

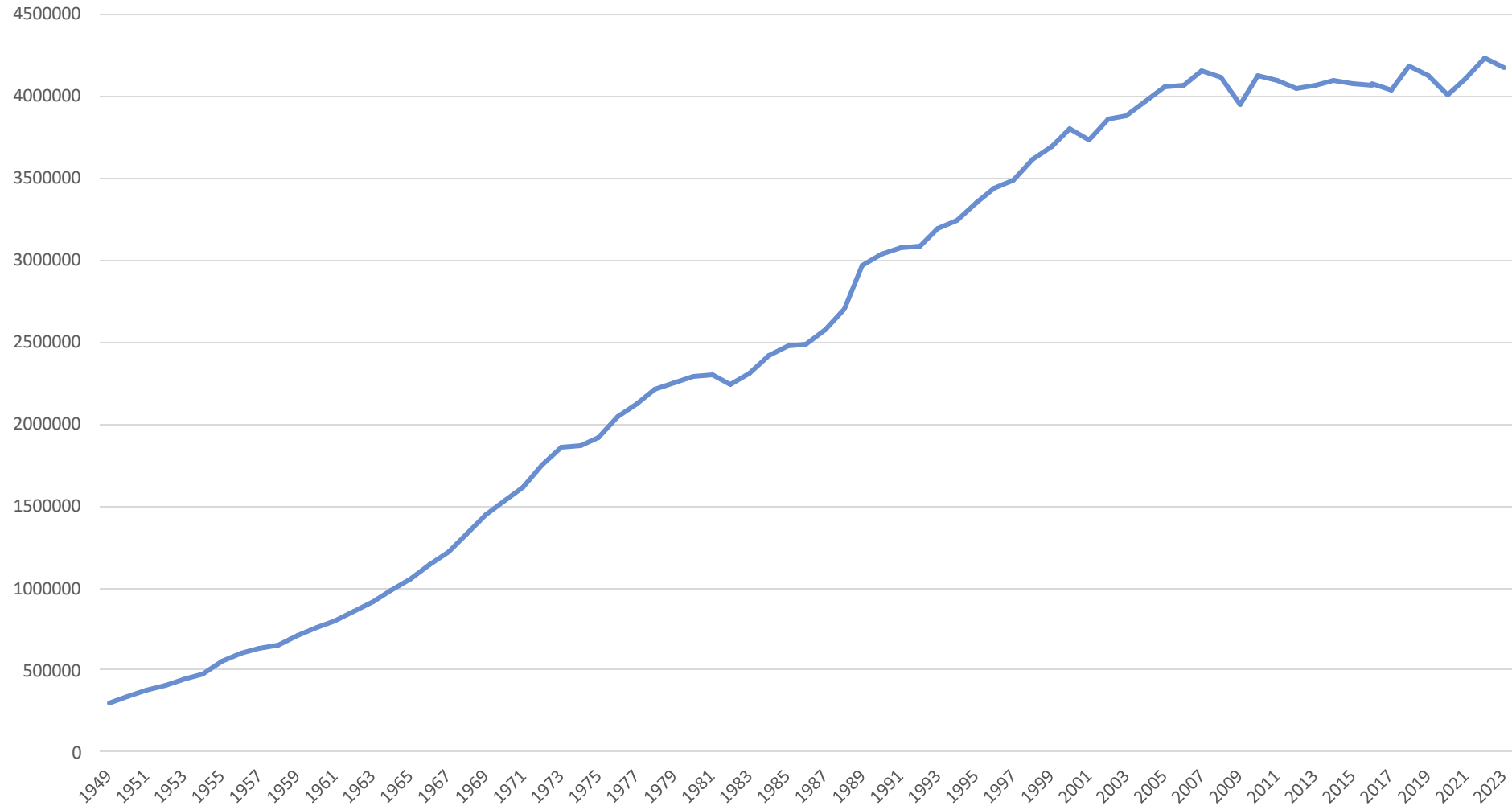
Energy End Use

Daniel Simmons

Takeaways

- Electricity demand is increasing
- But we have lost the ability to build new transmission
- Electricity rates increasing

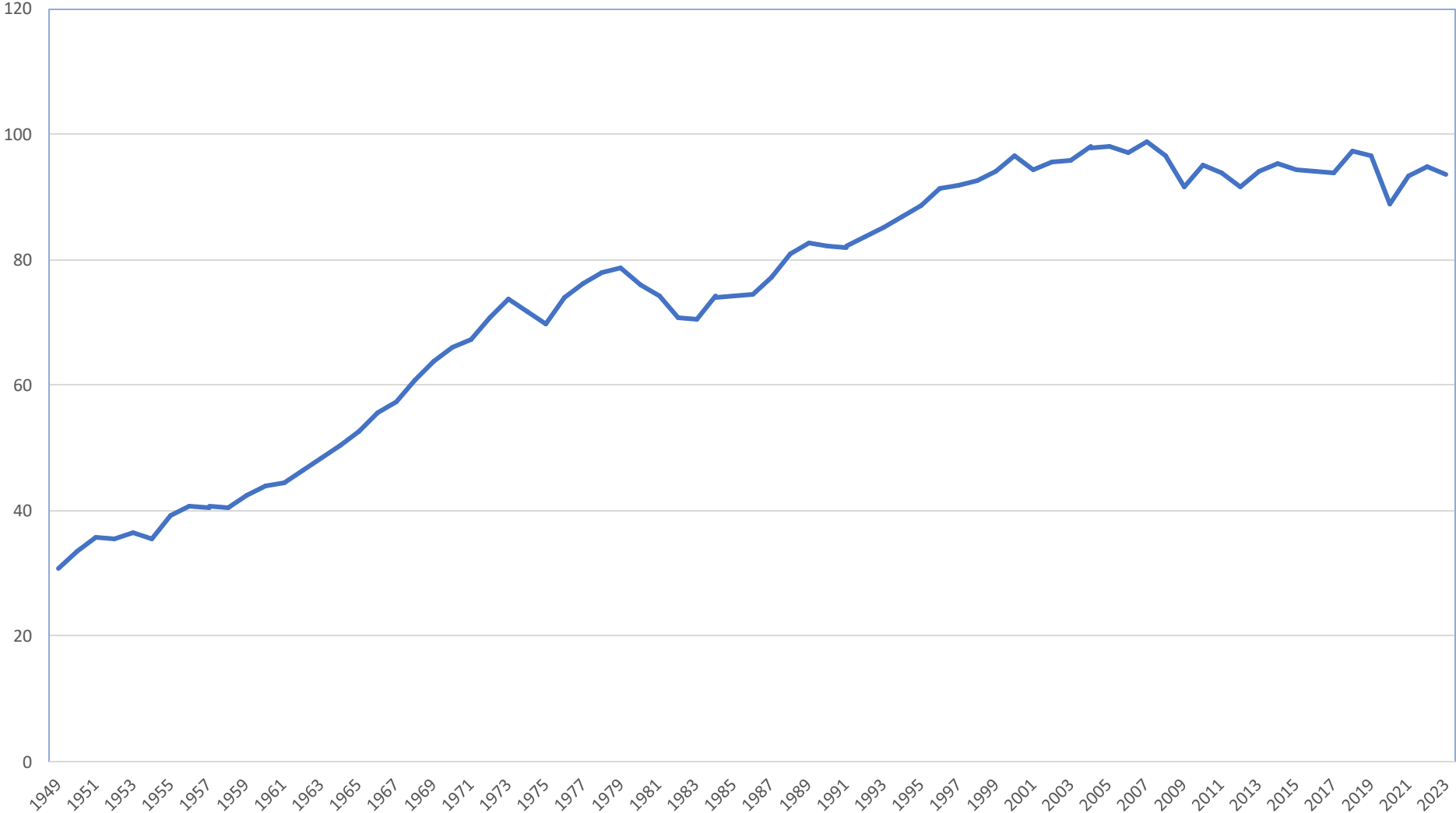
U.S. Electricity Net Generation 1949-2023



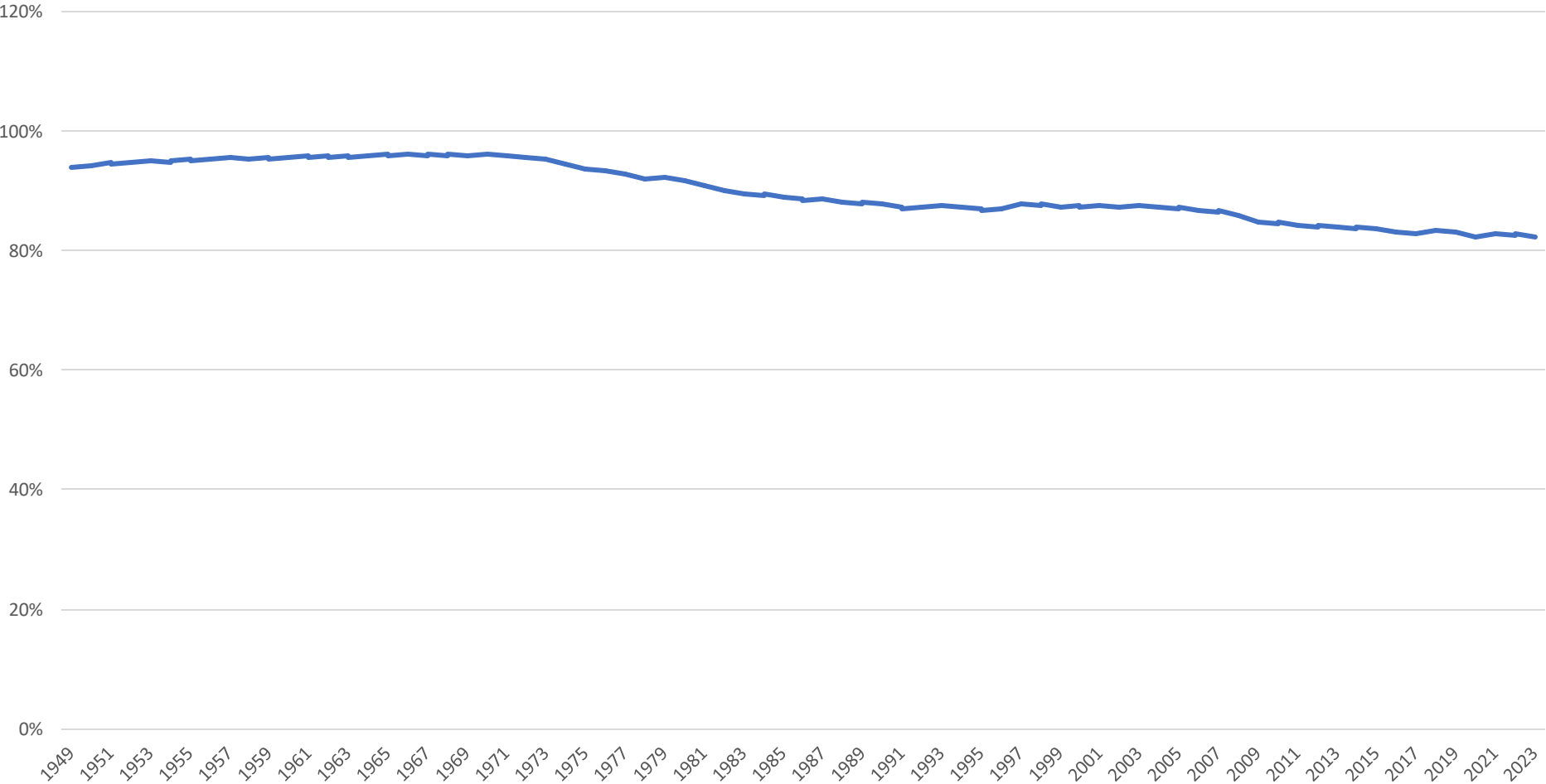
Source: Energy Information Administration, *Monthly Energy Review*, Table 7.2a, <https://www.eia.gov/totalenergy/data/monthly/>

U.S. Primary Energy Use

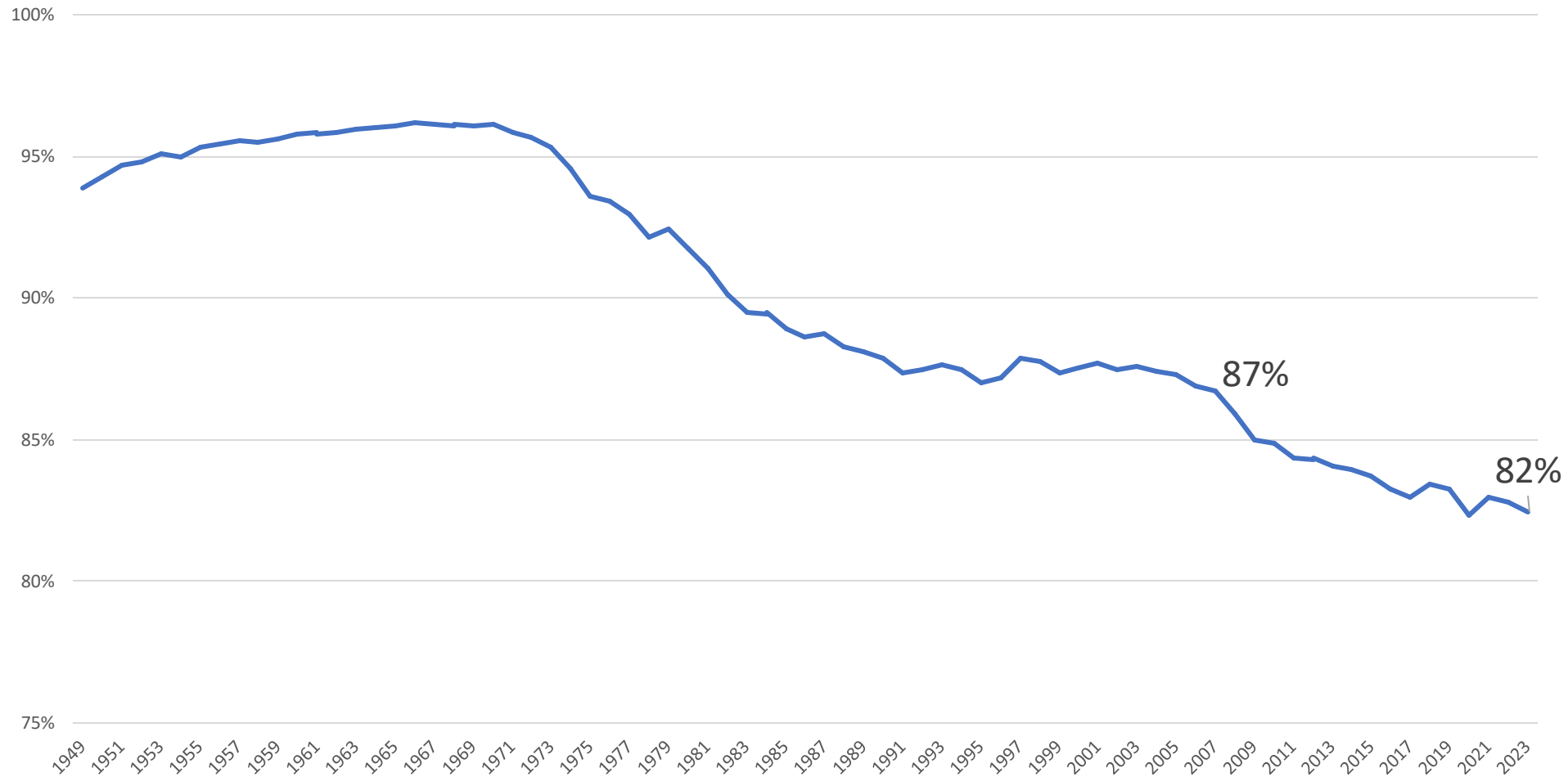
1949-2023



U.S. Fossil Fuel as percentage of Consumption 1949-2023

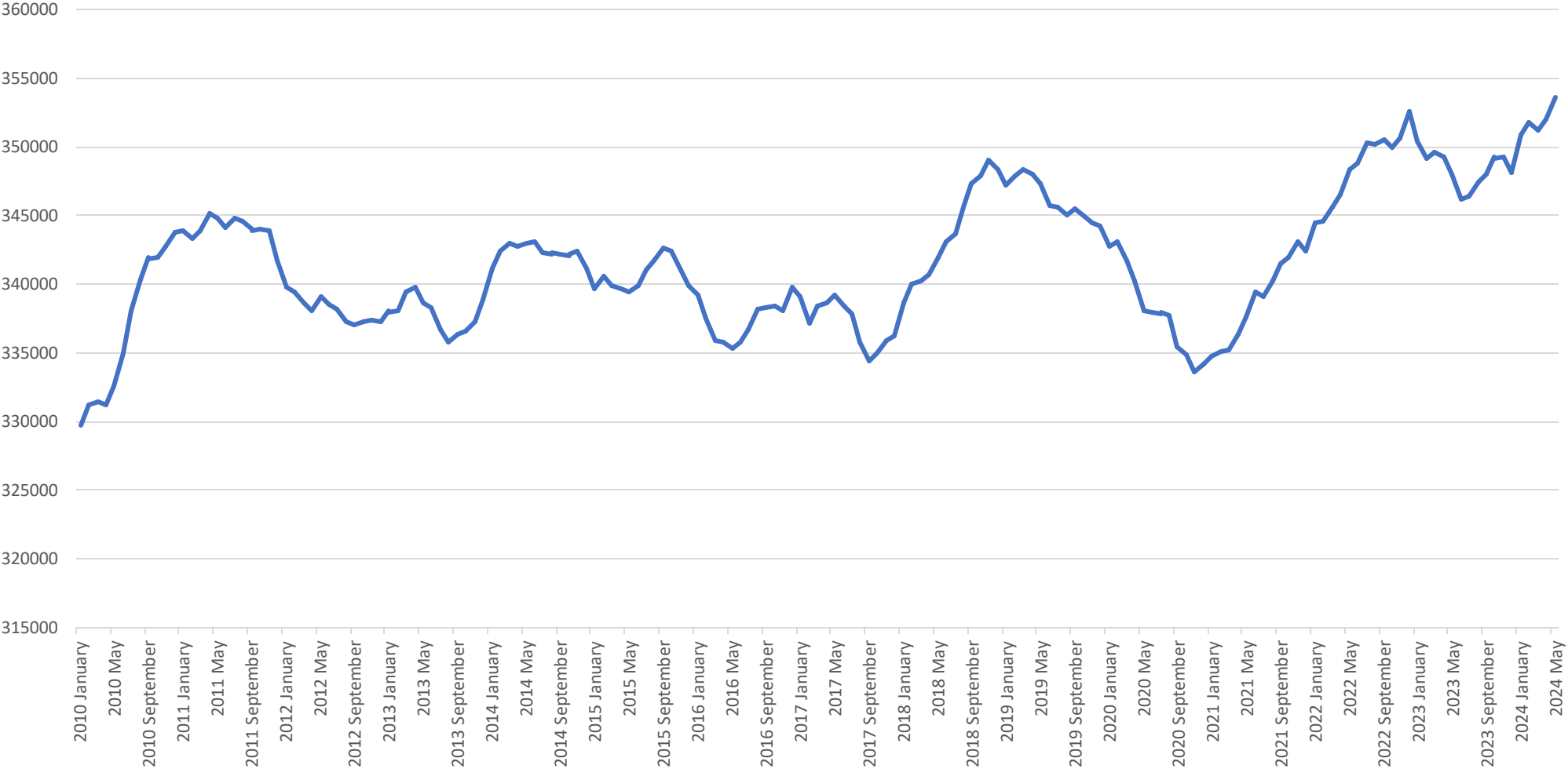


U.S. Fossil Fuel as percentage of Consumption 1949-2023



U.S. Net Generation

Rolling Average Jan 2010-May 2024

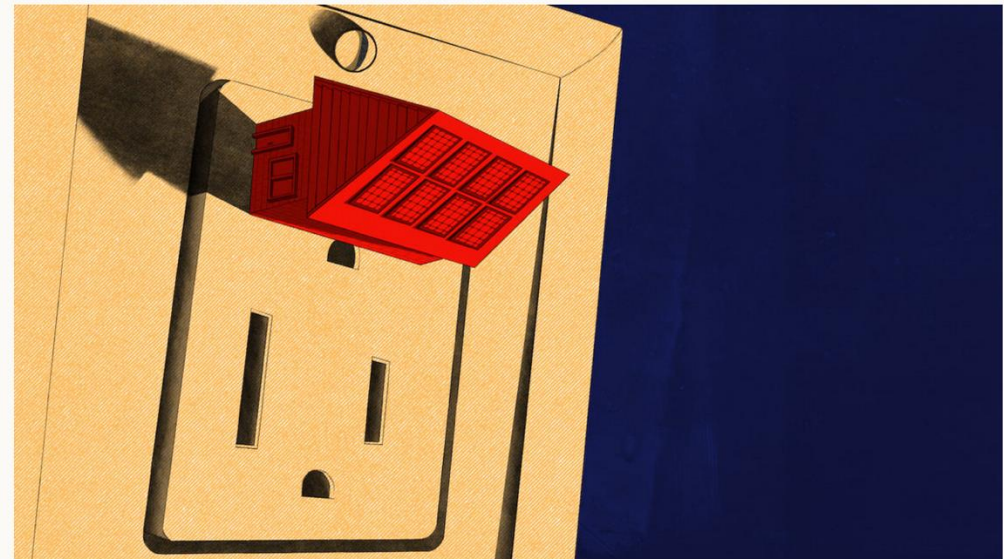


Things driving electricity demand

- Electrify Everything?
- Electric vehicles?
- New manufacturing?

YaleEnvironment360
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SAMAN SARHENG / YALE E360

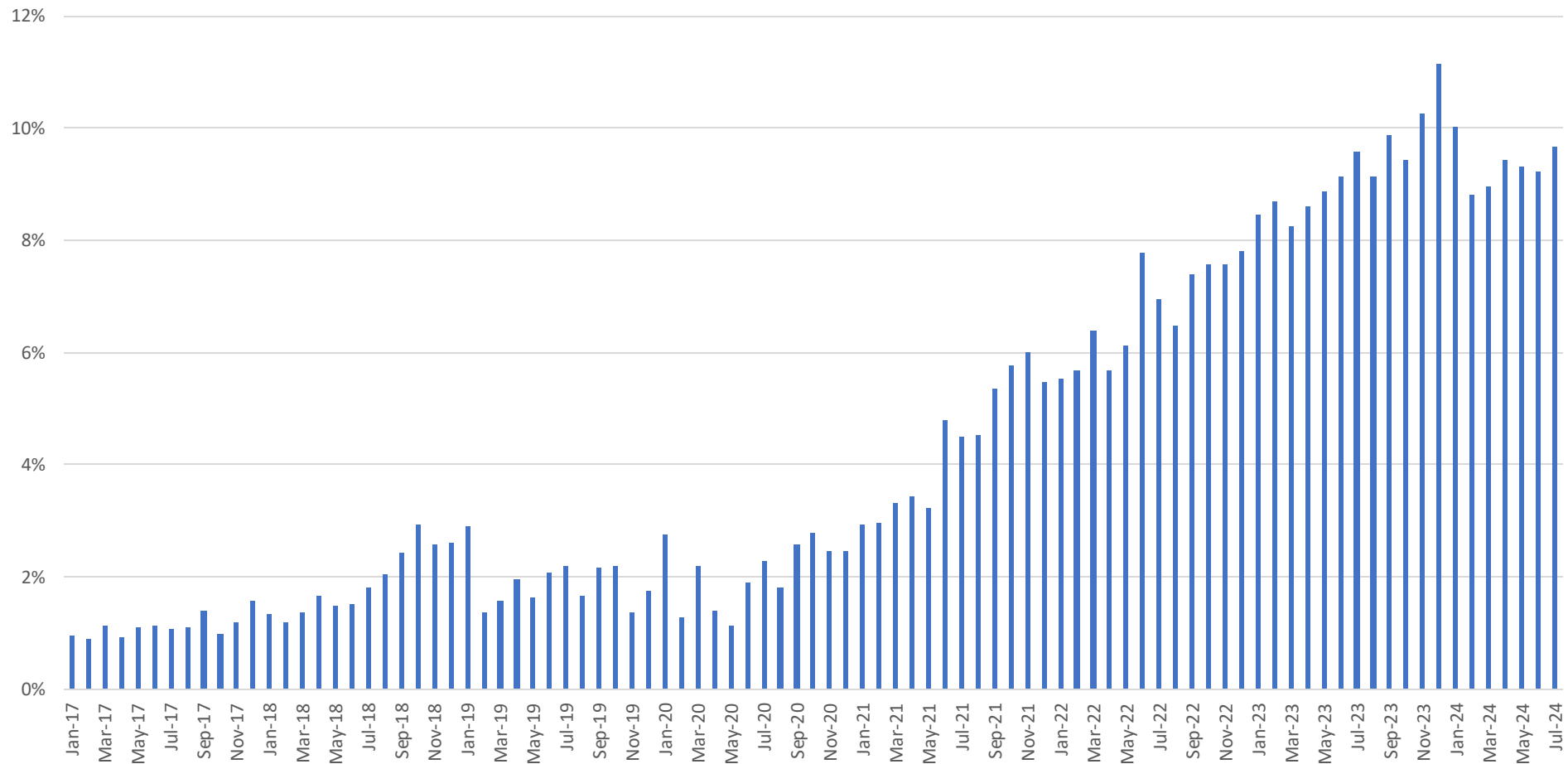
OPINION

From Homes to Cars, It's Now
Time to Electrify Everything

“Investment in American manufacturing is hitting a 50-year high, fueled by new federal tax breaks to lift microchip and clean-tech production. Since 2021, companies have announced plans to spend at least \$525 billion on factories for semiconductors, batteries, solar panels and more.”

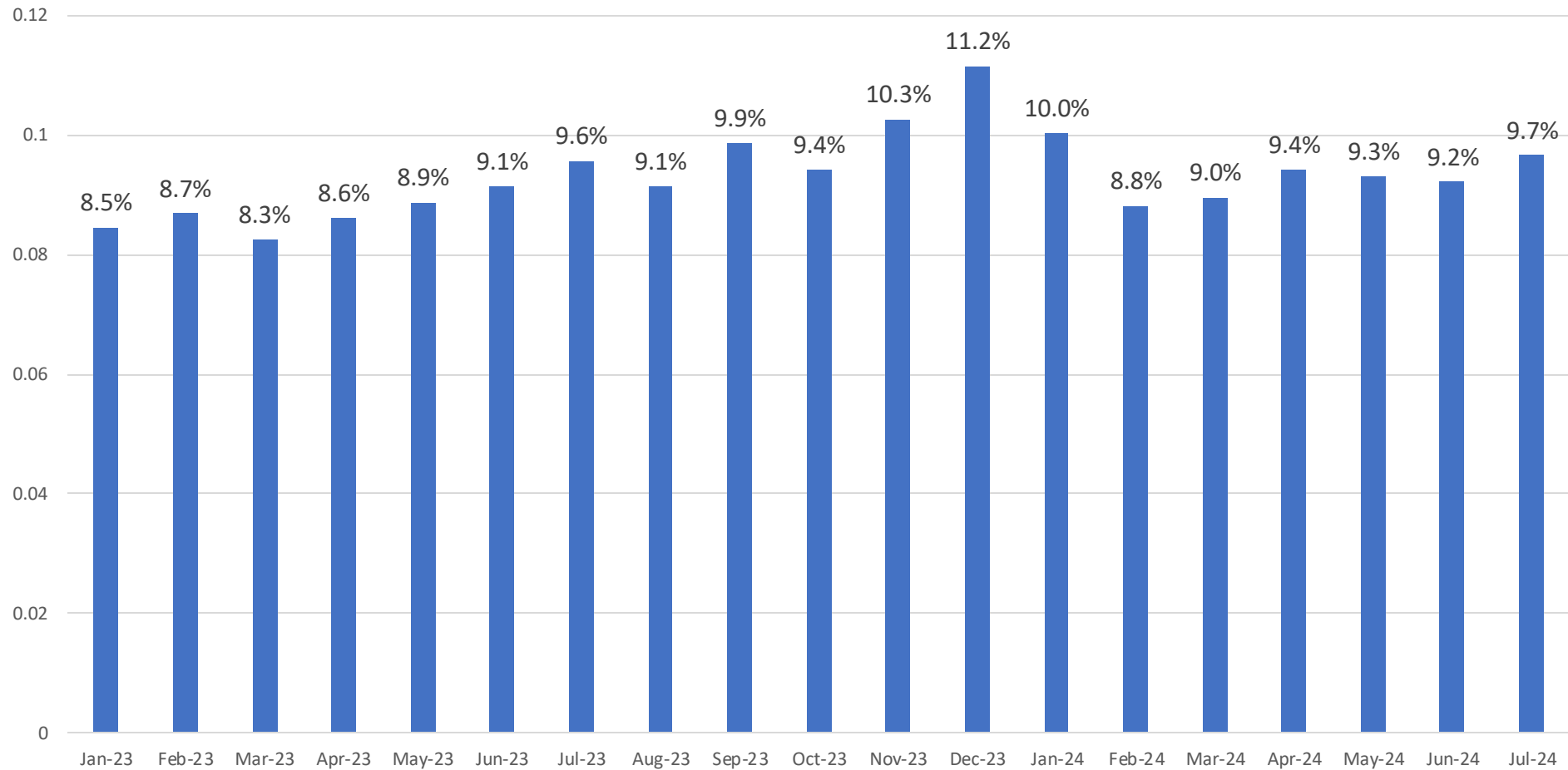
New York Times, A New Surge in Power Use Is Threatening U.S. Climate Goals, March 14, 2024

Percentage of sales of Battery Electric Vehicles and Plug-In Hybrids January 2017-July 2024

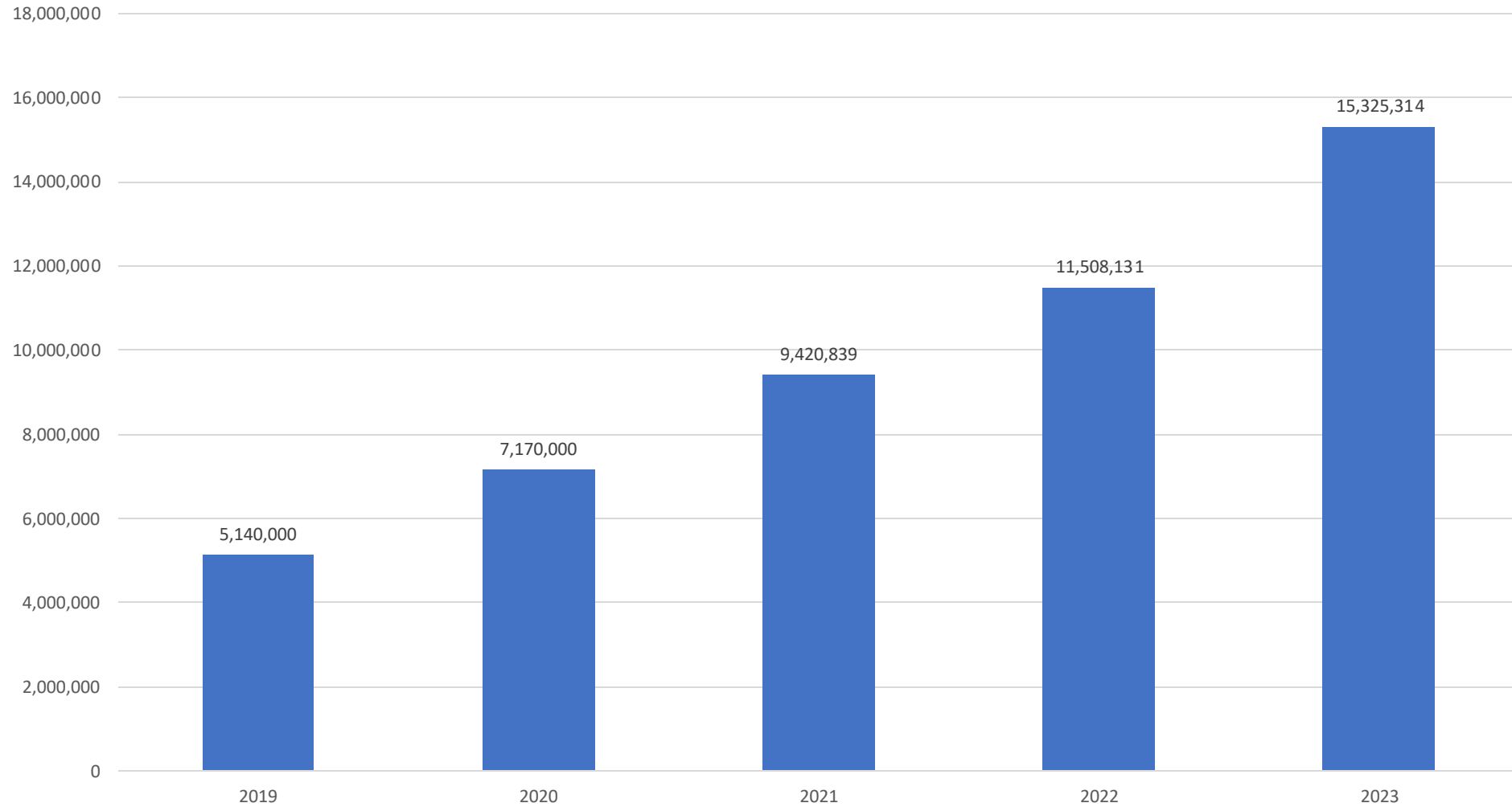


Source: Argonne National Laboratory, Light Duty Electric Drive Vehicles Monthly Sales Updates, <https://www.anl.gov/esia/light-duty-electric-drive-vehicles-monthly-sales-updates>

Percentage of sales of Battery Electric Vehicles and Plug-In Hybrids January 2023-July 2024



Meta's (Facebook) Total Electricity Consumption



Meta 2024 Sustainability Report, <https://sustainability.atmeta.com/wp-content/uploads/2024/08/Meta-2024-Sustainability-Report.pdf>

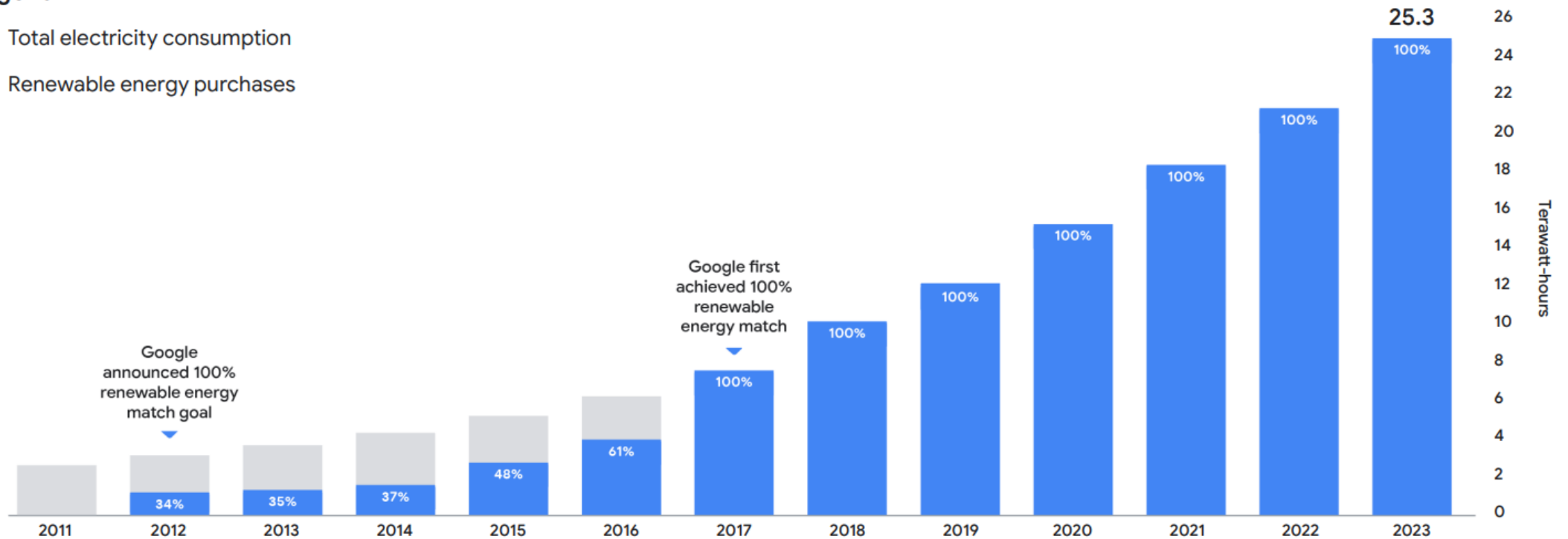
Google's electricity consumption

FIGURE 17

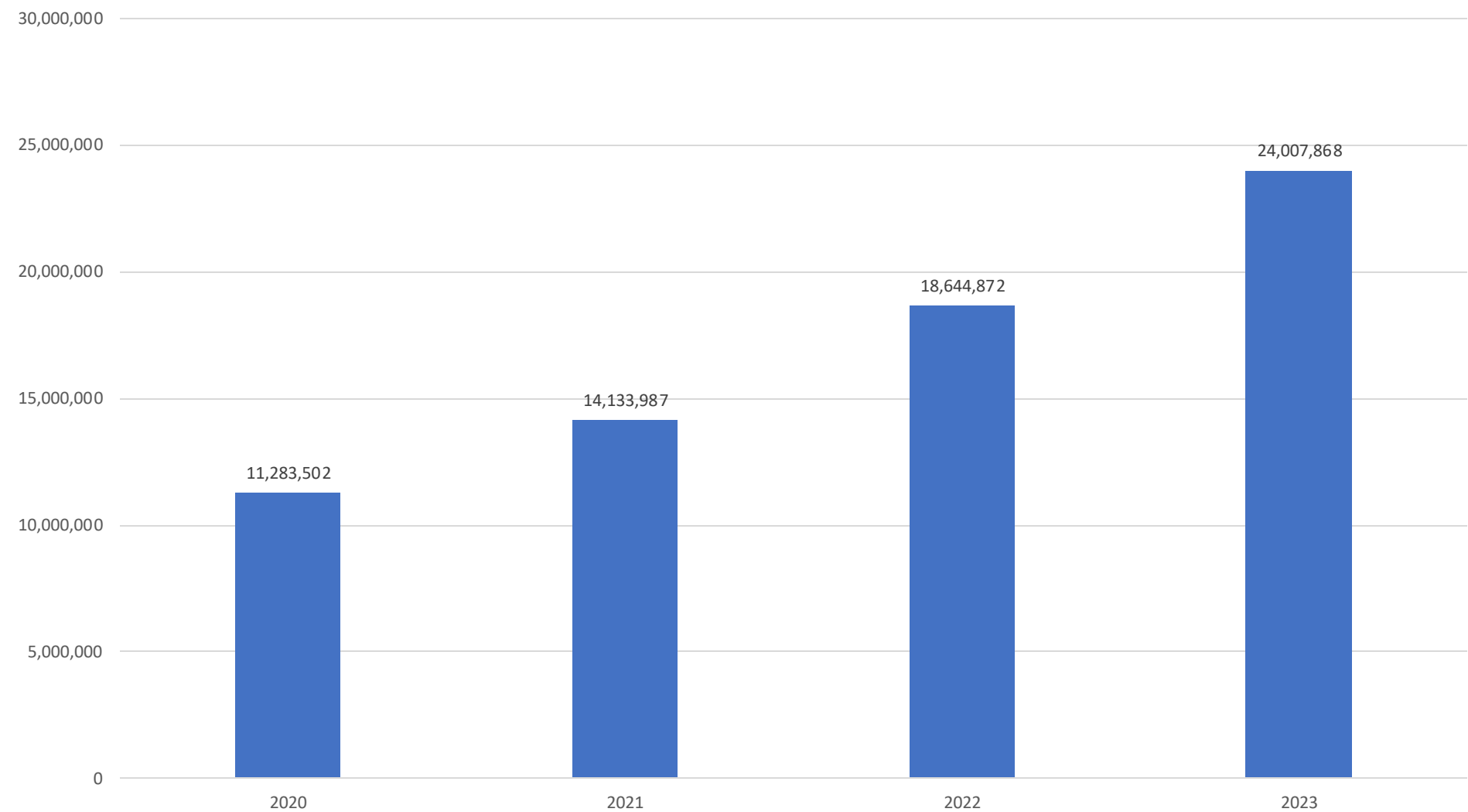
Renewable energy purchasing compared with total electricity

Legend

- Total electricity consumption
- Renewable energy purchases




Microsoft's Total Electricity Consumption



Source: Microsoft 2024 Environmental Sustainability Report: <https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RW1lmju>

ARTIFICIAL INTELLIGENCE

AI is poised to drive 160% increase in data center power demand

May 14, 2024 Share 

On average, a ChatGPT query needs nearly 10 times as much electricity to process as a Google search. In that difference lies a coming sea change in how the US, Europe, and the world at large will consume power — and how much that will cost.

DOE cites cost, reliability concerns for new gas plants as it details how to meet surging power demand

Rising electricity demand will require a portfolio of resources, including energy storage, hydropower, nuclear, grid-enhancing technologies and demand-side management, DOE said.

Published April 18, 2024



Robert Walton
Senior Reporter



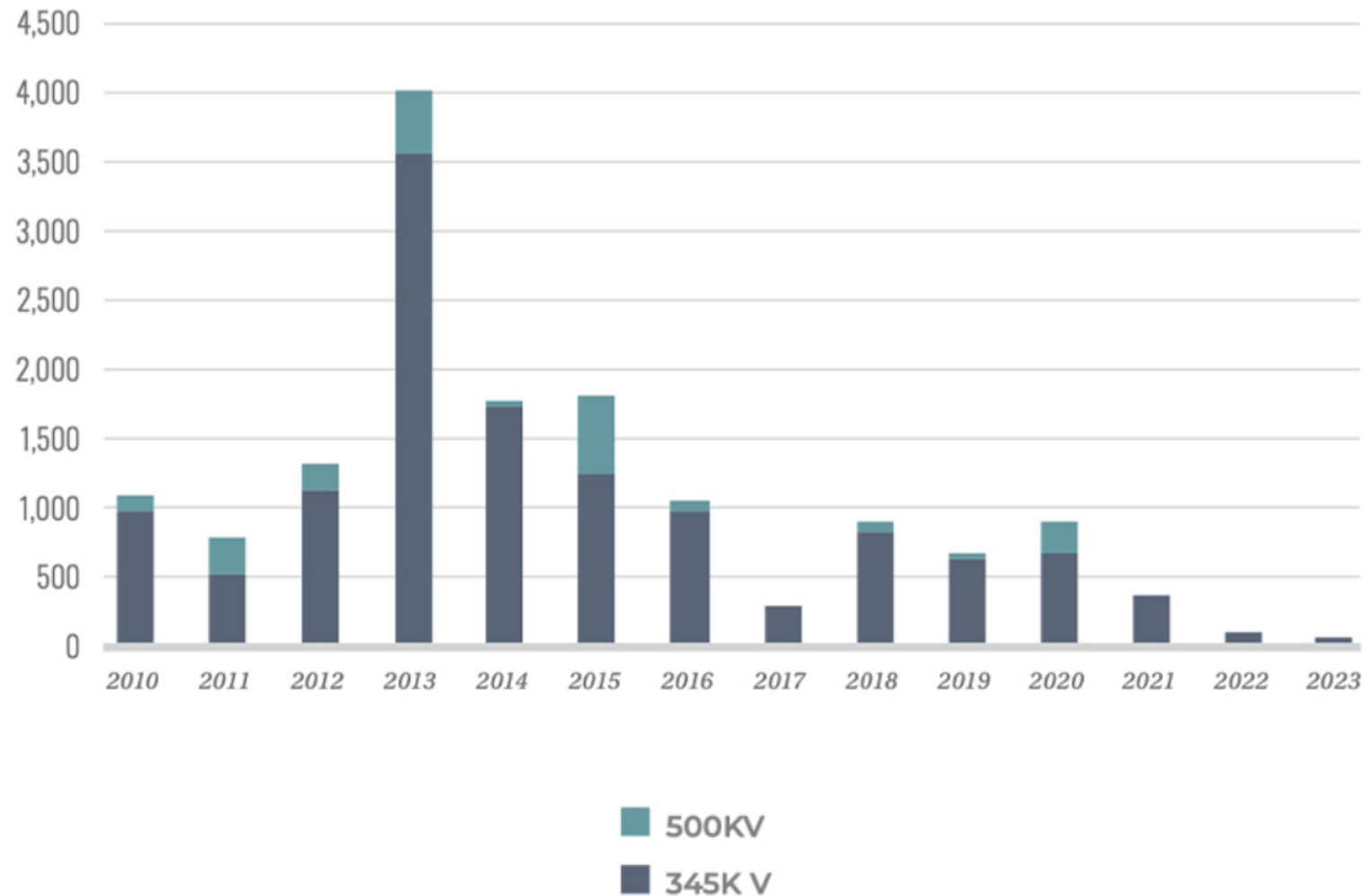
A slate of clean energy resources will be needed to meet growing U.S. electricity demand, including energy storage, hydropower, nuclear, geothermal, grid enhancing technologies and demand-side resources, according to a Department of Energy report.

Courtesy of Hyundai Motor Group.

- The rise of artificial intelligence is poised to accelerate that trend: By 2030, electricity demand at U.S. data centers could triple, using as much power as 40 million homes, according to Boston Consulting Group.
- PJM Interconnection, which oversees the nation's largest regional grid, stretching from Illinois to New Jersey, is now expecting an additional 10,000 megawatts of demand by 2030 that wasn't forecast last year. That's akin to adding another New York City to the system.

Source: <https://www.utilitydive.com/news/DOE-future-resource-adequacy-electricity-demand-growth/713561/>
<https://www.nytimes.com/interactive/2024/03/13/climate/electric-power-climate-change.html>

MILES OF 345 KV+ TRANSMISSION LINES ADDED EACH YEAR



A graph from ACEG's report showing total transmission lines added to the grid by year. | ACEG

Source: Americans for a Clean Energy Grid, <https://www.rtoinsider.com/84266-electric-industry-added-55-miles-transmission-2023/#:~:text=The%20U.S.%20electricity%20industry%20added%20just%2055%20miles,Grid%20said%20in%20a%20report%20released%20July%2030.>

Tribes, environmental groups sue federal court to block \$10B energy transmission project in Arizona



ENVIRONMENTAL LAW & POLICY CENTER

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PRESS RELEASE

January 18, 2022

Federal District Court Stops Cardinal-Hickory Creek Transmission Line Running Through Upper Mississippi River National Wildlife and Fish Refuge

1 of 3 | This aerial photo taken on Nov. 13, 2023, by Archaeology Southwest with a volunteer pilot and Lighthawk, a nonprofit pad sites west of the San Pedro River, near Redrock Canyon, in Arizona. The image was included in a lawsuit filed Jan. 17, 2024.

CLIMATEWIRE

Maine transmission line is stalled despite court victories

By Benjamin Storrow | 04/27/2023 06:38 AM EDT

Legal fights and permitting problems have delayed a project that is supposed to help New England lower its emissions. It might mark a national trend.

ENERGYWIRE

What's next after legal win for contentious Midwest power line

By Jeffrey Tomich | 08/03/2023 06:38 AM EDT

The Cardinal-Hickory Creek project has become a flashpoint in the debate over high-voltage transmission lines.

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Fight across state over transmission towers for reliable energy



The federal government is looking to address the need to increase the regional capacity of electrical transmission corridors (NIETCs). One proposed route is the Midwest-Plains corridor, which runs through Missouri, Illinois and a portion of Indiana.

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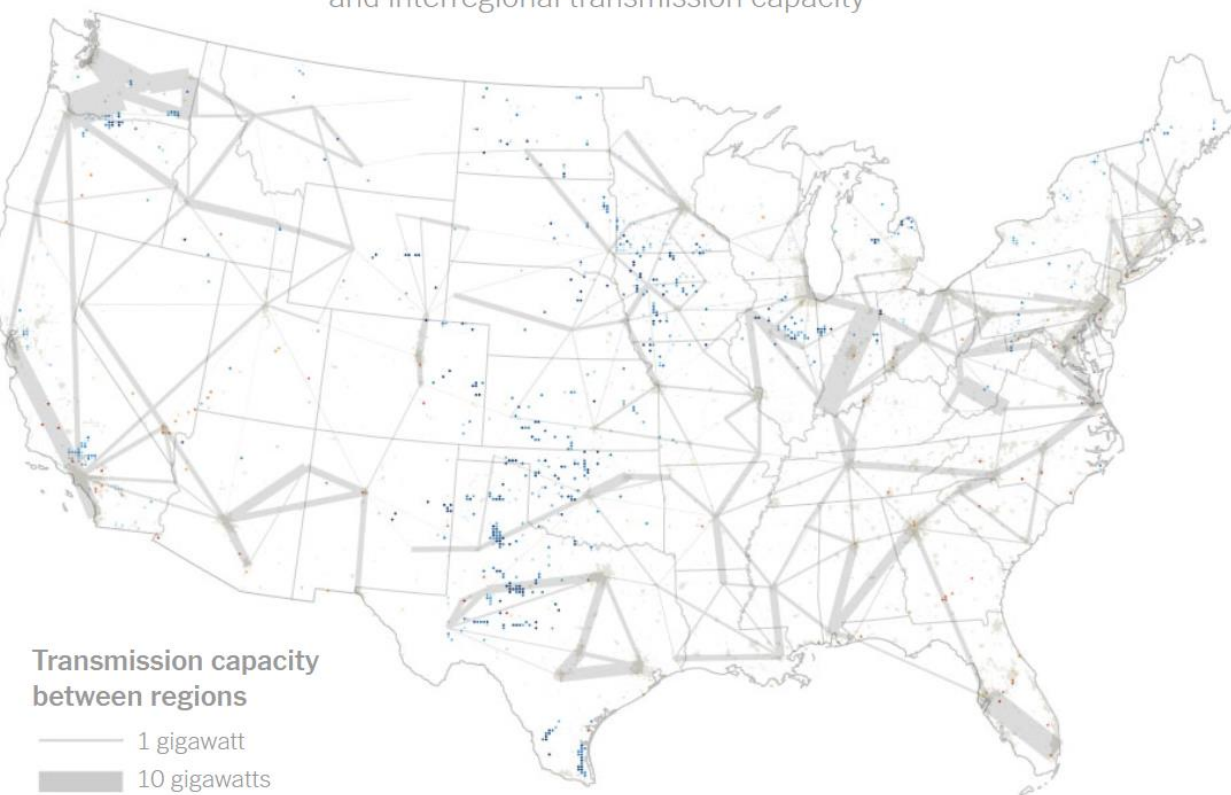


A portion of the Cardinal-Hickory Creek transmission line is pictured. American Transmission Co.

Why the U.S. Electric Grid Isn't Ready for the Energy Transition

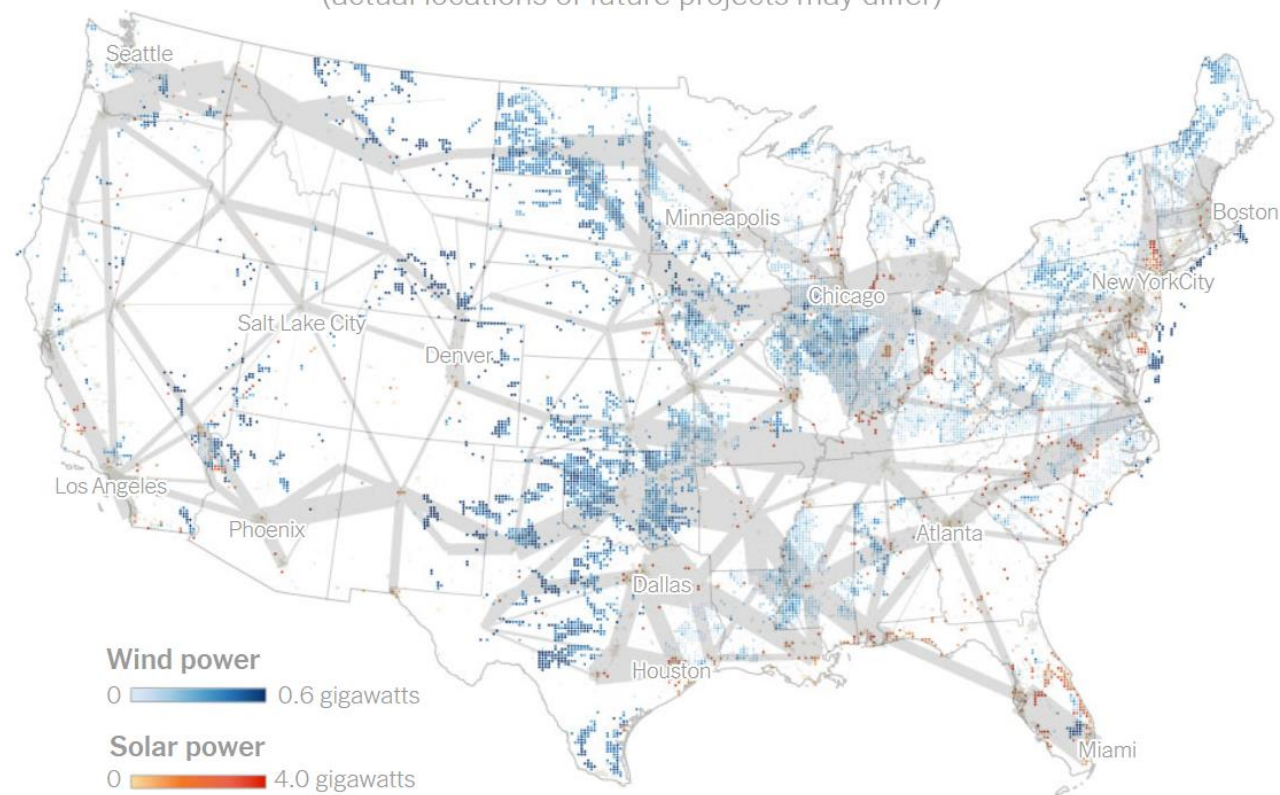
2020

Current large-scale renewable energy projects and interregional transmission capacity



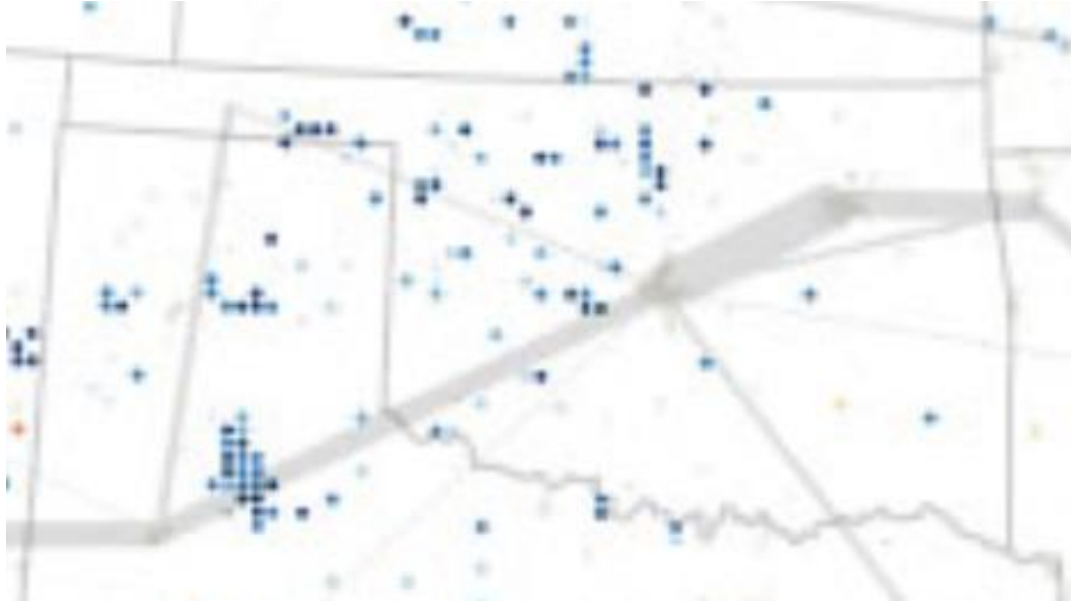
2035

Estimated need for reaching 100 percent clean power (actual locations of future projects may differ)



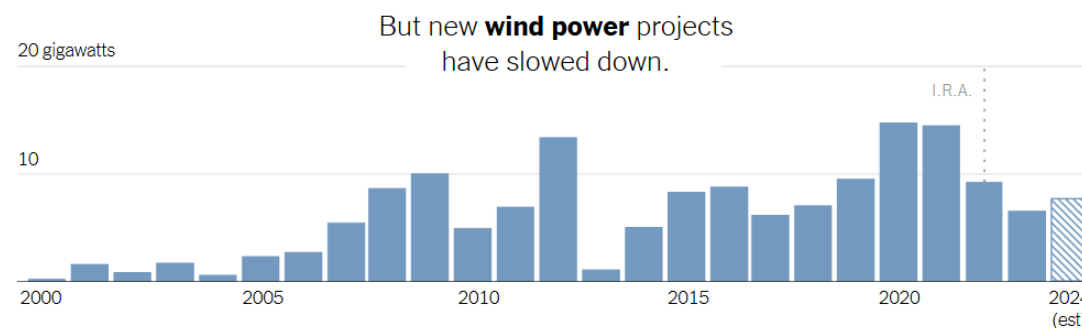
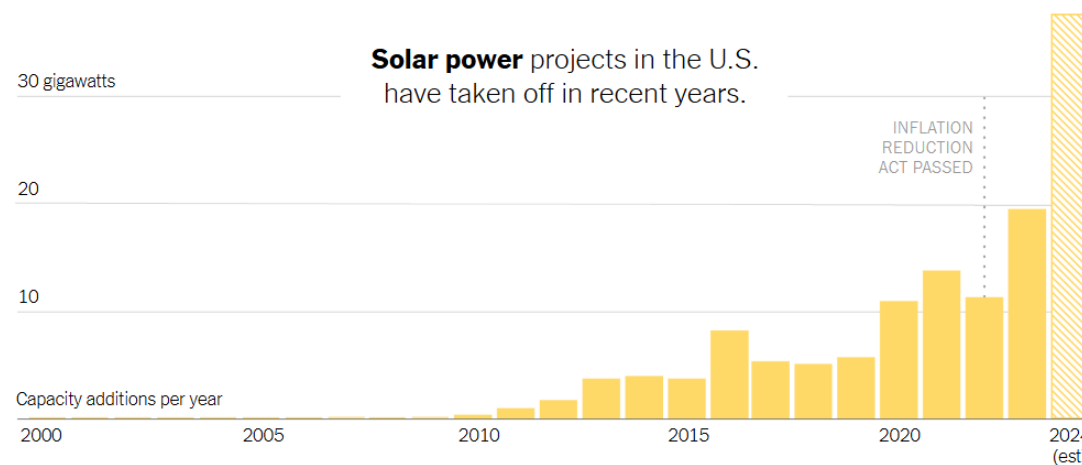
Source: National Renewable Energy Laboratory | The 2035 map is based on the “All Options” path from NREL’s [100% Clean Electricity by 2035 Study](#). Both maps show utility-scale renewable projects, but do not include distributed installations, like rooftop solar.

Oklahoma renewable projects and transmission capacity 2020 vs. 2035



As Solar Power Surges, U.S. Wind Is in Trouble

By Brad Plumer and Nadja Popovich June 4, 2024



Source: U.S. Energy Information Administration - Notes: Annual utility-scale power capacity additions are shown. Estimates for 2024 include projects scheduled to come online this year.

Residential electricity rates up 27% since Biden took office

DIVE BRIEF

US electricity prices outpace annual inflation

Analysts cited transmission costs and federal policies for the 3.6% increase the Bureau of Labor Statistics reported Tuesday.

Published March 13, 2024



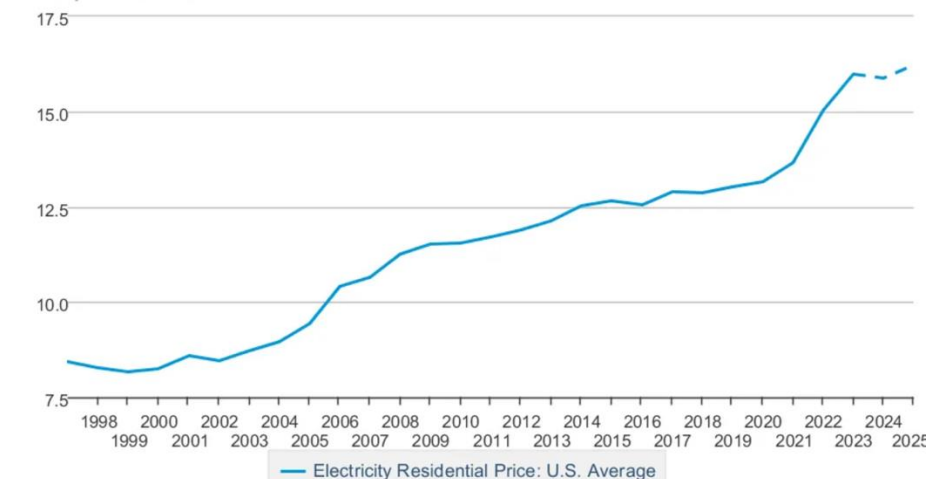
Robert Walton
Senior Reporter



Average U.S. residential customers will pay about 16.23 cents/kWh in 2025, the U.S. Energy Information Administration predicted on Wednesday. That would be the highest level across almost three decades. *Maudib via Getty Images*

Electricity Residential Price: U.S. Average

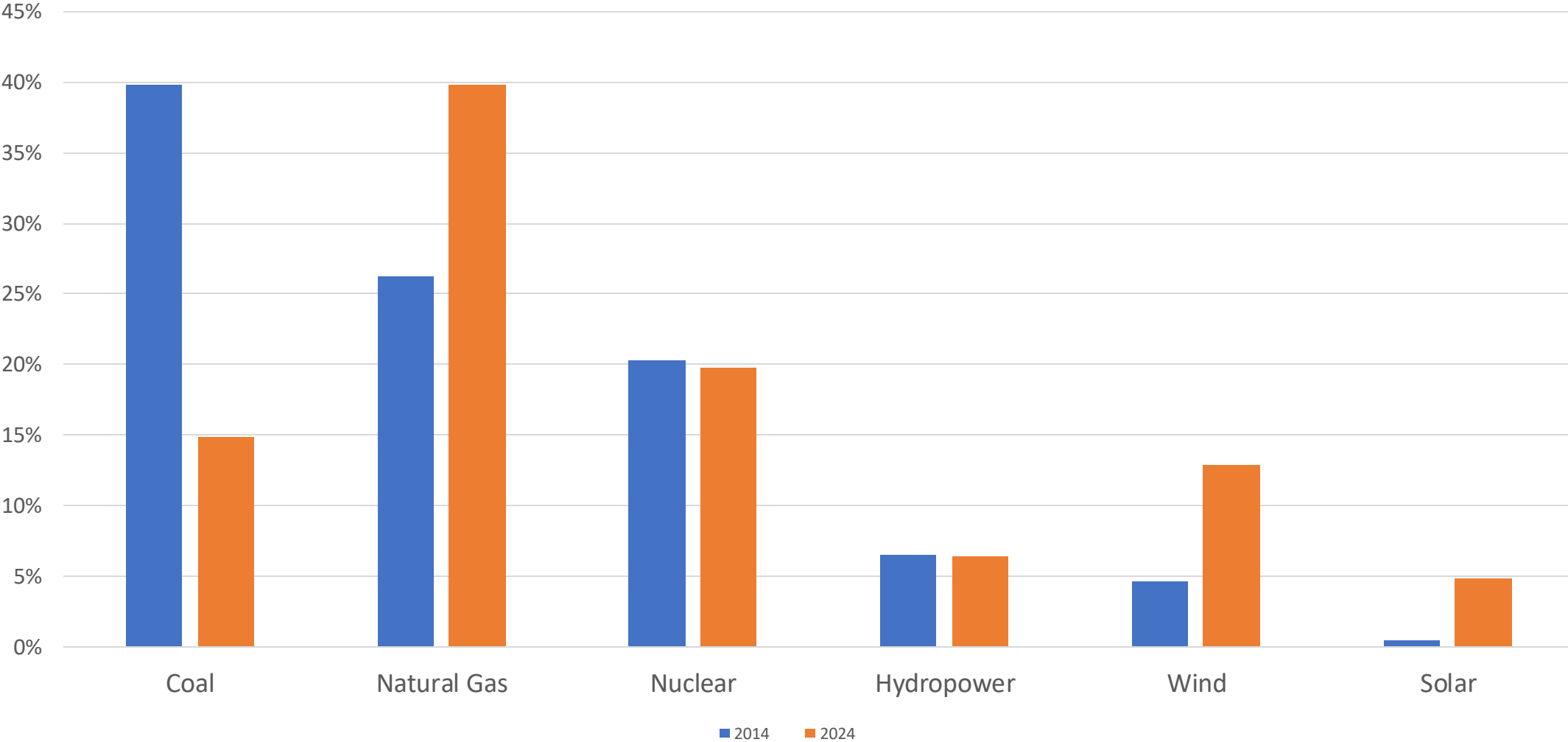
cents per kilowatthour



Data source: U.S. Energy Information Administration

Source: <https://www.instituteeforenergyresearch.org/the-grid/will-electric-rates-become-the-new-gas-price/>
https://www.eia.gov/totalenergy/data/monthly/pdf/sec9_11.pdf

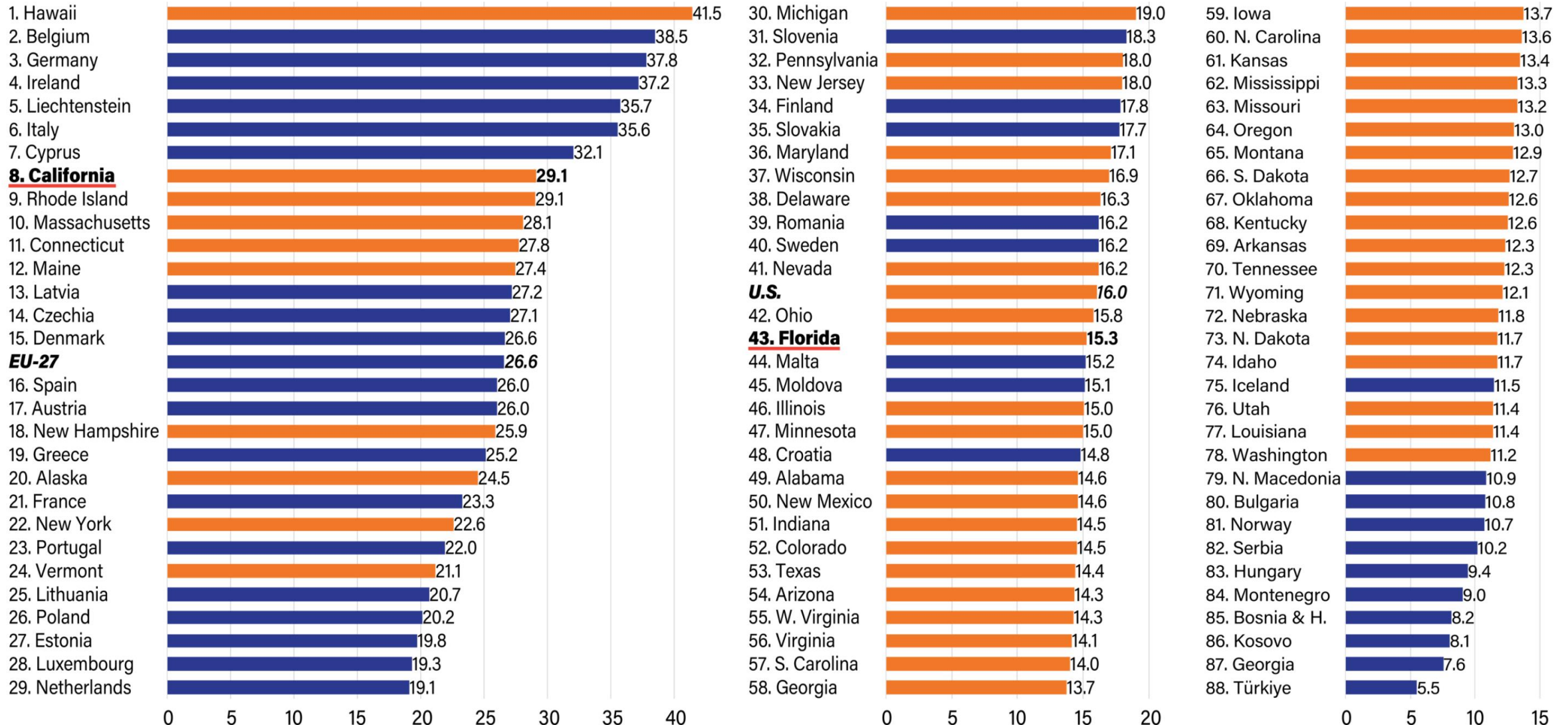
U.S. electricity generation by source 2014 vs. 2024



EIA, MER, Table 7.2b, https://www.eia.gov/totalenergy/data/monthly/pdf/sec7_6.pdf

Europe vs. U.S. States

Average Household Electricity Prices (cent/kWh) in Second Half of 2023



Note: The household electricity prices paid by ultimate customers exclude VAT and other recoverable taxes and levies. The EUR-USD exchange rate of 1.082 (average during the period) is applied.

Sources: EIA, Eurostat, ECB, Energy Policy Research

Takeaways

- For the first time in 20 years, electricity demand is increasing
 - Building new transmission/generation is a challenge
 - AI is consuming huge amounts of electricity, but other factors can drive electricity demand too
 - Electricity rates are already up 27% since 2020
 - The backdrop of Biden-Harris net zero by 2035
-
- Daniel.Simmons@gmail.com