



34th Biennial Institute
FOR **Georgia Legislators**

Powering Economic Development



Powering Economic Development in Georgia

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UNIVERSITY OF GEORGIA

COLLEGE OF ENGINEERING AND CENTER FOR INTERNATIONAL TRADE & SECURITY

2024 UGA BIENNIAL

DECEMBER 9, 2024

Bottom Line Up Front

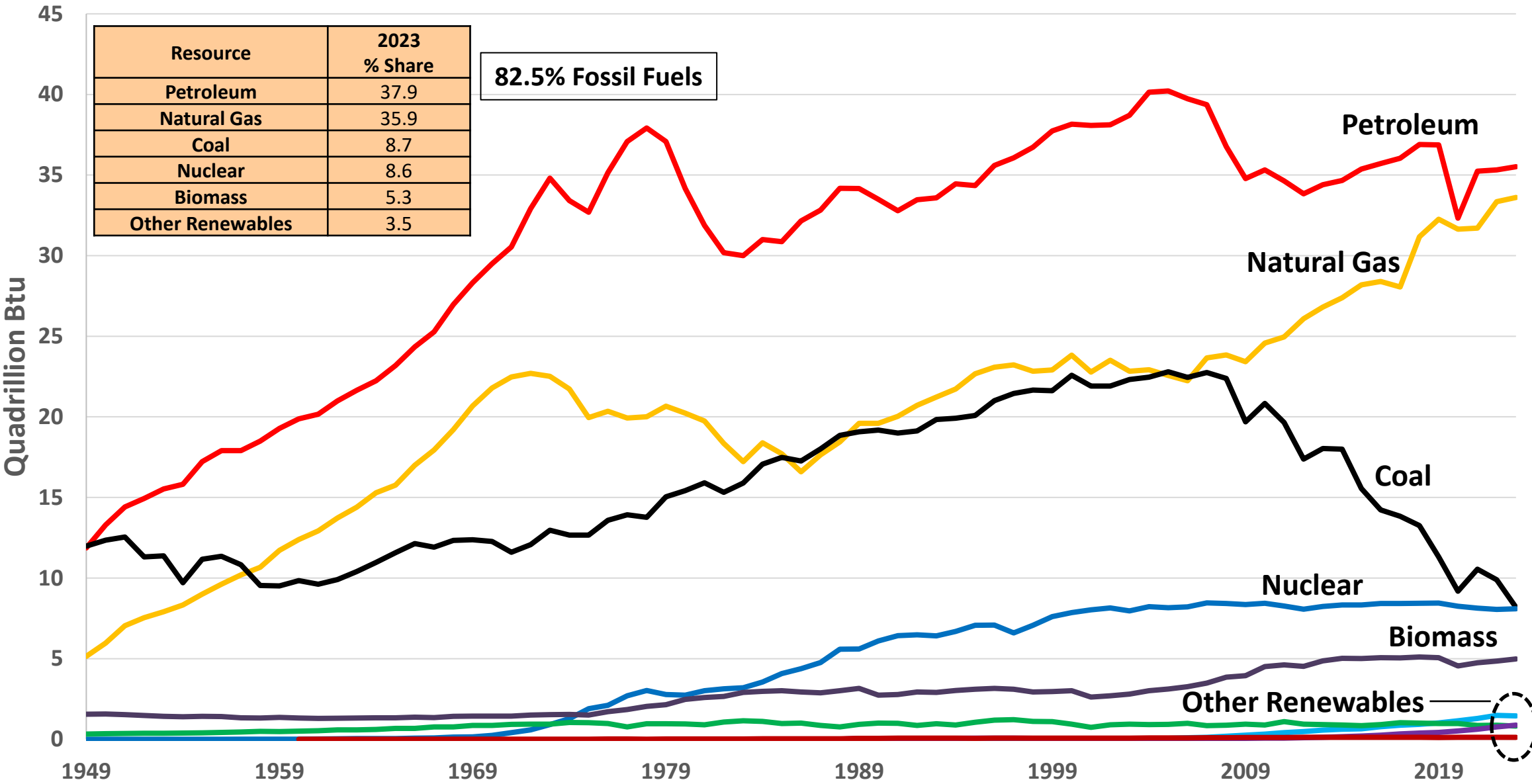
For the first time in over 20 years, the U.S is experiencing increased demand for electricity while at the same time debating a proposal to transition away from fossil fuels to a greater dependency on renewables. This upward pressure on demand, downward pressure on reliable fossil fuels, and pressure to rely on renewable resources represents uncharted territory for America.

We're already seeing signs of stress on grids across the country. And if these competing pressures continue, it will be a perfect storm for electric power sectors across the U.S. with implications for energy security and economic development.

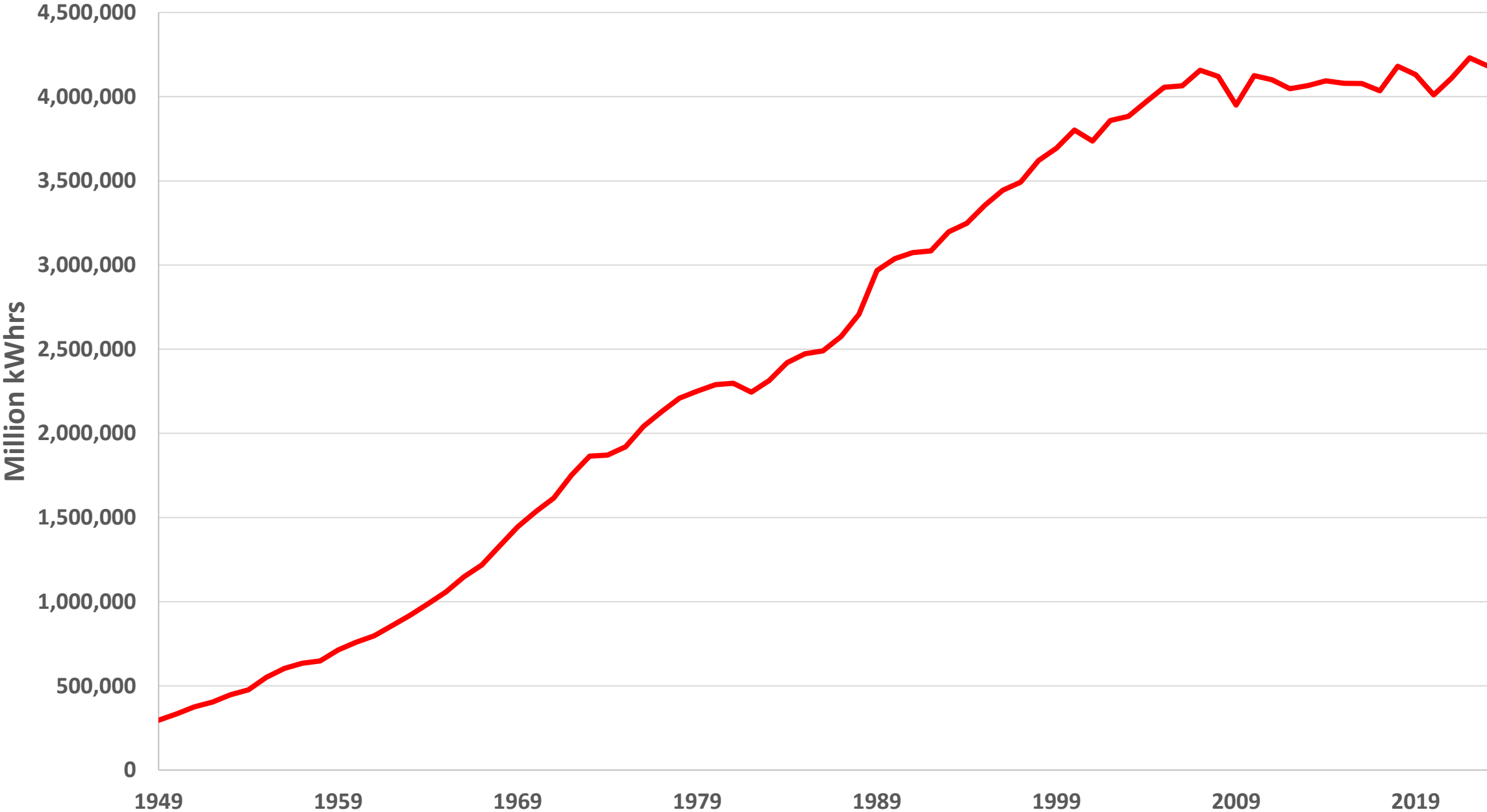
Georgia is positioned well to meet this challenge, while growing its economy, provided it does so strategically, with a long-term integrated resource planning approach for its power sector that continues to prioritize reliability

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

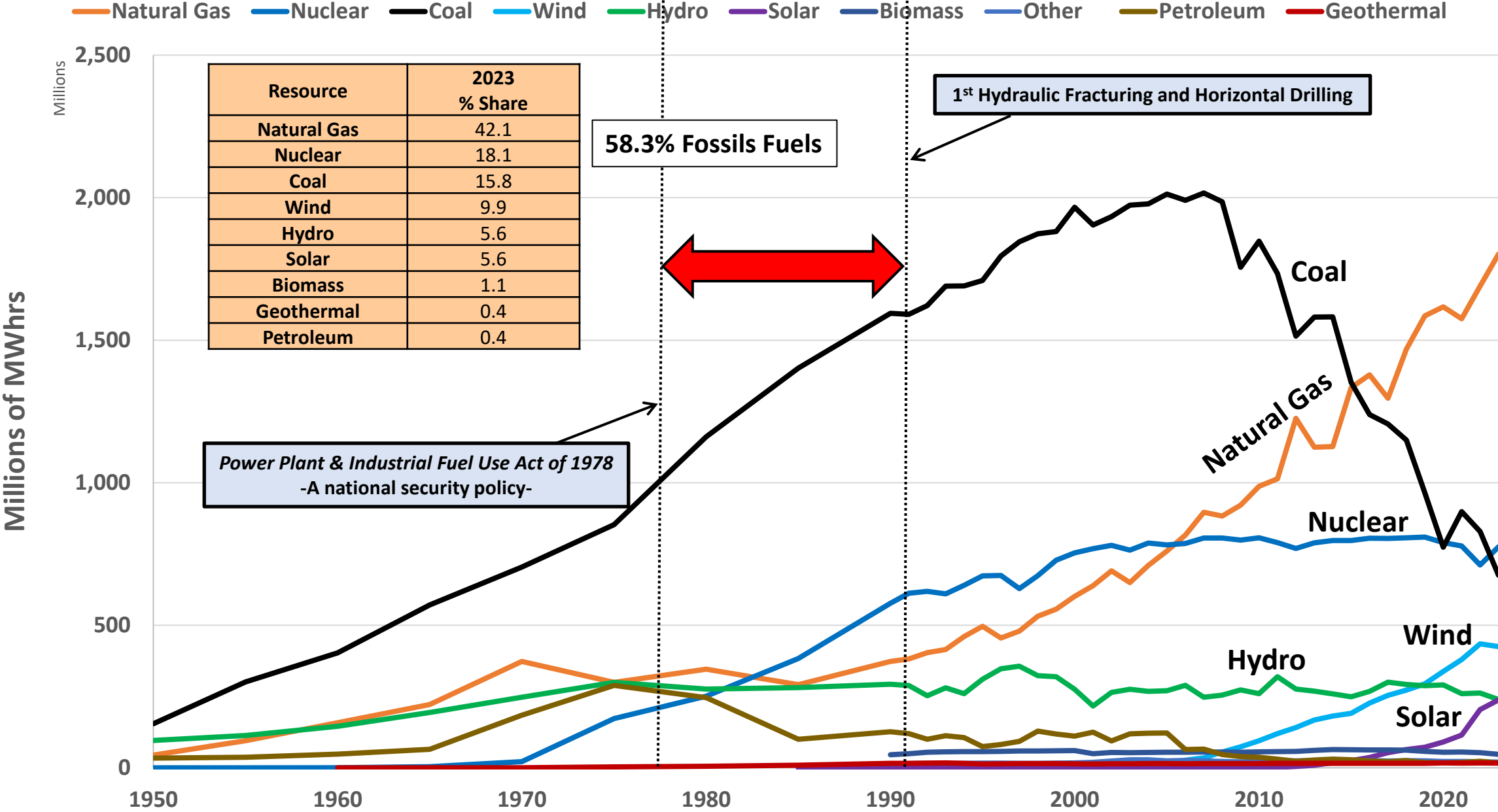
Petroleum Natural Gas Coal Nuclear Biomass Wind Hydro Solar Geothermal



U.S. Electricity Generation

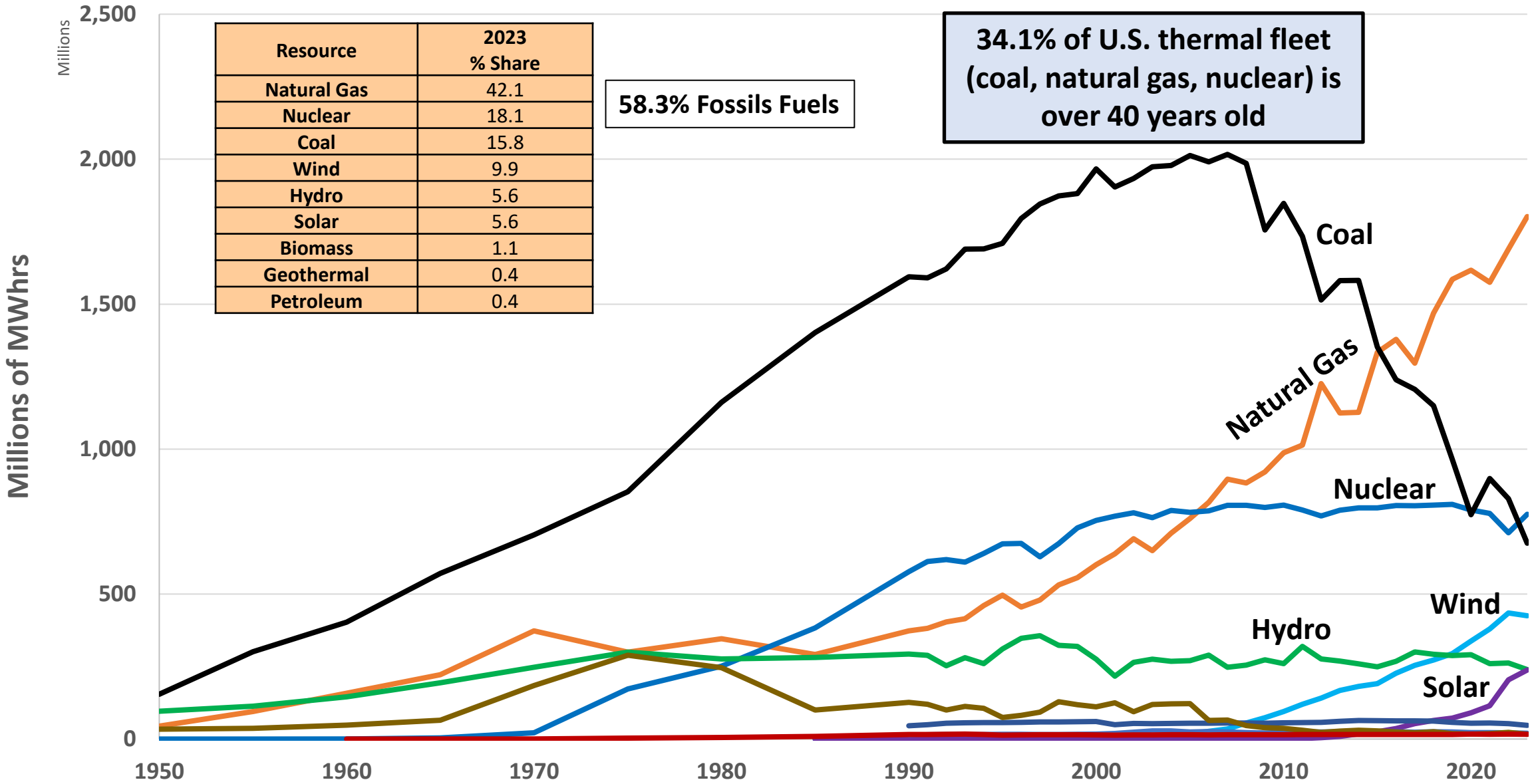


U.S. Electricity Generation by Resource



U.S. Electricity Generation by Resource

Natural Gas Nuclear Coal Wind Hydro Solar Biomass Other Petroleum Geothermal



POWER GRID INTERNATIONAL

Whitepapers

Renewable Energy

NERC: Poor models, studies to blame for renewable energy reliability issues

NERC found that 10 large-scale grid disturbances on the bulk power system since 2016 involved the "widespread and unexpected" reduction of nearly 15,000 MW of inverter-based resource output, including 10,000 MW in the past four years.

John Engel
6.5.2024

Share | X f in e

T&DWorld

T&D WORLD LIVE ENERGY TECH MICROGRID KNOWLEDGE UTILITY ANALYTICS INSTITUTE SMART U

NERC: Despite Improvements, North America is Still Vulnerable to Electricity Shortfalls

Nov. 14, 2024

The corporation found that especially during extreme weather conditions, the power grid is vulnerable in part due to natural gas supply issues and increasing demand for electricity

Jeff Postelwait

UTILITY DIVE Deep Dive Opinion Library Events Press Releases

Generation T&D Grid Reliability Electrification Load Management Renewables Storage

NERC sounds alarm over winter gas supplies, potential grid impacts

December could be colder than normal across the northern U.S., and grid operators and the natural gas sector say they are preparing.

Published Sept. 19, 2024

Robert Walton
Senior Reporter

in f X e

NRECA

Energy & Technology Our Communities The Cooperative Advantage Our Mission Issues & Policy

NERC: Extreme Winter Weather Could Cause Energy Shortfalls in Much of U.S.

Published November 15, 2024

Author Molly Christian

Share f X in



Growing electricity demand and plant retirements are putting parts of the U.S. at elevated risk of power shortages this winter if weather is severe, NERC said Nov. 14. (Photo By: Tony Tedder-Loffland/Oklahoma Electric Cooperative)

ENERGY WIRE

US grid monitor details build-out needed to battle blackouts

By Peter Behr | 11/10/2024 8:38 AM EST

To keep the lights on, the U.S. needs to build enough regional power lines to move the equivalent of three dozen nuclear reactors' worth of power.

ENERGY WIRE

Low-carbon shift raises risk of blackouts, grid execs warn

By Peter Behr | 04/05/2024 8:38 AM EST

Snowballing policy and infrastructure issues pose a threat to electric reliability as a greener U.S. economy demands more power.

Reuters

World US Election Business Markets Sustainability Legal Breakingviews Techn

U.S. grids face greater risks as generators retire, demand rises - NERC

By Nikola Jao


December 14, 2023 11:33 AM EST - Updated a year ago

Bookmark Aa Share

JUNE 10, 2024

NERC reports some U.S. regions at risk for energy shortfalls in extreme summer conditions

Risk of electricity supply shortfalls and summer peak demand in NERC's 2024 Summer Reliability Assessment



high risk potential for insufficient operating reserves in normal peak summer conditions
elevated risk potential for insufficient operating reserves in above-normal peak summer conditions
low risk sufficient operating reserves expected

ea

Data source: North American Electric Reliability Corporation (NERC), 2024 Summer Reliability Assessment

Summary Point #1

The U.S. electric power sector, across all states, is facing a perfect storm of challenges:

- Upward pressure on energy consumption and electricity demand
 - Re-shoring of manufacturing
 - Electrified transportation
 - Data centers
- Downward pressure on fossil fuels from climate/carbon reduction policies
- Aging thermal fleet (coal, natural gas, nuclear)

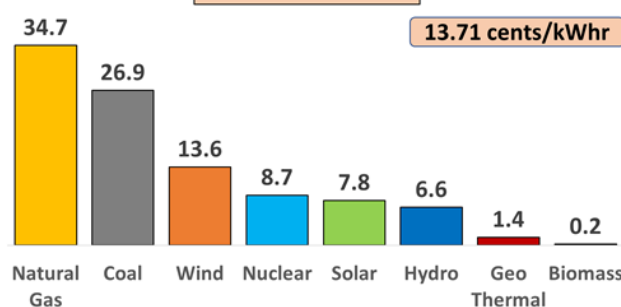
Residential Rates 2023

U.S. Avg: 15.98 cents/kWhr

2023 Data
Accessed 3/20/2024

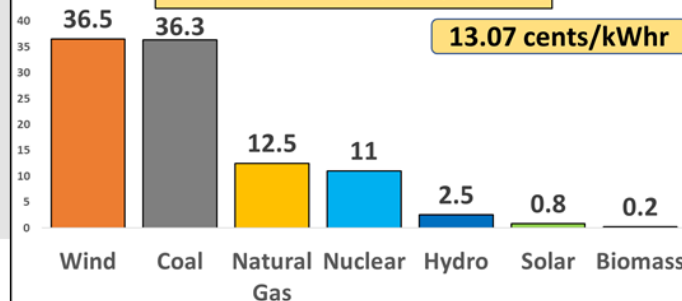
Mountain: % Share

13.71 cents/kWhr



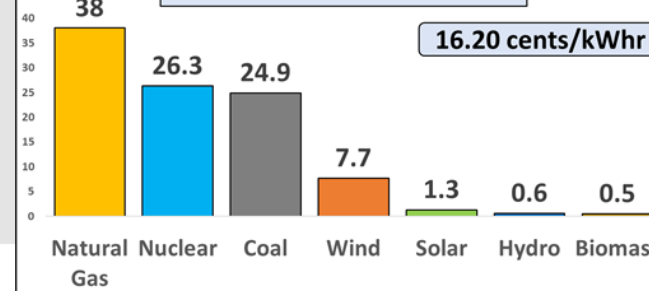
West North Central: % Share

13.07 cents/kWhr



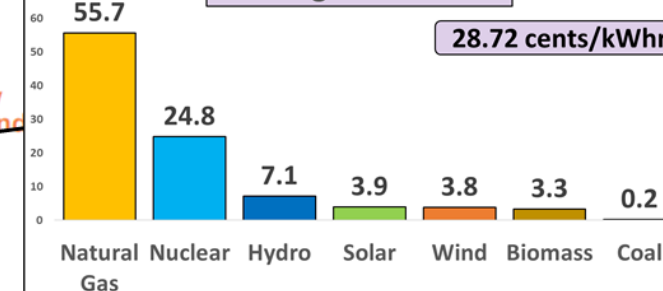
East North Central: % Share

16.20 cents/kWhr



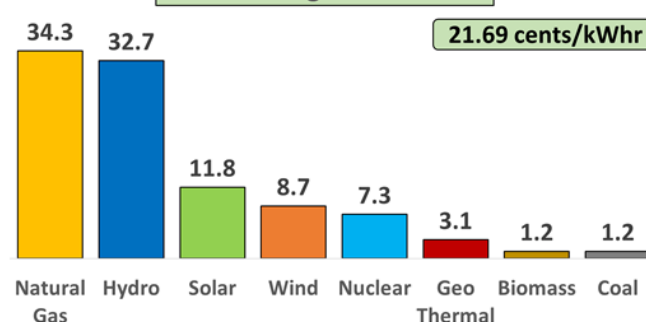
New England: % Share

28.72 cents/kWhr



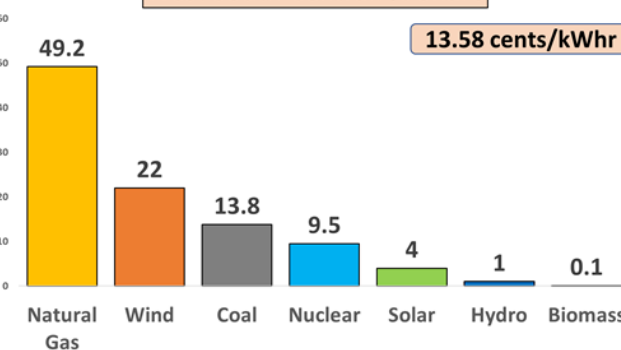
Pacific Contiguous: % Share

21.69 cents/kWhr



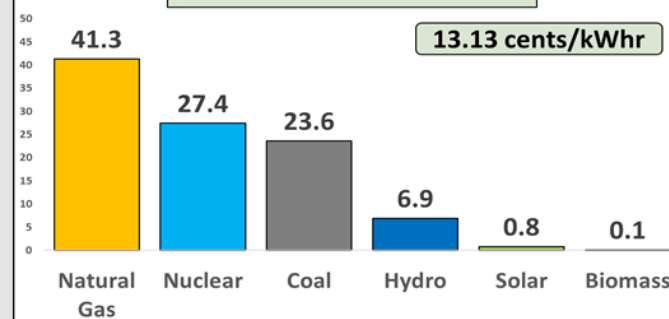
West South Central: % Share

13.58 cents/kWhr



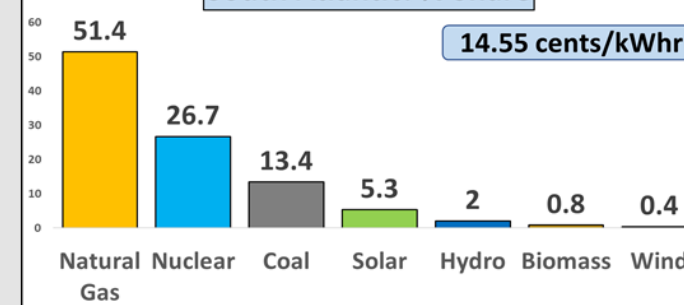
East South Central: % Share

13.13 cents/kWhr



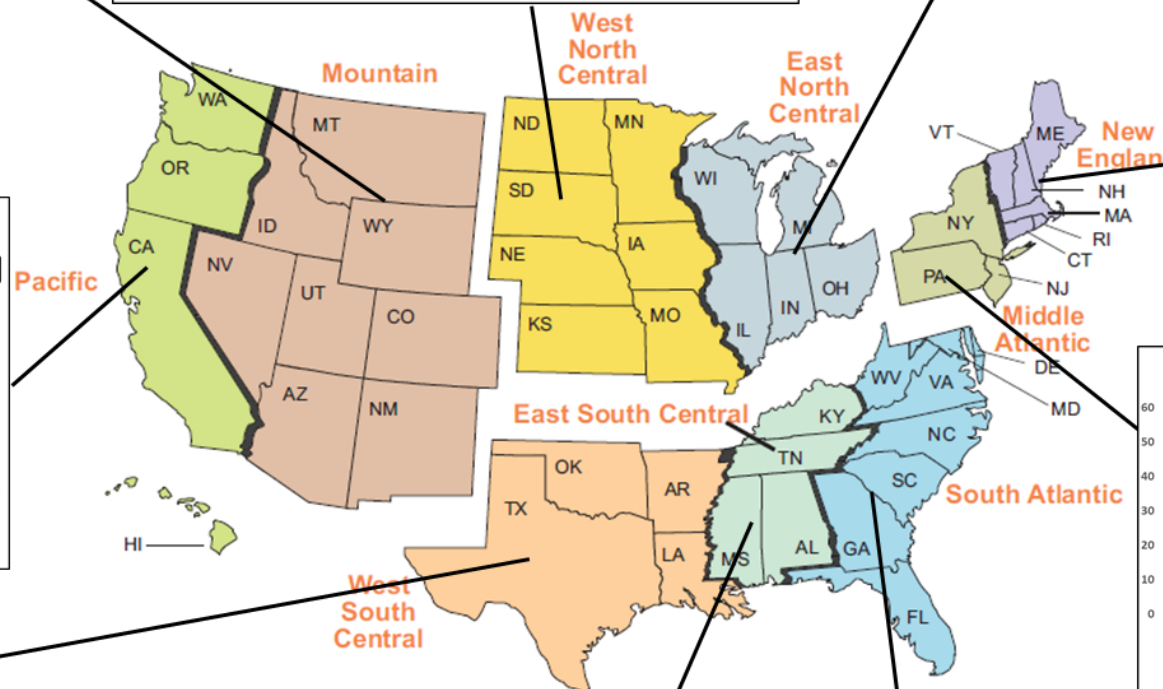
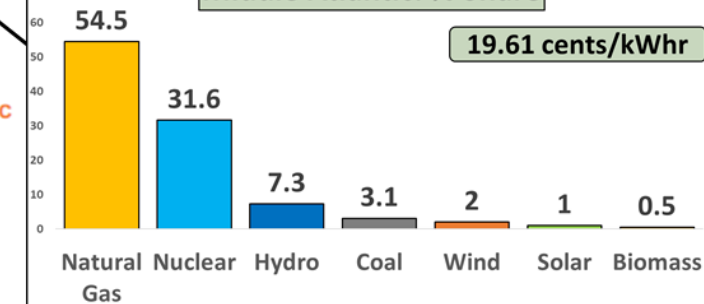
South Atlantic: % Share

14.55 cents/kWhr



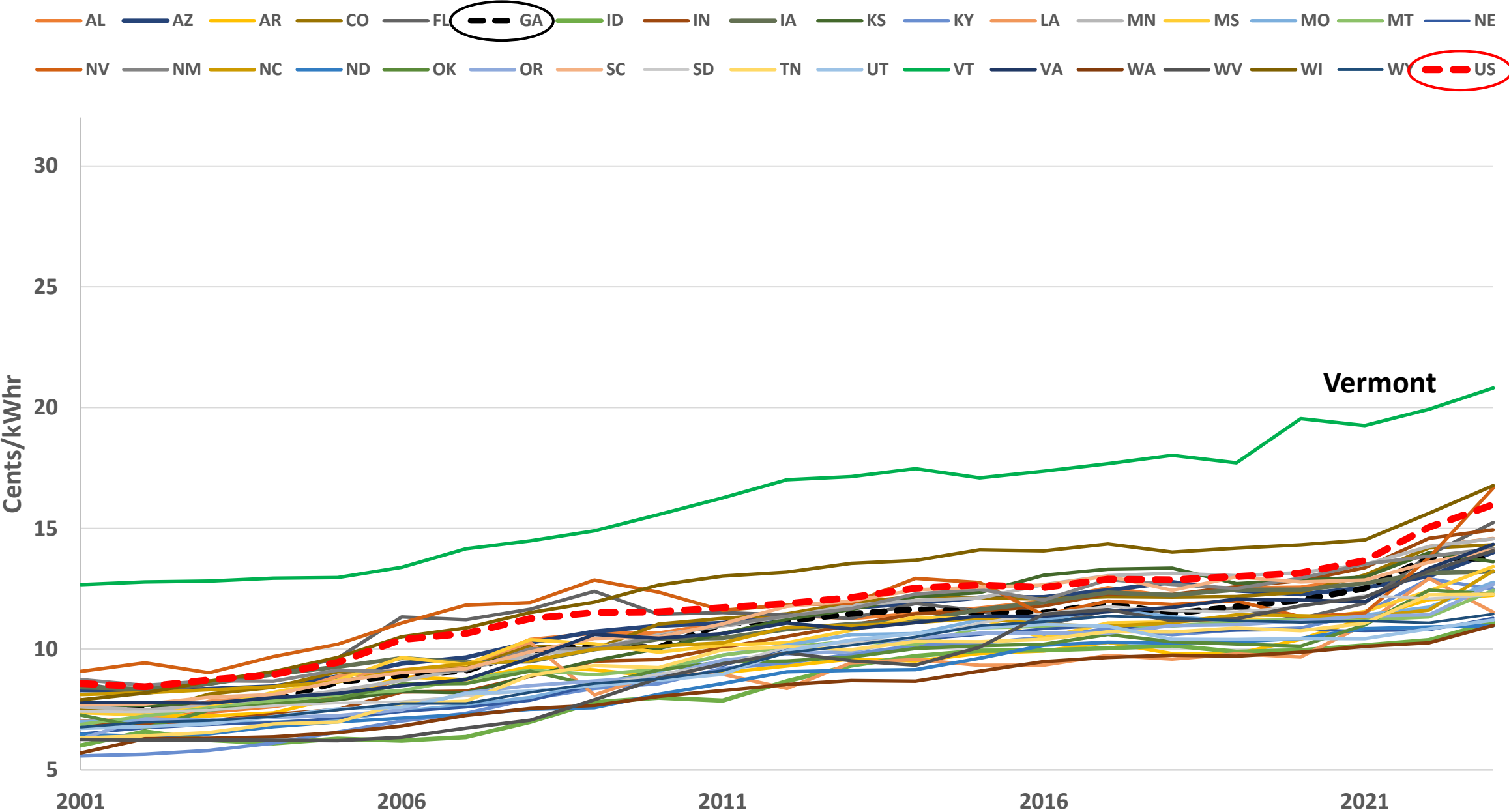
Middle Atlantic: % Share

19.61 cents/kWhr

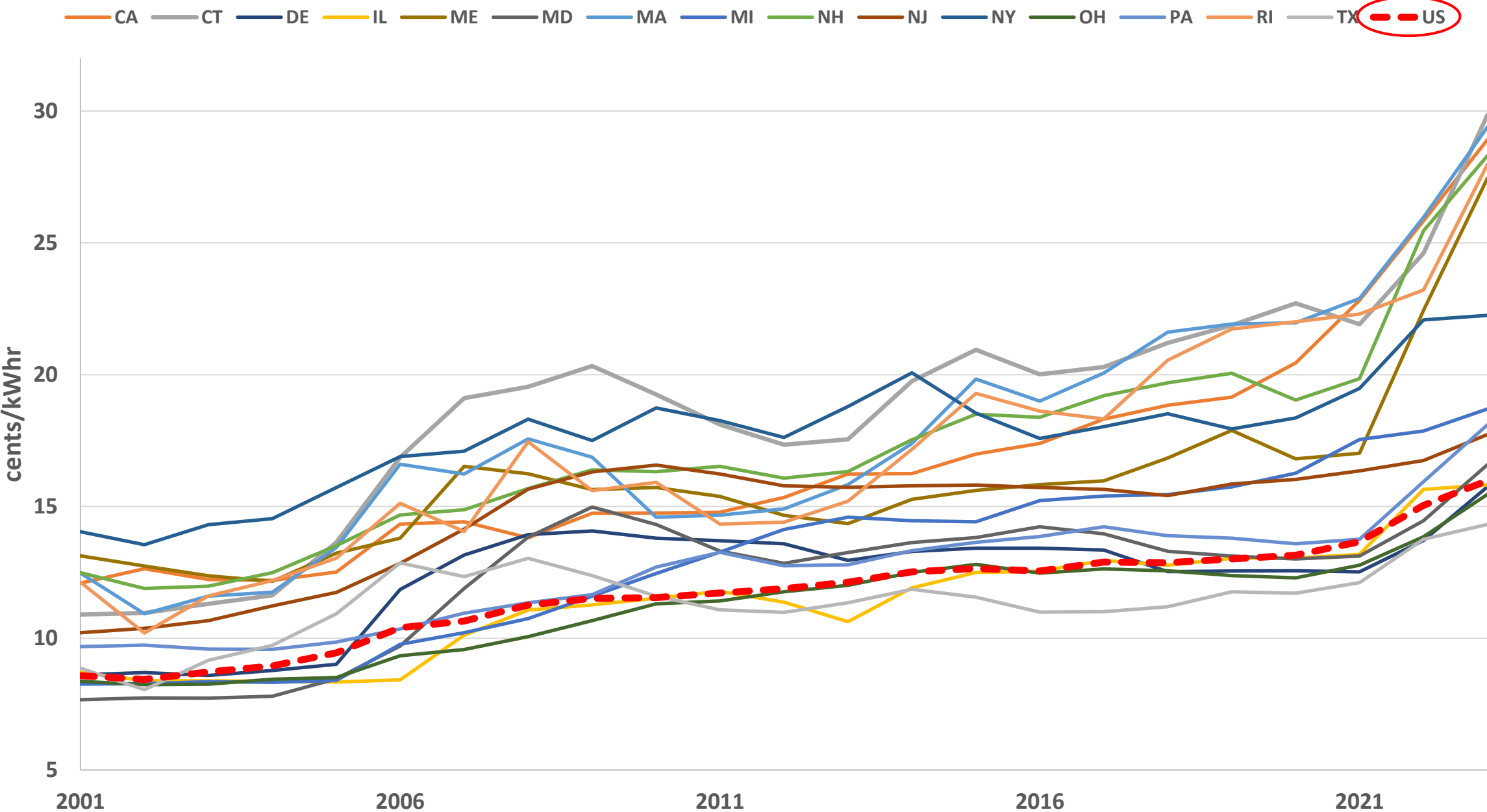


Data Source: US EIA
Compiled by: David Gattie

Regulated: Average Retail Residential Rates



Deregulated: Average Retail Residential Rates



Summary Point #2

*REGULATED MARKETS HAVE CONSISTENTLY
RETURNED LOWER AVERAGE RESIDENTIAL RATES
WITH LESS VOLATILITY COMPARED WITH
DEREGULATED MARKETS.*

The Value Proposition of Diversity for the Power Sector:

ENERGY RESOURCES & TECHNOLOGIES

Power Generation Technologies

Coal



Natural Gas



Wind



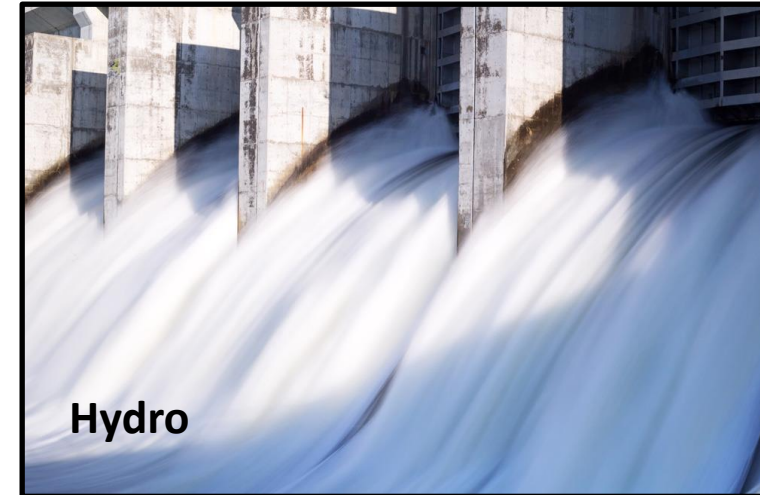
Nuclear



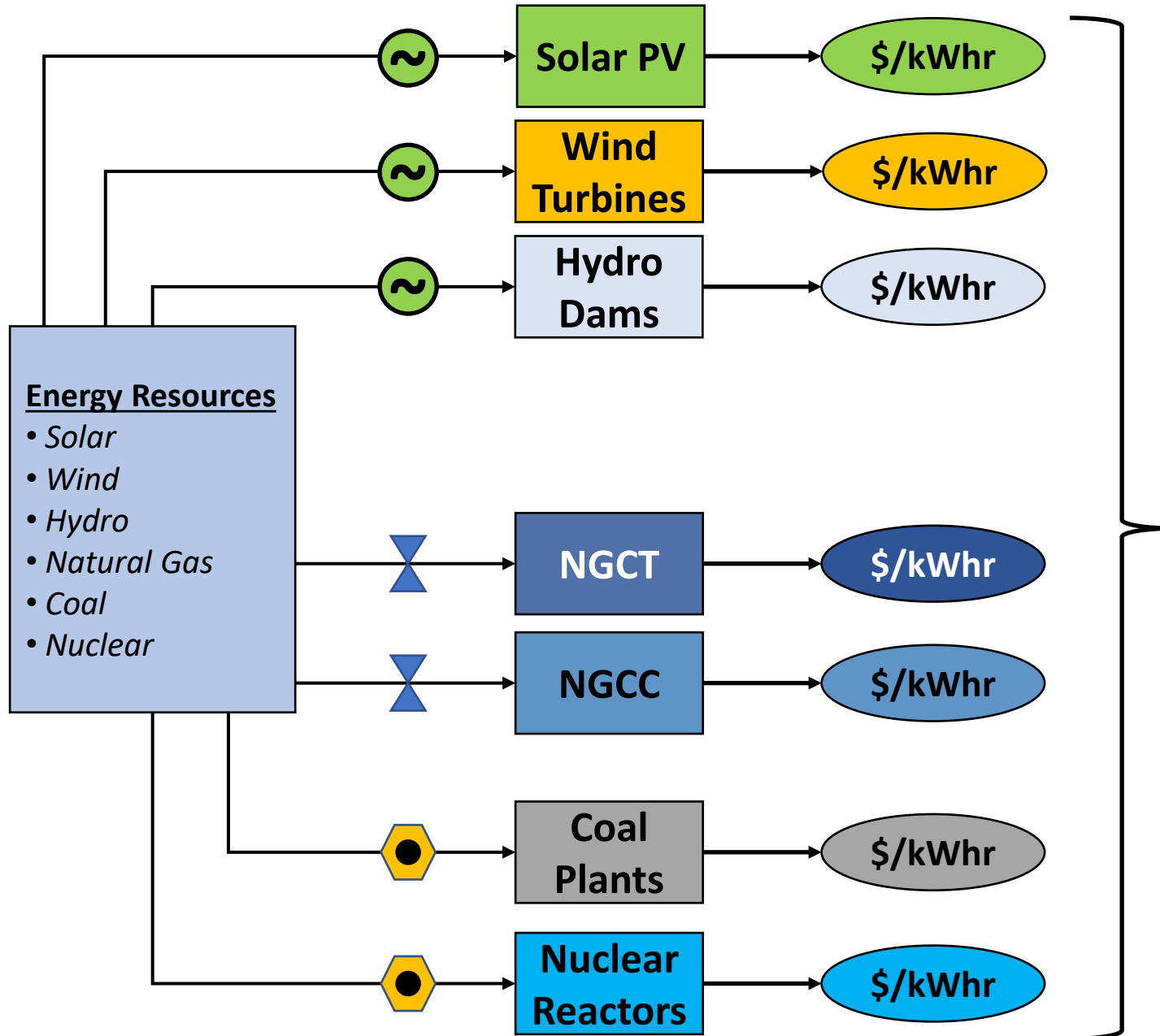
Solar PV



Hydro



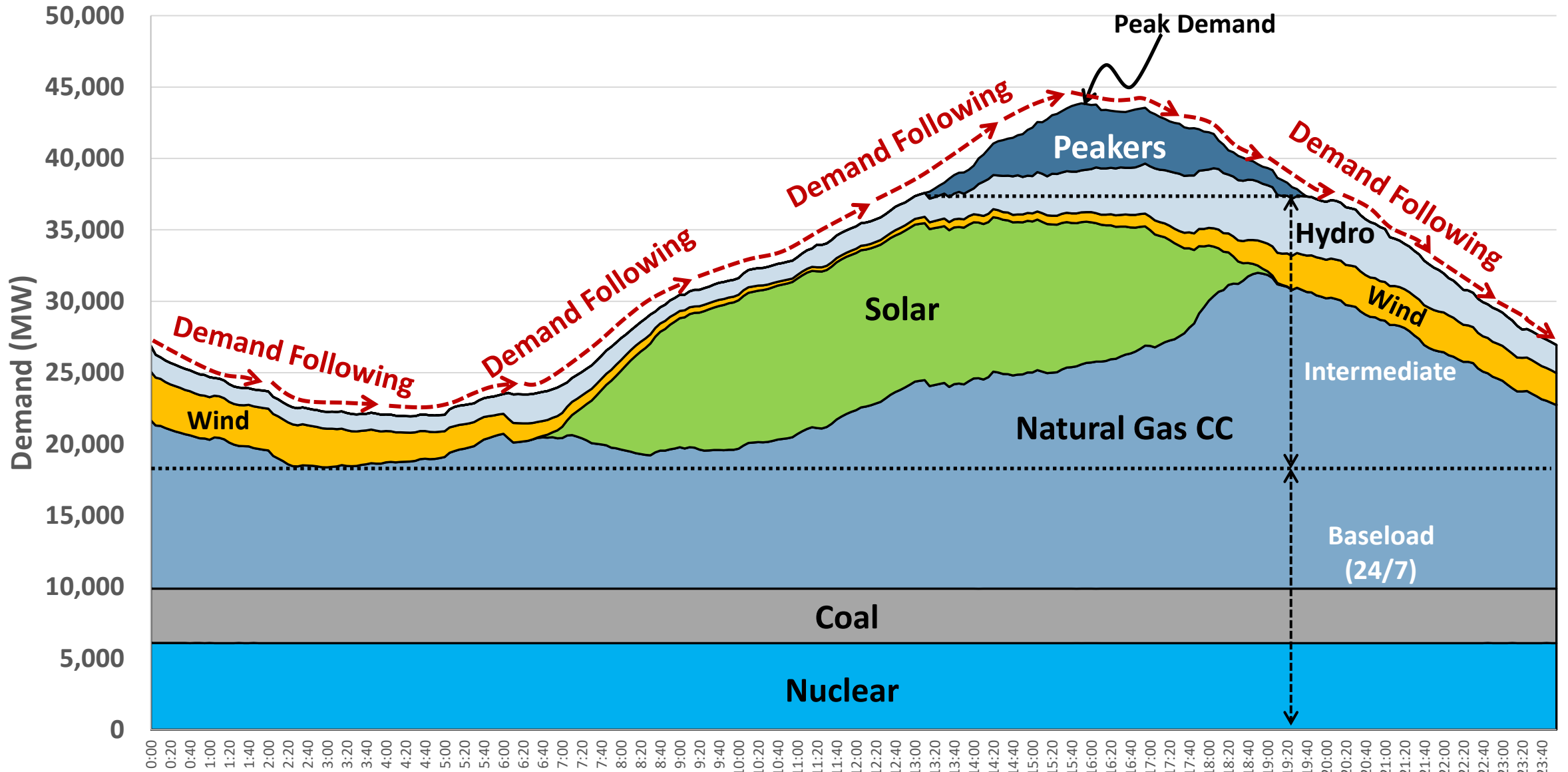
Resources + Technologies → Electricity (at a cost to generate)



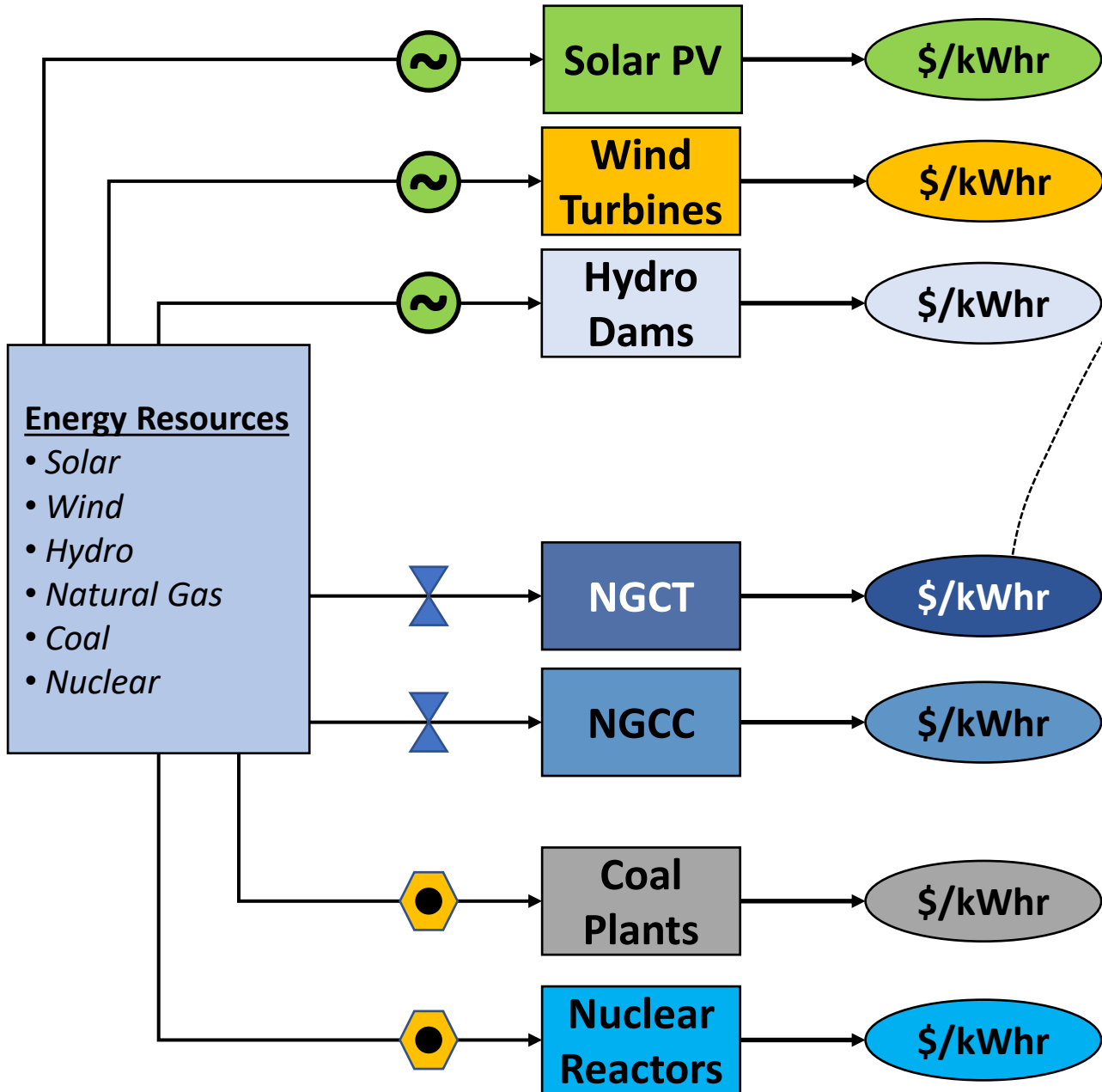
The cost of generation is a critical constraint, but generation cost doesn't represent the reliability value proposition to the grid of electricity generated from the different resources.

Daily Demand Curve

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

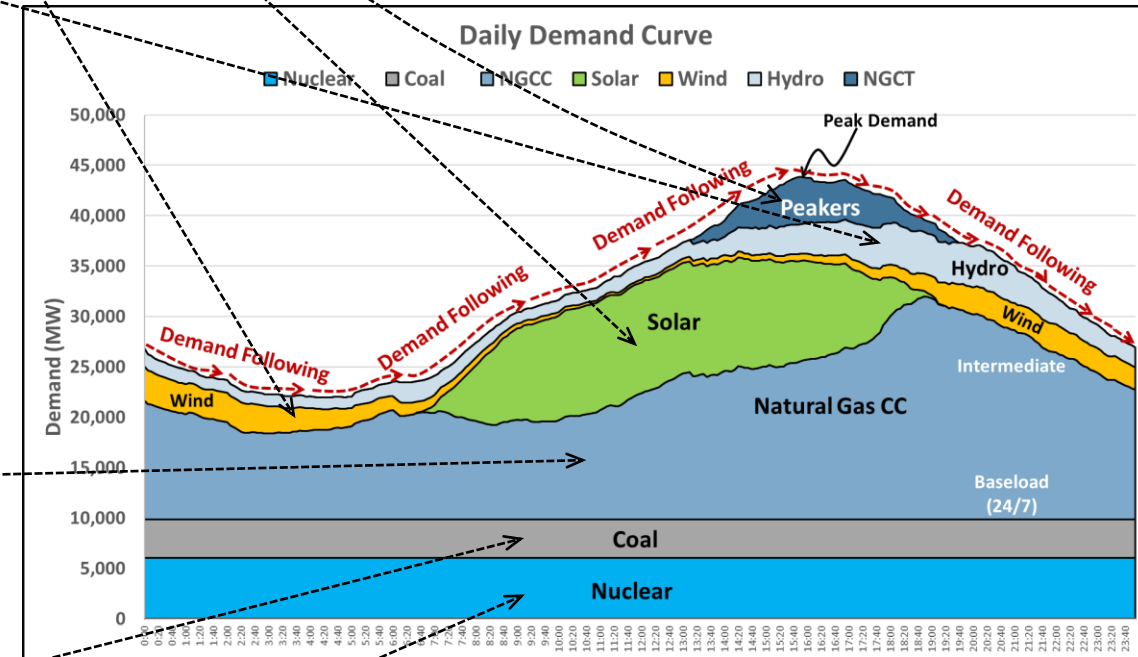


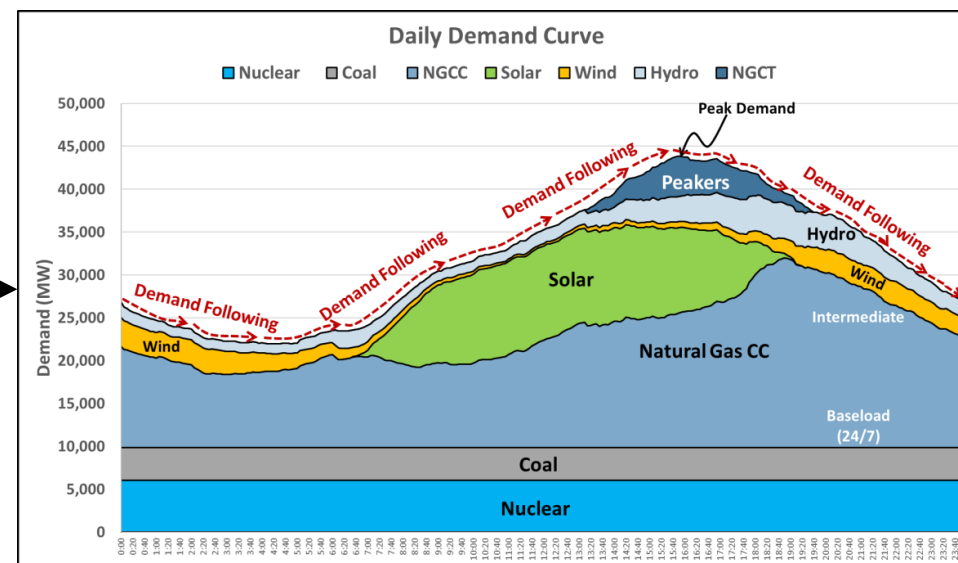
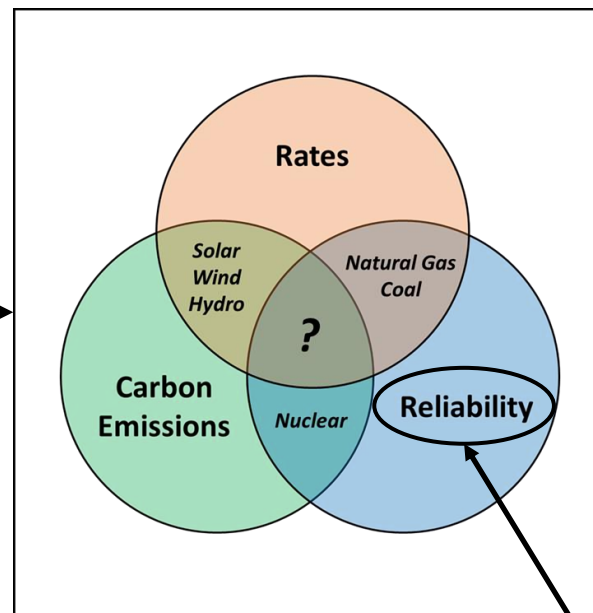
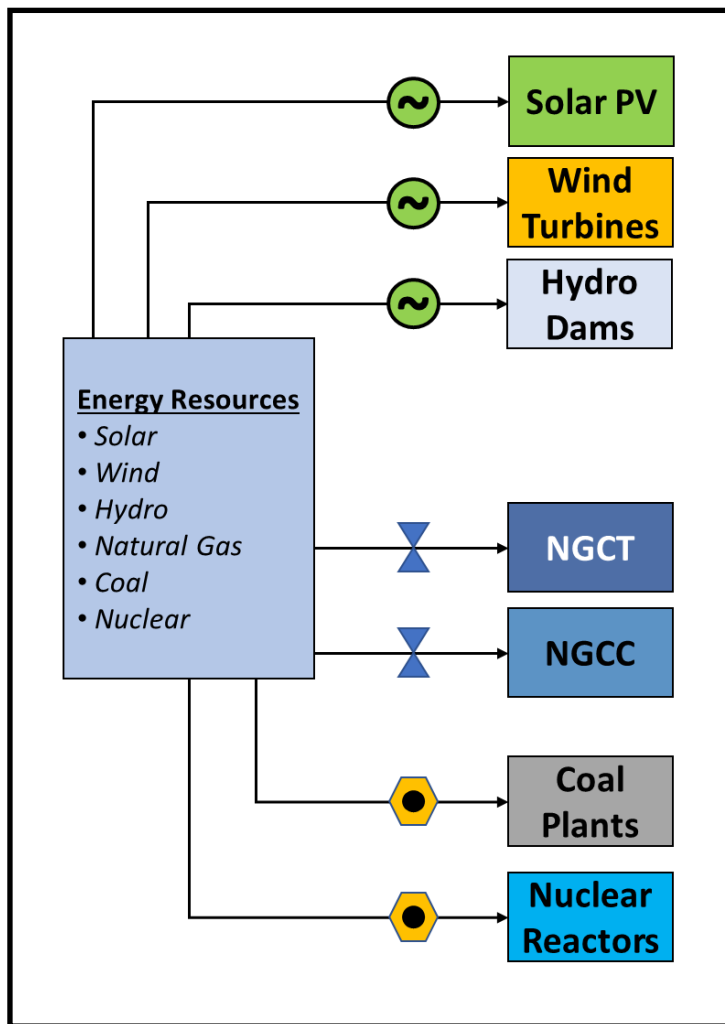
Resources + Technologies



Value Proposition

Each resource and technology maps into the demand curve for different purposes—e.g., reliability, onsite storage, availability, load-following, generation cost, carbon emissions. Each has a value proposition that must be accounted for in long-term resource planning.





The priority

Summary Point #3

ENERGY RESOURCES HAVE INHERENTLY DIFFERENT PHYSICAL PROPERTIES, POWER GENERATION TECHNOLOGIES HAVE DIFFERENT OPERATING CHARACTERISTICS, EACH YIELDING DIFFERENT GENERATION COSTS AND DIFFERENT VALUE PROPOSITIONS FOR THE GRID.

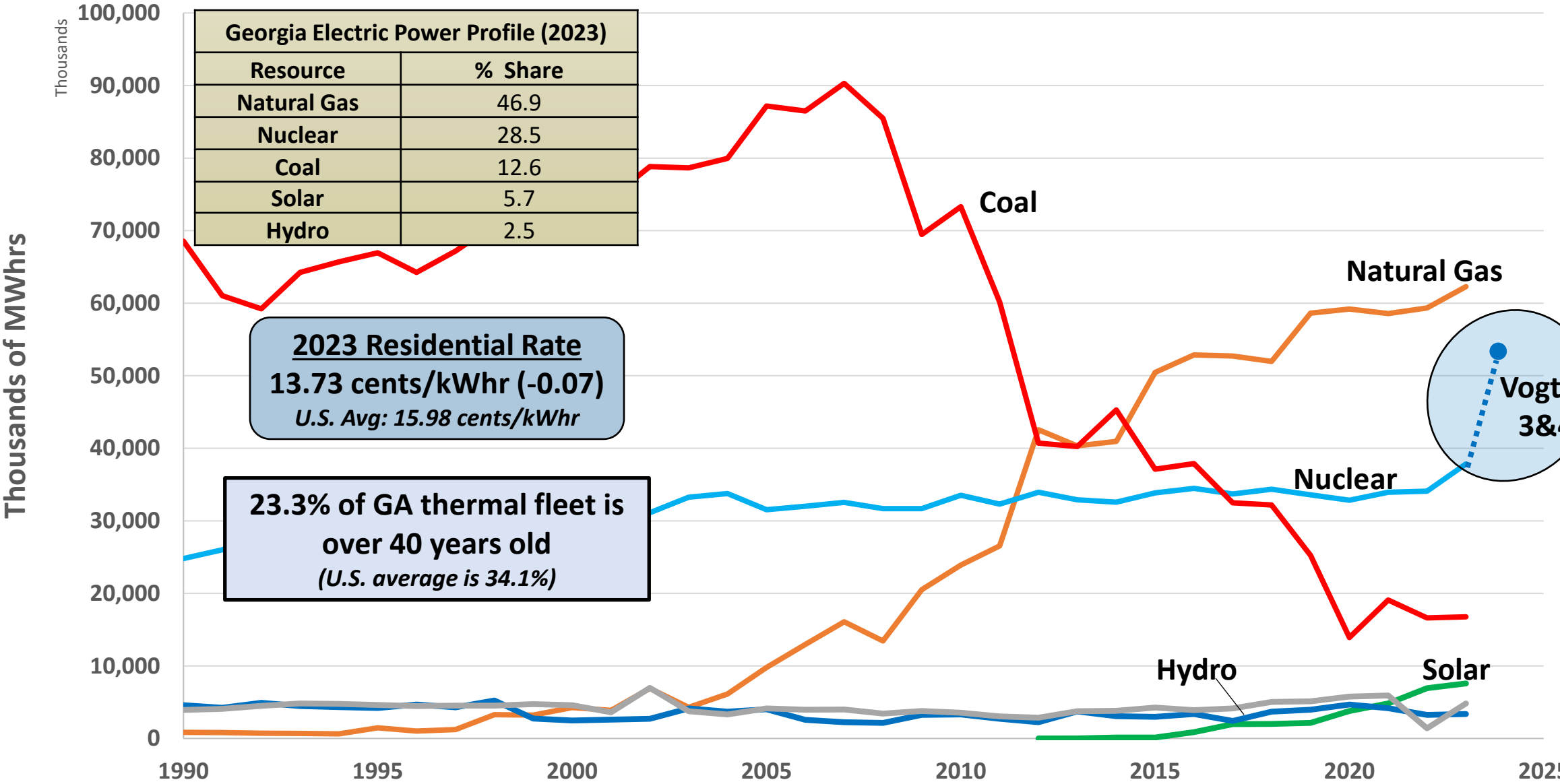
DIVERSITY UNDERPINS GRID FLEXIBILITY AND RELIABILITY

Georgia: Relative to Top GDPs

Top 8 State GDPs Constitute 50% of Total US GDP and 43.9% of Electric Power Capacity in the U.S.

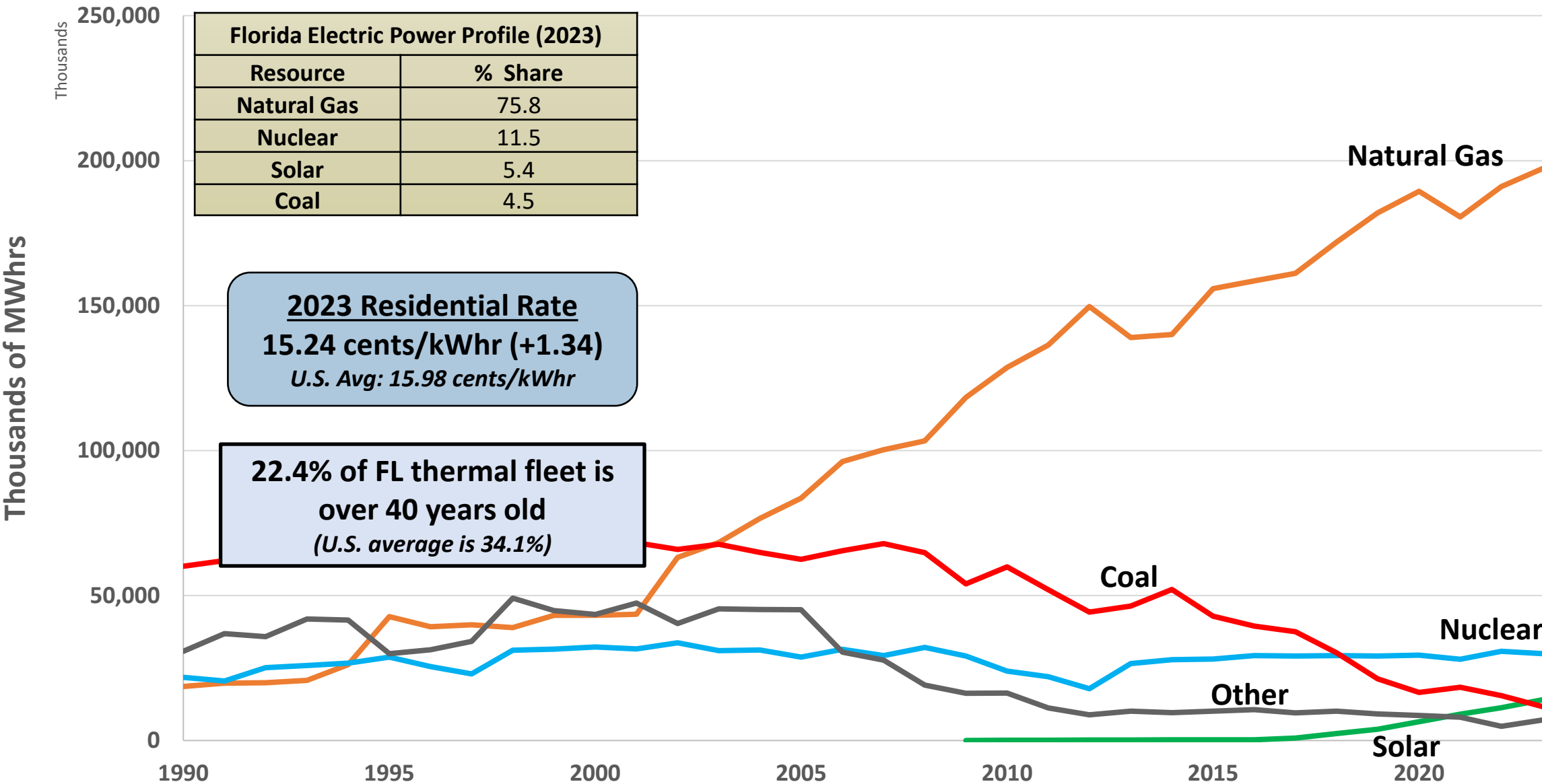
Georgia Generation (Regulated)

Natural Gas Nuclear Coal Solar Hydro Other



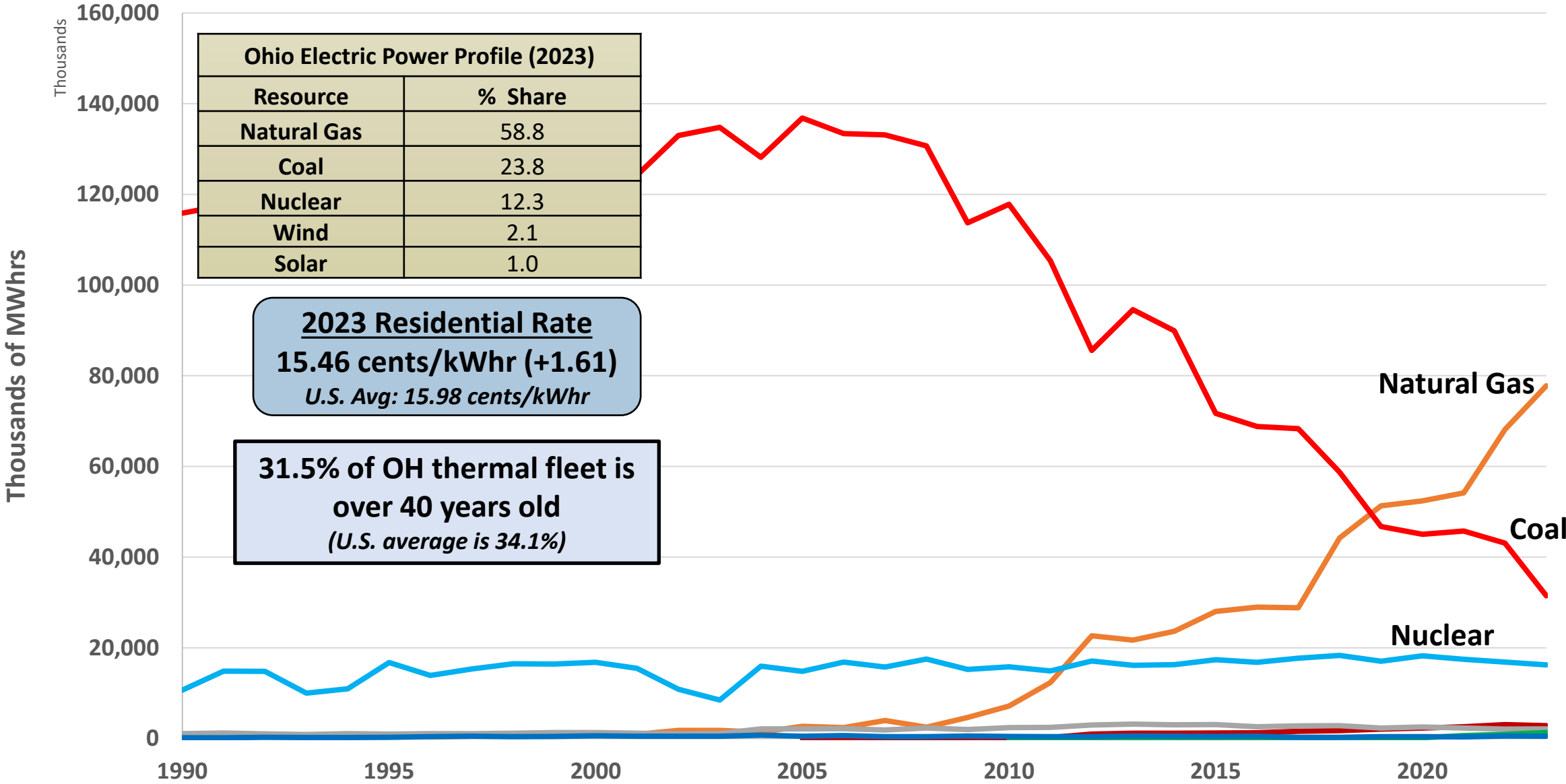
Florida Generation (Regulated)

Natural Gas Nuclear Solar Coal Other



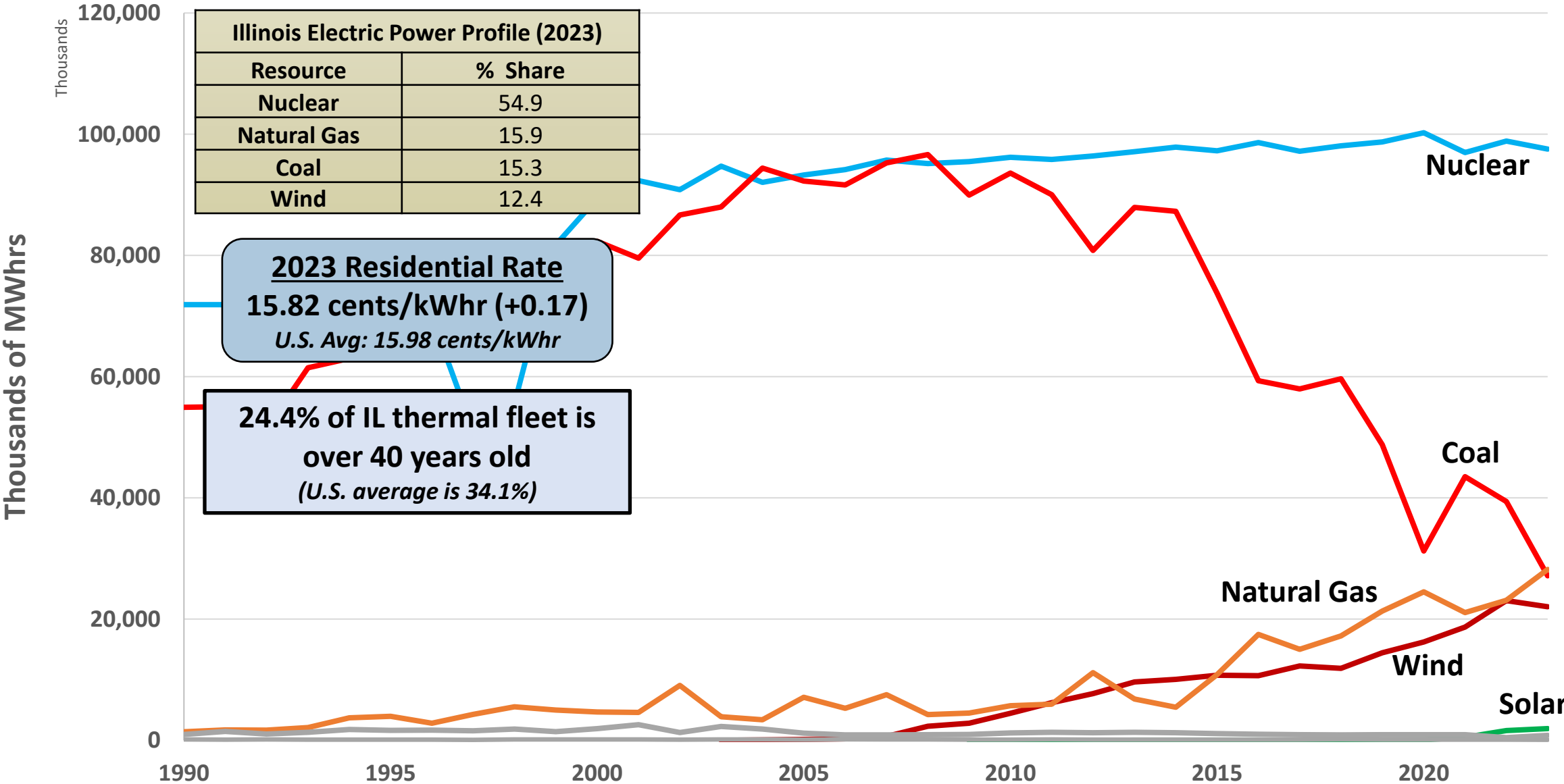
Ohio Generation (Deregulated)

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



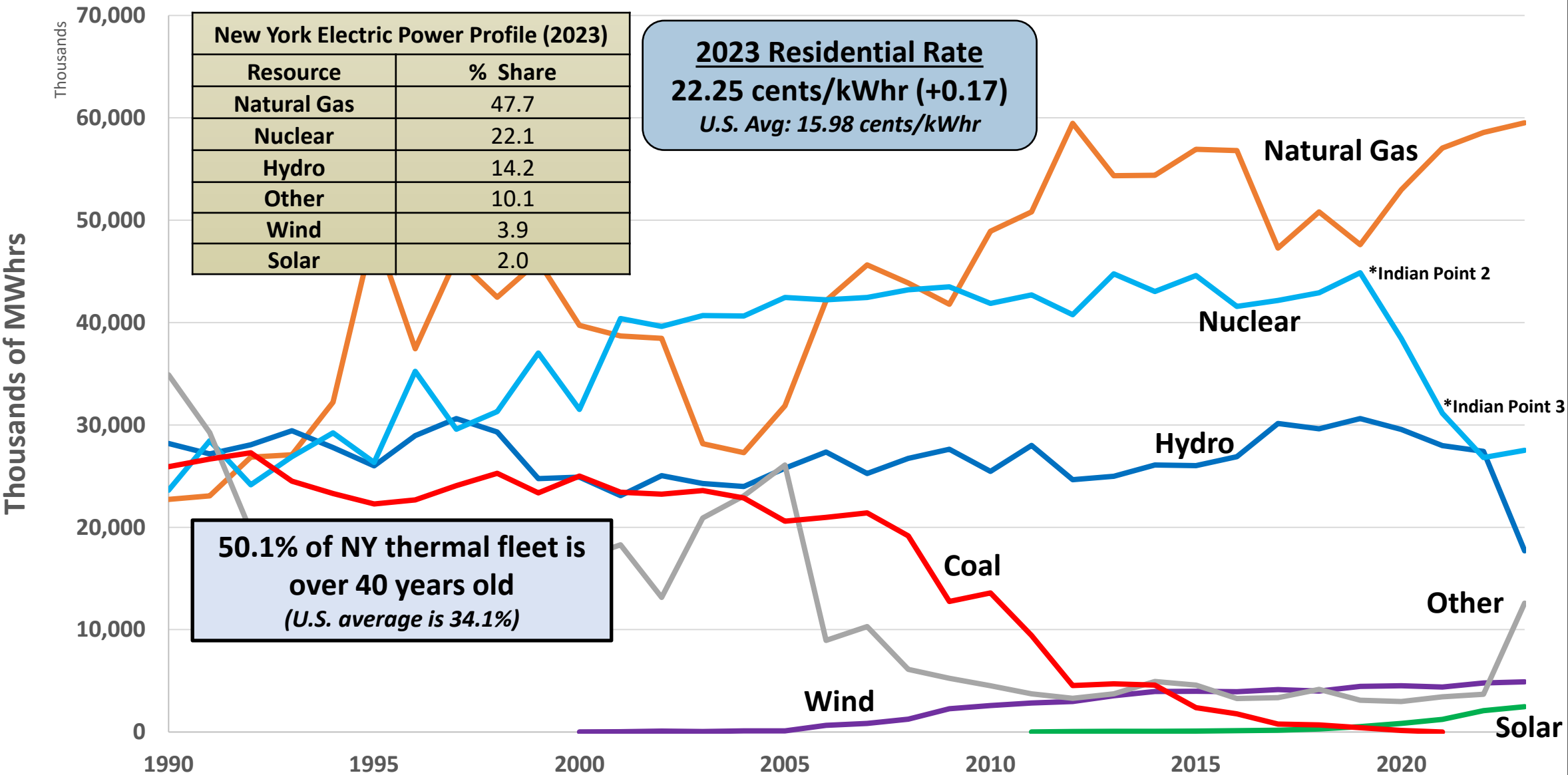
Illinois Generation (Deregulated)

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



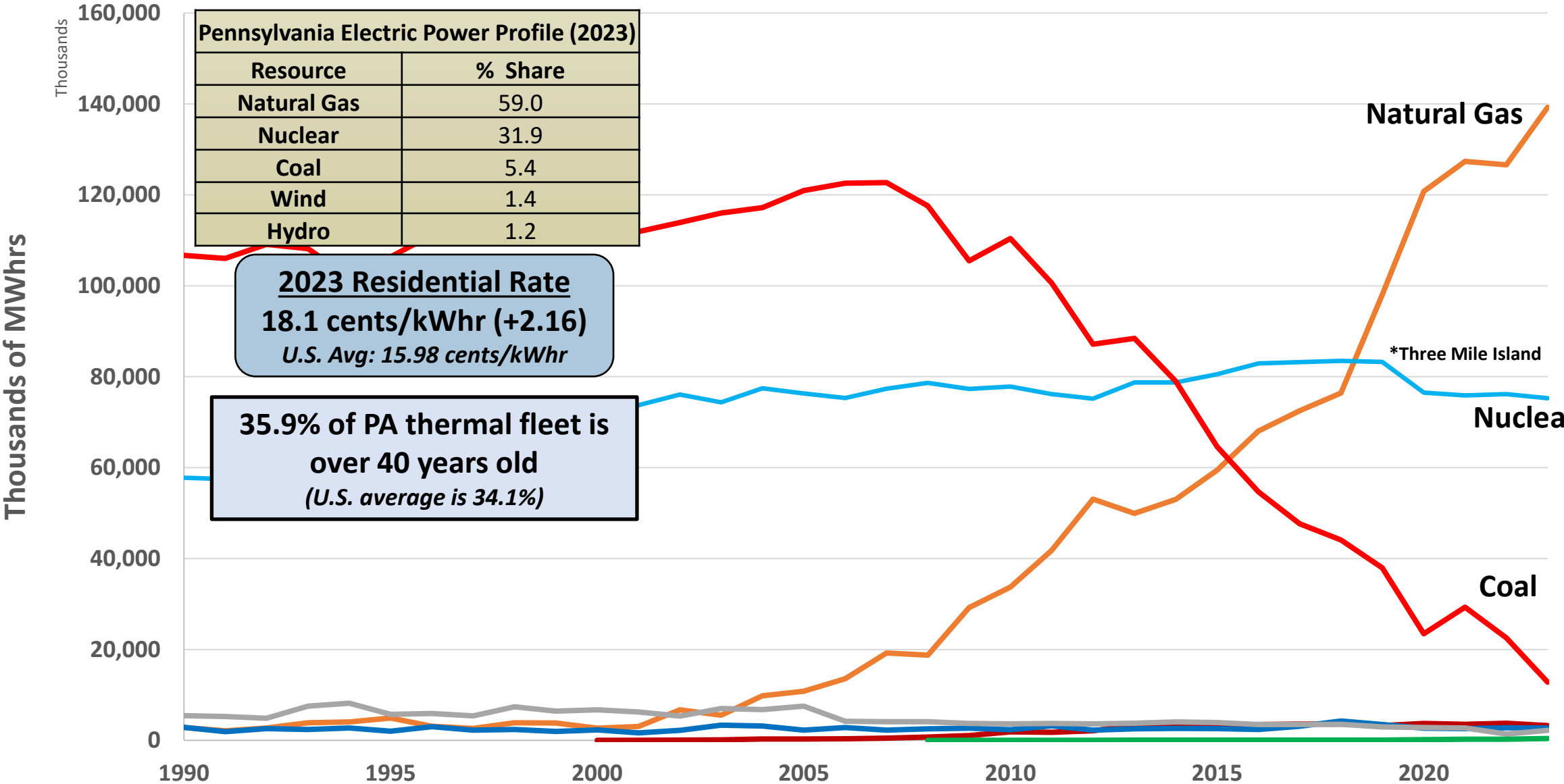
New York Generation (Deregulated)

Natural Gas Hydro Nuclear Wind Solar Other Coal



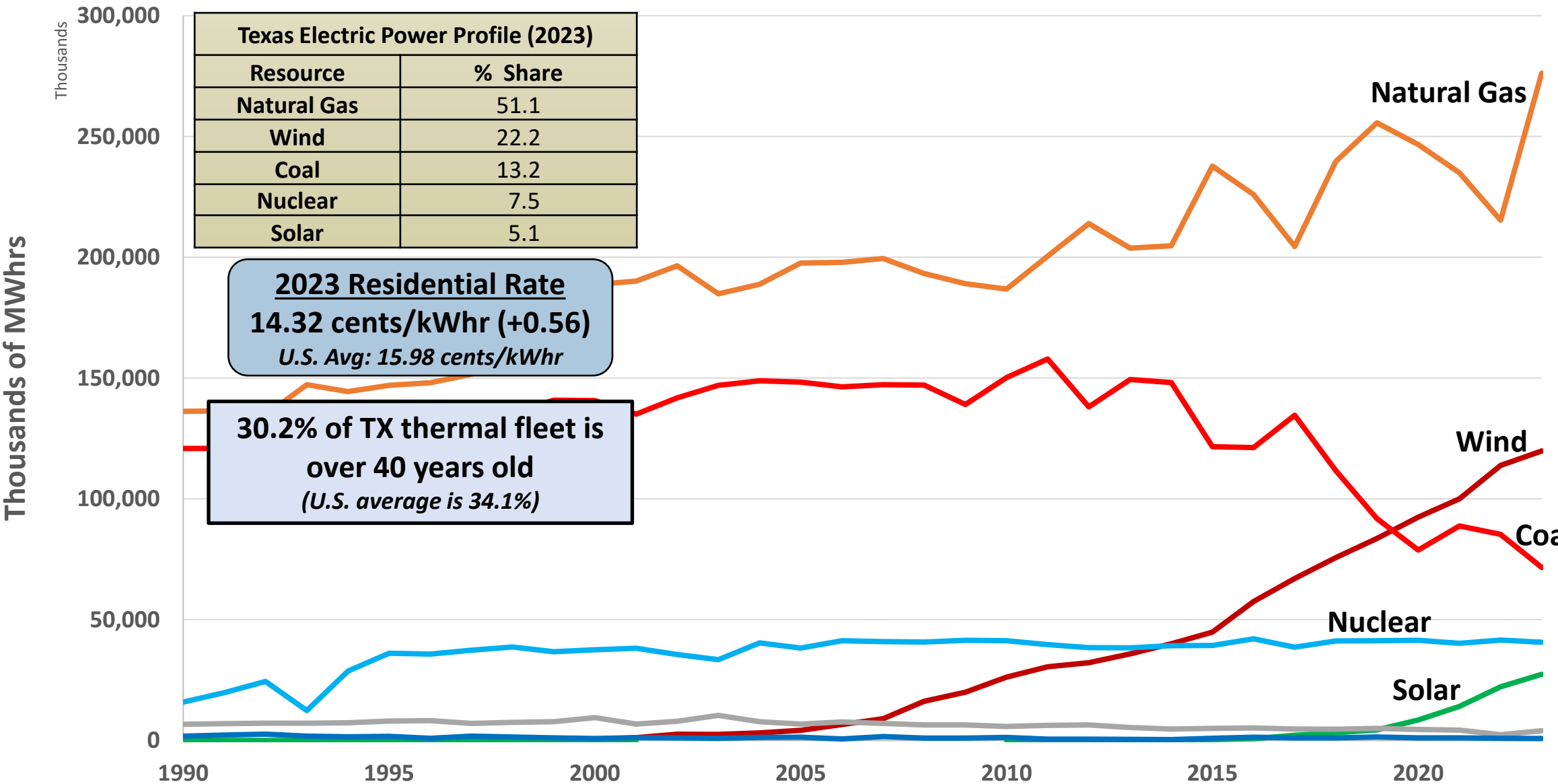
Pennsylvania Generation (Deregulated)

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

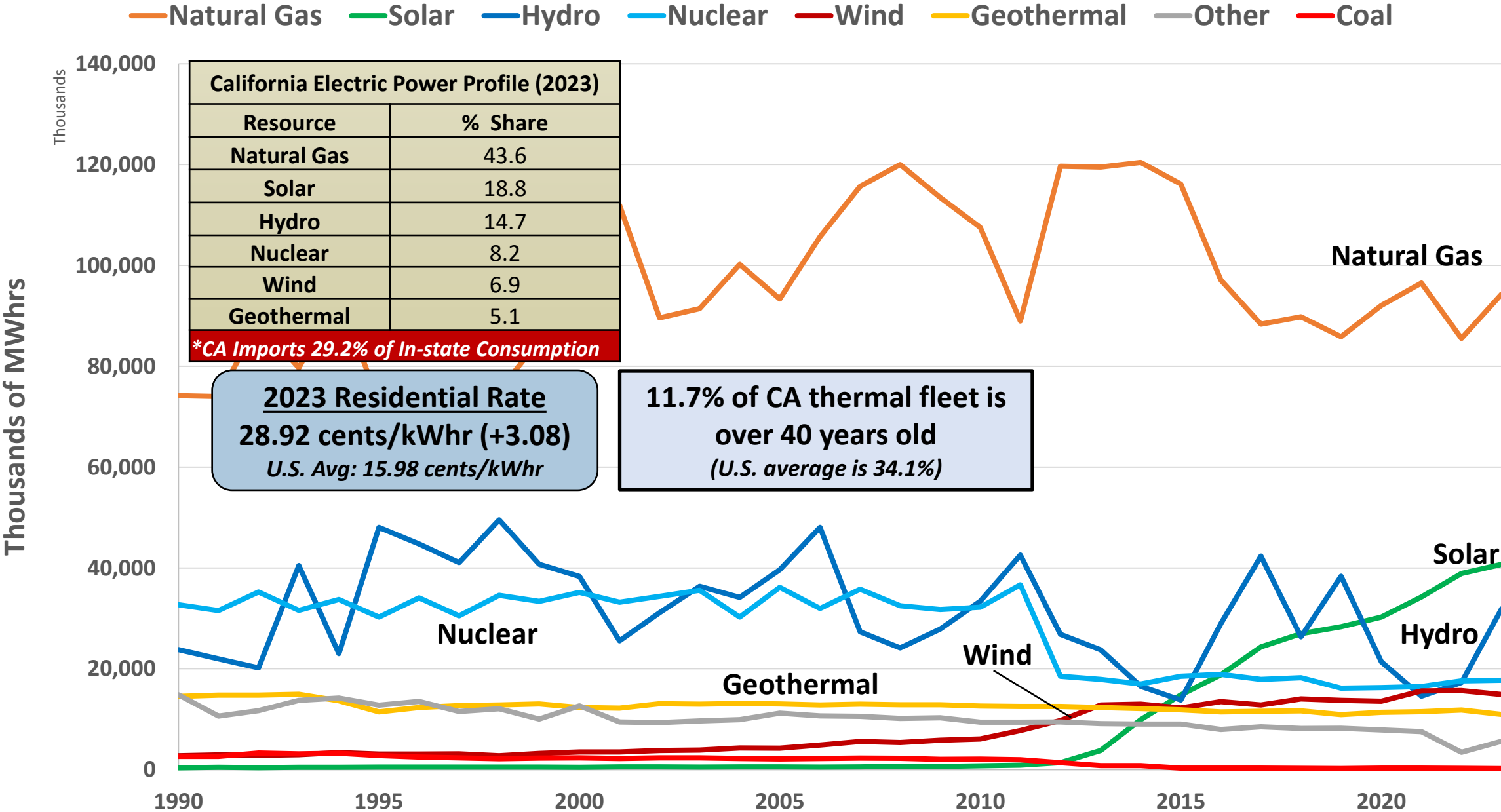


Texas Generation (Deregulated)

Natural Gas
Wind
Coal
Nuclear
Solar
Other
Hydro

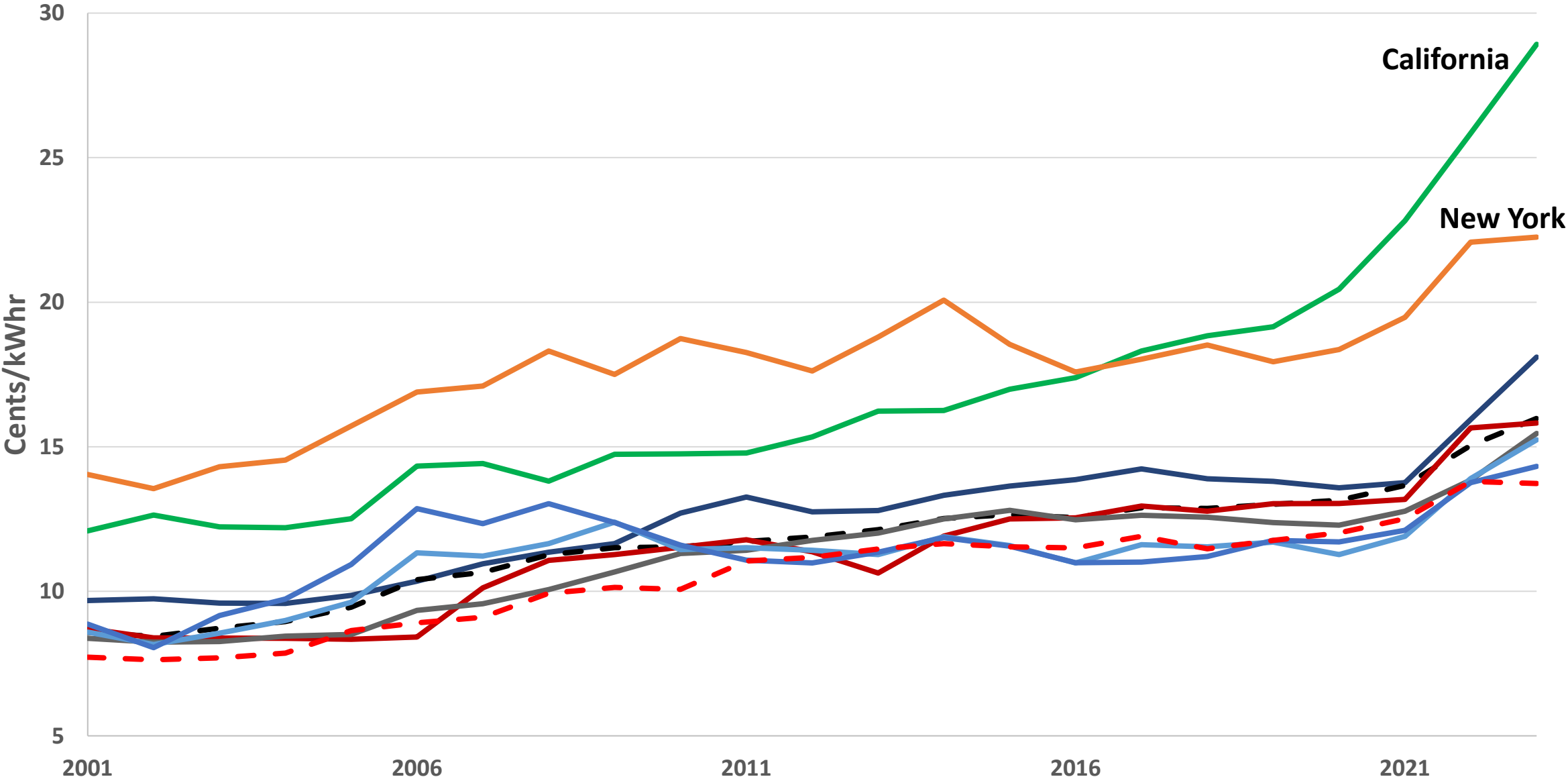


California Generation (Deregulated)



Average Residential Rates: Top 8 GDPs

CA NY PA -US IL OH FL TX GA



Recent Issues in Deregulated Markets

PJM capacity auction to lead to double-digit rate hikes for Exelon utilities: CFO

When asked about possible power plant ownership, Exelon President and CEO Calvin Butler said, "We're working with our [state utility] commissions on all types of scenarios."

Published Aug. 2, 2024



Ethan Howland
Senior Reporter



Exelon expects the PJM Interconnection's latest capacity auction will drive up customer bills by more than 10%, a company official said Aug. 1, 2024, during an earnings conference call. *imaginima via Getty Images*

The spike in capacity prices was driven by power plant retirements, increased load, and new market rules that aim to better reflect risks from extreme weather — coupled with new resource accreditation metrics that are designed to reflect how much capacity a resource delivers during system stresses, Stu Bresler, PJM executive vice president for market services and strategy, said during a media briefing. "The auction prices mainly reflect tighter electricity supply and higher demand, according to Bresler".

It is "great to see" the five PJM governors recognize the need for more resources on the grid to meet rising demand, according to Glen Thomas, P3 Group president. "Hopefully, they will use this opportunity to look at their own state's policies to determine how those policies are contributing to the current power supply demand challenges," Thomas said in an email Monday.

UTILITY DIVE Deep Dive Opinion Library Events Press Releases Topics ▾

5 governors call for PJM capacity market rule changes to reduce 'unnecessary' consumer costs

LS Power has identified 4.4 GW in potential capacity and storage projects in PJM totaling \$8 billion but said unstable market rules hinder investment decisions.

Published Oct. 28, 2024



Ethan Howland
Senior Reporter

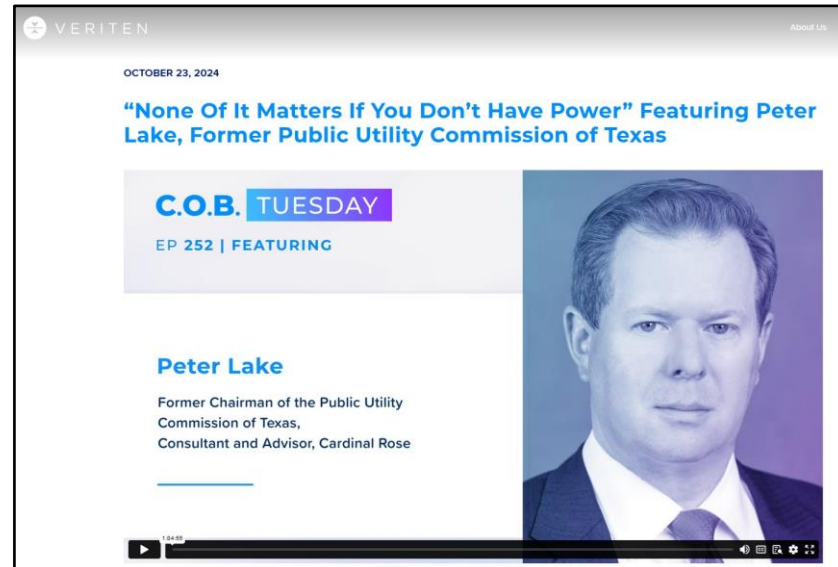


Talen Energy's 966-MW, coal-, gas- and oil-fired Herbert A. Wagner power plant near Baltimore. Governors from Delaware, Illinois, Maryland, New Jersey and Pennsylvania on Oct. 25, 2024, asked the PJM Interconnection to change its process for buying capacity. *The image by Acroterion is licensed under CC BY-SA 4.0*

"The country has been leaning on and borrowing on the reliability and the operating reserves that were developed over the last 30 years. So the investments that were made to build that dispatchable, reliable power fleet we have been leaning on that as we have over the last 10 years stopped building those plants and built only solar, wind and now batteries. So we're going to get caught up on that kind of credit card debt that we've been taking out on not building those types of reliable resources. So I don't know that we need to necessarily have new incentives. I just think we need to let the value of reliability, which has always been a core part of the energy policy of this country, get back to the front of the line where it belongs".

Link to podcast:

<https://veriten.com/stream/cobt-256/>



"We were 4 minutes and 37 seconds away from a black start, and that is a universal failure—25 million people without power for weeks, at best."

Before Uri: CARE

After Uri: RACE (Big R, in Bold)

Link to podcast: <https://veriten.com/stream/cobt-252/>

Summary Point #4

- Georgia is the only state in the country offsetting a reduction in baseload coal with dispatchable natural gas, baseload nuclear, & renewables while also reducing carbon emissions and prioritizing grid reliability
- Deregulated markets are:
 - Having to adjust their markets because those markets aren't behaving as needed—i.e., they aren't prioritizing the value proposition of reliability
 - Doing reactively what regulated markets do proactively through integrated resource planning

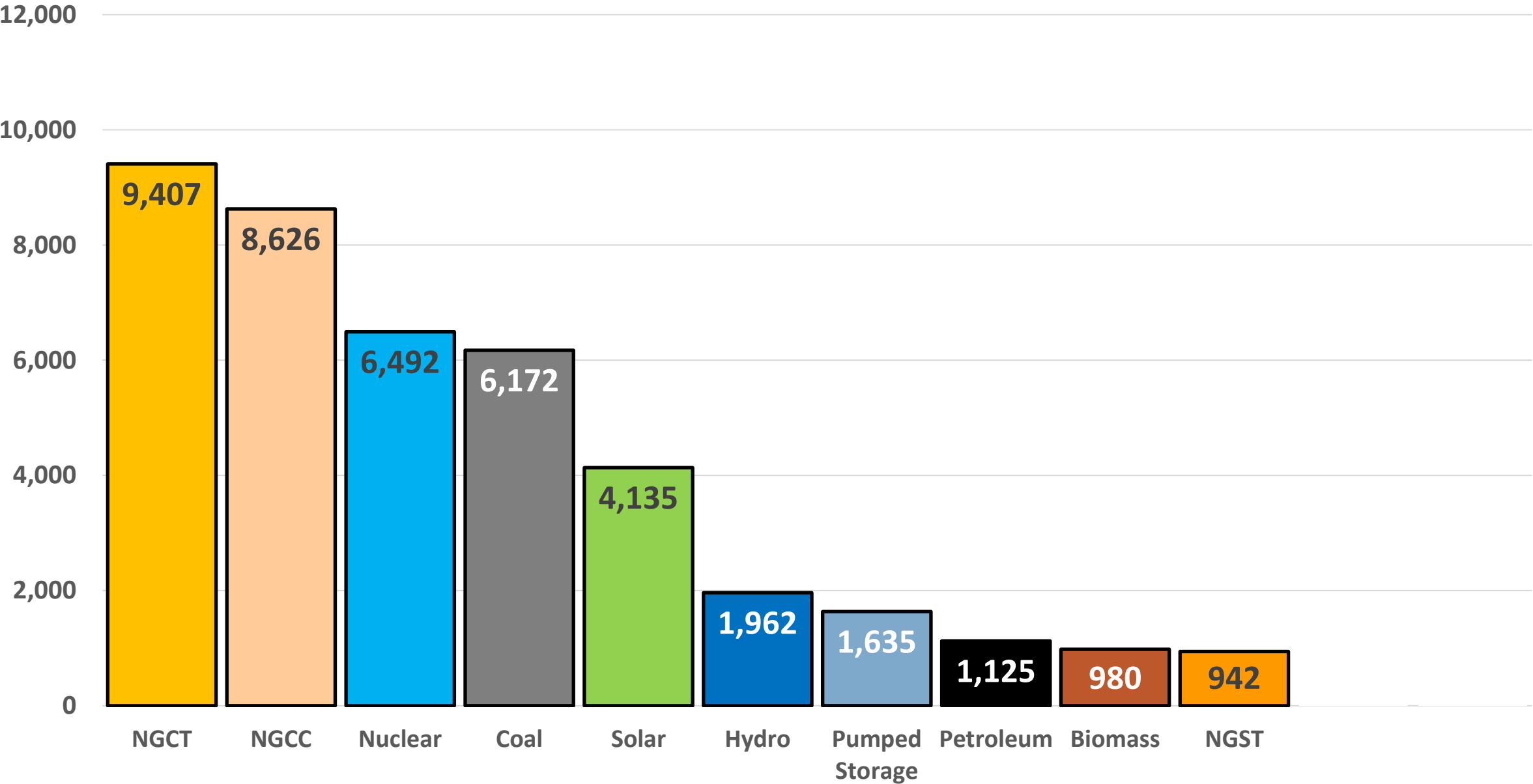
Potential Challenges & Opportunities for Georgia

*INCREASED POWER DEMAND AND A
BROADER CONTEXT*

Data Source: *US EIA*
(Accessed 6/13/2024)

Compiled By: David Gattie

Georgia Capacity by Generation Type (MW)





OTR Freight

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

<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/>


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



Natural Gas-Fired Power Plants

<https://www.energyindustrywiring.com/energy-industrywiring-articles/energy-industrywiring-articles>

<https://www.enr.com/company/energy-industry/generating-plants/mc-donald-100553111>



Nuclear Power Plants

<https://www.george-power.com/company/about-us/nuclear-power-plants/plant-waste.html>

<https://www.georgiapower.com/company/energy-industry/generating-plants/plant-yogtle.html>

Agriculture & Food Production

<https://www.wal.com/articles/5-1-farmers-who-once-fed-the-world-overtaken-by-new-world-powers-1492700974>

<https://www.wsj.com/articles/u-s-farmers-who-once-fed-the-world-overtaken-by-new-world-powers-1492700574>



Defense Industrial Base

Data

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

Photo: MIT Technology Review

<https://www.defensenews.com/industry/2020/02/05/does-the-defense-industrial-base-deserve-a-passing-grade/>



Data Centers

Photo: MIT Technology Review

Photo: MIT Technology Review

[-storm-s-nation-electric-power-grid.htm](#)



Rail & Shipping

<https://www.cato.org/publications/policy-analysis/jones-act-burden-america-can-no-longer-boat>

<https://www.cato.org/publications/policy-analysis/jones-act-burden-america-can-no-longer-bear>

Cement Production



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

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



Coal-Fired Power Plants

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

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



Chemical Production

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

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



Iron and Steel Forging

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

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

Oil and Natural Gas Refining

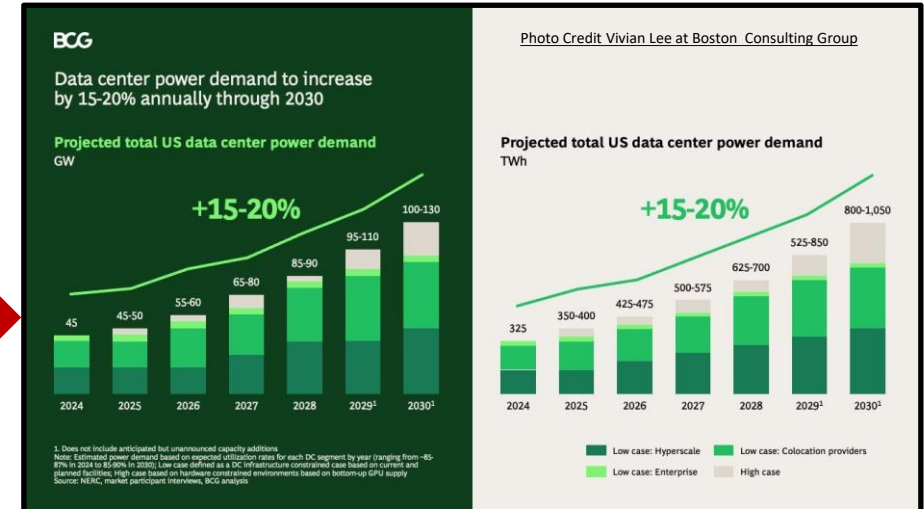


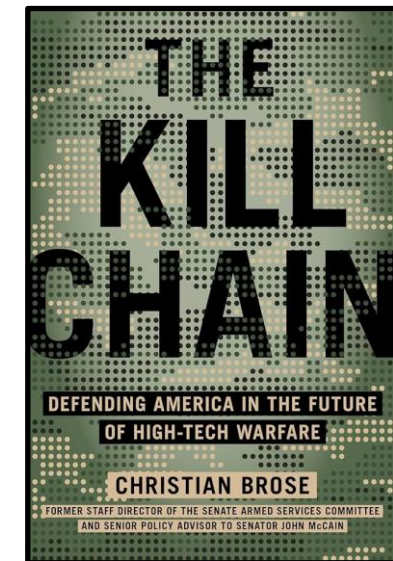
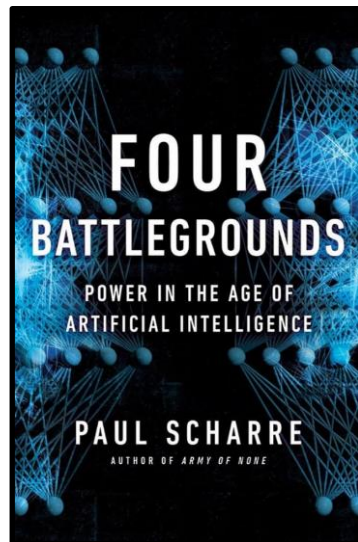
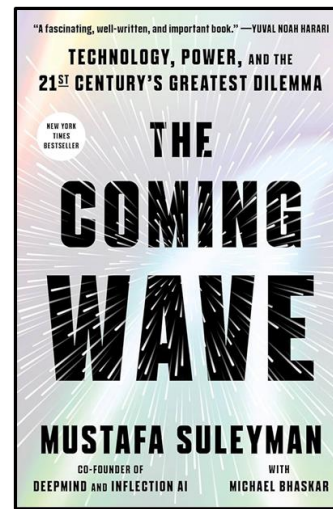
<https://www.3trb.com/renewable-energy/2023/01/22/hour-utah-refineries-now-produce/>

<https://www.sltib.com/renewable-energy/2023/01/22/four-utah-refineries-now-produce/>

Data Centers & AI

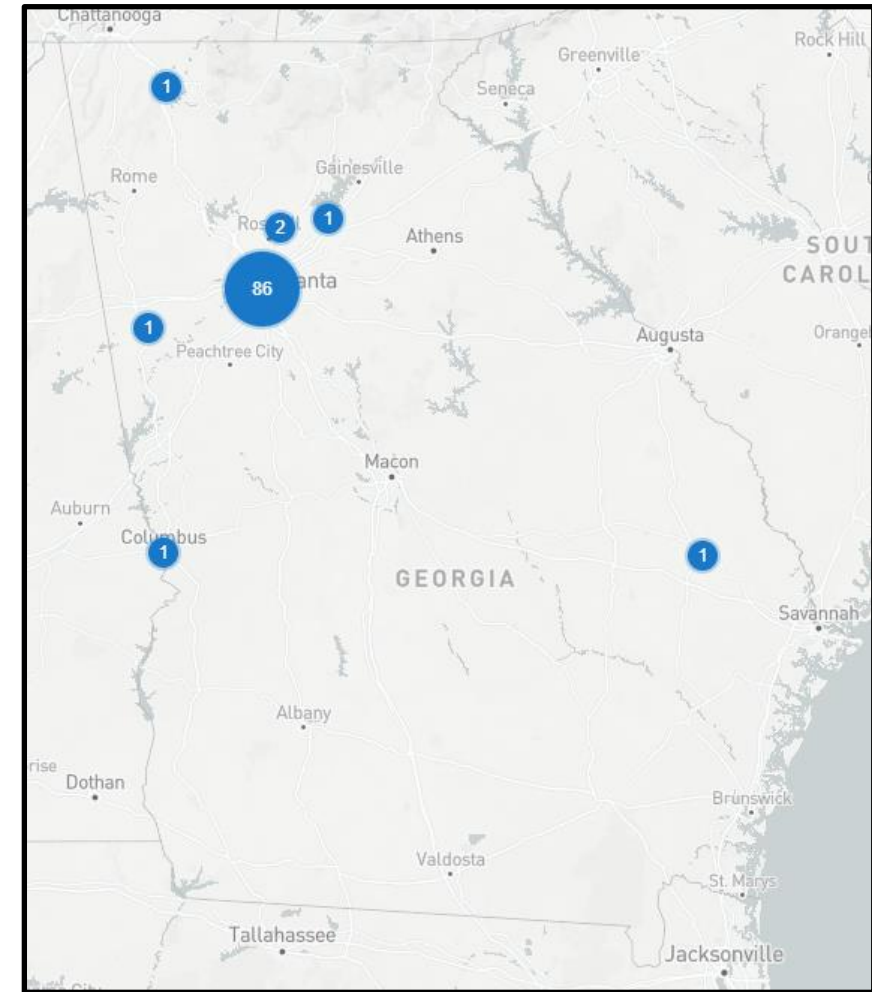
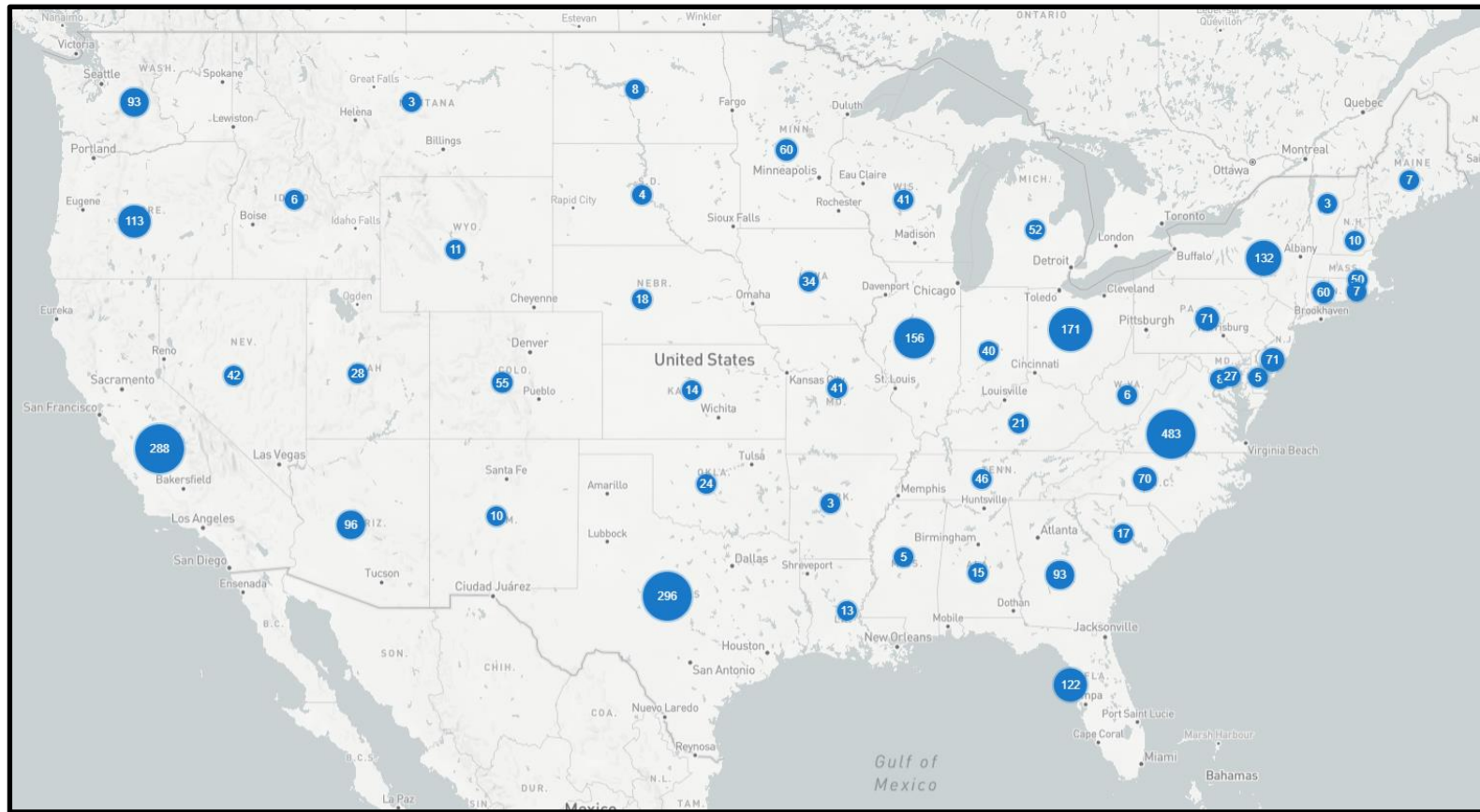
Power Demand & National Security





Data Centers

U.S. (3,059) & Georgia (93)

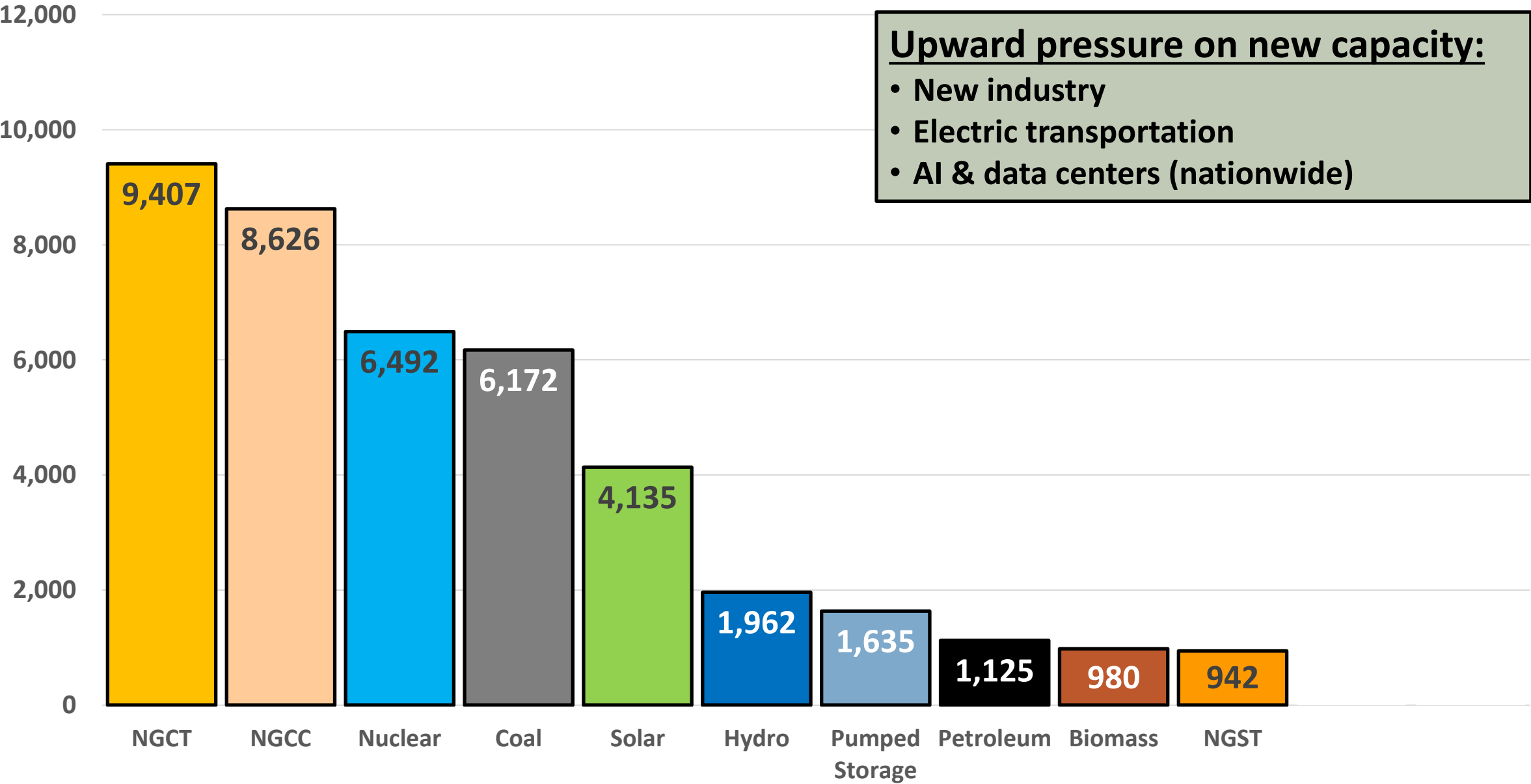


Source: <https://www.datacentermap.com/usa/>

Data Source: US EIA
(Accessed 6/13/2024)

Georgia Capacity by Generation Type (MW)

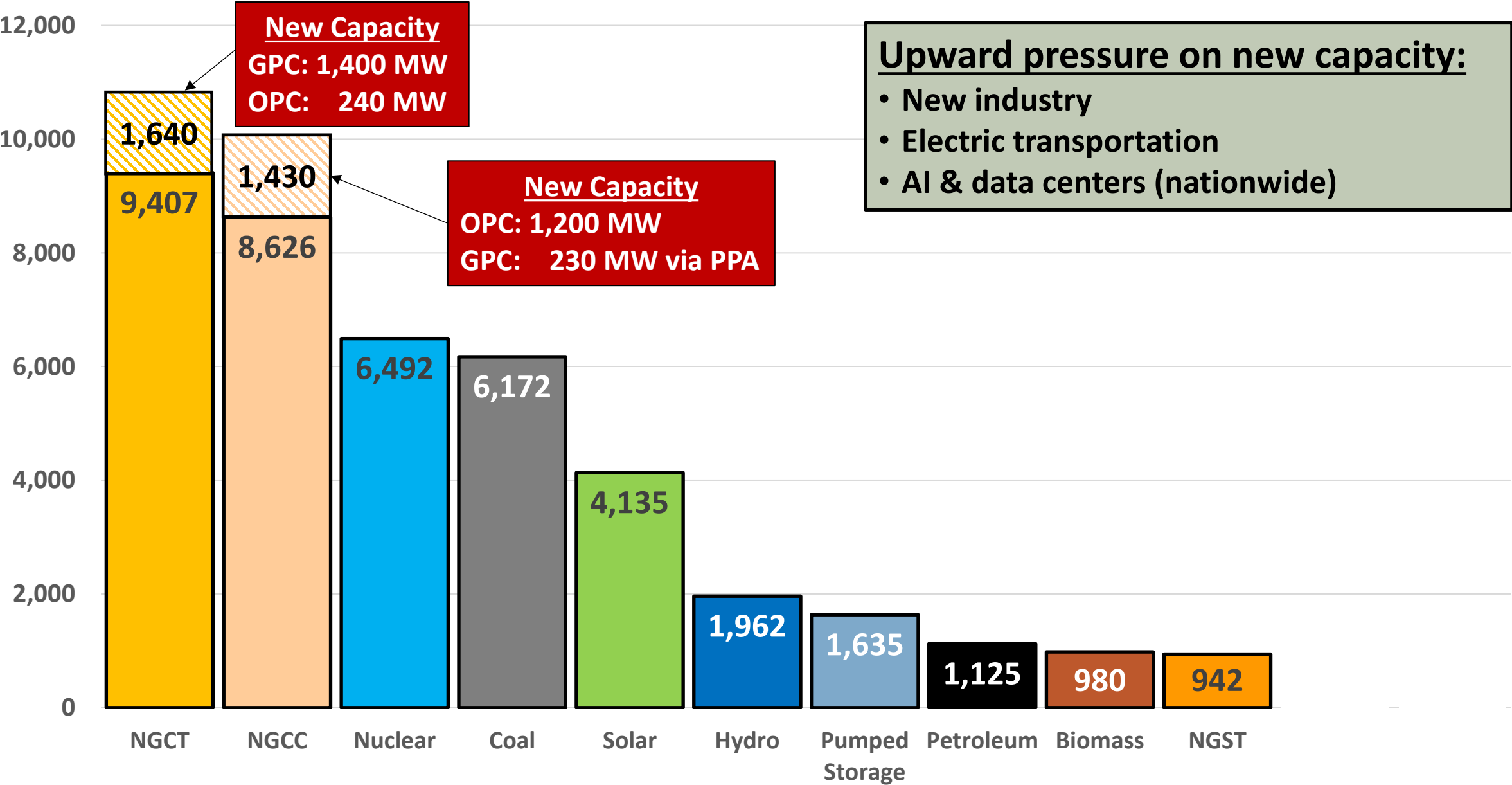
Compiled By: David Gattie



Data Source: US EIA
(Accessed 6/13/2024)

Compiled By: David Gattie

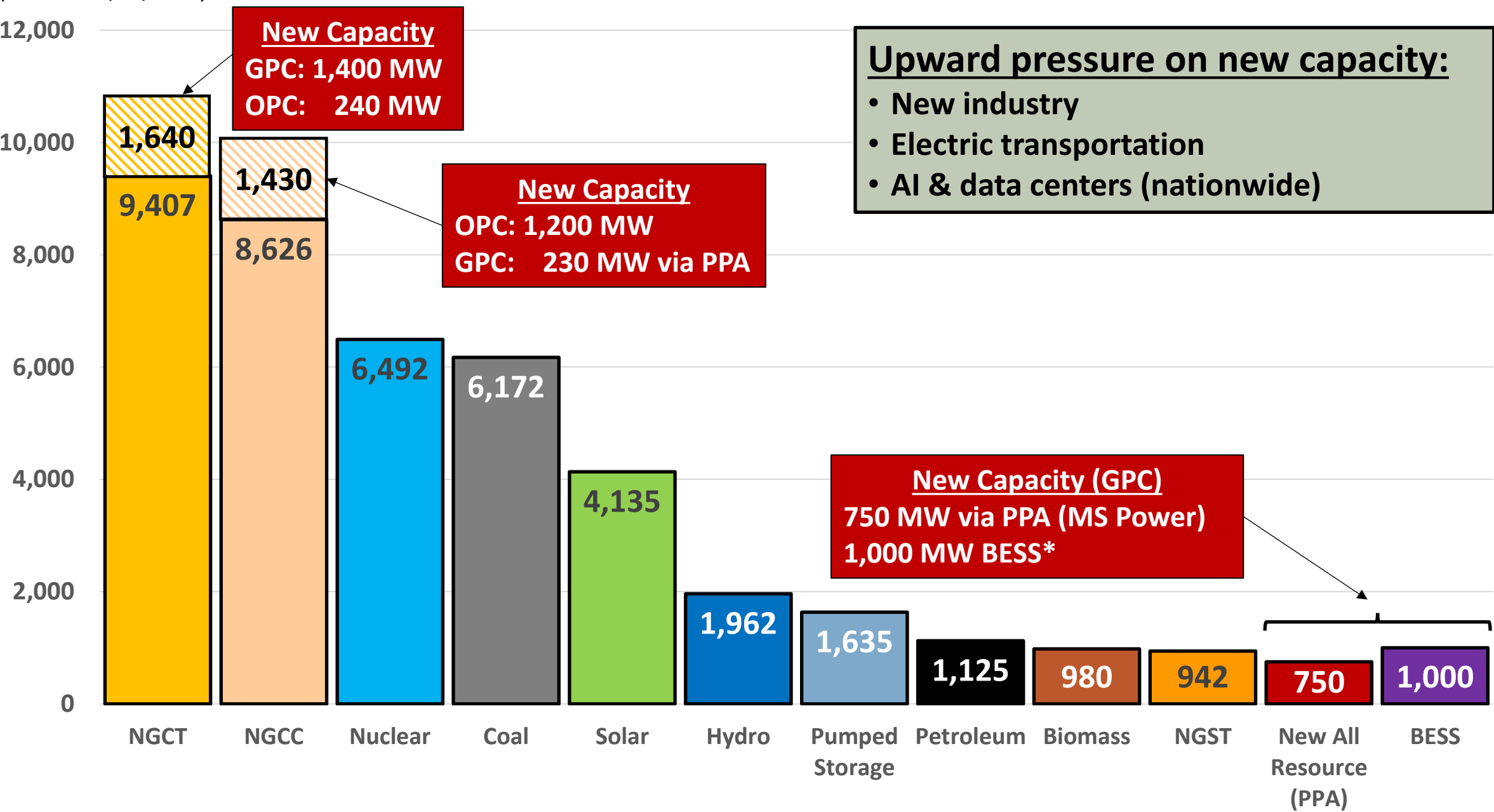
Georgia Capacity by Generation Type (MW)



Data Source: US EIA
(Accessed 6/13/2024)

Compiled By: David Gattie

Georgia Capacity by Generation Type (MW)



Summary Point #5

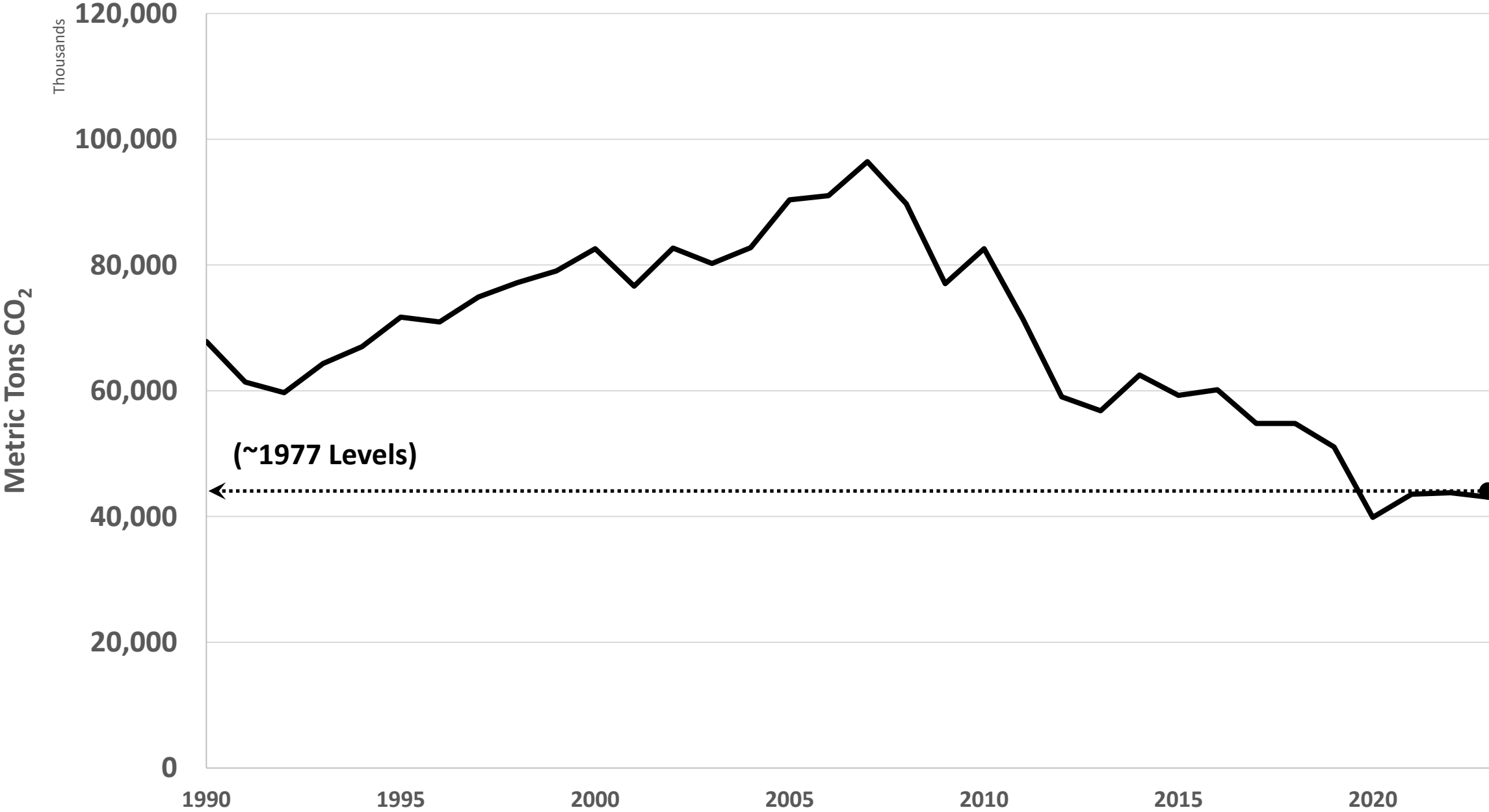
Data Center Growth:

- Needs to be calculated, with benefits to the state as the priority
- Shouldn't be allowed to put upward pressure on rates
- Shouldn't be allowed to impact Georgia's model for long-term integrated resource planning where reliability is the priority

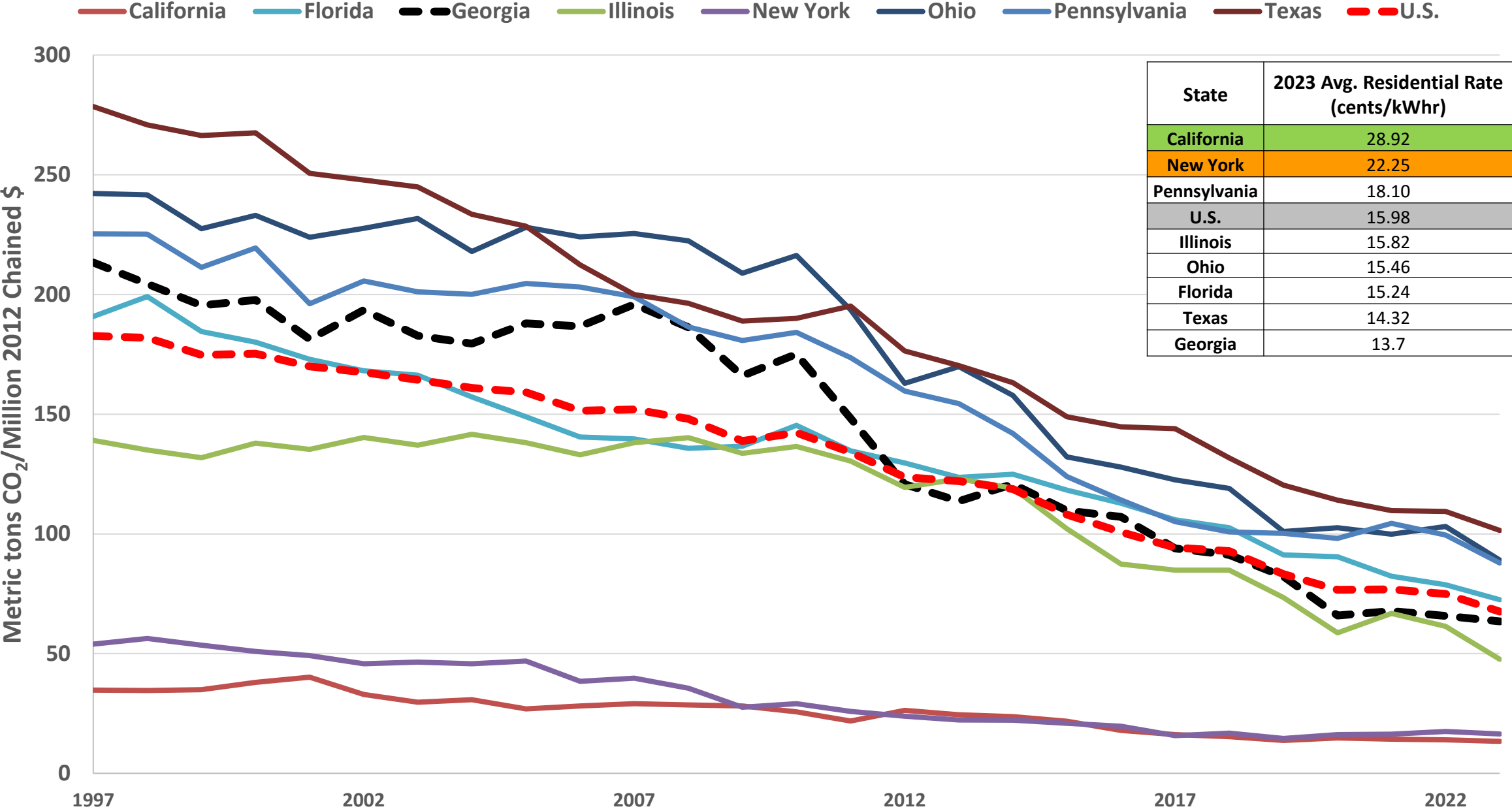
The Carbon Question

DOWNWARD PRESSURE ON RELIABLE RESOURCES: COAL AND
NATURAL GAS

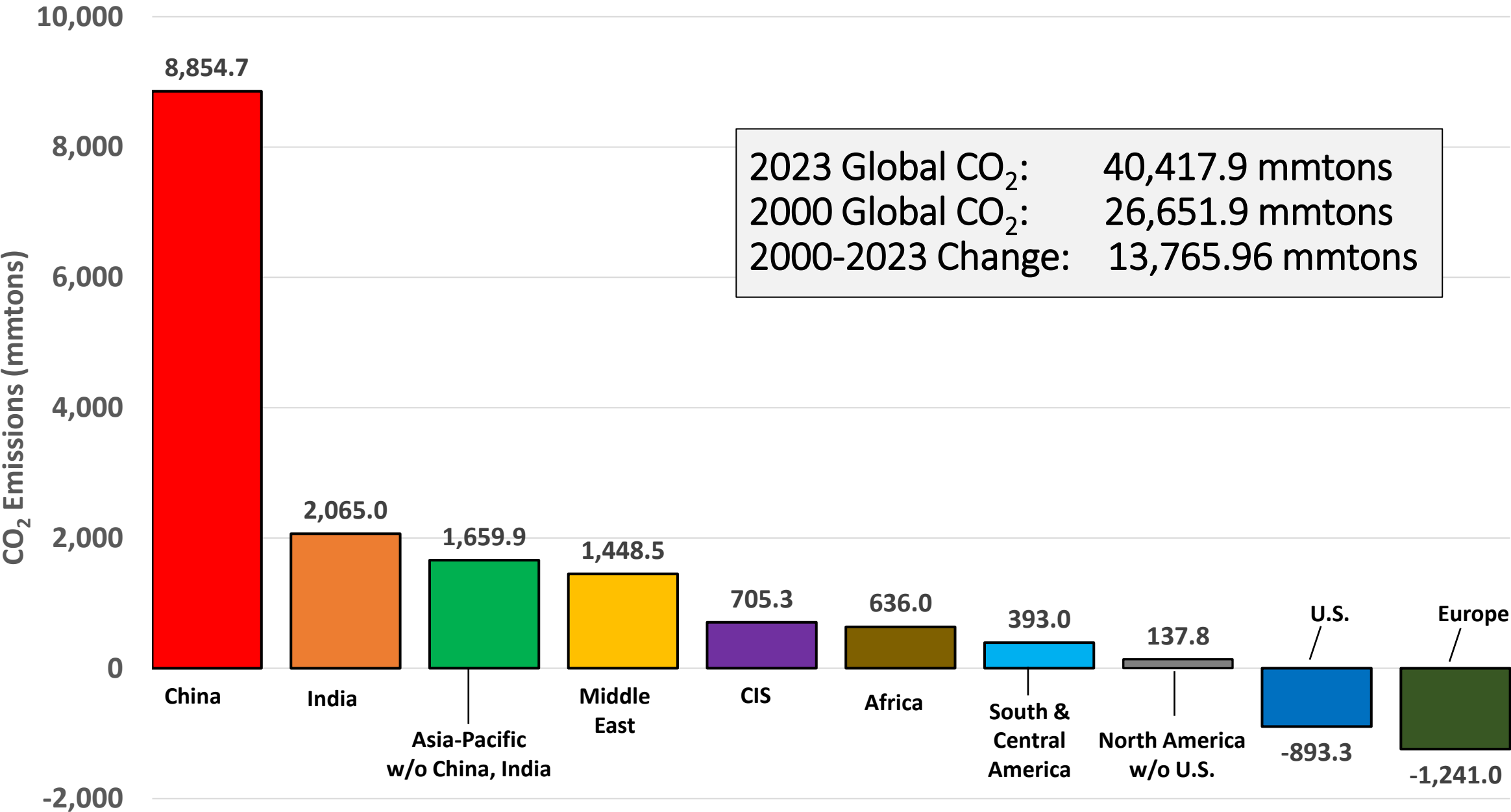
Georgia CO₂ Emissions: Power Sector



Electric Power Sector: CO₂ Intensity

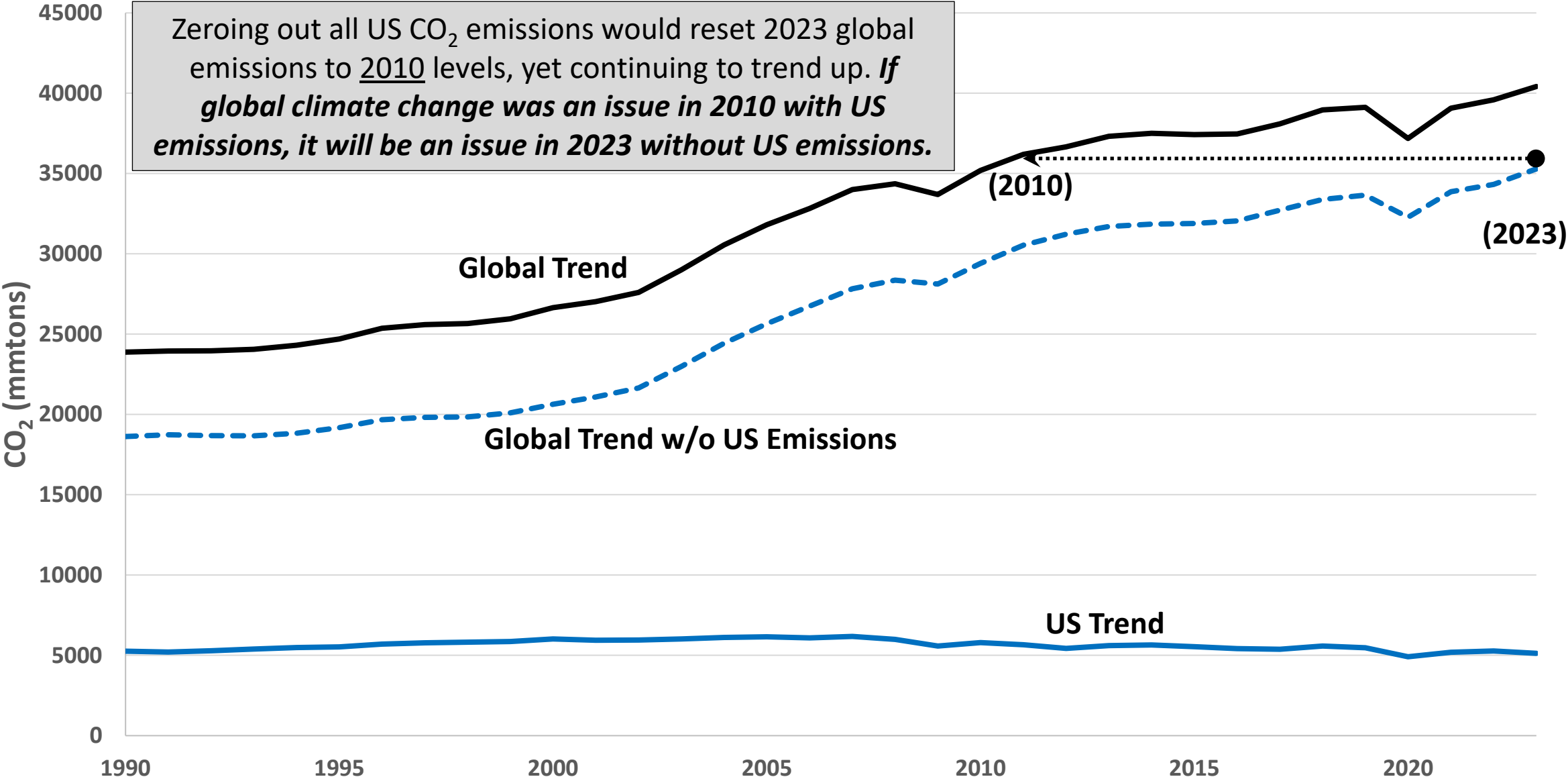


Change in CO₂ Emissions (2000-2023)



CO₂ Emissions: U.S. & World Comparison

— World — US - - - World w/o US



Summary Point #6

*THE CARBON INTENSITY OF GEORGIA'S ELECTRIC POWER
SECTOR IS BELOW THE NATIONAL AVERAGE AND IS
COMPETITIVE WITH TOP GDPs*

Concluding Points

- Continue leveraging existing GA's core competitive advantages
 - Vertically-integrated, regulated market structure
 - Long-term Integrated Resource Planning—electricity as a necessity, not just a market commodity
 - Prioritizing reliability—it will attract new industry
- As the economy becomes increasingly electrified & demand increases
 - Begin looking into small modular and advanced reactors
 - Continue planning for additional natural gas capacity
 - Maintain resource diversity—including coal
- Be strategic on the data center front—leverage to benefit GA

Thank You

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Residential Rates

Residential rates in this presentation are from the U.S. Energy Information Administration. These rates represent a weighted average of consumer revenue and sales for a state, and do not equal the per KWhr rate charged by the electric power industry participant to an individual consumer. They are offered here in order to provide a common metric for comparison across states.

(Reference: <https://www.eia.gov/electricity/monthly/pdf/AppendixC.pdf>)



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