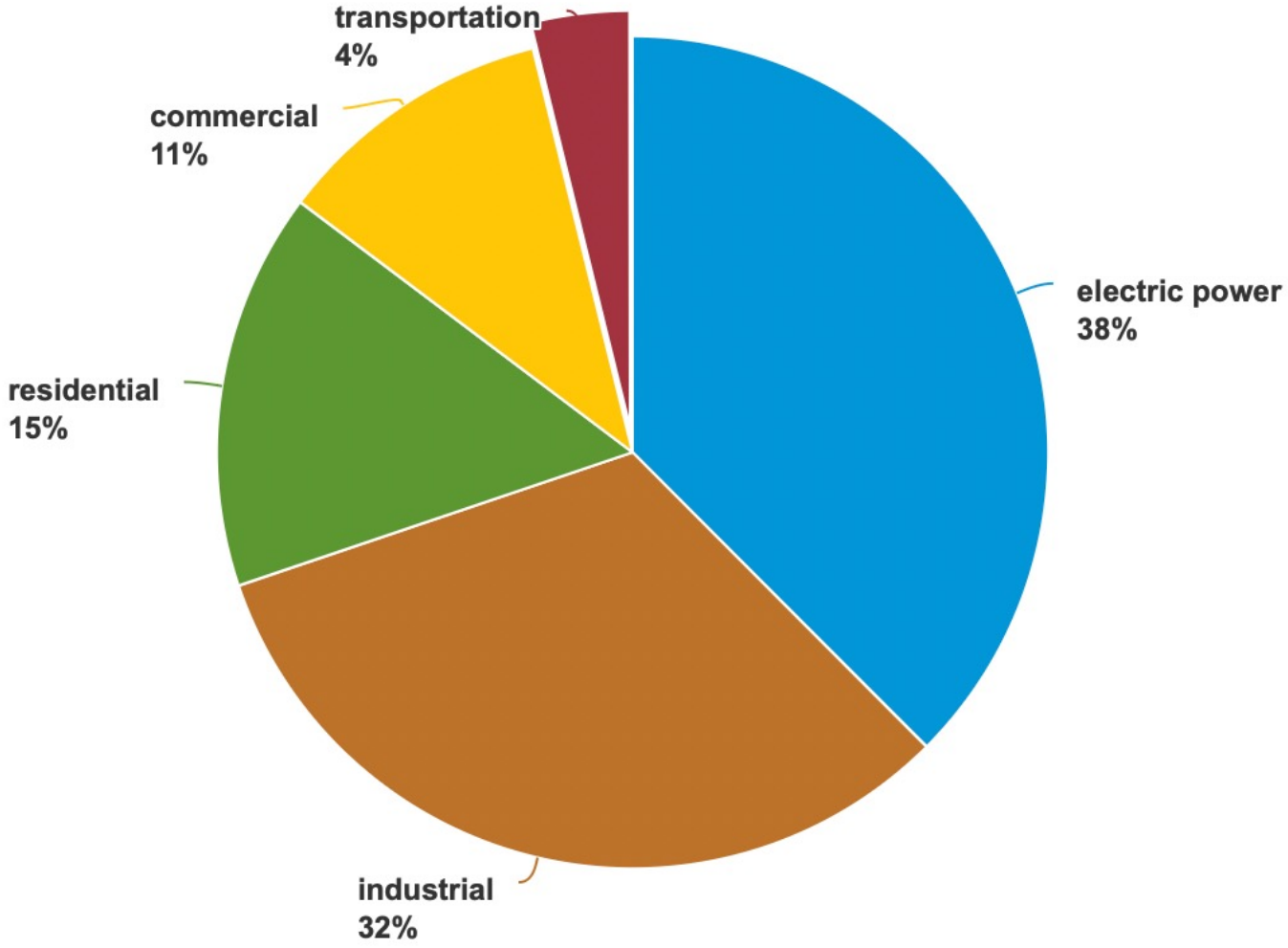
Competitive Electric Generation:

The Marcellus and Utica Powering the PJM

Top Uses of Natural Gas in U.S.



38% **Electric Power -** ***12.12 Tcf***

32% **Industrial -** ***10.44 Tcf***

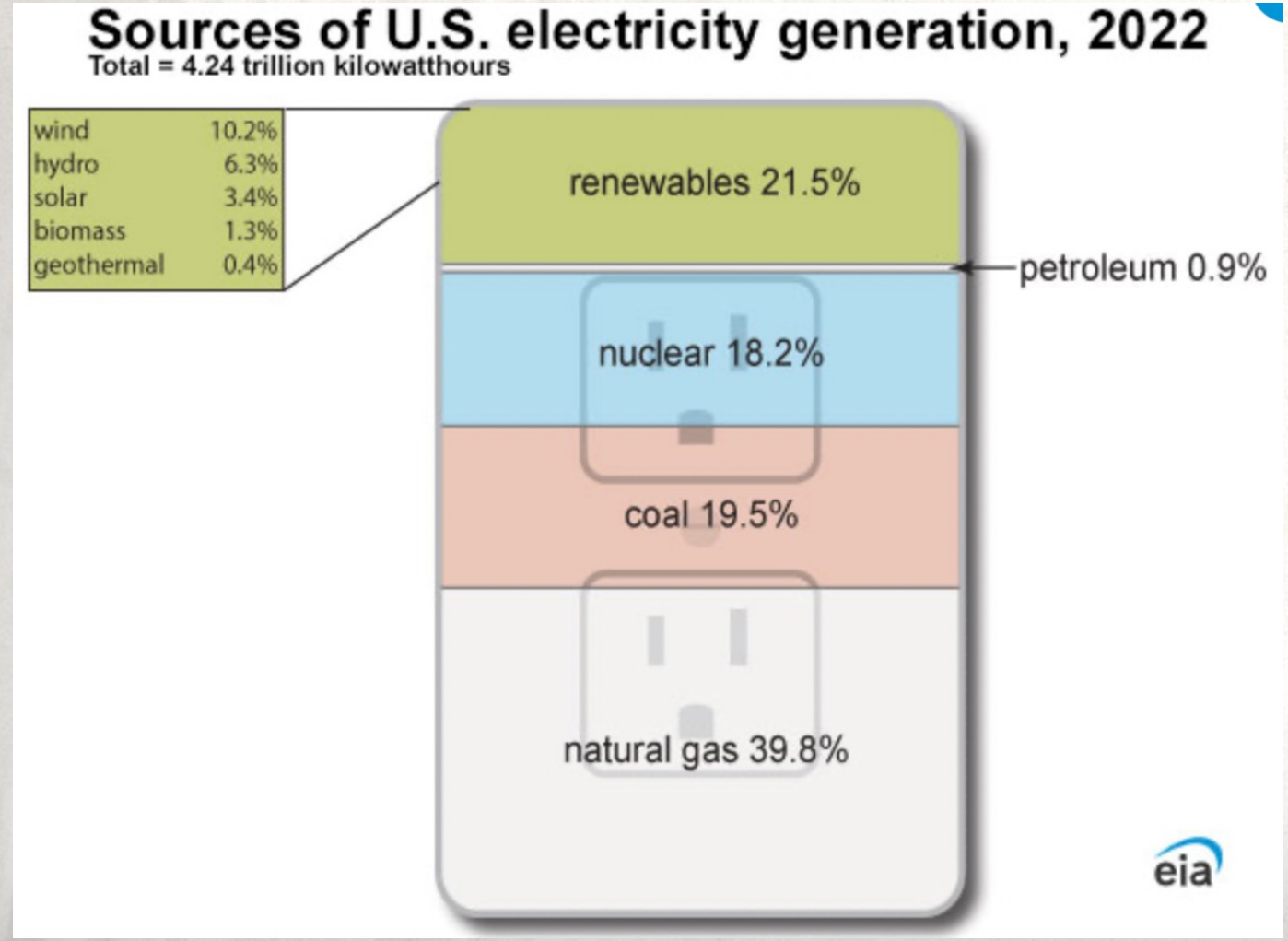
15% **Residential -** ***4.99 Tcf***

11% **Commercial -** ***3.52 Tcf***

4% **Transportation -** ***1.24 Tcf***

ORION Strategies

U.S. Electricity by Source: 2022



More wholesale generation coming online than ever before

- Utilities continue to divest of generation
- Dispatchable Combined Cycle
- Renewables Growth
- Coal dropped from 52% to 19% and will continue to fall

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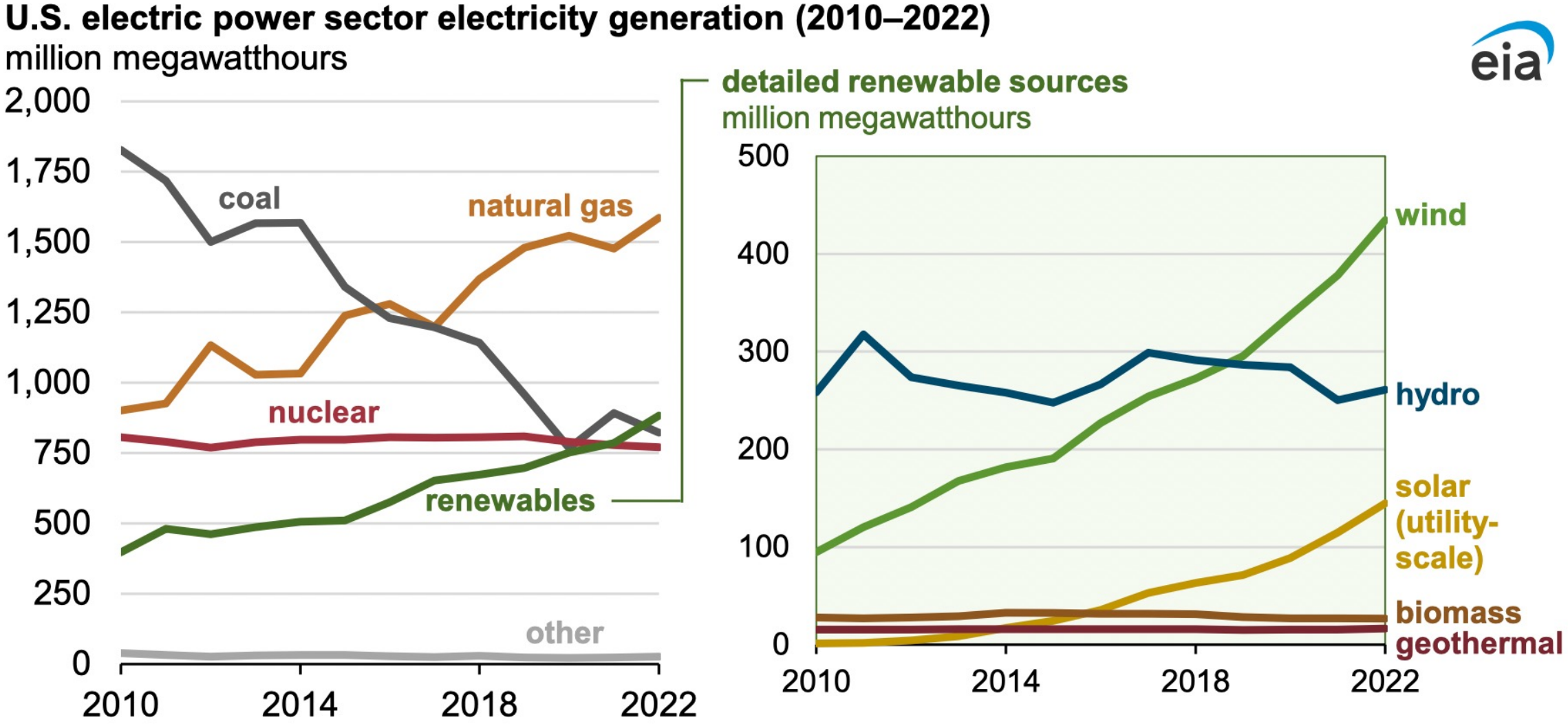
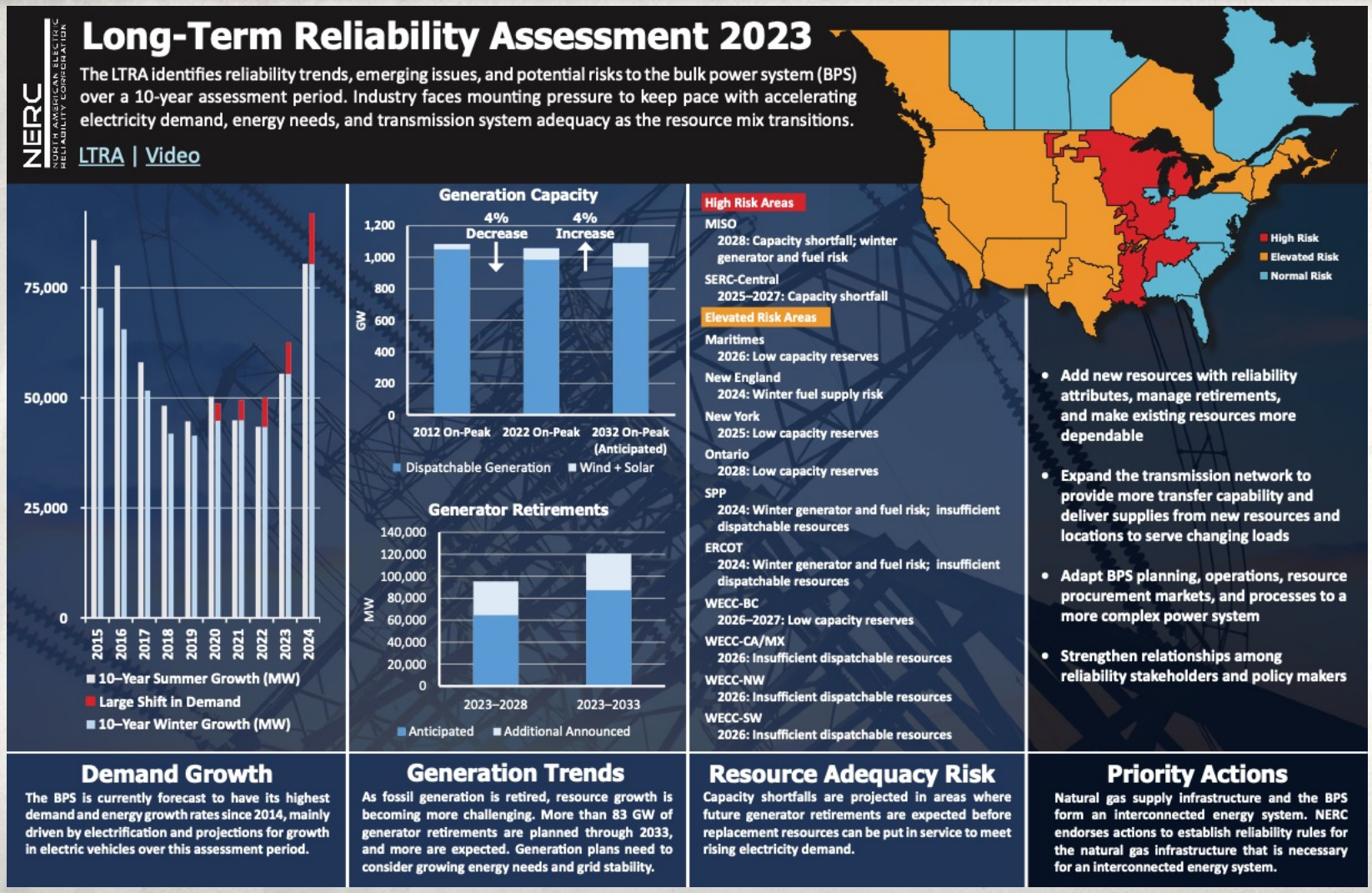
U.S. Electricity by Source: 2022



PJM – Grid Reliability



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Future of Electric Demand in U.S.

- **Efficiency has leveled**
- **Manufacturing Reshoring**
- **Data Centers Rapidly Expanding**
- **Electrification**

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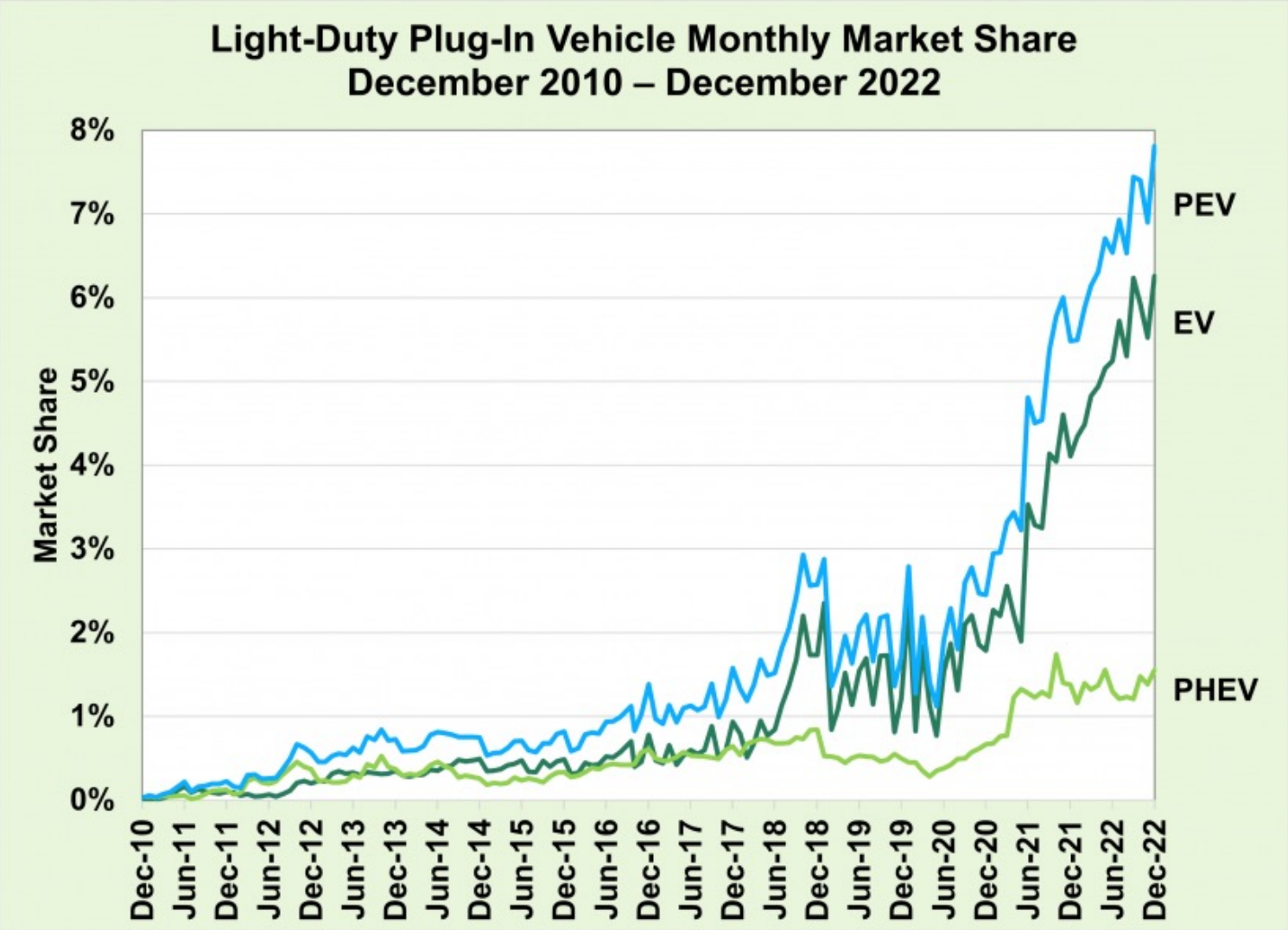
Electric Demand – Electric Vehicles



1.2 Million EVs sold US 2023

1 EV Electricity = 23 fridges

PJM 2024 = 500,000 EVs

PJM 2039 = 23 Million EVs

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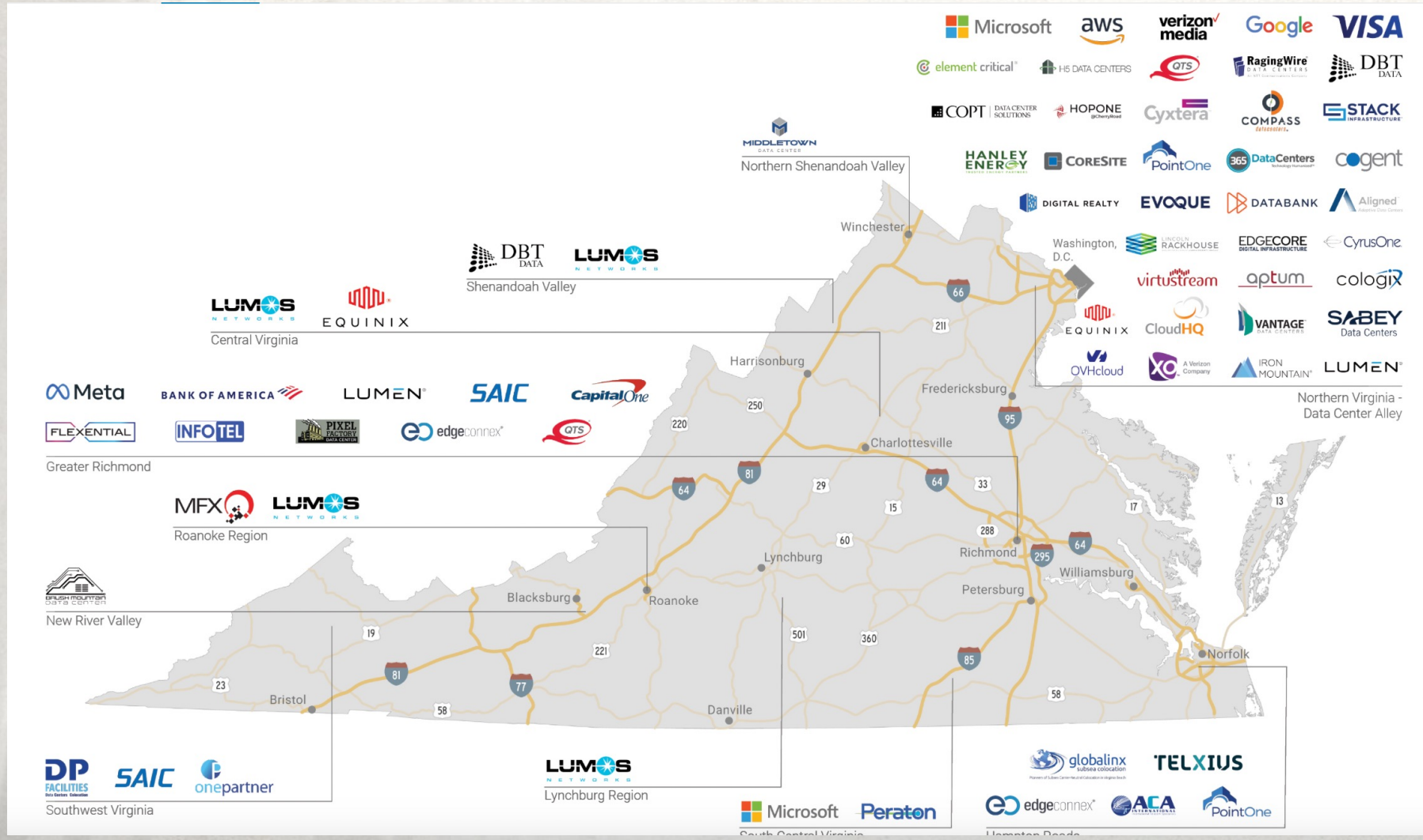
Electric Demand – Data Centers



PJM triples annual load growth forecast driven by data centers, electrification

ORION Strategies

Projected U.S. Gas-Fired Generation

2023 Standard Scenarios Report:
A U.S. Electricity Sector Outlook

Primary Authors: Pieter Gagnon, An Pham, Wesley Cole

Contributing Authors: Sarah Awara, Anne Barlas, Maxwell Brown, Patrick Brown, Vincent Carag, Stuart Cohen, Anne Hamilton, Jonathan Ho, Sarah Inskeep, Akash Karmakar, Luke Lavin, Trieu Mai, Joseph Mowers, Matthew Mowers, Caitlin Murphy, Paul Pinchuk, Anna Schleifer, Brian Sergi, Daniel Steinberg, and Travis Williams

National Renewable Energy Laboratory

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Contract No. DE-AC36-08GO28308

Technical Report
NREL/TP-6A40-87724
December 2023

US gas-fired capacity to grow, even under 95% carbon reduction scenario: NREL

Fossil-fueled power plants without carbon capture equipment would produce 14% of U.S. electricity by 2050, according to "mid-case" modeling by a DOE laboratory.

"Mid-case" scenario tied to existing policies, U.S. gas-fired capacity increase by 2050 = 200 MW

If C02 cut by 95%, US gas-fired capacity increase by 2050 = 130 GW

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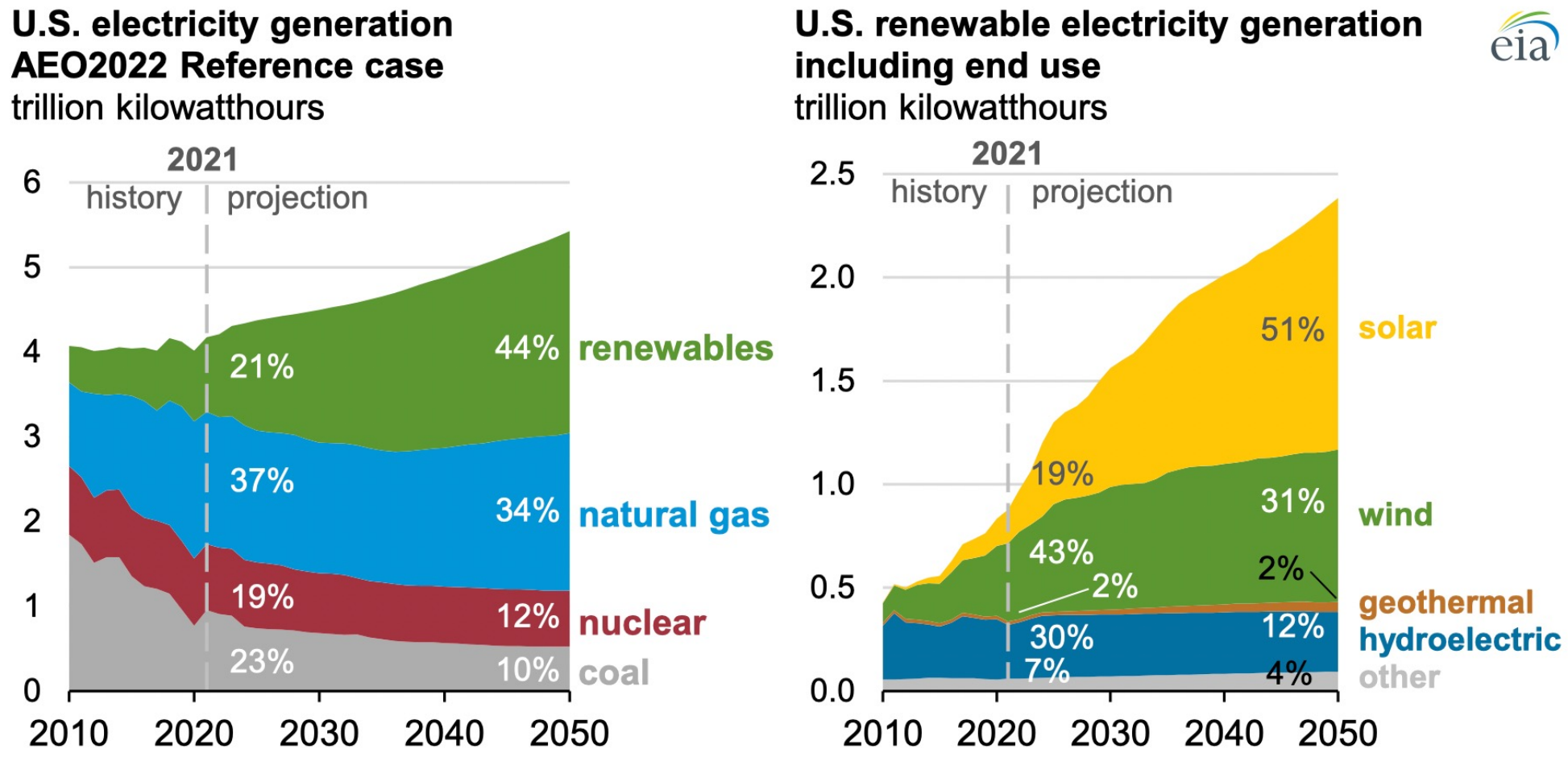
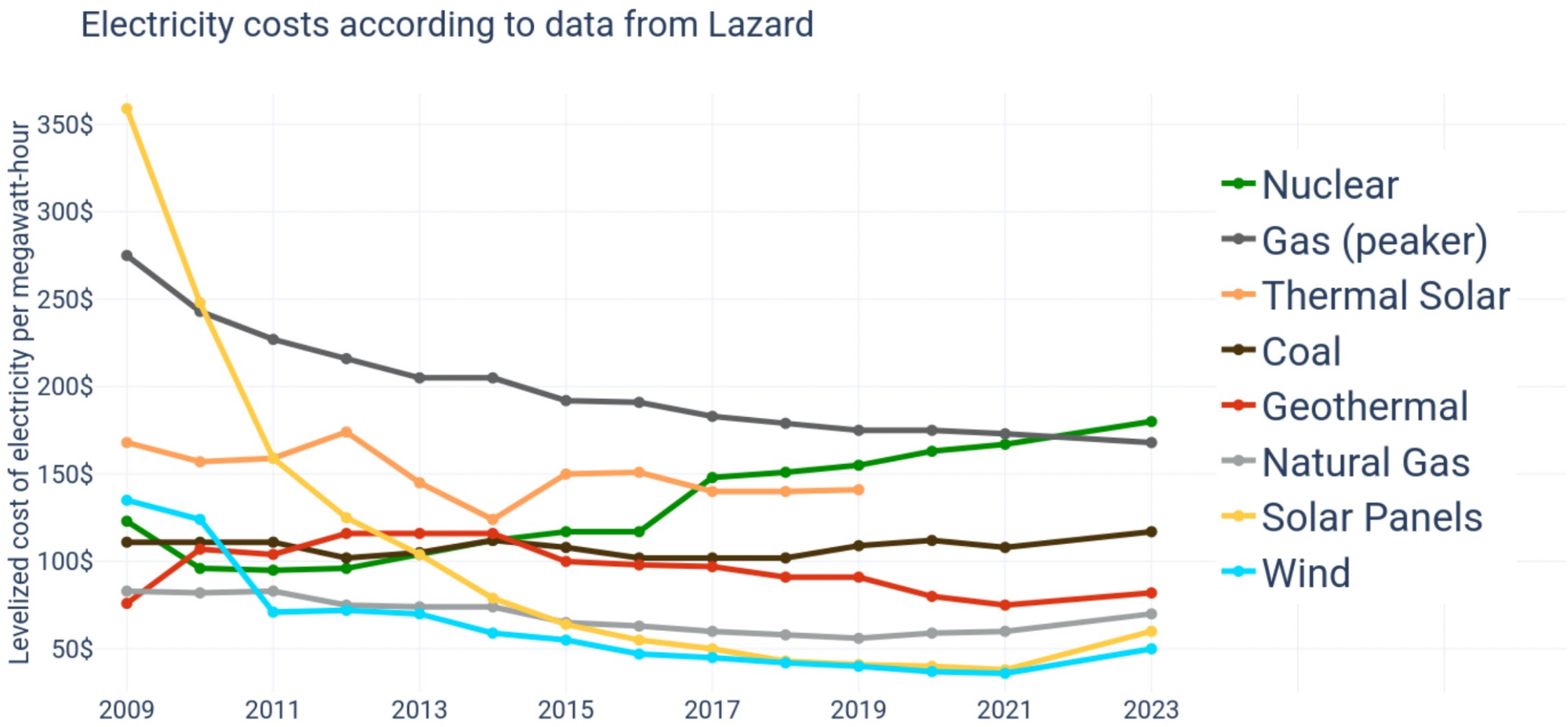
Projected U.S. Generation by Source



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* (AEO2022)
Note: Biofuels are both shown separately and are included in petroleum and other liquids.

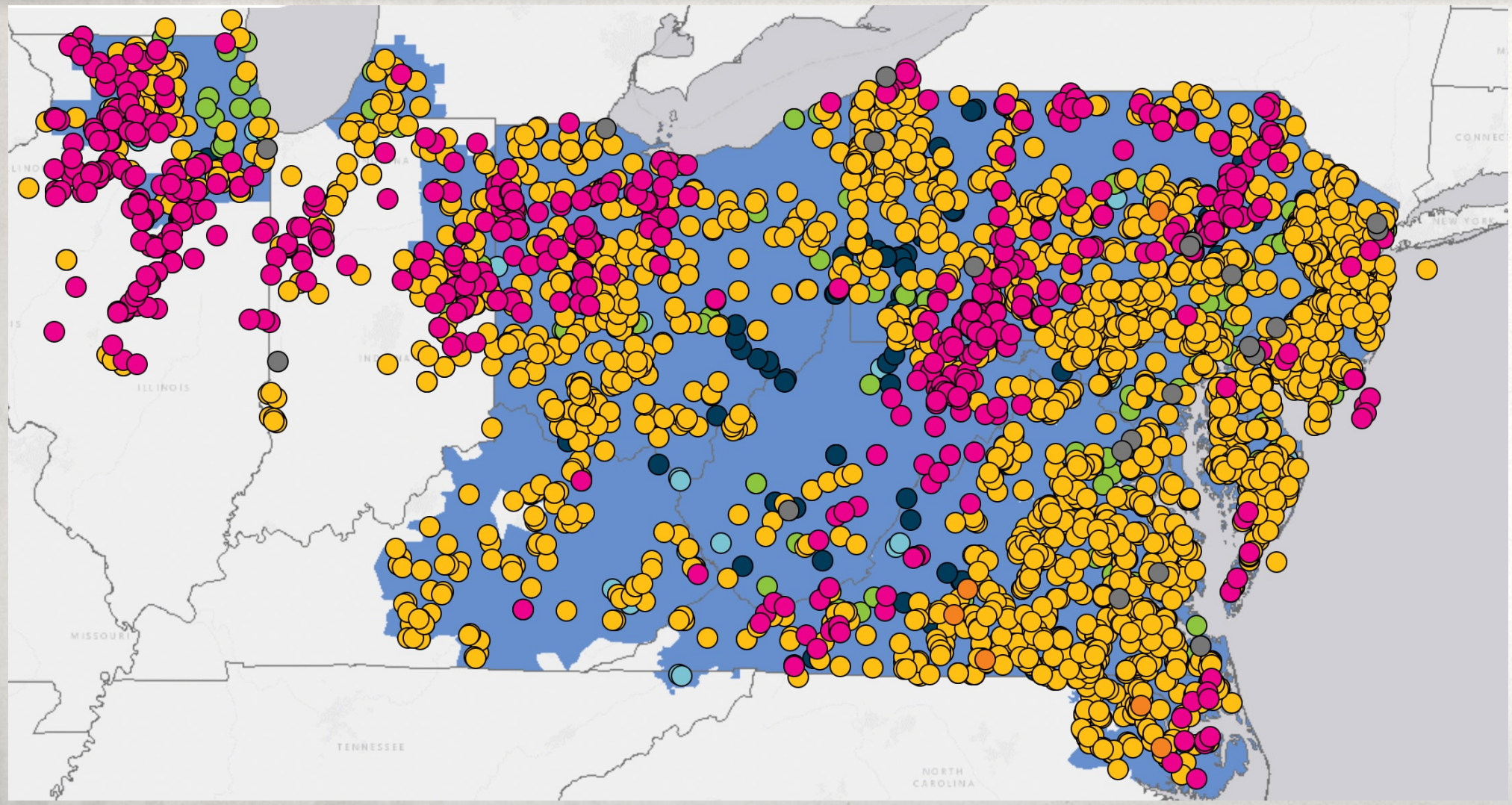
Levelized Cost of U.S. Electricity



PJM Queue Changes

- 260,000 MW (mostly renewable) to be studied over 3 years
- PJM system's current total capacity = 184,000 MW
- 95% requesting grid connection are renewables or batteries
- 44,000 MW have completed PJM study process but not constructed
- In 2023, less than 2,200 MW of projects have come online
- PJM expects to clear 62,000 MW in 2024
    - 100,000 MW in 2025
    - 100,000 MW in 2026

Renewables Planned In PJM



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Issues to Monitor in PJM

Both Marketplace and Policy:

- **RGGI – Pennsylvania and Virginia**
- **Hydrogen Production**
- **Infrastructure**
  - **Pipelines (Natural Gas, Co2, H2)**
  - **Transmission Lines**
- **CCUS and Geology**

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Carbon Sequestration

- **Primacy – Louisiana became the 3rd State (*12/28/2023*)**
- **Geology – Storage, Cap Rock, Fault Lines**
- **Demand – Offtake and IRA Tax Credit**
- **Pipelines and Permitting**
- **Environmental Justice**

Hydrogen

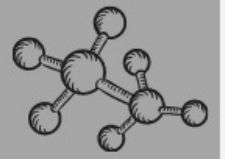
Grey Hydrogen

Process:

Steam Reforming

Source:

Natural Gas



Blue Hydrogen

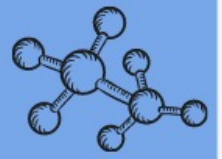
Process:

Steam Reforming

With Carbon Capture

Source:

Natural Gas



Green Hydrogen

Process:

Electrolysis

Source:

Renewable Energies

Black Hydrogen

Process:

Gasification

Source:

Coal

Pink Hydrogen

Process:

Electrolysis

Source:

Nuclear Energy

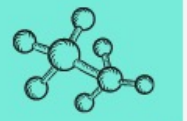
Turquoise Hydrogen

Process:

Pyrolysis

Source:

Natural Gas



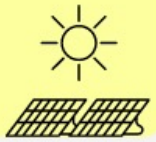
Yellow Hydrogen

Process:

Electrolysis

Source:

Solar Energy



THANK YOU