

Georgia's Advantageous Electricity Market Structure

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MEAG MAYORS SUMMIT

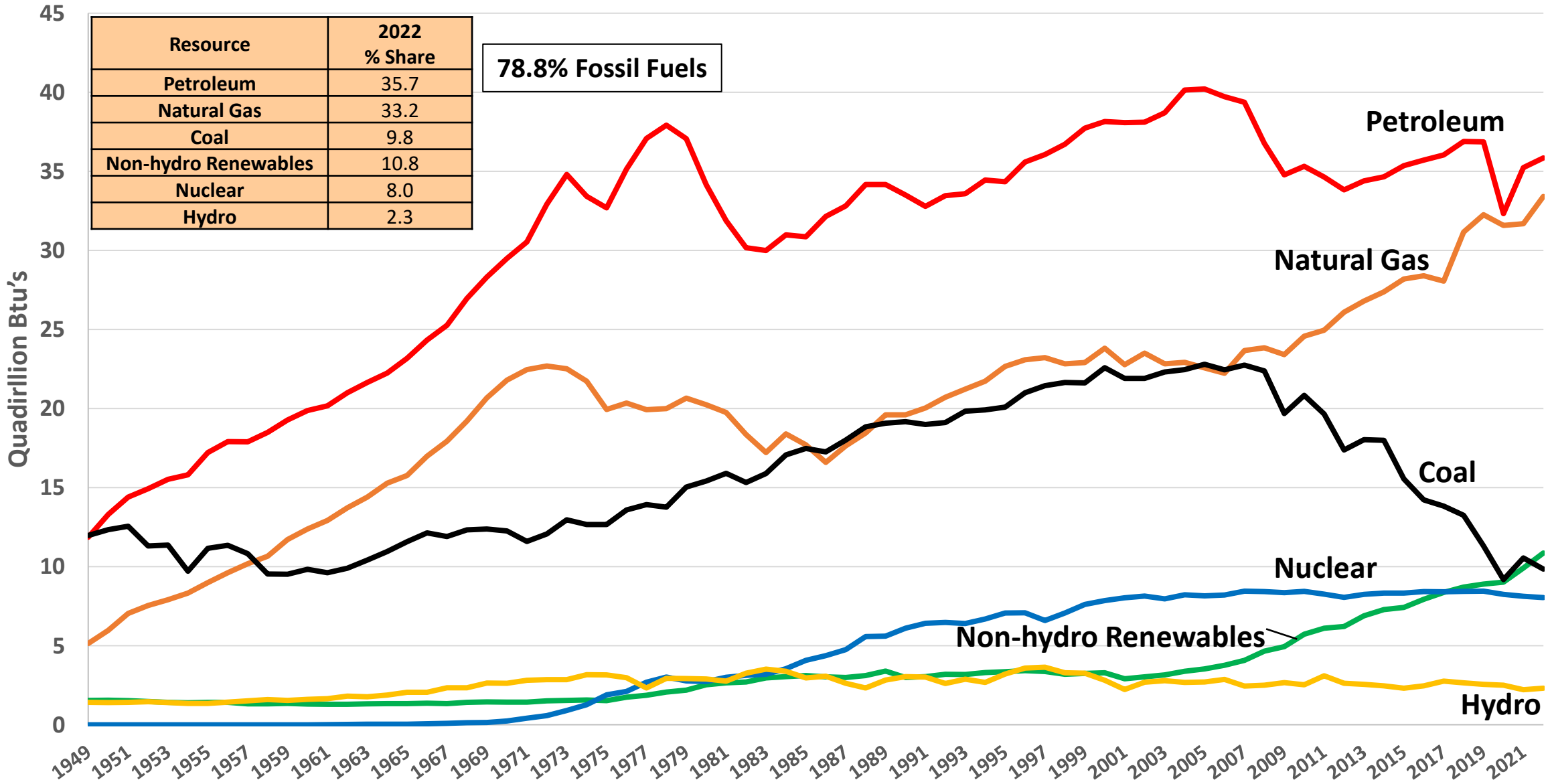
NOVEMBER 11, 2023

Outline

1. Energy and power generation overview
2. Georgia in context
 - Relative to top GDPs in the U.S.
3. U.S. energy policy
 - Broader implications

U.S. Total Energy Consumption: Transportation, Electricity, Heat

— Petroleum
 — Natural Gas
 — Non-hydro Renewables
 — Coal
 — Nuclear
 — Hydro



Resource	2022 % Share
Petroleum	35.7
Natural Gas	33.2
Coal	9.8
Non-hydro Renewables	10.8
Nuclear	8.0
Hydro	2.3

78.8% Fossil Fuels

Petroleum

Natural Gas

Coal

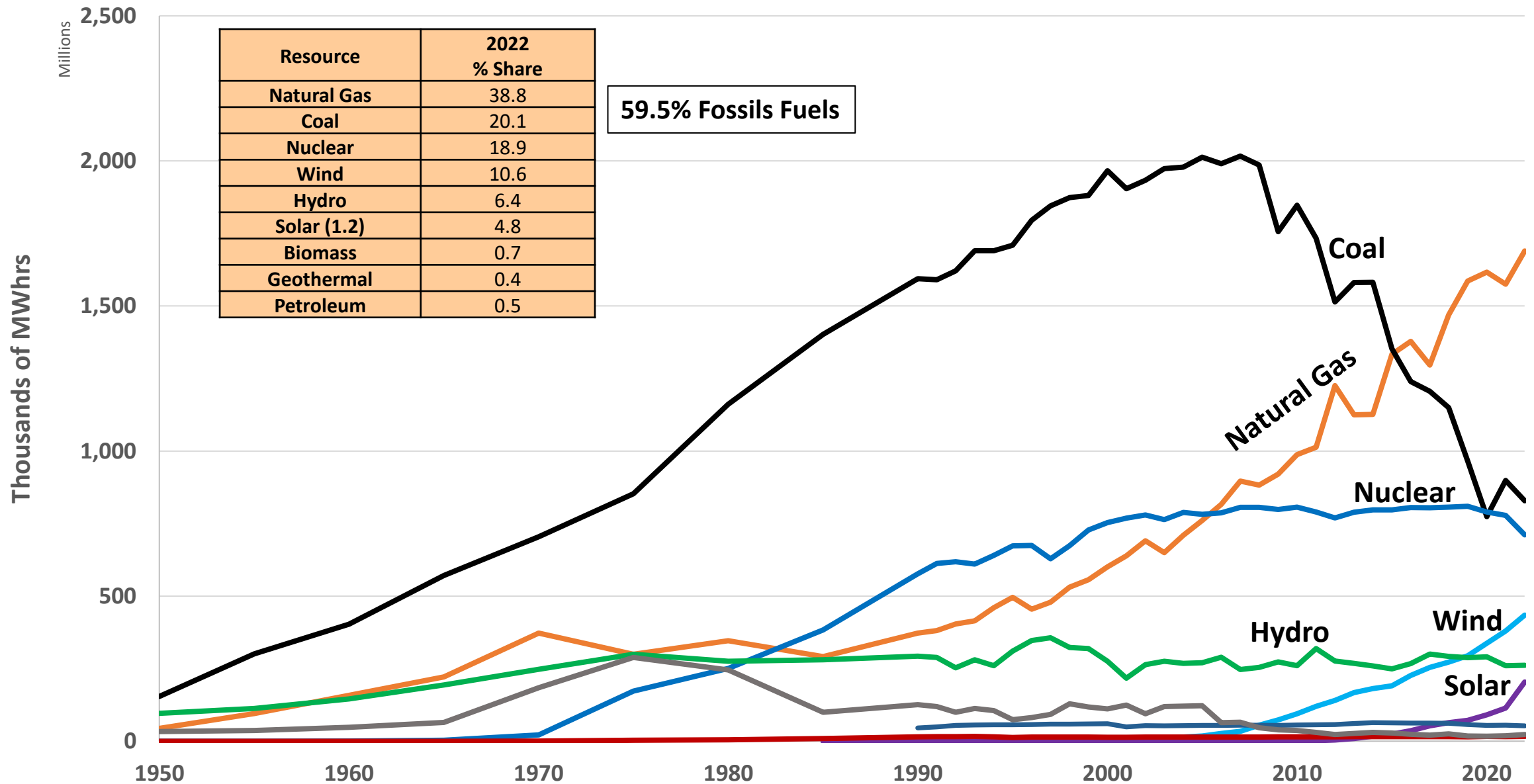
Nuclear

Non-hydro Renewables

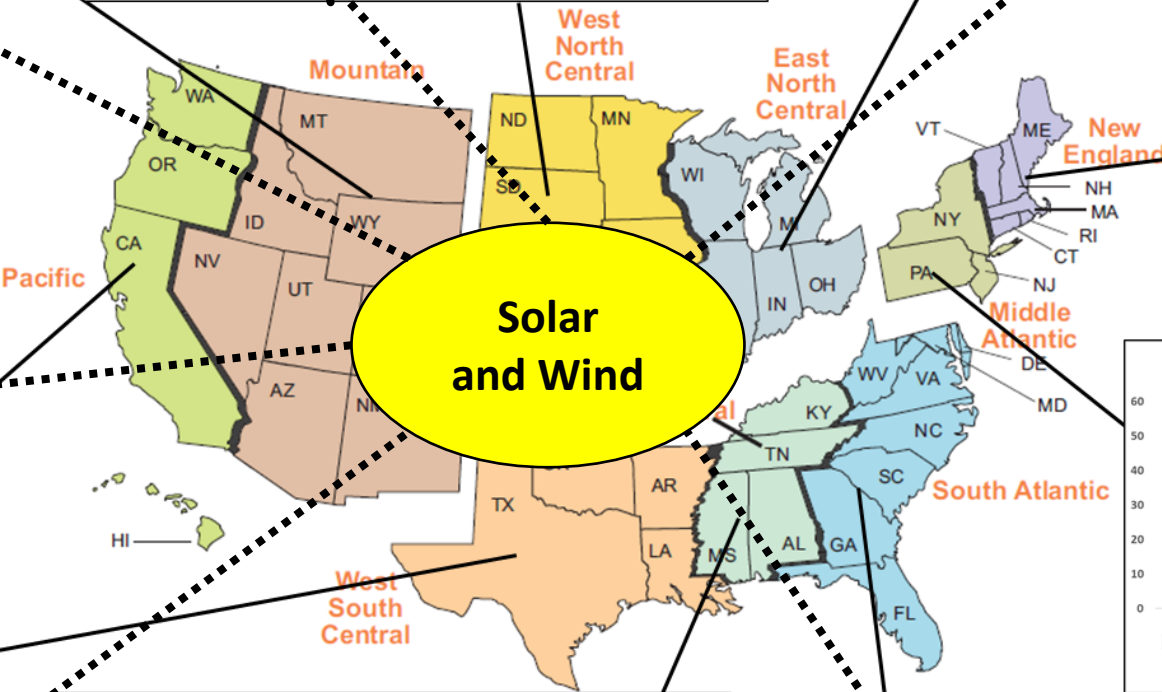
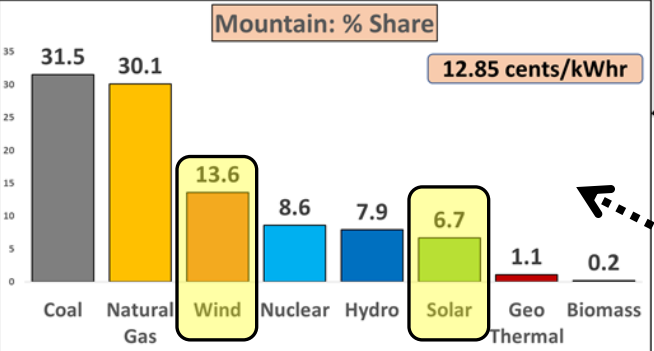
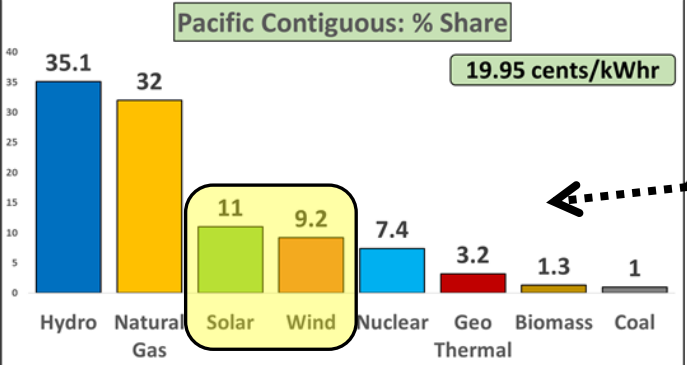
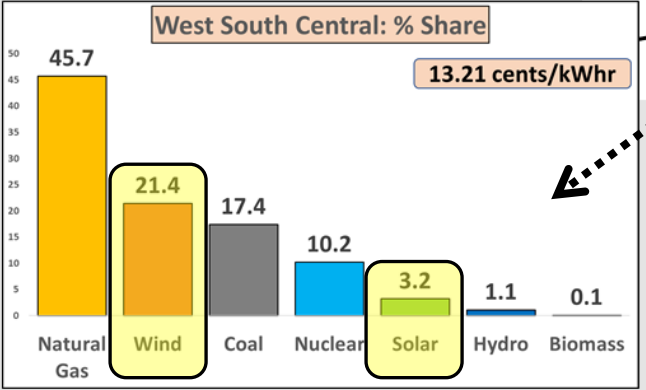
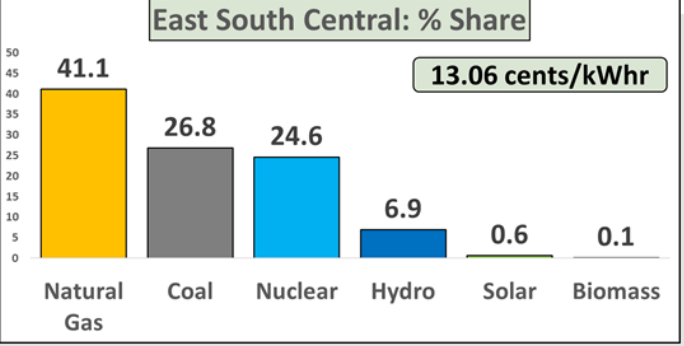
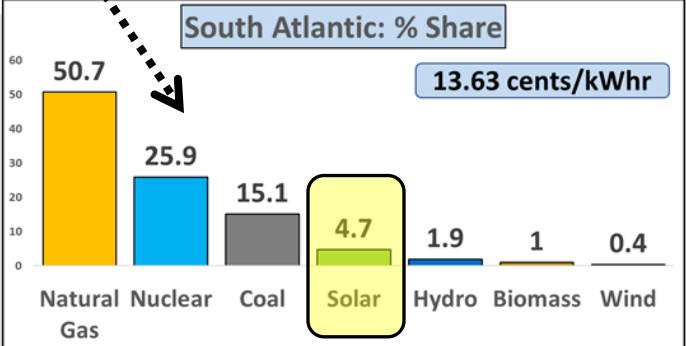
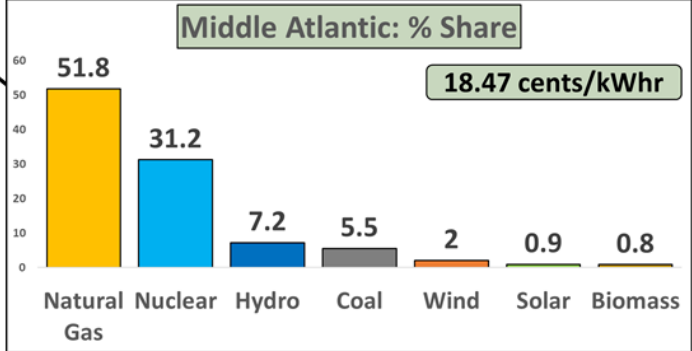
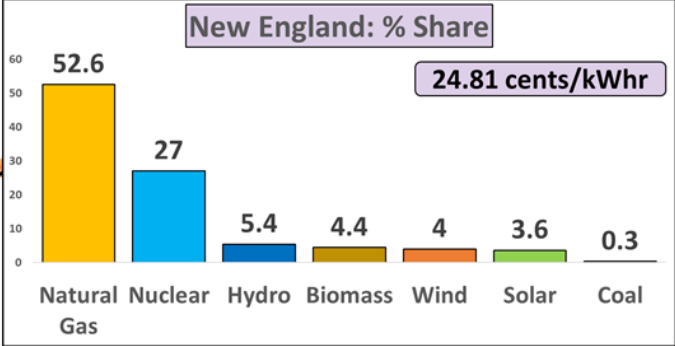
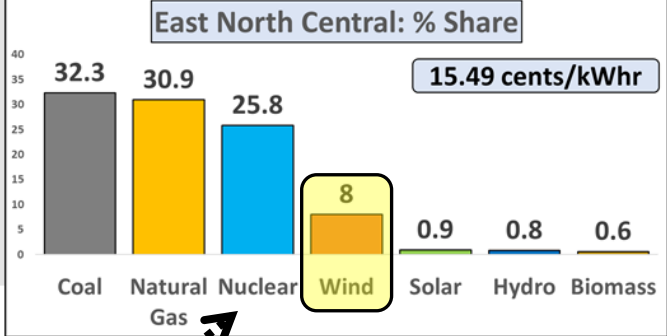
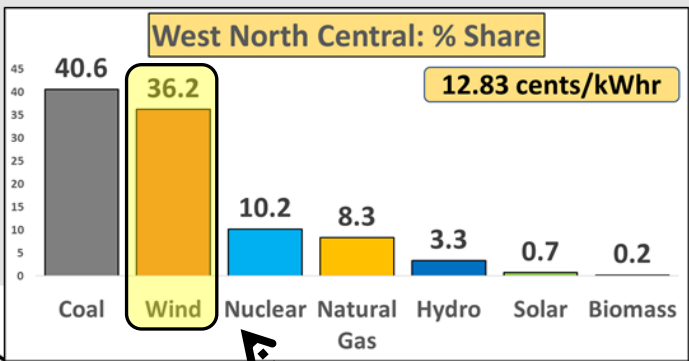
Hydro

U.S. Electricity Generation by Resource

Natural Gas Coal Nuclear Wind Hydro Solar Biomass Geothermal Petroleum

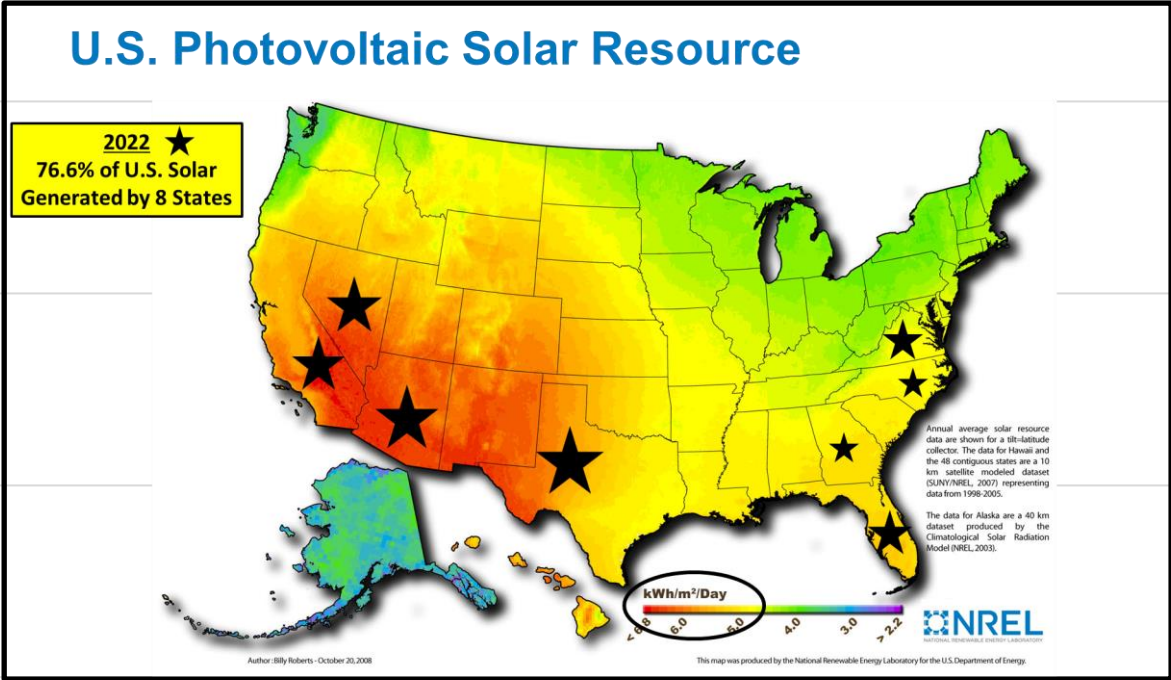
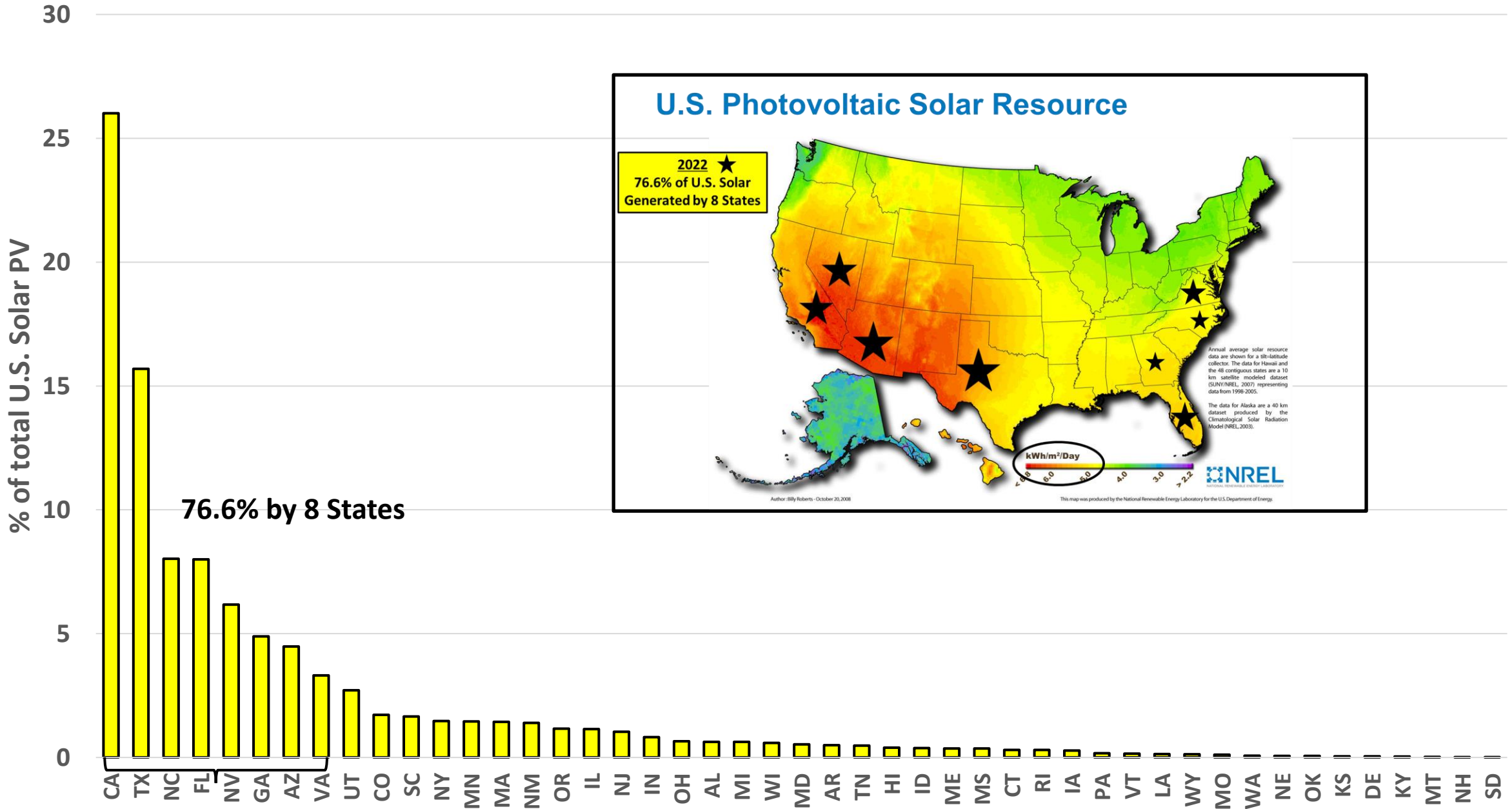


Residential Rates 2022
U.S. Avg: 15.12 cents/kWhr

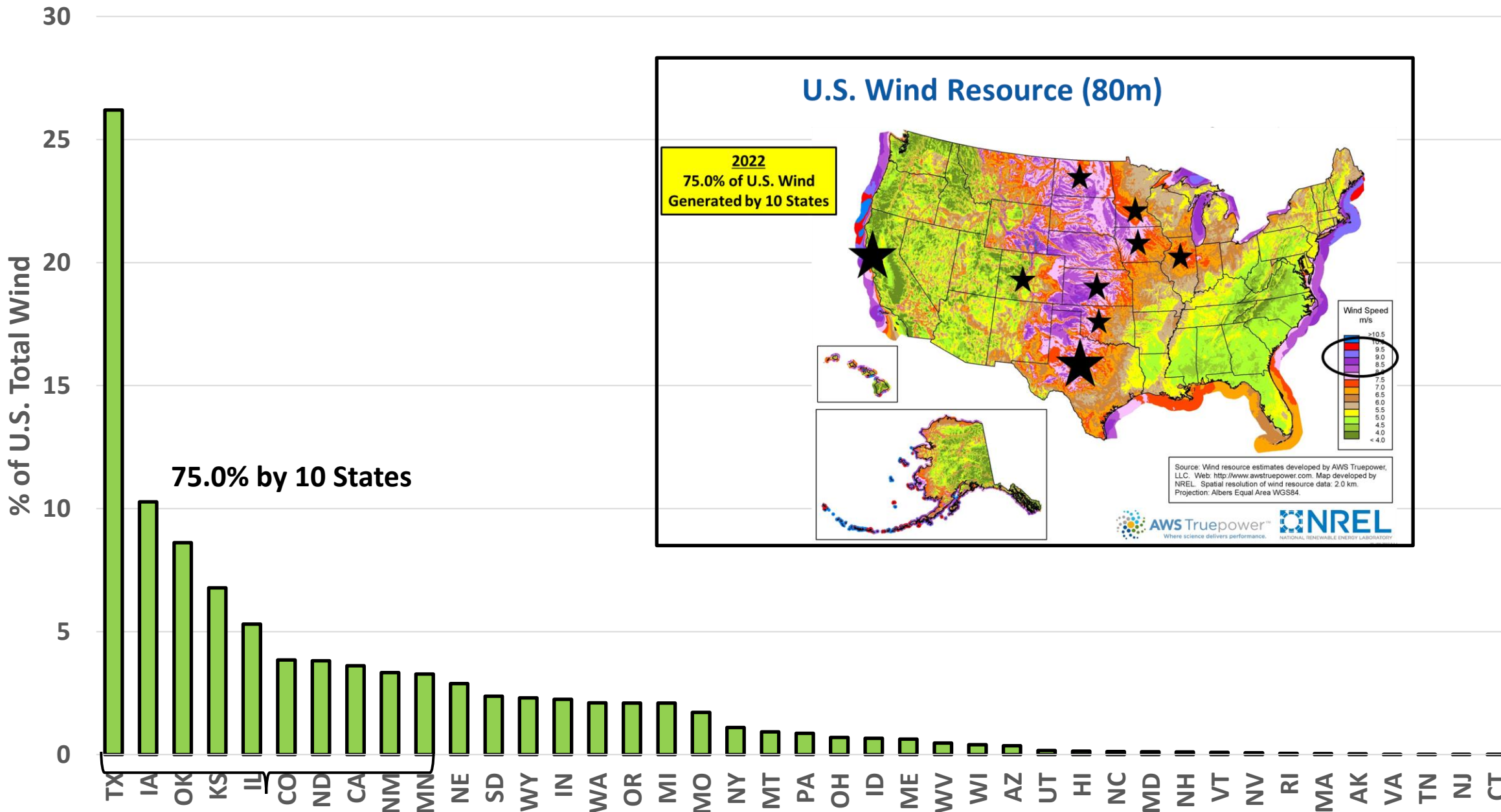


Data Source: US EIA

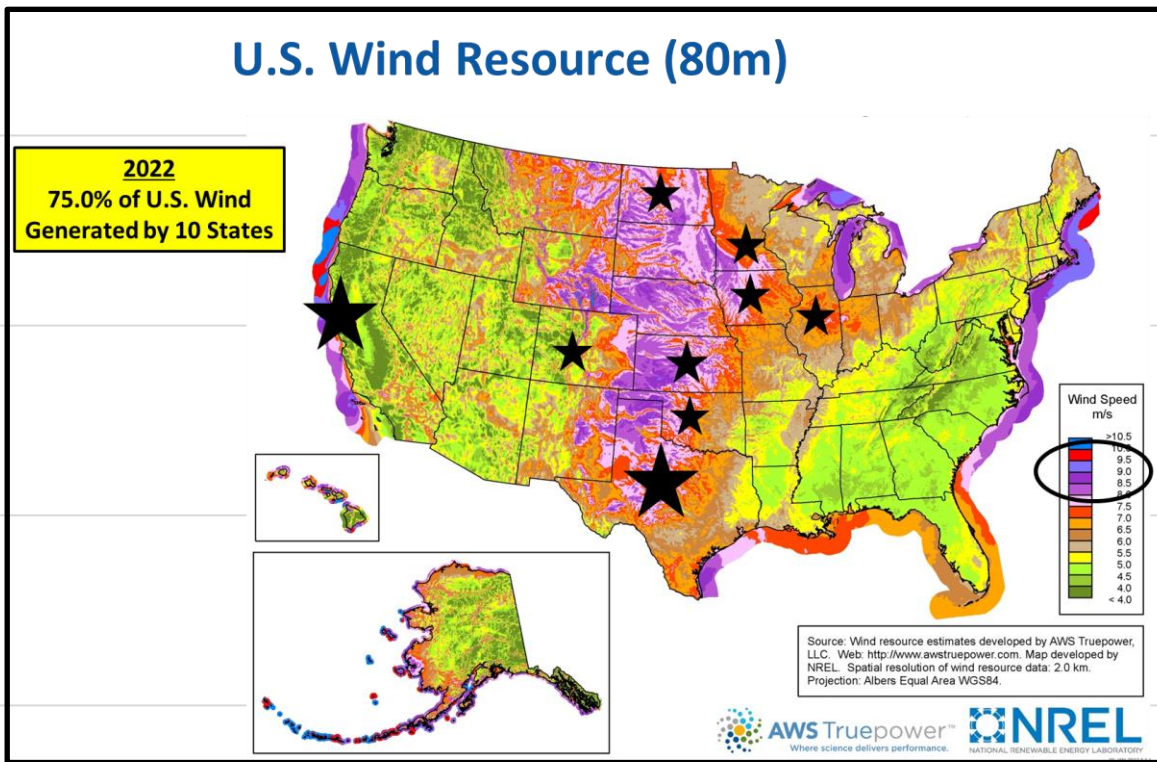
2022 Utility-Scale Solar PV Generation: % Share by State



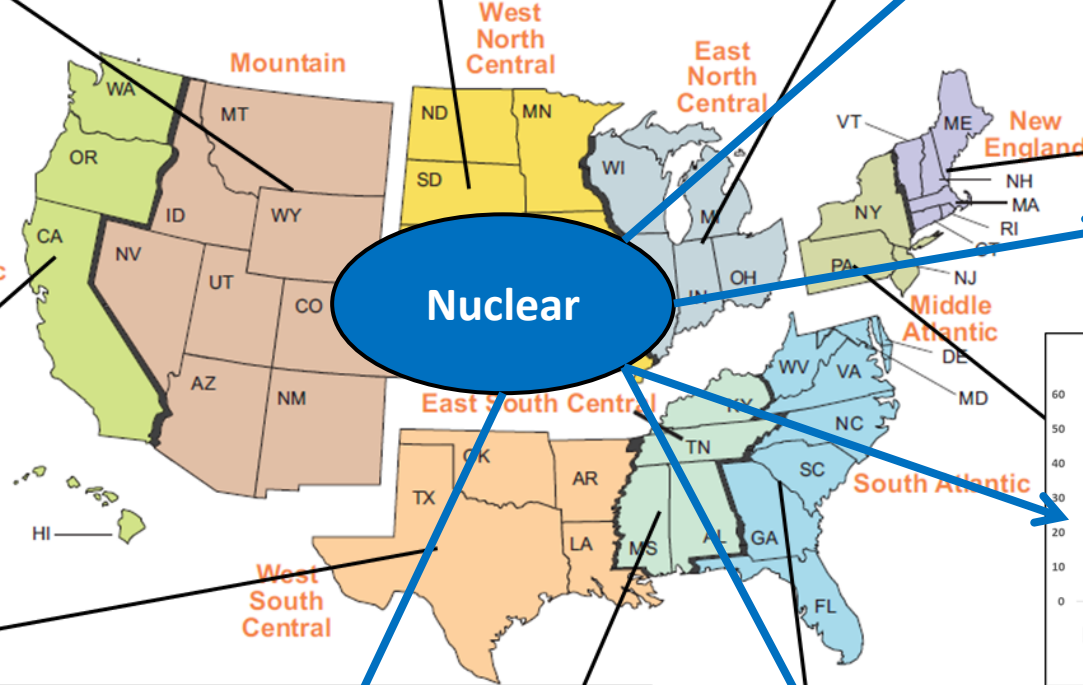
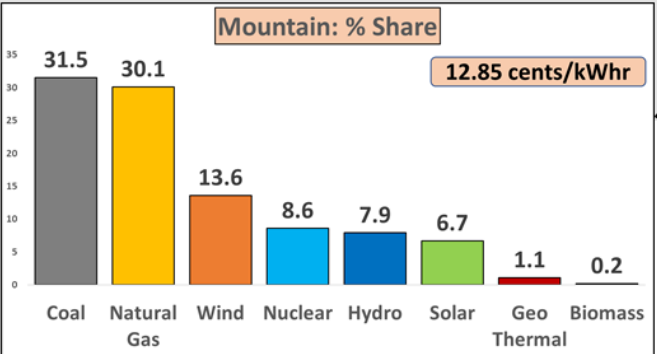
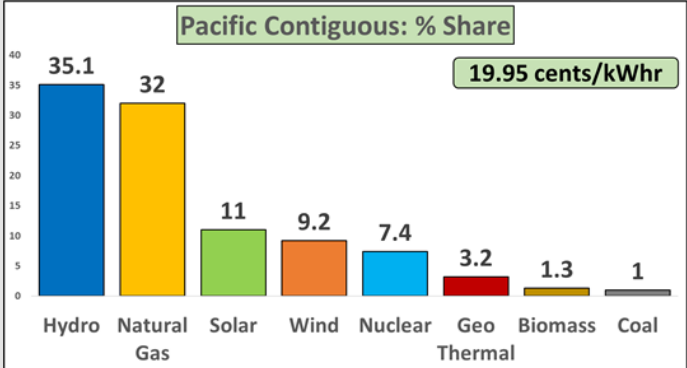
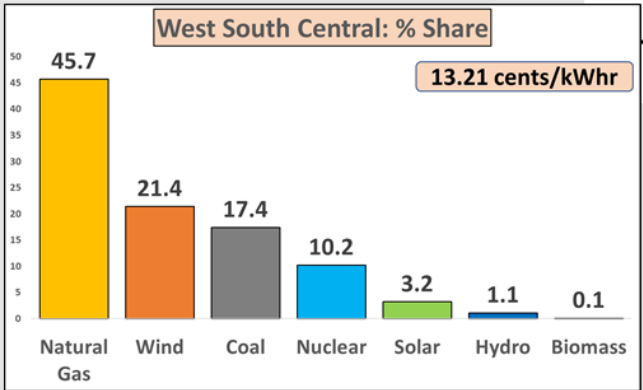
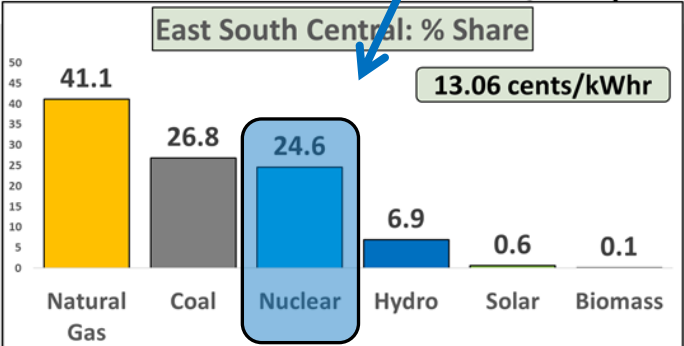
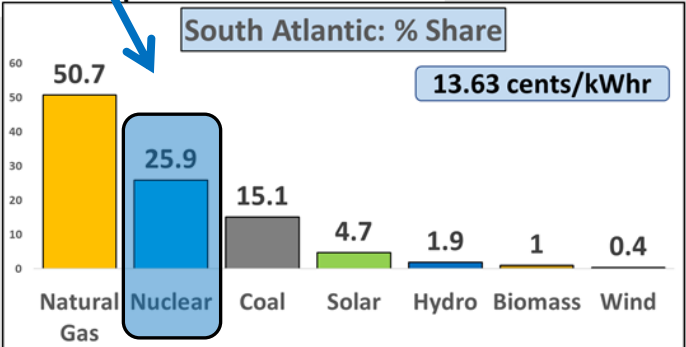
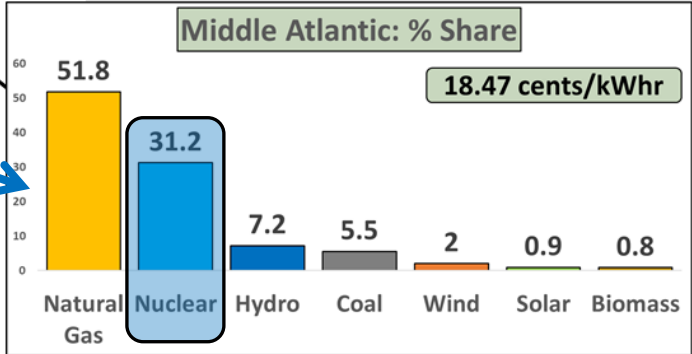
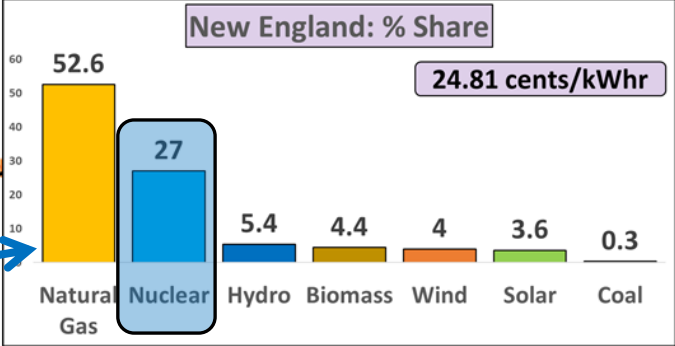
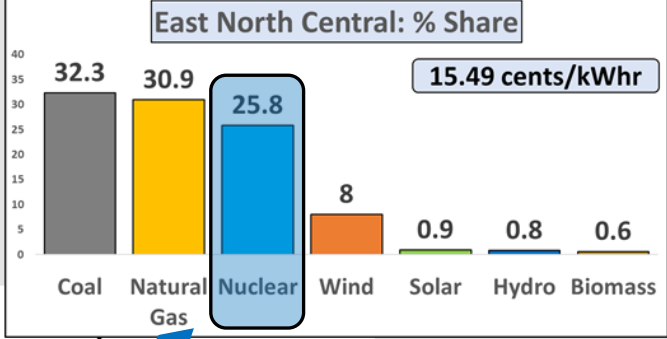
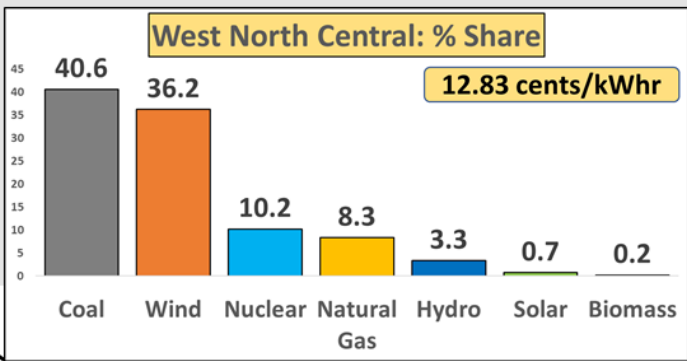
2022 US Wind Generation: % Share by State



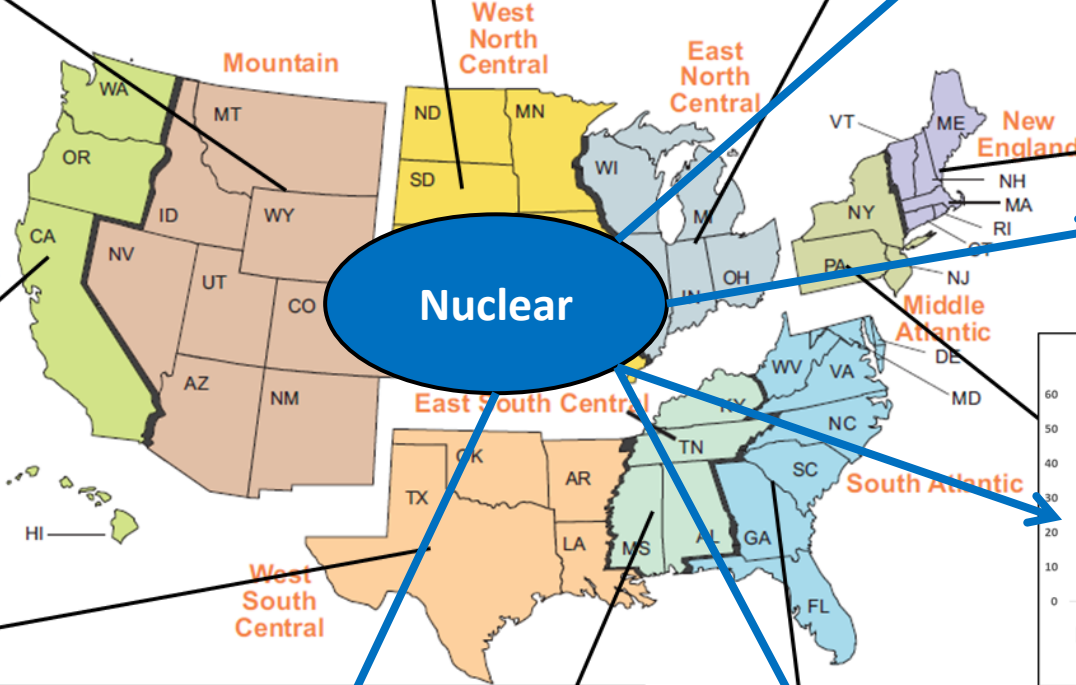
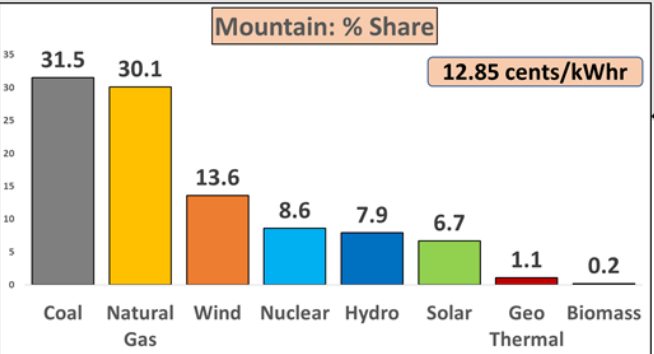
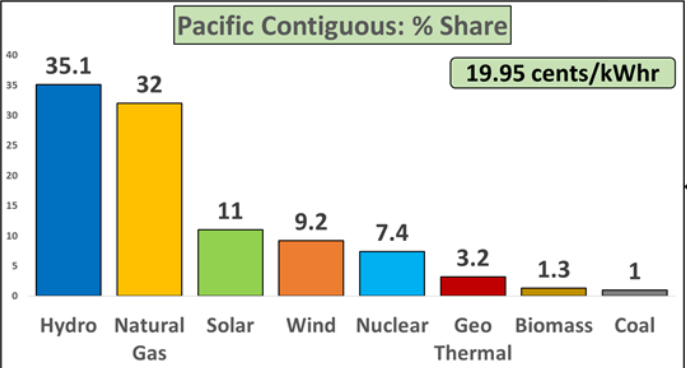
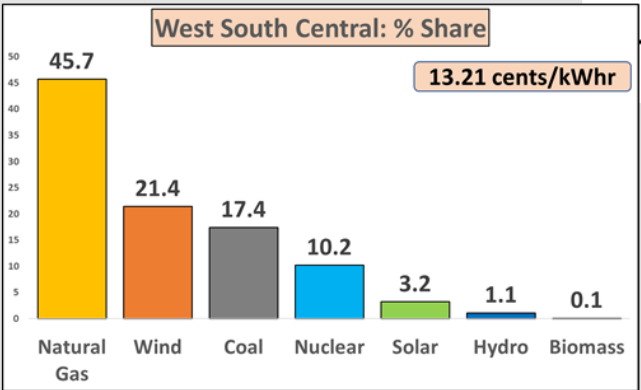
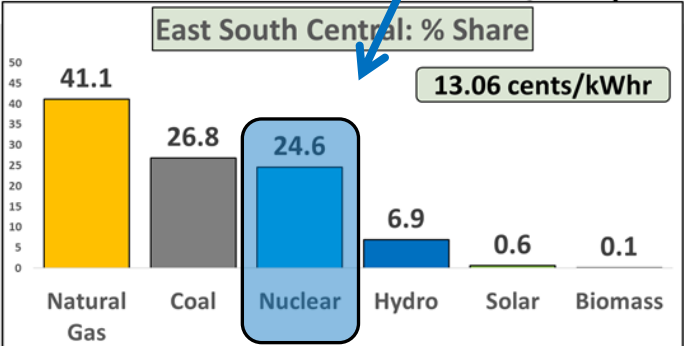
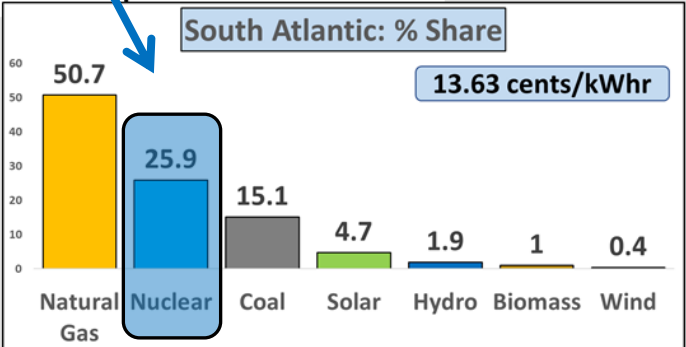
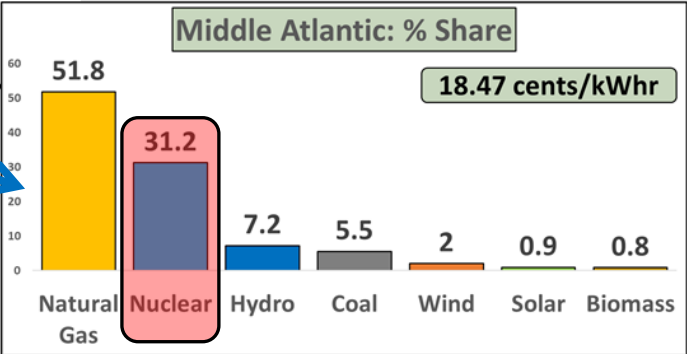
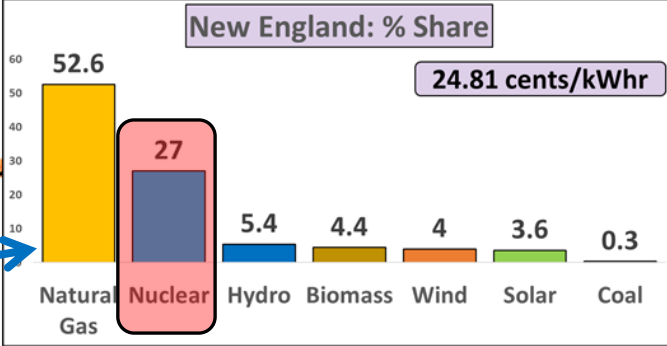
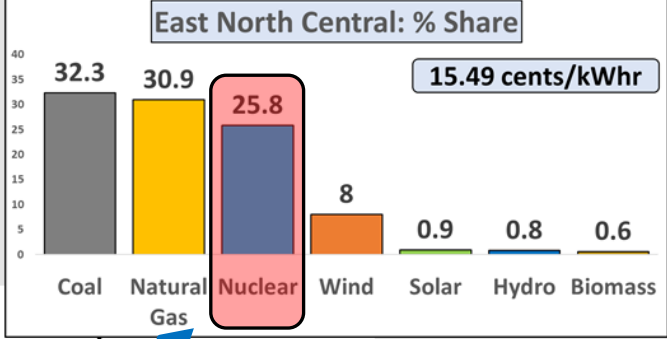
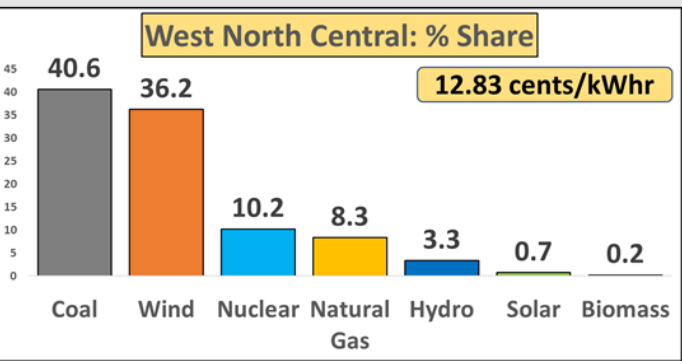
75.0% by 10 States



Residential Rates 2022
U.S. Avg: 15.12 cents/kWhr



Residential Rates 2022
U.S. Avg: 15.12 cents/kWhr



US Nuclear Reactors: Shutdown & Under Threat

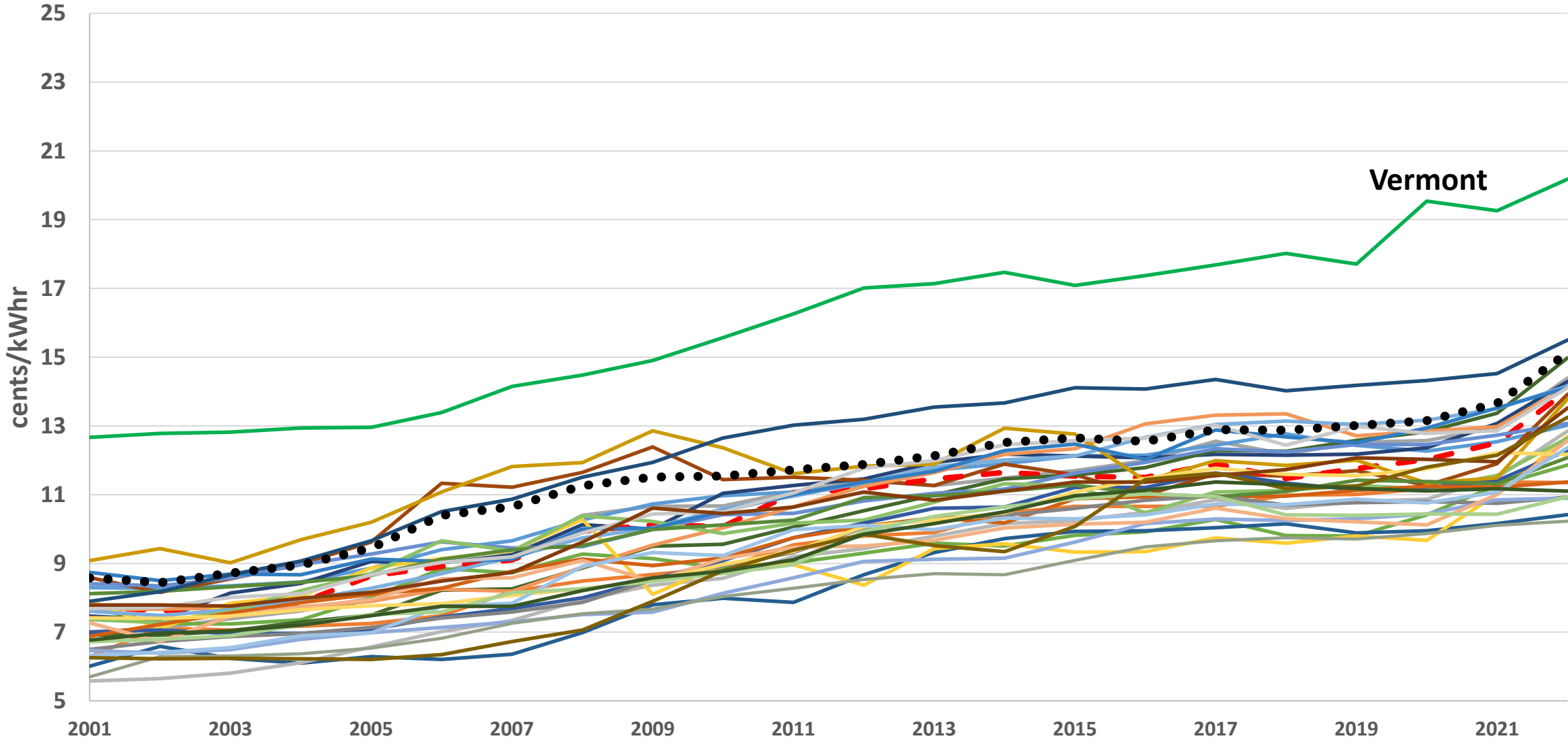
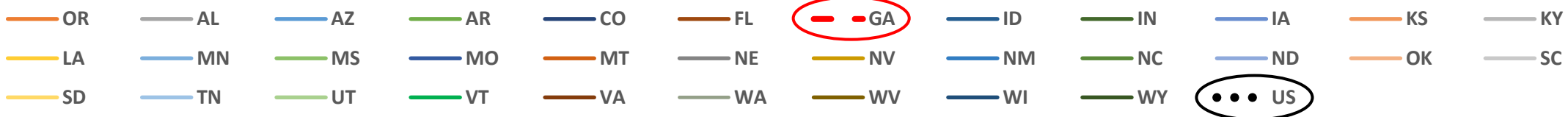
**Deregulated
Electricity
Markets**

Status	Plant	Capacity (MW)	Location	Generation (MWhrs)	Retirement Year (or announced)
Retired (13)	Crystal River	860	Florida	7,000,079	2013
	Kewaunee	566	Wisconsin	4,990,254	2013
	San Onofre 2 & 3	2,150	California	18,097,173	2013
	Vermont Yankee	604	Vermont	5,060,582	2014
	Fort Calhoun	483	Nebraska	3,425,235	2016
	Oyster Creek	608	New Jersey	4,585,091	2018
	Pilgrim	674	Massachusetts	5,414,318	2019
	Three Mile Island 1	803	Pennsylvania	5,214,196	2019
	Duane Arnold	601	Iowa	5,235,716	2020
	Indian Point 2	1,016	New York	8,351,945	2020
	Indian Point 3	1,038	New York	9,108,821	2021
	Palisades	772	Michigan	5,995,123	2022
	Total	10,175		82,478,533	
Planned But Stayed by State Action (22)	Diablo Canyon 1 & 2	2,240	California	16,258,298	2024, 2025
	Dresden 2 & 3	1,797	Illinois	15,478,888	2021
	Byron 1&2	2,300	Illinois	15,524,894	2021
	Davis-Besse	894	Ohio	7,228,063	2020 (Hold)
	Perry	1,240	Ohio	10,990,962	2021 (Hold)
	Beaver Valley 1 & 2	1,808	Pennsylvania	15,393,393	2021 (Hold)
	FitzPatrick	848	New York	6,588,676	2017 (Hold)
	R. E. Ginna	581	New York	4,332,888	2017 (hold)
	Clinton	1,065	Illinois	9,462,481	2017 (Hold)
	Nine Mile Point 1&2	2,054	New York	15,640,608	2017, 2018
	Quad Cities 1 & 2	1,819	Illinois	15,712,445	2018 (Hold)
	Salem 1 & 2	2,295	New Jersey	16,145,436	2020, 2021
	Hope Creek	1,172	New Jersey	10,592,697	2021 (Hold)
Millstone 2 & 3	2,073	Connecticut	15,714,855	2020 (Hold)	
Total	22,186		175,064,584		
Total All	30,551		257,543,117		

Data Source: US EIA; NEI; CRS
Retirement Years: Third Way; CRS

Data Source: U.S. EIA

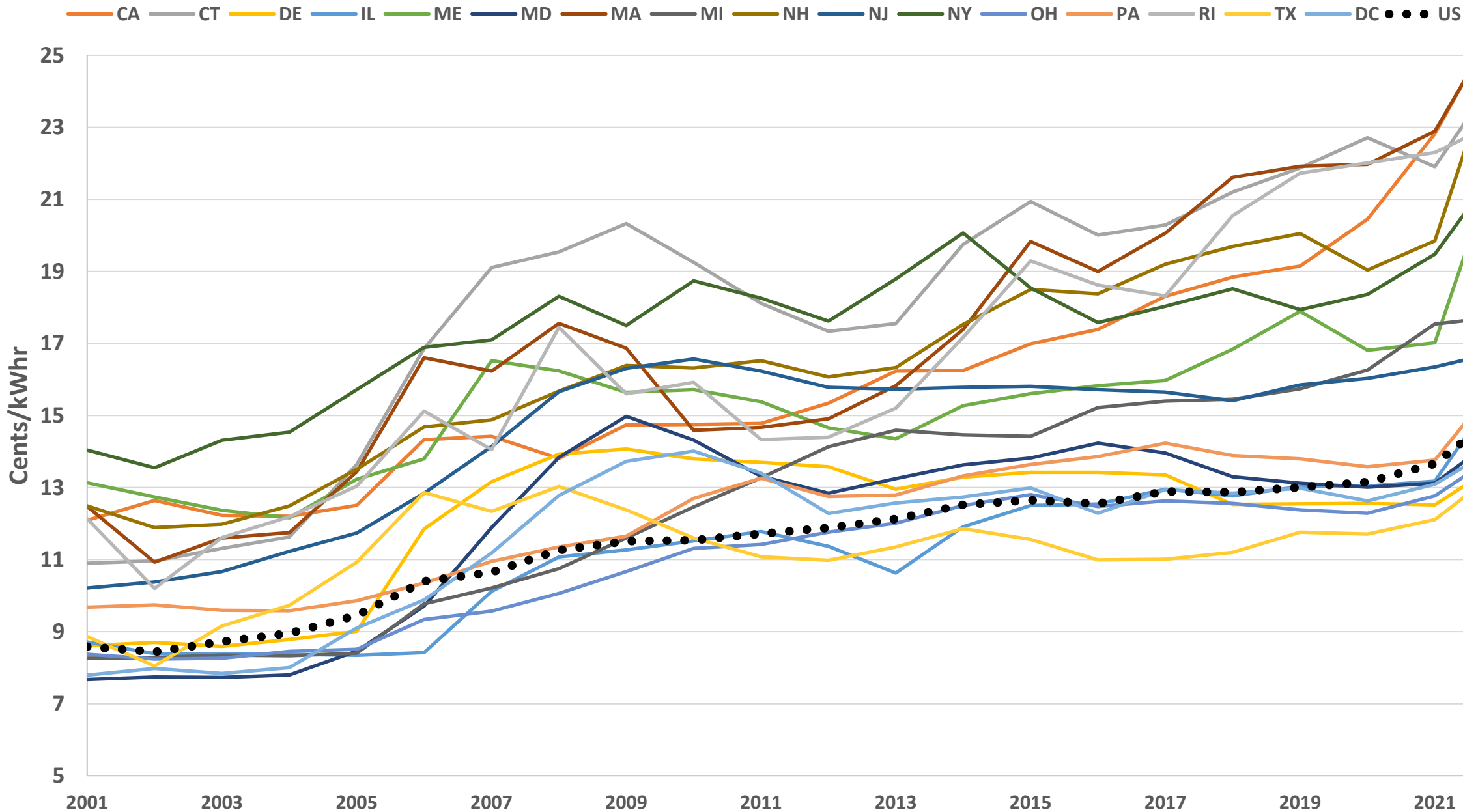
Regulated: Retail Residential Rates



Vermont

Data Source: U.S. EIA

Deregulated: Retail Residential Rates



Performance Comparisons

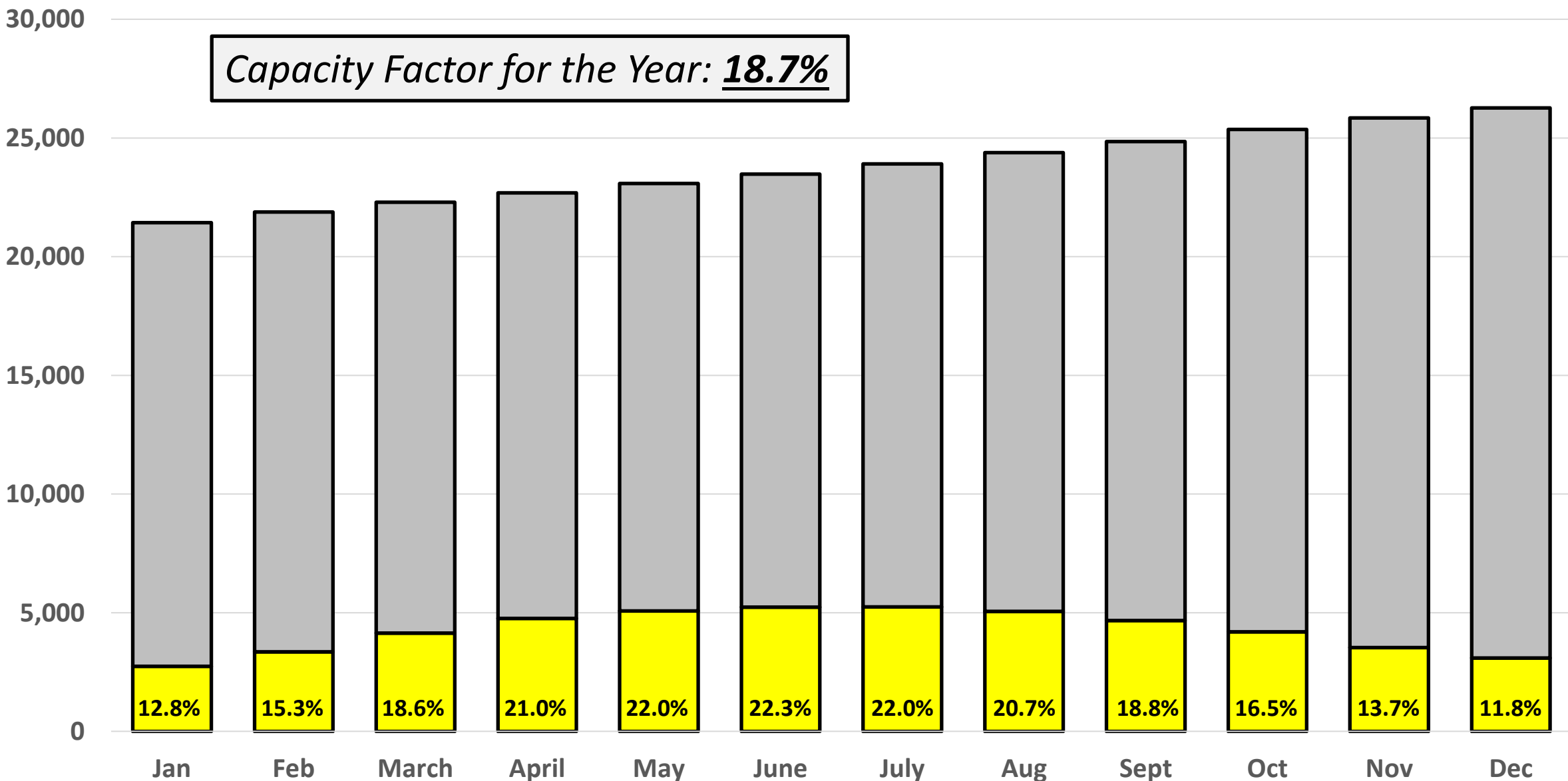
CAPACITY FACTORS:

SOLAR, WIND, COAL, NATURAL GAS, NUCLEAR

2022 U.S. Residential Solar PV (MW)

Actual Stranded

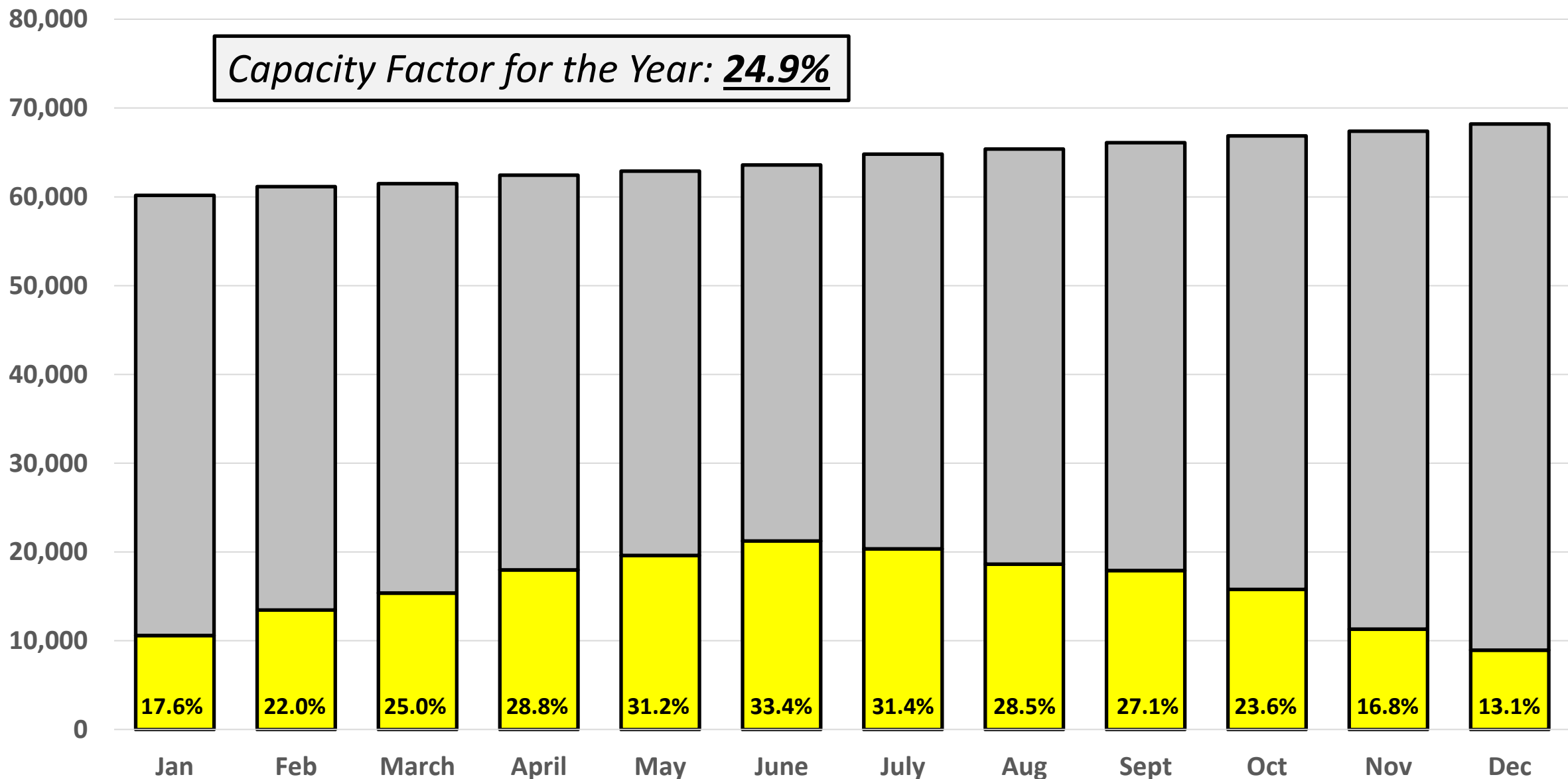
Capacity Factor for the Year: **18.7%**



2022 U.S. Utility-Scale Solar PV (MW)

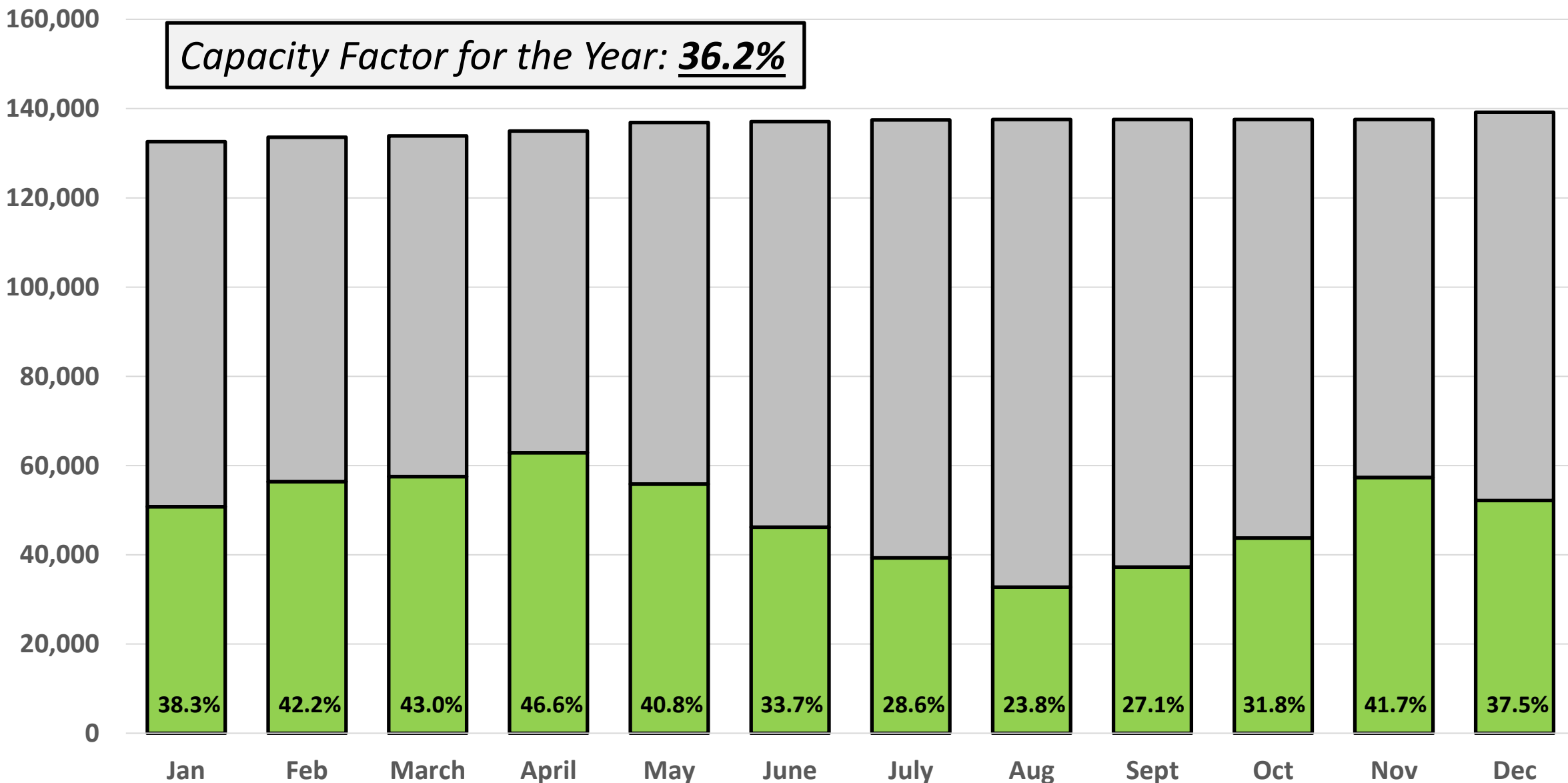
Actual Stranded

*Capacity Factor for the Year: **24.9%***



2022 U.S. Wind (MW)

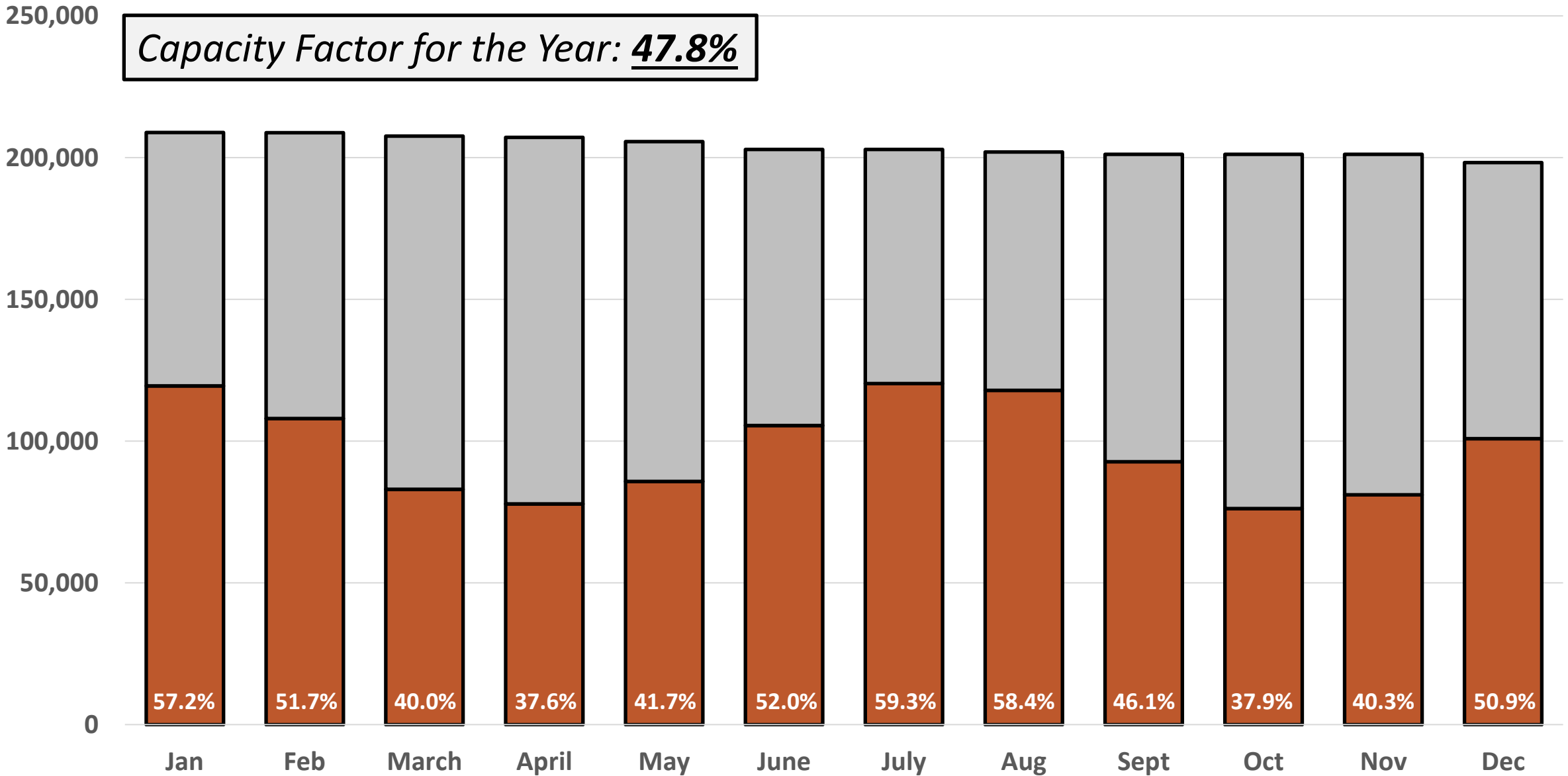
Actual Stranded



2022 U.S. Coal (MW)

Actual Stranded

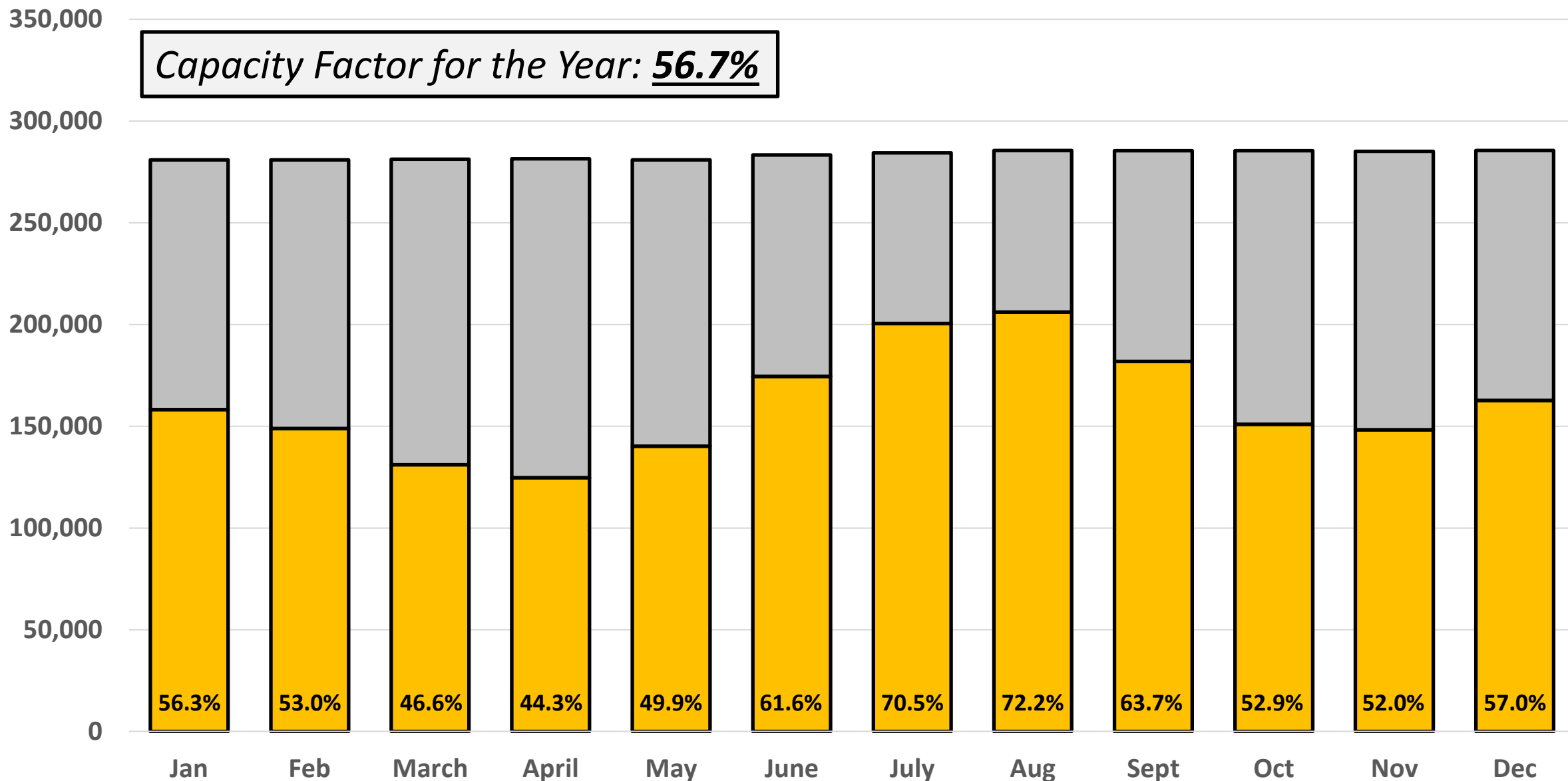
Capacity Factor for the Year: 47.8%



2022 U.S. Natural Gas Combined-Cycle (MW)

Actual Stranded

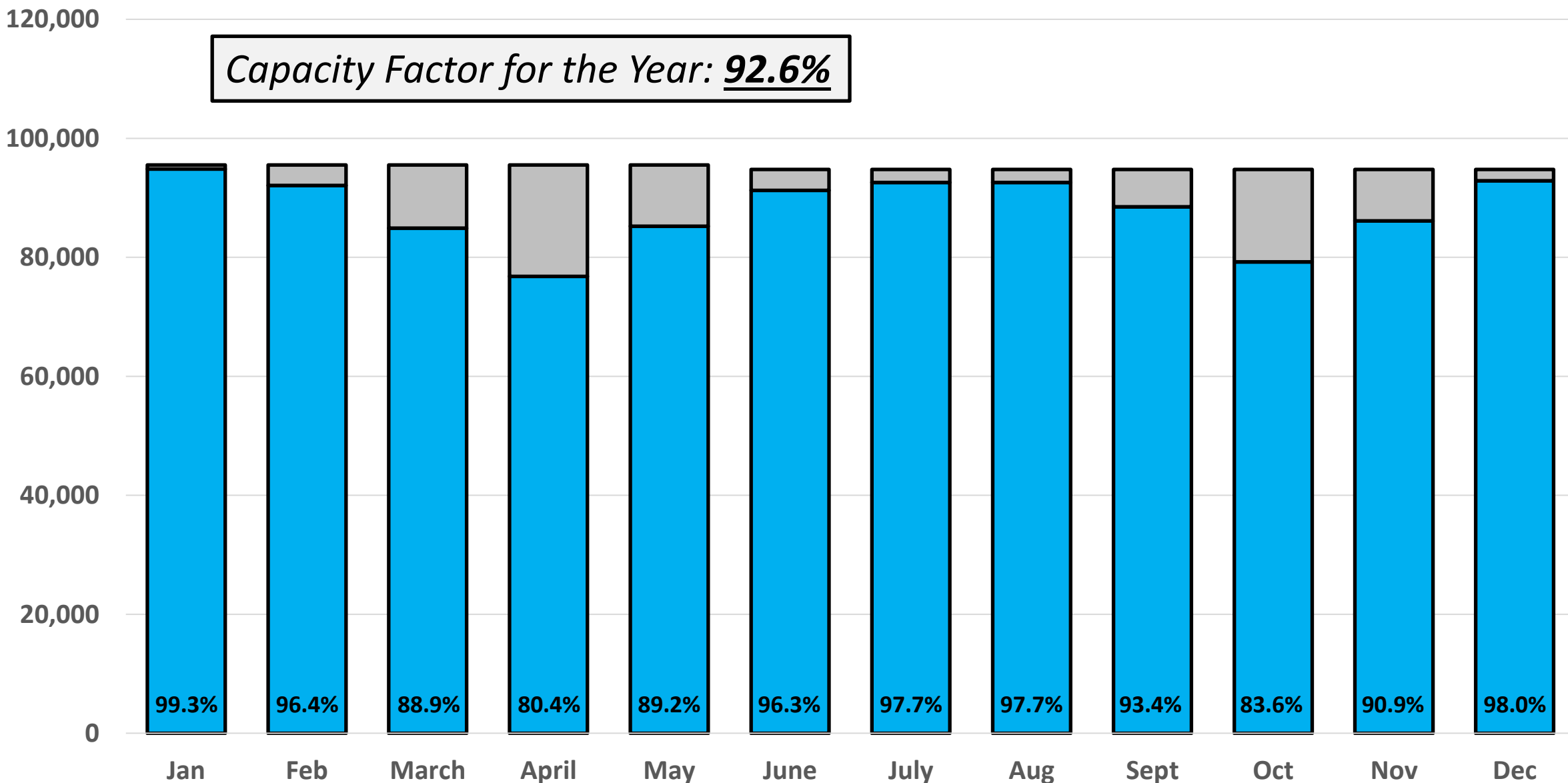
Capacity Factor for the Year: 56.7%



2022 U.S. Nuclear (MW)

Actual Stranded

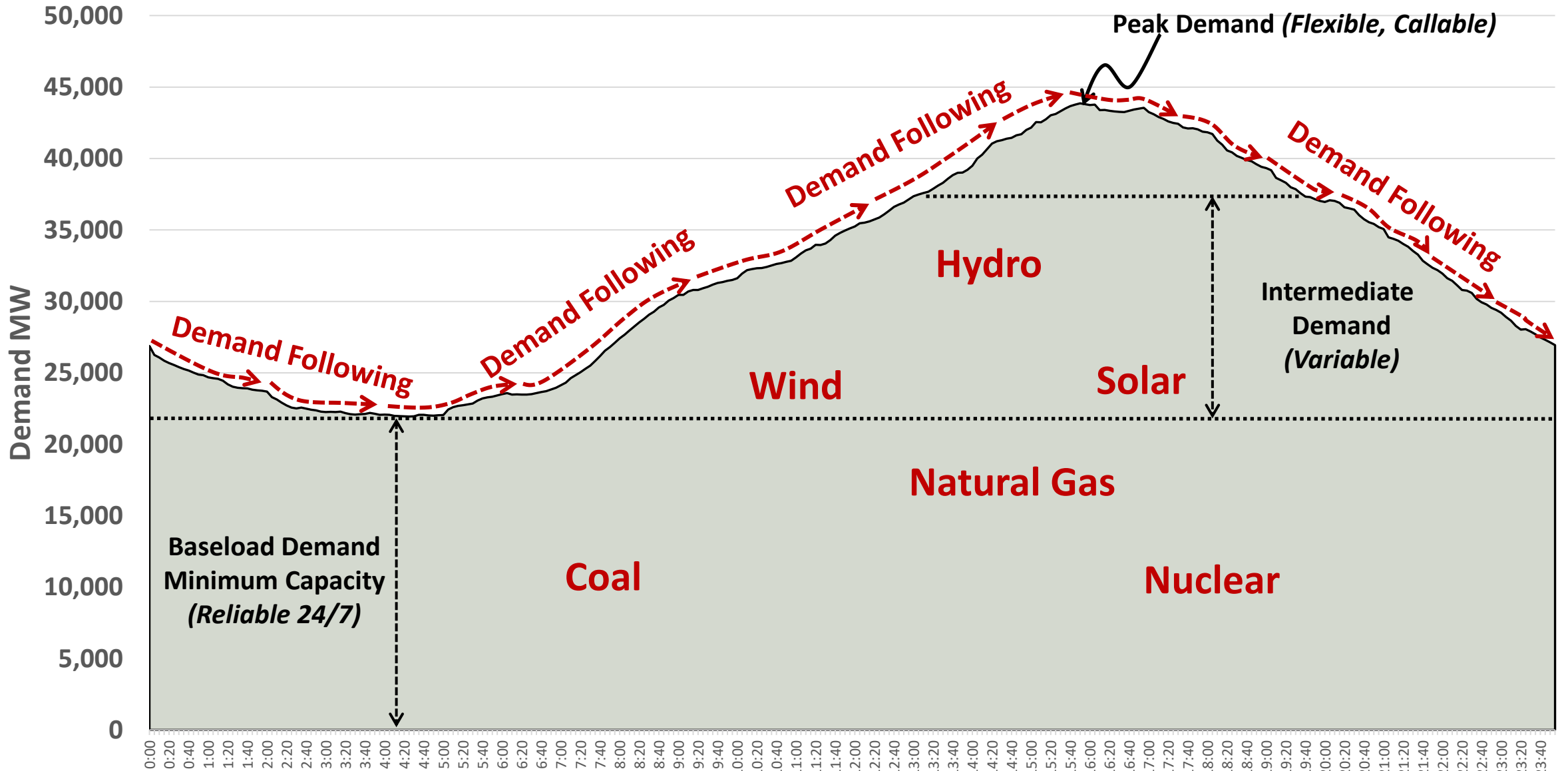
*Capacity Factor for the Year: **92.6%***



Value of Resource Diversity and Integrated Resource Planning

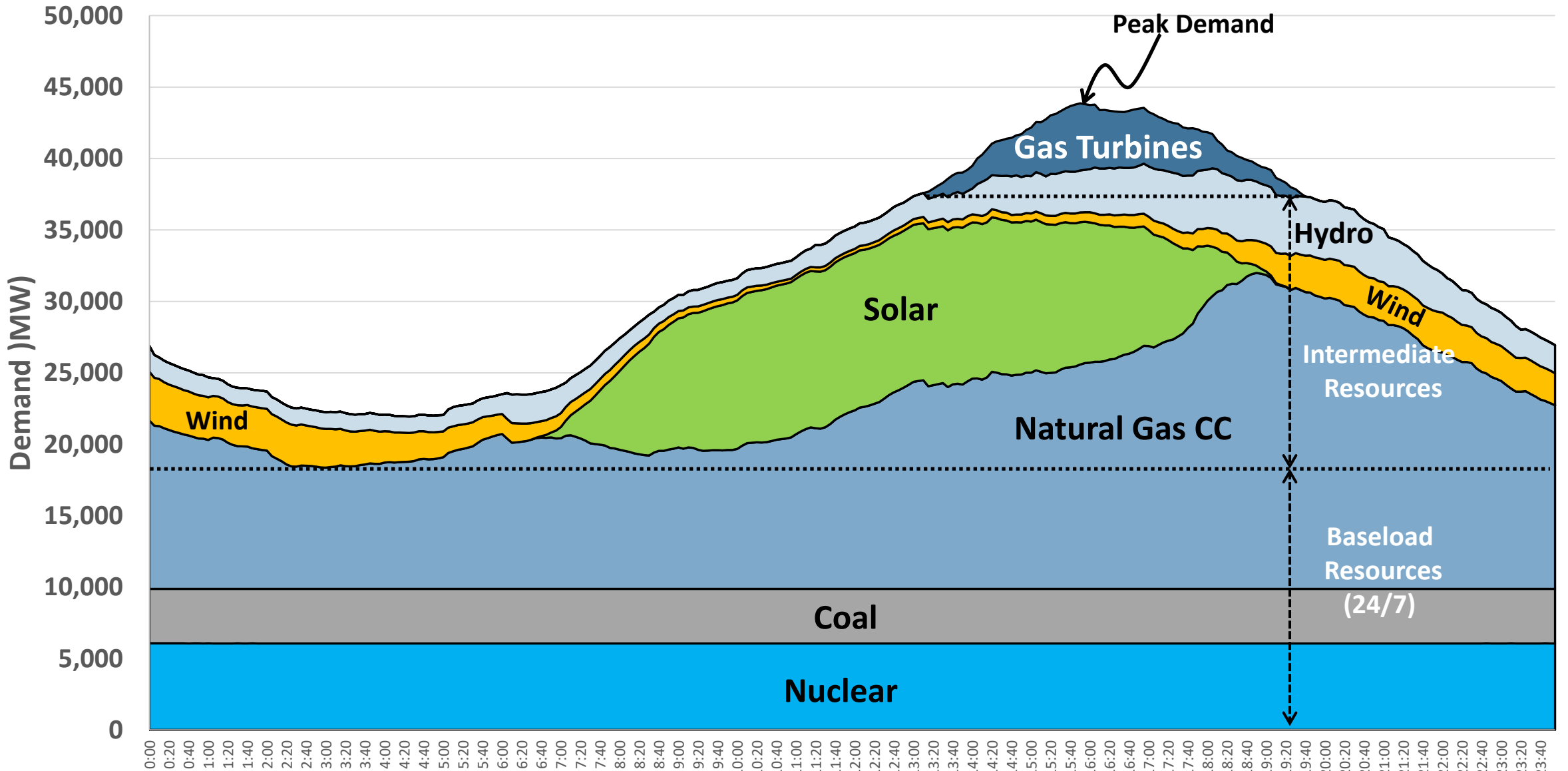
Daily Demand Curve

□ Total



Daily Demand Curve

■ Nuclear ■ Coal ■ NGCC ■ Solar ■ Wind ■ Hydro ■ NGCT

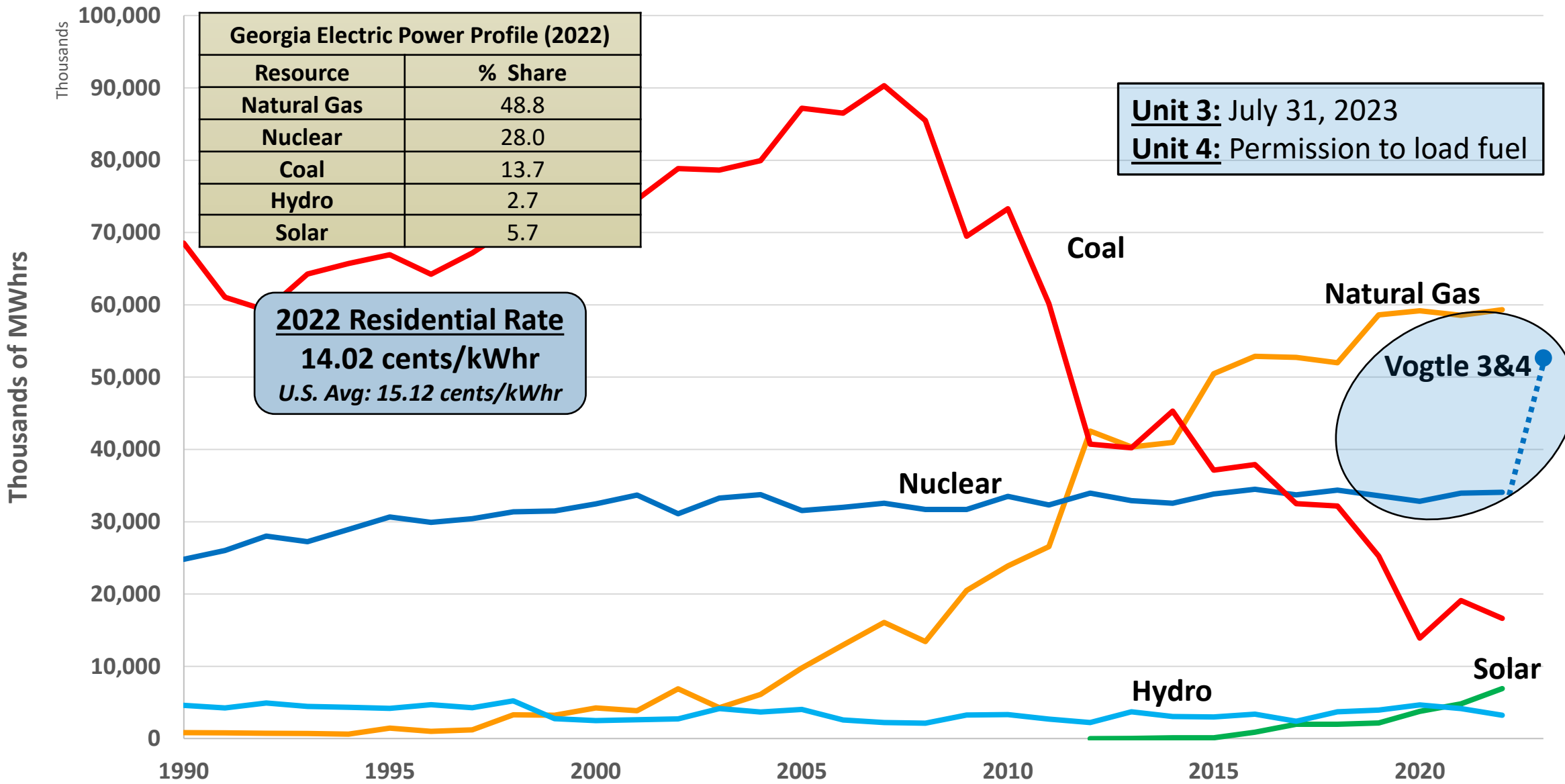


Georgia

IN CONTEXT

Georgia Electric Power Generation

— Natural Gas — Nuclear — Coal — Solar — Hydro



Georgia Electric Power Profile (2022)	
Resource	% Share
Natural Gas	48.8
Nuclear	28.0
Coal	13.7
Hydro	2.7
Solar	5.7

2022 Residential Rate
14.02 cents/kWhr
U.S. Avg: 15.12 cents/kWhr

Unit 3: July 31, 2023
Unit 4: Permission to load fuel

Vogtle 3&4

1990

1995

2000

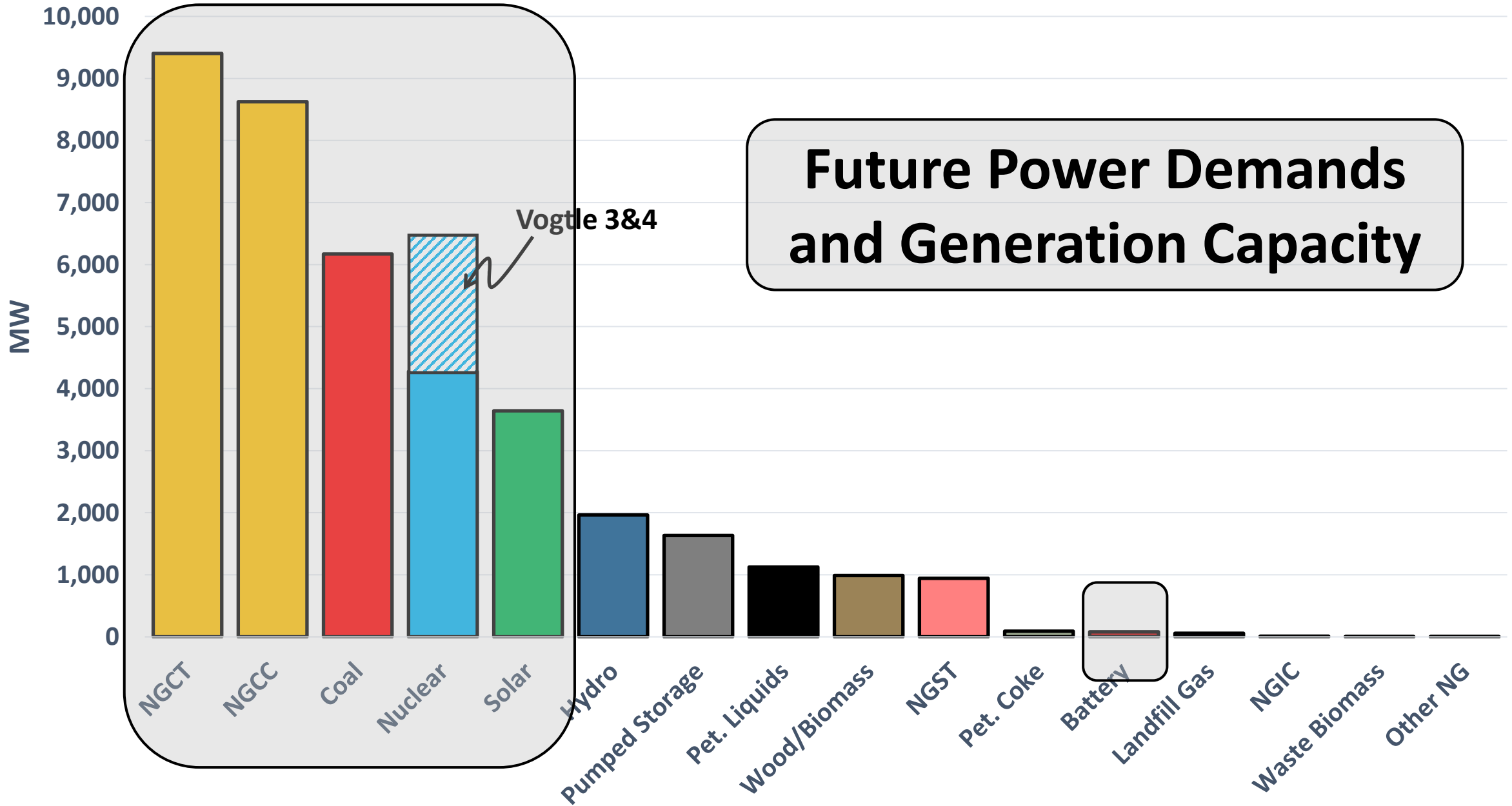
2005

2010

2015

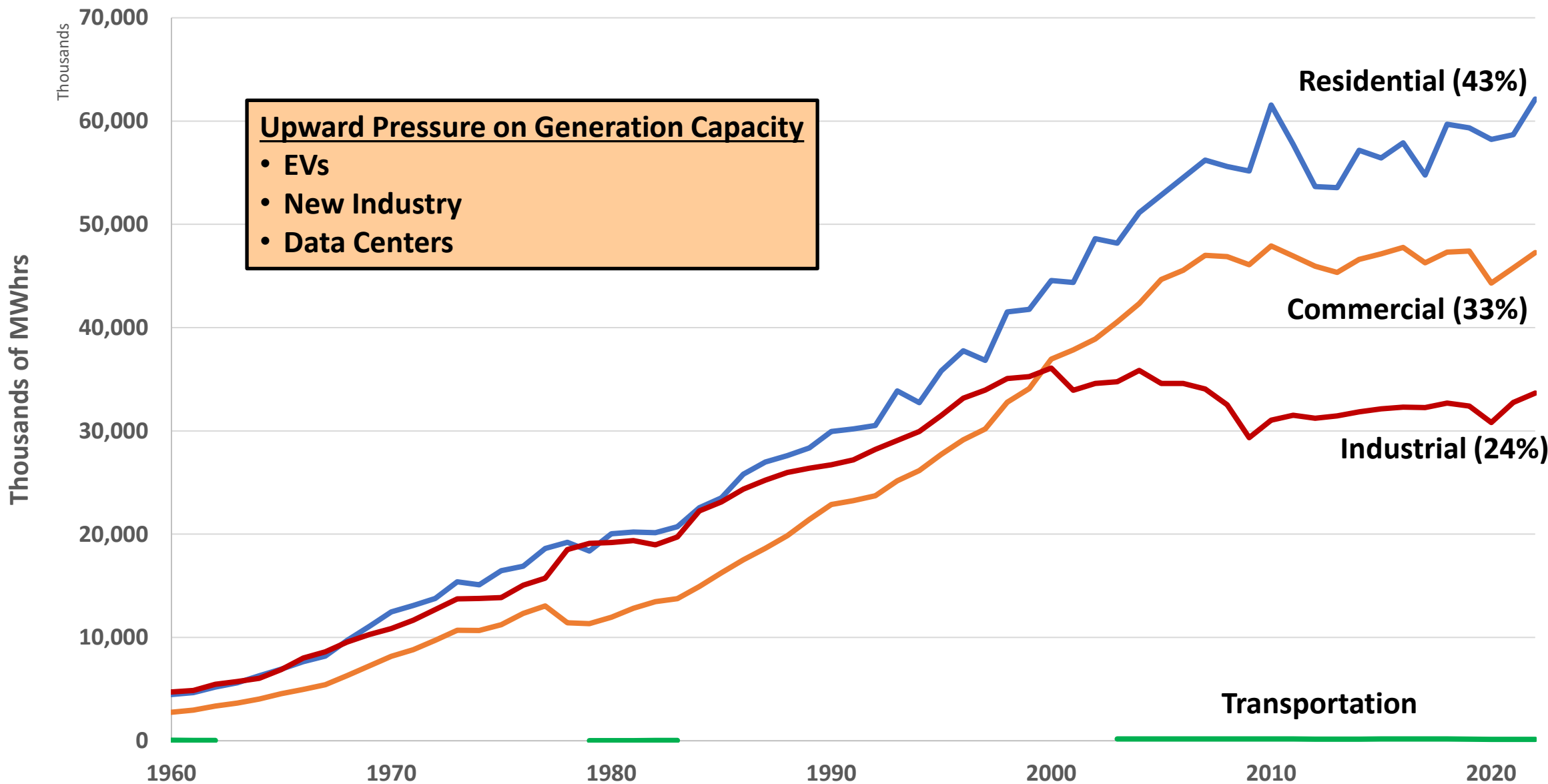
2020

Georgia: Capacity by Generation Type (MW)

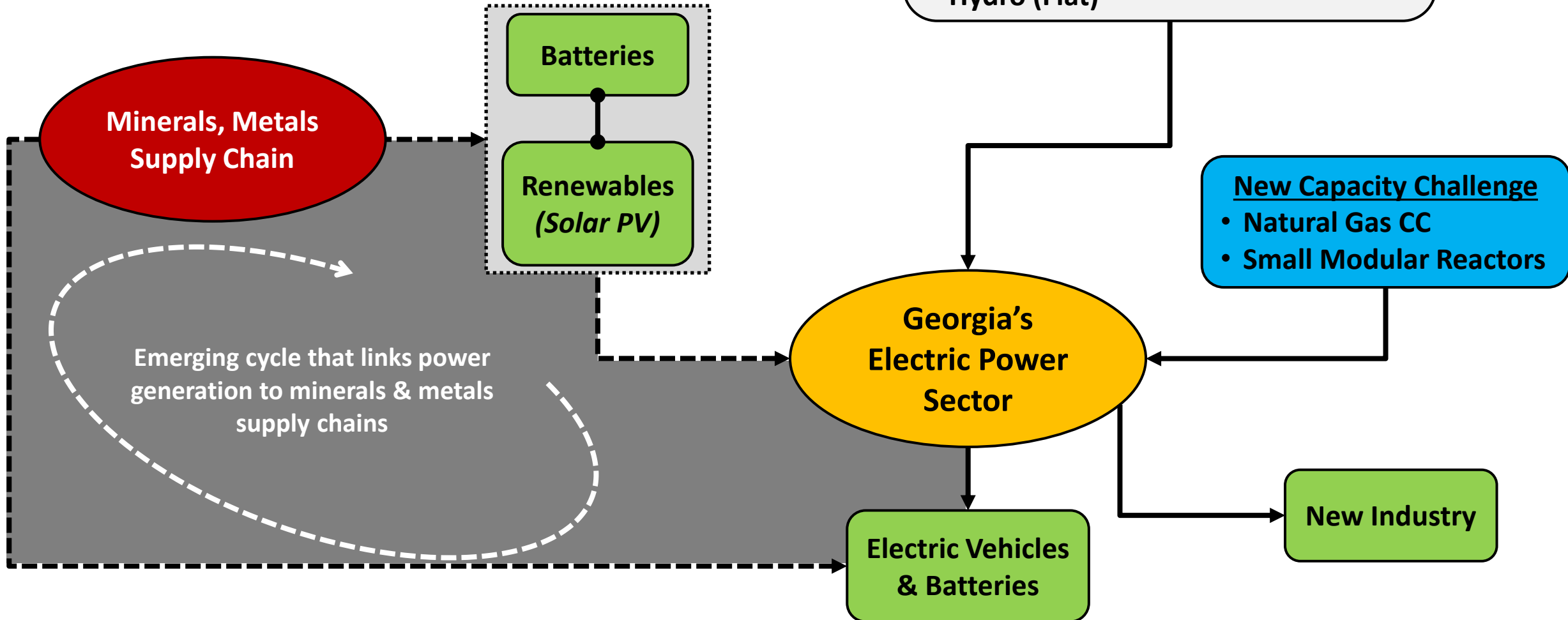


Georgia Electricity: End-Use Sectors

RESIDENTIAL COMMERCIAL INDUSTRIAL TRANSPORTATION



The Trend Toward Lower-Carbon Electrification

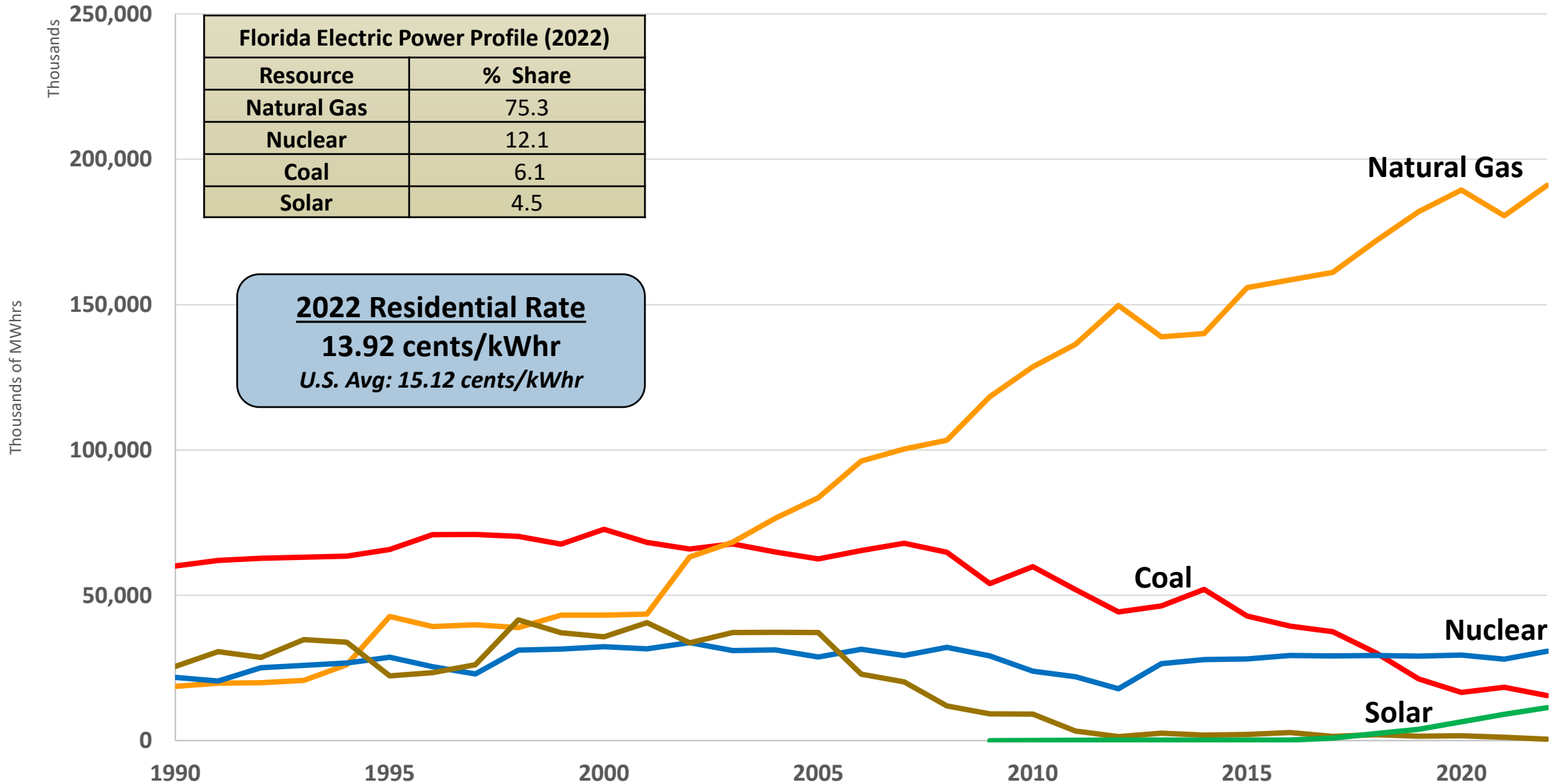


Relative to Top GDPs

Top 8 State GDPs Constitute 50% of Total US GDP

Florida Generation (Regulated)

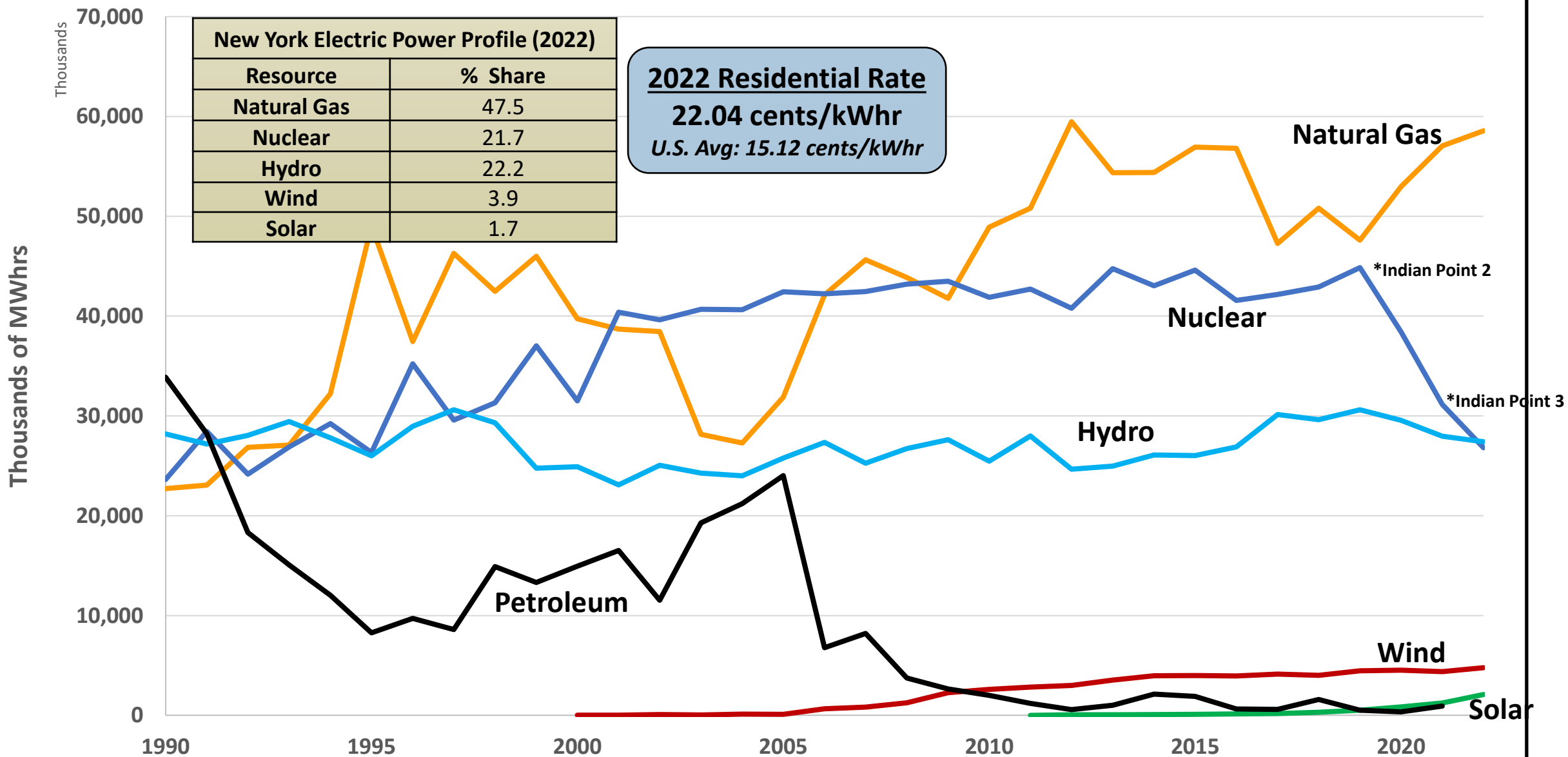
Coal Natural Gas Nuclear Petroleum Solar



Data Source: US EIA

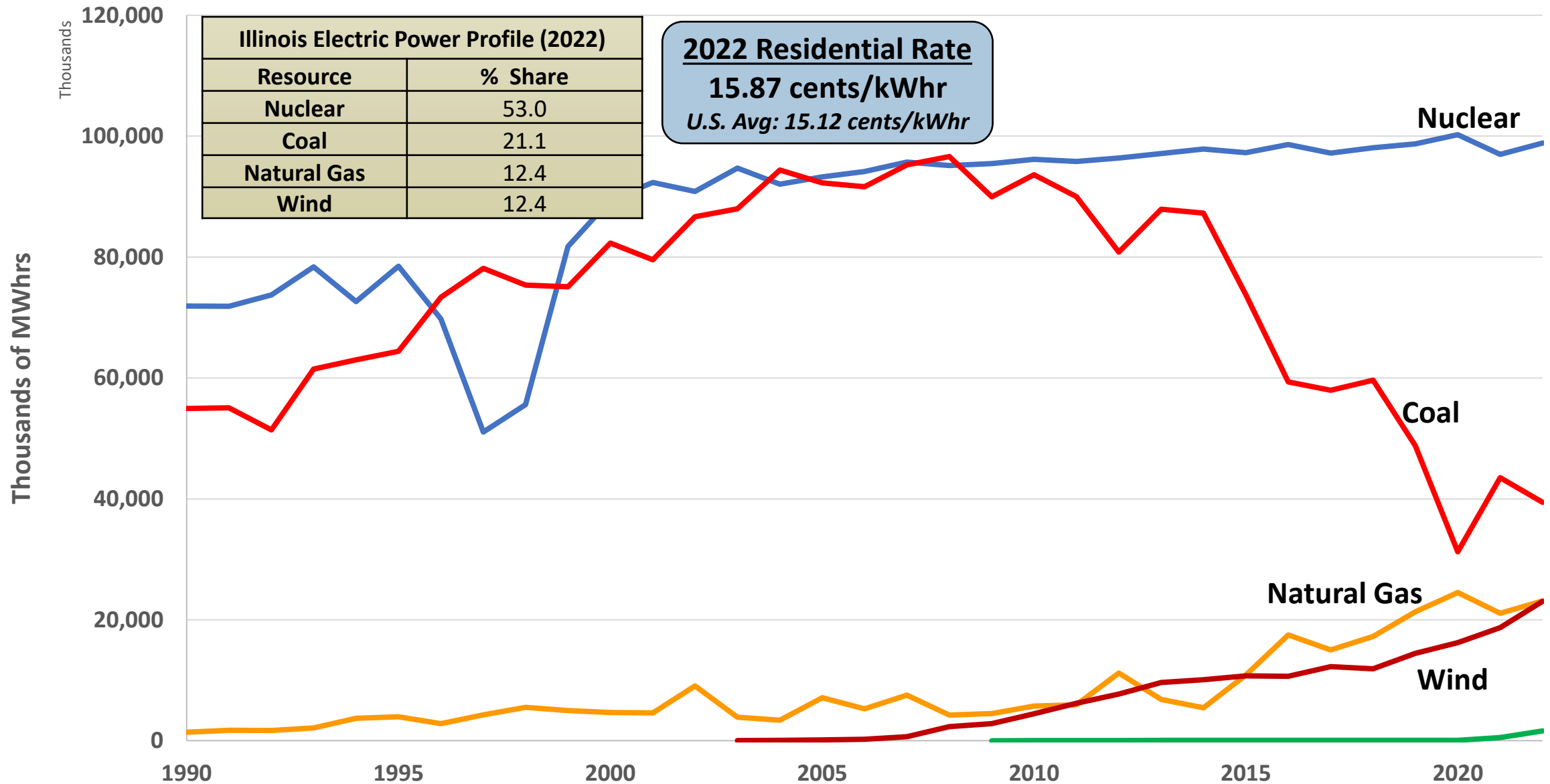
New York Generation (Deregulated)

— Natural Gas — Nuclear — Hydro — Wind — Solar — Petroleum



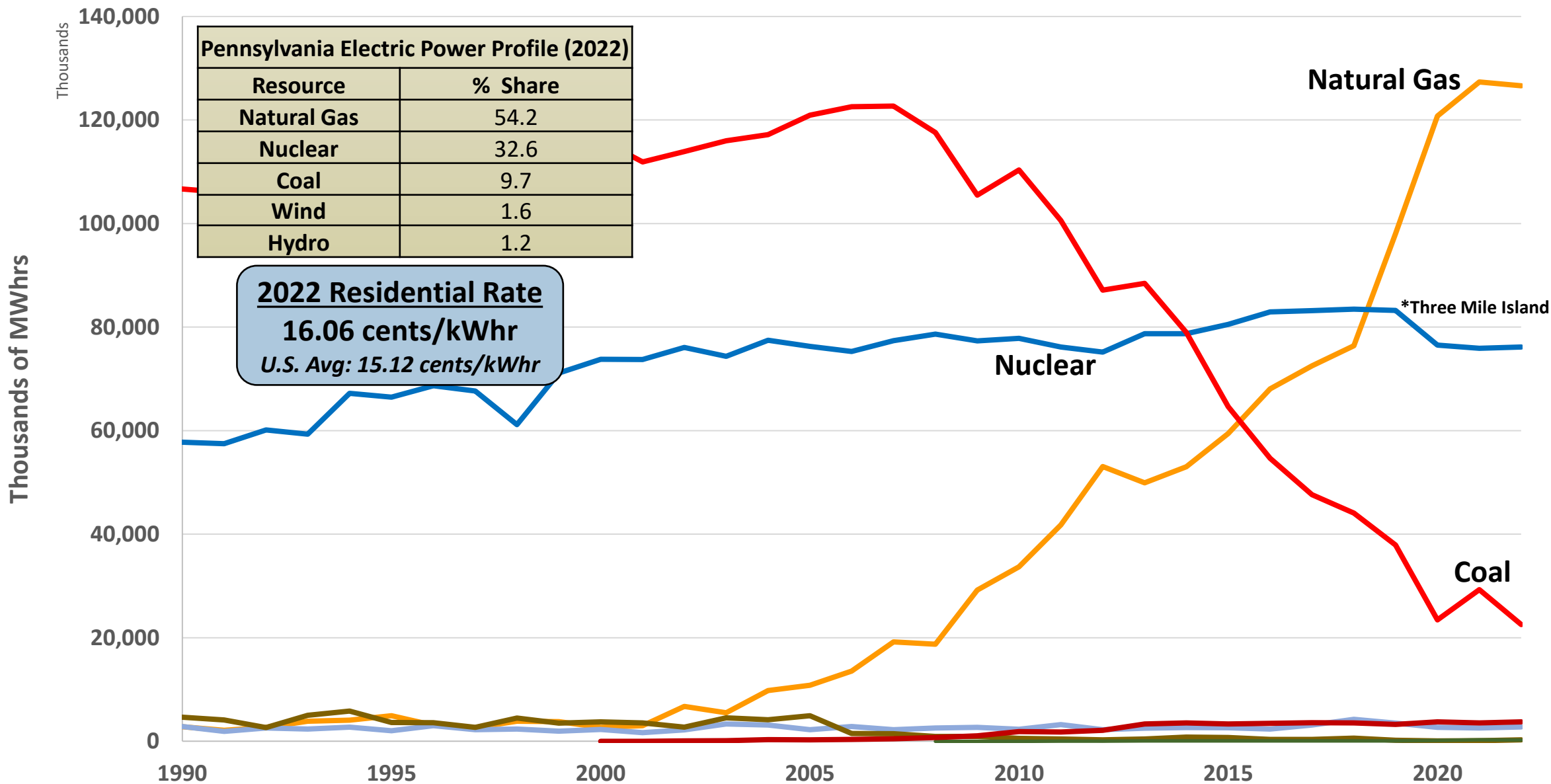
Illinois Generation (Deregulated)

— Nuclear — Coal — Natural Gas — Wind — Solar



Pennsylvania Generation (Deregulated)

— Natural Gas
 — Nuclear
 — Coal
 — Hydro
 — Petroleum
 — Solar
 — Wind



Pennsylvania Electric Power Profile (2022)	
Resource	% Share
Natural Gas	54.2
Nuclear	32.6
Coal	9.7
Wind	1.6
Hydro	1.2

2022 Residential Rate
16.06 cents/kWhr
U.S. Avg: 15.12 cents/kWhr

Natural Gas

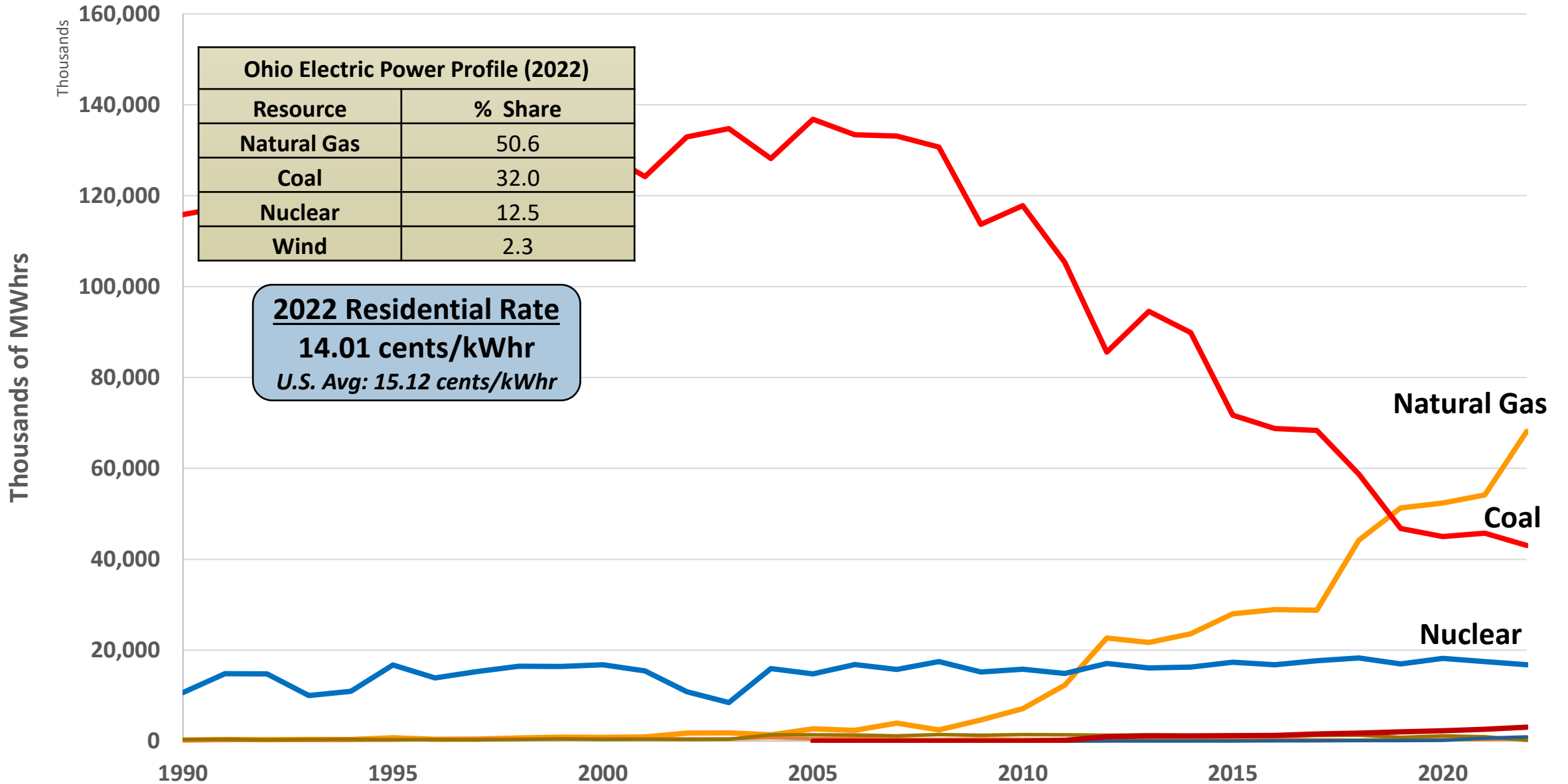
Nuclear

*Three Mile Island

Coal

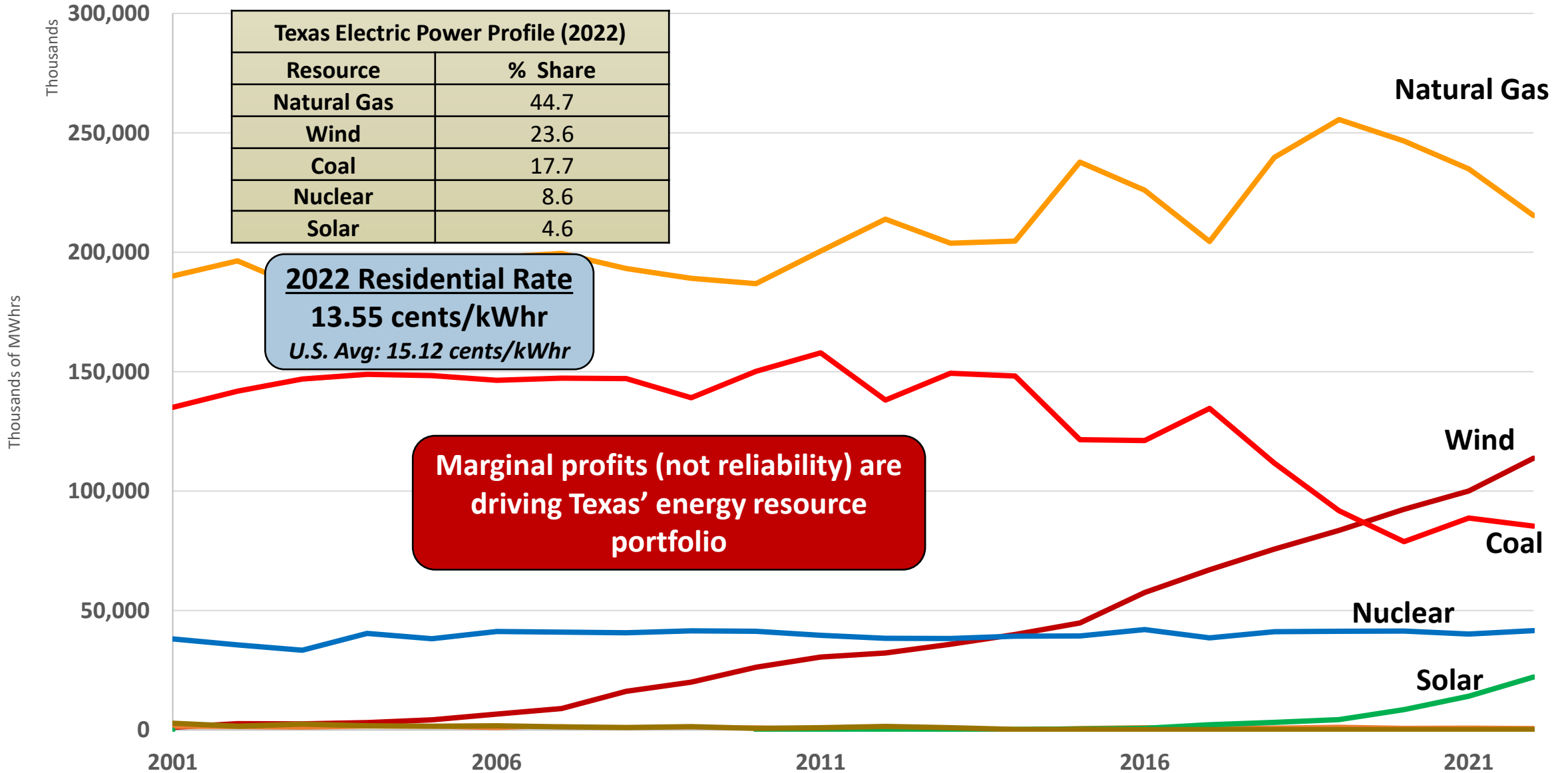
Ohio Generation (Deregulated)

— Natural Gas
 — Coal
 — Nuclear
 — Hydro
 — Petroleum
 — Solar
 — Wind



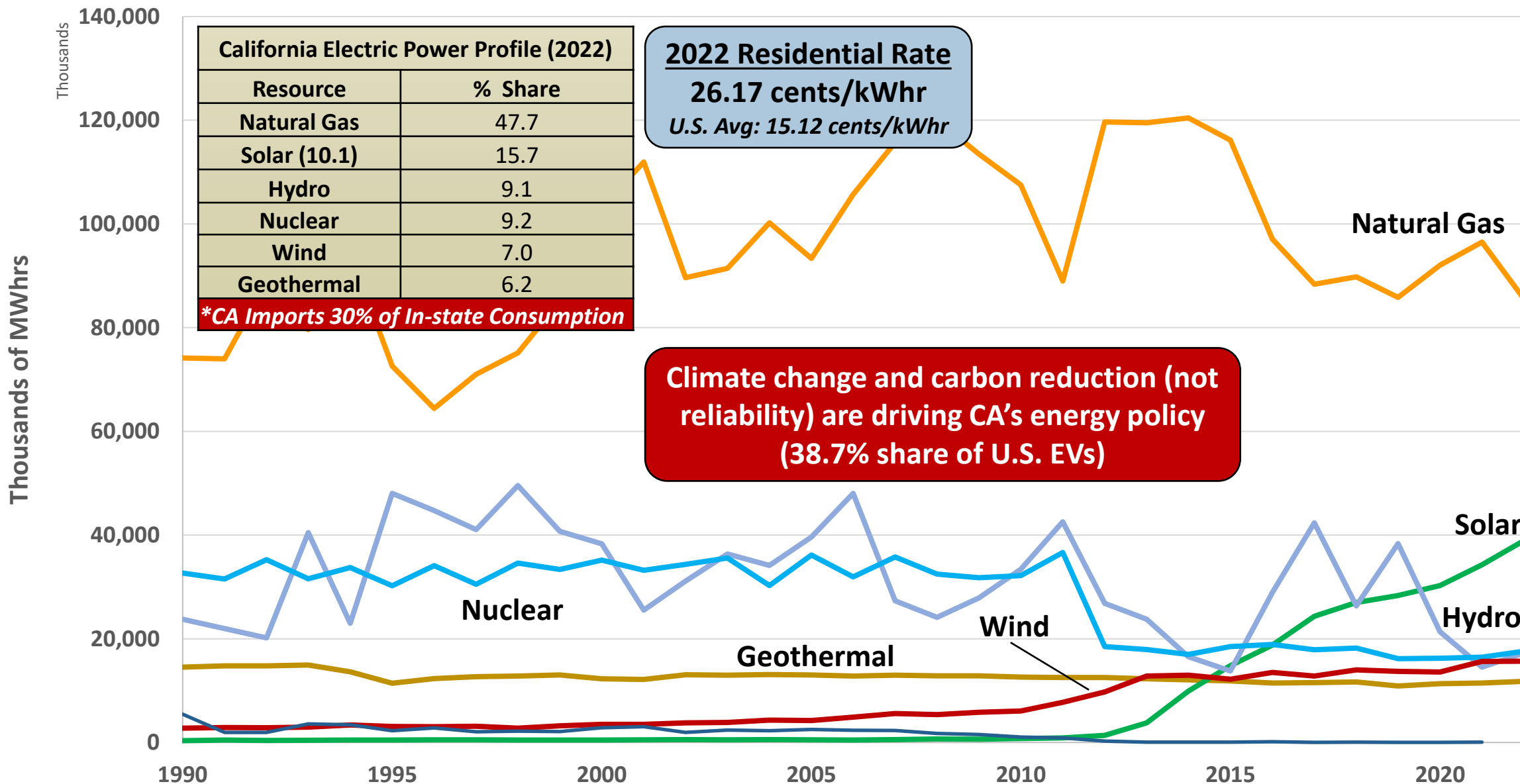
Texas Generation (Deregulated)

— Natural Gas — Wind — Coal — Nuclear — Hydro — Solar — Petroleum



California Generation (Deregulated)

Natural Gas Geothermal Solar Hydro Nuclear Wind Petroleum



California Electric Power Profile (2022)	
Resource	% Share
Natural Gas	47.7
Solar (10.1)	15.7
Hydro	9.1
Nuclear	9.2
Wind	7.0
Geothermal	6.2

**CA Imports 30% of In-state Consumption*

2022 Residential Rate
26.17 cents/kWhr
U.S. Avg: 15.12 cents/kWhr

Climate change and carbon reduction (not reliability) are driving CA's energy policy (38.7% share of U.S. EVs)

Natural Gas

Solar

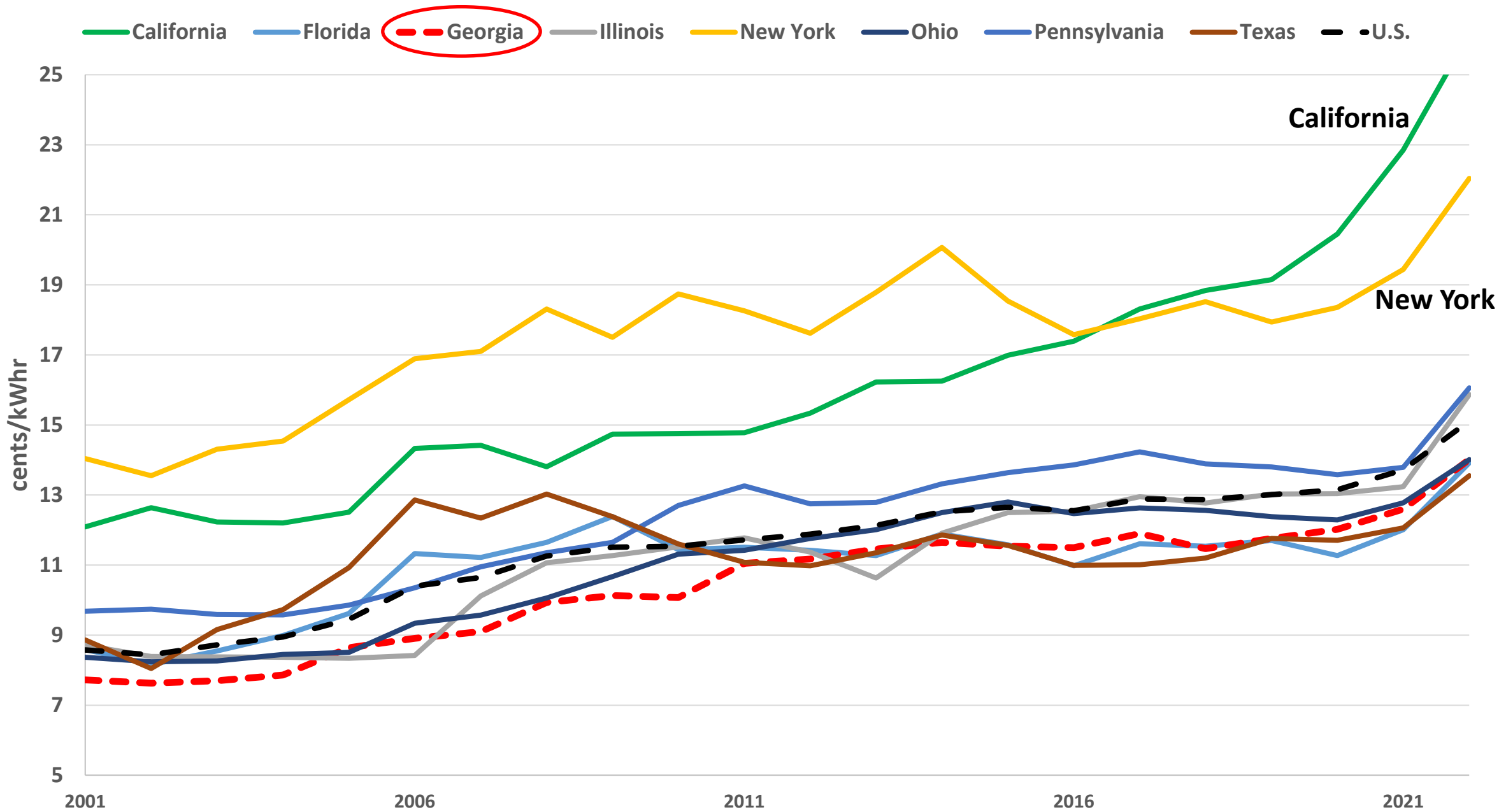
Hydro

Nuclear

Geothermal

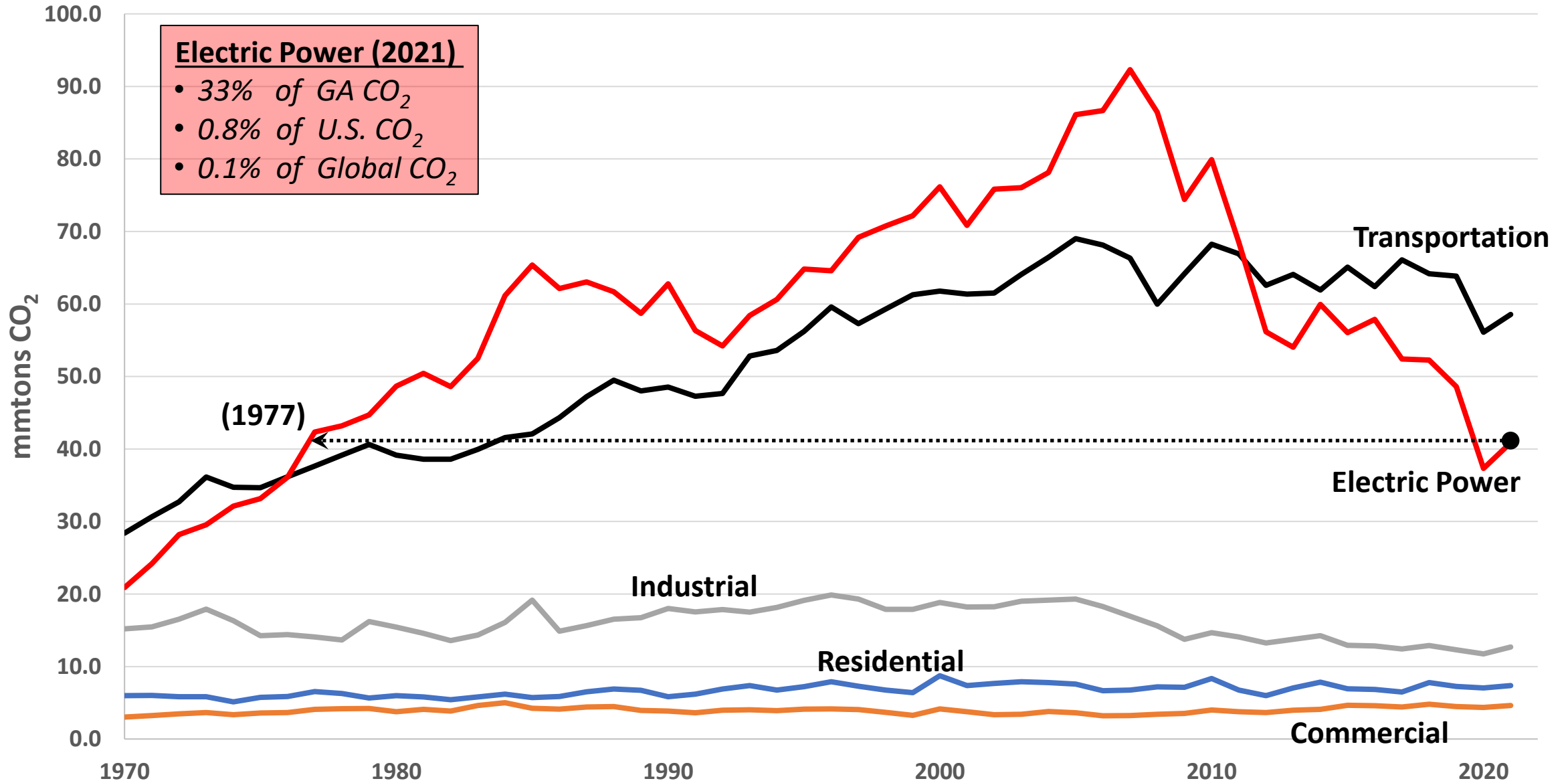
Wind

Residential Rates: Top GDPs



Georgia CO₂ Emissions by Sector

Residential Commercial Industrial Transportation Electric Power

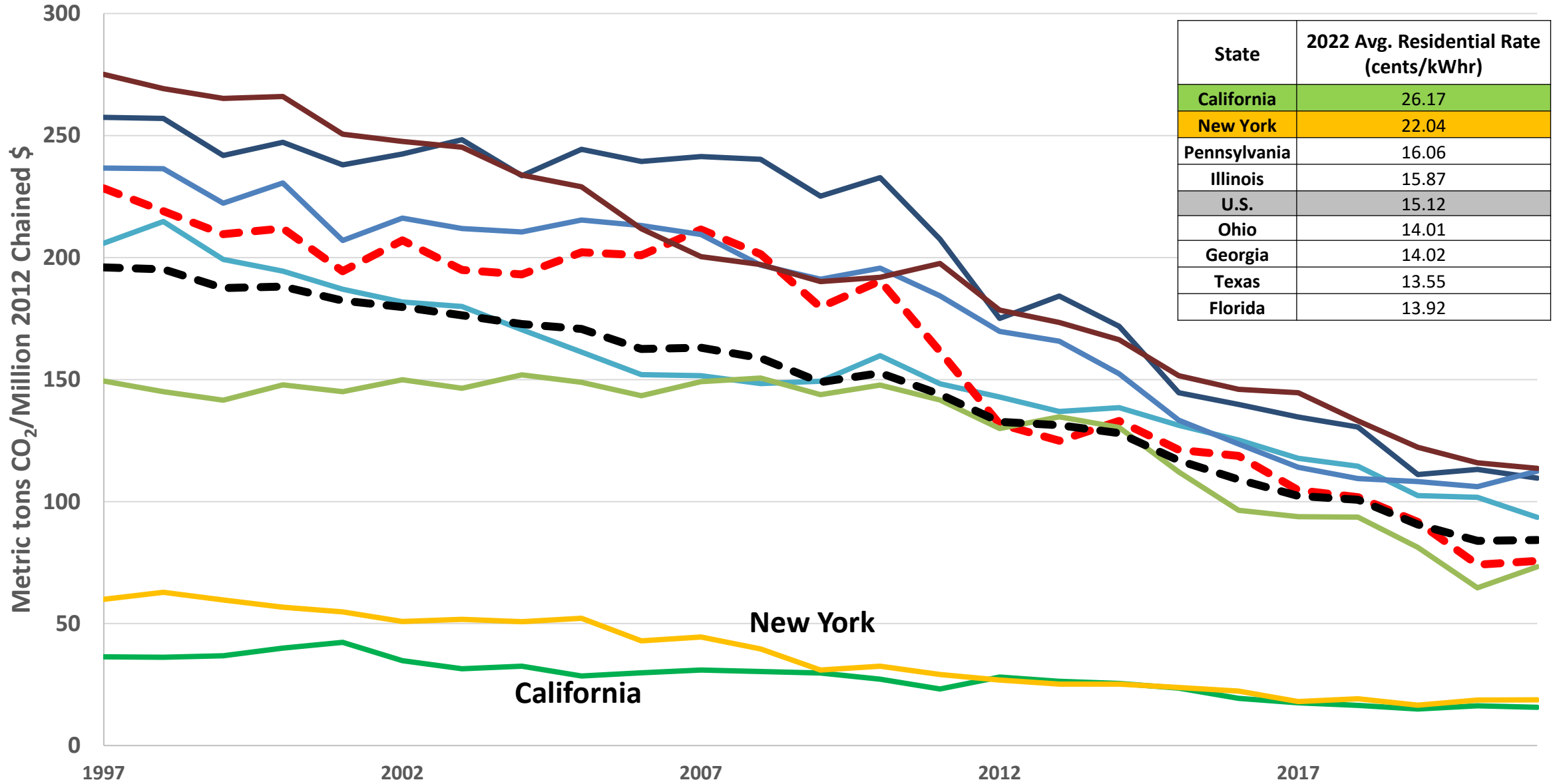


Data Sources:

U.S. EIA; U.S. Bureau Economic Analysis

Electric Power Sector: CO₂ Intensity

— California
 — Florida
 - - Georgia
— Illinois
 — New York
 — Ohio
 — Pennsylvania
 — Texas
 - - U.S.



Georgia's Electric Power Sector

- PRIORITIZING ENERGY SECURITY AND RELIABILITY
- KEEPING RATES AFFORDABLE AND CARBON EMISSIONS IN DECLINE
- ASSESSING INTEGRATED RESOURCE NEEDS FOR THE LONG-TERM



GEORGIA: THE MODEL FOR THE U.S.

*THE ONLY STATE IN THE COUNTRY OFFSETTING A REDUCTION IN BASELOAD COAL
WITH DISPATCHABLE NATURAL GAS, BASELOAD NUCLEAR, & RENEWABLES
WHILE ALSO
REDUCING CARBON EMISSIONS,
PRIORITIZING & MAINTAINING RELIABILITY
DEVELOPING AS A NATIONAL EV AND BATTERY MANUFACTURING HUB*

U.S. Energy Policy

BROADER IMPLICATIONS



PRESERVING OUR COMPETITIVE ADVANTAGE

PERSONNEL AND READINESS STRATEGY FOR 2030

OCTOBER 2020

“Both nations [China and Russia] seek military and technological superiority over the U.S. and *will continue attempts to overcome competitive disadvantages by fusing their national capabilities to destabilize the international order.* We will be fully engaged in great power competition with China and Russia, made increasingly complex by the continuing rogue actions of North Korea, Iran’s malign influence, and threats from violent extremist organizations.”

OTR Freight



<https://www.fleetequipmentmag.com/us-bank-freight-payment-index-shipments/>

Mining Oil, Natural Gas, Coal, Uranium, Minerals, Metals



<https://resource-erectors.com/career-blog/integrated-operations-management-in-minerals-metals-and-mining/>

Natural Gas-Fired Power Plants



<https://www.energyindustrygeneratingplants.com/energy-industry-generating-plants/>

Nuclear Power Plants



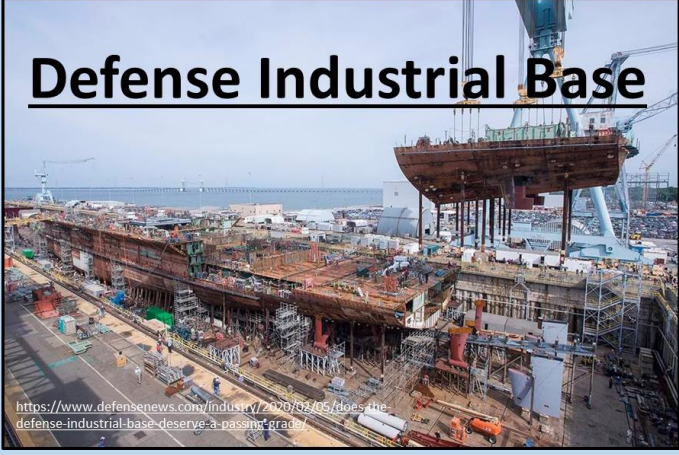
<https://www.scoriapower.com/company/energy-industry-generating-plants/>

Rail and Shipping



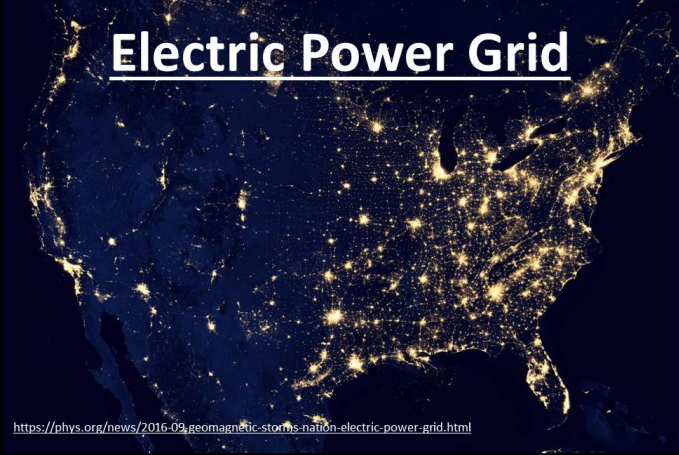
<https://www.cato.org/publications/policy-analysis/tonnes-act-but-an-america-can-no-longer-bear>

Defense Industrial Base



<https://www.defensenews.com/industry/2020/05/05/does-the-defense-industrial-base-deserve-a-passing-grade/>

Electric Power Grid



<https://phys.org/news/2016-04-geomagnetic-storms-nation-electric-power-grid.html>

Agriculture & Food Production



<https://www.wsi.com/articles/cs-farmers-who-once-fed-the-world-overtaken-by-new-world-powers-1492700274>

Cement Production



<https://www.britannica.com/technology/cement-building-material/Extraction-and-processing>

Coal-Fired Power Plants



<https://www.georgiapower.com/company/environmental-compliance/plant-list/plant-bowen.html>

Chemical Production



<https://www.aiiche.org/connected/2018/07/introduction-advanced-manufacturing-chemical-engineers>

Iron and Steel Forging



<https://www.steel.org/steel-technology/steel-production/>

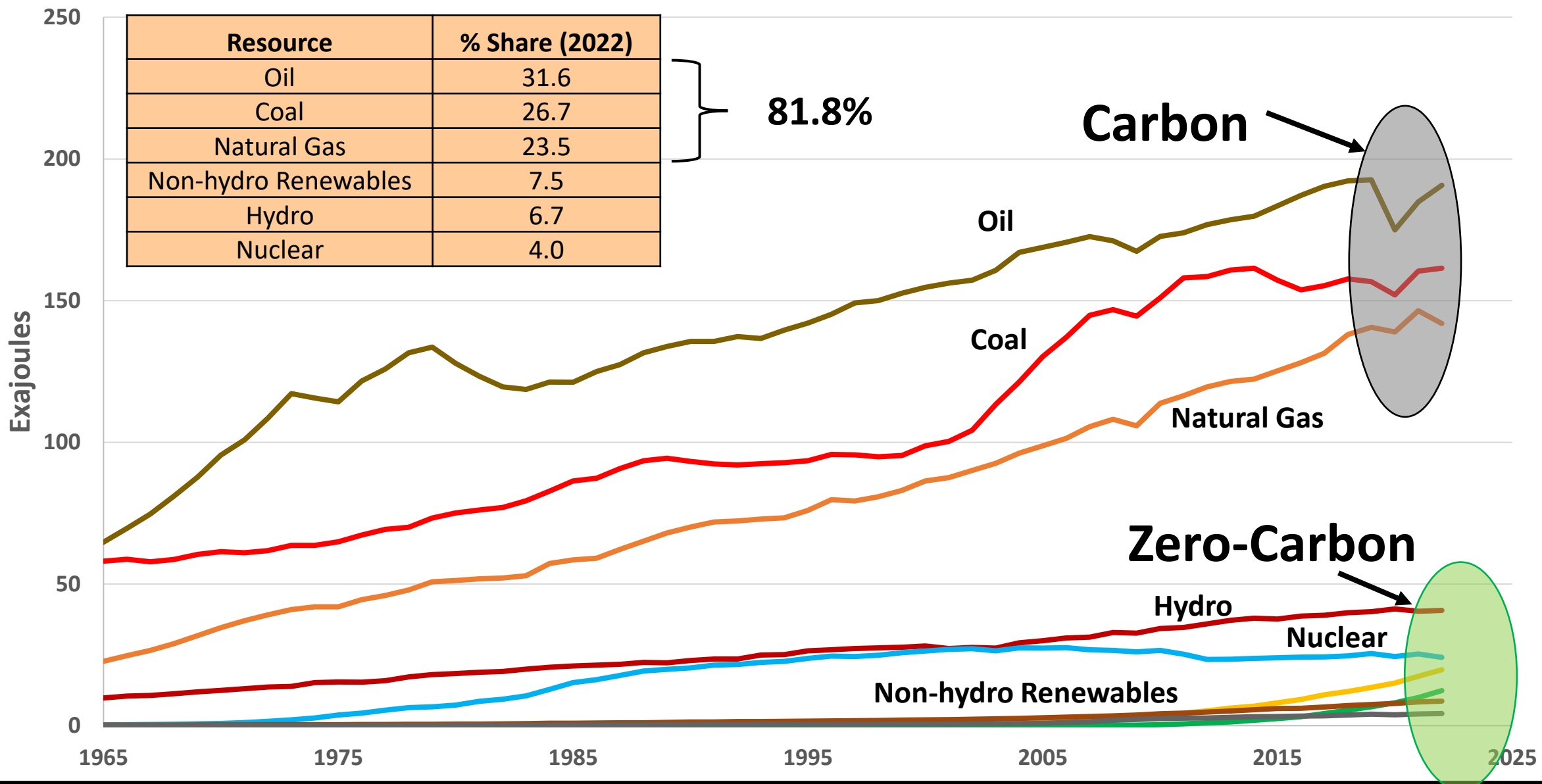
Oil and Natural Gas Refining



<https://www.slb.com/renewable-energy/2018/01/22/utah-refineries-now-produce/>

World Energy Consumption: Transportation, Electricity, Heat

Oil Coal Natural Gas Hydro Nuclear Wind Solar Biogeo Biofuels



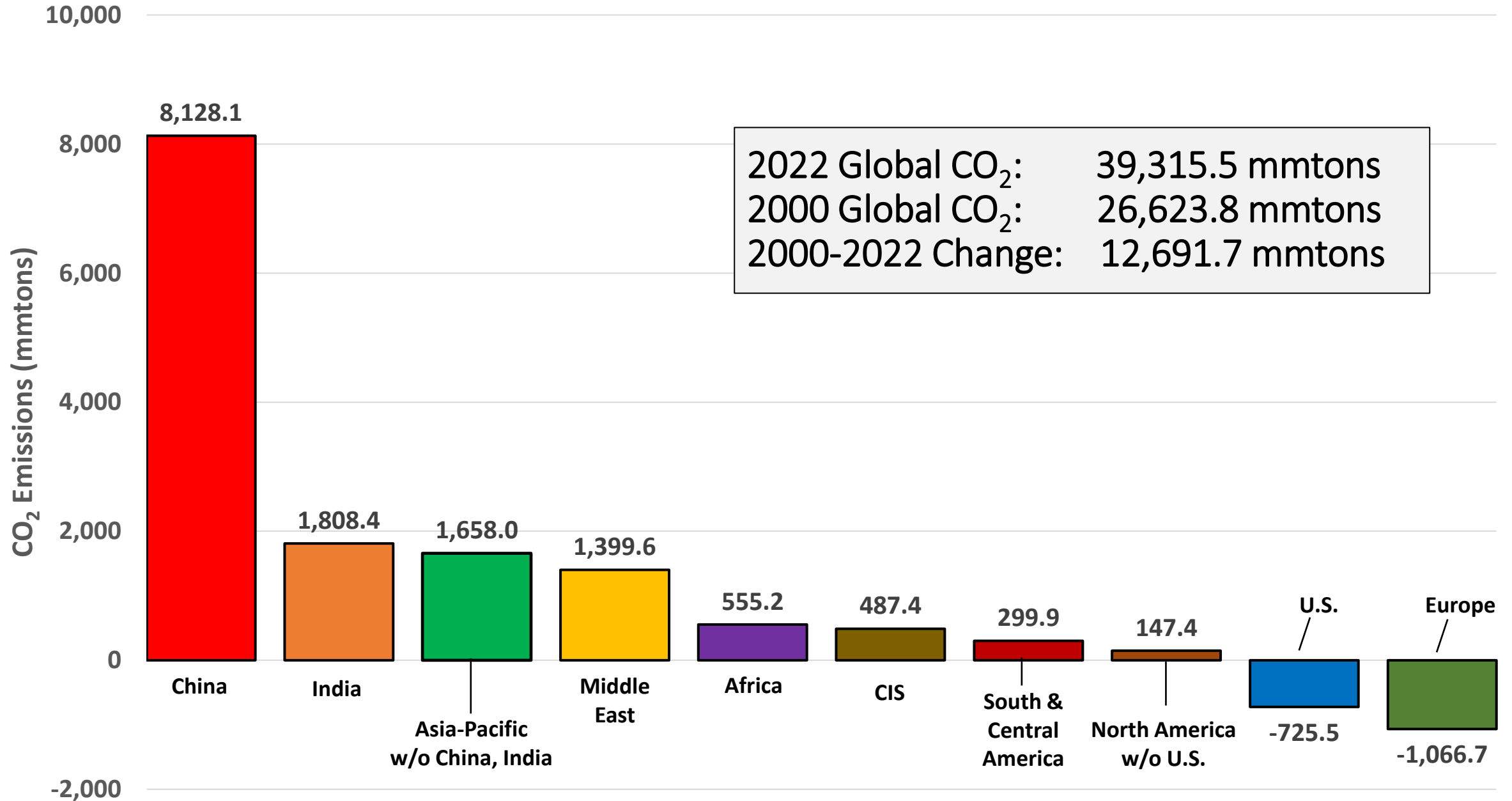
Resource	% Share (2022)
Oil	31.6
Coal	26.7
Natural Gas	23.5
Non-hydro Renewables	7.5
Hydro	6.7
Nuclear	4.0

81.8%

Carbon

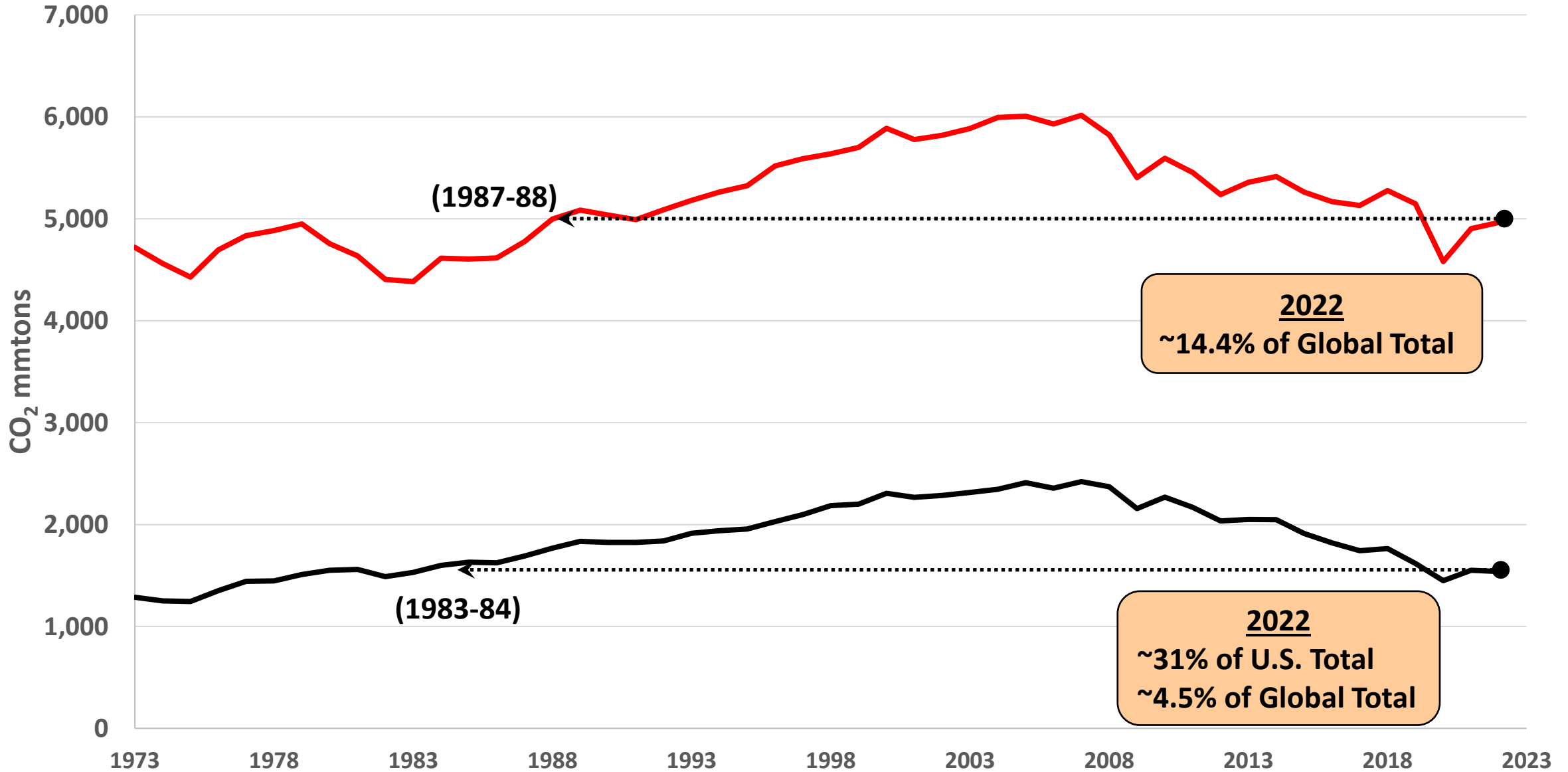
Zero-Carbon

Change in CO₂ Emissions (2000-2022)



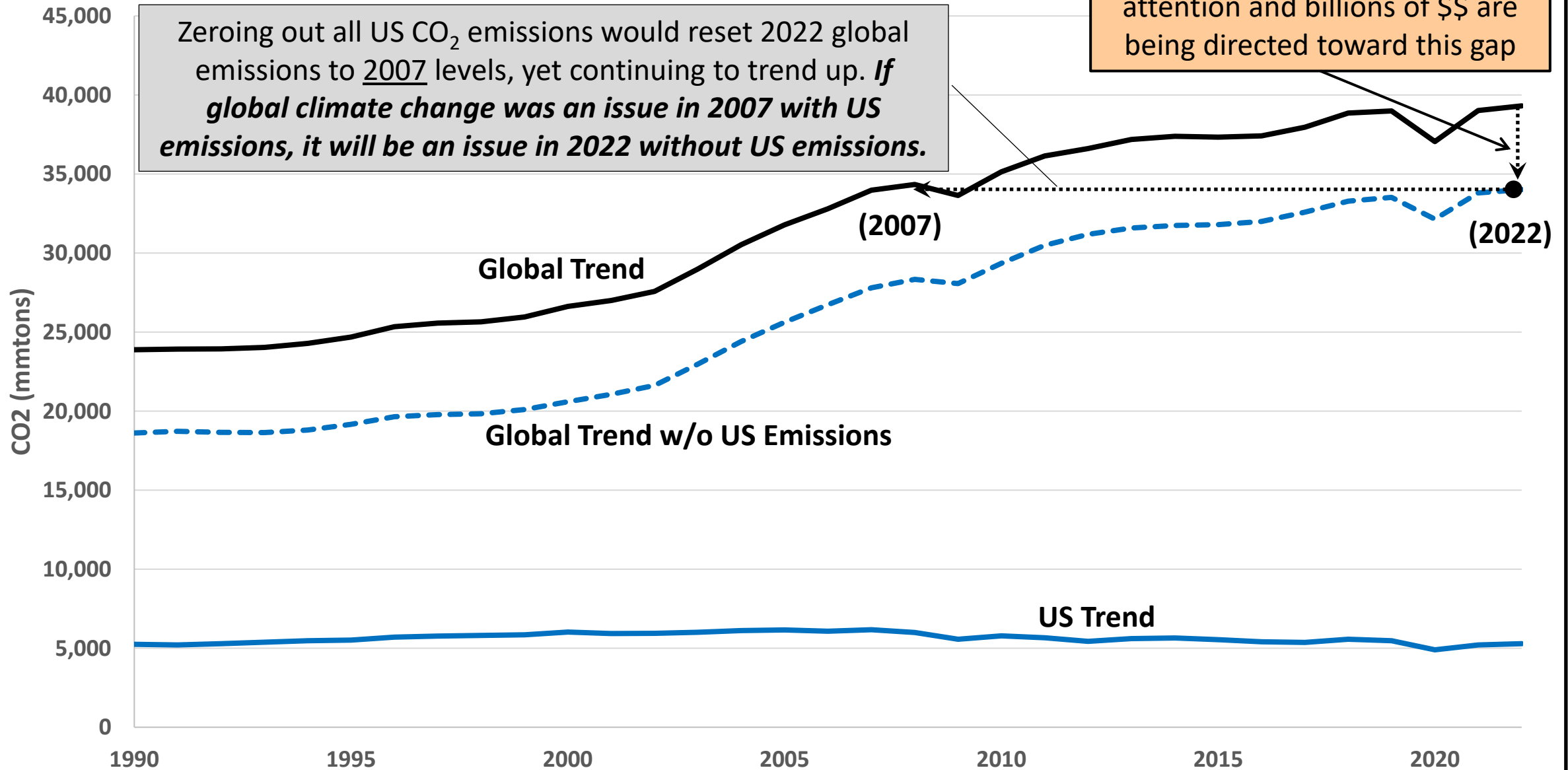
U.S. CO₂ Emissions

— Total Energy CO₂ — Power Sector CO₂



CO2 Emissions: U.S. & World Comparison

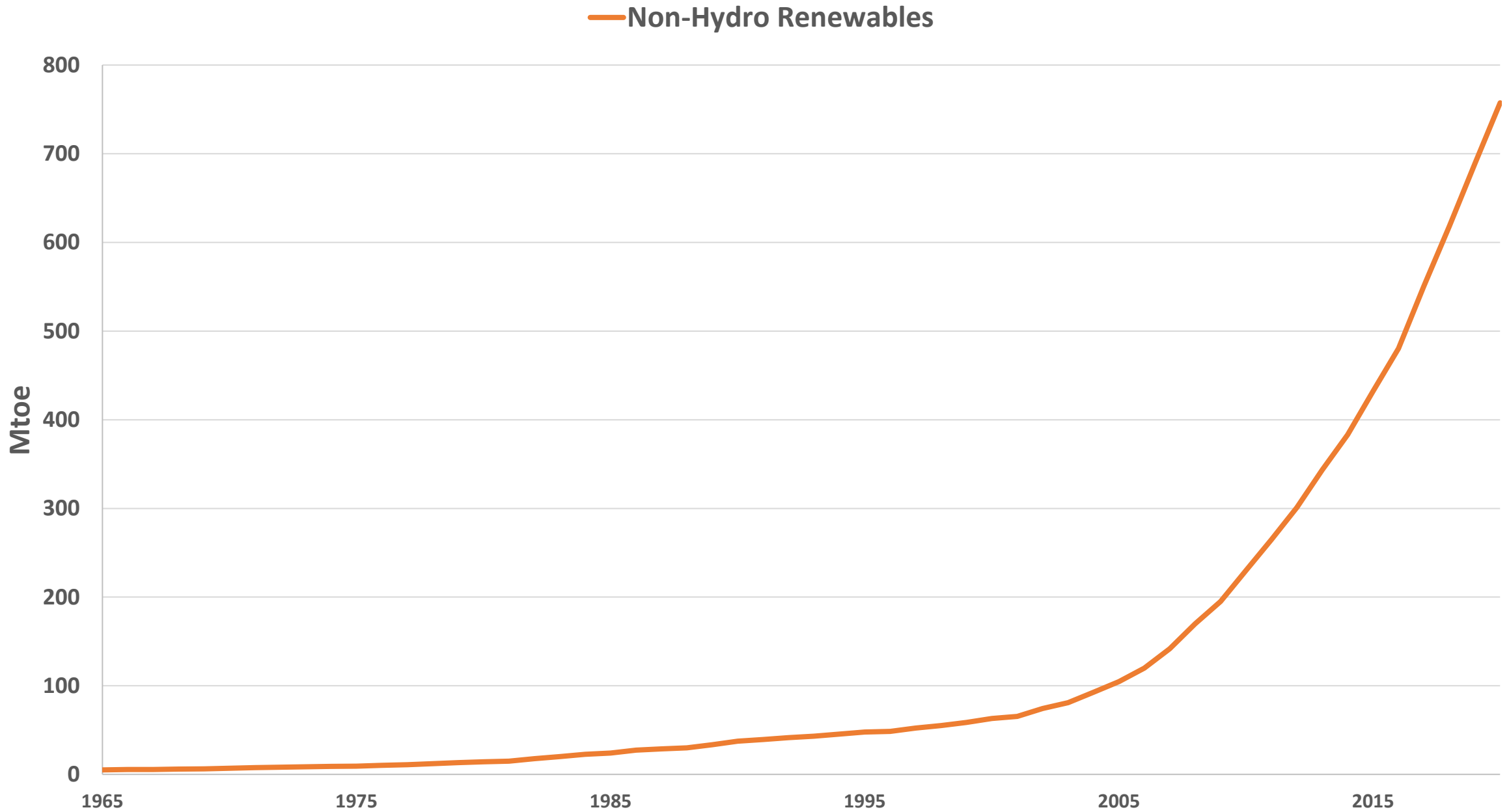
— World — U.S. - - - World w/o U.S.



Zeroing out all US CO₂ emissions would reset 2022 global emissions to 2007 levels, yet continuing to trend up. *If global climate change was an issue in 2007 with US emissions, it will be an issue in 2022 without US emissions.*

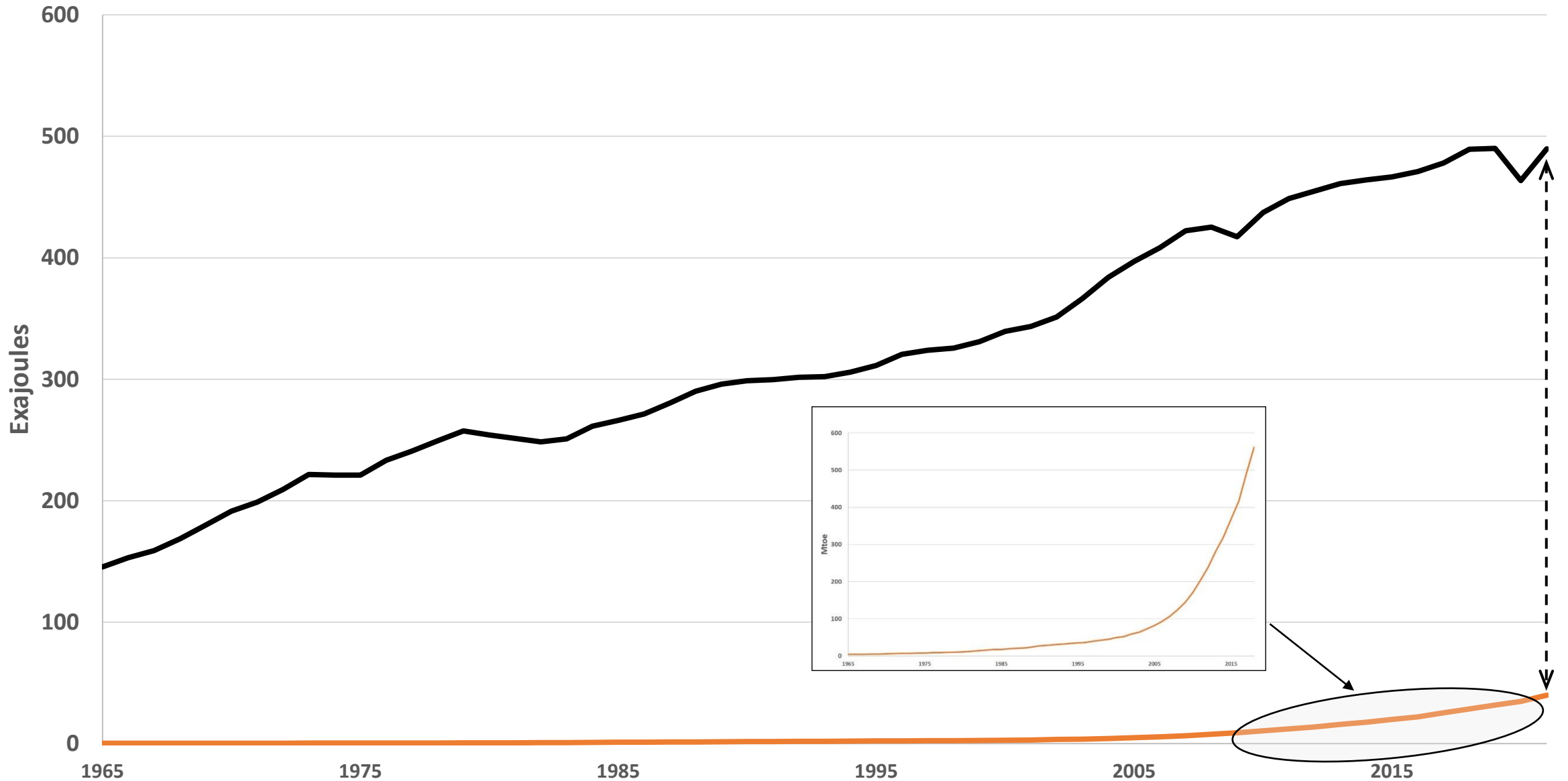
Substantial US energy policy attention and billions of \$\$ are being directed toward this gap

World Energy Consumption: Non-hydro Renewables



World Energy: Fossil Fuels & Non-Hydro Renewables

— Fossil Fuels — Non-hydro Renewables



Current U.S. Energy Strategy

- Executive Order 14008 (January 27, 2021)
 - *“Putting the Climate Crisis at the Center of United States Foreign Policy and National Security”*
- America’s National Security Strategy (October 12, 2022)
 - *“Climate” is defined as “the greatest and potentially existential for all nations”*
 - *“Combating the climate crisis, bolstering our energy security, and hastening the clean energy transition is integral to our industrial strategy, economic growth, and security. Events like Russia’s war of aggression against Ukraine have made clear the urgent need to accelerate the transition away from fossil fuels”*

* <https://www.theguardian.com/world/2022/jan/26/xi-jinping-warns-chinas-low-carbon-ambitions-must-not-interfere-with-normal-life>

Energy Strategy of America's Primary Competitor

- Xi Jinping's speech to the CCP (January 24, 2022)
 - *"Reducing emissions is not about reducing productivity, and it is not about not emitting at all, either...the gradual withdrawal of traditional energy must be based on the safe and reliable replacement by new energy. This in practice means less restrictions on fossil fuel."**
- Xi Jinping's "Report to the 20th National Congress of the Communist Party of China" (October 16, 2022)
 - *"Based on China's energy and resource endowment, we will advance initiatives to reach peak carbon emissions in a well-planned and phased way in line with the principle of building the new before discarding the old"*.

* <https://www.theguardian.com/world/2022/jan/26/xi-jinping-warns-chinas-low-carbon-ambitions-must-not-interfere-with-normal-life>

CHINA'S FOREIGN MINISTER SIGNALS DEEPER TIES WITH RUSSIA

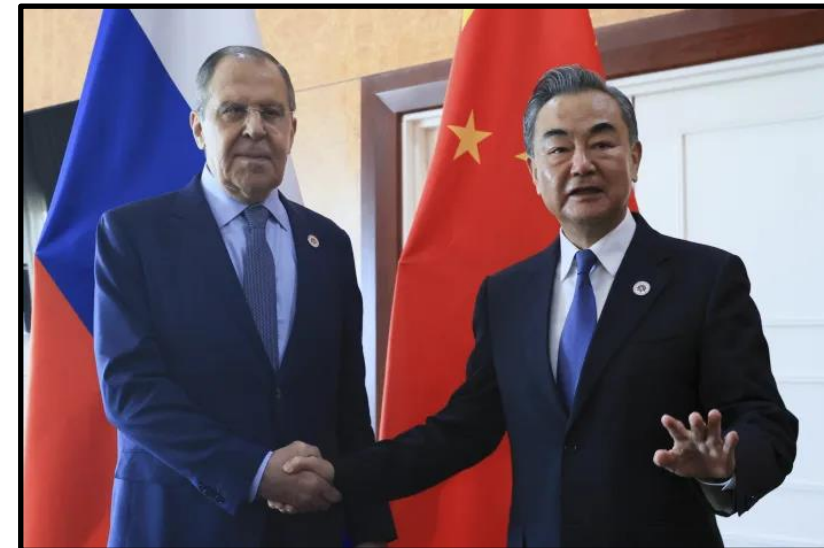
Chinese Foreign Minister Wang Yi defended what he said was his country's position of impartiality on the war in Ukraine on Sunday and signaled that China would deepen ties with Russia in the coming year and would "deepen strategic mutual trust and mutually beneficial cooperation" with Russia. Wang, speaking by video to a conference in the Chinese capital, also blamed America for the deterioration in relations between the world's two largest economies, saying that China has "firmly rejected the United States' erroneous China policy."
(December 25, 2022)



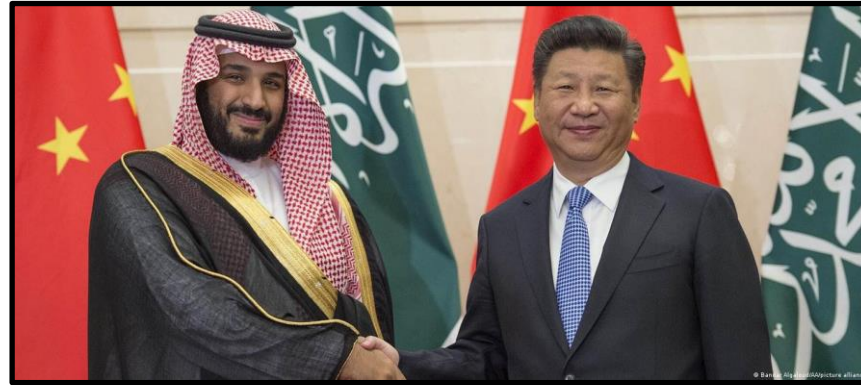
RUSSIA-CHINA ENERGY COOPERATION IN FOCUS AS PUTIN VISITS XI

"Since the start of the Ukrainian conflict, Russia, a leading global oil producer, has cemented its energy ties with China, the world's No. 2 oil consumer after the United States. Beijing has rejected Western criticism of its growing partnership with Moscow in light of Russia's conflict in Ukraine. It insists the ties do not flout international norms, and China has the prerogative to collaborate with whichever country it chooses."(October 2023)

Link: [Russia-China Energy](#)



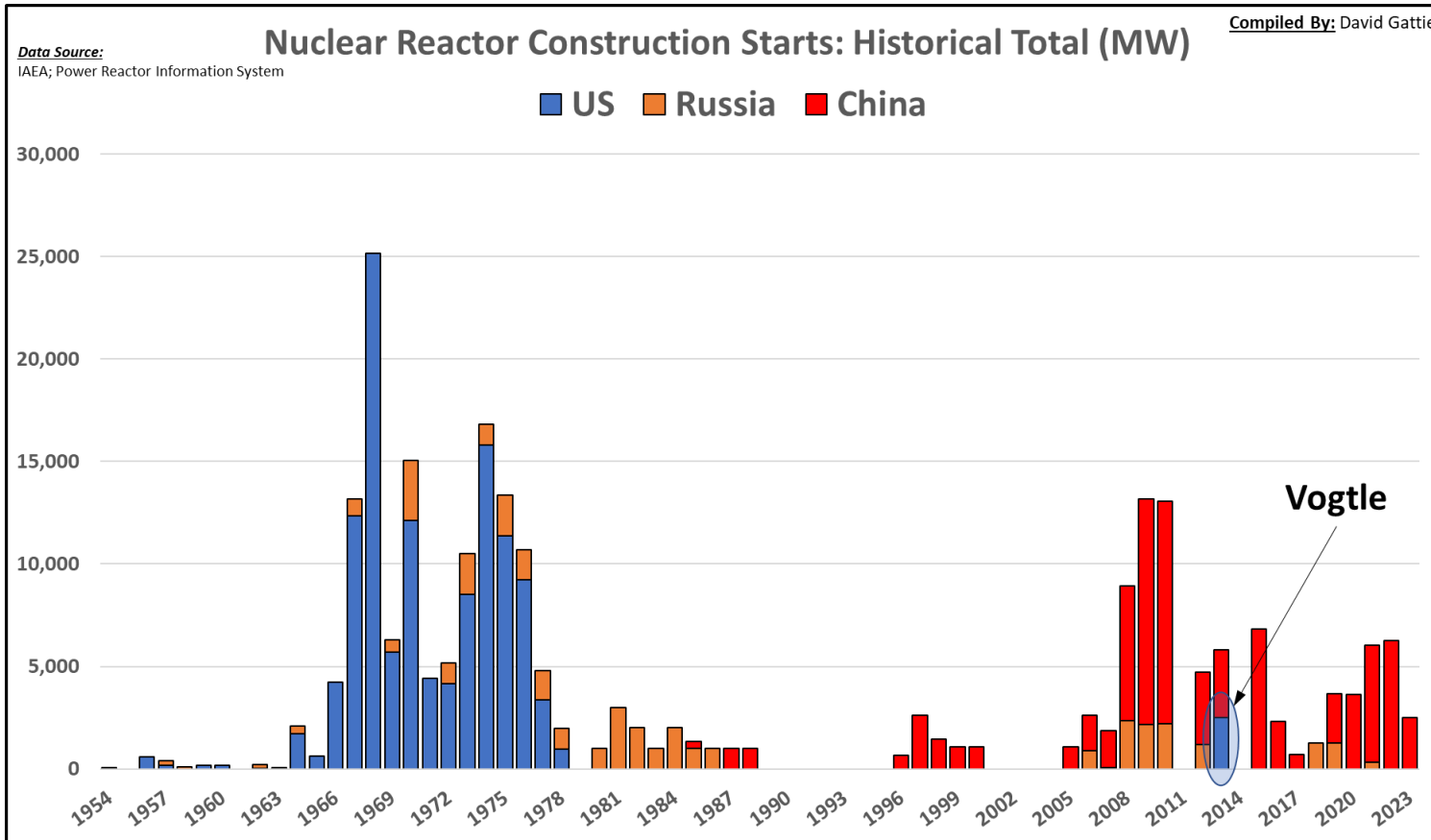
Xi Pledges More Energy Deals With Gulf Producers



"Saudi Arabia has always considered China as a strategic partner, and that the Committee strives for further alignment between the Saudi and China visions of the future, especially in the energy sphere, where there are multiple synergies," Prince Abdulaziz said. In the meeting, the co-chairs discussed areas where Saudi Arabia and China look to strengthen their relationship, such as oil and petrochemicals, decarbonization technologies, electricity and renewables, hydrogen, energy efficiency, civil nuclear energy, and supply chain security, in addition to industrial cooperation, the fourth industrial revolution, mining and logistics, civil aviation and aviation security, and digital economy." GCC countries are an energy tank for world economy (October 27, 2022)

Source: <https://www.zawya.com/en/projects/bri/saudi-arabia-china-agree-on-coordinating-investments-in-bri-states-jw964kz8>

Nuclear Power in the 21st Century



Of these 170 reactors, 114 are associated with China or Russia—either by location or by reactor technology.

Number of Reactors Since 2000			
Country	Connected to Grid	Under Construction	Russian or Chinese
China	52	21	73
Russia	13	3	16
India	12	8	4
South Korea	11	3	0
Japan	5	2	0
Pakistan	6	0	6
Czech Republic	2	0	2
Ukraine	2	2	2
Argentina	1	1	0
Belarus	2	0	2
Brazil	1	1	0
Iran	1	1	1
UAE	3	1	0
US	2	1	0
Romania	1	0	0
Bangladesh	0	2	2
Finland	1	0	0
France	0	1	0
Slovakia	1	1	2
Taiwan	0	0	0
Turkey	0	4	4
UK	0	2	0
Total	116	54	114

Source: World Nuclear Association; IAEA (2023)

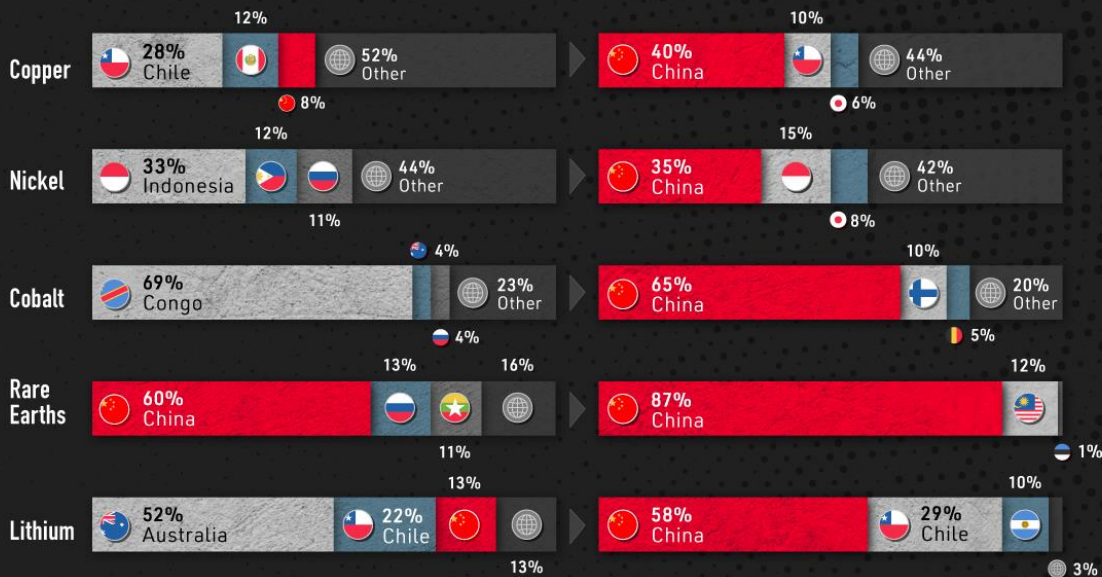
VISUALIZING CHINA'S DOMINANCE IN CLEAN ENERGY METALS

Renewable sources of energy are expected to replace fossil fuels in the next decades, as the world's economies try to reduce carbon emissions and mitigate climate change.

This graphic based on data from the International Energy Agency illustrates where the extraction and processing of key metals for the green revolution take place, and how China is leading the process.

Where Clean Energy Metals are Produced

Where Clean Energy Metals are Processed



World demand for lithium is forecast to more than double between 2020 and 2023 as global electric vehicle uptake rises.

The Biden administration has targeted rare earths among domestic supply chain priorities.

Of the 255,000 Congolese mining for cobalt, 40,000 are children.

Source: International Energy Agency

ELEMENTS

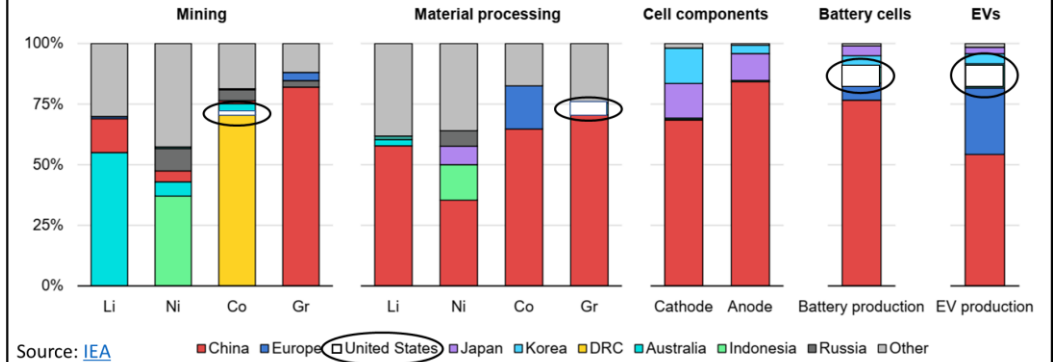
elements.visualcapitalist.com

The Earth's natural resources power our everyday lives. VC Elements breaks down the building blocks of the universe.

We live in a material world.

China dominates the entire downstream EV battery supply chain

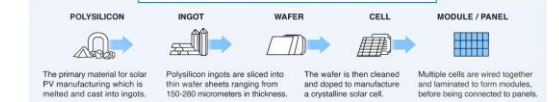
Geographical distribution of the global EV battery supply chain



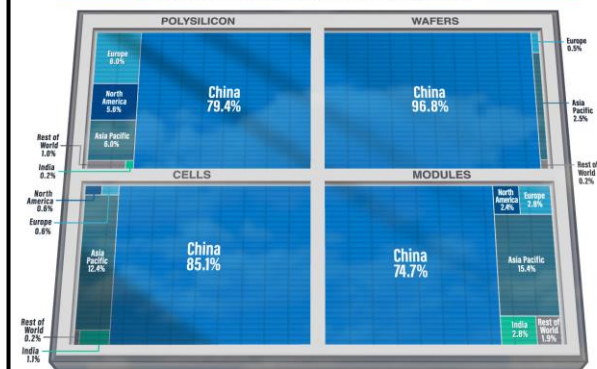
Source: IEA

Who Controls the Solar Panel Supply Chain?

The Manufacturing Process for Solar PV Panels



Share of Manufacturing Capacity by Country/Region in 2021



China made up 56% of global solar panel manufacturing capacity in 2010, with its share rising to 84% in 2021.

The total value of global solar PV related trade increased by more than 70% YoY to reach over \$40B in 2021.

ELEMENTS

Source: IEA

ELEMENTS.VISUALCAPITALIST.COM

A Contrast in Perspective & Strategy

Climate Change is at the Center of U.S. Foreign Policy and National Security

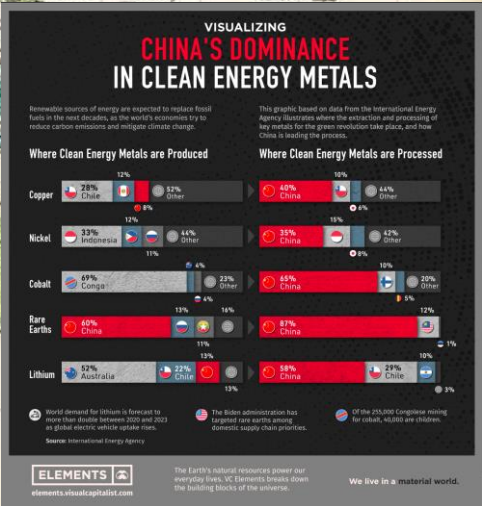
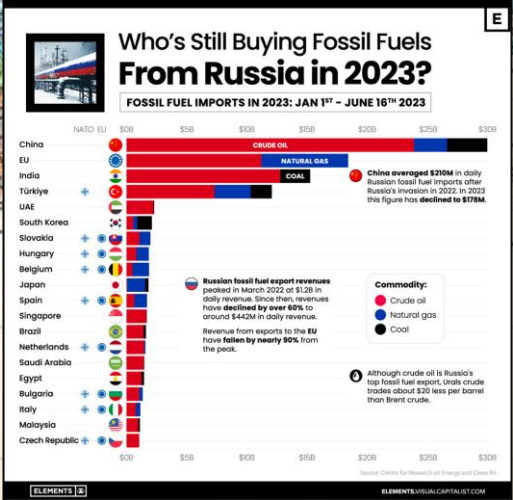
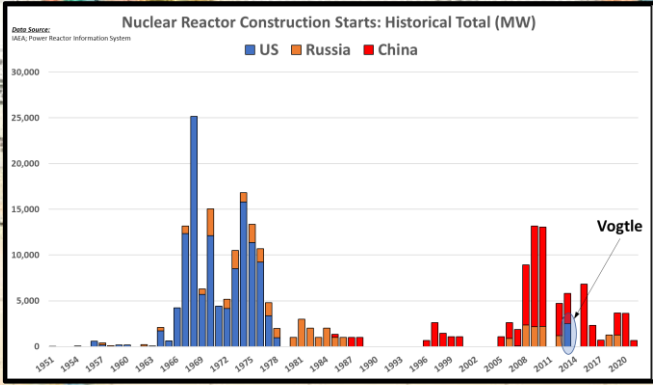
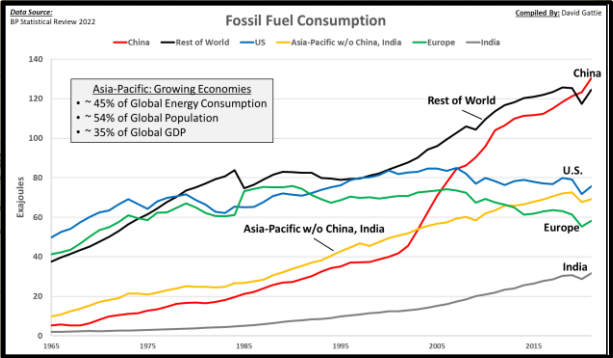
Photo Credit: *Atlanta Mirror* Source: *White House*

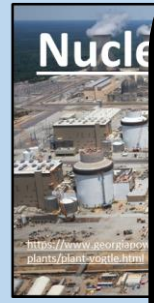


Russia
Oil, Gas,
Nuclear



China BRI
Coal, Nuclear, Solar &
Battery Supply Chain,
BRI Financing





America's Industrial Base
Depth, Diversity and Innovative
Capacity Are Critical
-Energy is a Core Resource-



To Which Great Power Competitor Belongs the Relative Advantage?



OTR Freight

Mining
Oil, Natural Gas,
Coal, Uranium,
Minerals, Metals

Natural Gas-Fired Power Plants

Nuclear Power Plants

Rail and Shipping

Agri Food

Coal-Fire

Oil Refining

Production

Industrial Strategy
Energy Transition

OTR Freight

Mining
Oil, Natural Gas,
Coal, Uranium,
Minerals, Metals

Natural Gas-Fired Power Plants

Nuclear Power Plants

China Aerospace Studies Institute
CHINA'S MILITARY-CIVIL
FUSION STRATEGY

Electric Power Grid

Rail and Shipping

Agri Food

Coal-Fire

Oil Refining

Production

Industrial Strategy
All Energy Resources



GEORGIA: THE MODEL FOR THE U.S.

*THE ONLY STATE IN THE COUNTRY OFFSETTING A REDUCTION IN BASELOAD COAL
WITH DISPATCHABLE NATURAL GAS, BASELOAD NUCLEAR, & RENEWABLES
WHILE ALSO
REDUCING CARBON EMISSIONS,
PRIORITIZING & MAINTAINING RELIABILITY
DEVELOPING AS A NATIONAL EV AND BATTERY MANUFACTURING HUB*

Thank You

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