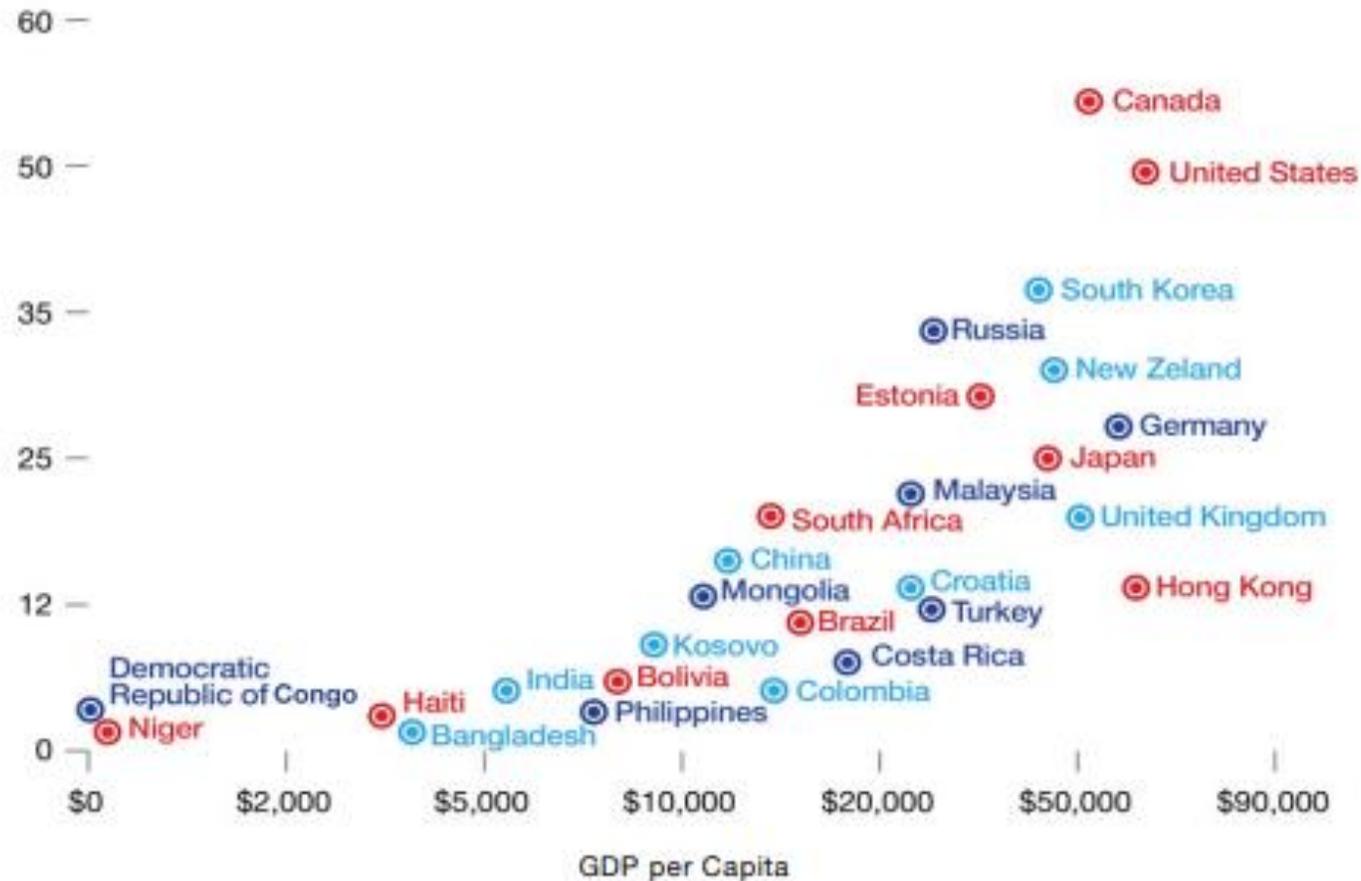


Source: CIA World Factbook, 2007

# Economic Growth Creates Demand for More Energy

## Per Capita Wealth vs. per Capita Energy Use

Energy per Capita (BOE/year)\*



Note: Total energy measured as barrels-of-oil-equivalent (BOE). Thus, the average person in Japan, where GDP/capita is about \$50,000 uses about 25 BOE per year vs. about 5 BOE in India, where GDP per capita is around \$5,000

3 Billion people in the world currently use less electricity than a typical American refrigerator



# The essentiality of electricity to modernity

Over 1.2 billion people – 20% of the world's population – are still without access to electricity worldwide, almost all of whom live in developing countries. This includes about 550 million in Africa, and over 400 million in India.

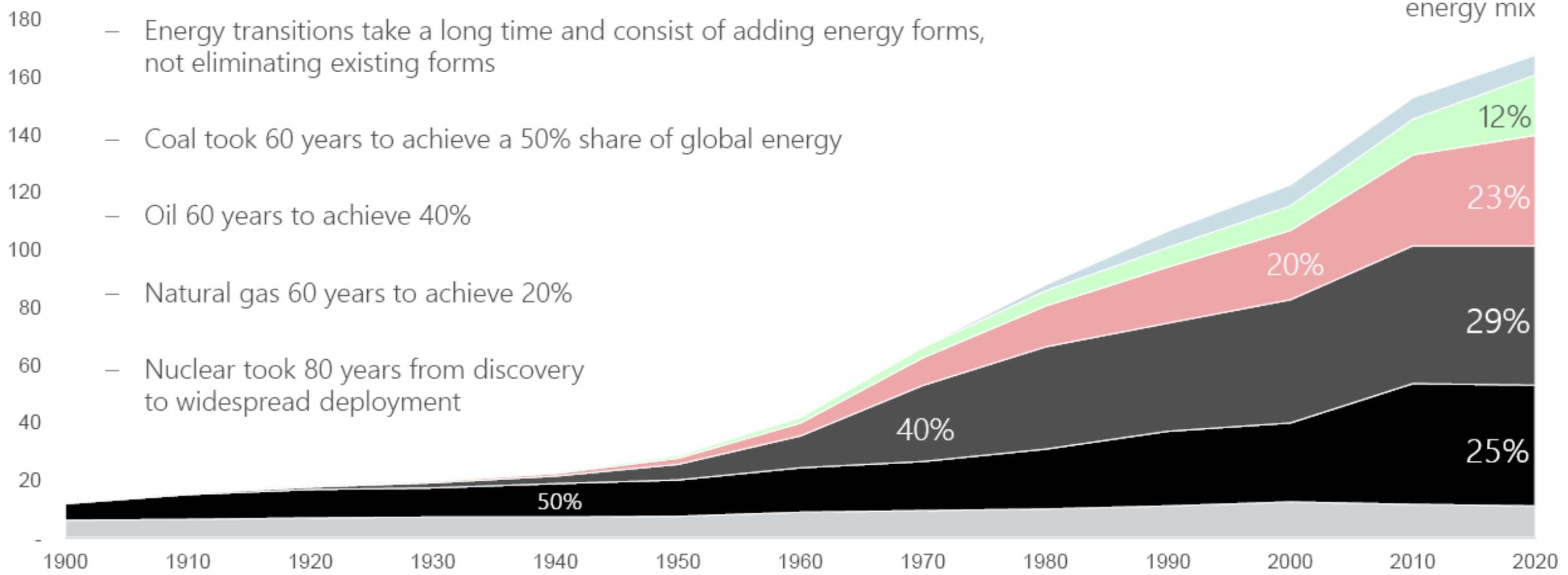


# Energy Transitions Take Time

Our assets and services will be needed for a very long time

GLOBAL ENERGY MIX BY FUEL PWh

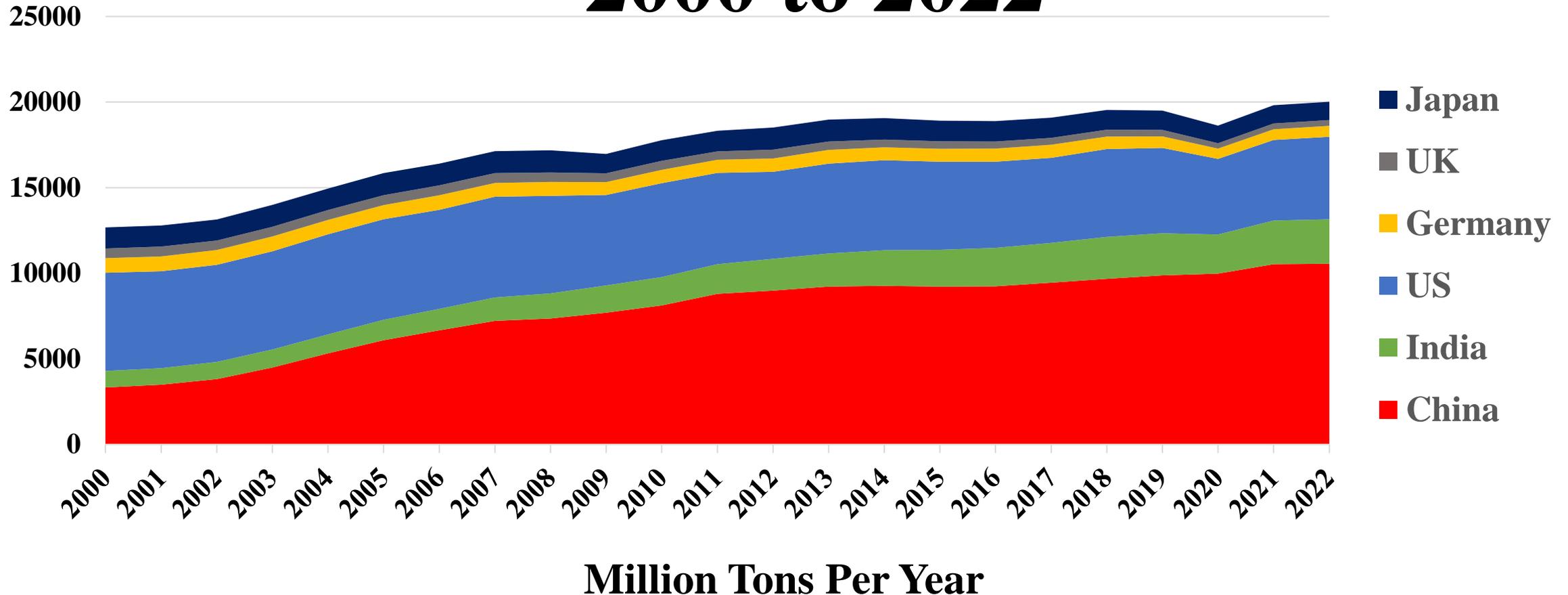
■ Biomass ■ Coal ■ Oil ■ Natural gas ■ Renewables ■ Nuclear



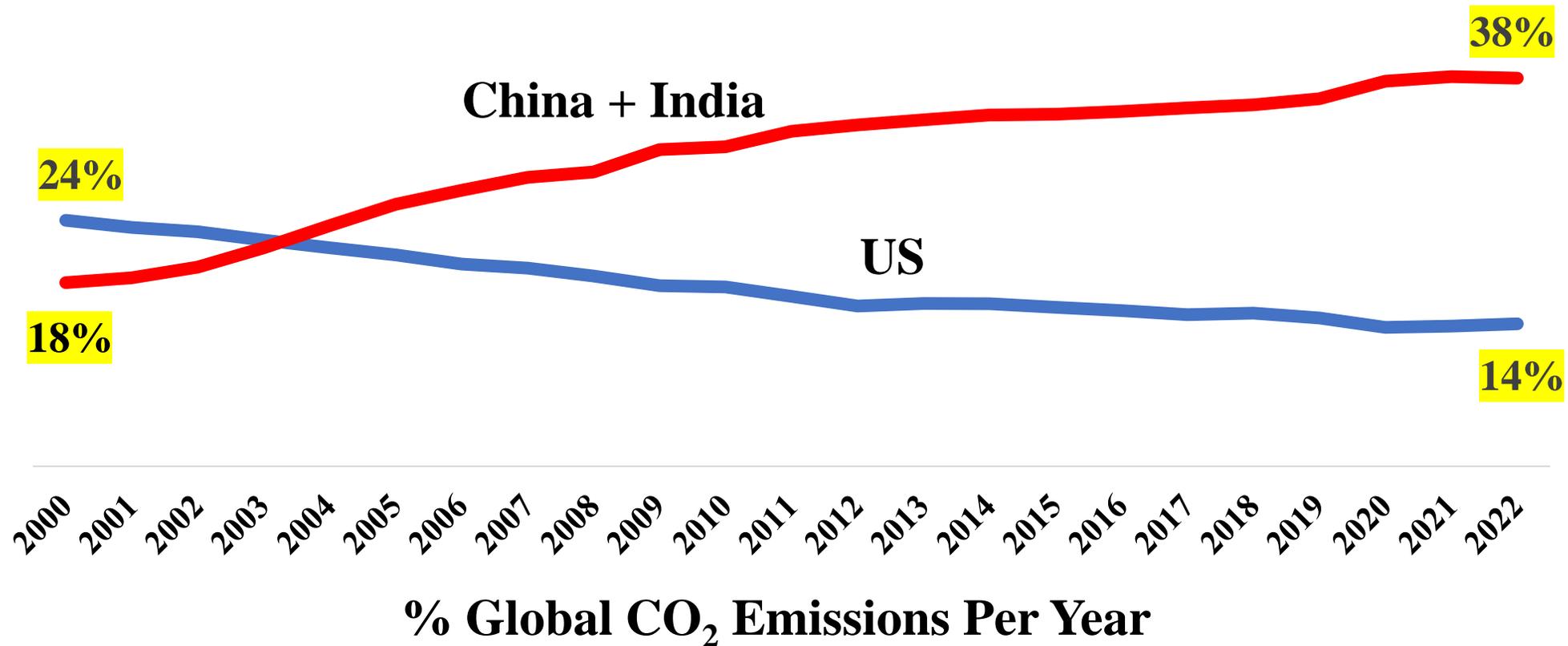
Source: Pre-1965 from *Energy Transitions: Global and National Perspectives*; 1965 and beyond from BP's Statistical Review of World Energy.

# What Energy Transition?

## CO<sub>2</sub> Emissions In Six Largest Economies, 2000 to 2022



# Share Of Global CO<sub>2</sub> Emissions, US Versus China + India, 2000 to 2022



# In 2021, US Hydrocarbon Use Grew 5.7x Faster Than Wind + Solar Combined

Wind + Solar



Net W+S:  
+ 0.7 EJ

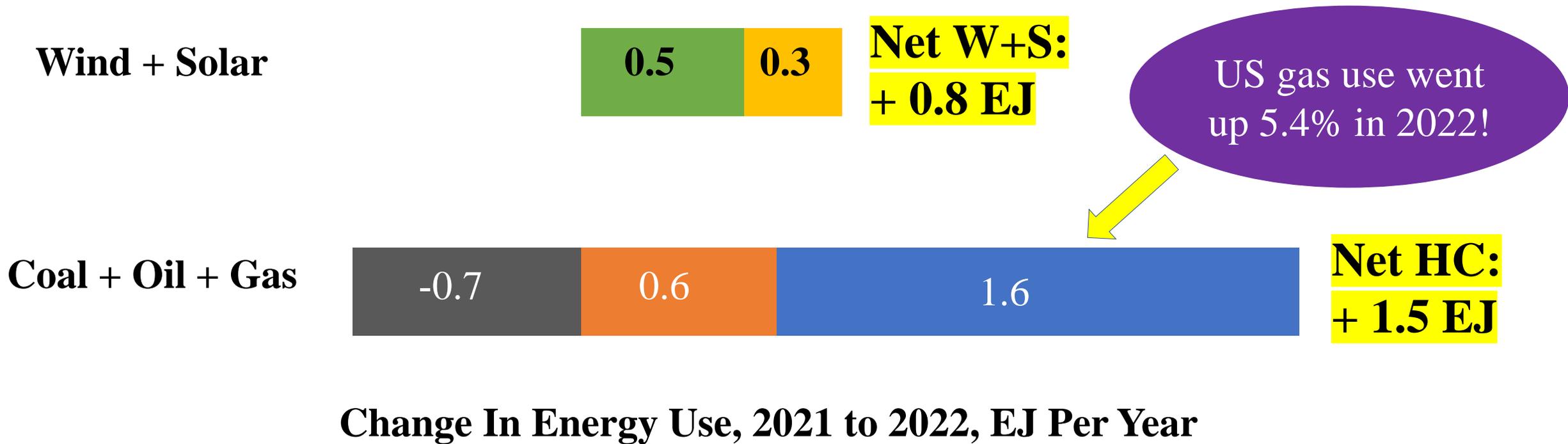
Gas + Oil + Coal



Net HC:  
+ 4.0 EJ

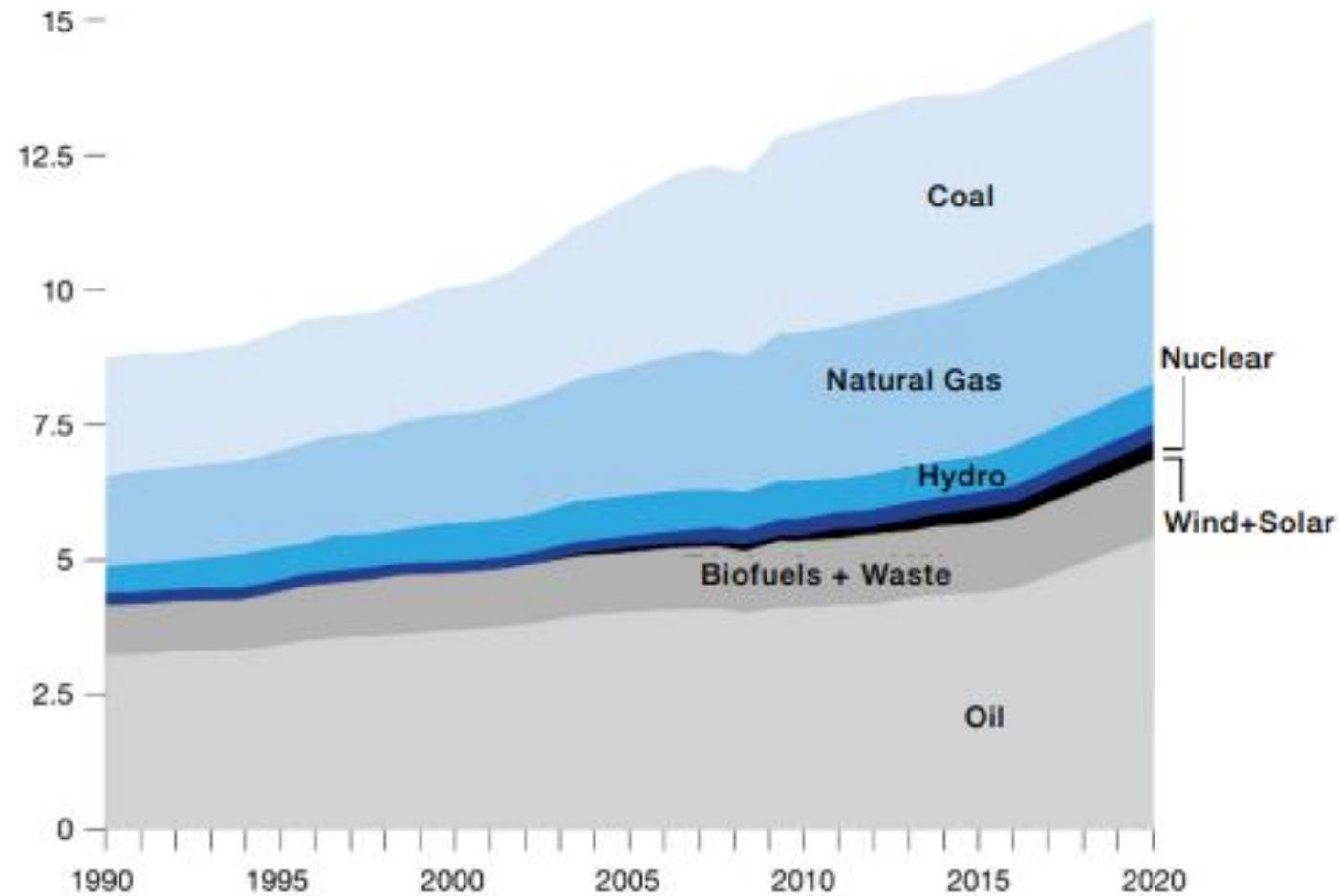
Change, EJ per year

# In 2022, US Natural Gas Use Grew 2x Faster Than W + S Combined



# Growth in Global Energy Supplies

(Oil Equivalent Billion Tons/Year)



Note: 1 billion tons oil/year = 20 million barrels/day.

Source: BP, Statistical Review of World Energy 2022.

Are there lessons to be learned by what happened in Germany/Europe?

## Energy Security?

- By the year 2020, Gazprom will supply nearly 70% of the European Union's natural gas.
- Would you pursue a conflict with a country that you depend on for the majority of your energy needs?

**Closing Bell**

# LNG Diplomacy: Keystone XL Pipeline, Part 2?

October 2012

**Closing Bell**

## The Glacial Pace Of LNG Exports

By John Harpole

September 2014

**Closing Bell**

# The Putin Vortex

April 2014

**Closing Bell**

## Time To 'Out' Russia?

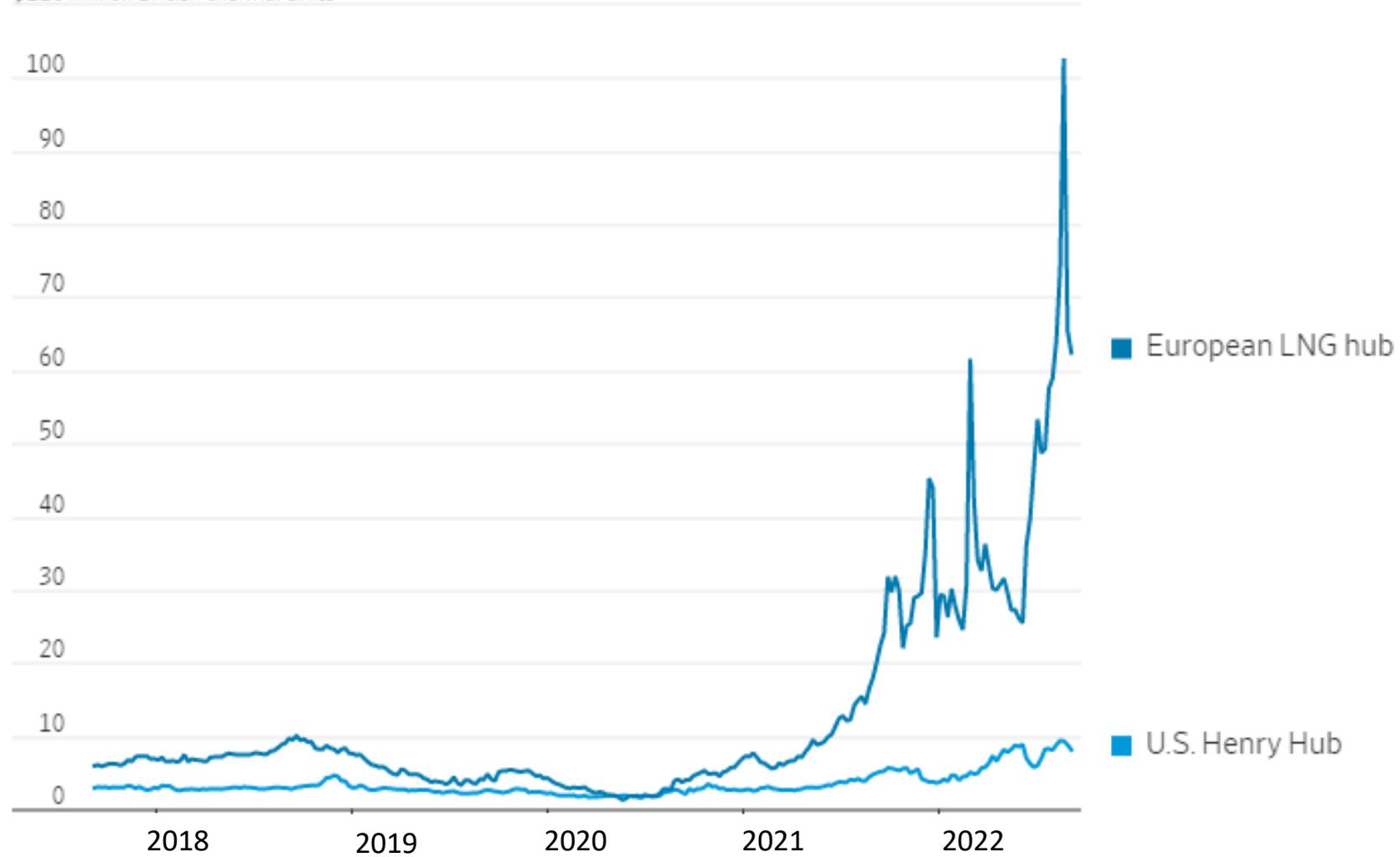
By John Harpole

January 2015

- Over reliance on renewables
- Retired coal plants too early
- Retired nuclear plants too early
- Under reliance on fossil fuels

## Natural gas price

\$110 million British thermal units



Source: FactSet

## One-Year Forward Strip

NYMEX Henry Hub	\$ 7.725
LNG Delivered Price to Europe	\$97.993

## One-Year Forward Strip

NYMEX Henry Hub	\$ 3.22
LNG Delivered Price to Asia	\$15.27
LNG Delivered Price to Europe	\$14.50

## Three-Year Forward Strip

NYMEX Henry Hub	\$ 4.02
LNG Delivered Price to Asia	\$14.52
LNG Delivered Price to Europe	\$14.00

\* Settled price as of September 27, 2023, prices in \$/MMBtu

# The Former Chancellor Who Became Putin's Man in Germany



Gerhard Schröder, Chancellor of Germany from 1998 to 2005

# Merkel's Major Mistake – Trusting Putin



Angela Merkel, Chancellor of Germany from 2005 to 2021

“Germany’s reliance on Russian gas surged to **55 percent** before Russia’s attack on Ukraine began in February, from 39 percent in 2011, amounting to 200 million euros, or about **\$220 million, in energy payments every day to Russia.**”

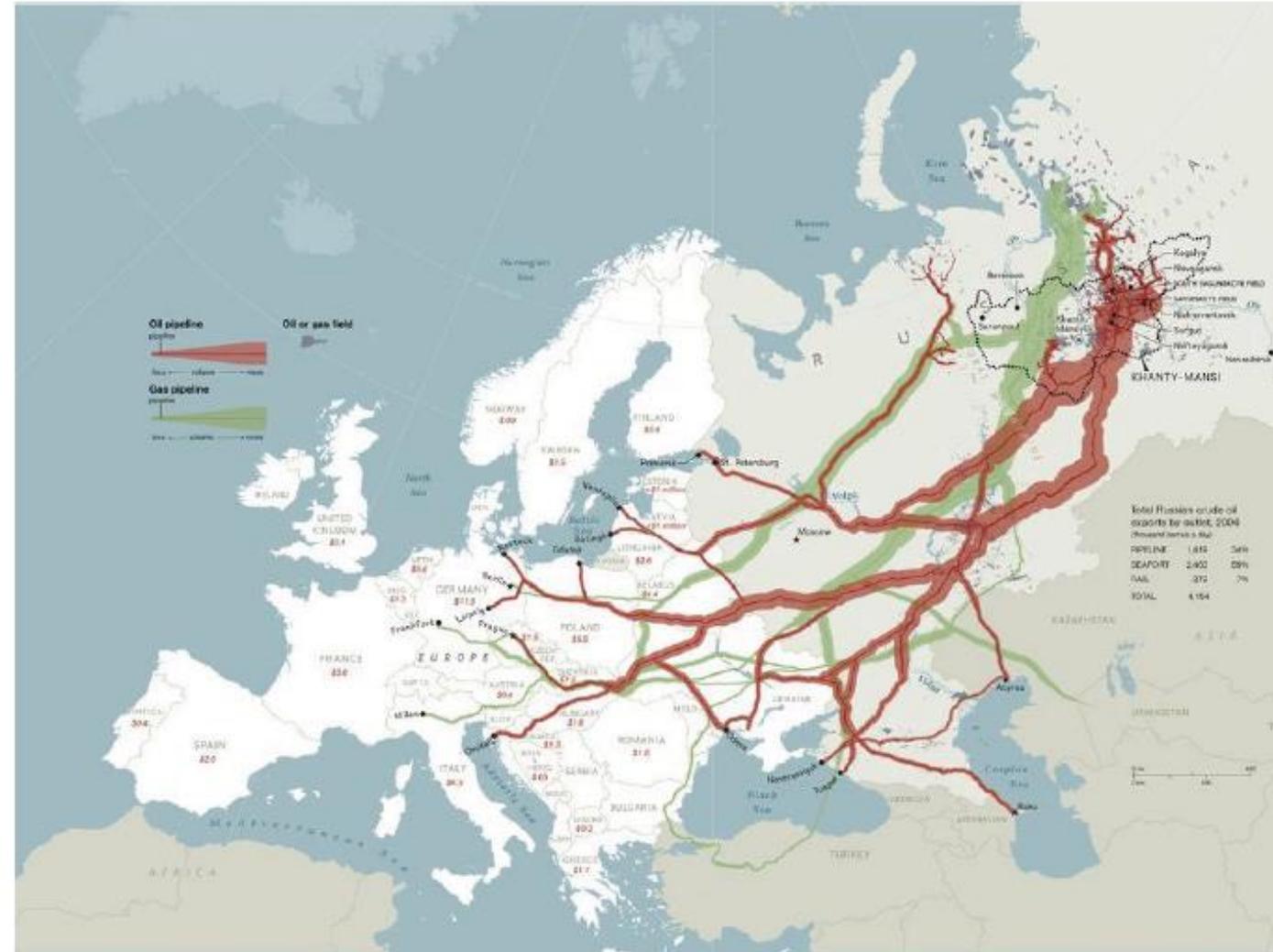


## Russian Energy Figures

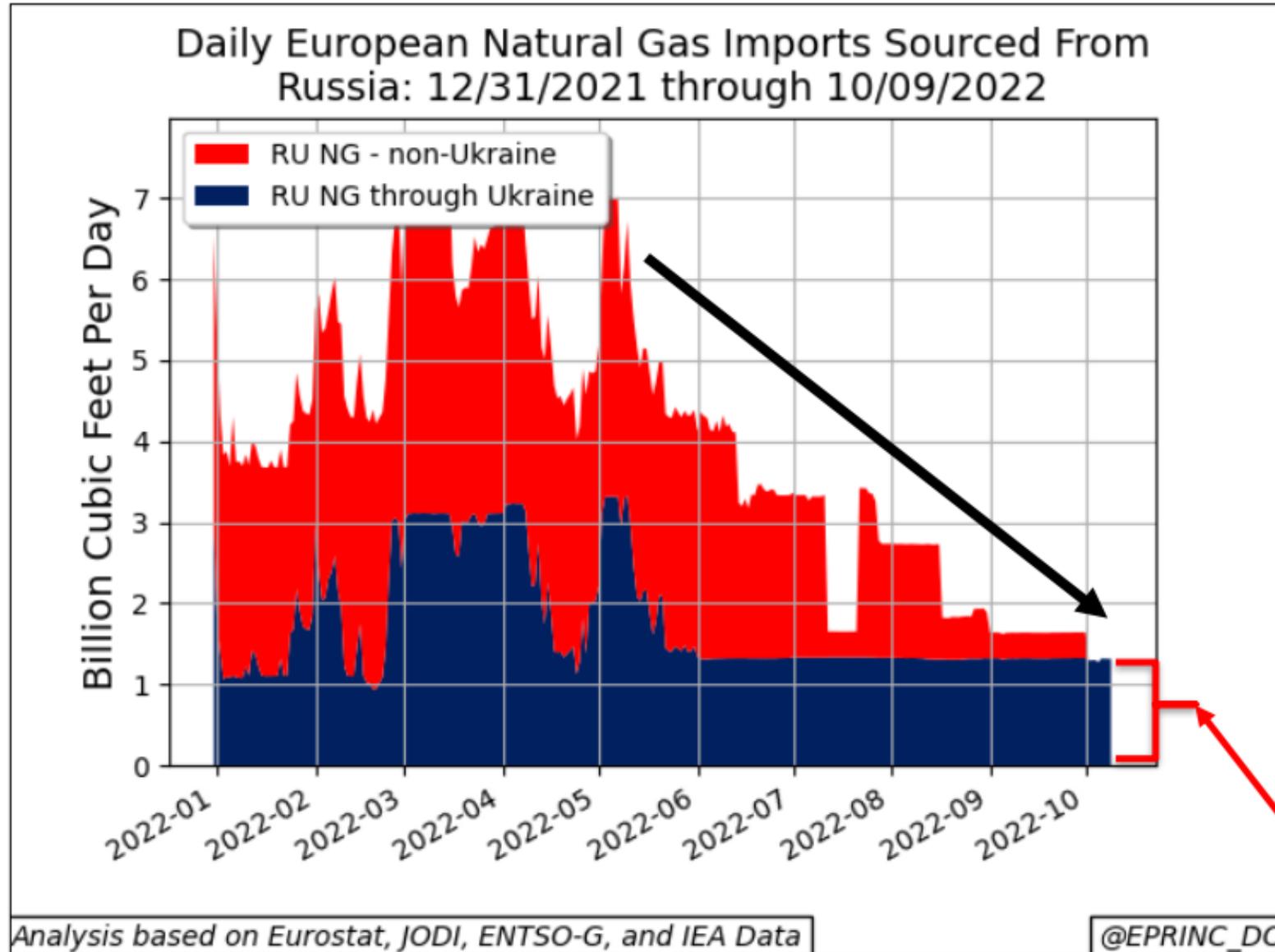
- Natural gas production: 70 Bcf/d (2<sup>nd</sup> largest)
- Natural gas pipe exports: 19 Bcf/d (1<sup>st</sup> largest)
- Oil production: 10.6 MMBpd (3<sup>rd</sup> largest)
- Oil exports: 7.5 MMBpd (2<sup>nd</sup> largest)

## Europe's Reliance on Russian Energy

- ~40% of EU's gas demand met by Russia
- ~45% of EU's coal imports from Russia
- ~30% of EU's oil imports met by Russia



# Europe – Daily Natural Gas Receipts During 2022

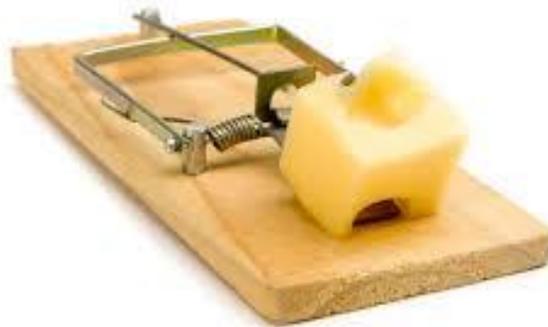


European supply diversification away from Russia  
takes **17 BCF/d** out of **50 BCF/d** market



Source: Wood Mackenzie, "Wellhead to LNG: Producers & Export Deals," September 2022, Image: Reuters

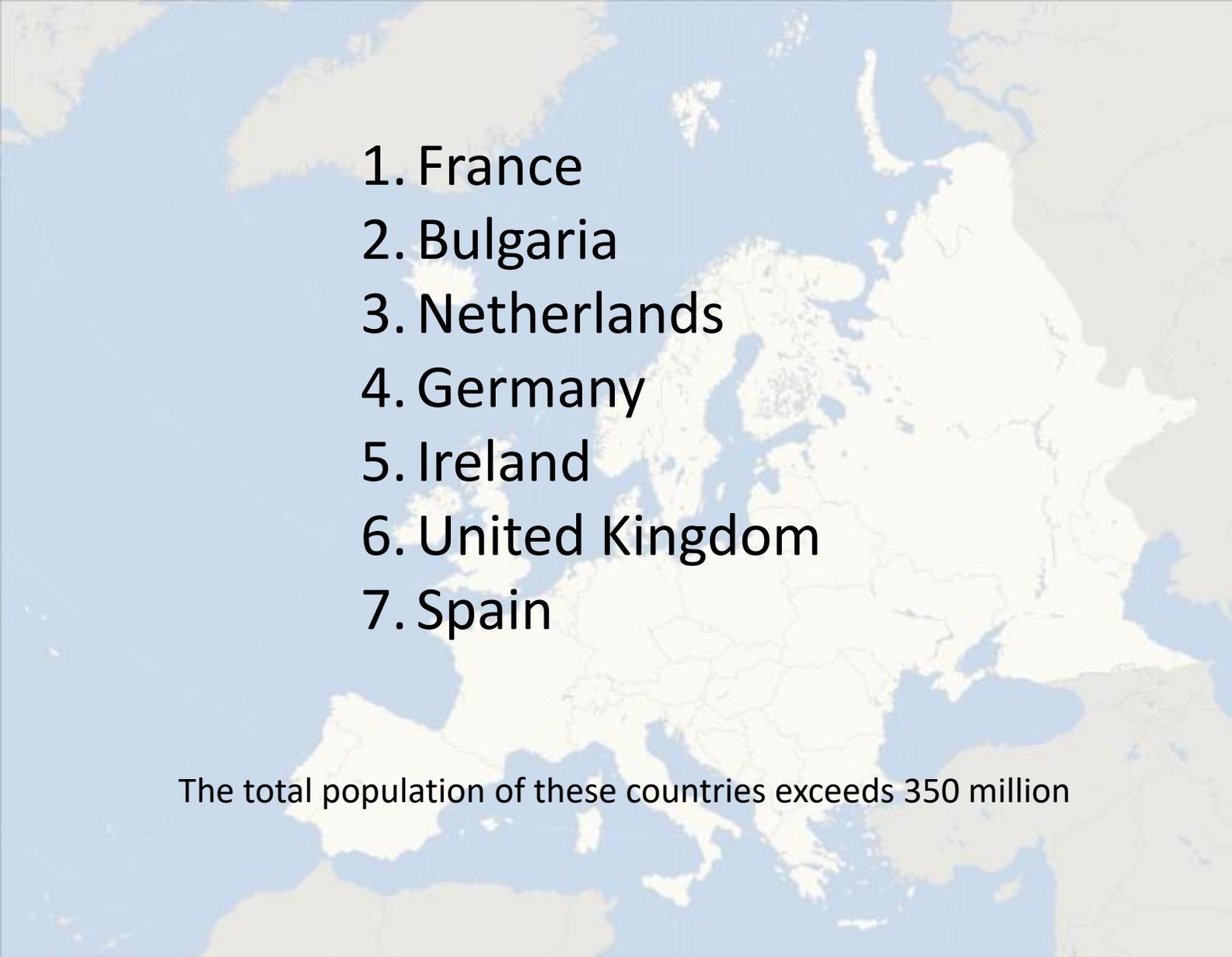
This was a trap laid by Vladimir Putin 20 years in the making.



Former NATO Secretary General Anders Fogh Rasmussen backs up the Romanian claim. He said in London recently,

“Russia, as part of their sophisticated information and disinformation operations, engaged actively with so-called nongovernmental organizations – environmental organizations working against shale gas – to maintain [Europe’s] dependence on imported Russian gas.”

- Former NATO Secretary General Anders Fogh Rasmussen

- 
- A map of Europe is shown in the background, with a list of seven countries overlaid in the center. The countries listed are France, Bulgaria, Netherlands, Germany, Ireland, United Kingdom, and Spain.
1. France
  2. Bulgaria
  3. Netherlands
  4. Germany
  5. Ireland
  6. United Kingdom
  7. Spain

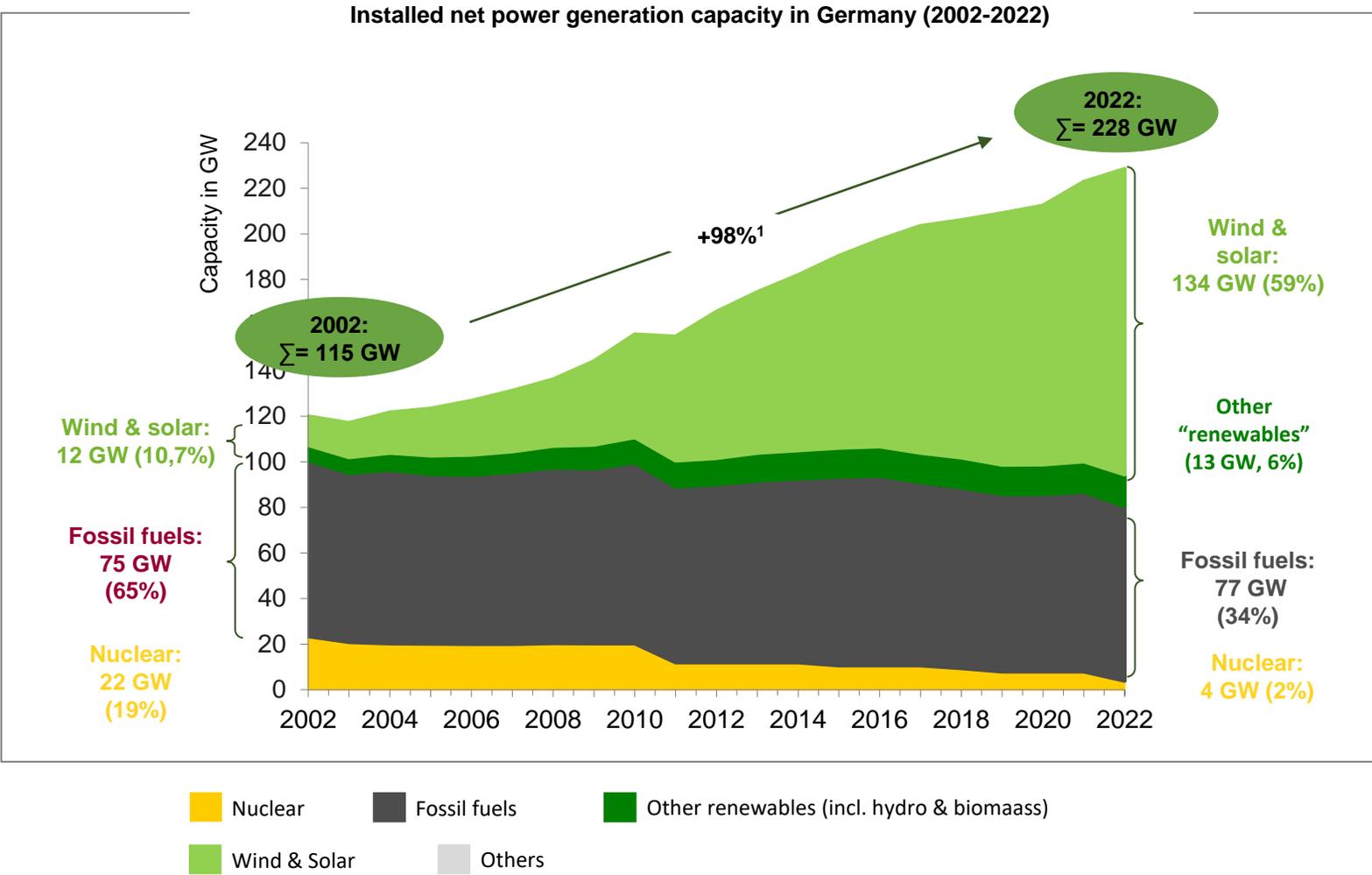
The total population of these countries exceeds 350 million

## ***Goldman Sees \$2 Trillion Surge in European Household Energy Bills by 2023***

- September 6, 2022, Bloomberg.com

3,500 energy intensive industries are surveyed, only half have hedges in place for energy requirements

- July 25, 2022, Oilprice.com

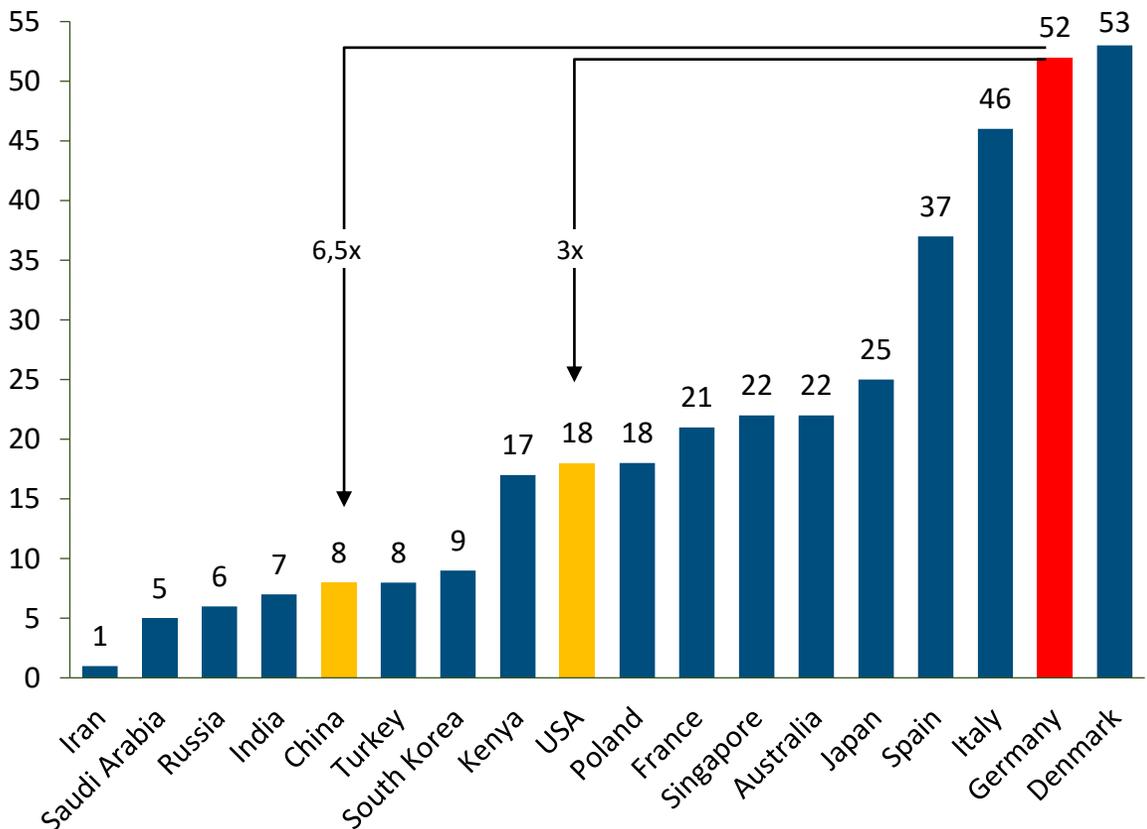


Source: Schernikau on Energy Policy

(1) CAGR: +3,5%; (2) CAGR: +0,1%; (3) CAGR -0,9%; (4) Including hydro & biomass  
 Sources: Schernikau Research and Analysis based on Fraunhofer Institute ([link](#)), Agora Energiewende ([https://static.agora-energiewende.de/fileadmin/Projekte/2022/2022\\_01\\_DE-JAW2021/A-EW\\_247\\_Energiewende-Deutschland-Stand-2021\\_WEB.pdf](https://static.agora-energiewende.de/fileadmin/Projekte/2022/2022_01_DE-JAW2021/A-EW_247_Energiewende-Deutschland-Stand-2021_WEB.pdf)), AG Energiebilanzen (<https://ag-energiebilanzen.de/daten-und-fakten/primaerenergieverbrauch/>) and <https://ag-energiebilanzen.de/daten-und-fakten/zusatzinformationen/>); Statista for industrial power prices <https://www.statista.com/statistics/1050448/industrial-electricity-prices-including-tax-germany/>

**Germa Industrial Electricity Prices:**  
 2002: 7 ct / kWh  
 2023: 40 ct / kWh

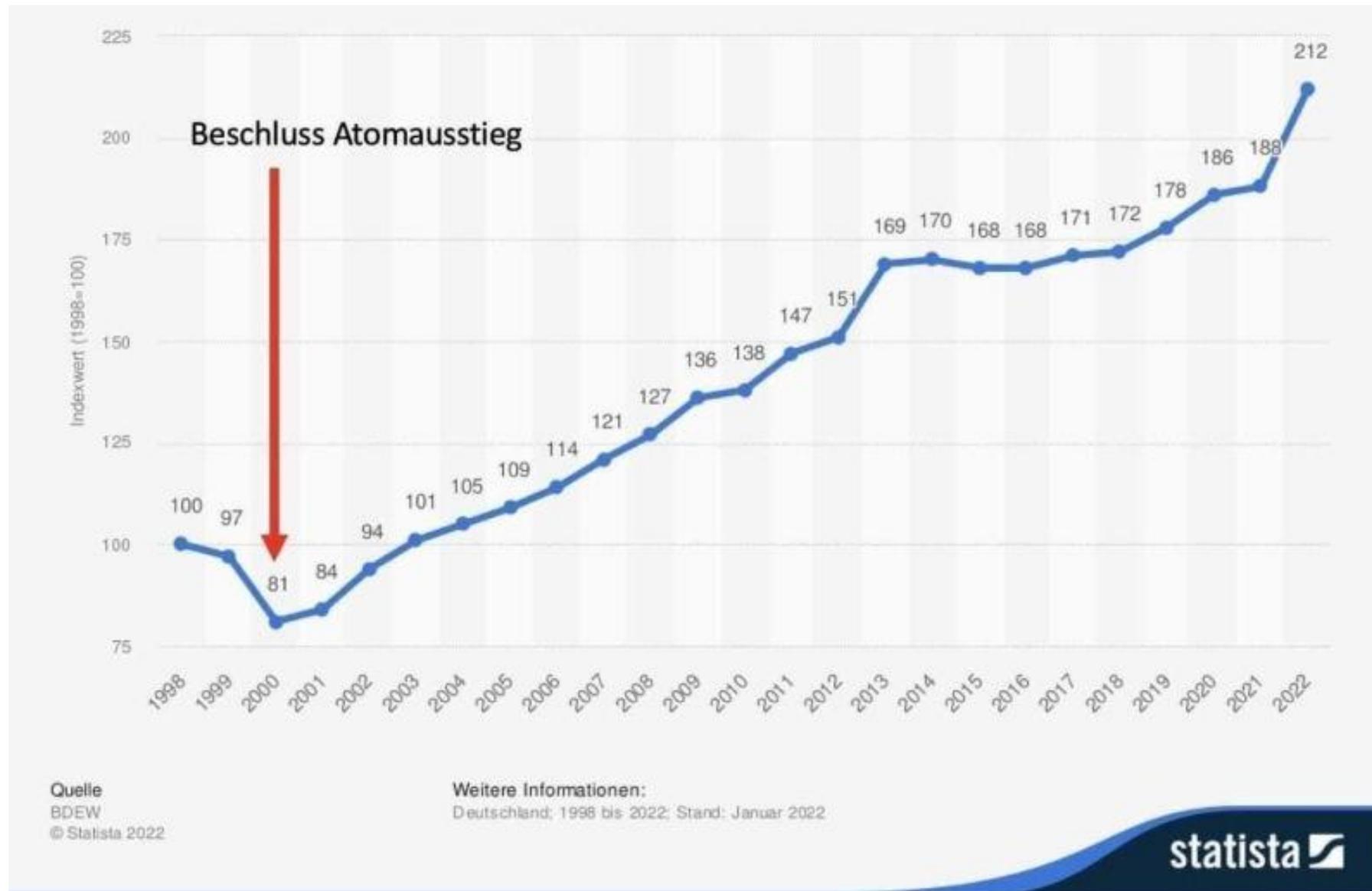
**Consumer electricity prices**  
 by country in 2022 (US\$/kWh)



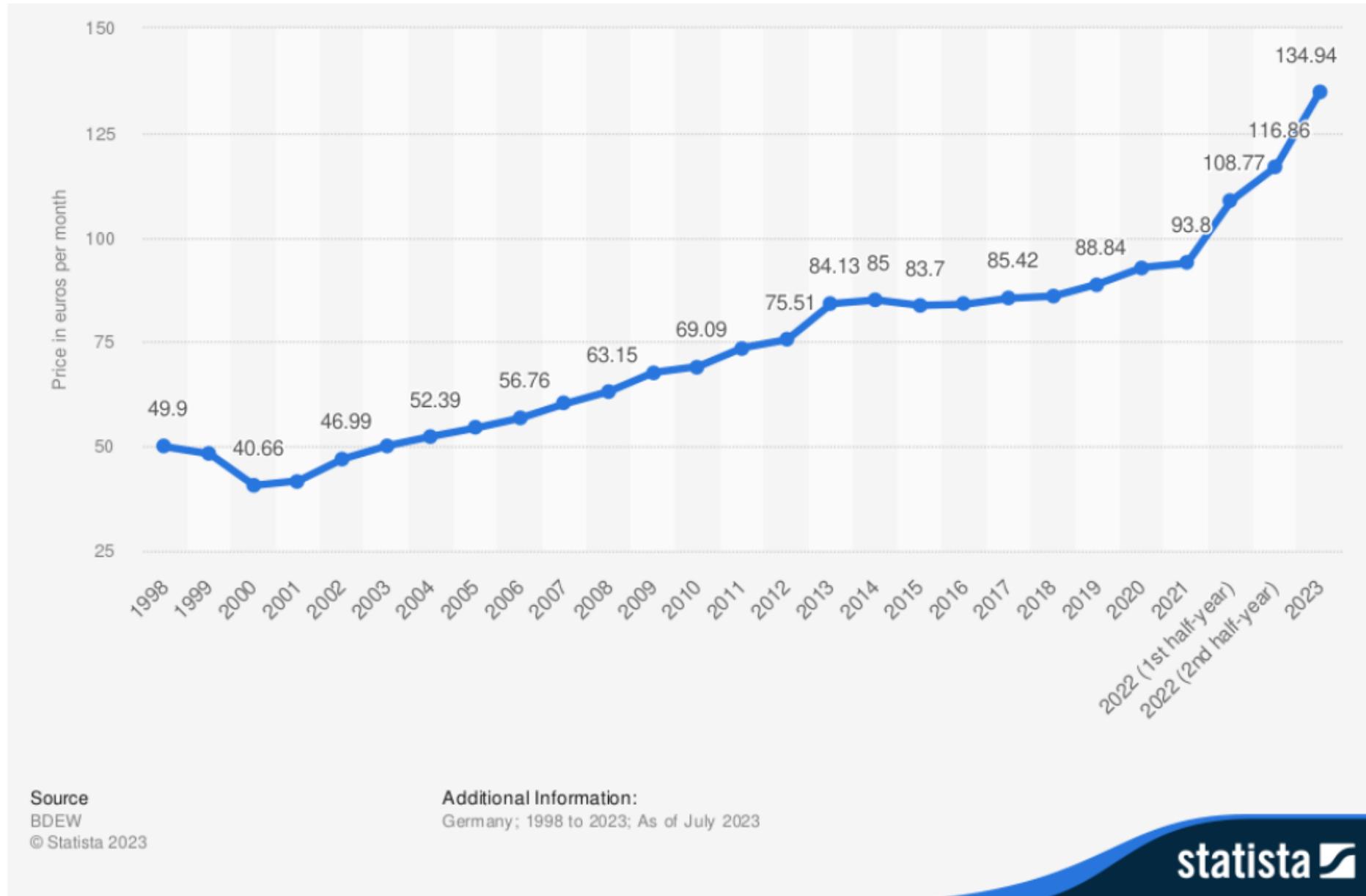
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 Sources: Schernikau Research and Analysis based on Fraunhofer Institute ([link](https://static.agora-energiemende.de/fileadmin/Projekte/2022/2022_01_DE-JAW2021/A-EW_247_Energiemende-Deutschland-Stand-2021_WEB.pdf)), Agora Energiewende ([https://static.agora-energiemende.de/fileadmin/Projekte/2022/2022\\_01\\_DE-JAW2021/A-EW\\_247\\_Energiemende-Deutschland-Stand-2021\\_WEB.pdf](https://static.agora-energiemende.de/fileadmin/Projekte/2022/2022_01_DE-JAW2021/A-EW_247_Energiemende-Deutschland-Stand-2021_WEB.pdf)), AG Energiebilanzen (<https://ag-energiebilanzen.de/daten-und-fakten/primaerenergieverbrauch/> and <https://ag-energiebilanzen.de/daten-und-fakten/zusatzinformationen/>); Statista for industrial power prices <https://www.statista.com/statistics/1050448/industrial-electricity-prices-including-tax-germany/>

# Electricity price index in Germany from 1998 to 2022.



# Average electricity bill for a 3-person household in Germany from 1998 to 2023 (in euros per month)





## “Over and out: Germany switches off its last nuclear plants”

Apr 15, 2023 – Germany has switched off its three remaining nuclear power plants as part of a long-planned transition toward renewable energy.

- AP News

## **Germany's Shrinking Economy Sparks a Struggle for Solutions**

- WSJ, August 29, 2023

## **Russian Gas Cuts Threaten World's Largest Chemical Hubs**

- WSJ, June 27, 2022

## **Germany faces a looming threat of deindustrialization**

- Economist, September 11, 2022

## **Rust Belt on the Rhine: The Deindustrialization of Germany**

- Politico, July 13, 2023

## **Germany went from envy of the world to the worst-performing major developed economy. What happened?**

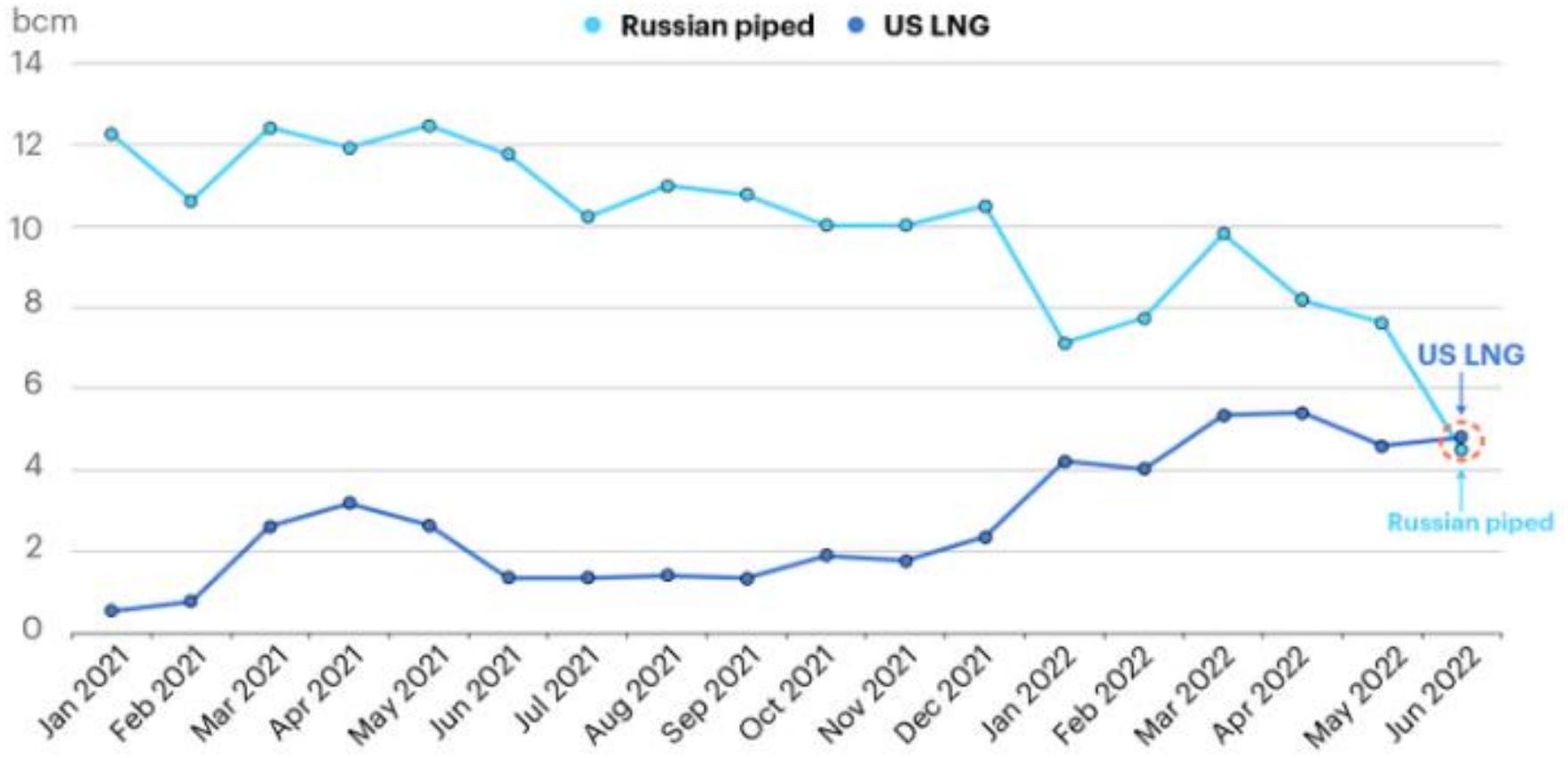
- ABC News, September 19, 2023

# Gas crisis forces Germany to flatten wind farm for coal mine



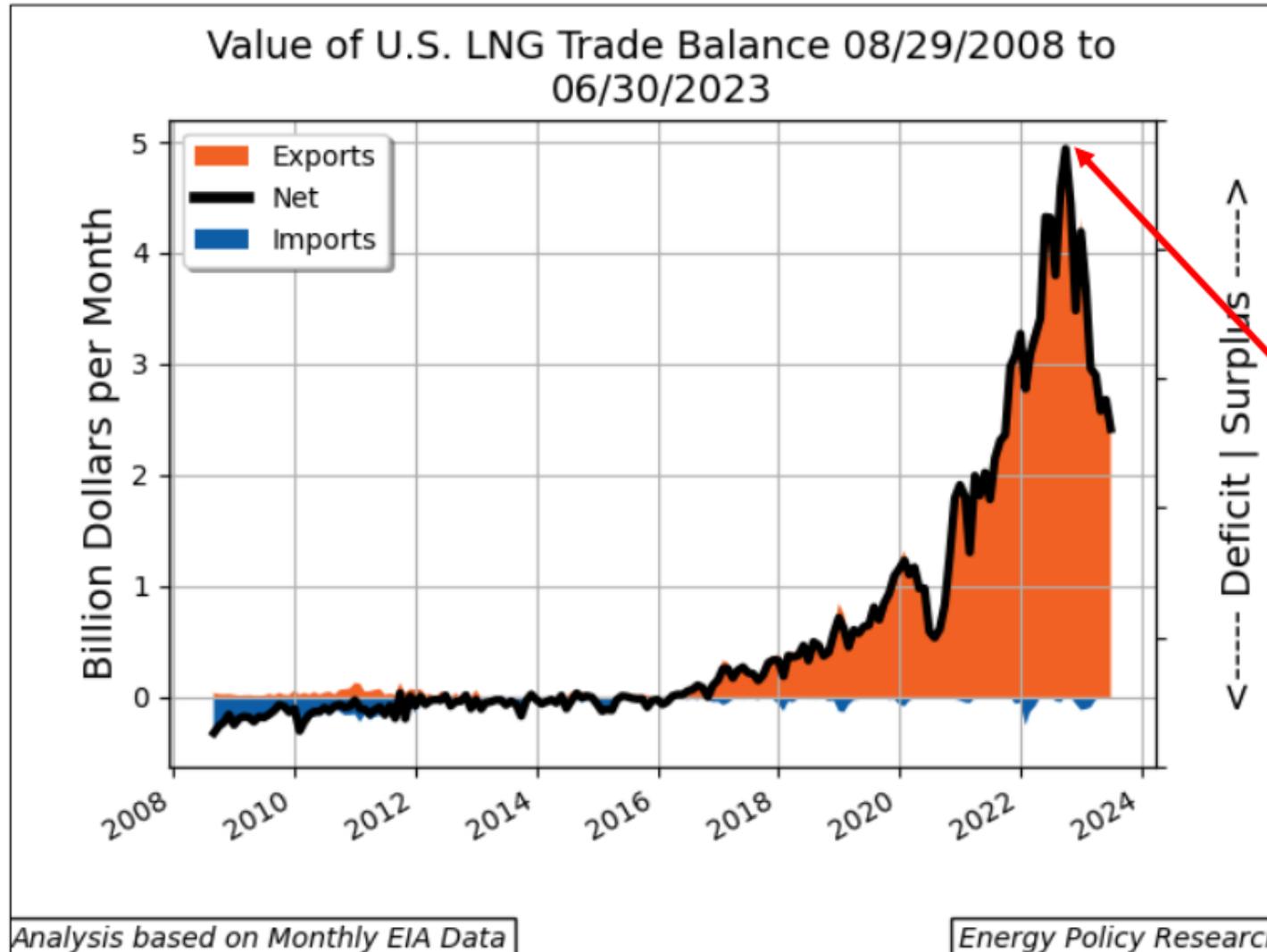
## US liquefied natural gas (LNG) overtakes Russian piped gas in EU gas imports in June 2022

IEA analysis



International Energy Agency

## LNG Trade Lowers U.S. Trade Deficit

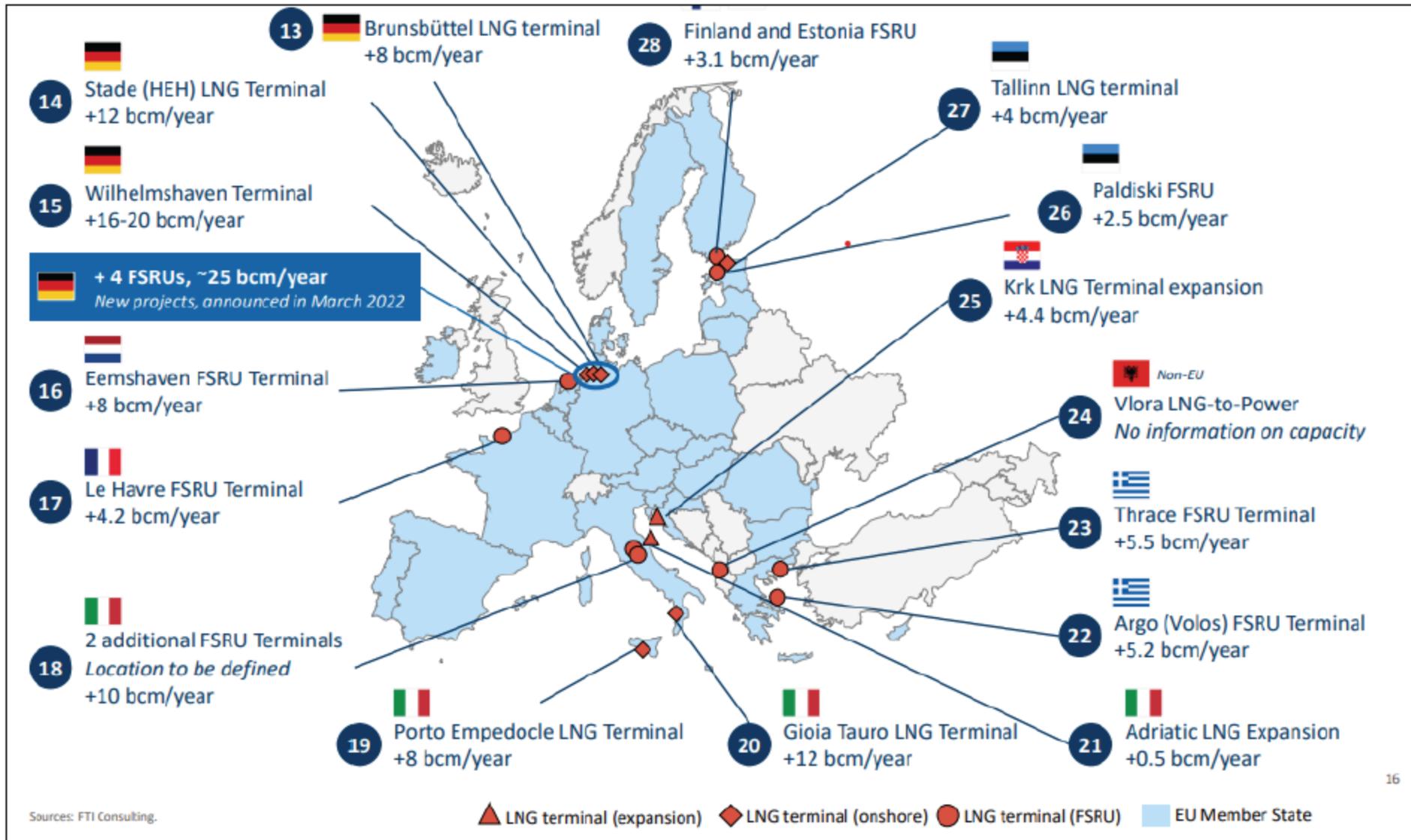


**At this peak, the August 2022 trade deficit was \$67B (\$261B exports, \$328B imports).**

**U.S. LNG exports in that month was \$4.95B.**

**Without LNG trade, the August 2022 deficit would have been \$72B, or 7.5% higher.**

# Europe has authorized 21 new LNG projects



<https://www.fticonsulting.com/-/media/files/emea-files/insights/white-papers/2022/may/new-lng-regasification-terminals-europe.pdf>



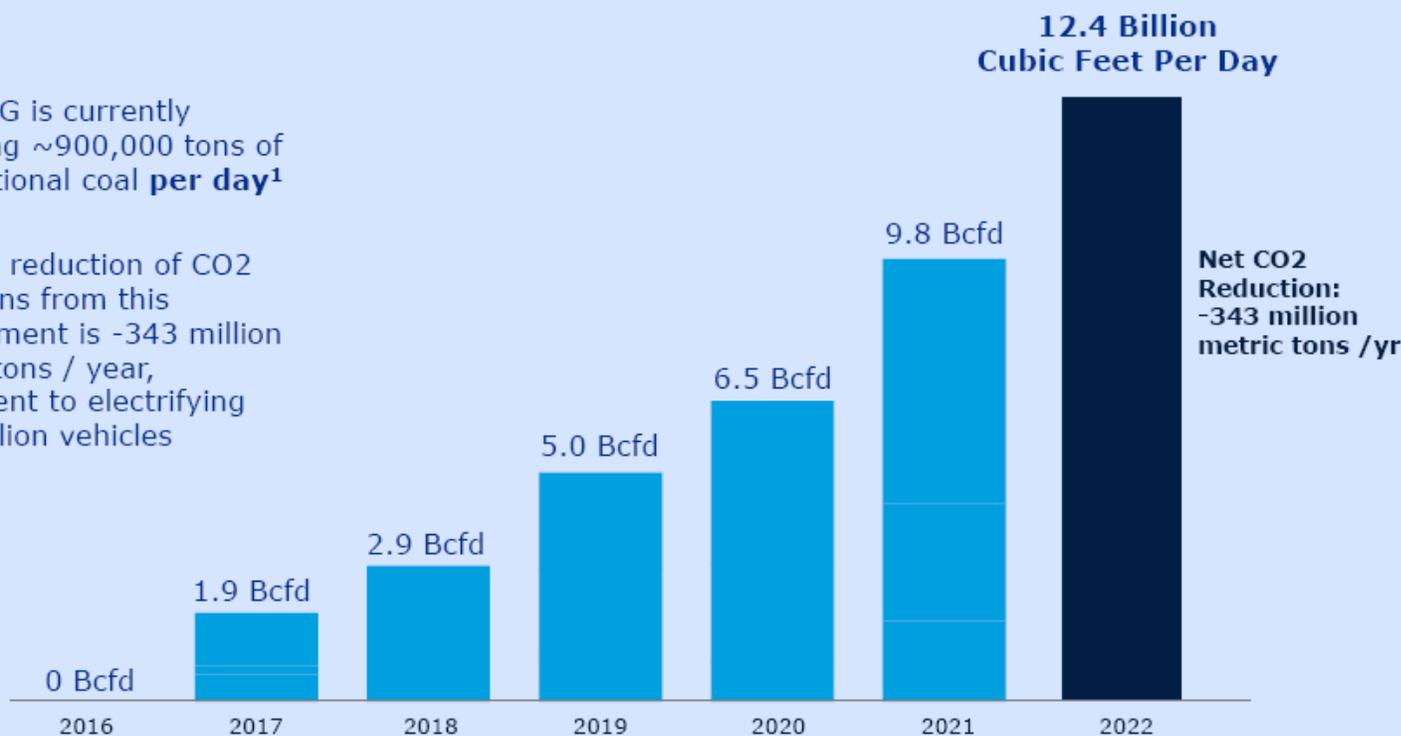
## U.S. LNG Export Capacity

LNG export facilities are currently located predominantly on the Gulf Coast



U.S. LNG is currently replacing ~900,000 tons of international coal **per day**<sup>1</sup>

The net reduction of CO2 emissions from this replacement is -343 million metric tons / year, equivalent to electrifying 125 million vehicles

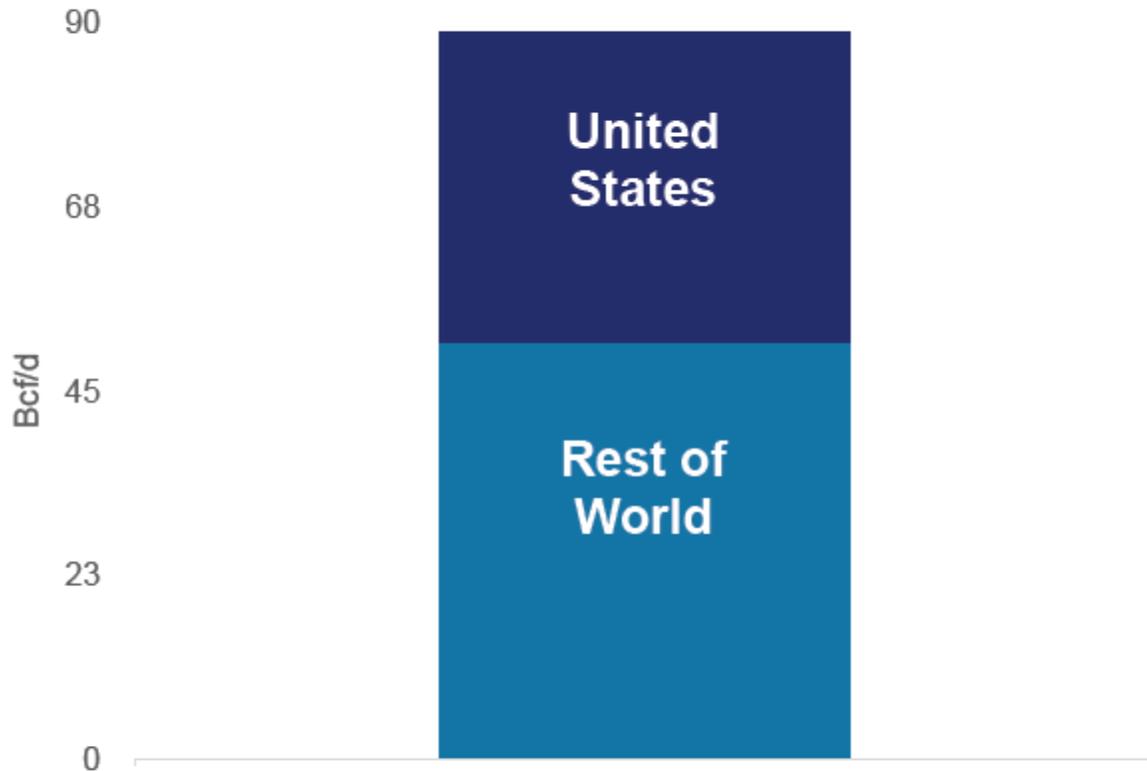


1. International coal displaced is calculated by total thermal unit generated by gas divided by average heating content of coal (~19.8 mmbtu/short ton) // Net GHG reduction is calculated based on the emission differential between coal and natural gas (~560 CO2e kg/MWh) based on a study from ICF.

Source: EIA U.S. Natural Gas Exports and Re-Exports by Point of Exit, Reuters, EIA CO2 emission coefficient.

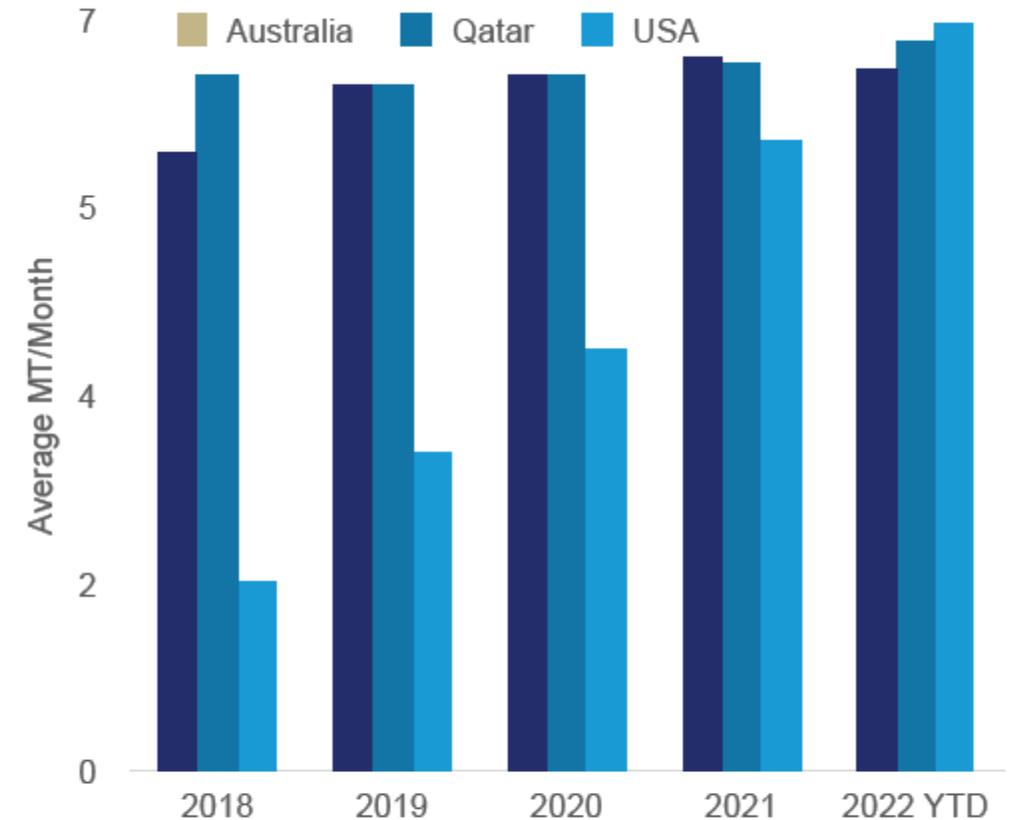
# The United States has been the key driver of global natural supply growth

## Net Global Natural Gas Supply Growth Since 2007



- Since 2007, 42% of global natural gas supply growth has come from the United States

## Top 3 LNG exporters

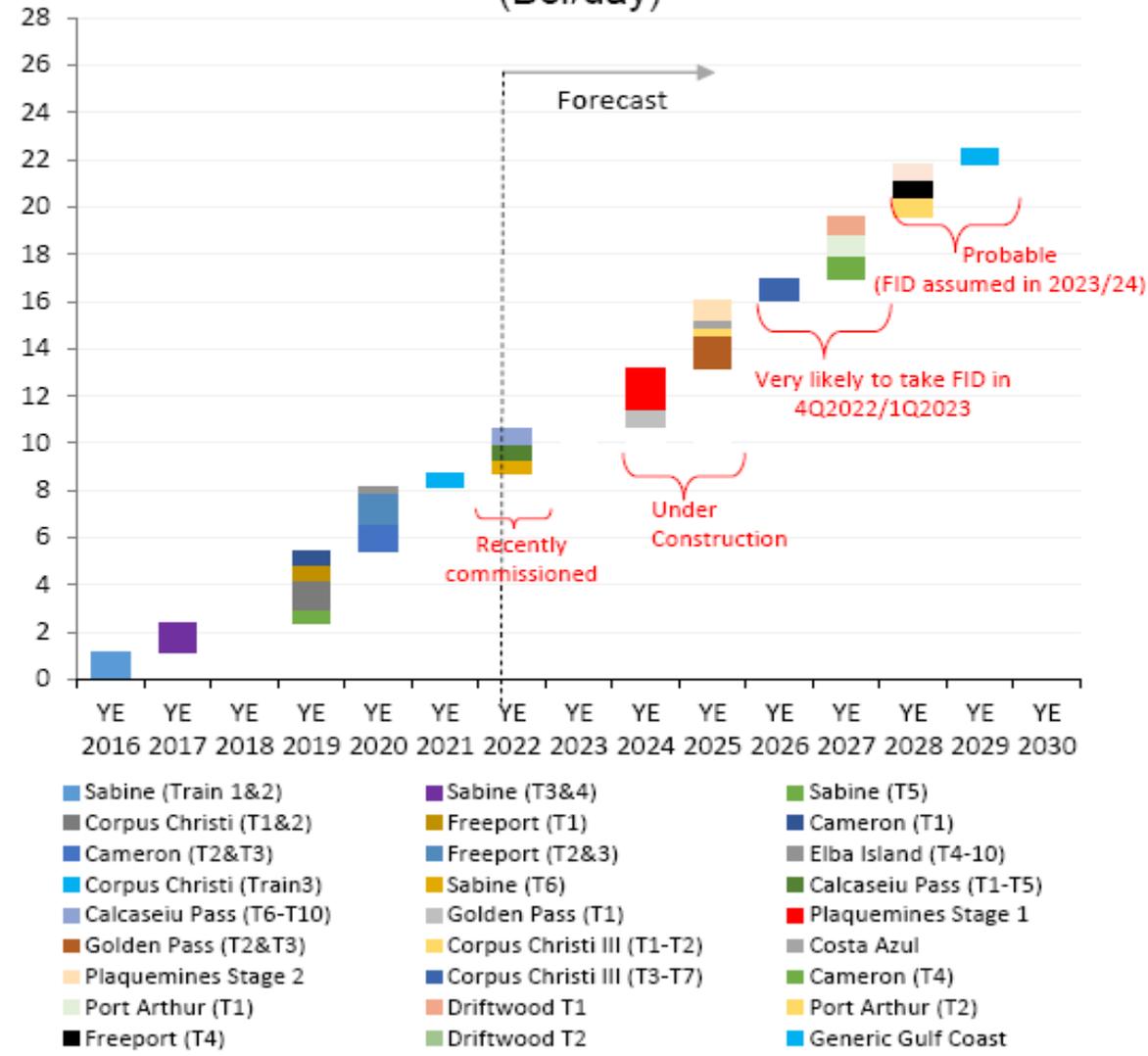


- US natural gas supply growth has supported LNG exports, with the US overtaking Qatar this year

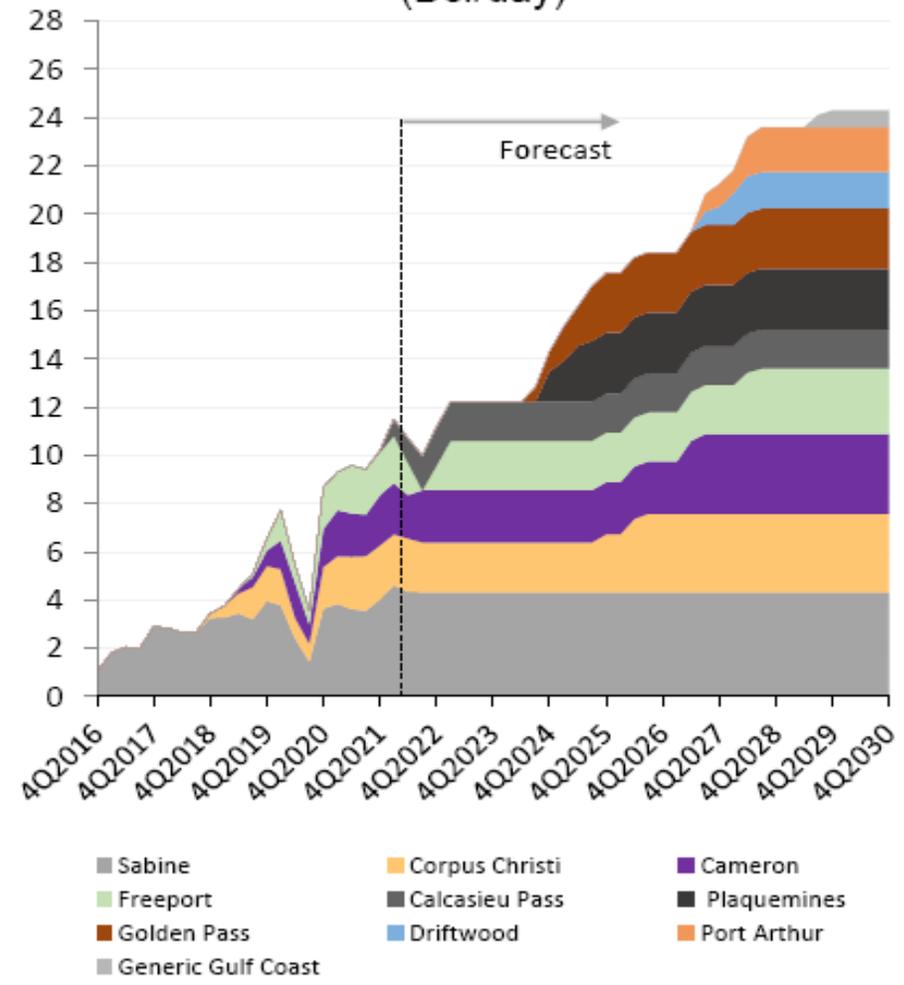
Source: Wood Mackenzie, IHS Markit  
Note: 2022 YTD = January 1 to June 15, 2022

# USGC LNG feed gas is expected to reach ~24 Bcf/d by 2030, adding ~14 Bcf/d to regional demand (from 2021 average of ~10 Bcf/d)

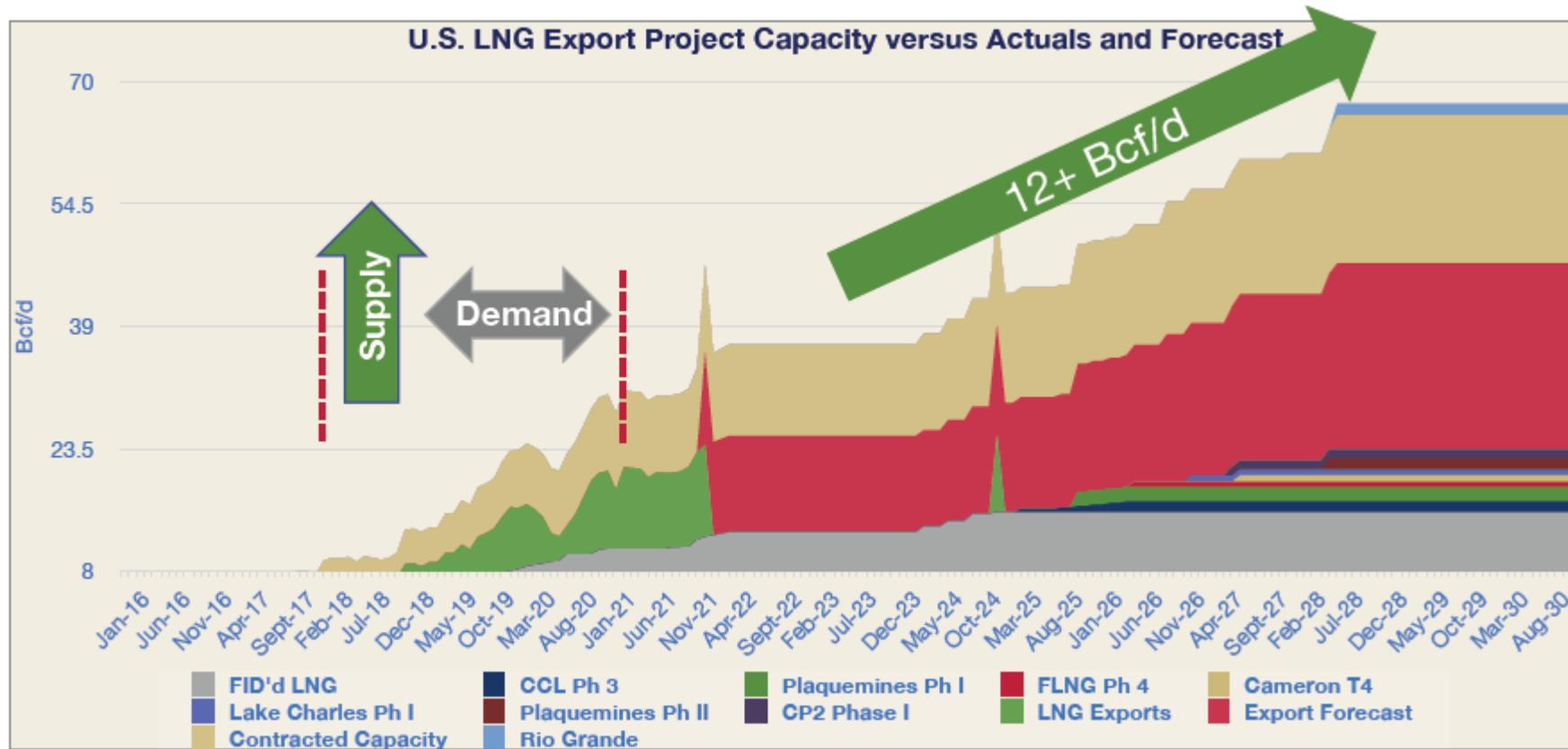
### USGC LNG Export Nameplate Capacity Forecast (Bcf/day)



### USGC LNG Feed Gas Volume Forecast (Bcf/day)

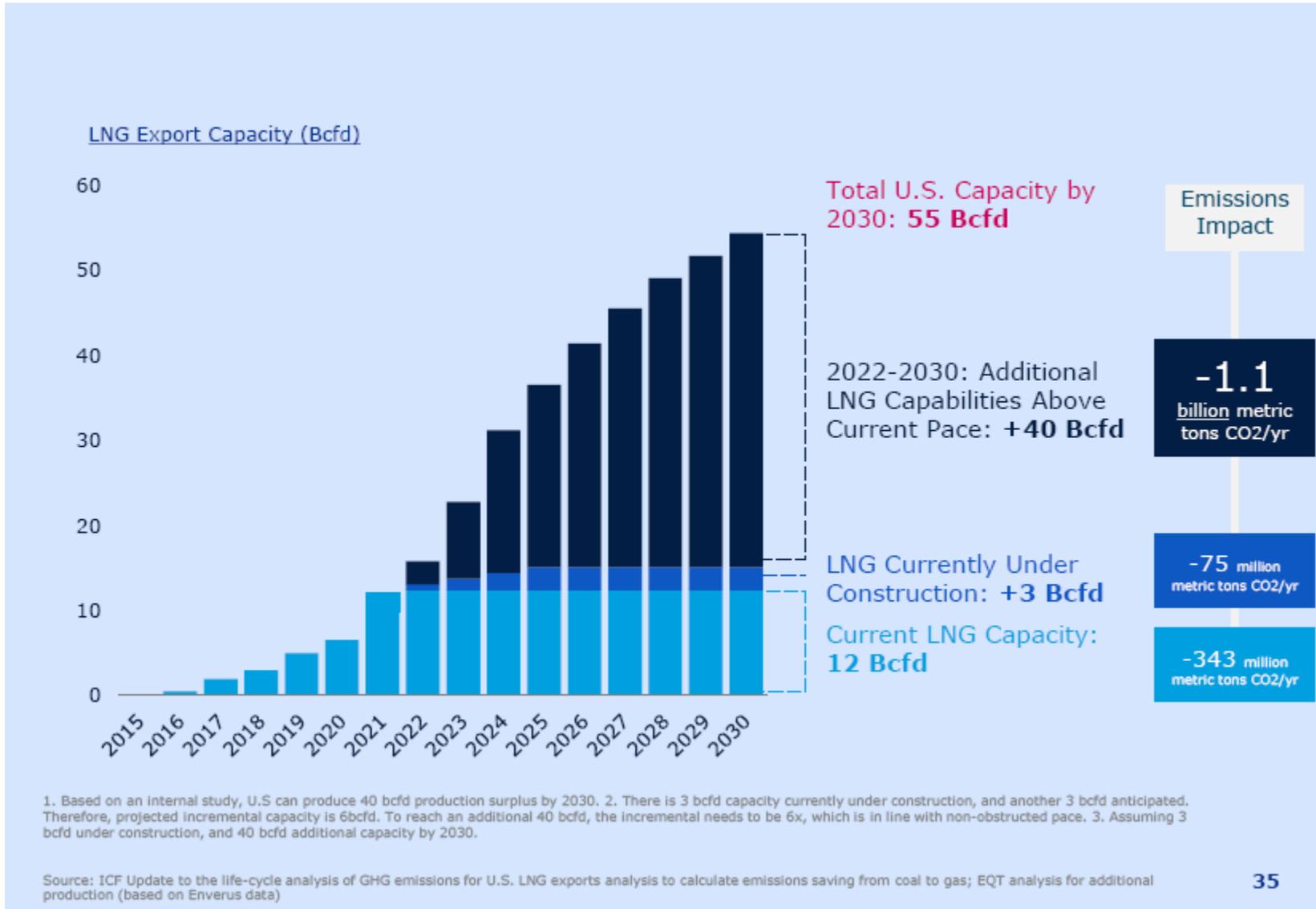


# 2024 to 2030



Where will all the gas come from to meet this massive increase in Demand?

# Projected LNG Export Capacity Through 2030<sup>1</sup>



- The goal of fertilizing grains is to increase the yield



# There are only four types of grain.

65-70% of the world caloric food intake is related to 4 grains:

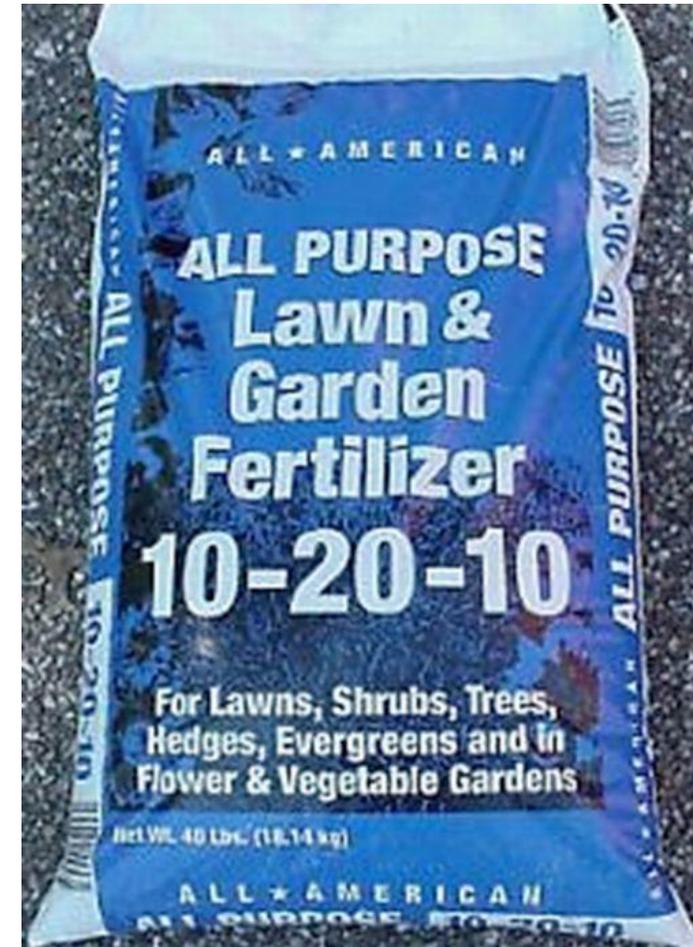
- Wheat
- Rice
- Corn
- Soybeans



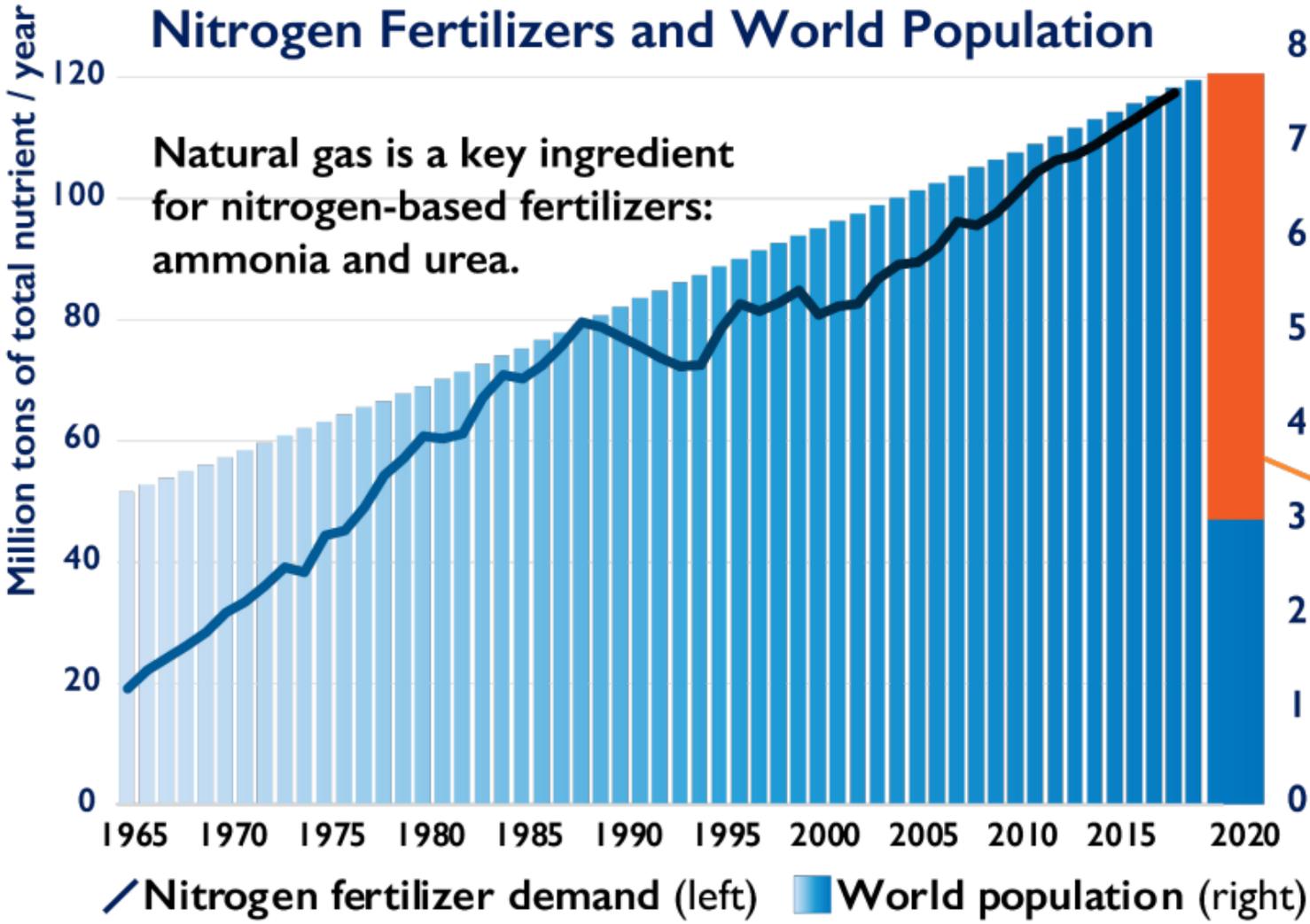
All require intense use of nitrogen fertilizers

# There are only three types of fertilizers:

- Potash (K) mined
- Phosphate (P) mined
- Nitrogen (N) man-made



# Food for Thought: Natural Gas is Critical for Global Food Production



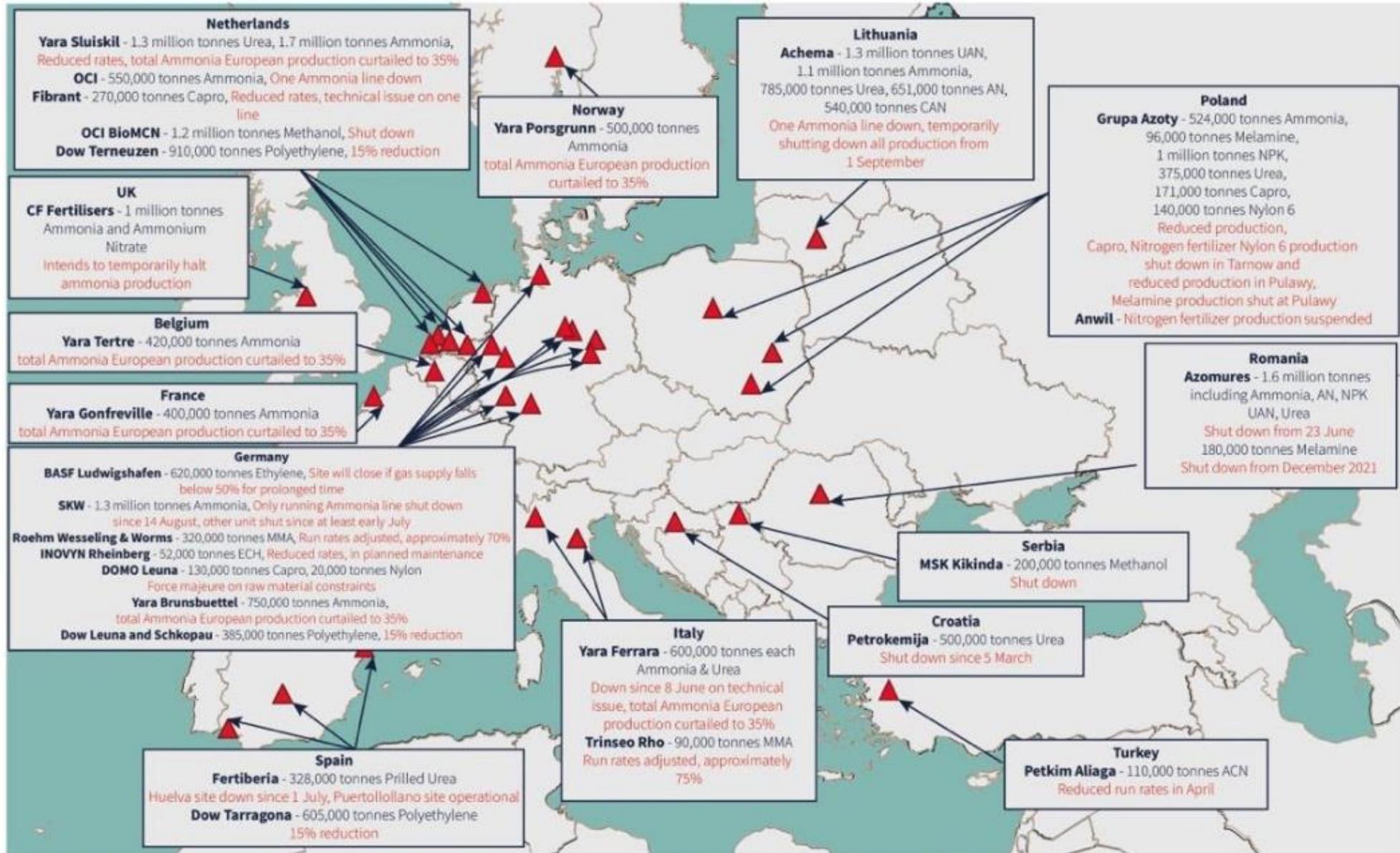
Without fossil fuel-based fertilizers, agriculture can support, at most, 3 billion people on plant-based diets, vs. today's 8 billion on mixed diets.

Sources: Vaclav Smil, FAO, World Bank, Statista,

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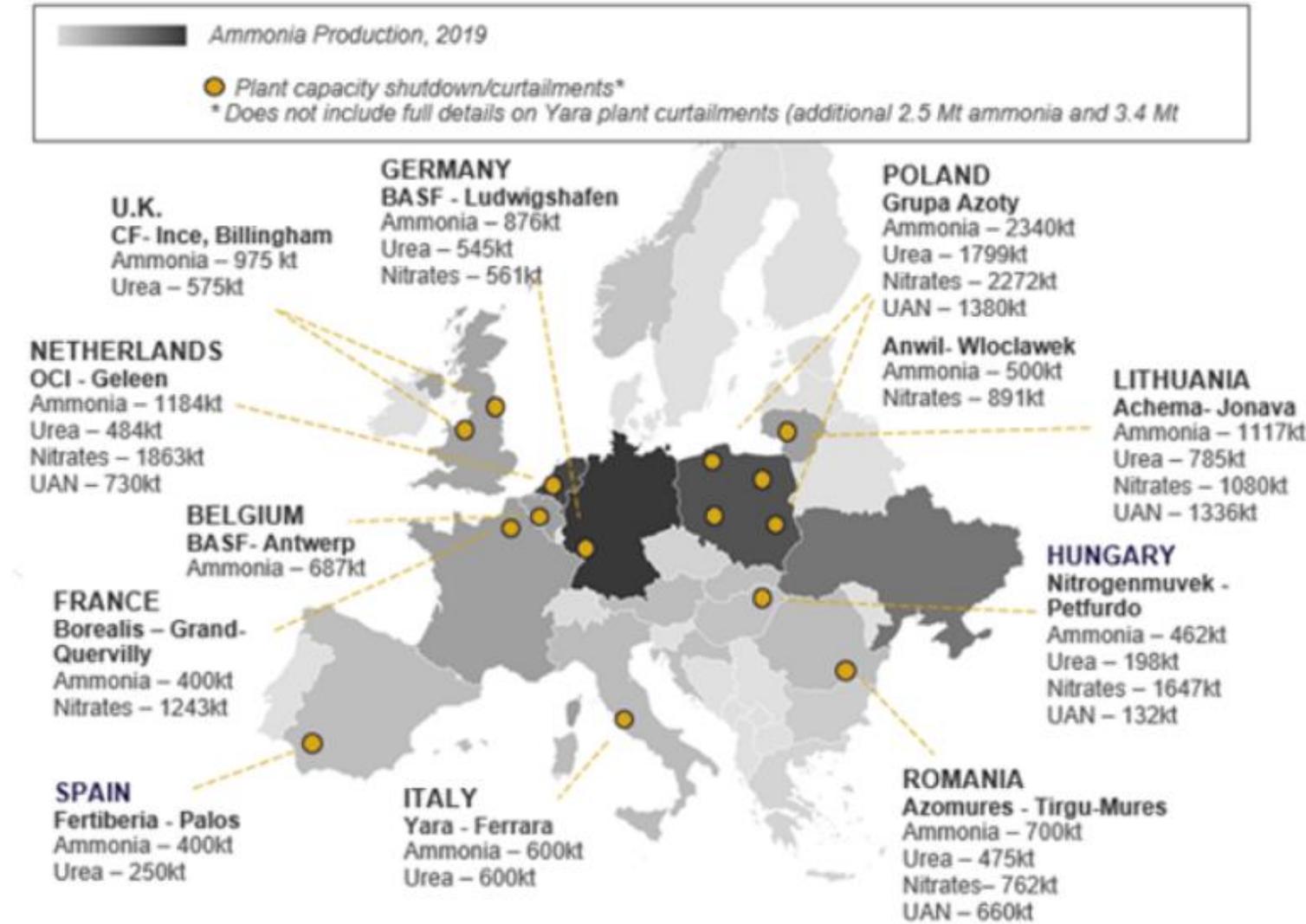
If you aggregate the world's daily demand for natural gas (**11 Bcf/day**) that is converted into fertilizer (through the Haber Bosch process) into one country, that country would rank 10<sup>th</sup> in the world for daily natural gas demand

# Soaring gas prices hit Europe fertilizers, chemicals



# 70% of Europe's nitrogen fertilizer plants closed during 2022

Figure 1: European nitrogen production shutdowns and curtailments



DATA: CRU, IFA

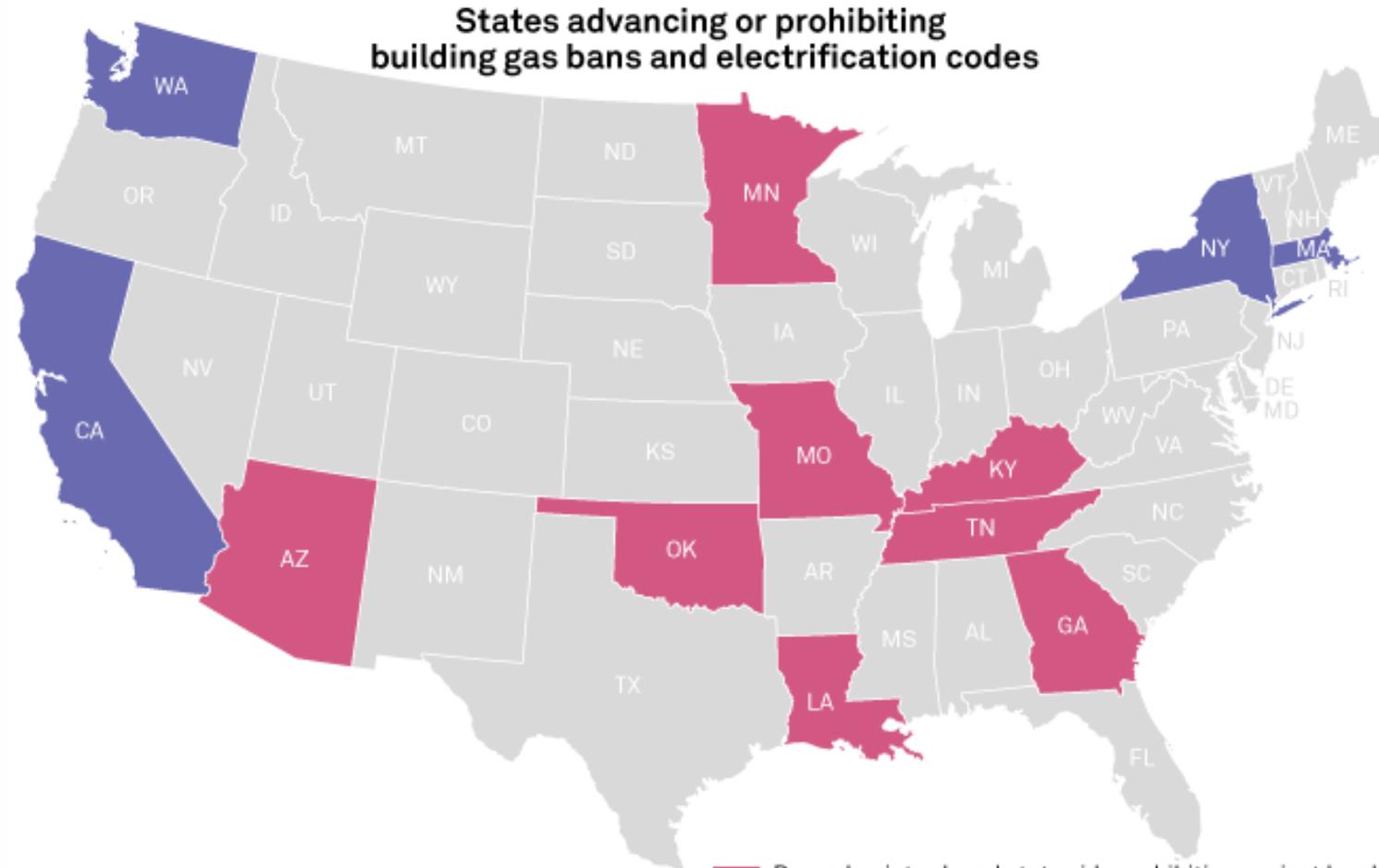
# Surging Fertilizer Prices Set to Exacerbate African and Mid-East Food Crisis

- Use of nutrients may shrink by a third in sub-Saharan Africa
- Import-dependent region may face increasing food shortages



“That could potentially curb cereals output by 30 million tons, enough to feed 100 million people.”

– Sebastian Nduva, Program Manager at AfricaFertilizer.Org



**S&P Global**  
Market Intelligence

As of May 29, 2020.  
Map credit: Elizabeth Thomas  
Source: S&P Global Market Intelligence

-  Passed or introduced statewide prohibition against local measures to block access to utility service based on fuel type, including gas bans.
-  Local building gas bans and electrification codes adopted or in development.

- Approximately 33 ammonia plants in the U.S.
- Natural gas usage at 2 of those plants is equal to all U.S. cooktop stove usage
  - Approximately 240,000 MMBtu/day



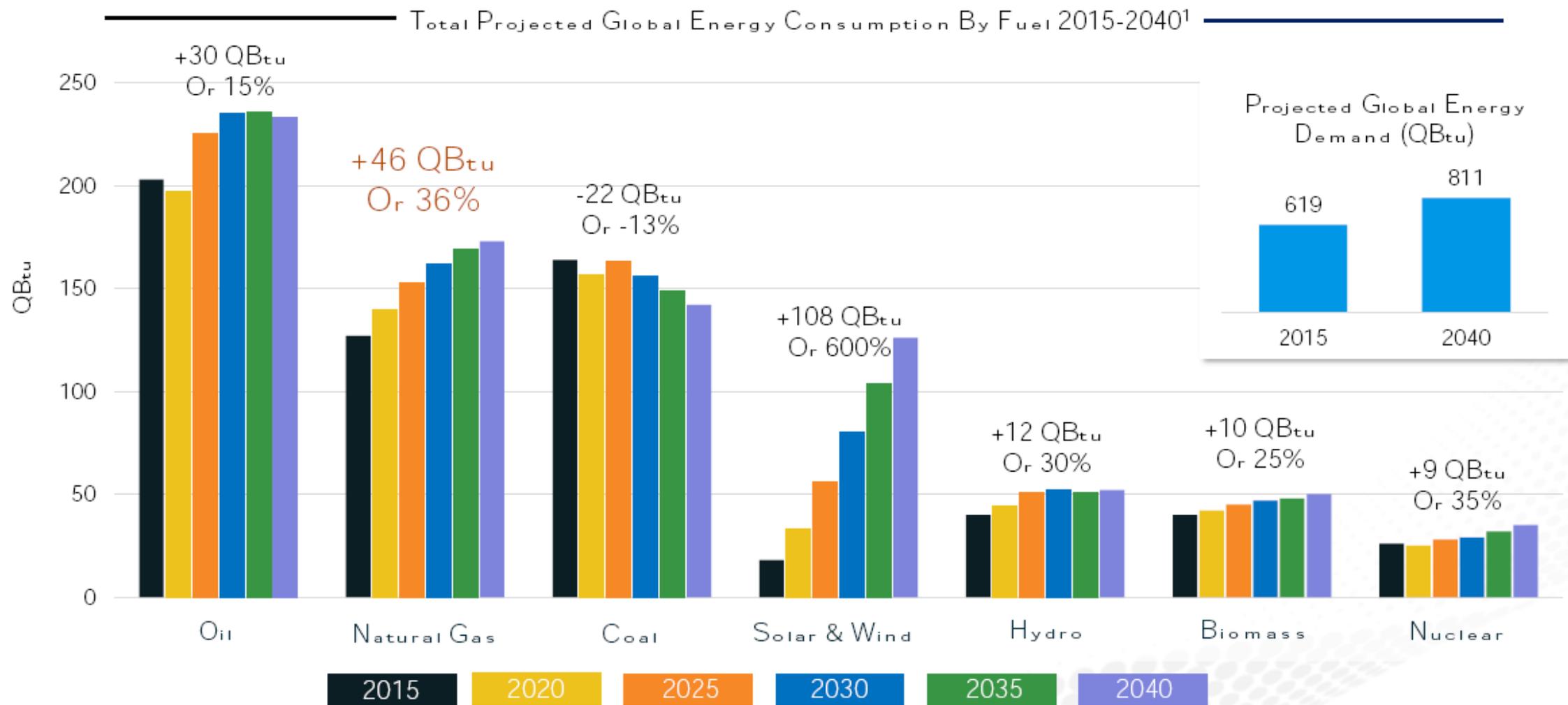
# Is the natural gas industry a sunset business?

*A leading indicator of a sunset business is the inability to attract capital investments into expensive, long-term projects. This is not happening in natural gas.*



- Over the past year and a half, nearly 50 binding contracts have been signed for LNG offtake from facilities on the U.S. Gulf Coast
- Of these contracts, about 75% contemplate a start date in 2026 or 2027
- Of these contracts, over 70% run for 20 years and about 25% run for 15 years
- Conclusion: **Sophisticated investors are betting material capital that this will remain a good business through at least 2045**

# Nearly one-quarter of global energy demand growth through 2040 projected to be filled by natural gas

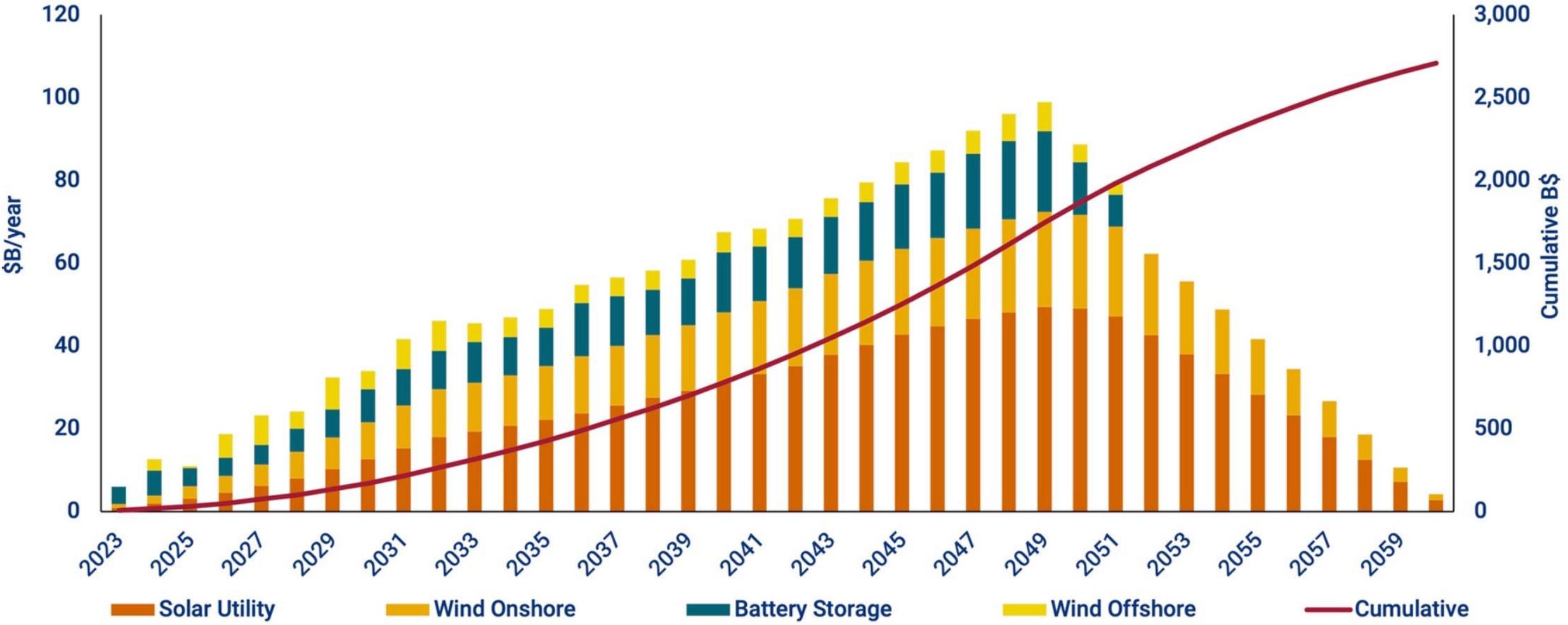


<sup>1</sup>Source: S&P Global Commodity Insights ©2023 May 2023 Reference Case

## The Inflation Reduction Act



# Cost of the Inflation Reduction Act

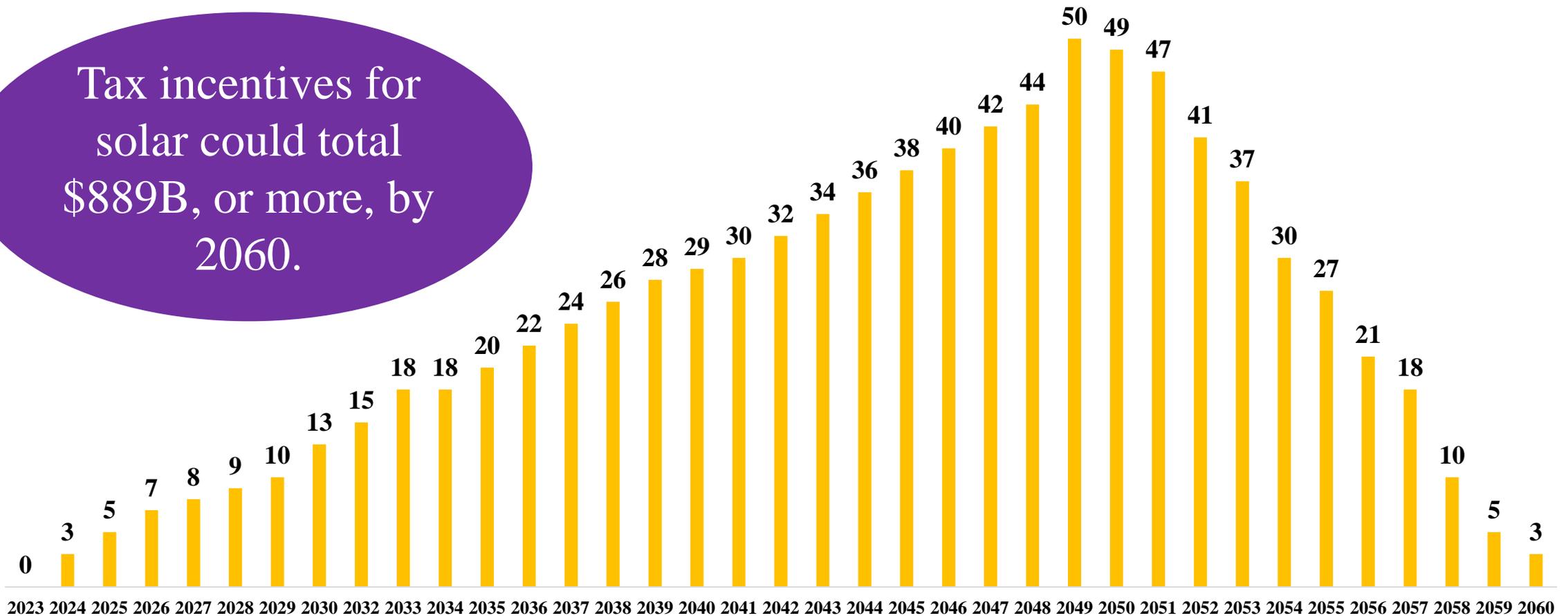


**Final Cost = \$3 Trillion**

Source: Robert Bryce, Substack

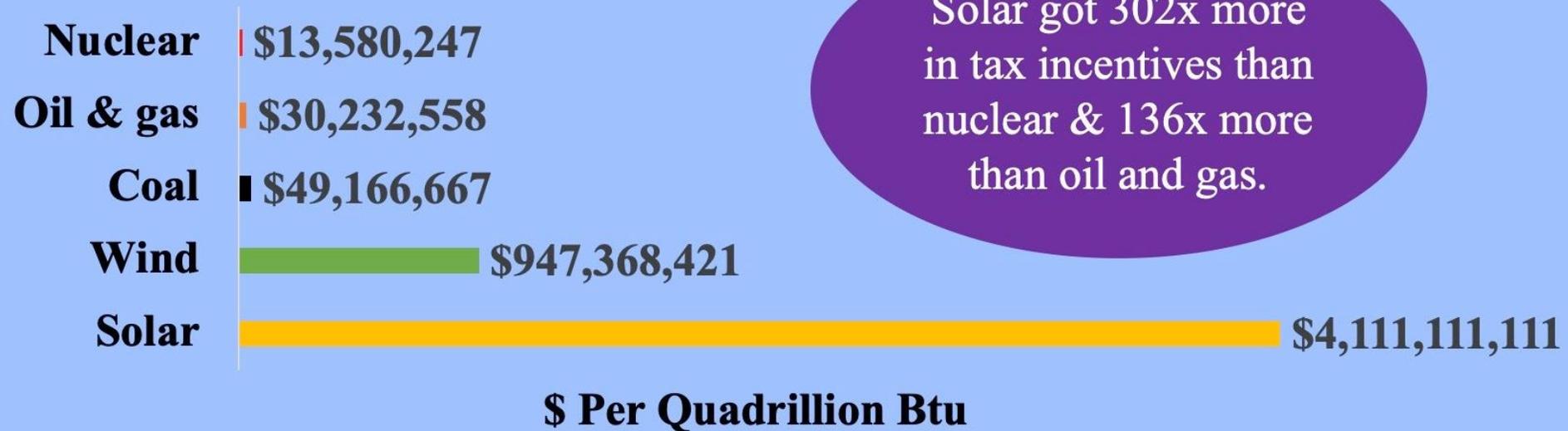
# Solar Subsidies Under Inflation Reduction Act Could Total \$900B

Tax incentives for solar could total \$889B, or more, by 2060.



Tax incentives, \$Billion per year

# EIA Data: Tax Incentives For Solar, Wind, Coal, Oil & Gas, & Nuclear, Per Unit of Energy Produced, 2022



Source: EIA, <https://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf#page=31>, <https://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf#page=22>, author calculations

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“The International Energy Agency’s (IEA) ‘sustainable development scenario’ results in a

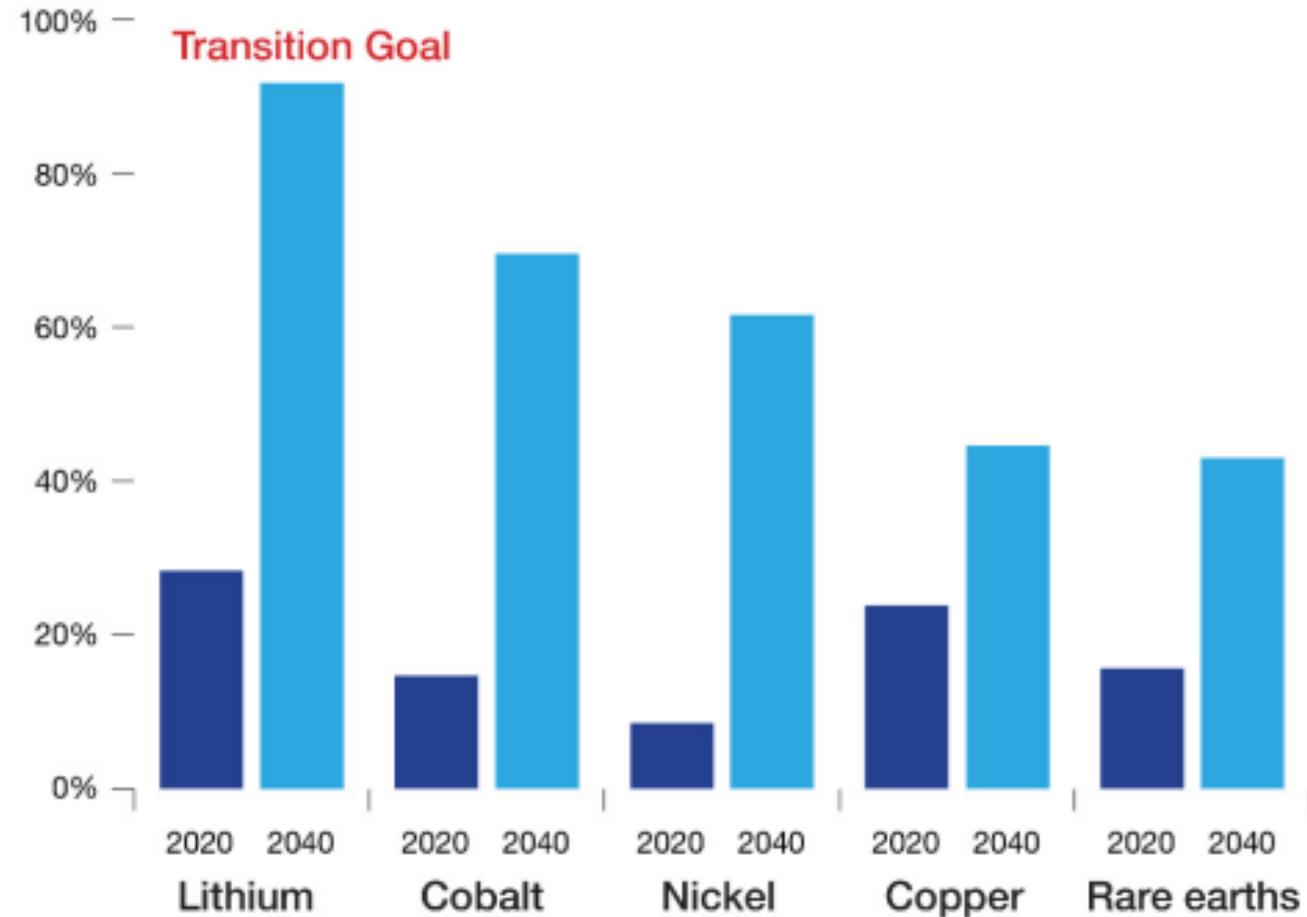
- 42-fold increase in lithium demand,
- 25-fold increase in graphite demand,
- 21-fold increase in cobalt demand,
- 19-fold increase in nickel demand,
- 7-fold increase in rare earth demand by 2040”



# Energy Transition Policies are Inflationary

## Energy Sector Share of Mineral Demands for All Purposes

Share of All Uses



## Sources of Key Energy Transition Minerals

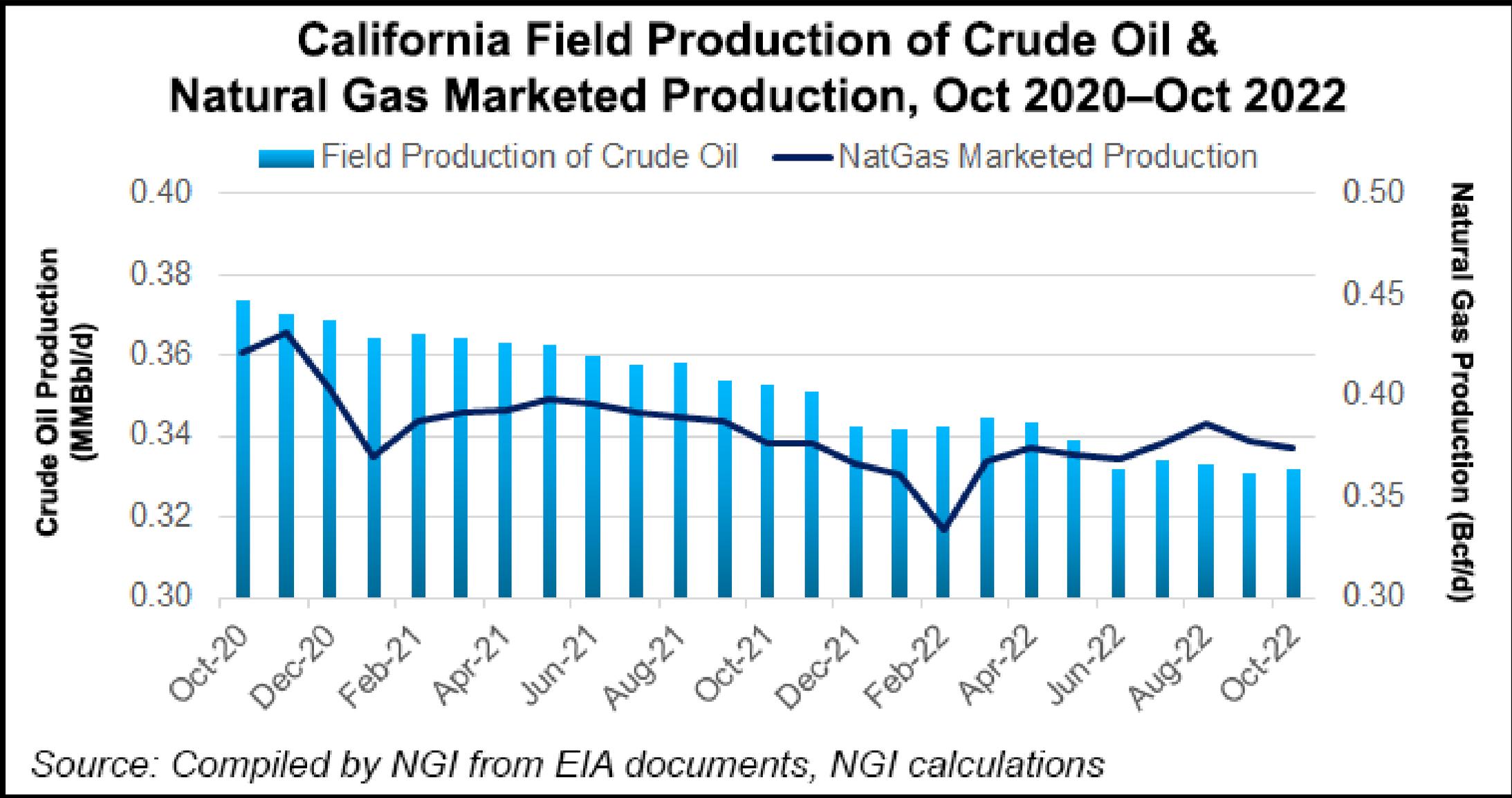


“There are simply not enough minerals in the pipeline to meet this kind of demand. One example of this is shown by research done by EV Expert Steve LeVine. Using major metals production forecasts, LeVine found that by 2030, **there will only be enough metals for 15.6 million EVs, while automakers claim they want to produce over 40 million.**”



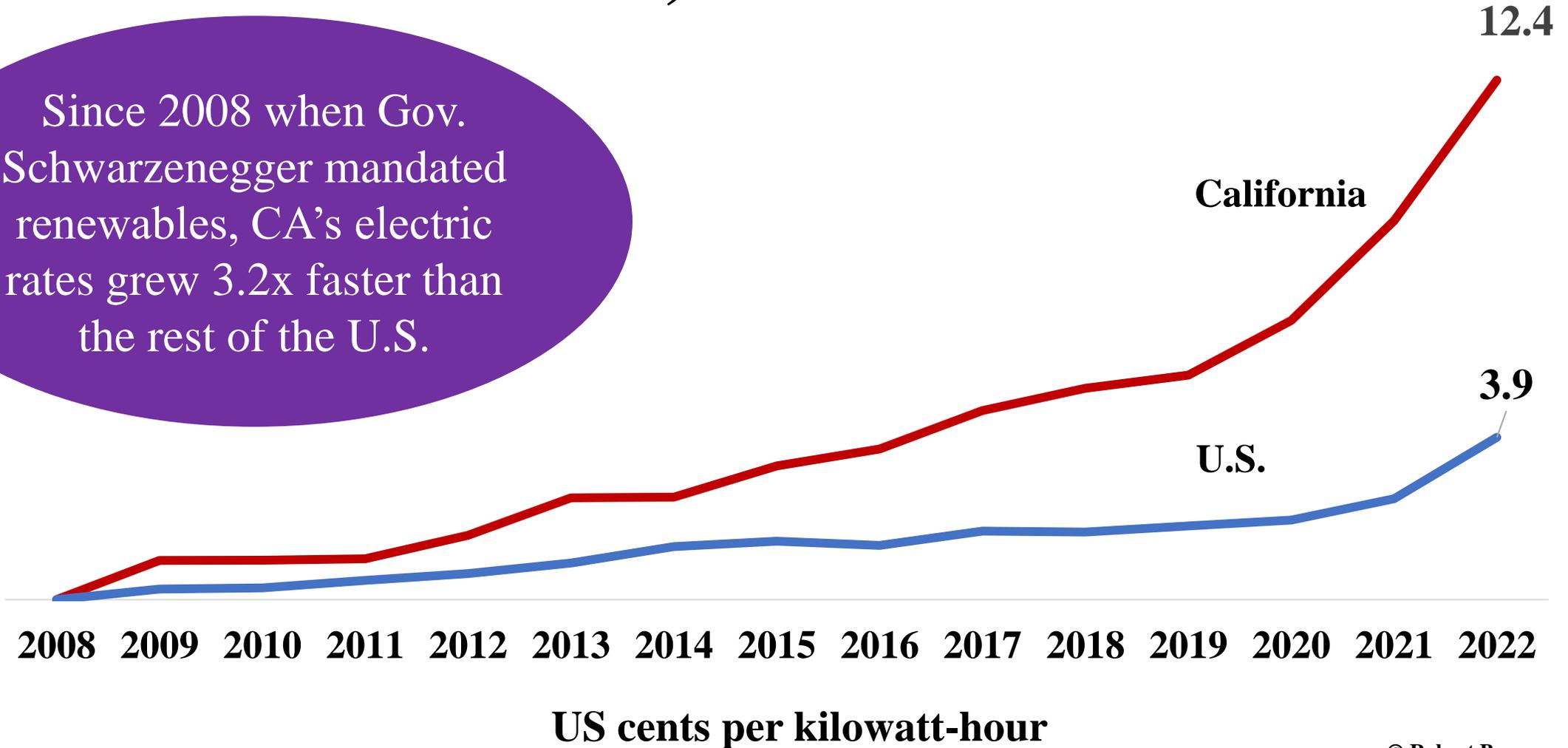
**YES**

# Los Angeles County to Ban New Natural Gas and Oil Wells



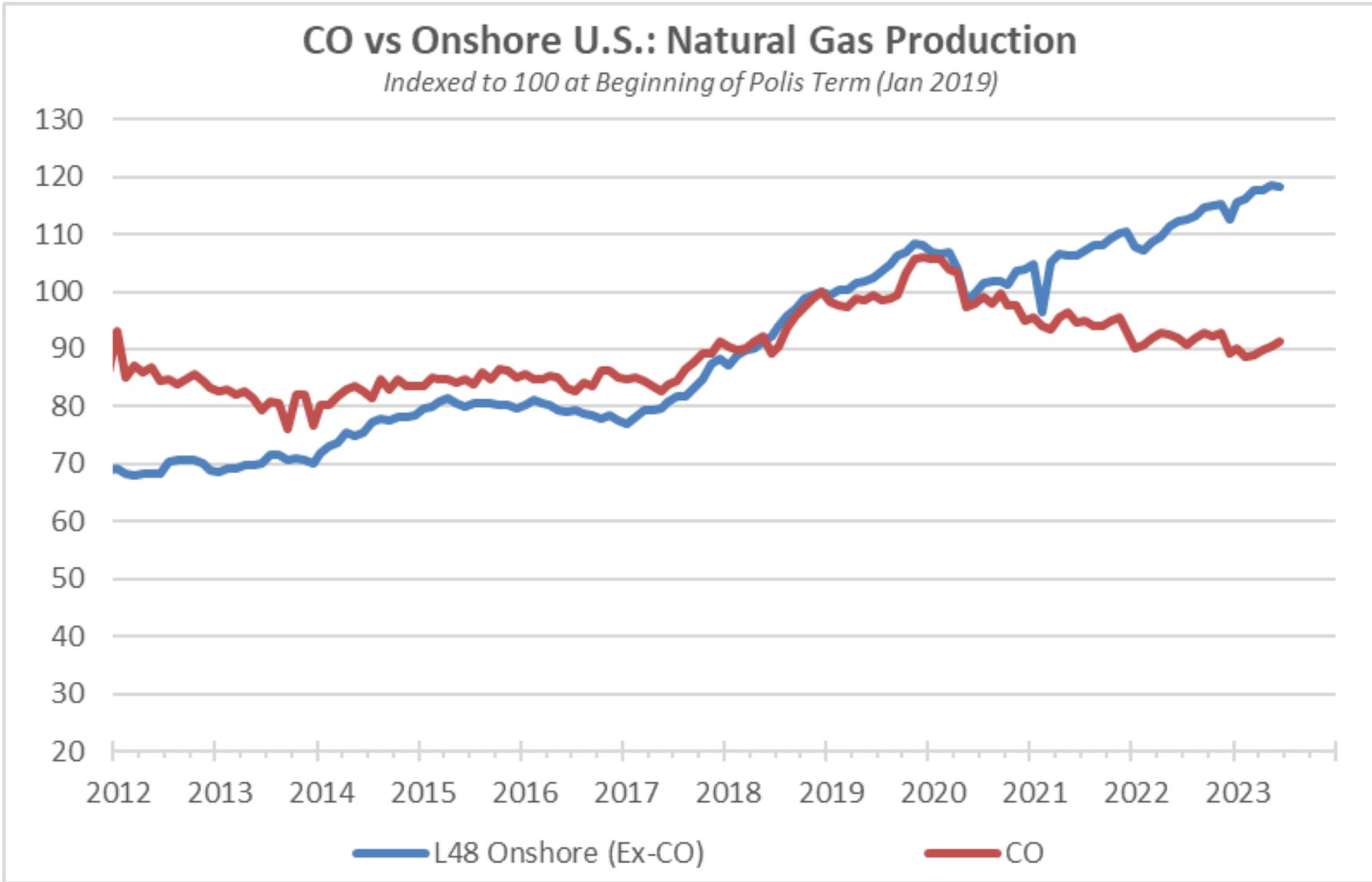
# Change In California Residential Electricity Prices, 2008 to 2022

Since 2008 when Gov. Schwarzenegger mandated renewables, CA's electric rates grew 3.2x faster than the rest of the U.S.



**YES**

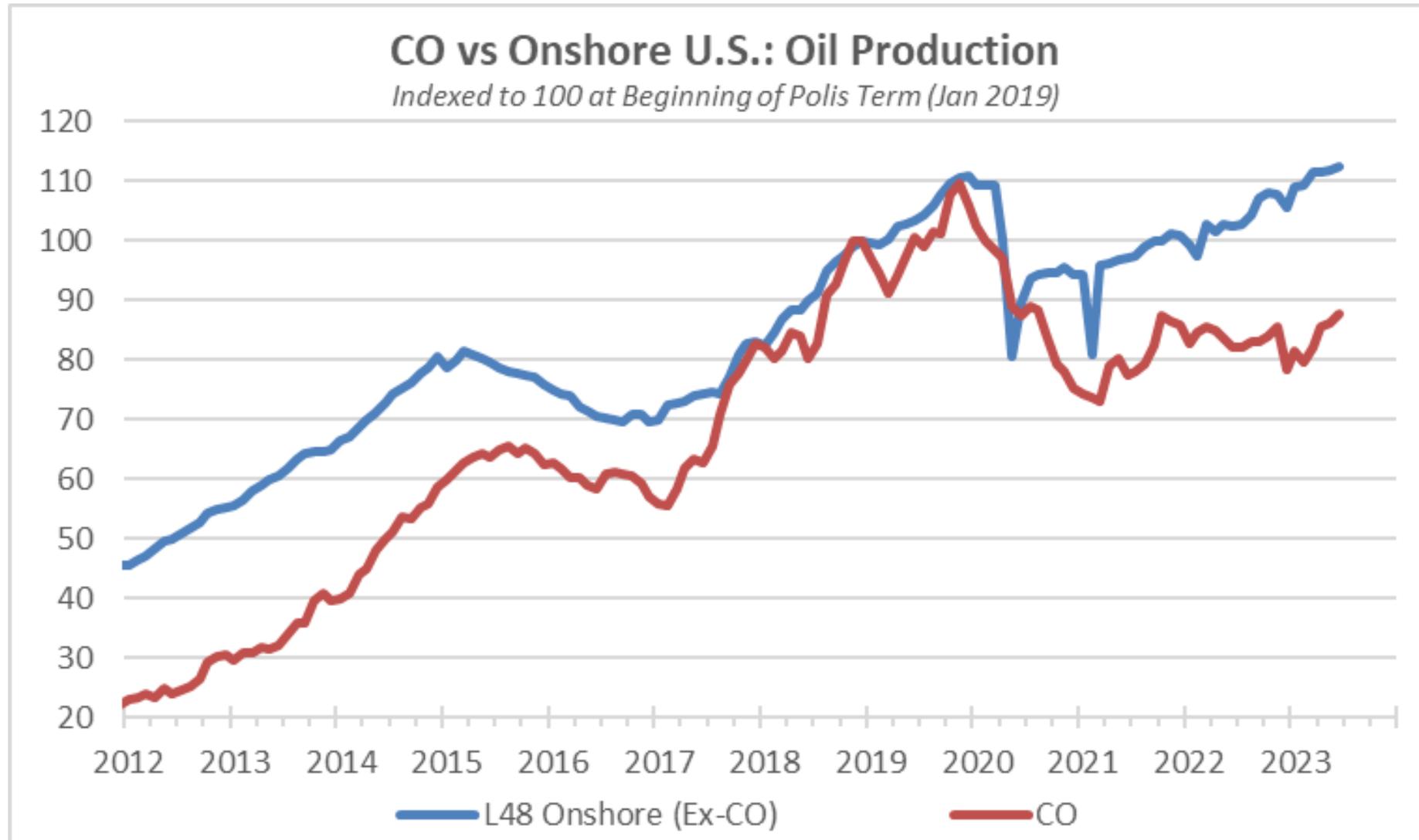
# Colorado Natural Gas Production Down 9% Since Polis Took Office\*



Rest of L48 onshore is up 8%, so effectively a 27% decline in gas production

Source: Ryan Zorn, Bijou Insights

# Colorado Oil Production Down 12% Since Polis Took Office\*



Rest of Lower 48 is up 12% so effectively a 24% decline in oil production

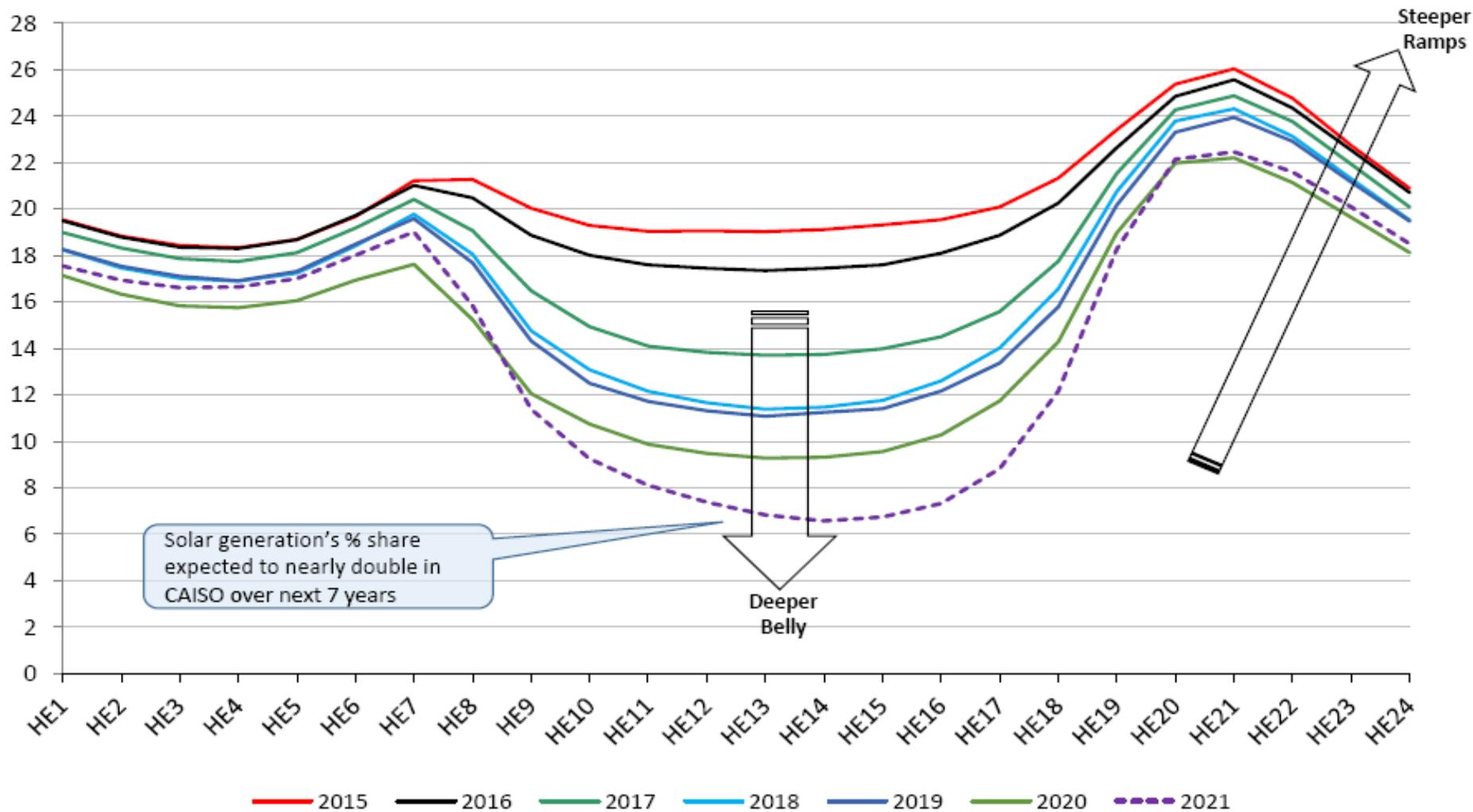
Colorado Governor Jared Polis's goal of 100% renewable (wind, solar, and batteries) electric grid by 2040 (hereafter, the "Polis Plan") would cost the state \$318.8 billion through 2050

Xcel announced two days ago that they plan to:

- Close all coal-fired electric generation plants by 2030
- Add 3,400 MW of wind resources
- Add 2,000 MW of solar resources
- Add 19 MW of biomass capacity at the Hayden Generating Station
- Add 628 MW of highly flexible natural gas combustion turbines
- Retire a total of 1,800 MW of dispatchable resources

# Growth in wind/solar resource will amplify hourly swings in net load stressing pipeline systems that rely on ratable 1/24 deliveries

Average Hourly Net Load Profile (April)  
(GW)



nuclear phase-out

## Katrin Göring-Eckardt expects electricity prices to fall

The Vice-President of the Bundestag believes that concerns about rising electricity prices after the nuclear phase-out are unfounded. "The price of electricity will of course become cheaper," she says.

Updated on April 11, 2023 at 1:25 p.m. © / Source: ZEIT ONLINE, AFP, dpa, isd / 672 comments / /

hear article

ZEIT ONLINE



## Switching to renewable energy could save trillions - study

By Jonah Fisher  
BBC Environment Correspondent

🕒 2 days ago



PHILIP SILVERMAN

The cost of green energy like wind and solar has been falling for decades

## Personality predictors of left-wing authoritarianism:

- Coherent set of beliefs statistically associated with progressive causes
- Allied with the willingness to impose them with **fear of force and compulsion**
- Manipulativeness
- Predatory parasitism
- Narcissism

“It takes a particular kind of evil snake to mask your psychopathic power-mongering in the guise of compassion.”

- When it comes to human freedom and human nature, does banning certain options for energy sound like democracy or authoritarianism and compulsory communism?
- The net-zero zealots want to change the way you eat, drive, cook and heat your house in defiance of the laws of physics and thermodynamics.
- Does that sound like freedom, does that sound like democracy?
- Why does every solution to climate change require another step down into the basement of socialism?

Progressives don't understand scale.

Daniel Yergin: "... this is a \$90 trillion world economy that gets 80% of its energy from hydrocarbons. It's not going to change overnight."

## Bryce Advice



Be skeptical

[RobertBryce.substack.com](http://RobertBryce.substack.com)

[Unreportedstoryrsociety.com](http://Unreportedstoryrsociety.com)

[AlexEpstein.substack.com](http://AlexEpstein.substack.com)

[@Shellenberger](https://twitter.com/Shellenberger)

[Committeetounleashprosperity.com](http://Committeetounleashprosperity.com)

[Doomberg.substack.com](http://Doomberg.substack.com)

[RogerPielkejr.substack.com](http://RogerPielkejr.substack.com)

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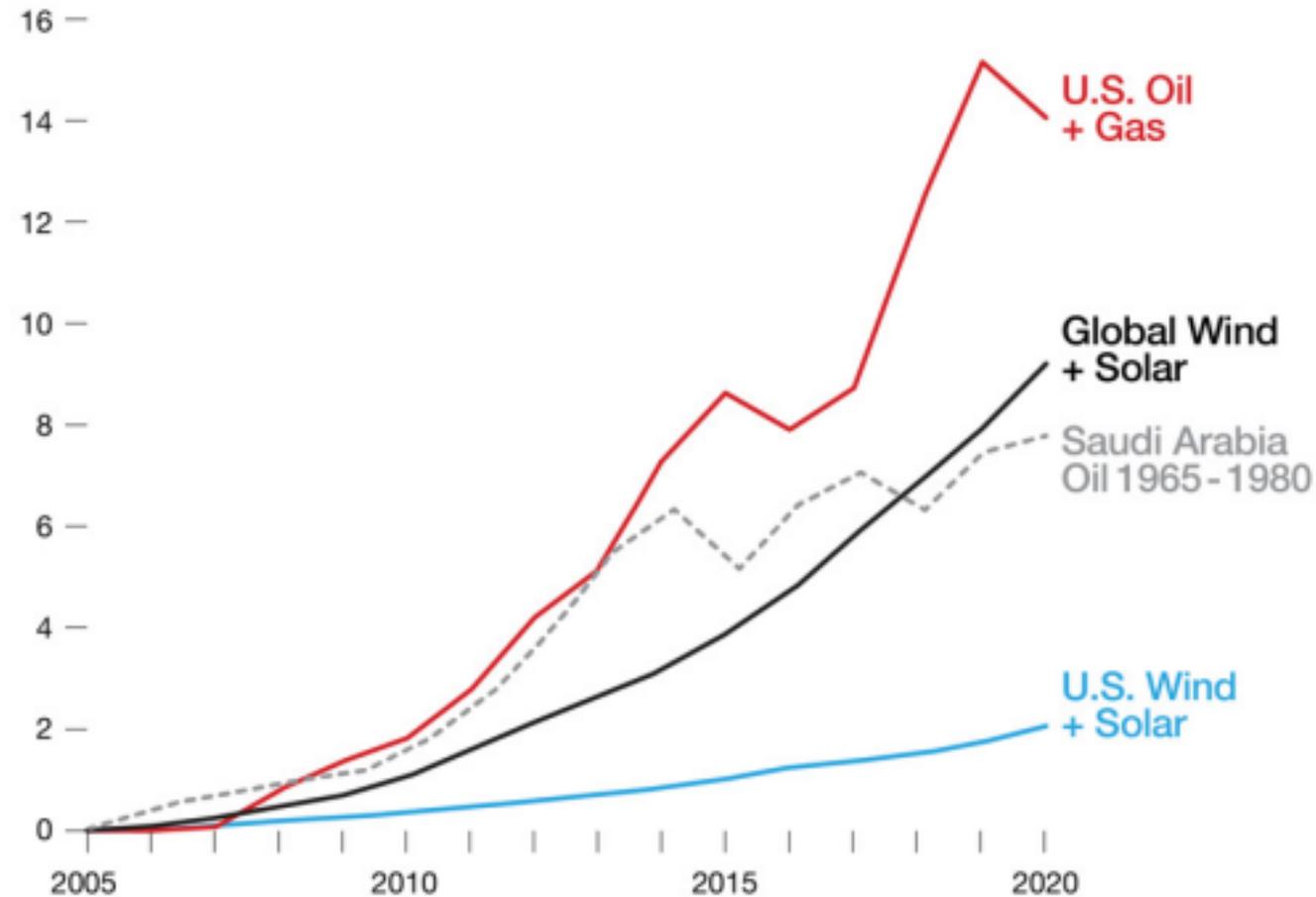
(303) 478-3233 (mobile)



# Shale Technology is History's Biggest Energy Revolution

**Growth of Shale Energy vs. Wind+Solar 2005–20, Compared with Saudi Arabia Oil 1965–80**

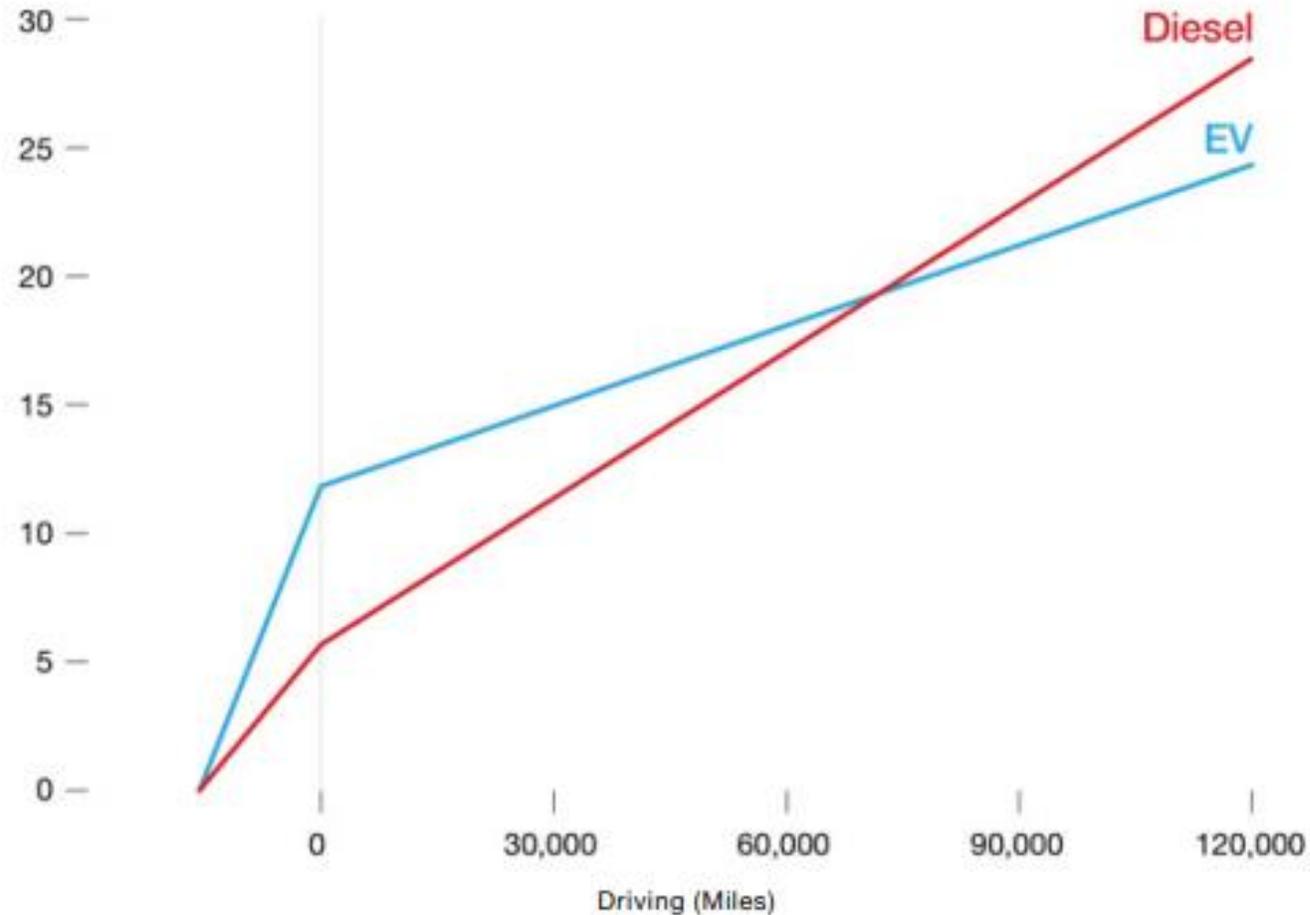
Increased Production (Million BOE/Day)



# Green Energy Isn't Carbon-Free

Miles Driven Before an EV Emits Less CO<sub>2</sub> than a Diesel Car

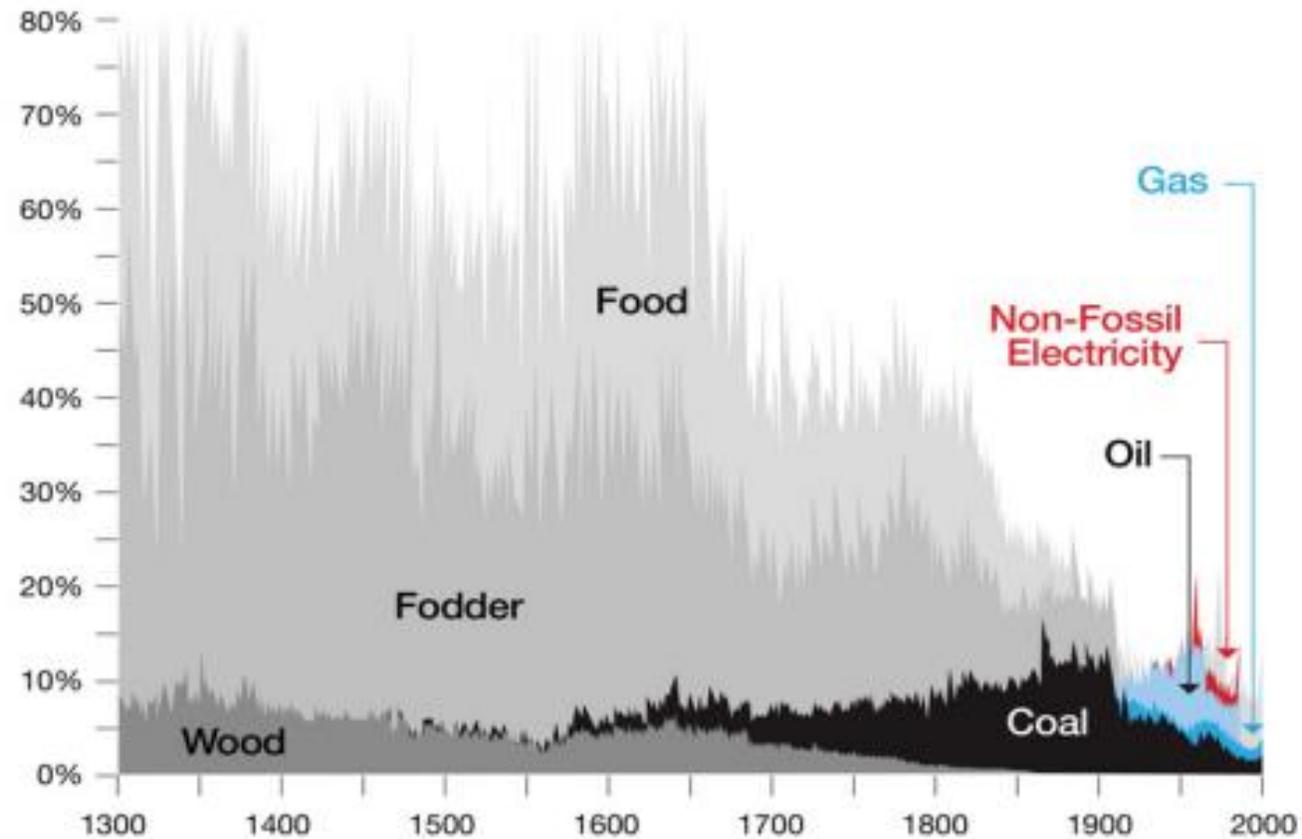
Tons CO<sub>2</sub> per Car



# Markets and Consumers Want Reliably Cheap Energy

## Share of Economies Consumed by Acquiring Fuel and Food

Share GDP Spent on Energy



Source: John W. Day et al., "The Energy Pillars of Society: Perverse Interactions of Human Resource Use, the Economy, and the Environmental Degradation," *BioPhysical Economics and Resource Quality* 3, no. 2 (February 2018)

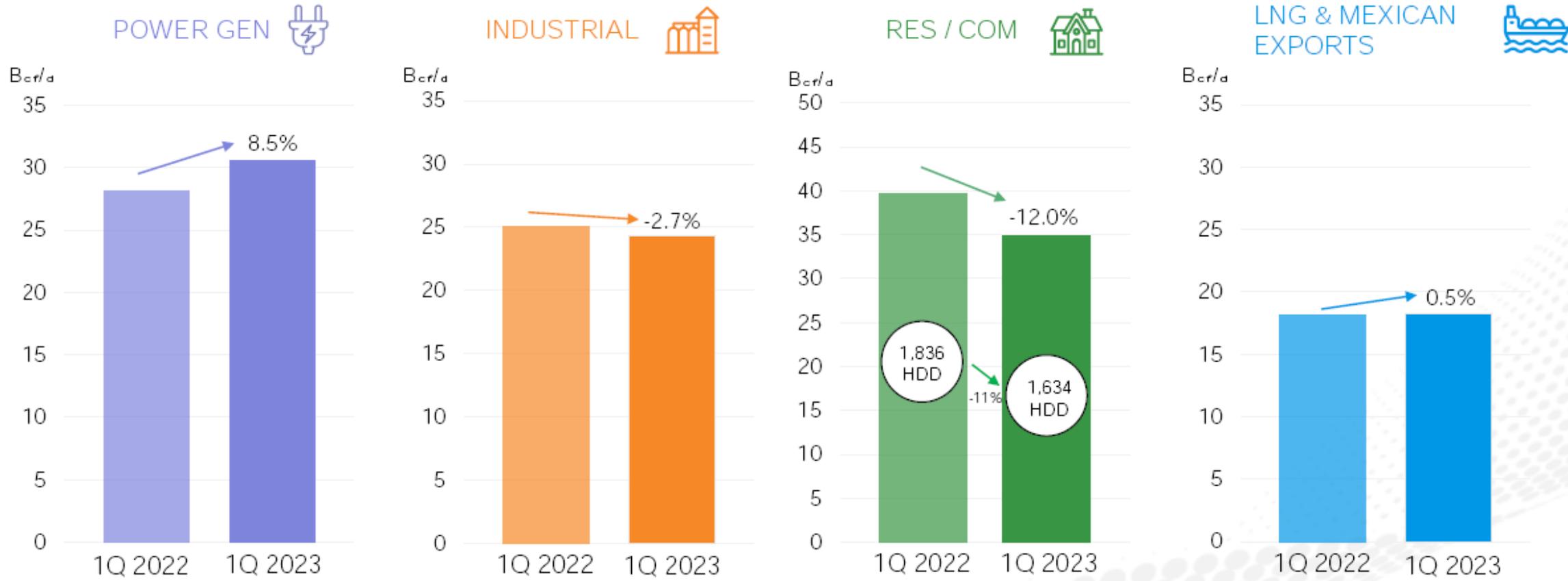
The "Energy Transition" Delusion: A Reality Reset, Mark P. Mills, The Manhattan Institute, August 2022

100 BCF	Average U.S. Daily Production and Demand
70 BCF	Russian Daily Production
50 BCF	European Union average daily usage
18 BCF	Russian export volume to Europe (2021)
12 BCF	U.S average daily LNG Export volume (2022)
12 BCF	Expected growth in U.S. LNG export capacity next 4 years
11 BCF	Worldwide daily volume of natural gas that is converted to fertilizer
11 BCF	Anticipated 24-hour swing in natural gas demand in California by 2035

- 7-8 BCF California peak day natural gas usage (2022)
- 4 BCF Colorado peak day natural gas usage
- 3 BCF Volume contained in the average LNG tanker
- 2.5 BCF Daily volume of natural gas managed by Mercator Energy
- 2 BCF Xcel Energy peak day natural gas usage (CO)
- 84 Dth Typical annual average use per U.S household
- 1 Dekatherm (Dth) = 1 MMBtu = 1 MCF (approx.)
- 10 Therms = 1 Dekatherm
- 4/10 of 1%: Percentage of total U.S. gas stove usage vs. total U.S. gas usage

# Strong gas-fired power generation driving demand

Total demand including exports averaged 116 Bcf/d in 1Q 2023 compared to 119 Bcf/d in 1Q 2022, driven by declines in the Res/Com sector due to a mild winter season

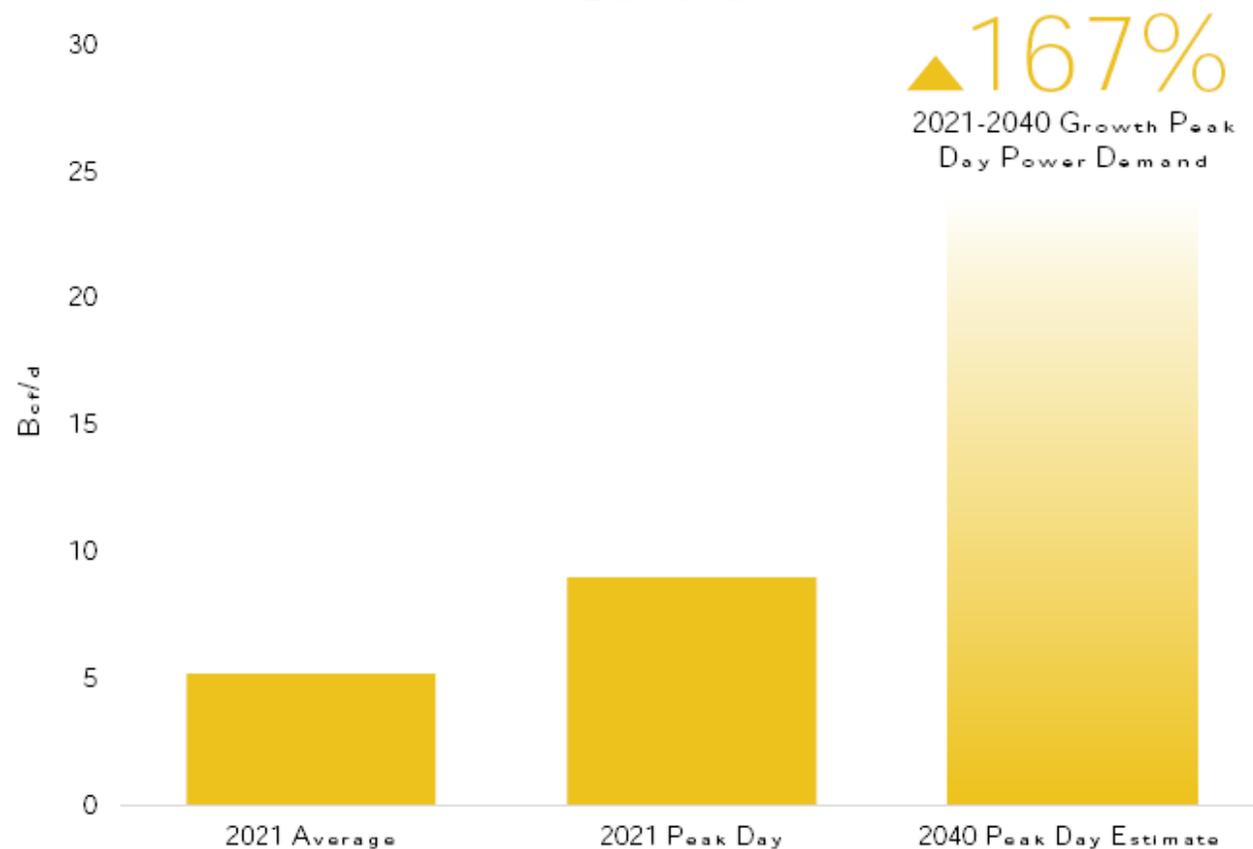


LOWER-48 NATURAL GAS DEMAND + EXPORTS 1Q 2022 v. 1Q 2023 COMPARISON

Source: S&P Global Commodity Insights ©2023. Note: Pipetoss/Fuel demand is excluded from the charts and that HDD is U.S. population-weighted Heating Degree Days.

# Access to natural gas pipeline capacity critical to ensure reliability

2021 PJM Average and Peak Day Power Demand versus 2040 Estimated Peak Day Power Demand<sup>1</sup>



Natural gas plays a critical role in decarbonizing U.S. power supply



PJM peak day gas demand for power generation expected to increase due to growth in electrification



Natural gas pipeline contracted capacity is critical to ensure electric reliability on peak days



Transco footprint situated to benefit from contracted capacity to meet growing peak day demand

<sup>1</sup>"The role of gas in the transition to a cleaner, more reliable power supply," McKinsey & Company, June 2023. McKinsey & Company deep power decarbonization scenario assumes all public commitments are met, resulting in 85% renewable power generation by 2040 and growth of electricity demand to 7.3 TWh by 2040 (from 4.3 TWh in 2022).

**I WOULD RATHER  
ADJUST MY LIFE  
TO YOUR ABSENCE  
THAN ADJUST MY  
BOUNDARIES TO  
ACCOMMODATE  
YOUR DISRESPECT.**