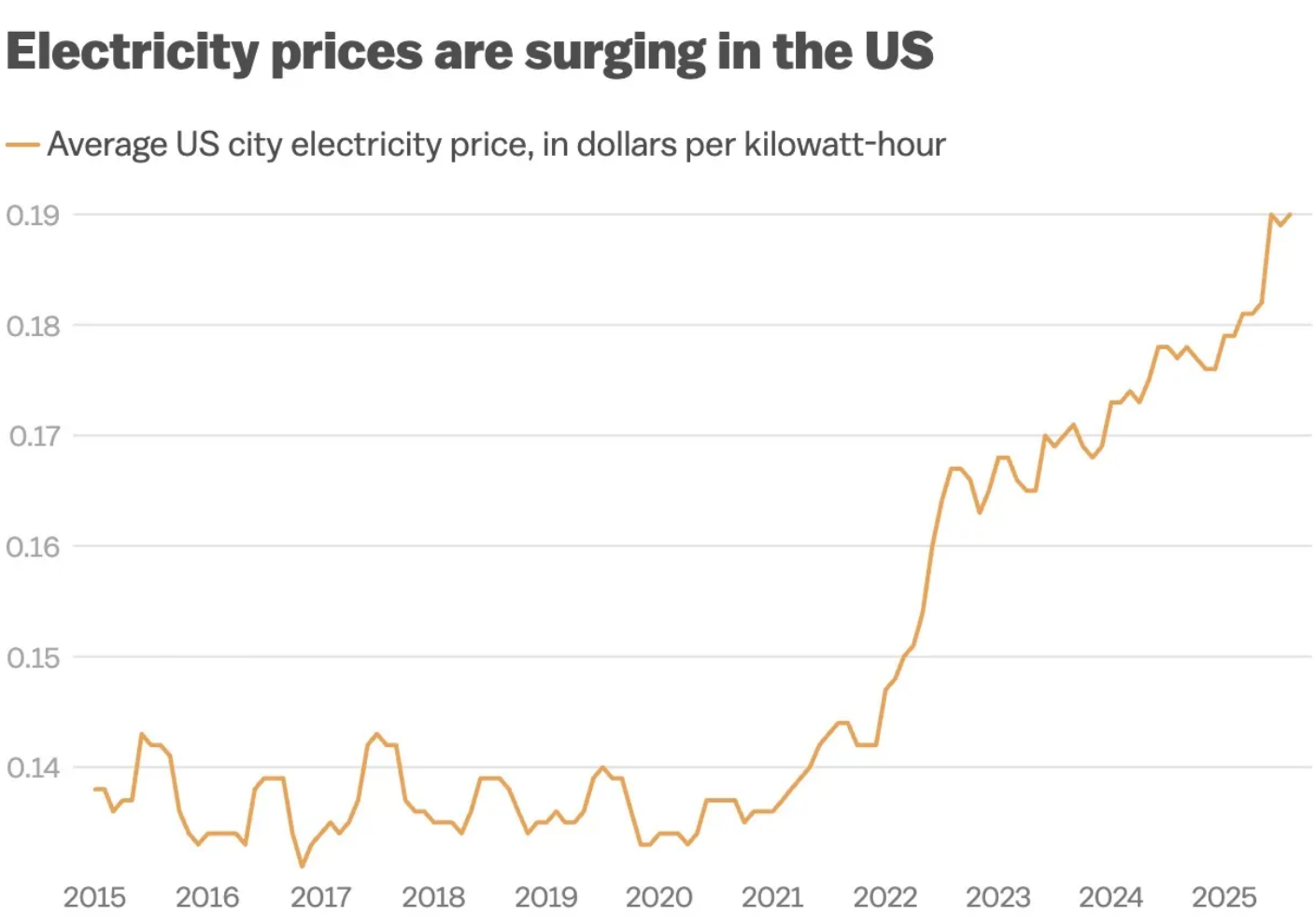
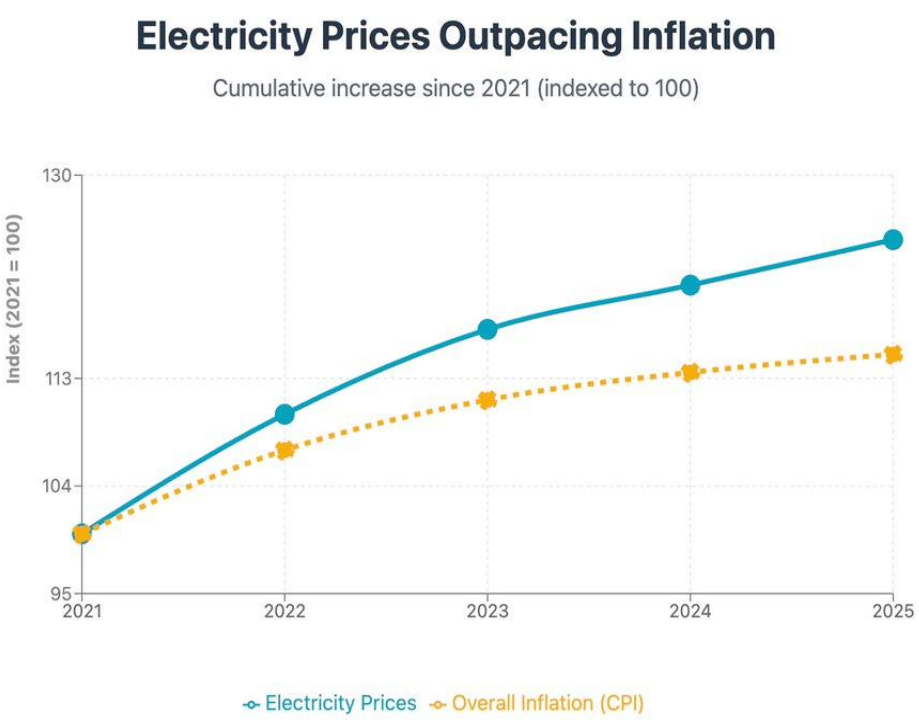
The Increasing Impact of Unaffordable Electricity

Richard Heinberg

Post Carbon Institute

12/16/25





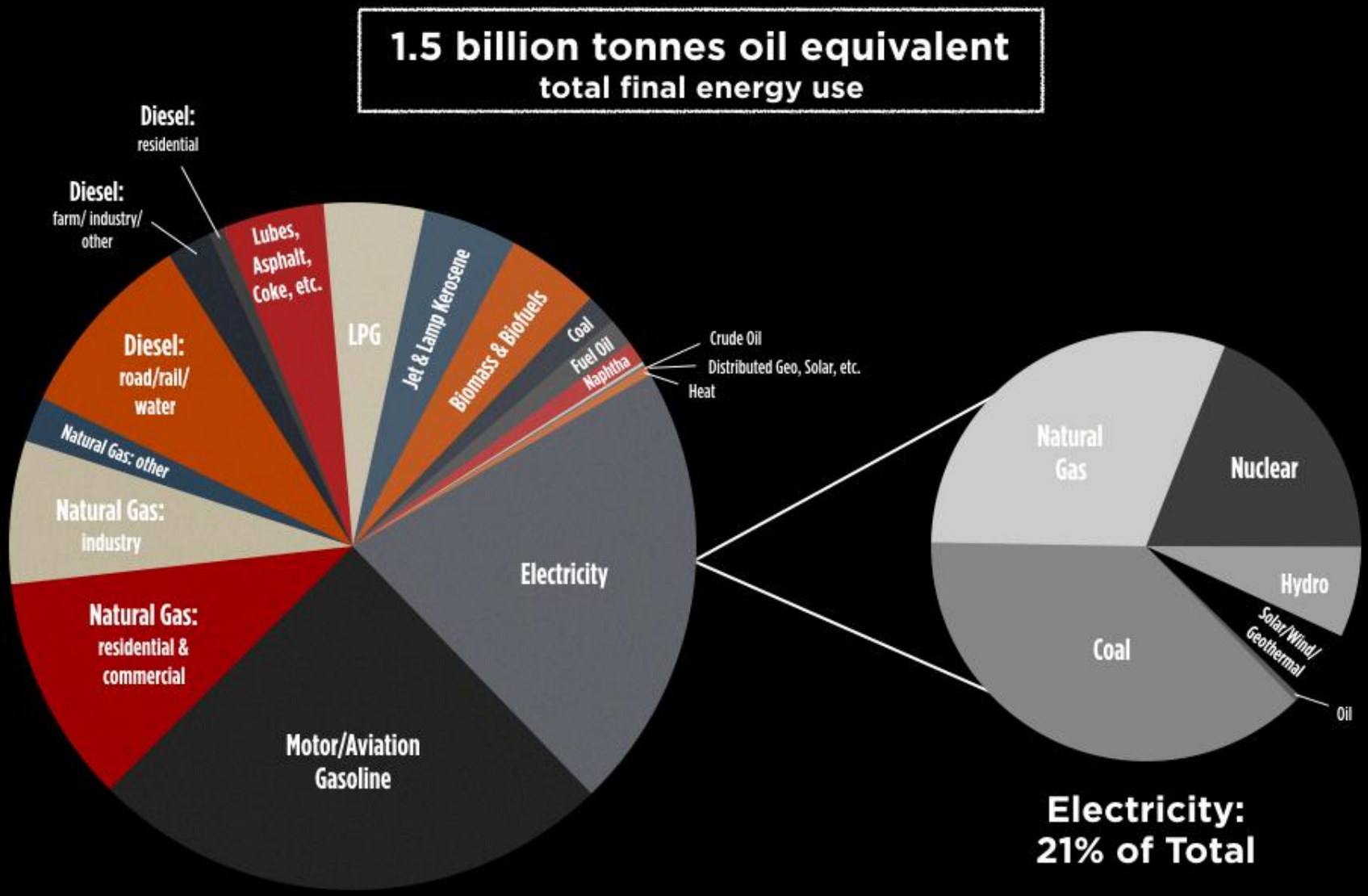
Source: Wired wired.com/story/power-bills-in-the-us-are-soaring-and-will-rise-further-still/

much higher than the rate of inflation

Why is this a problem?

- Energy *is* the economy
- Electrification and the energy transition

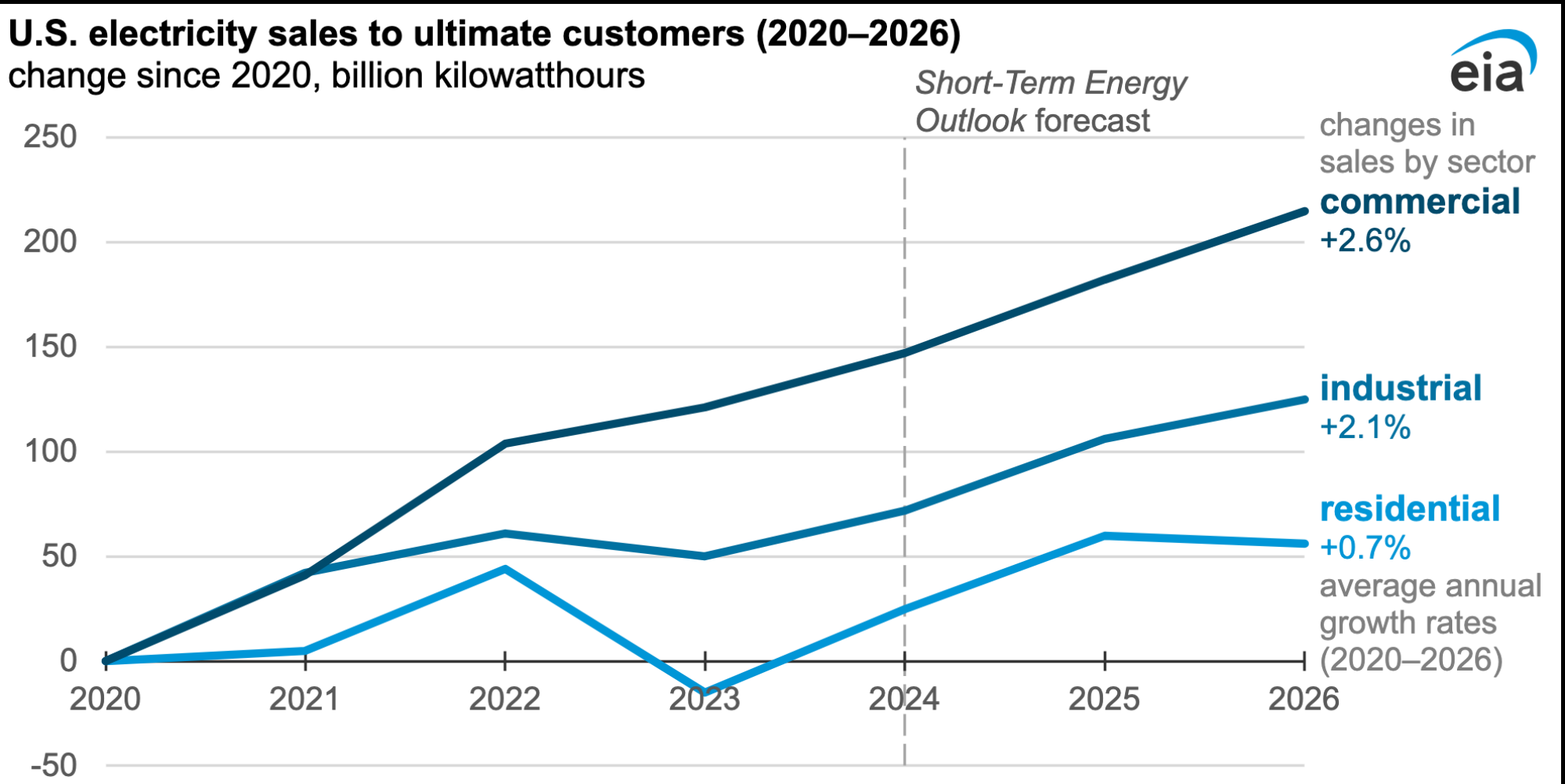
U.S. final energy consumption



sources: IEA Energy Balances; U.S. EIA

Why is this a problem?

- Energy *is* the economy
- Electrification and the energy transition
- Could the crippling 1970s oil crisis recur—
  but with electricity instead?


U.S. electricity sales to ultimate customers (2020–2026)
change since 2020, billion kilowatthours
Short-Term Energy Outlook forecast
eia
250
200
150
100
50
0
-50
2020
2021
2022
2023
2024
2025
2026
changes in sales by sector
commercial
+2.6%
industrial
+2.1%
residential
+0.7%
average annual growth rates (2020–2026)

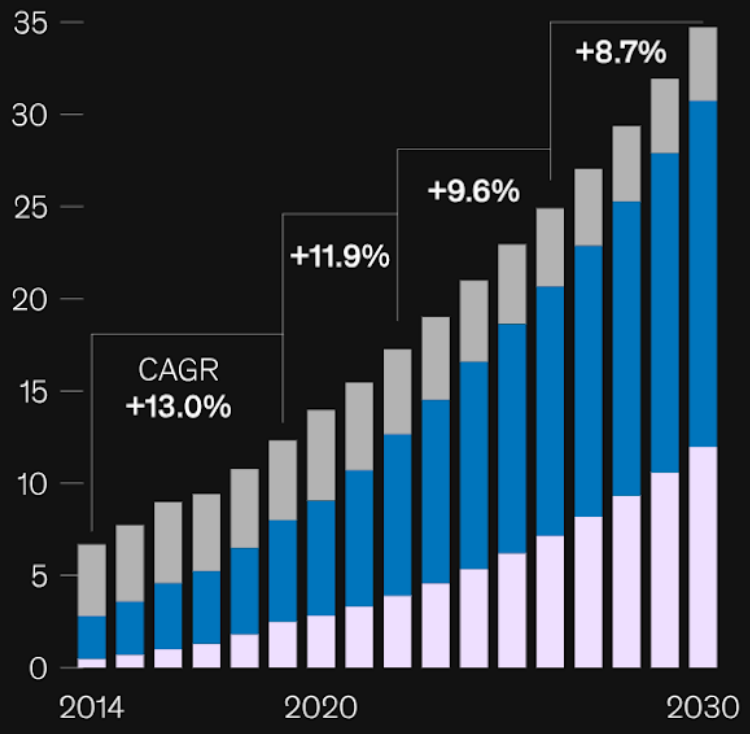
Over 1200 new data centers

each requiring up to 100 megawatts of power

Photo: Associated Press

US data center demand is forecast to grow by some 10 percent a year until 2030.

Data center power consumption, by providers/enterprises,[1] gigawatts



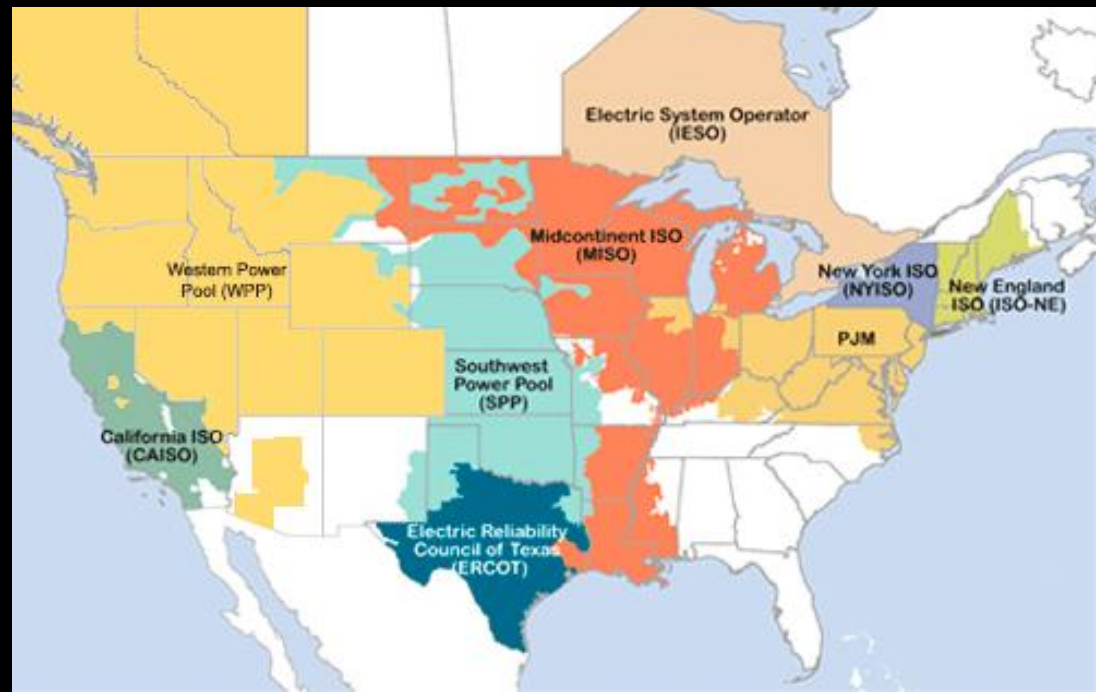
[1]Demand is measured by power consumption to reflect the number of servers a data center can house. Demand includes megawatts for storage, servers, and networks.

McKinsey & Company

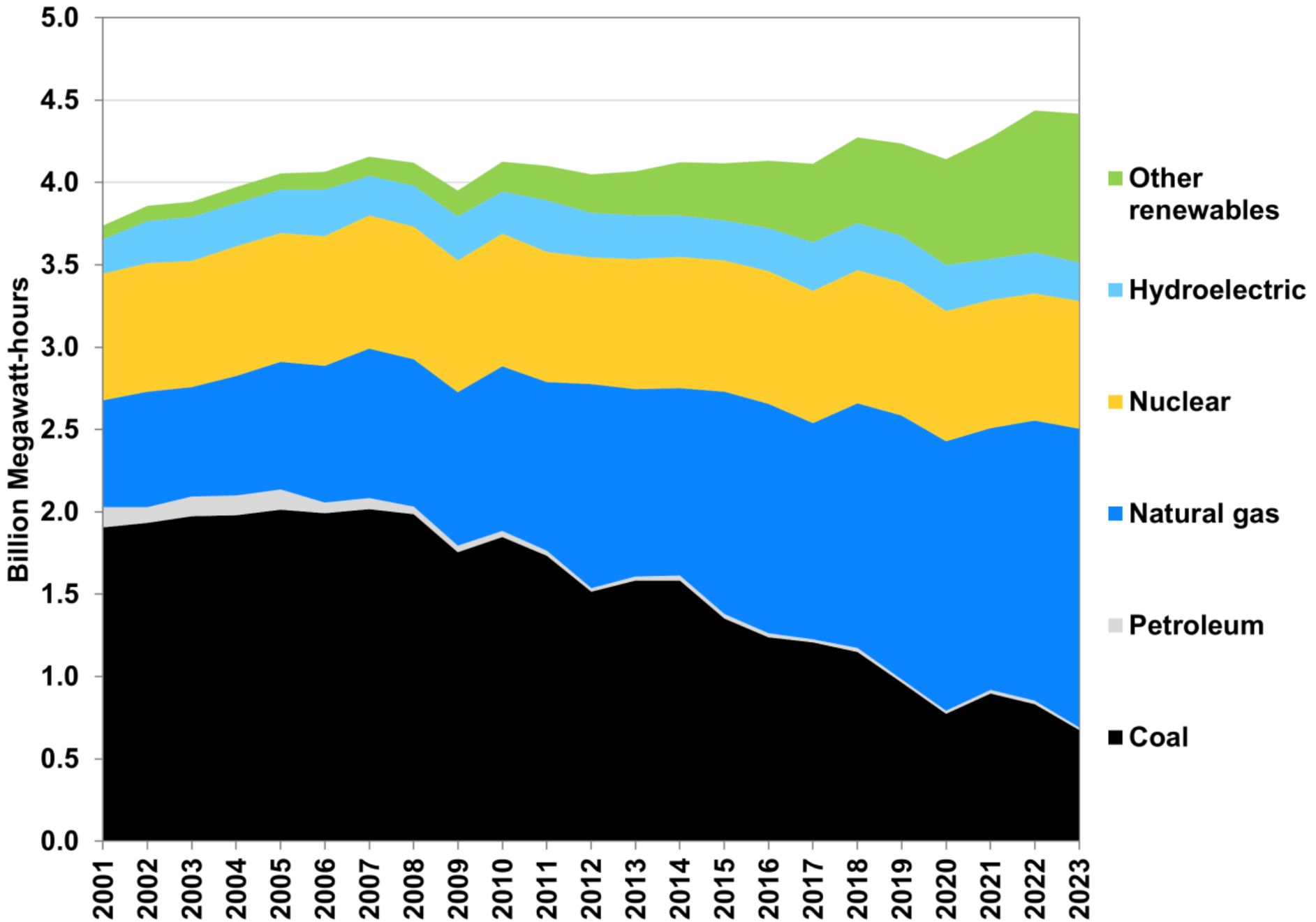
Estimates: 10-12% of total US electricity demand by 2030

Case study

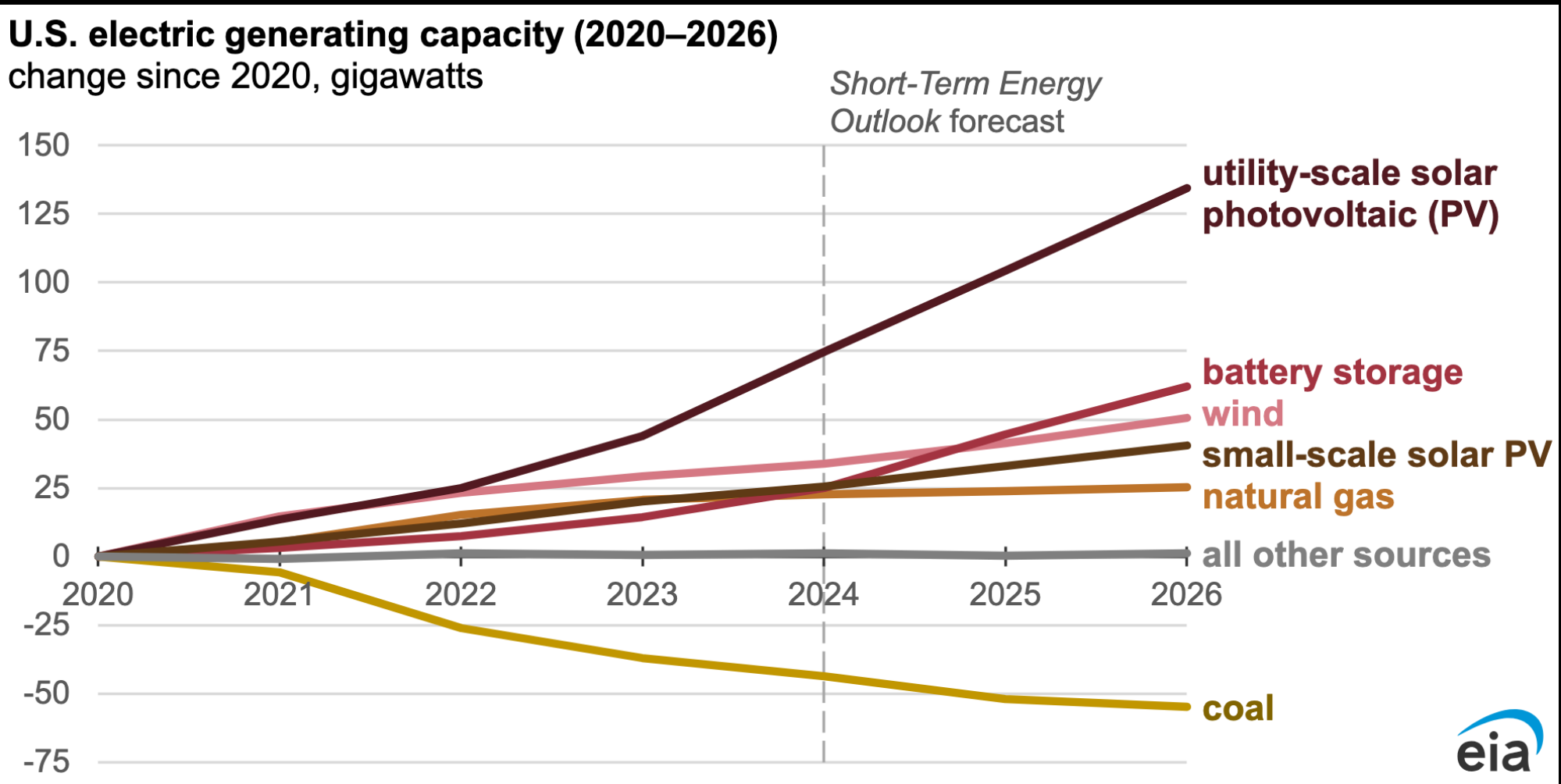
- PJM Interconnection adds data centers to the grid in mid-Atlantic and Midwest states
- Regulatory watchdog Marketing Analytics advises FERC not to permit more PJM connections due to risk of blackouts



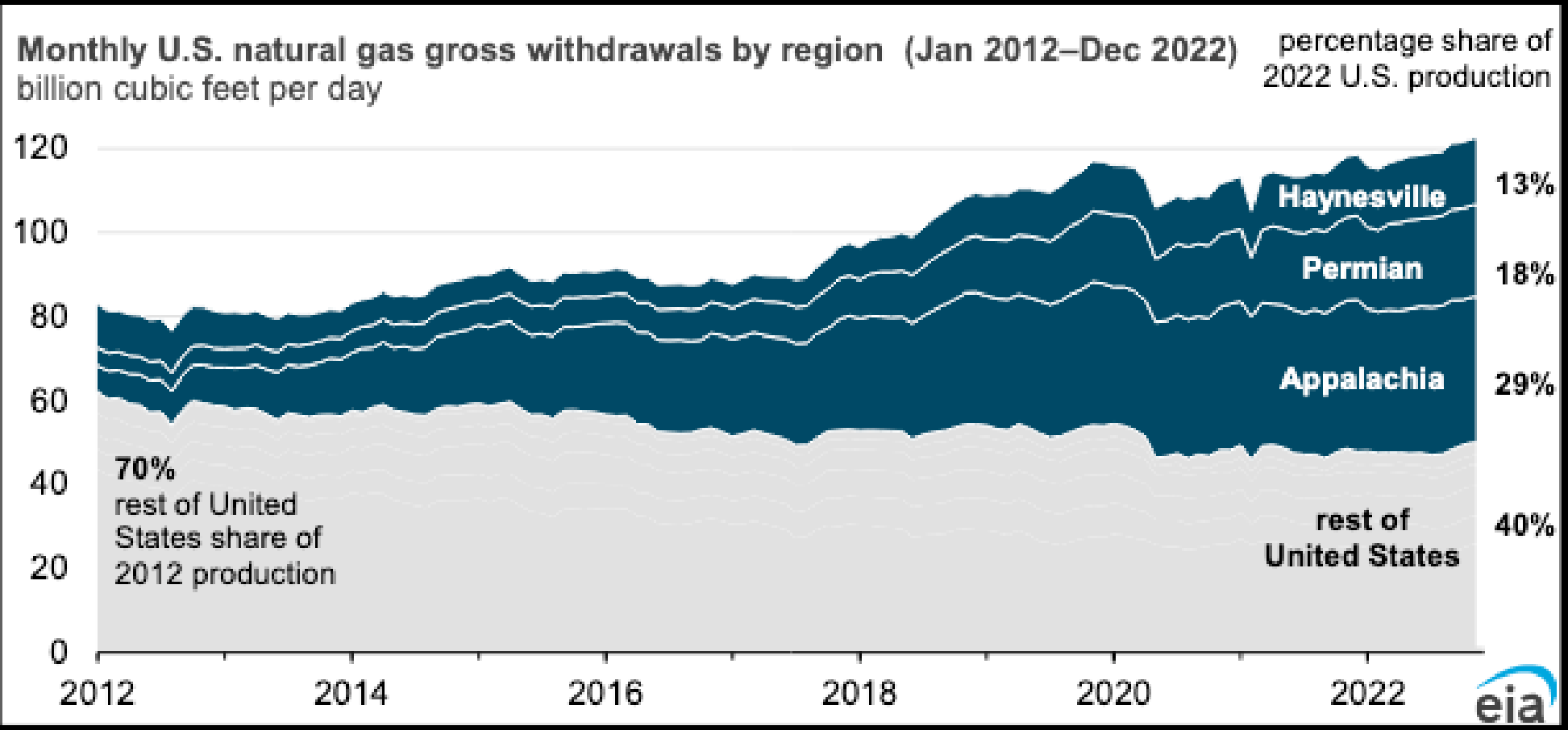
utilitydive.com/news/pjm-data-center-interconnection-market-monitor-ferc-complaint/806527/


Net Generation of Electricity for All Sectors by Source, 2001–2023
Billion Megawatt-hours
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Other renewables
Hydroelectric
Nuclear
Natural gas
Petroleum
Coal

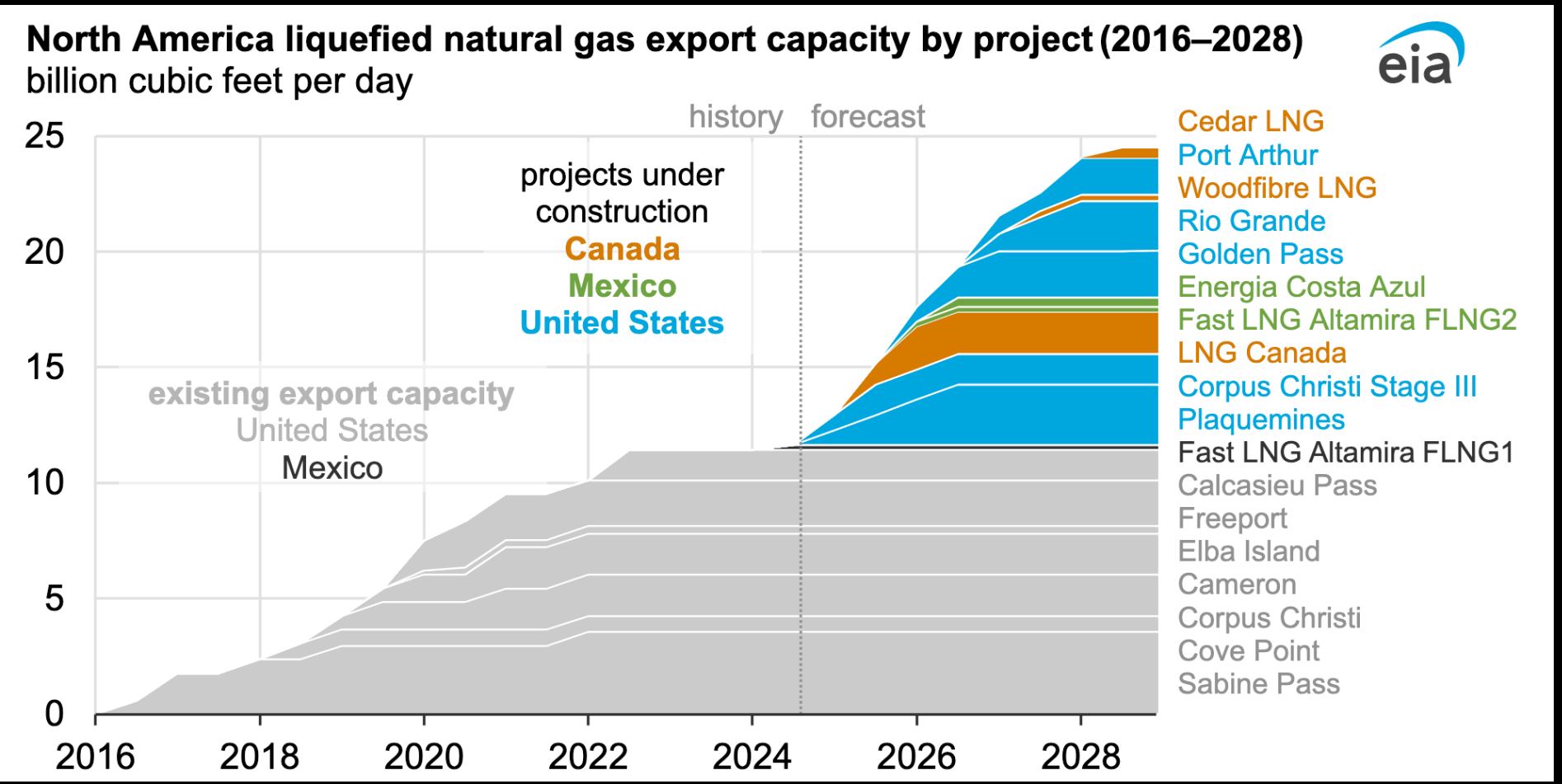
Source: EIA


U.S. electric generating capacity (2020–2026)
change since 2020, gigawatts
Short-Term Energy Outlook forecast
150
125
100
75
50
25
0
-25
-50
-75
2020
2021
2022
2023
2024
2025
2026
utility-scale solar photovoltaic (PV)
battery storage
wind
small-scale solar PV
natural gas
all other sources
coal
eia

Natural Gas

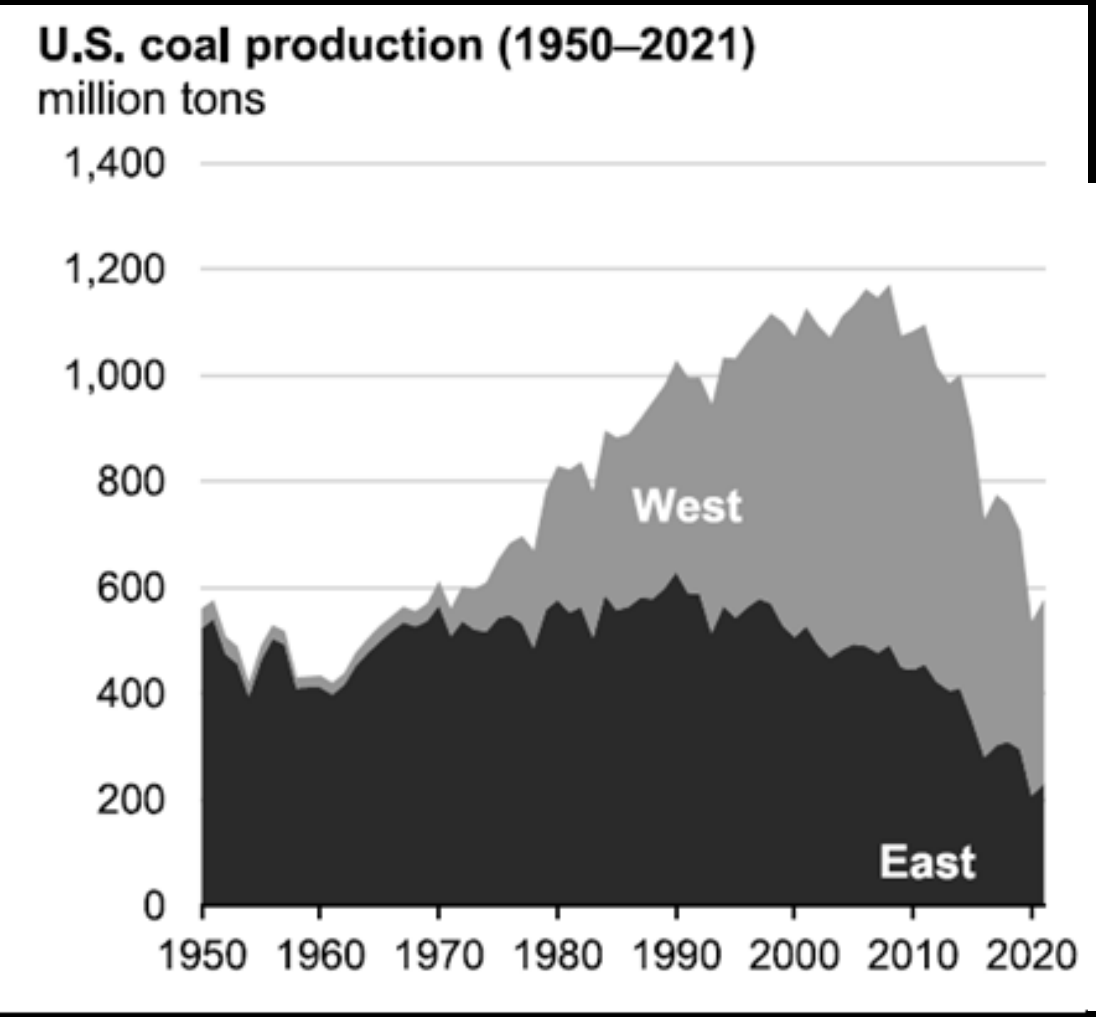

Monthly U.S. natural gas gross withdrawals by region (Jan 2012–Dec 2022)
billion cubic feet per day
percentage share of 2022 U.S. production
120
100
80
60
40
20
0
2012
2014
2016
2018
2020
2022
Haynesville
13%
Permian
18%
Appalachia
29%
rest of United States
40%
70% rest of United States share of 2012 production
eia

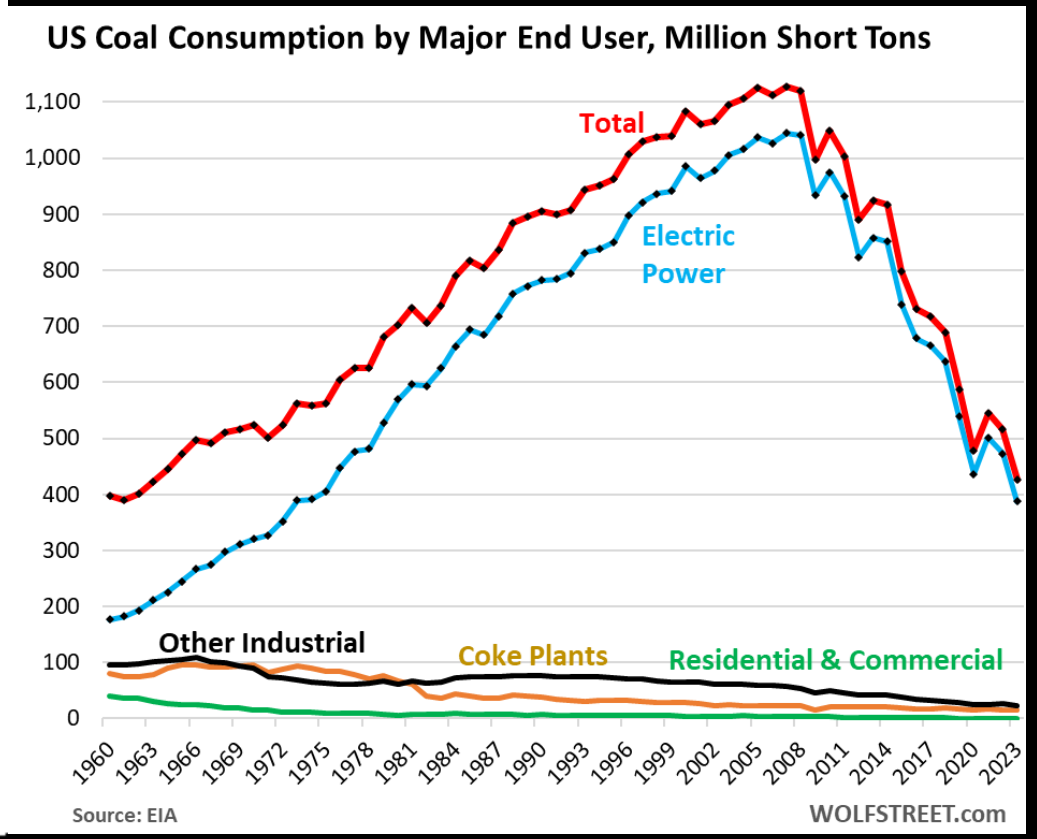
LNG



10% of total gas production by 2030

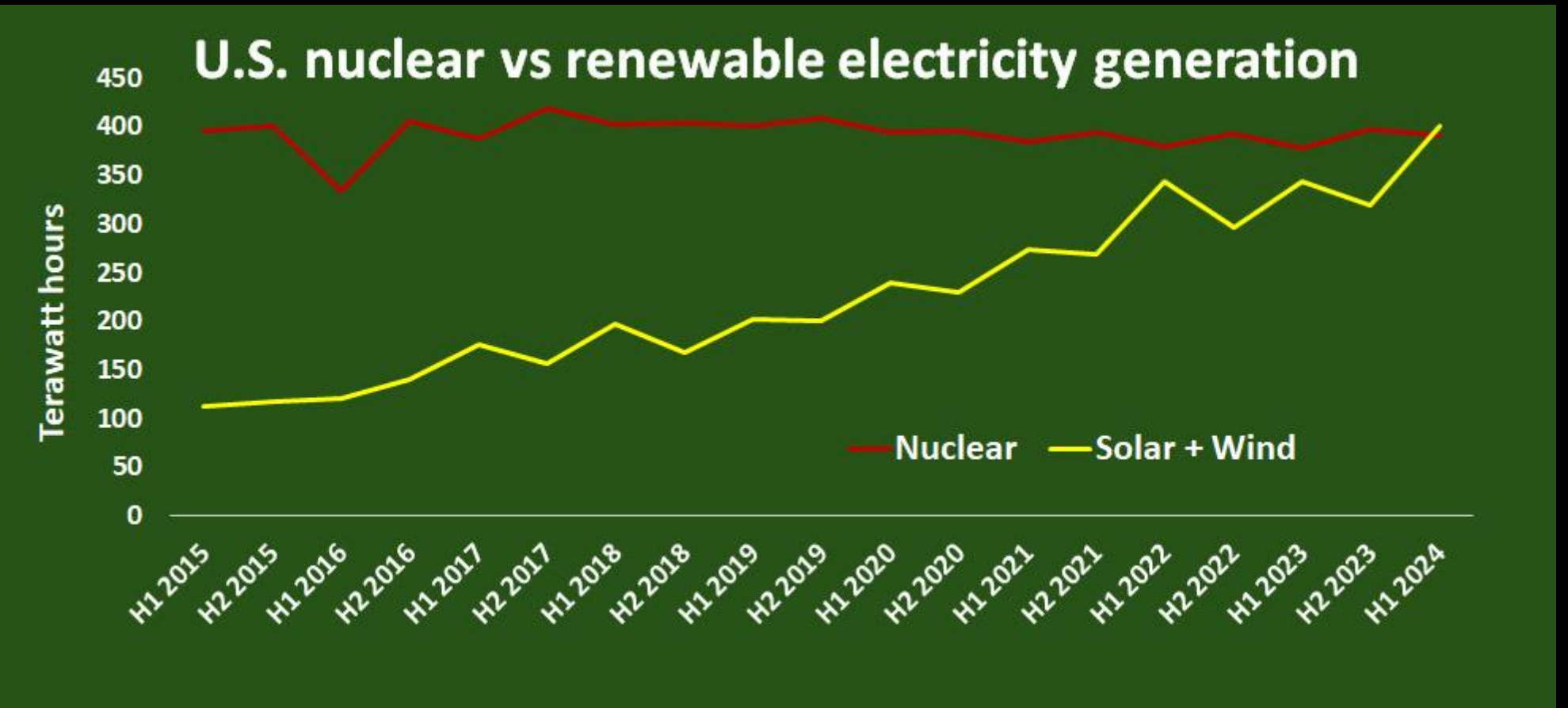
Coal


U.S. coal production (1950–2021)
million tons
1,400
1,200
1,000
800
600
400
200
0
1950
1960
1970
1980
1990
2000
2010
2020
West
East


US Coal Consumption by Major End User, Million Short Tons
1,100
1,000
900
800
700
600
500
400
300
200
100
0
Total
Electric Power
Other Industrial
Coke Plants
Residential & Commercial
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020
2023
Source: EIA
WOLFSTREET.com

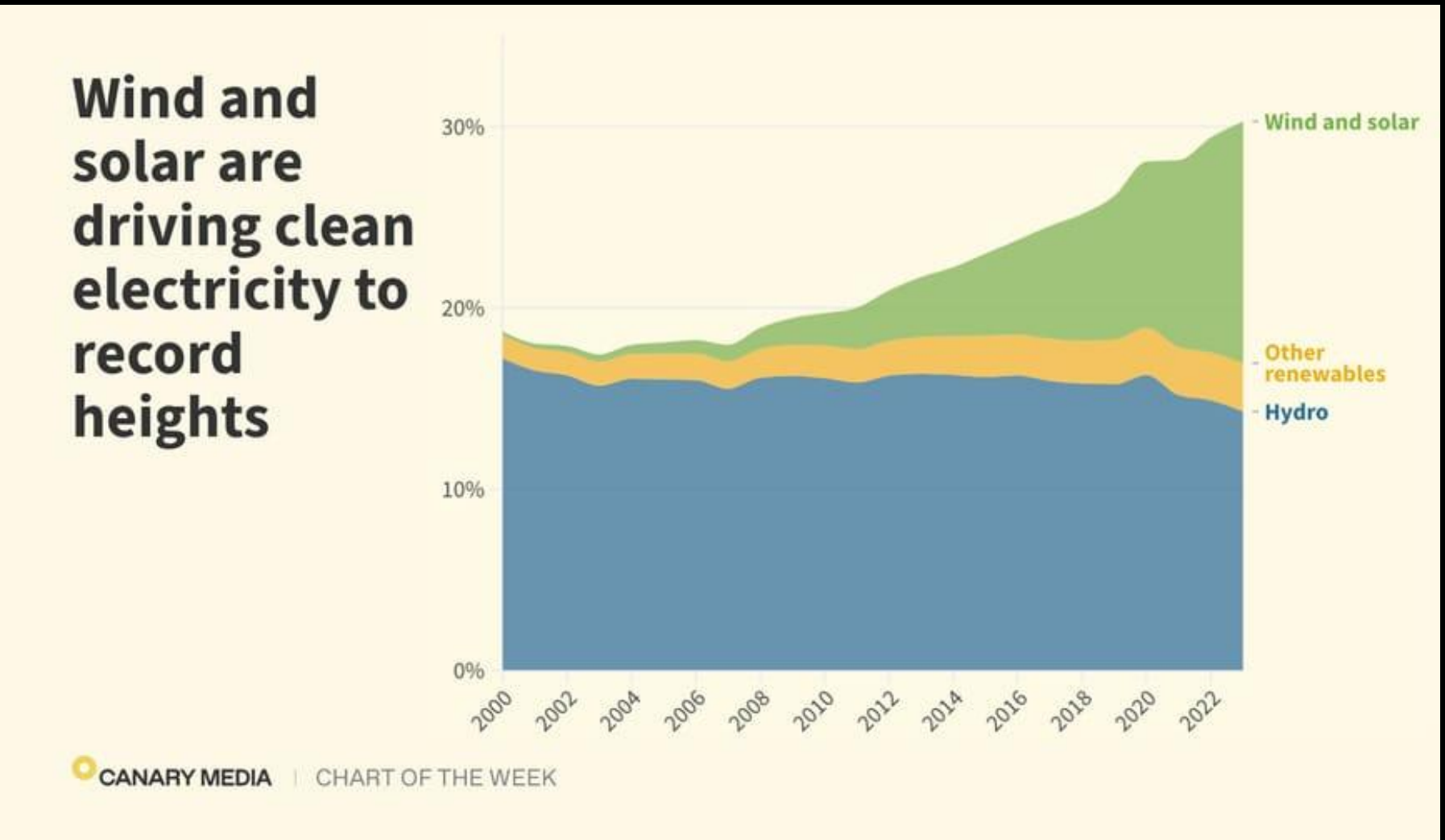
Nuclear

Last 20 years: 12 plants retired, 2 new ones put in service



Data: EIA

Renewables



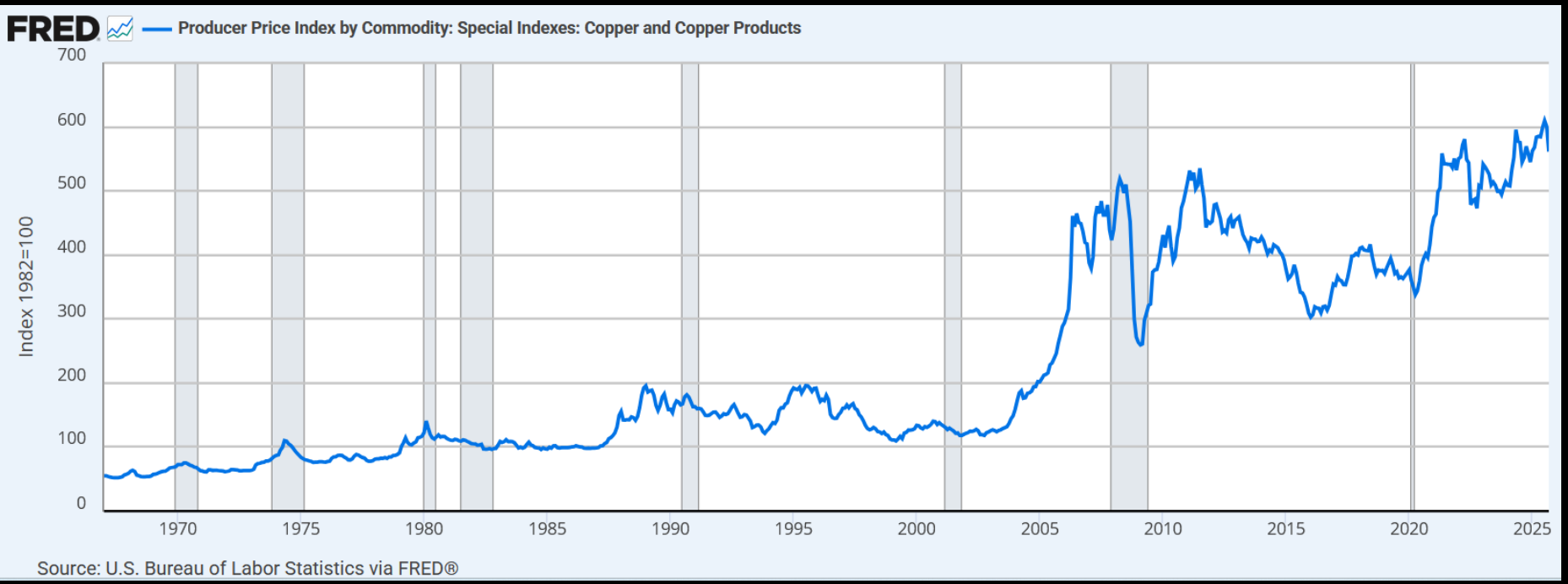
Data: EIA

Materials for renewable transition

- Many are scarce, including rare earths
- Some are already significantly depleted, including copper and sand
- Geopolitical challenges
- Recycling is possible but insufficient

Copper

- Ore grades are declining, requiring more energy per unit of production
- Discoveries declining, most mines are old



Grid vulnerabilities

- Complexity, spare parts, materials
- Hostile acts, foreign or domestic
- Carrington event
- Demand growth makes other problems harder to solve

Energy transition

- Electrify everything!
- Biggest industrial project in history
- Unrealistic without demand management and reduction

Big picture

- The transition to renewable energy (via electrification) is inevitable, necessary, and in progress
- Most attention is focused on how to *supply* renewable energy; less on how we *use* energy, how to develop substitutes for complex production processes, and how to restructure supply chains
- Vast efforts will be required to electrify and decarbonize
- Efficiency and reduction of demand must be at least as high a priority as supply

Solution: Demand management

- Regulate AI, including limiting data centers
- AI dedicated generation, renewables

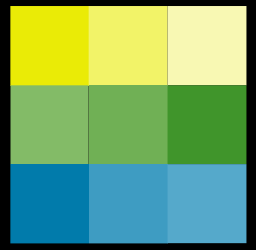
Data centers with dedicated generation,
not grid-tied, renewable sources:
currently only a tiny segment

Demand management

- Regulate AI, including limiting data centers
- AI dedicated generation, renewables
- More electric coops and community ownership, less investor ownership

Still required:
action from national government

- Energy conservation as national priority
- Long-range planning for supply and demand management during the transition
- Technology assessment
- AI regulation



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