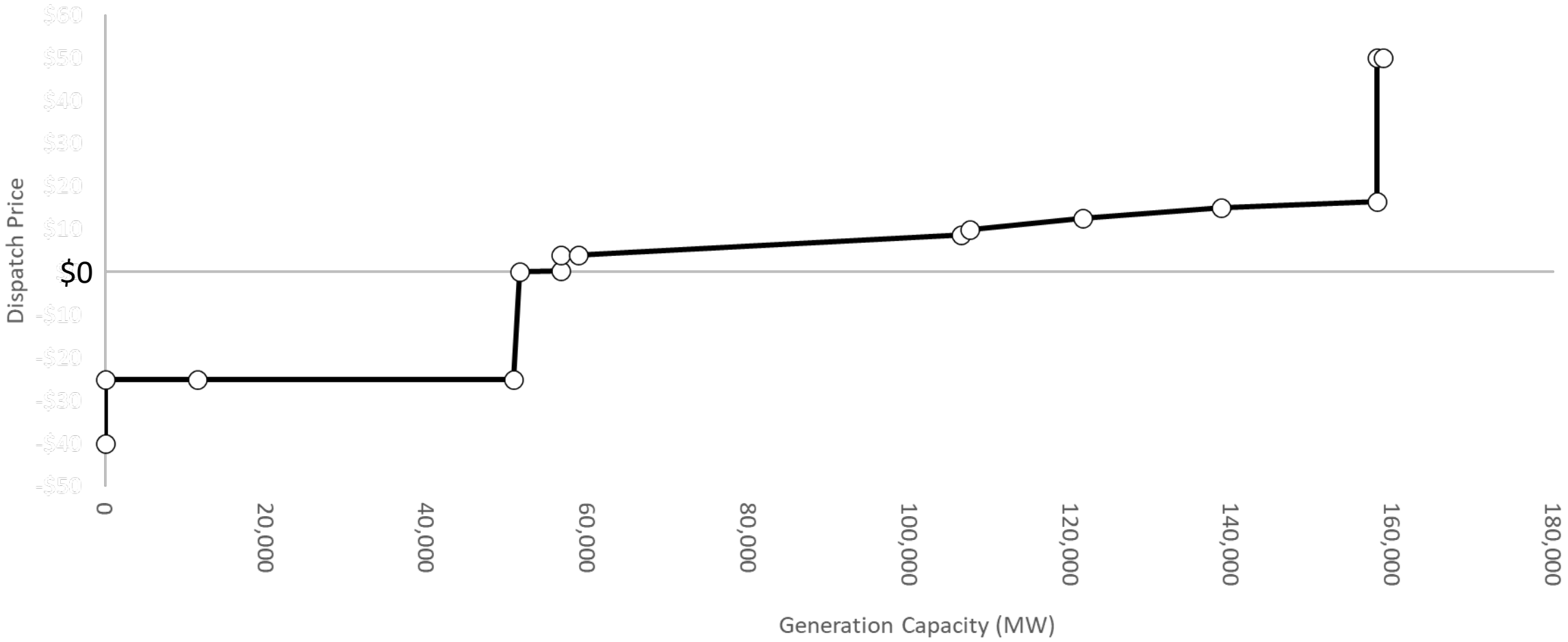
TEA
THE EnergyAuthority®

WHAT'S SHAPING THE FUTURE OF NATURAL GAS PRICING?

WITH A BRIEF FORAY INTO RENEWABLES

WHY IS NATURAL GAS IMPORTANT?

The merit order



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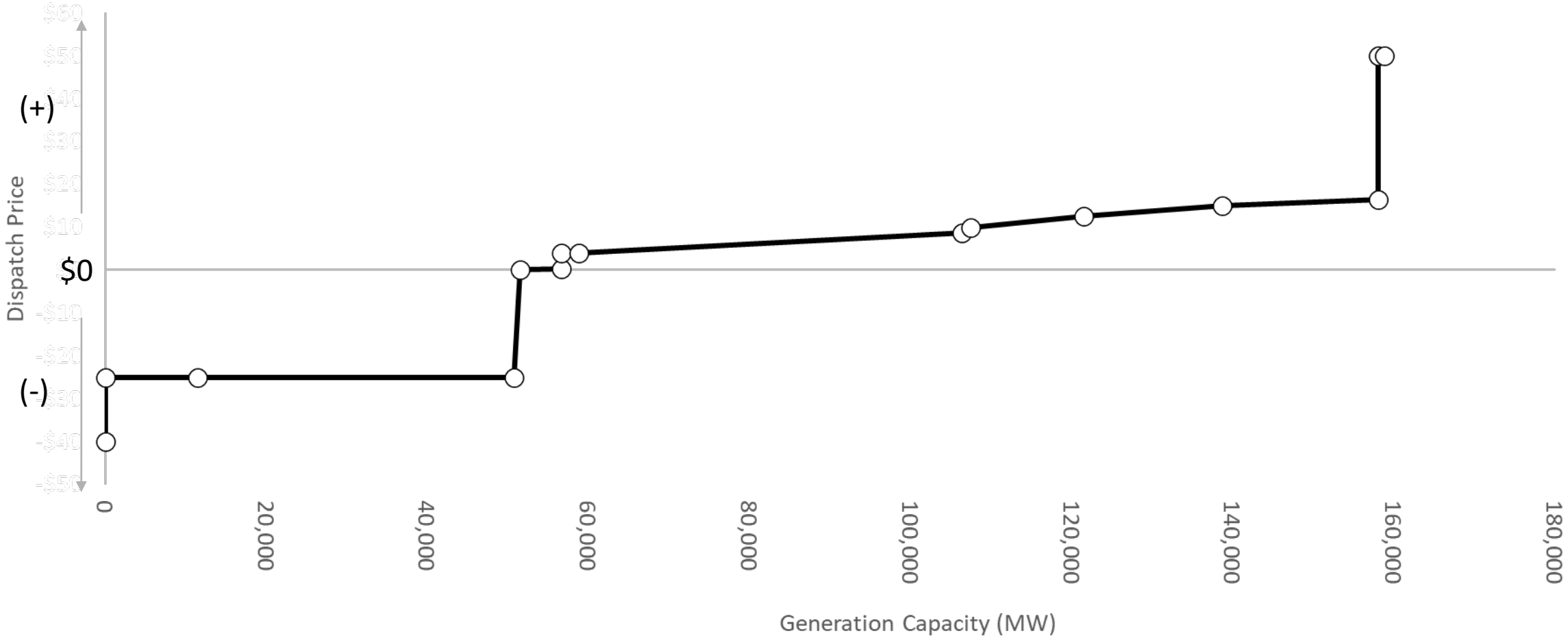

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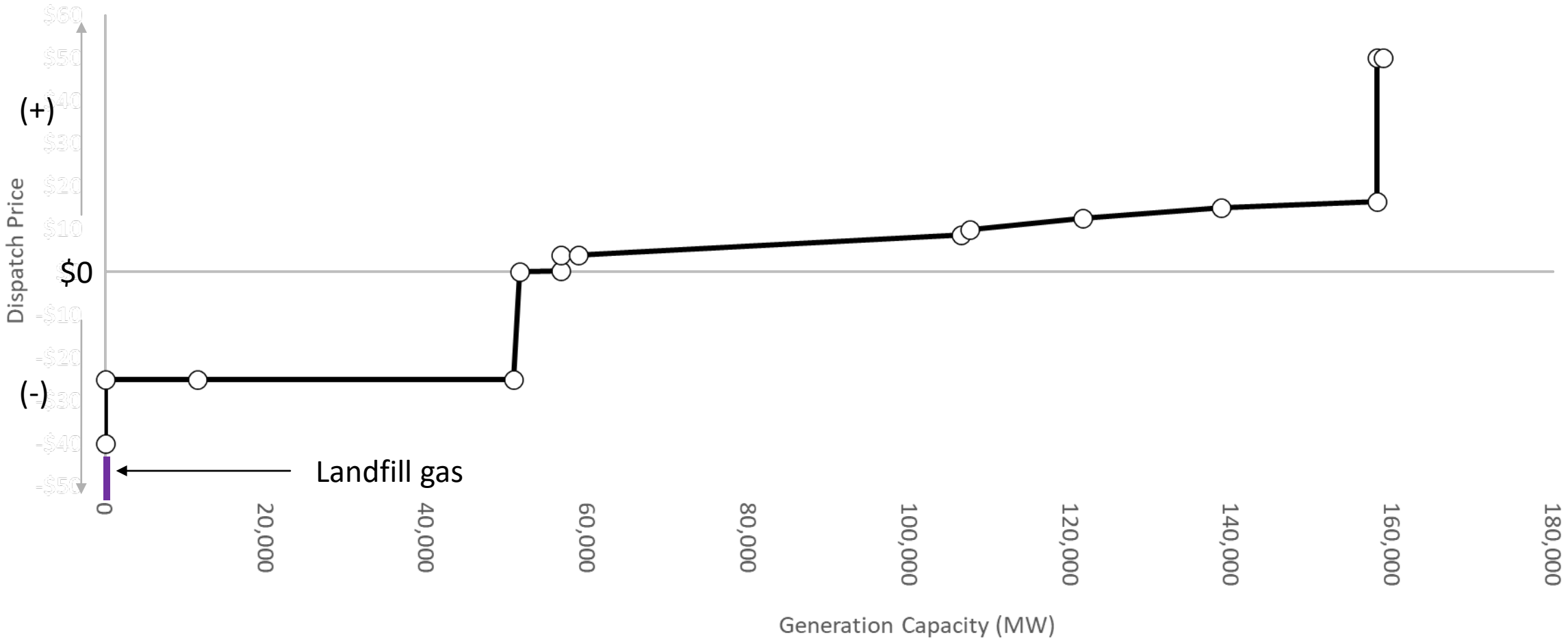

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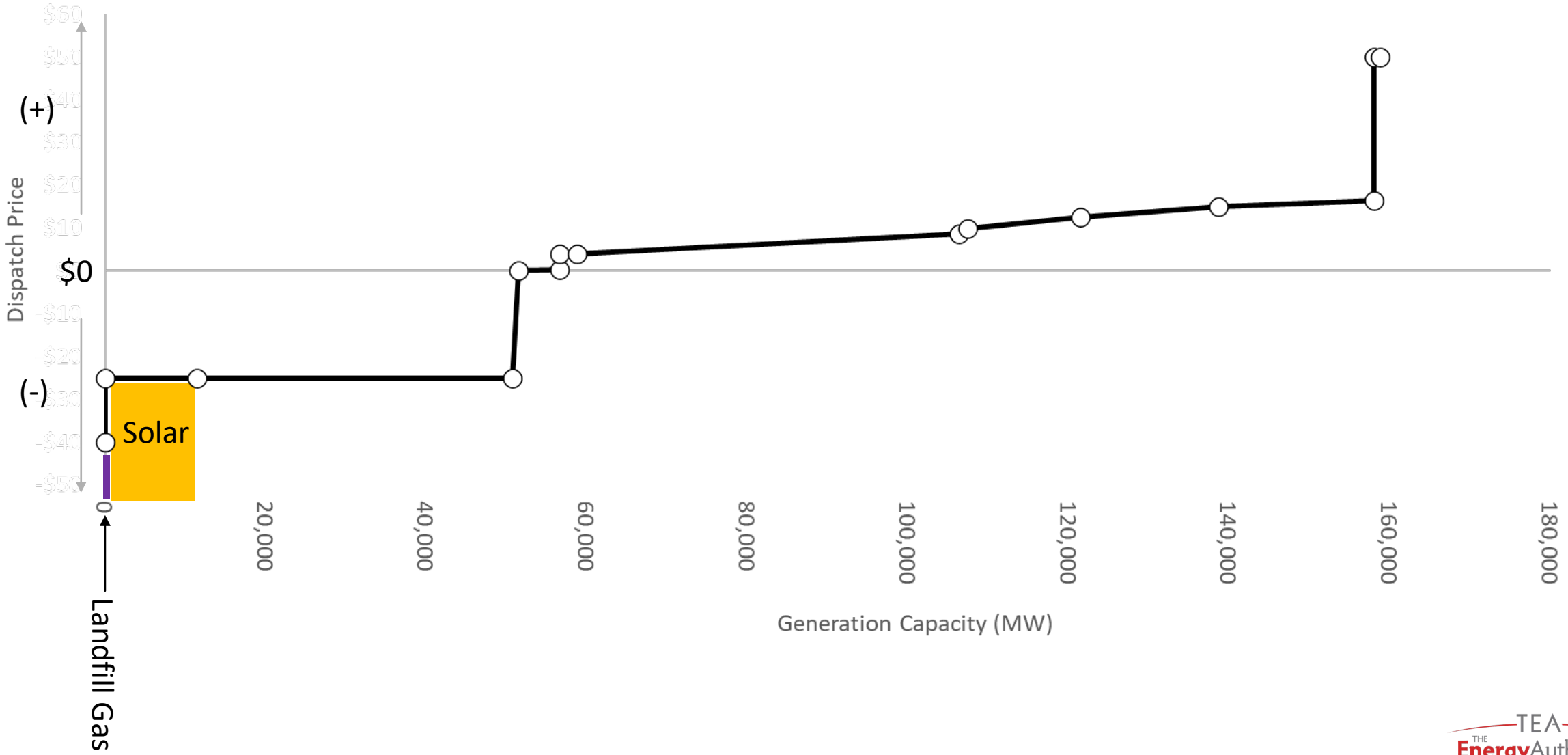

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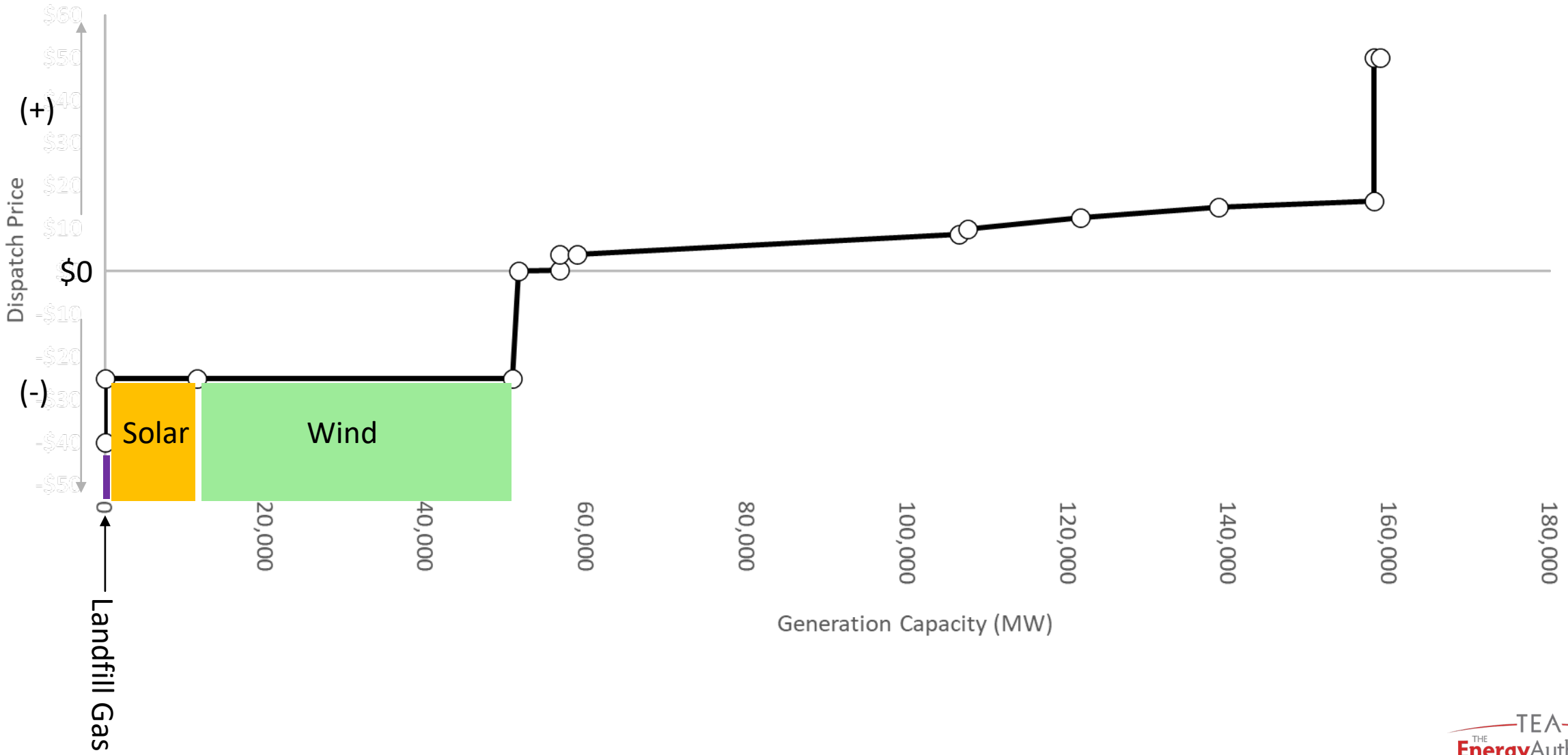

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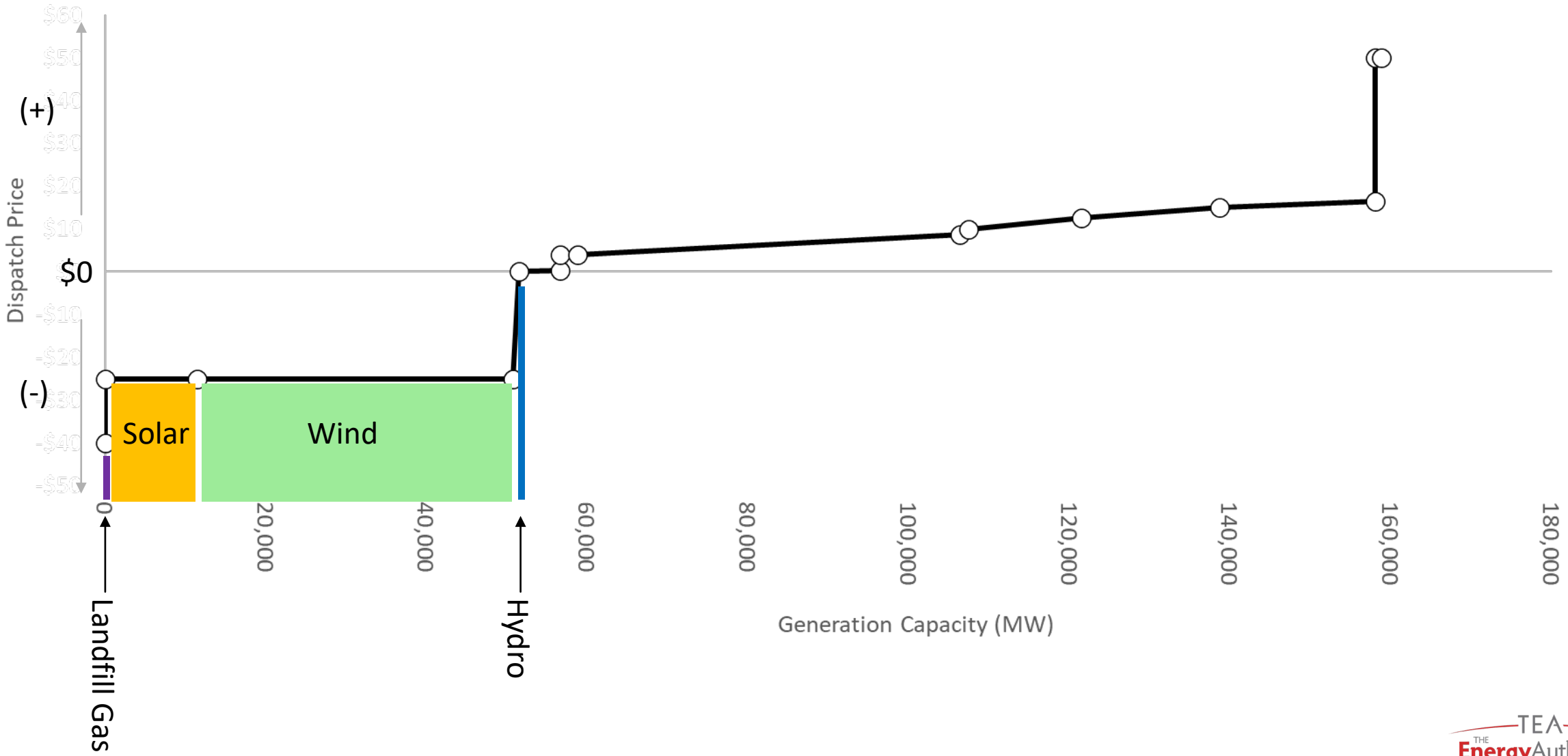

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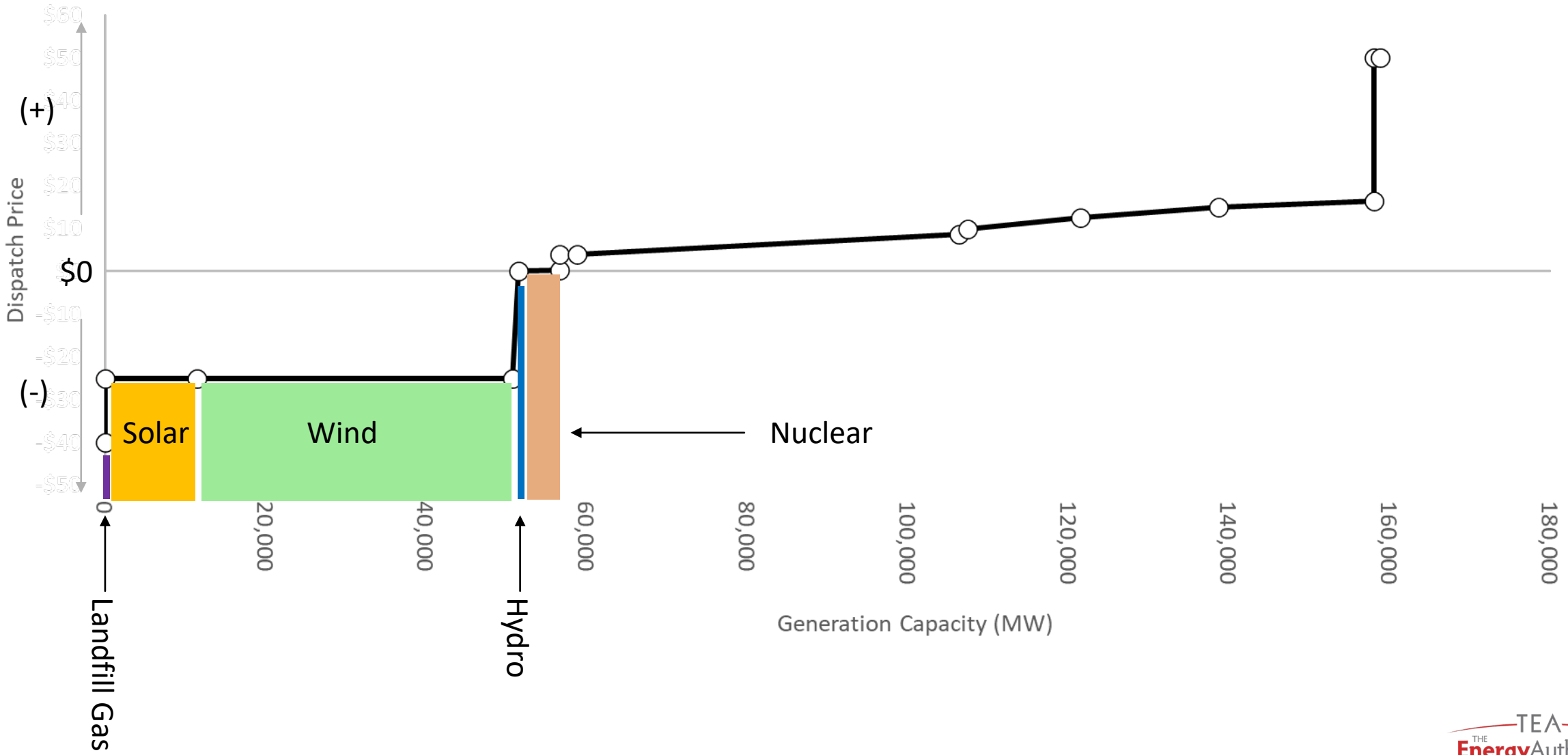

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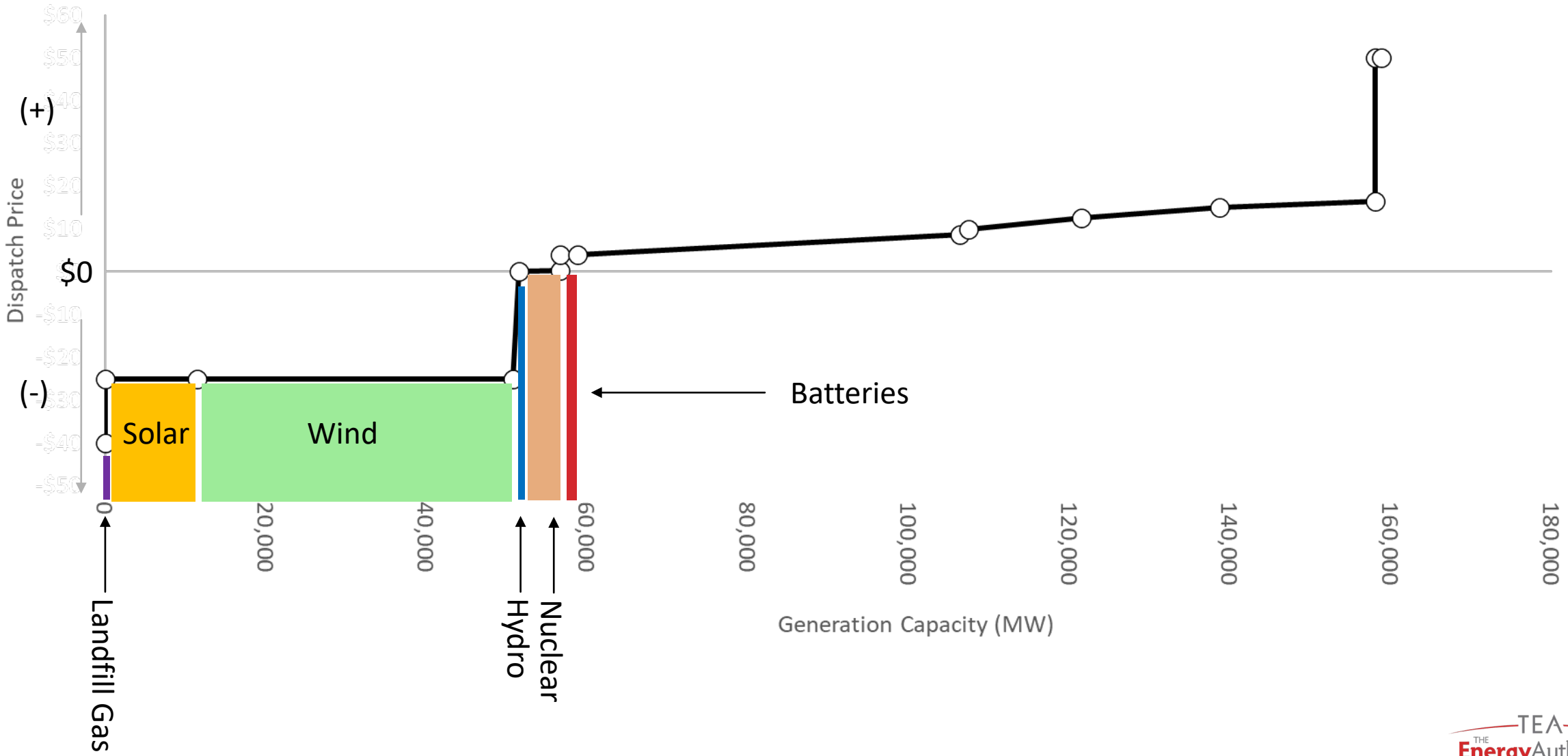

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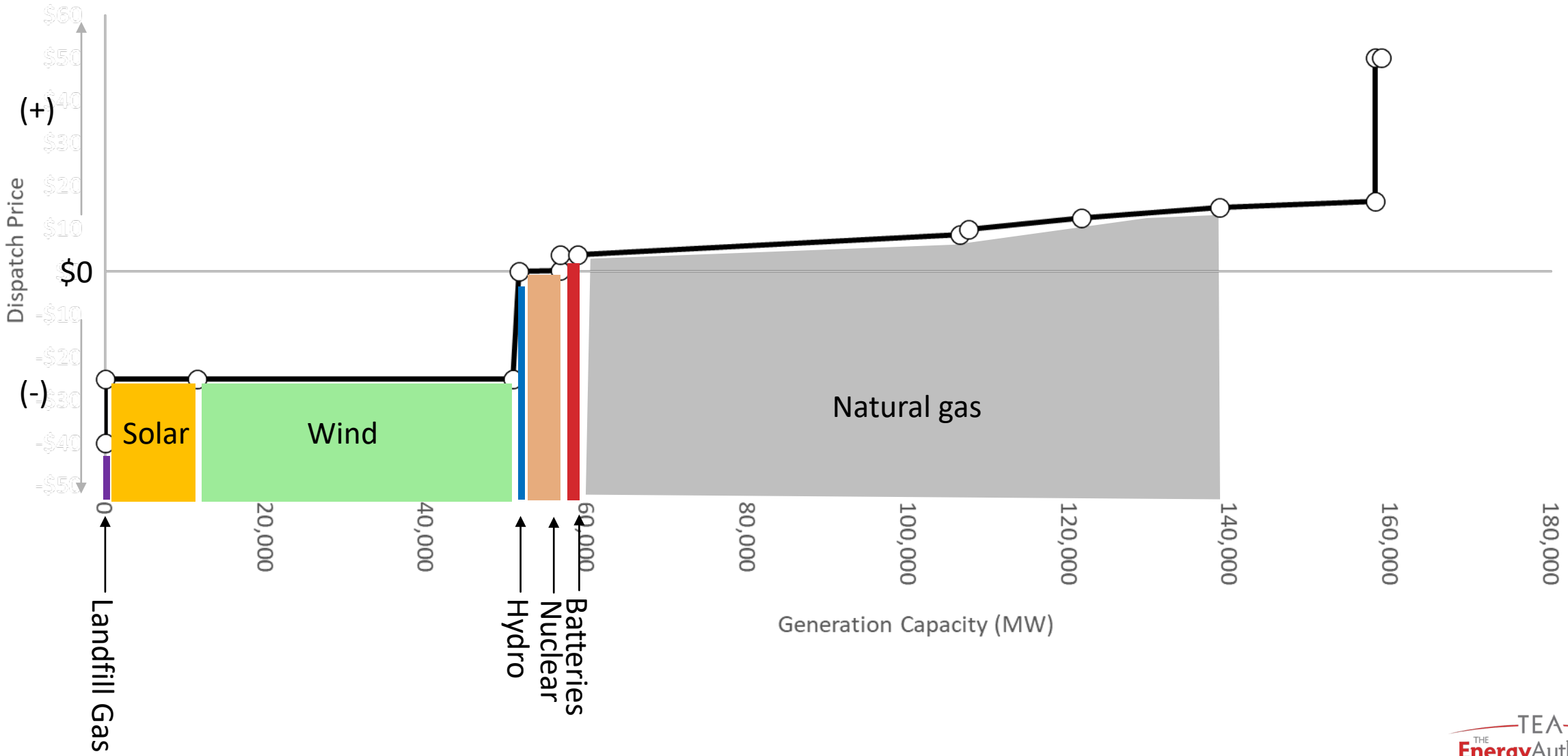

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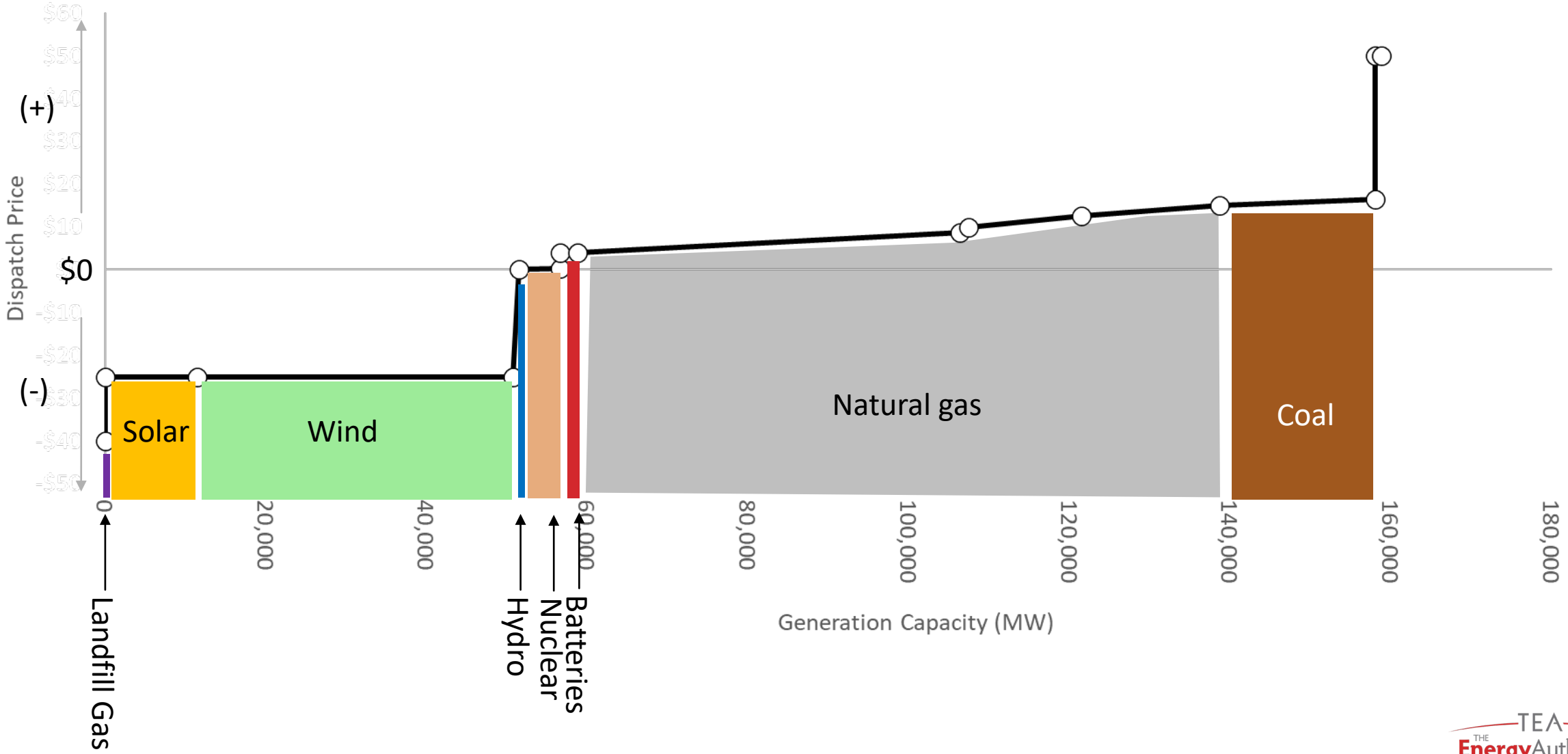

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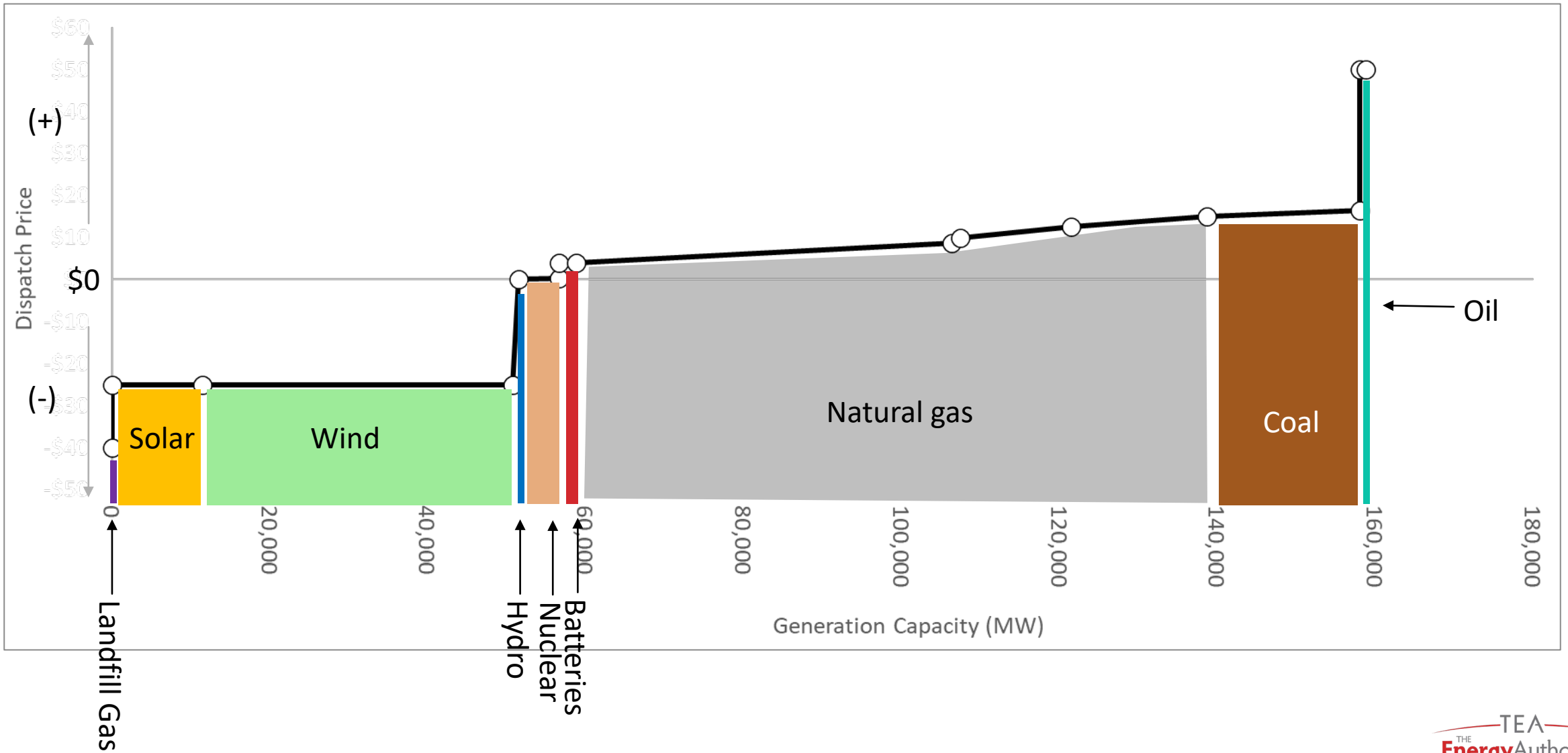

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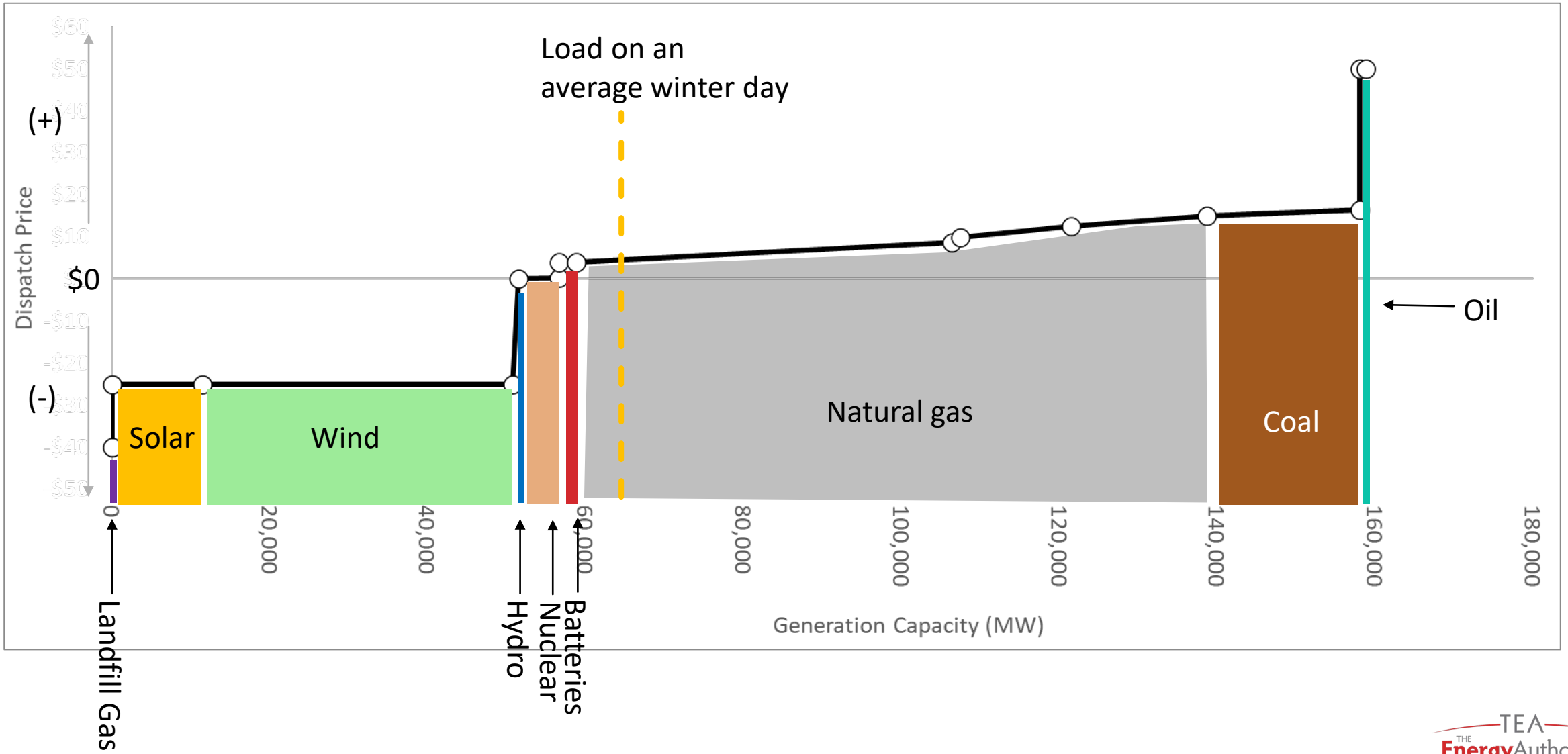

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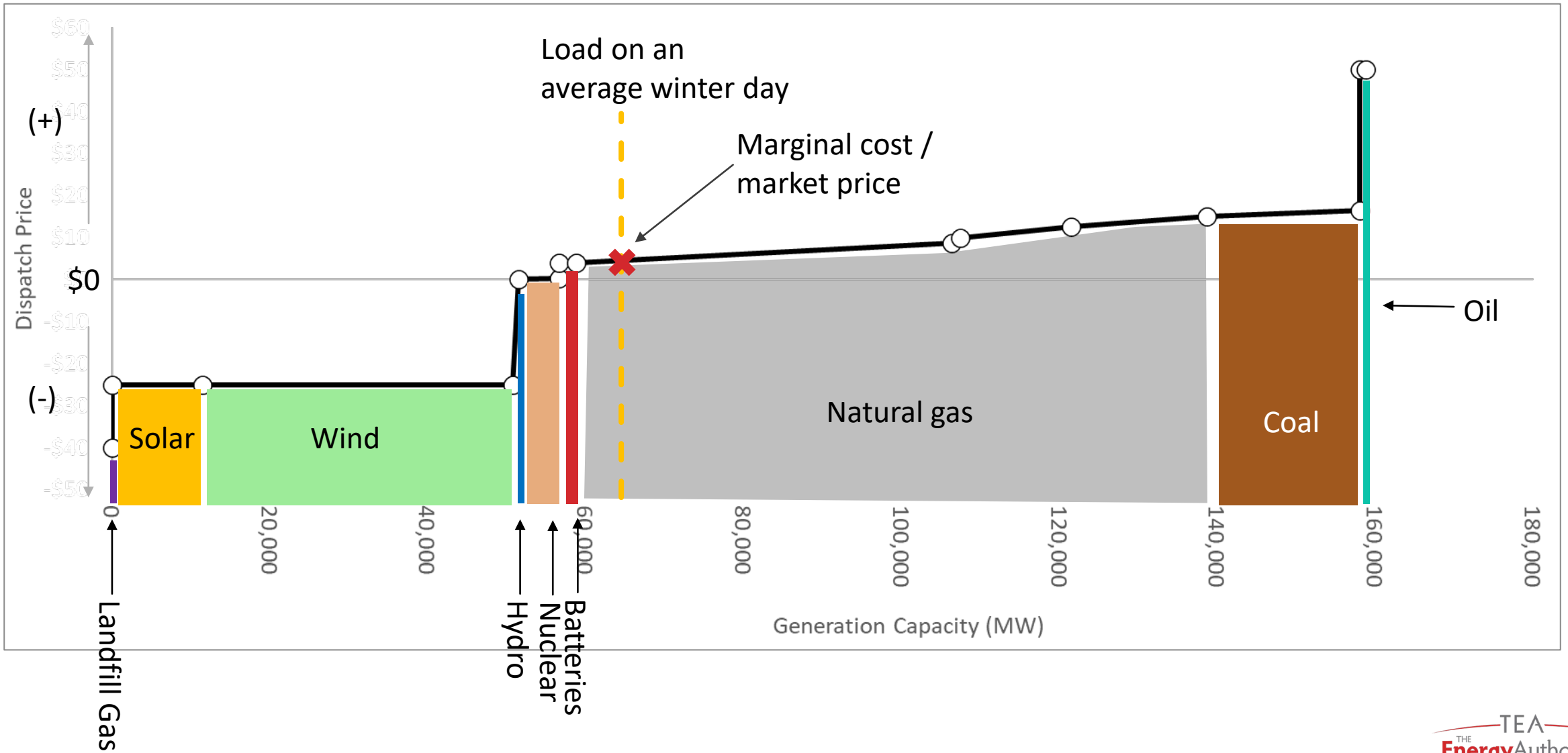
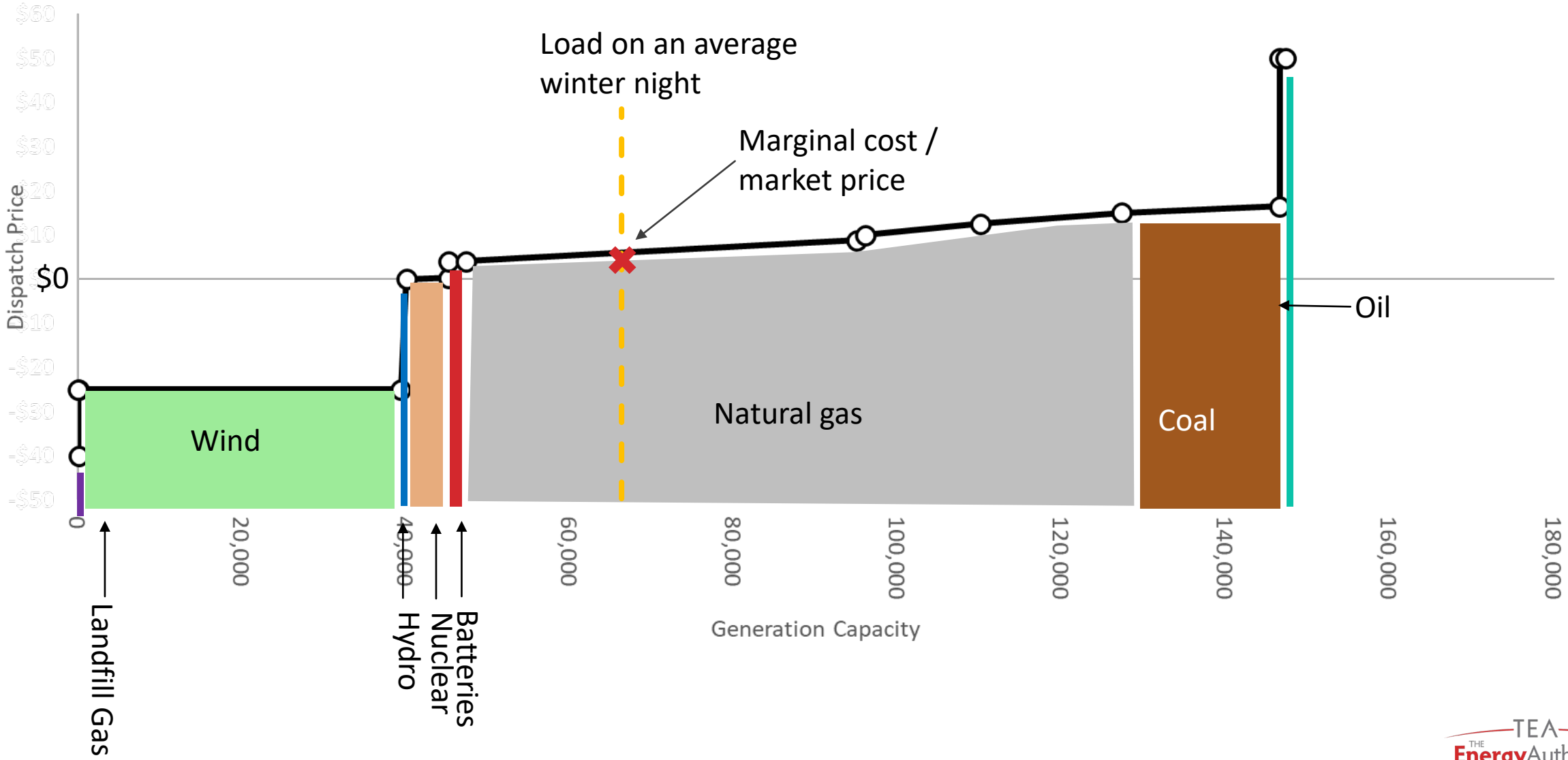
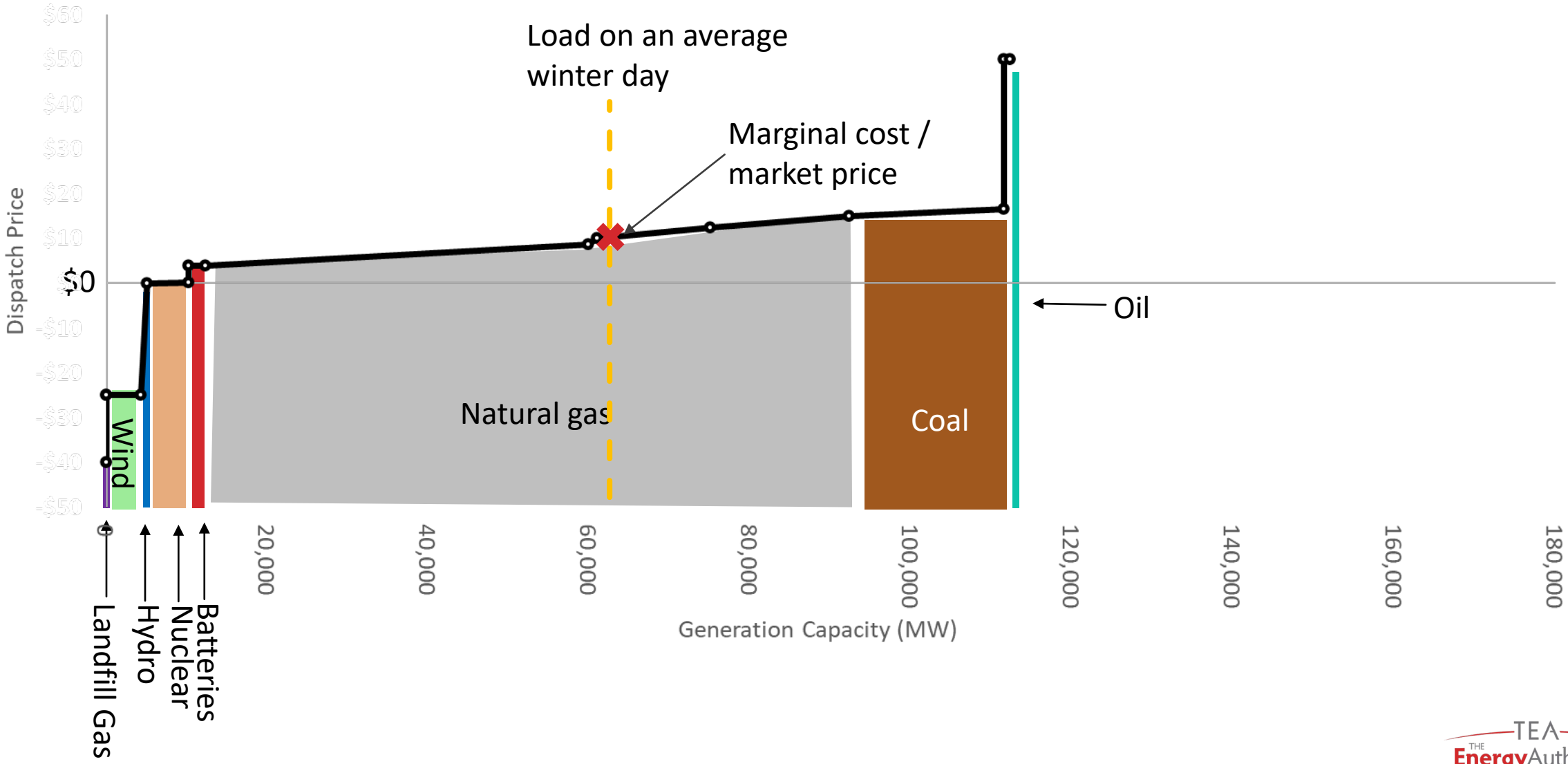


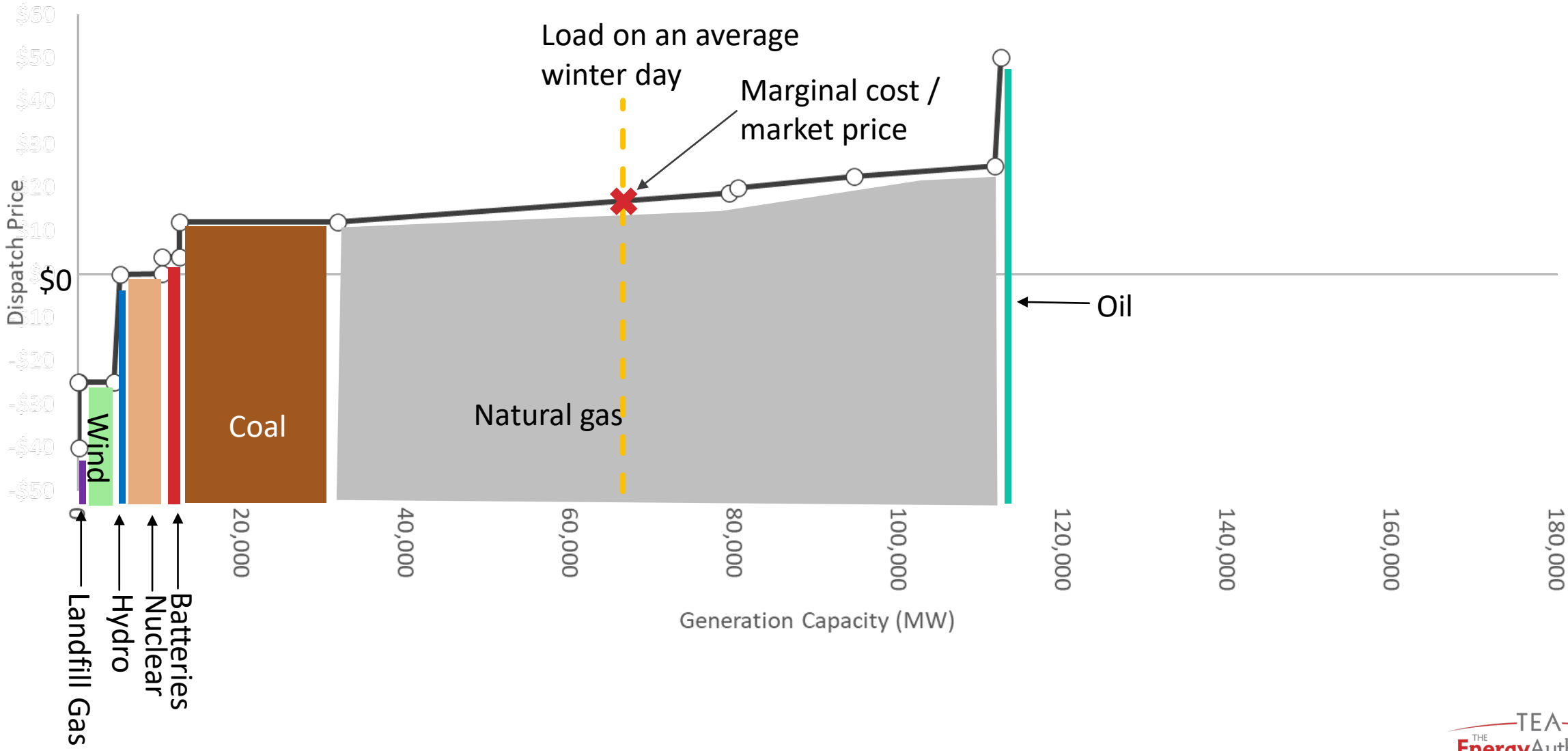
But what if it's nighttime?



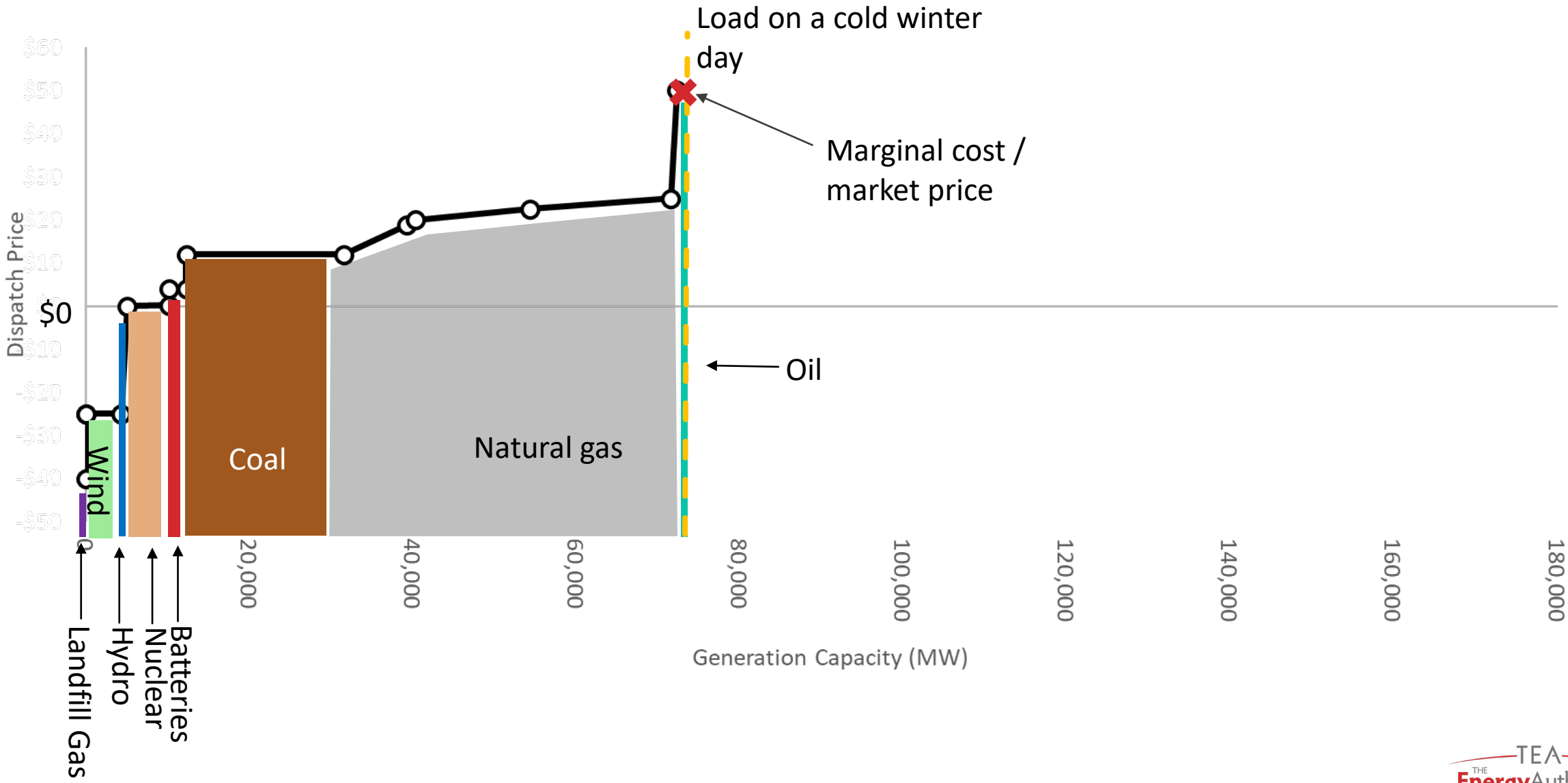
Or the wind stops blowing?



Or natural gas prices go higher?



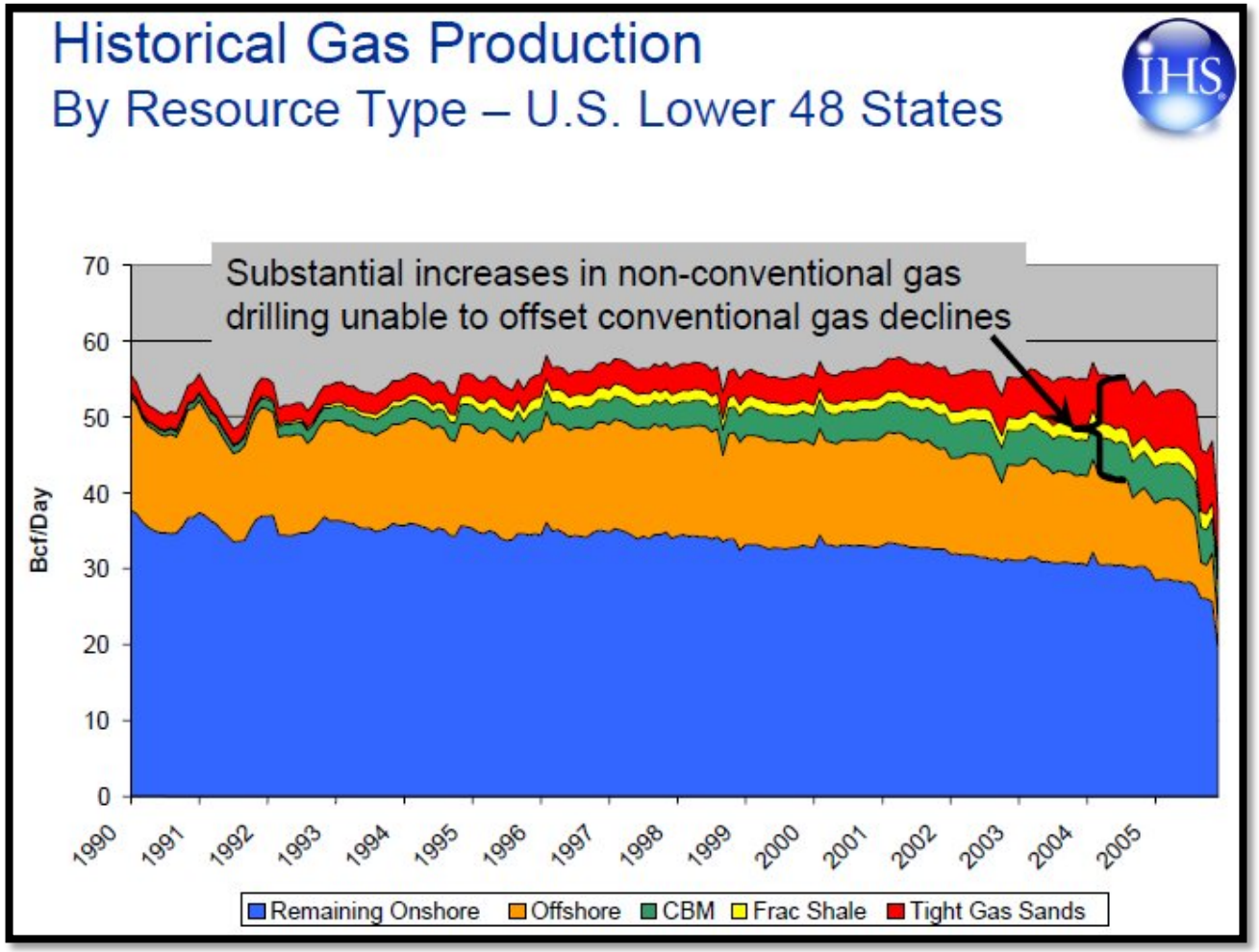
Expensive resources can set the marginal costs in extreme weather



NATURAL GAS FUNDAMENTALS

A TRIP DOWN MEMORY LANE

20 years ago…we were quickly running out of gas



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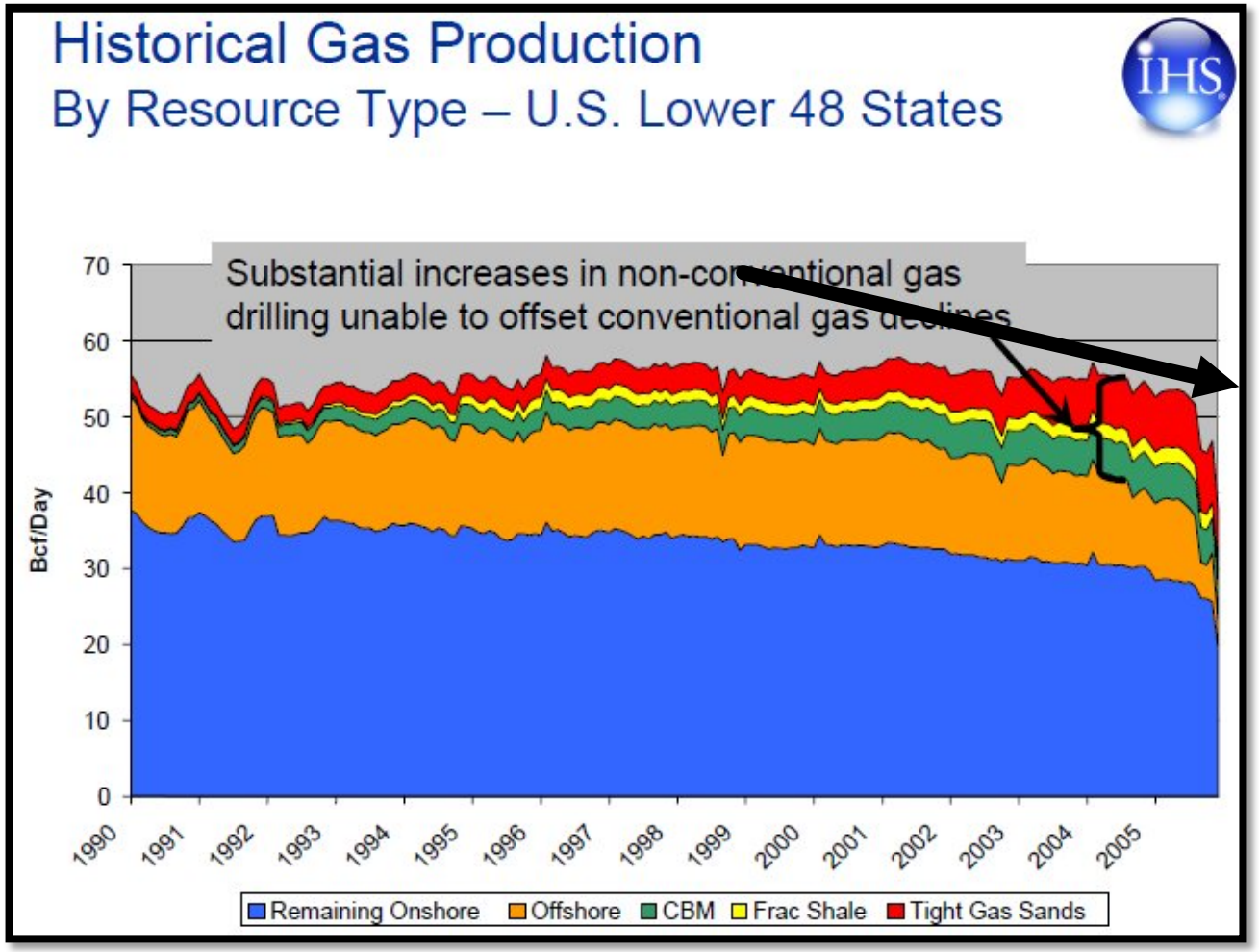
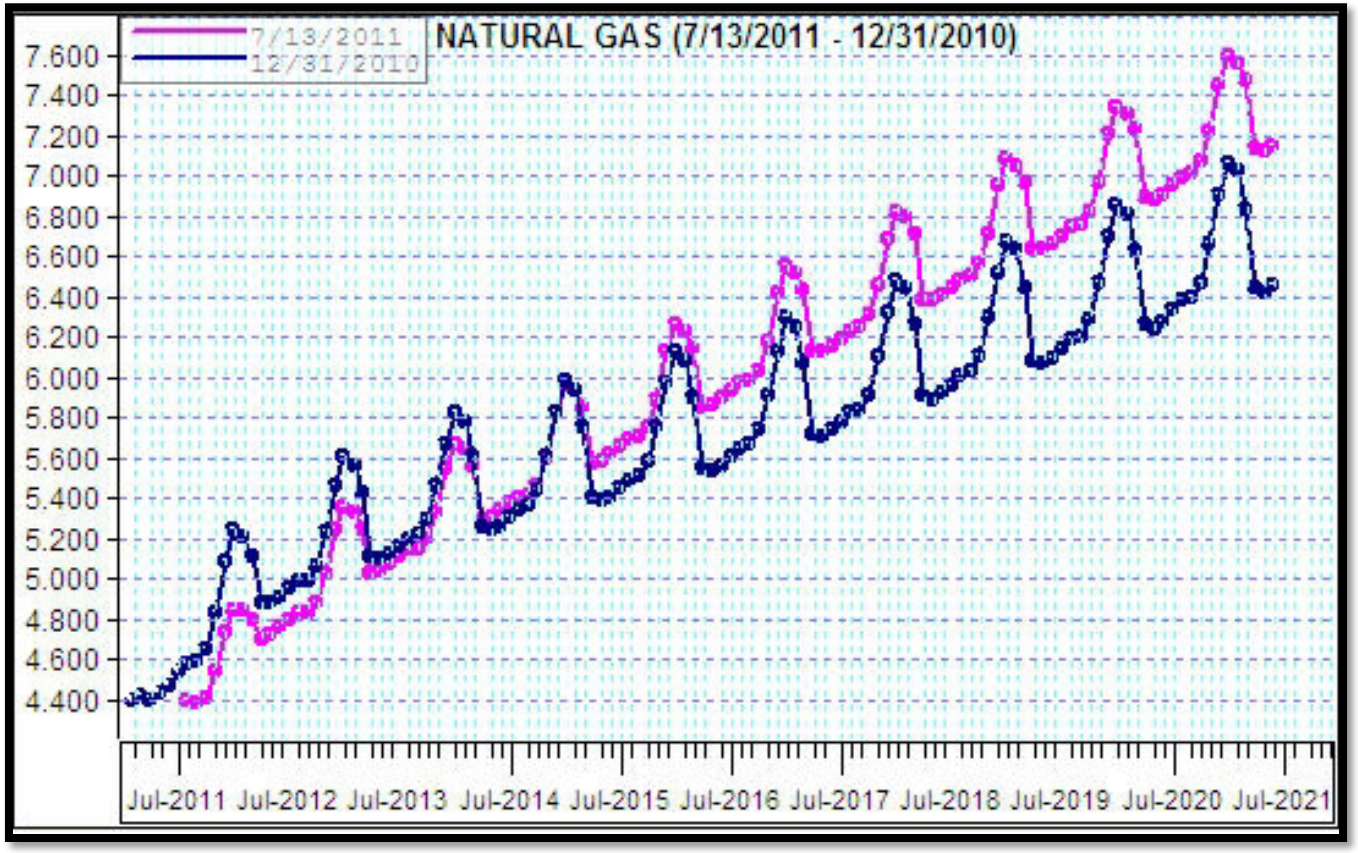


Which led to this



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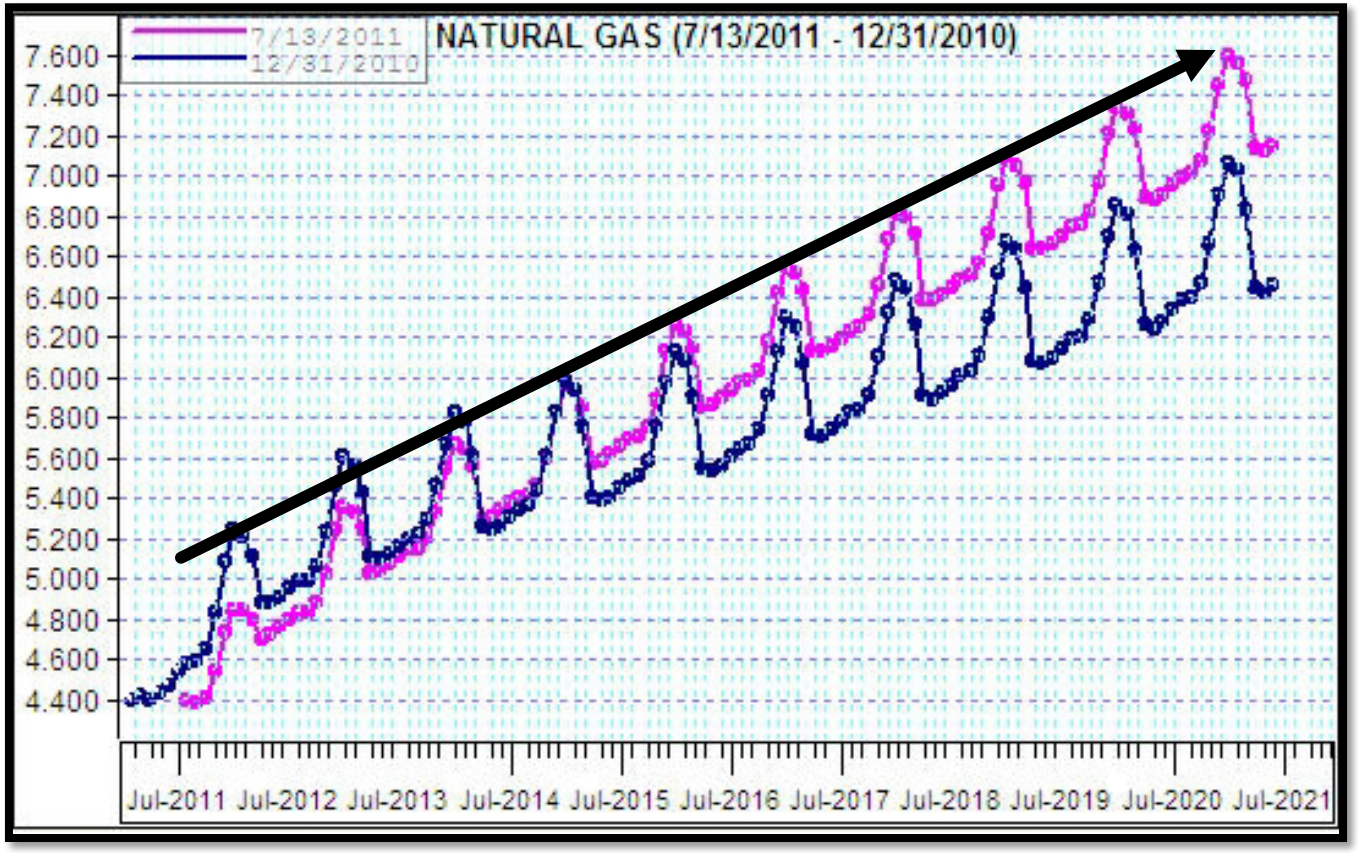
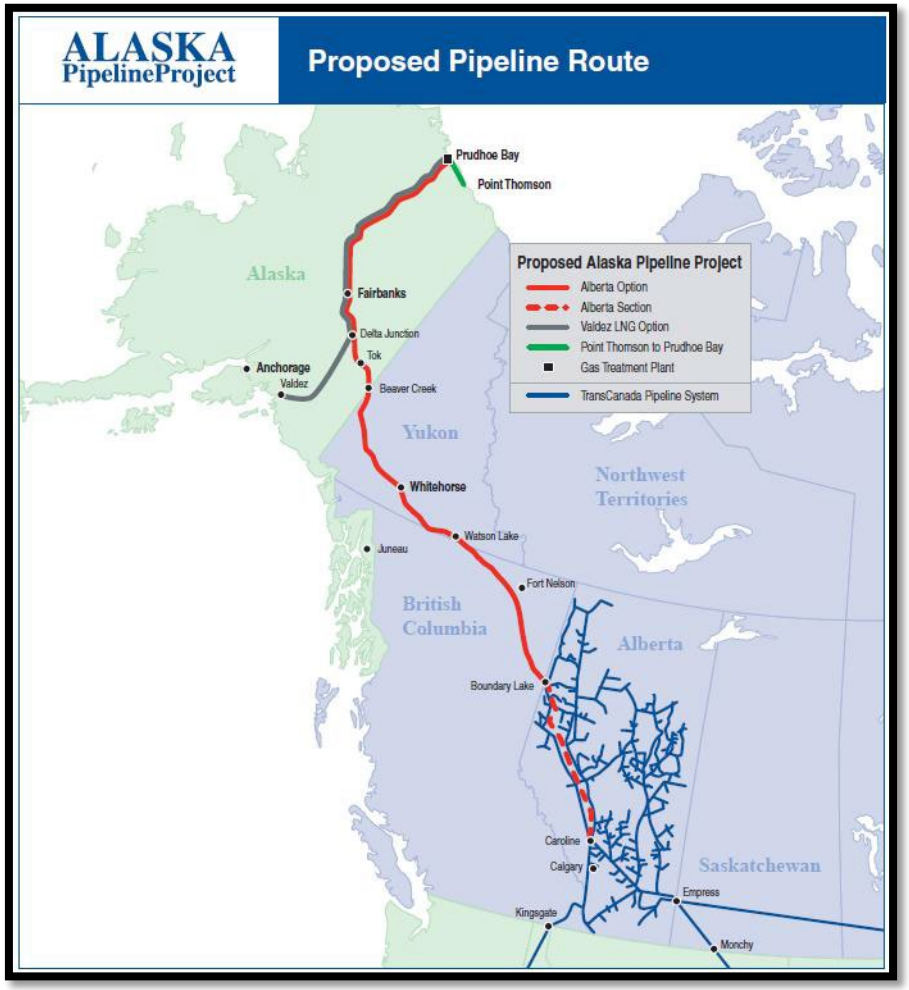


Forwards have gas increasing from $4 to $8 in a decade

And thus these



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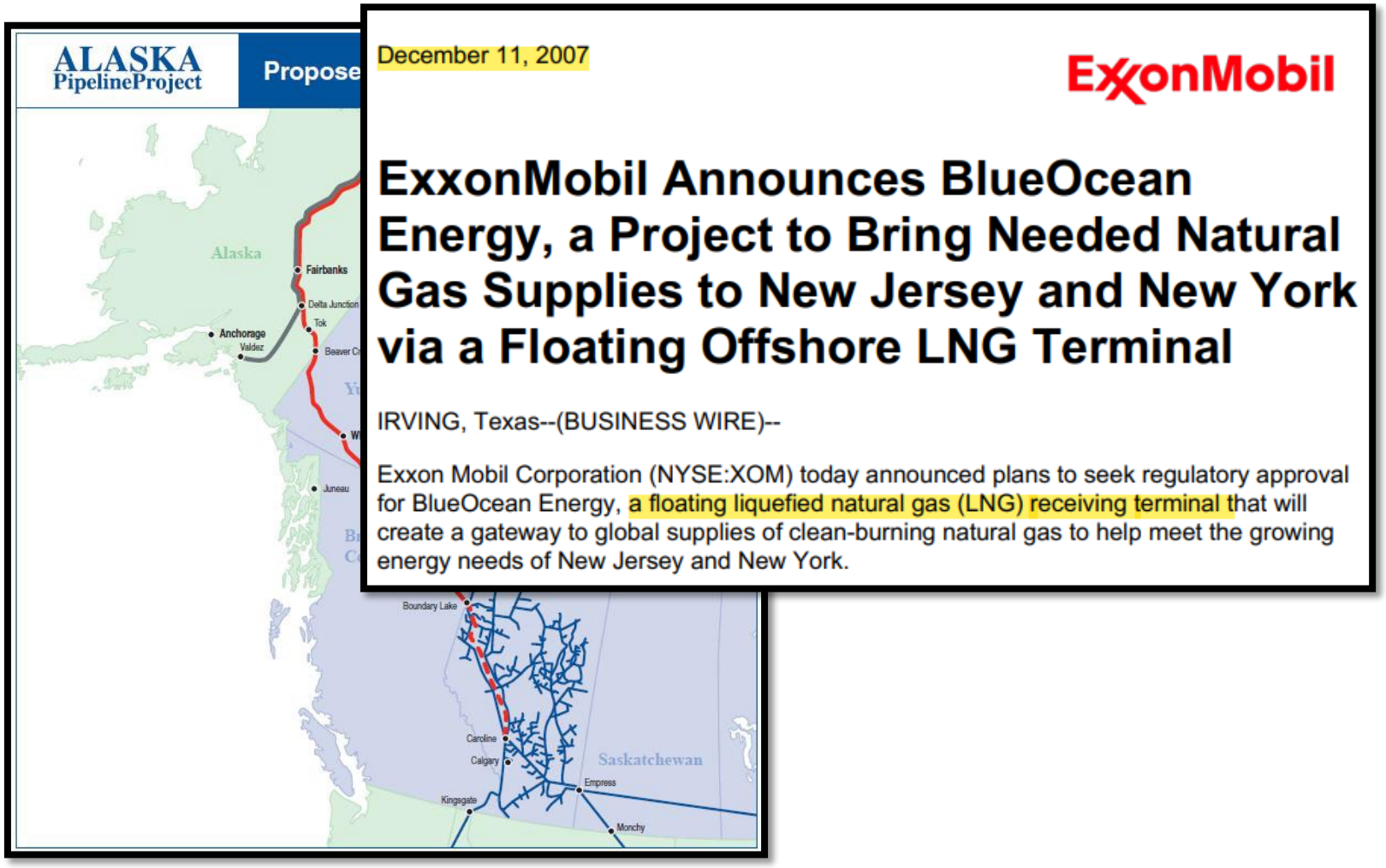

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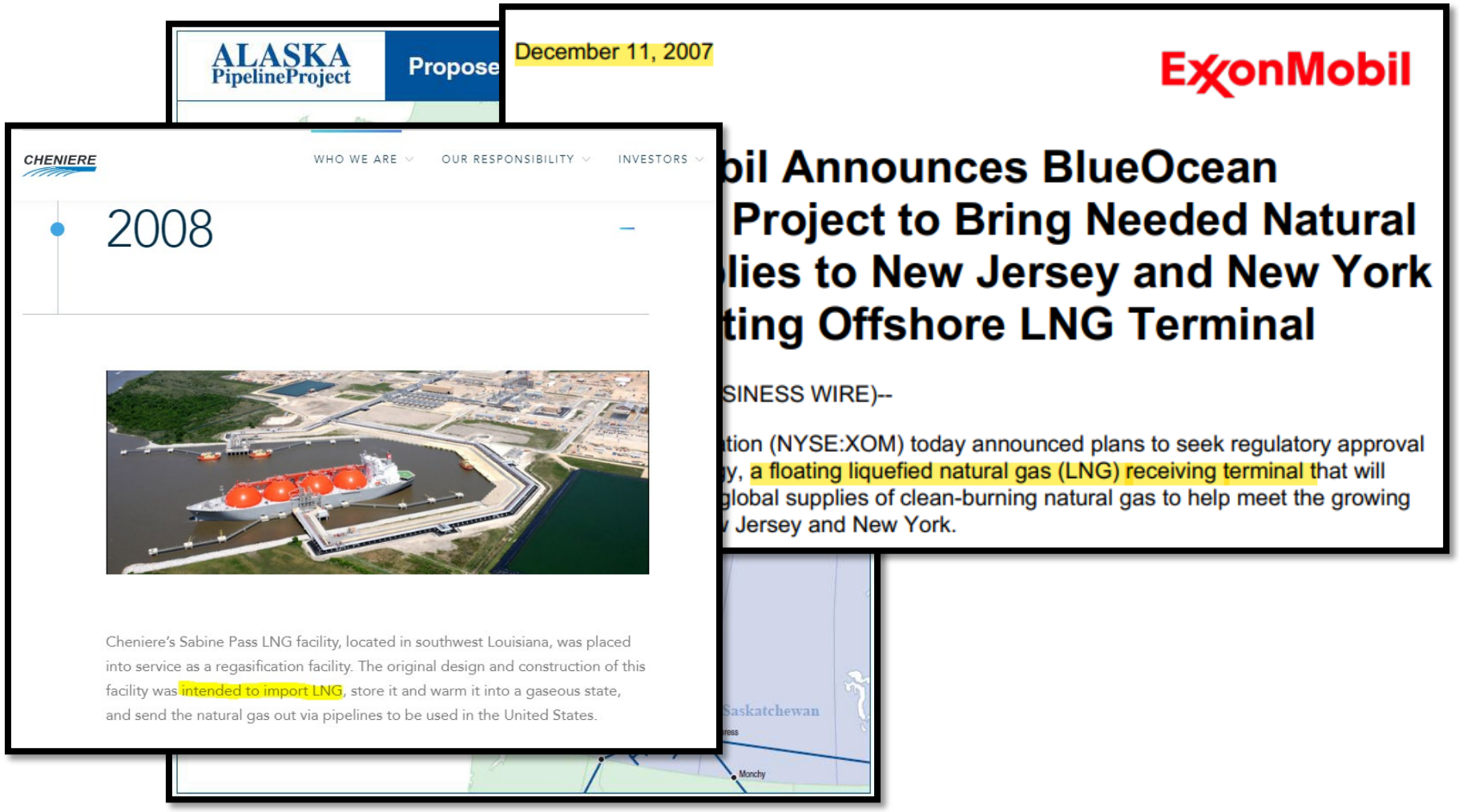

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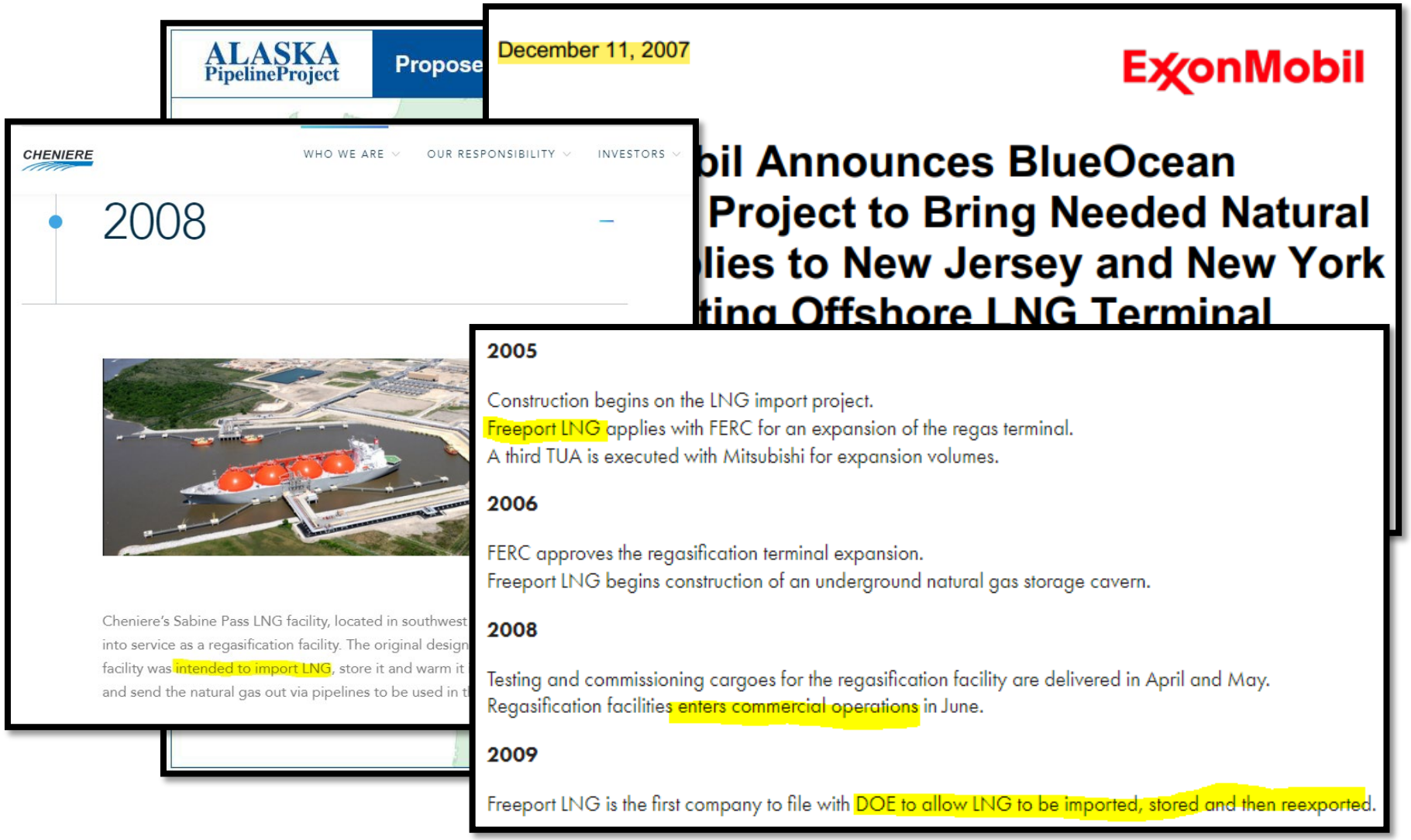
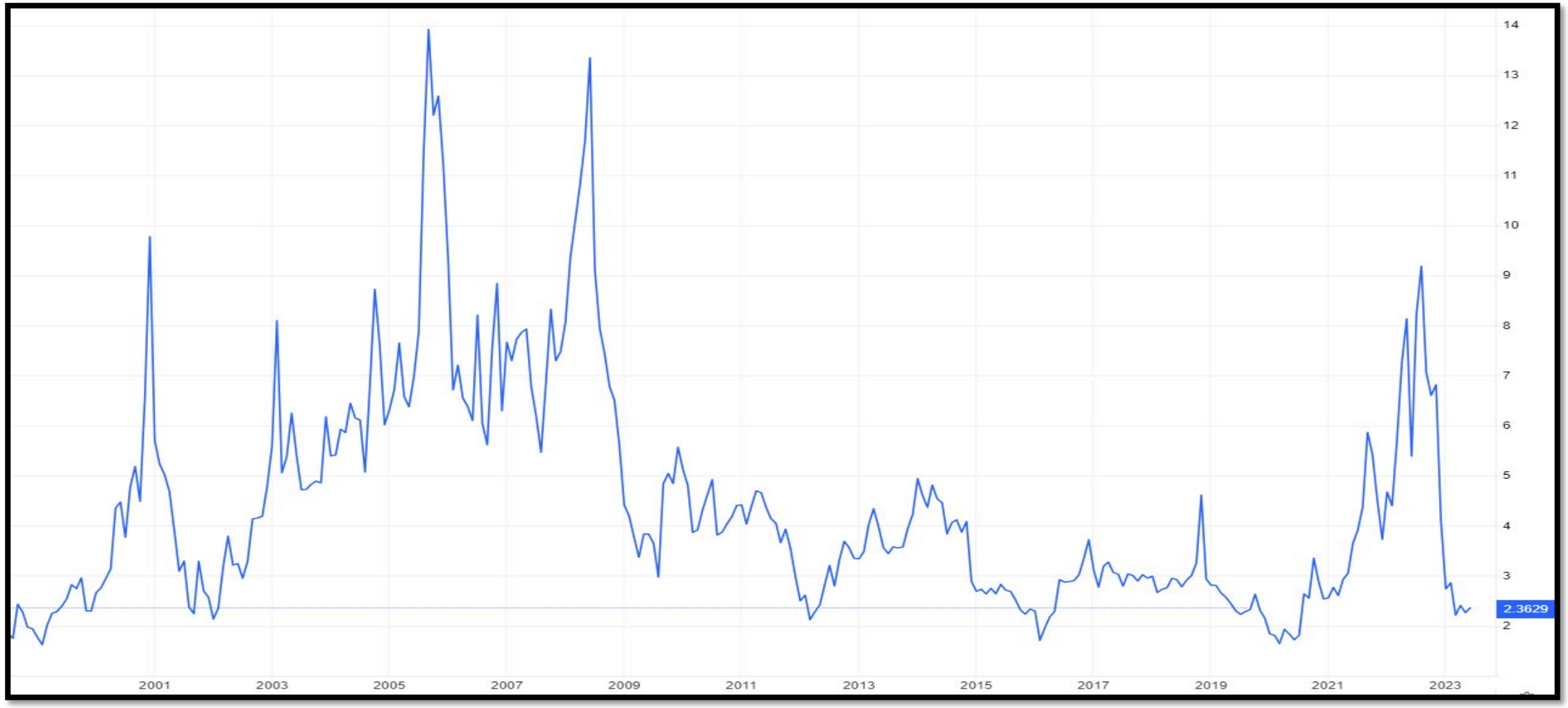


And then this happened

Commodity prices are path dependent

Henry Hub prompt month continuation ($/mmbtu)



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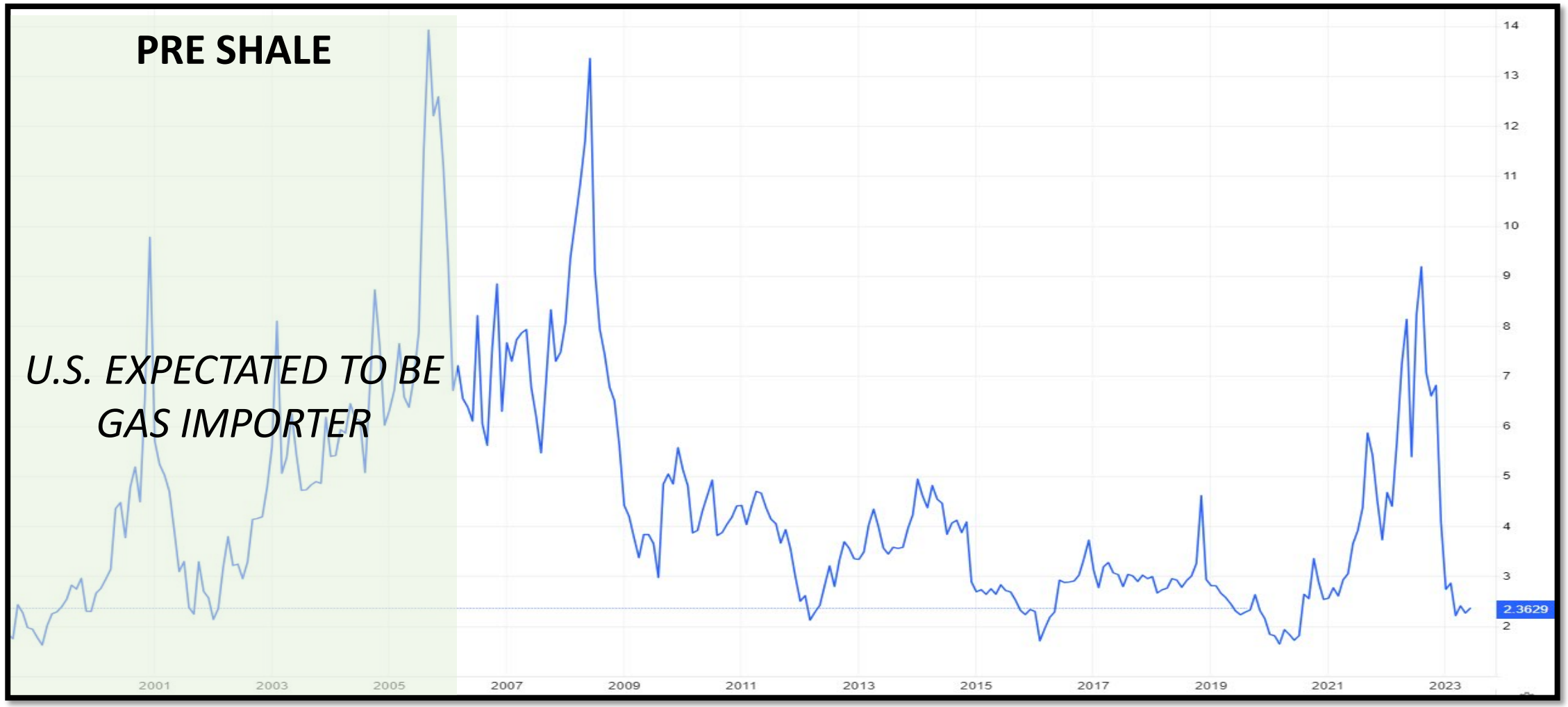

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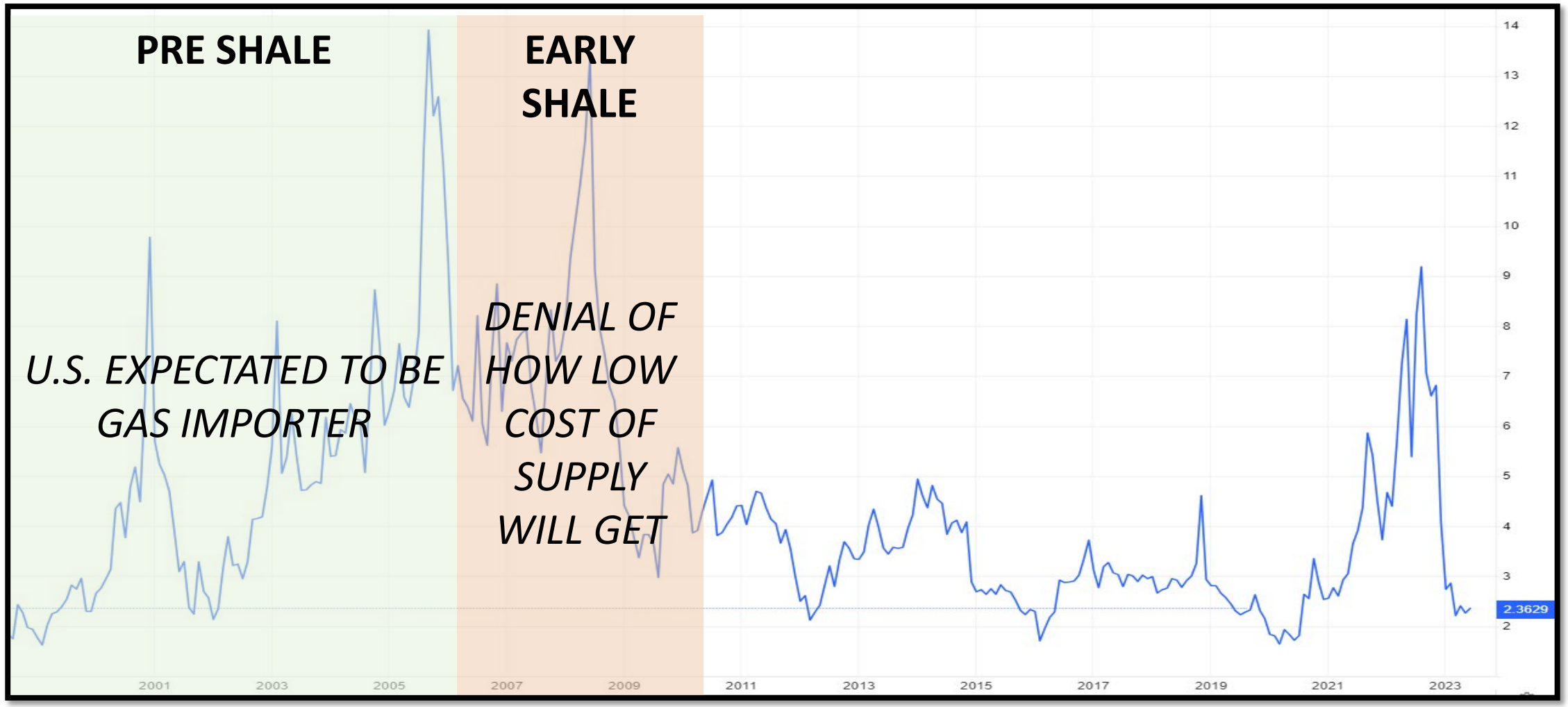

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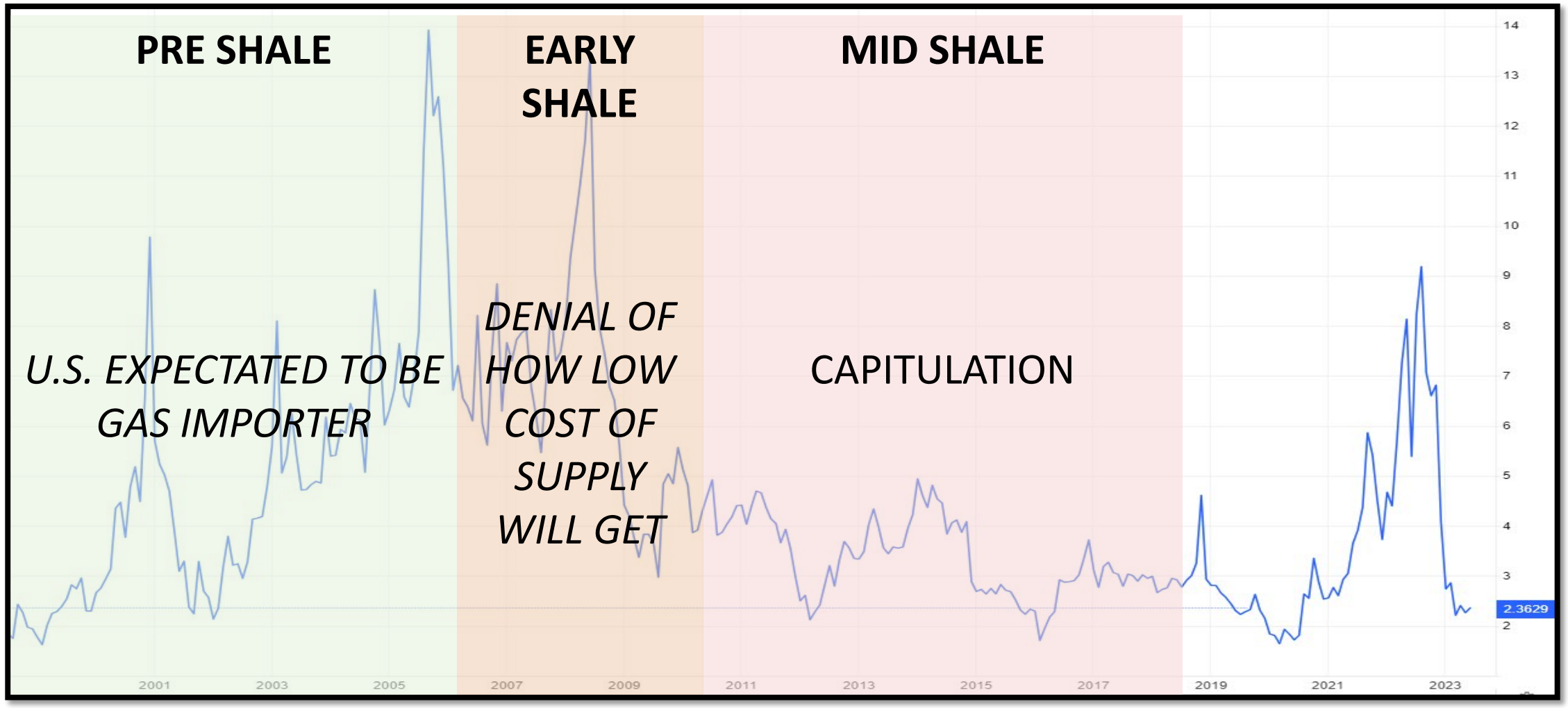

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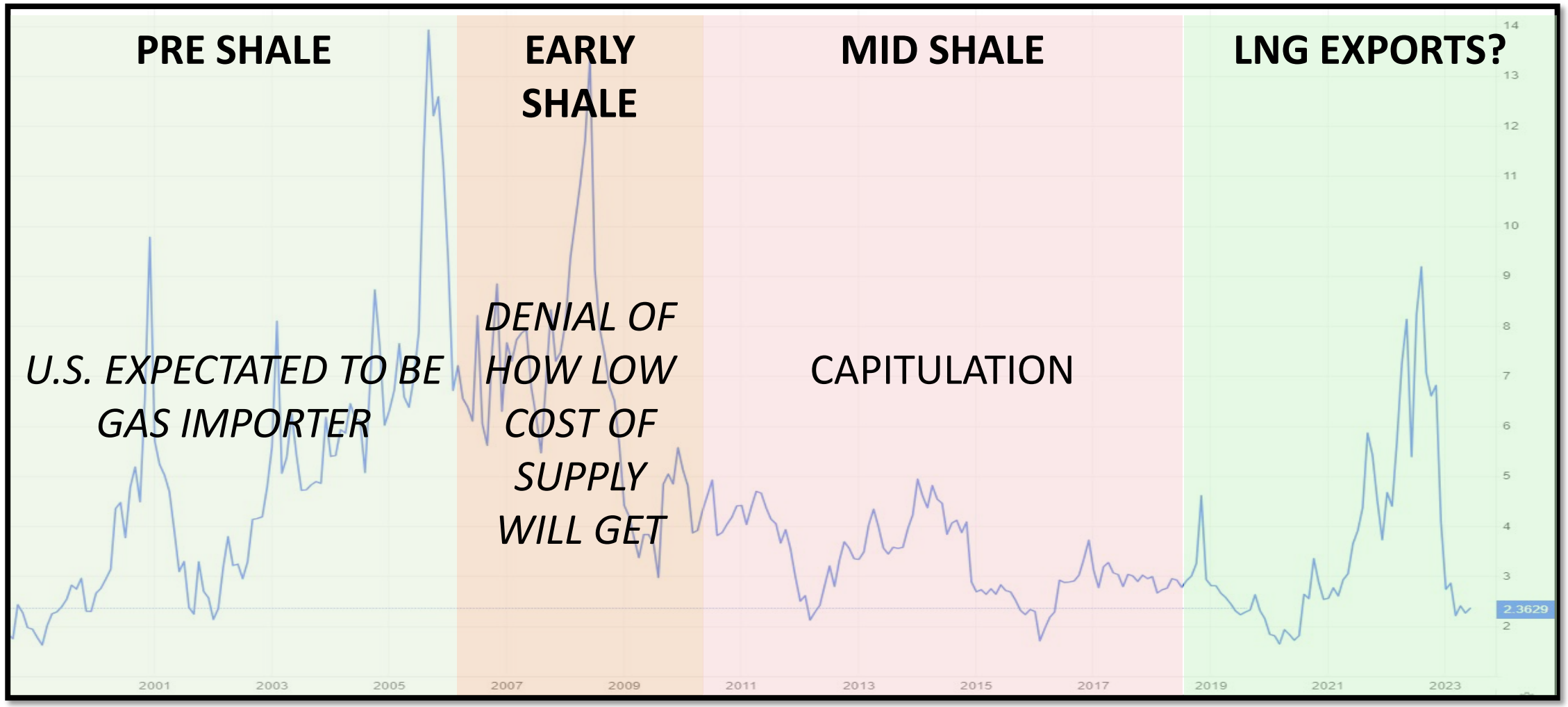

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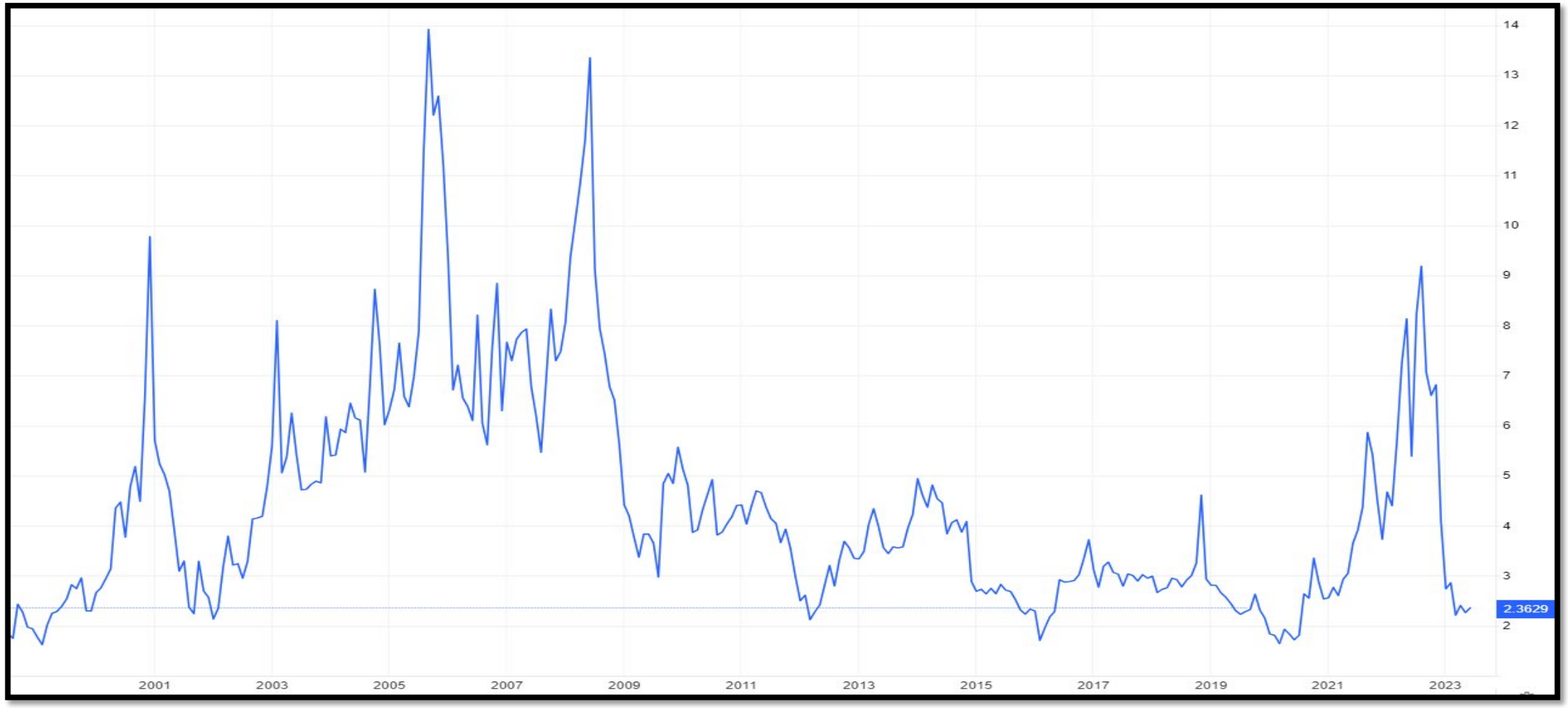

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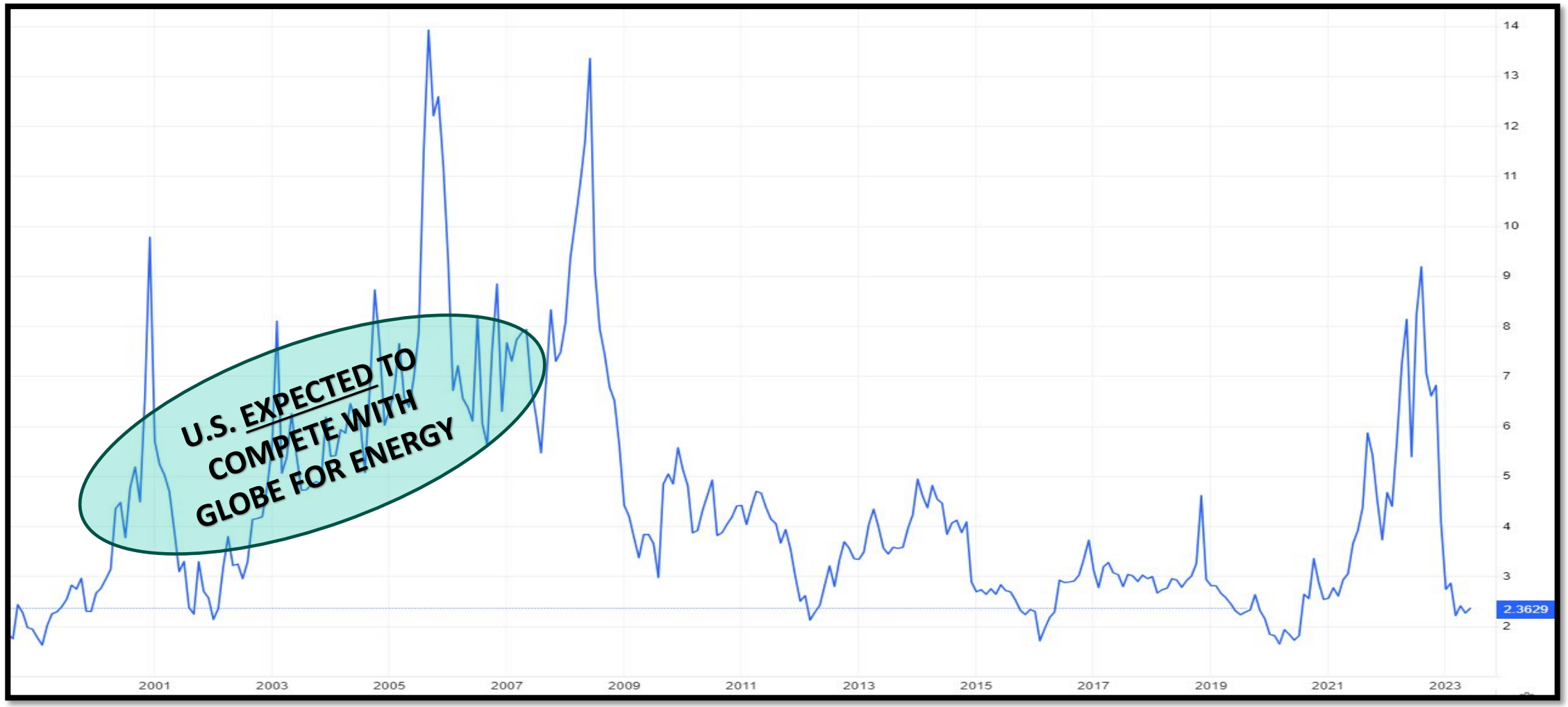

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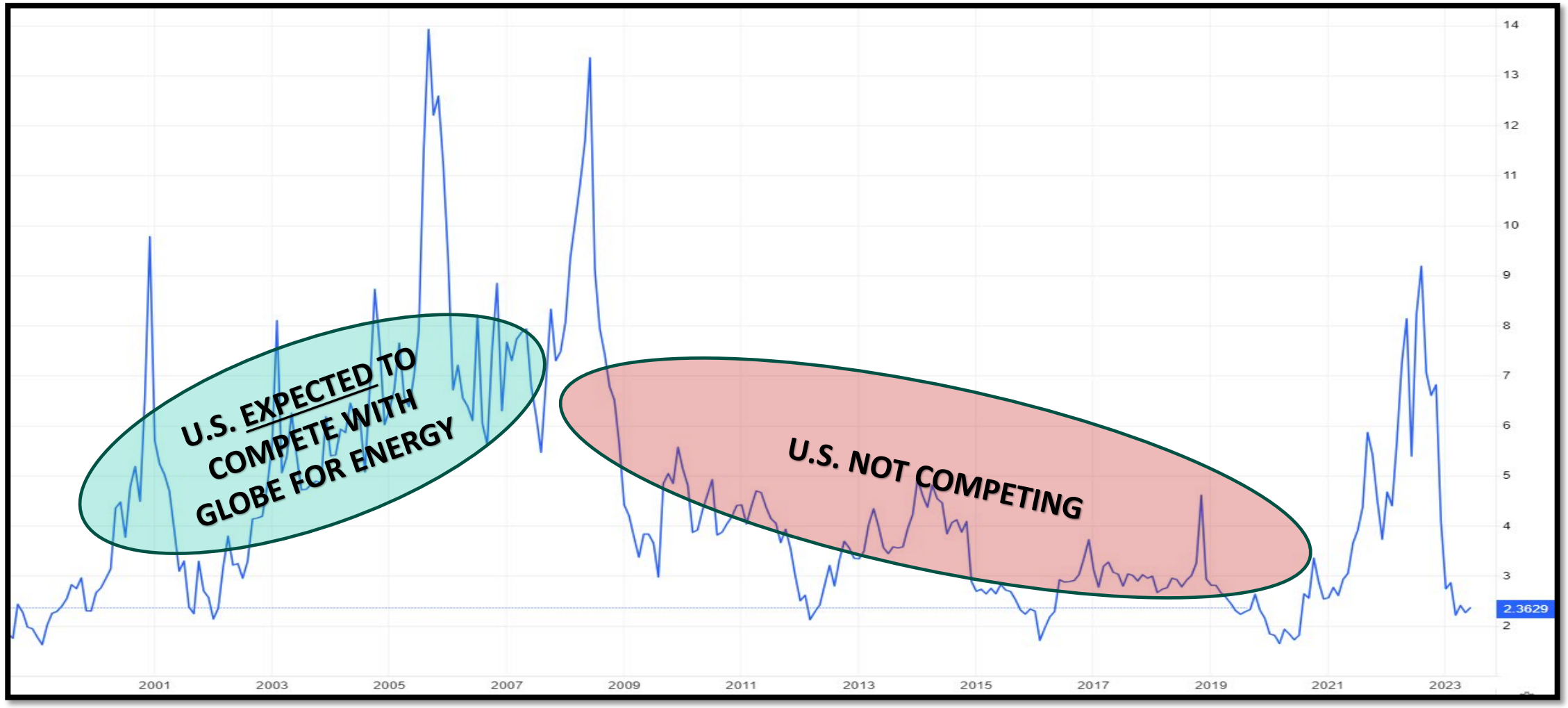

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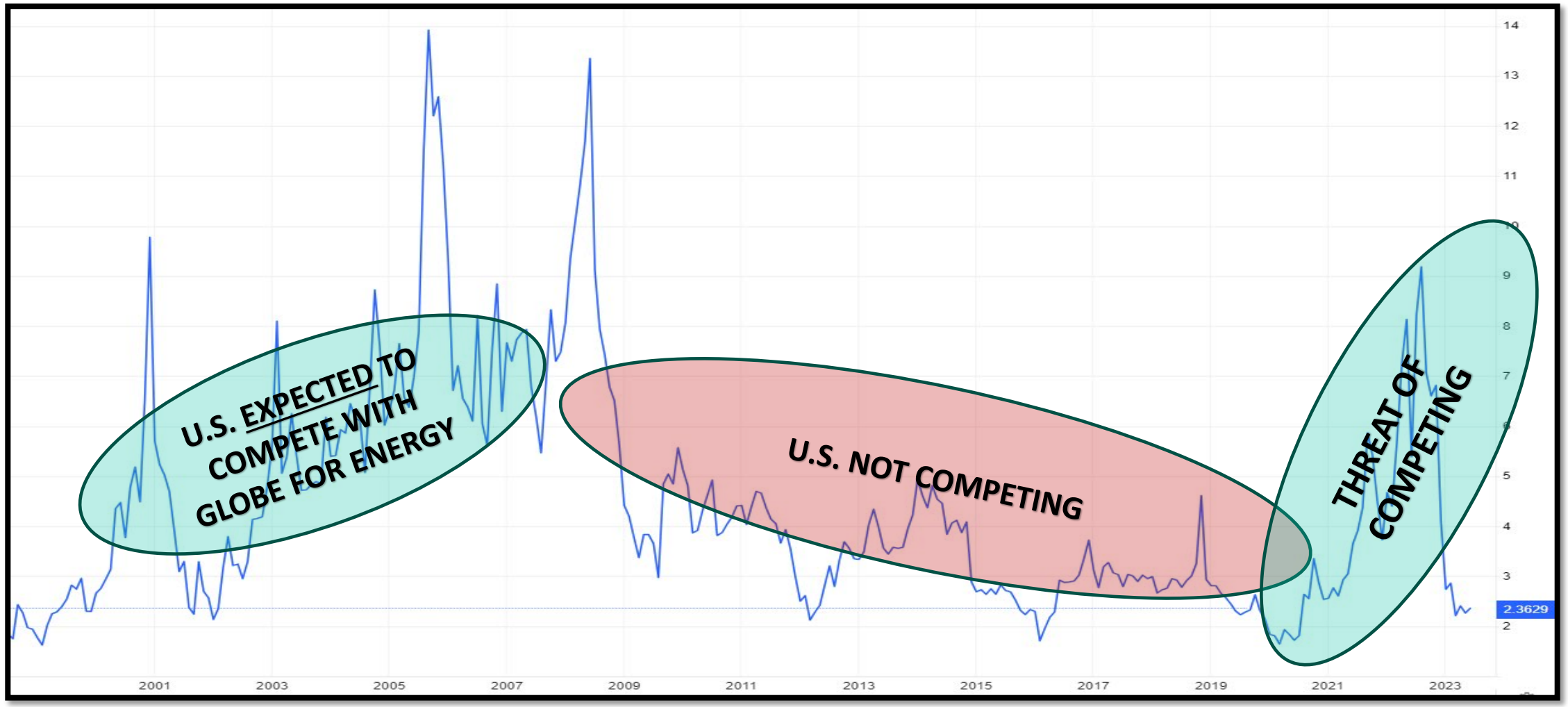
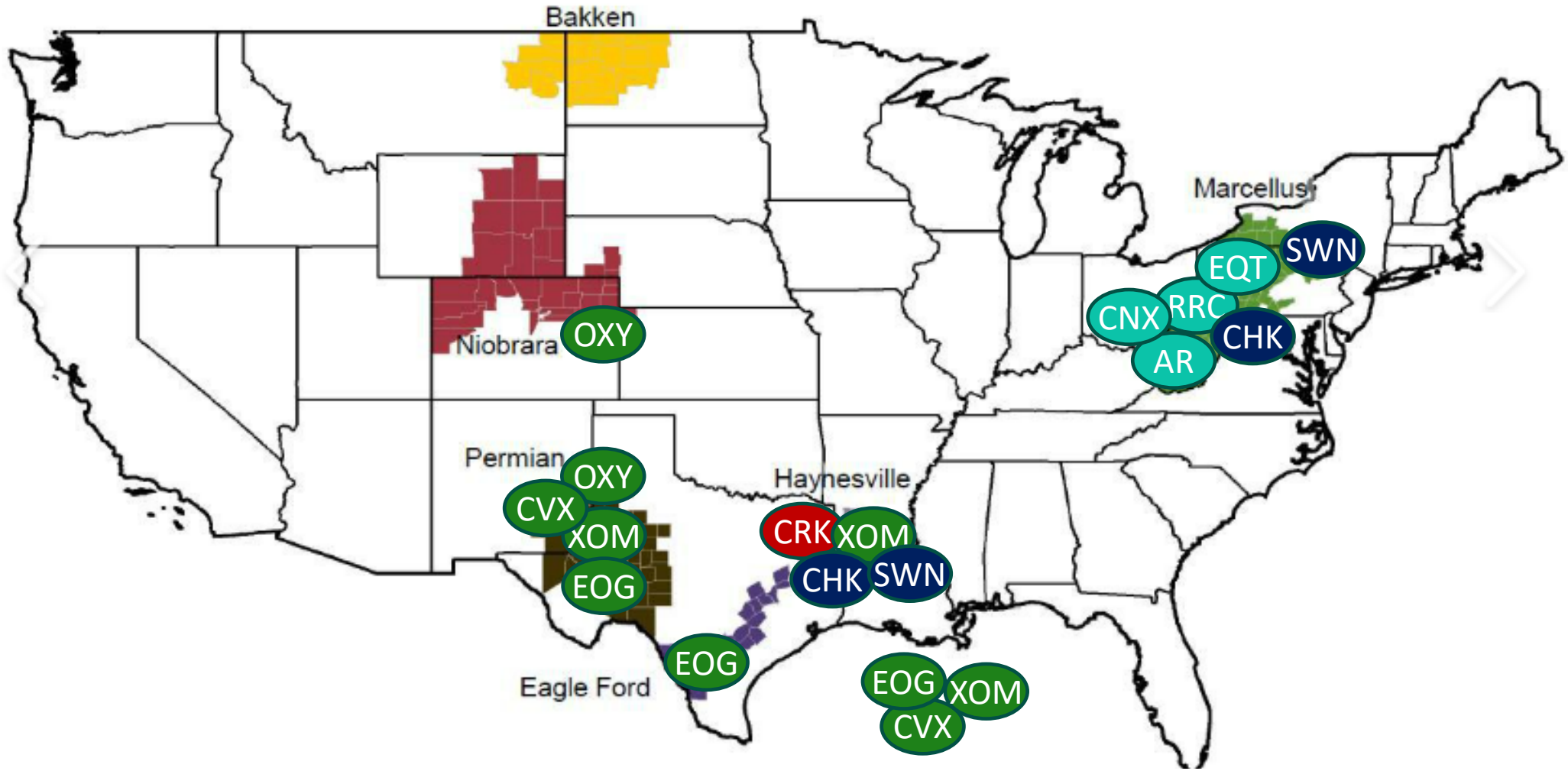
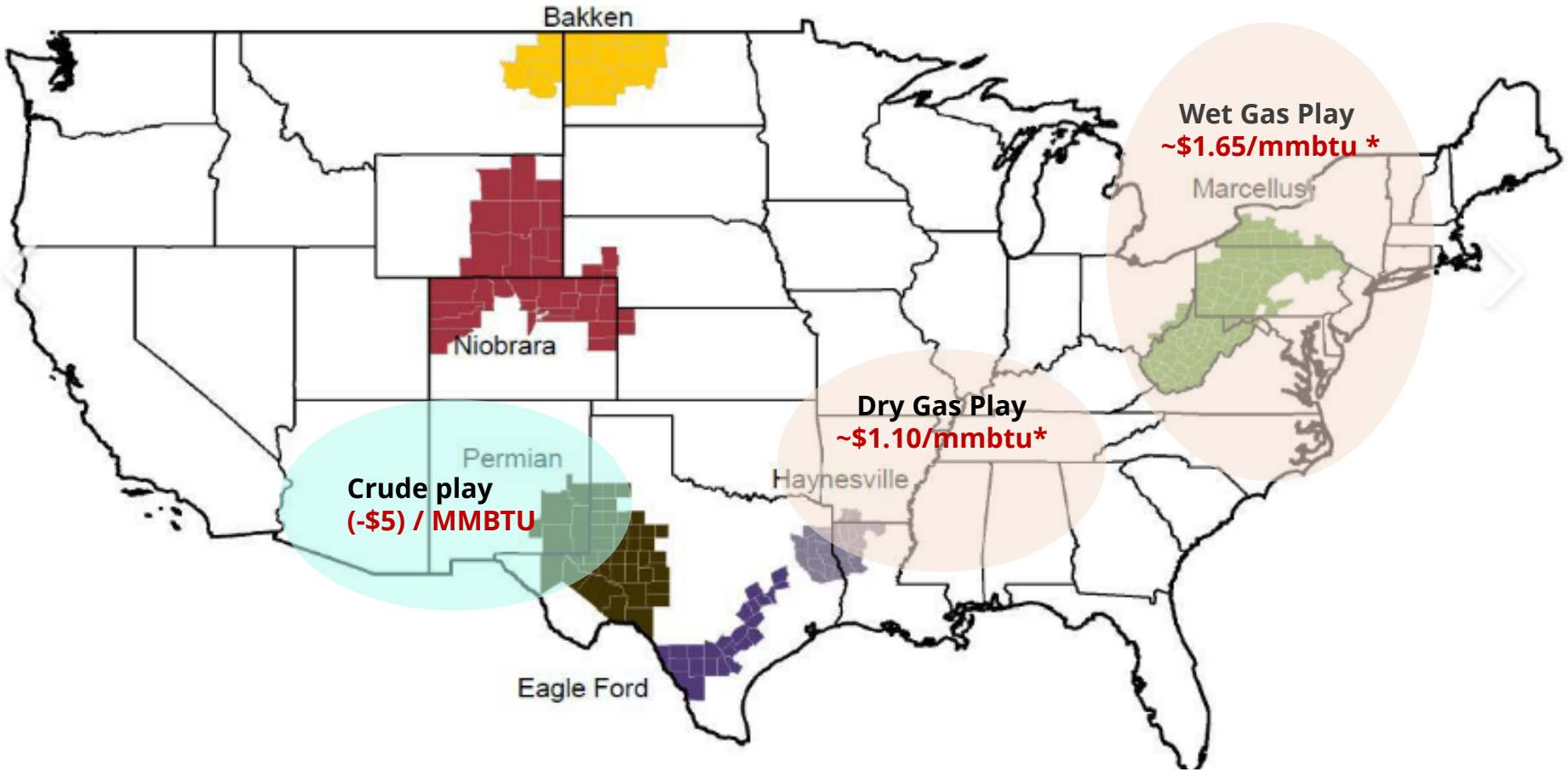


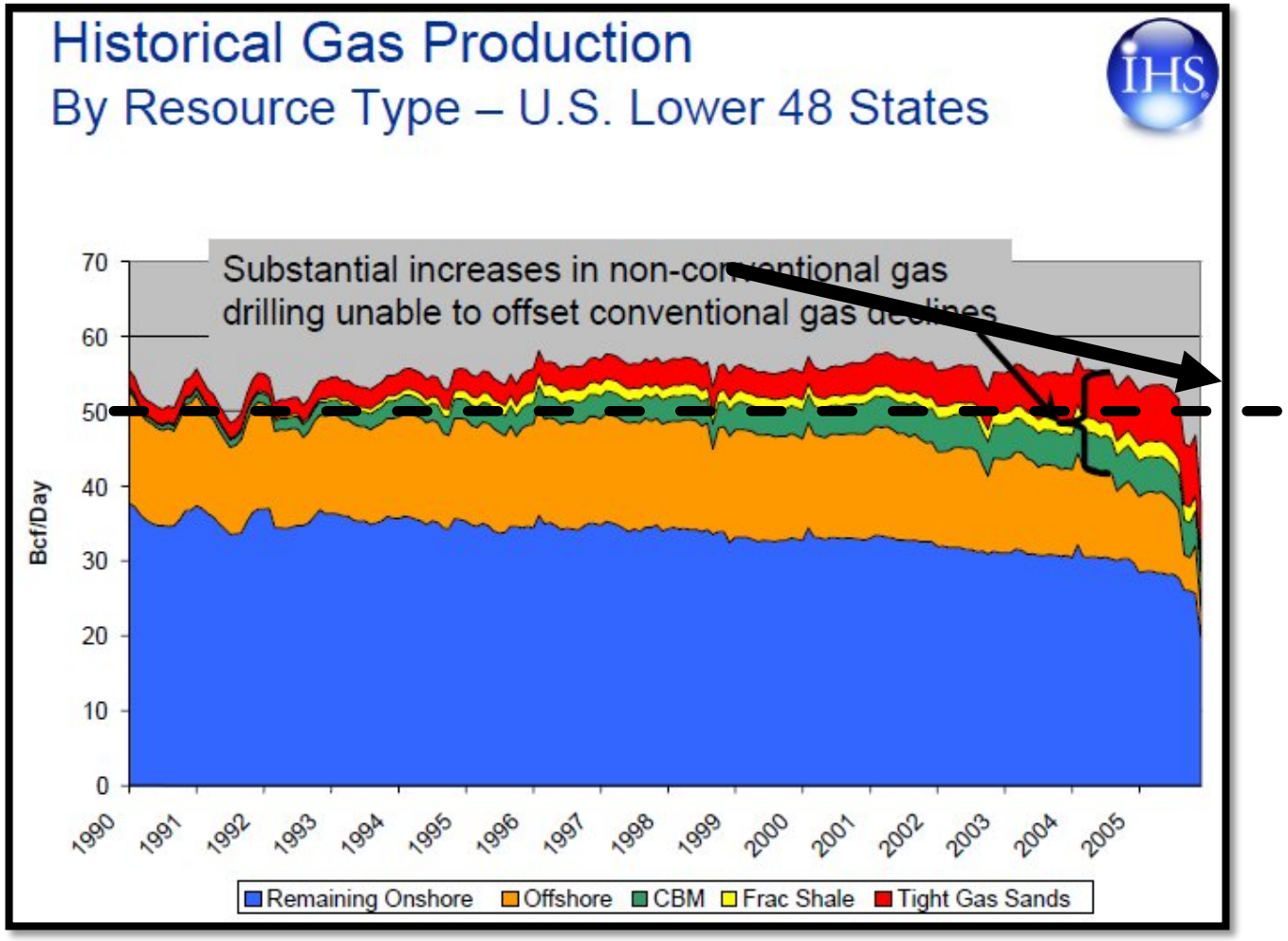
Gas is really cheap to produce



Natural gas is cheap to produce



And we produce a lot of it



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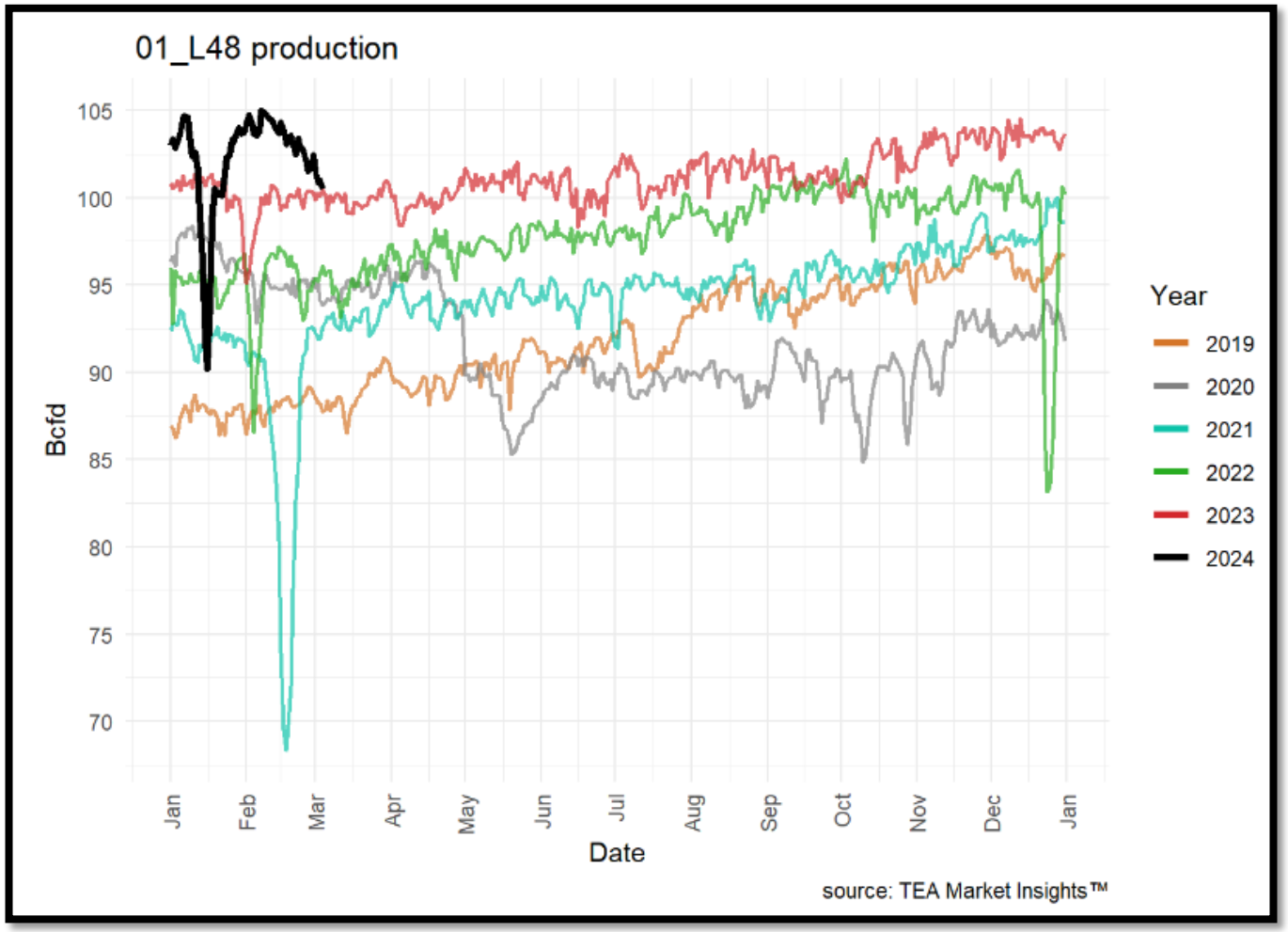

NATURAL GAS DEMAND (AND PRICE) DRIVERS

How the US uses natural gas

Natural gas use by U.S. consuming sectors by amount and percentage share of total U.S. natural gas consumption in 2022 was:[1]

38%	32%	15%	11%	4%
12.12 Tcf	*10.44 Tcf*	*4.99 Tcf*	*3.52 Tcf*	*1.24 Tcf*
electric power	industrial	residential	commercial	transportation

Source: https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php

1. Heating

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25% is used for heating and cooking

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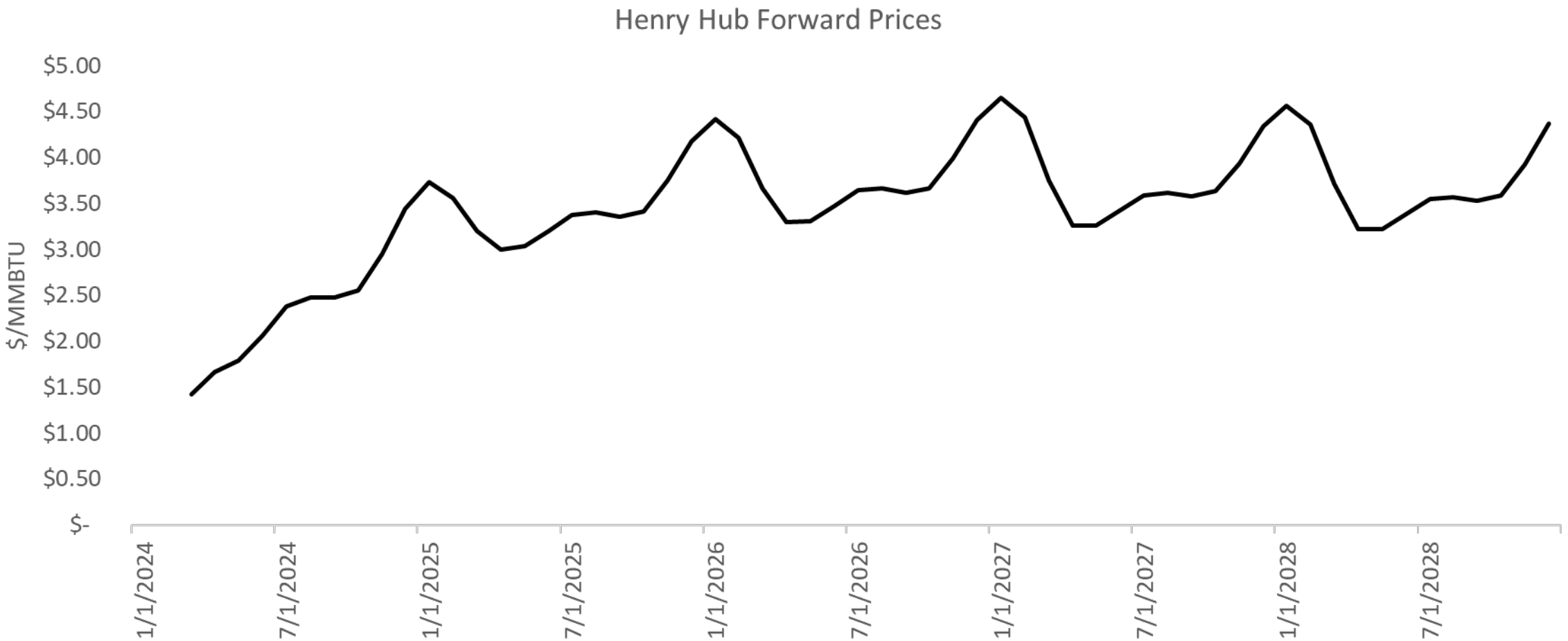
Expected heating demand impacts forward prices



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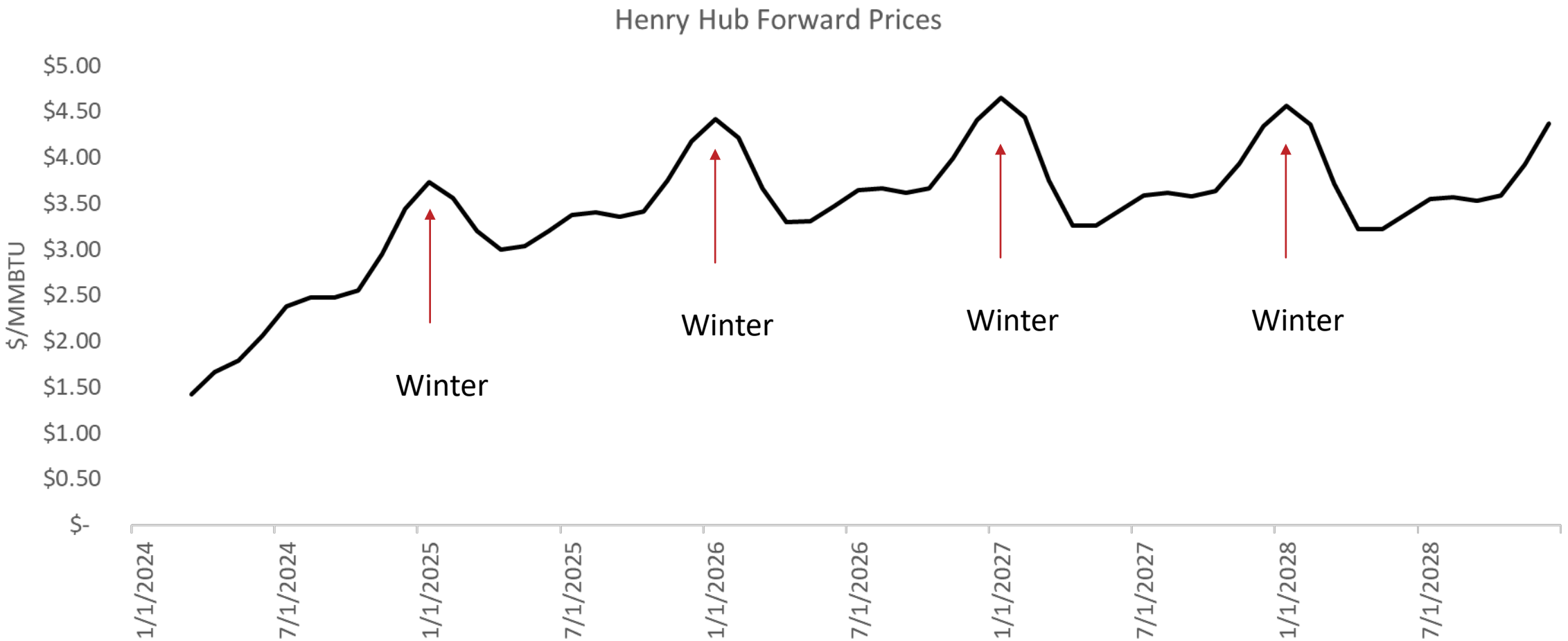
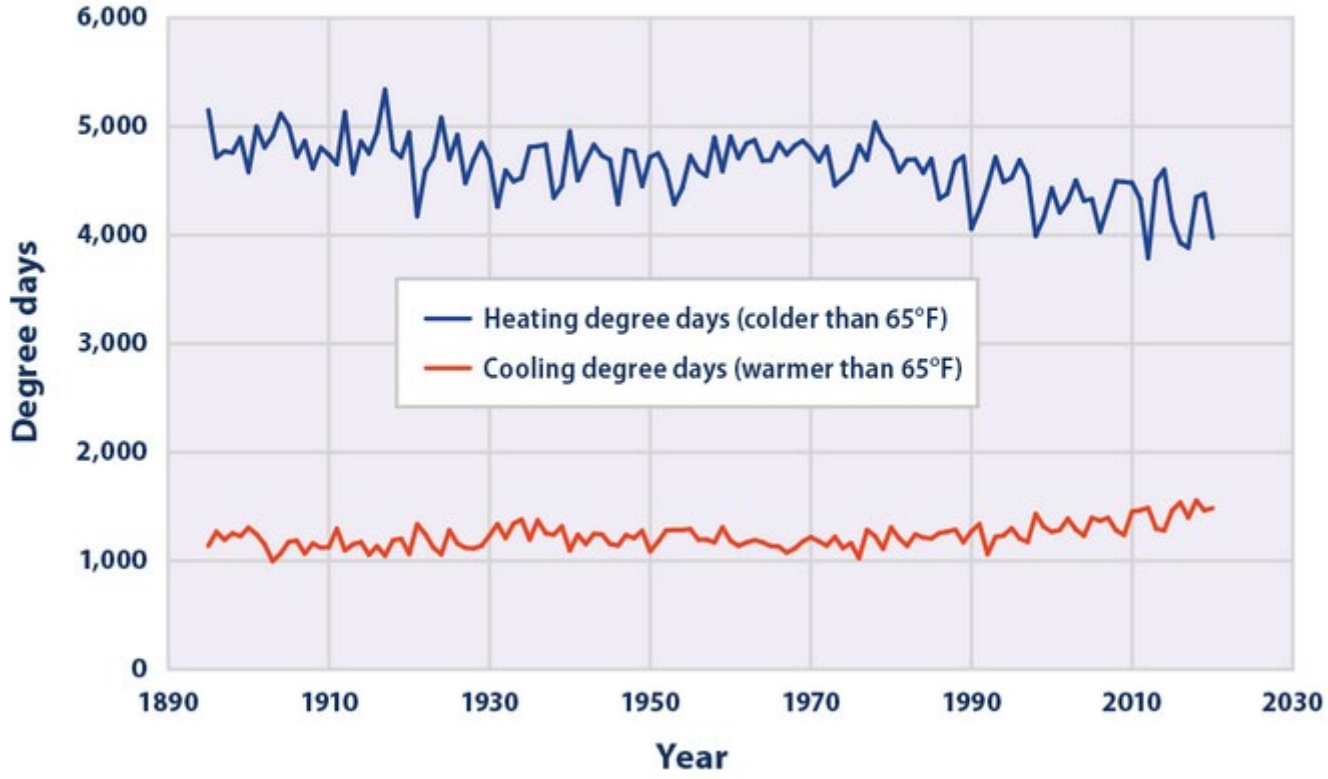


Both winter and summers are getting warmer

Figure 1. Heating and Cooling Degree Days in the Contiguous 48 States, 1895–2020



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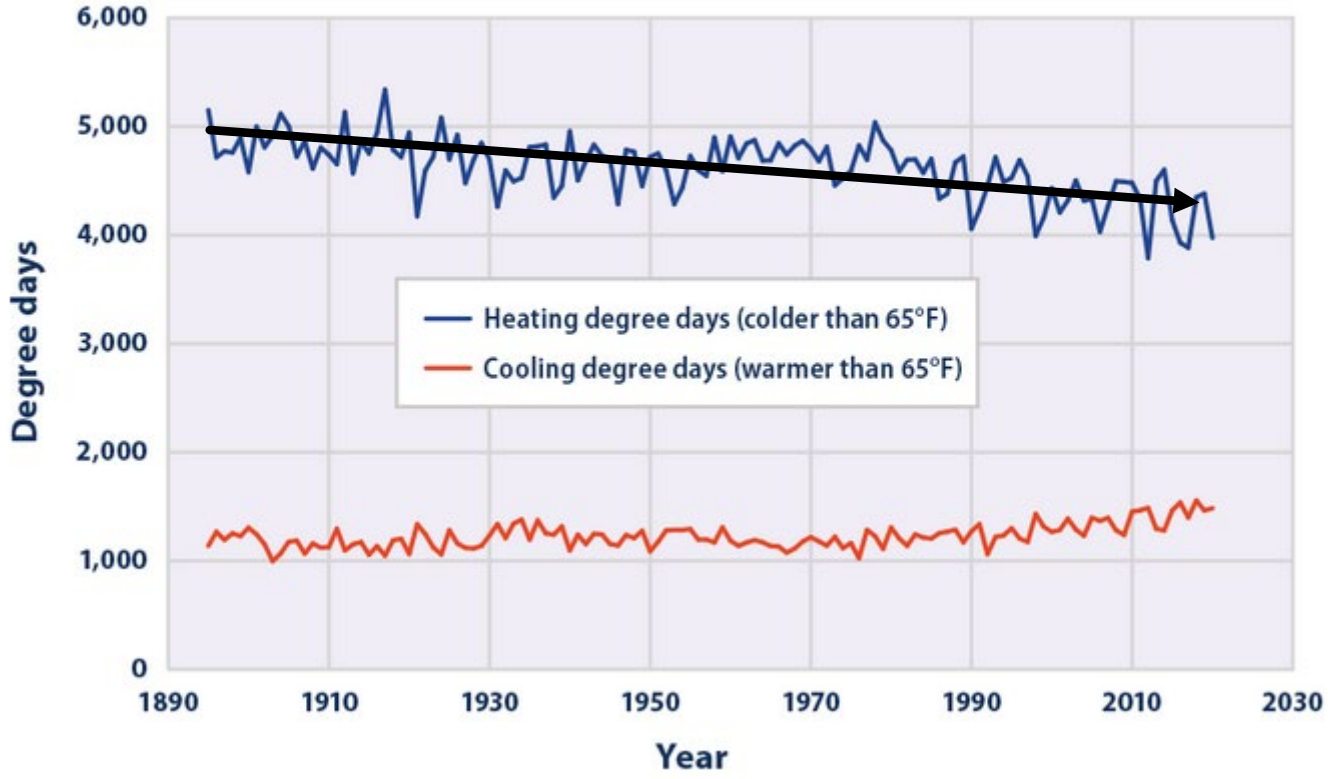

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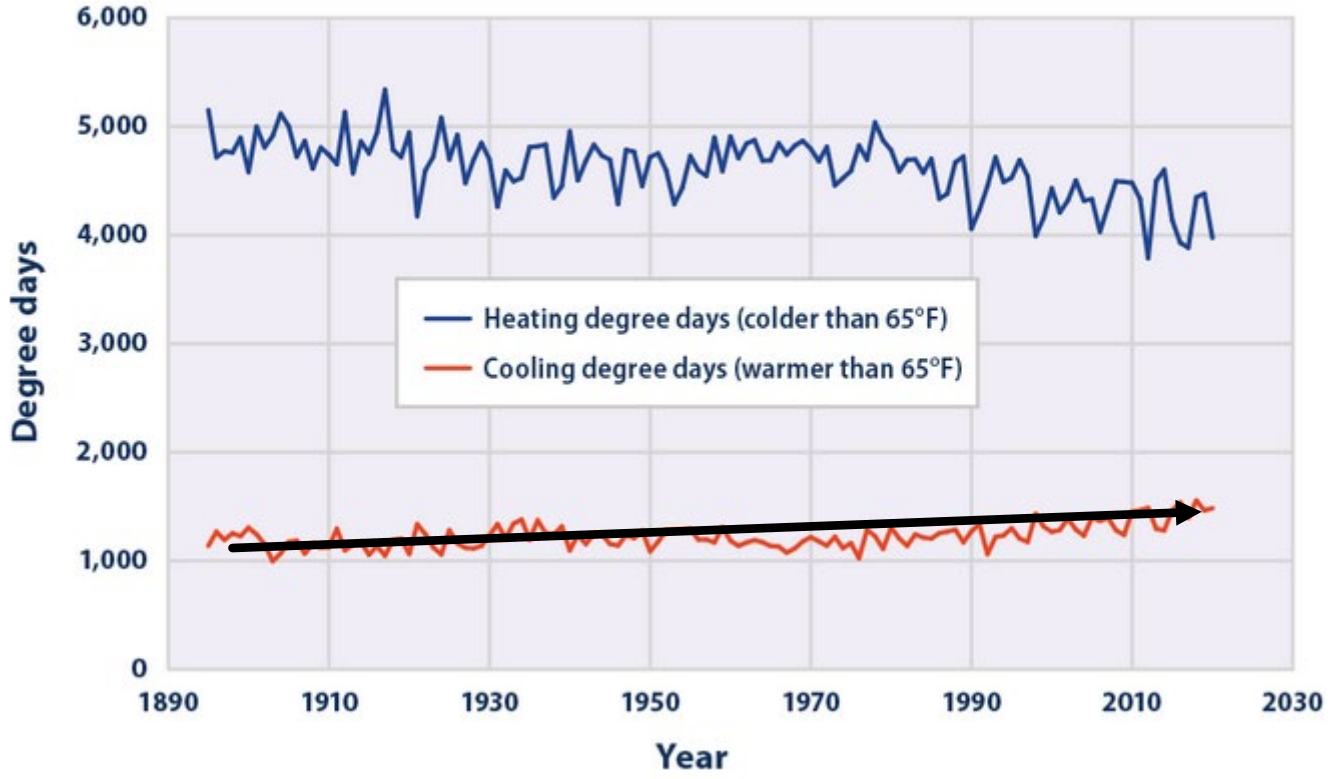

2. Industrial and LNG exports

Natural gas use by U.S. consuming sectors by amount and percentage share of total U.S. natural gas consumption in 2022 was:[1]

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electric power	industrial	residential	commercial	transportation

Includes 3.85 Tcf exported

Source: https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php

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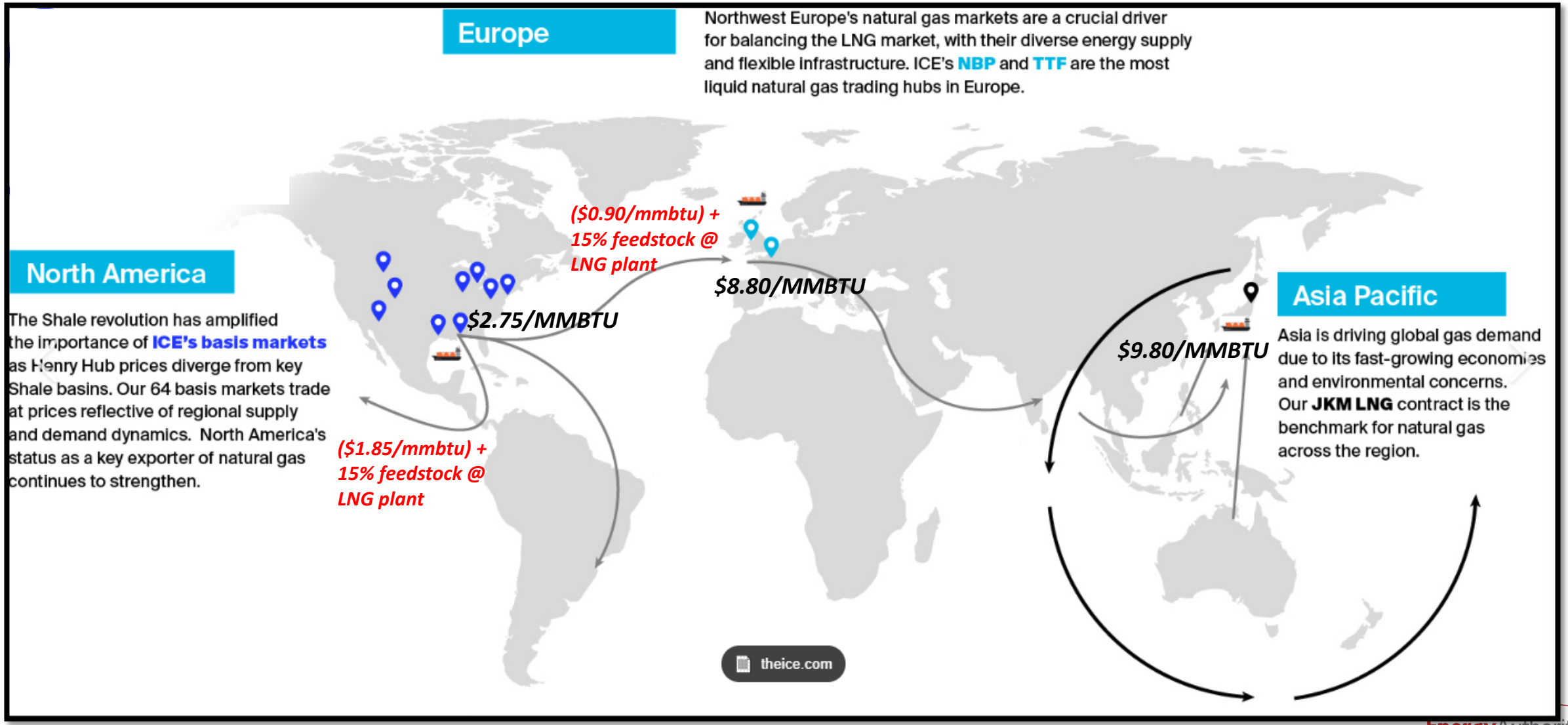
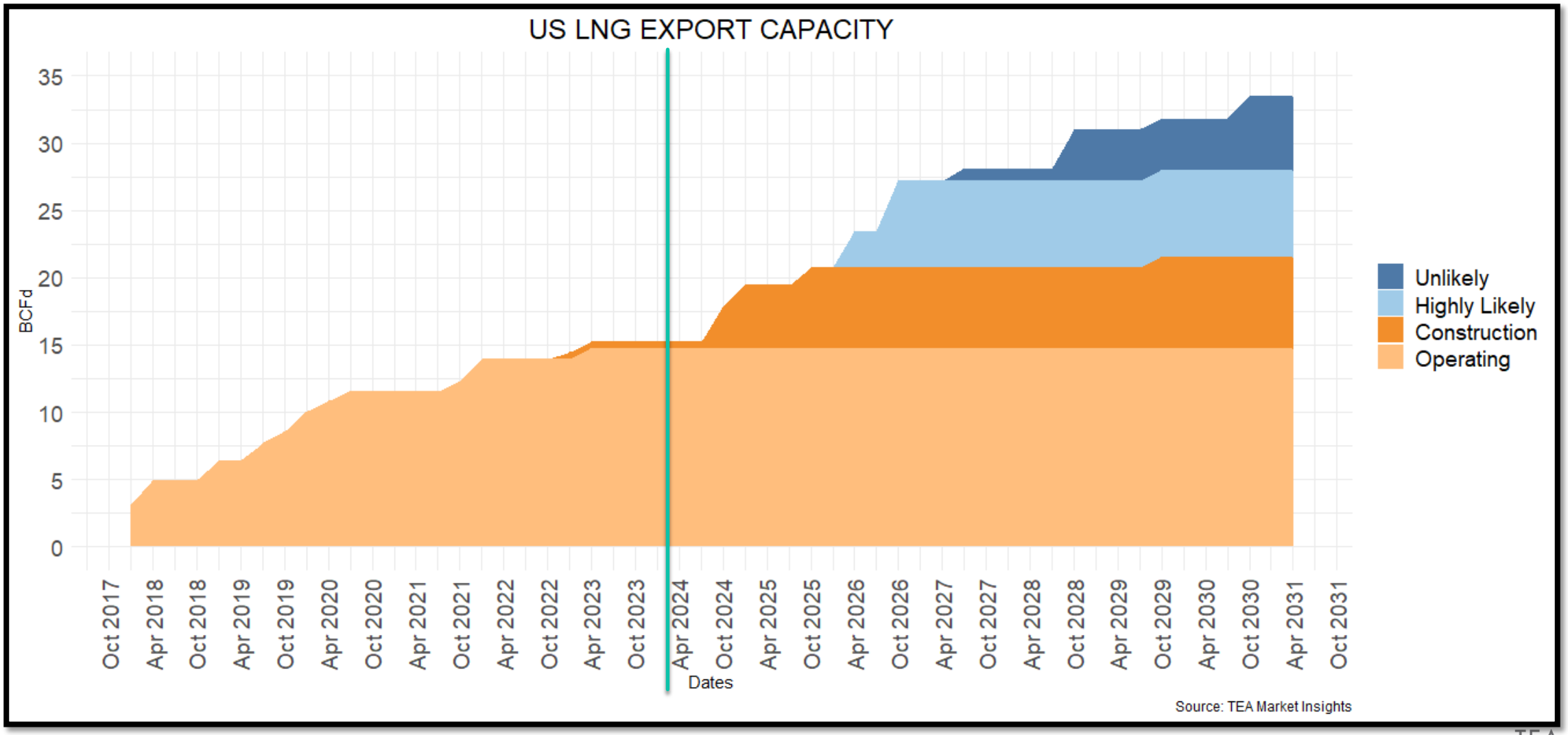
About 15% are LNG exports

Source: https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php

LNG exports are a function of price and capacity



LNG export capacity continues to grow



3. Electricity generation

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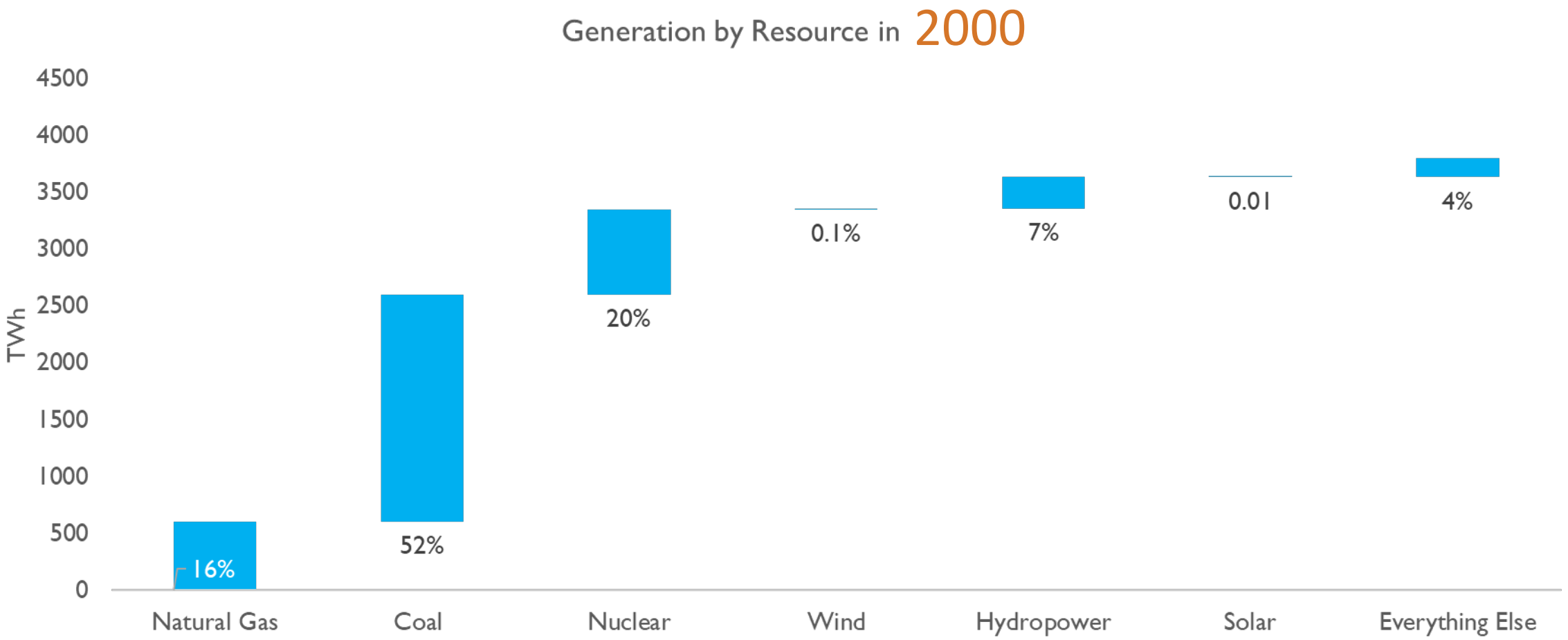
Source: https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php

Our resource mix changed a lot in 20 years



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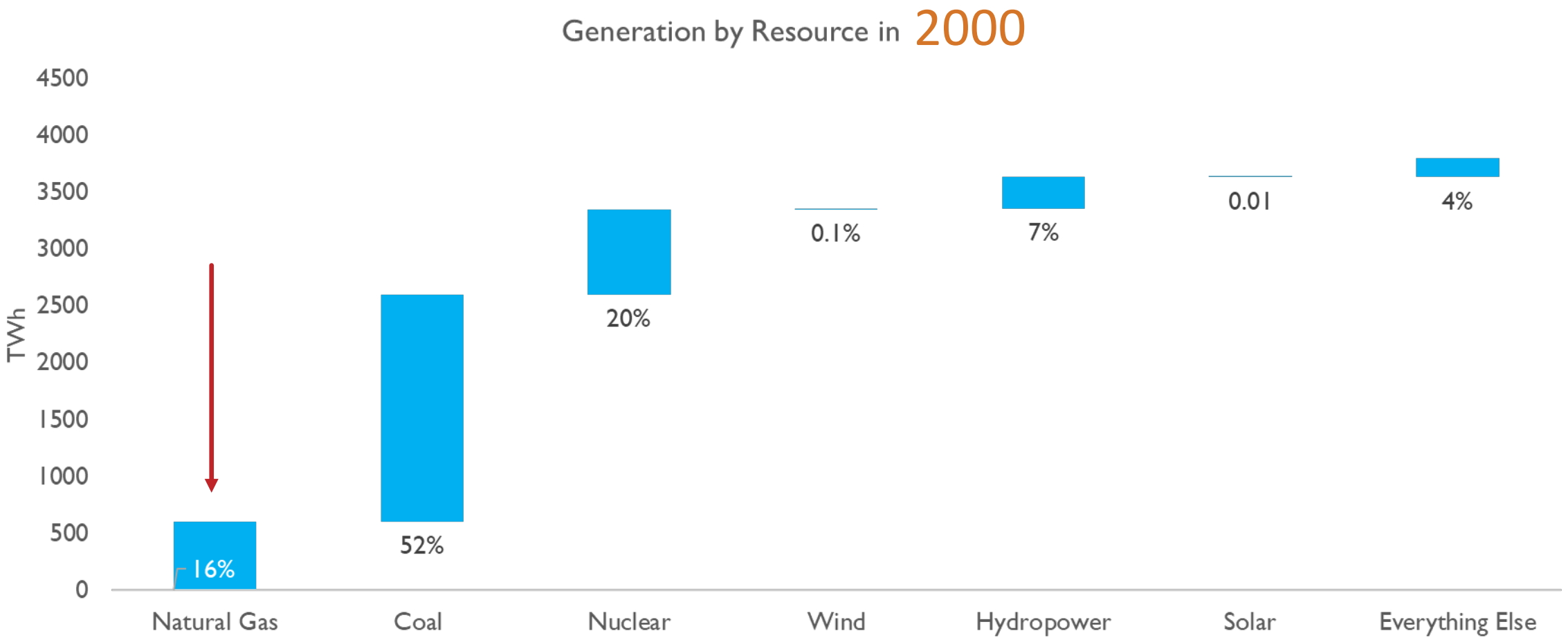
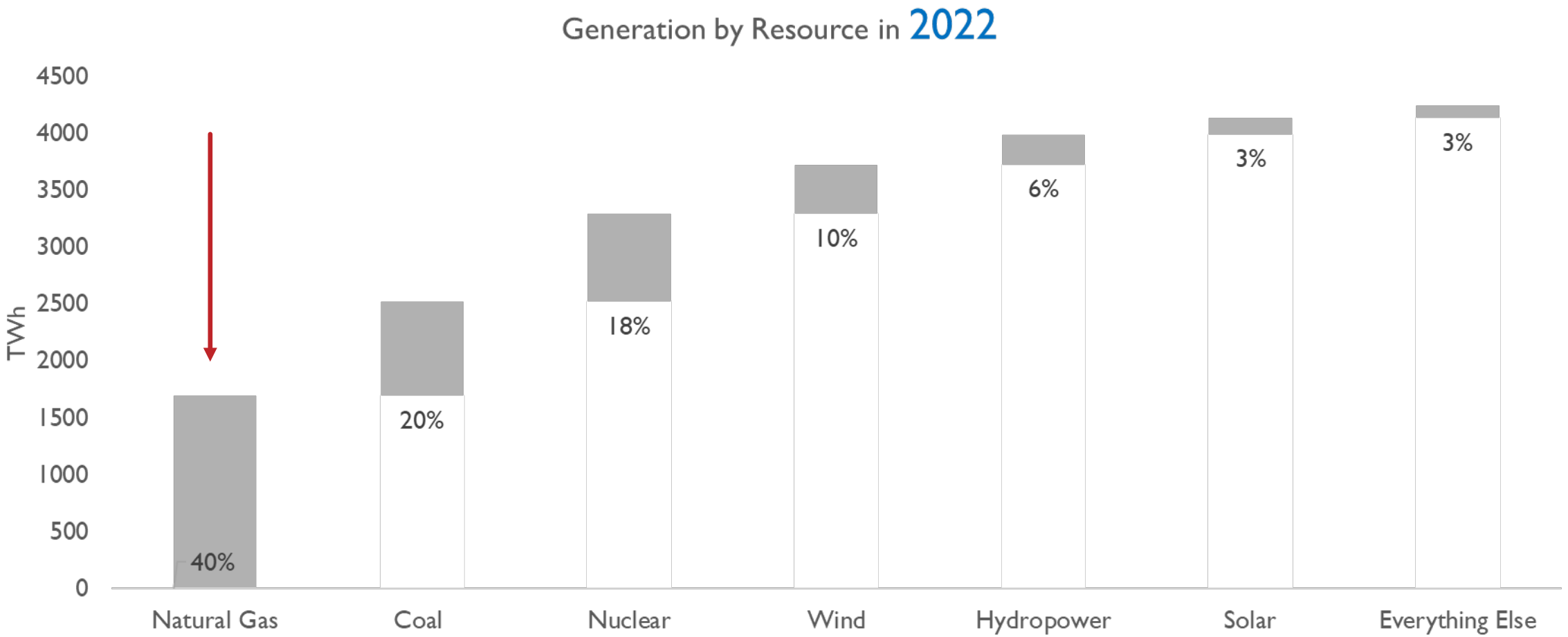
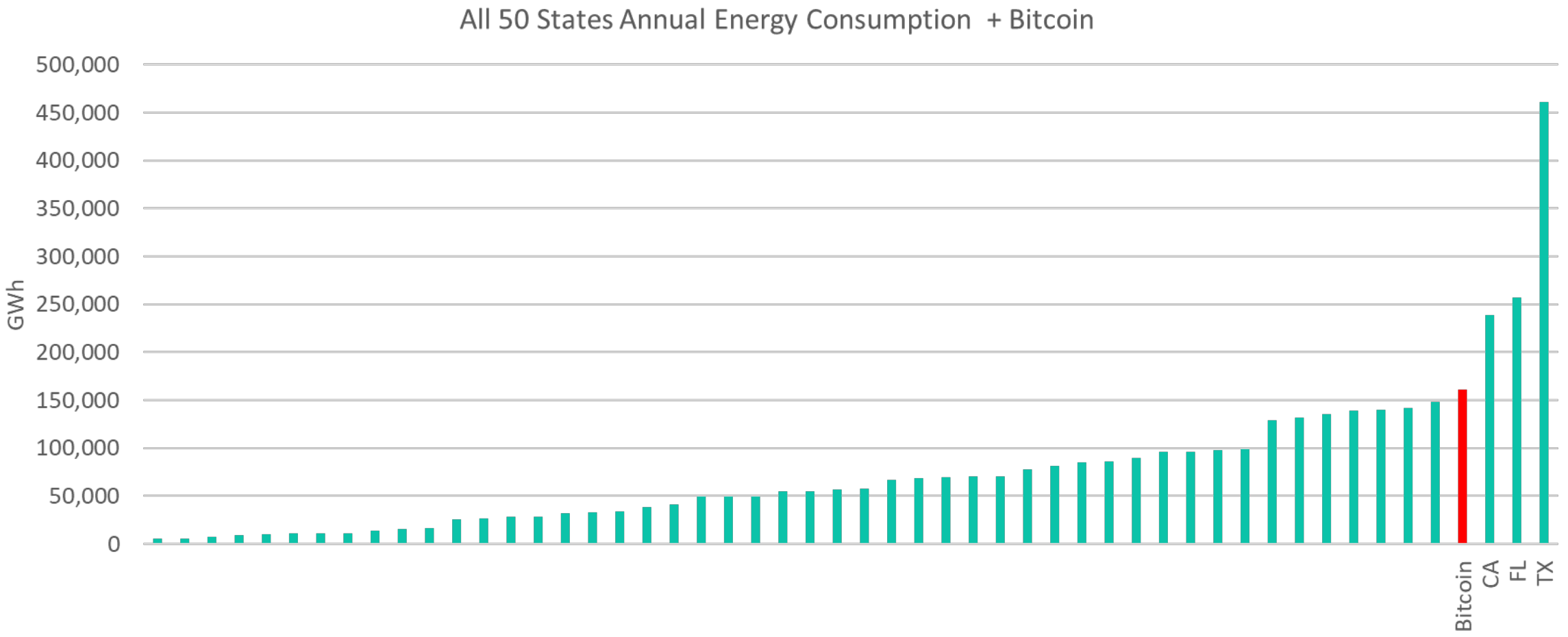


Gas jumped from 16% to 40%



There’s no shortage of load growth

Bitcoin uses *a lot* of energy

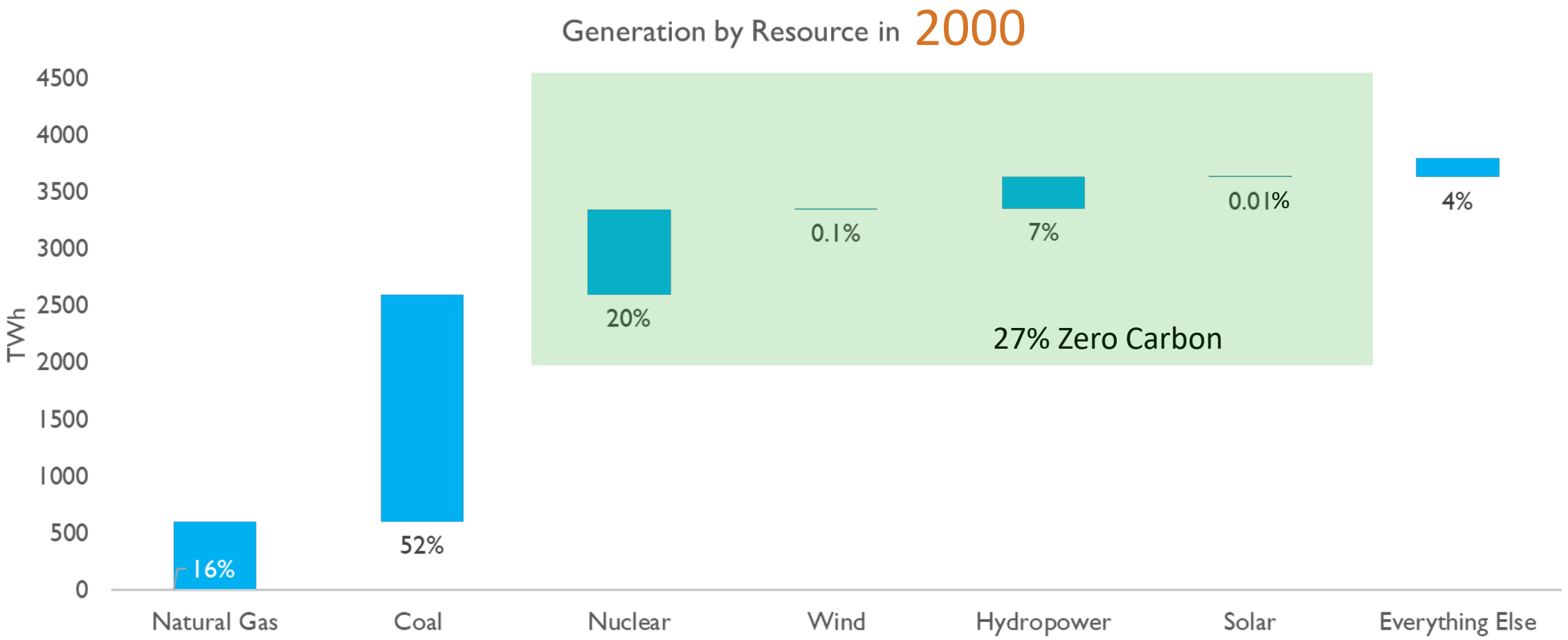


RENEWABLE FUNDAMENTALS

THE “OTHER” PRICE DRIVER

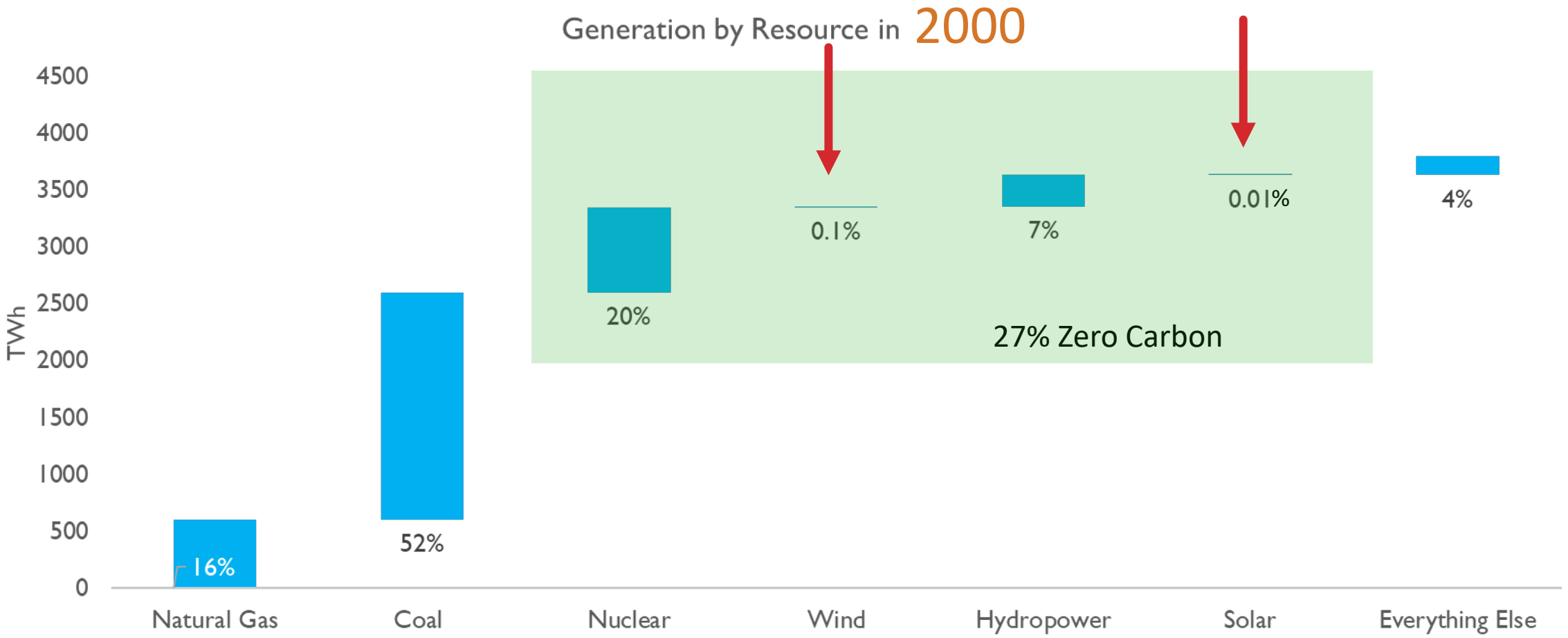

OLD MAN YELLS AT CLOUD

HOW MUCH DID RENEWABLES CONTRIBUTE YESTERDAY?



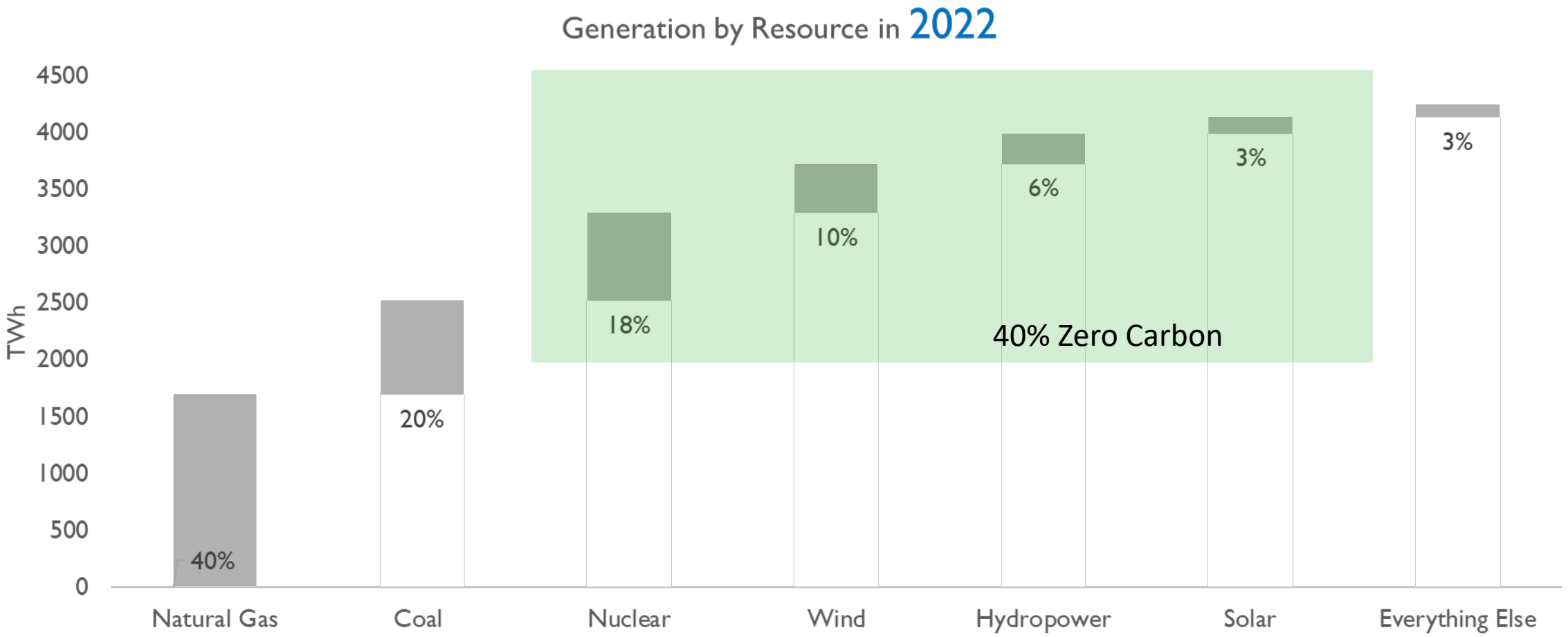
Source: Energy Information Administration: What is US electricity generation by energy source?

HOW MUCH DID RENEWABLES CONTRIBUTE YESTERDAY?



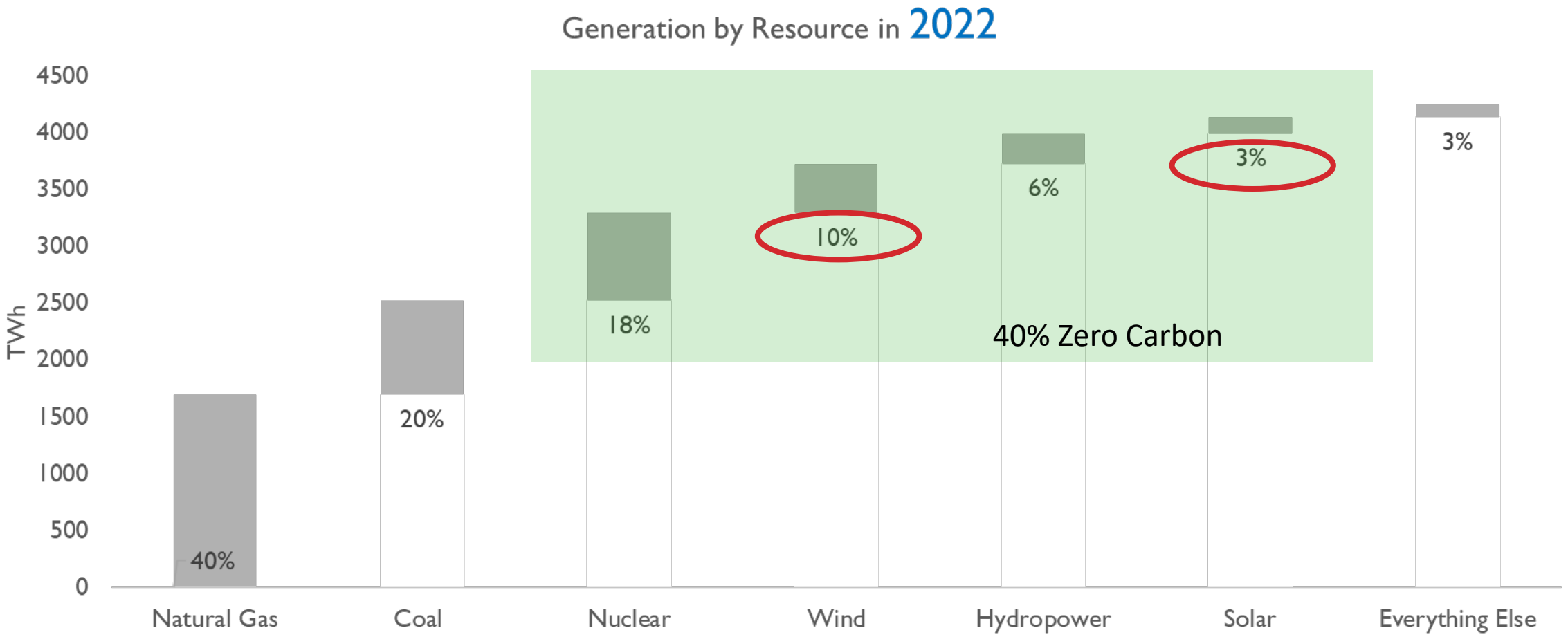
Source: Energy Information Administration: What is US electricity generation by energy source?

HOW MUCH DO RENEWABLES CONTRIBUTE TODAY?



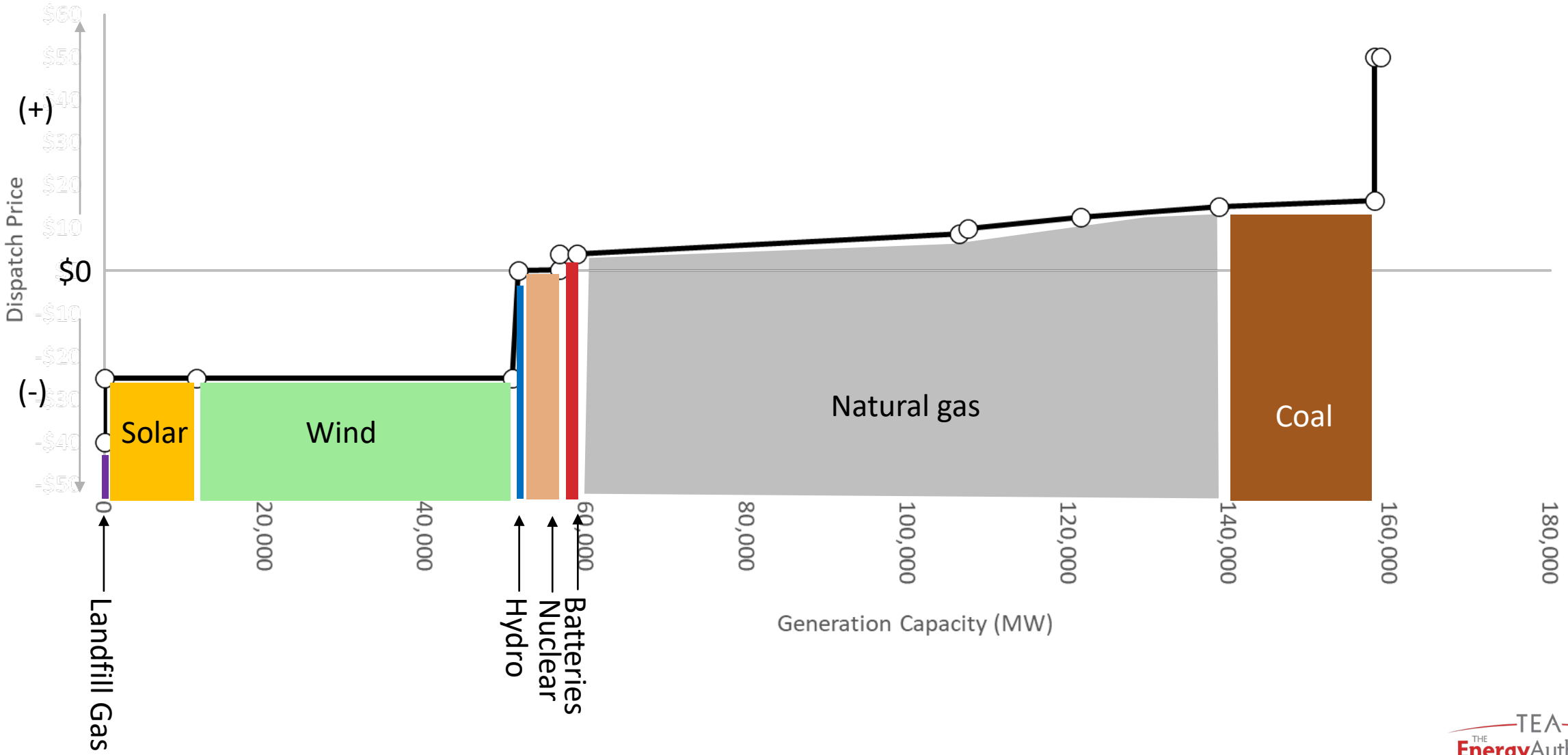
Source: Energy Information Administration: What is US electricity generation by energy source?

HOW MUCH DO RENEWABLES CONTRIBUTE TODAY?



Source: Energy Information Administration: What is US electricity generation by energy source?

The merit order



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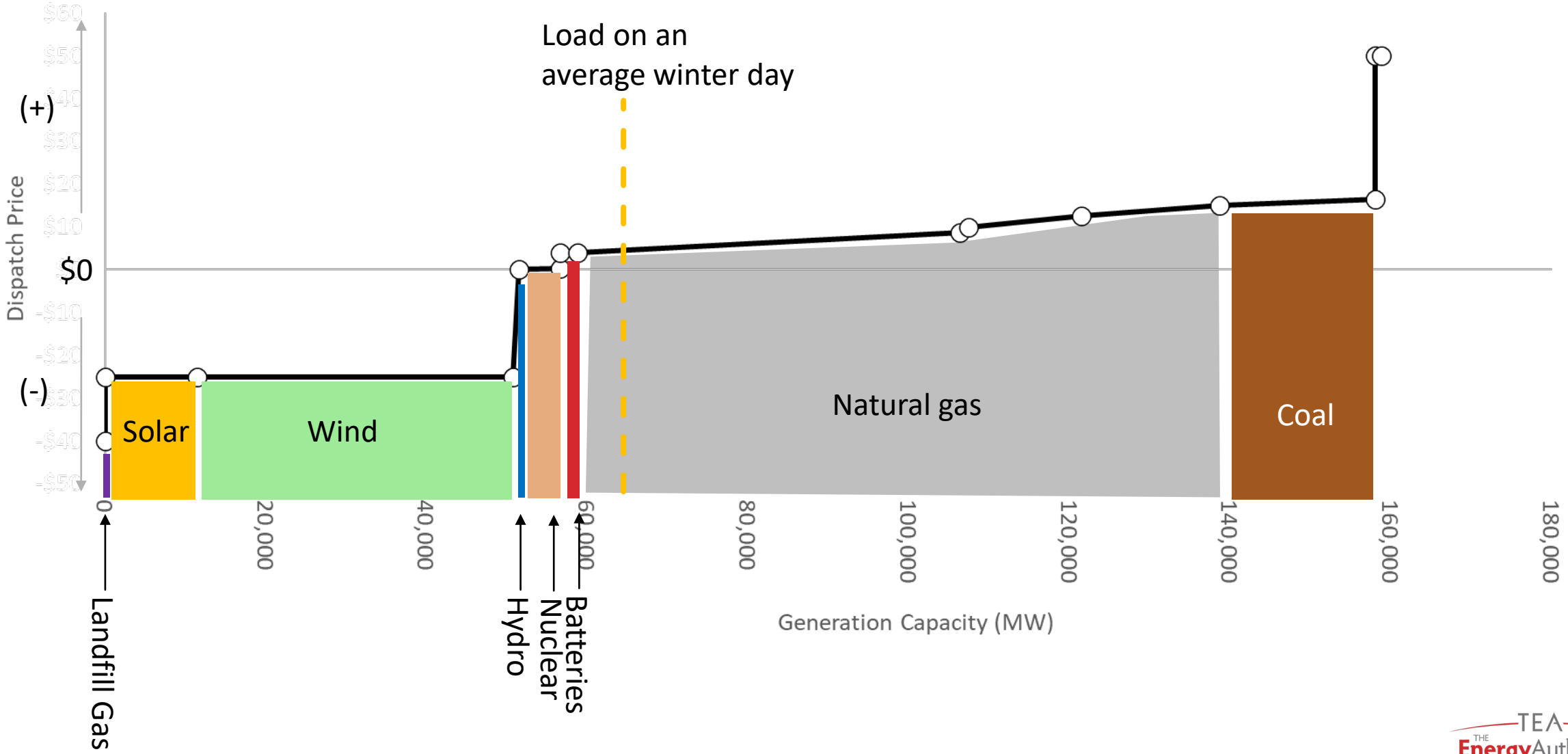

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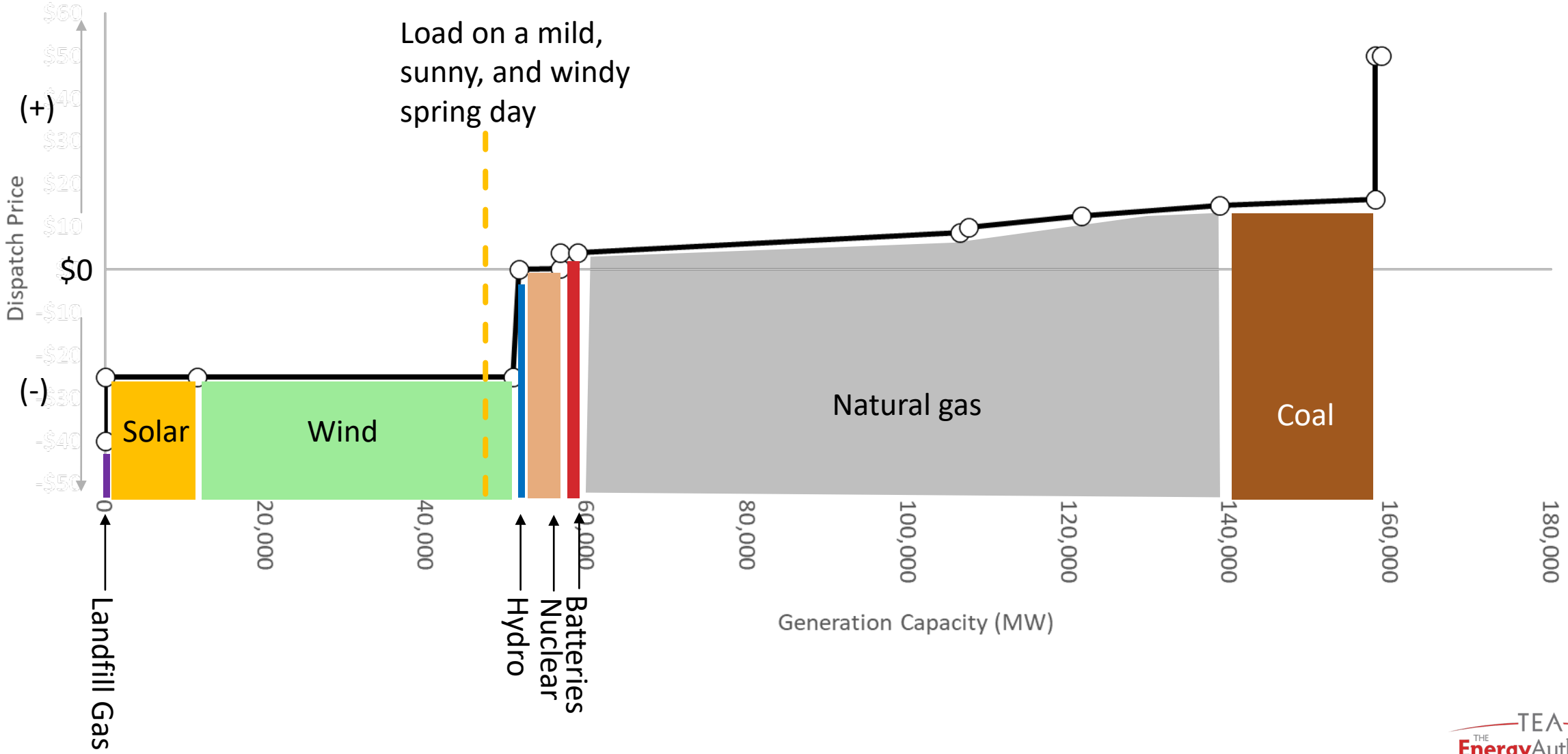

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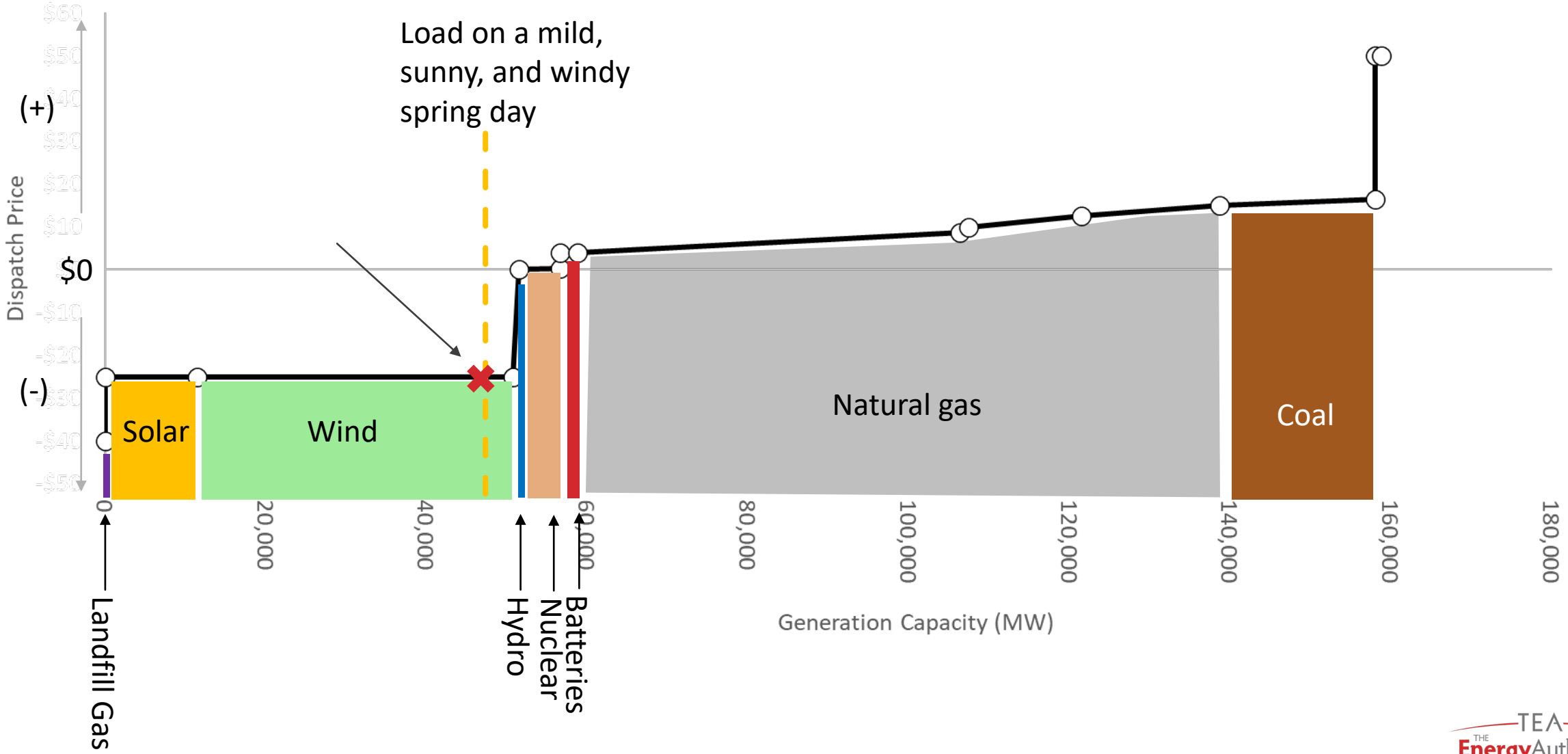
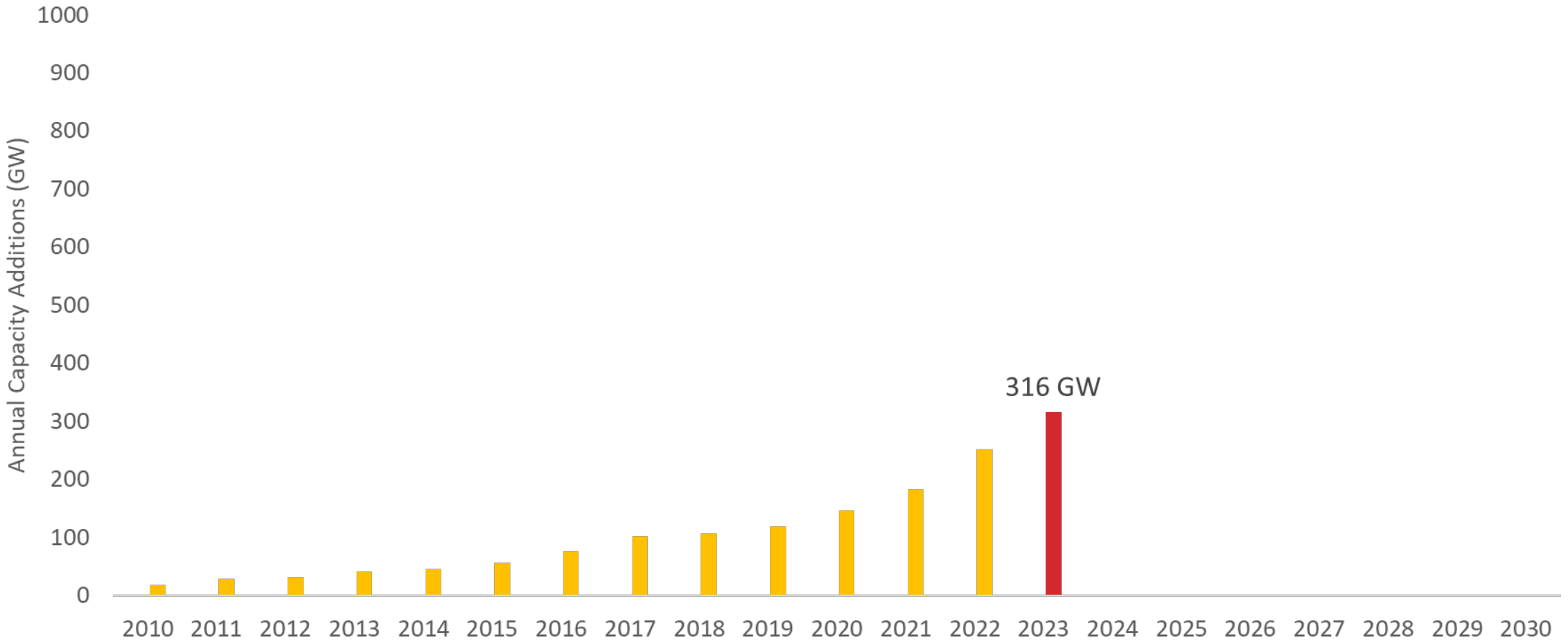
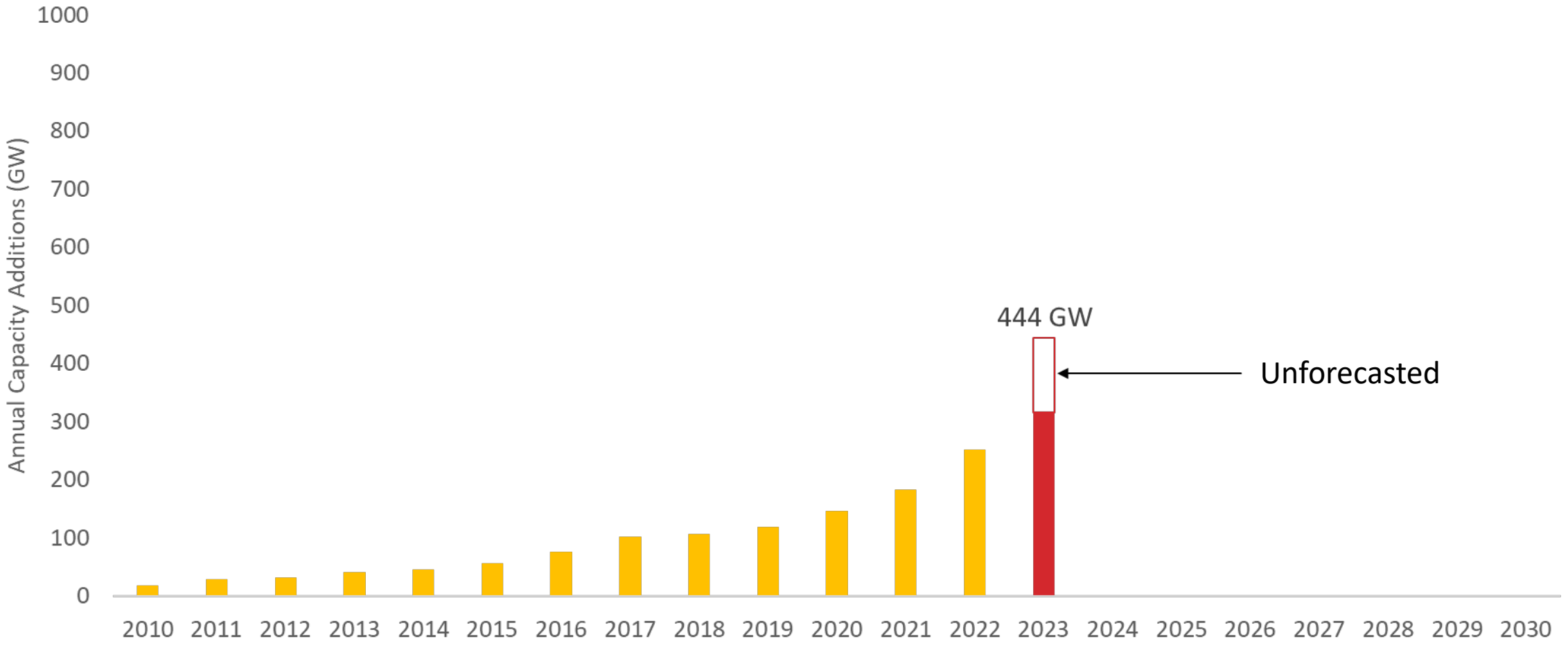


How did the solar forecast for 2023 compare to actuals (globally)?



Source: 1Q 2023 Global PV Market Outlook

Actual installations were 130GW higher than forecasted



Source: BNEF 1Q 2023 Global PV Market Outlook; Jenny Chase (BNEF)

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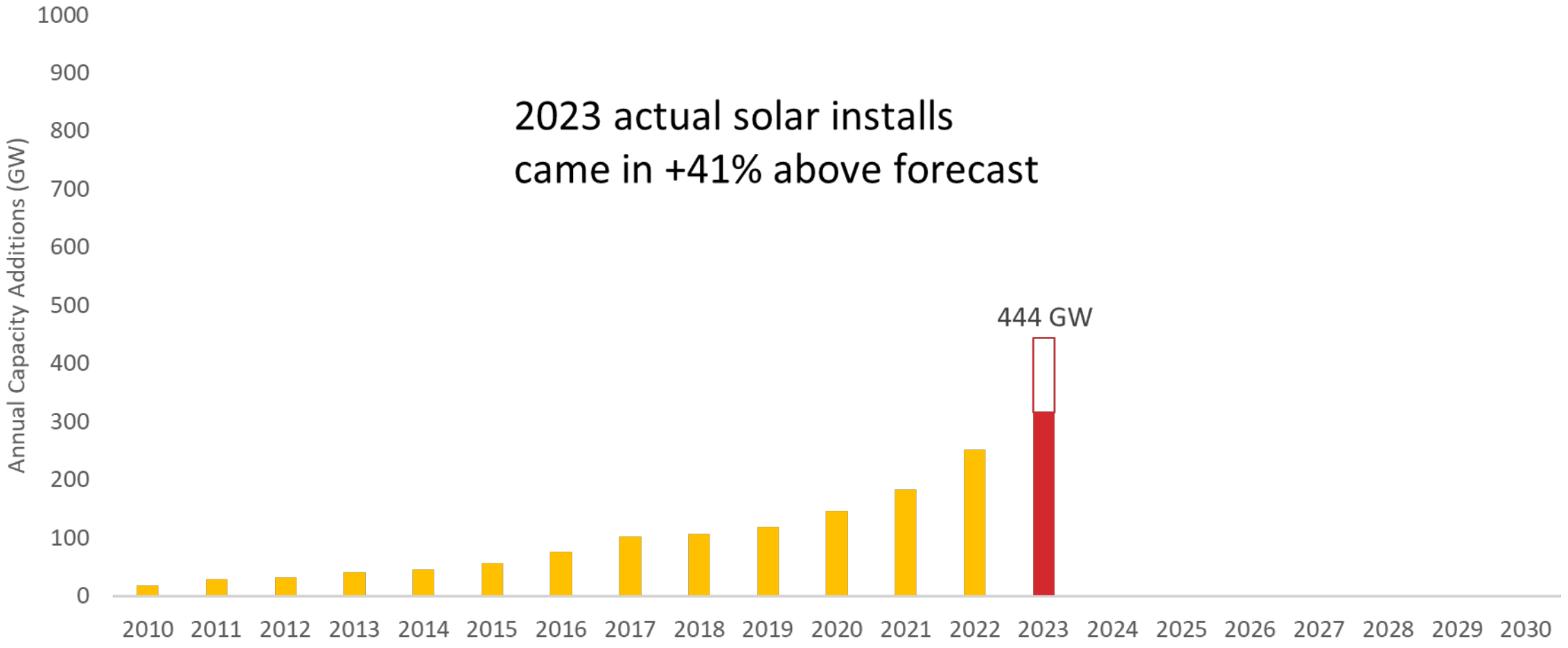
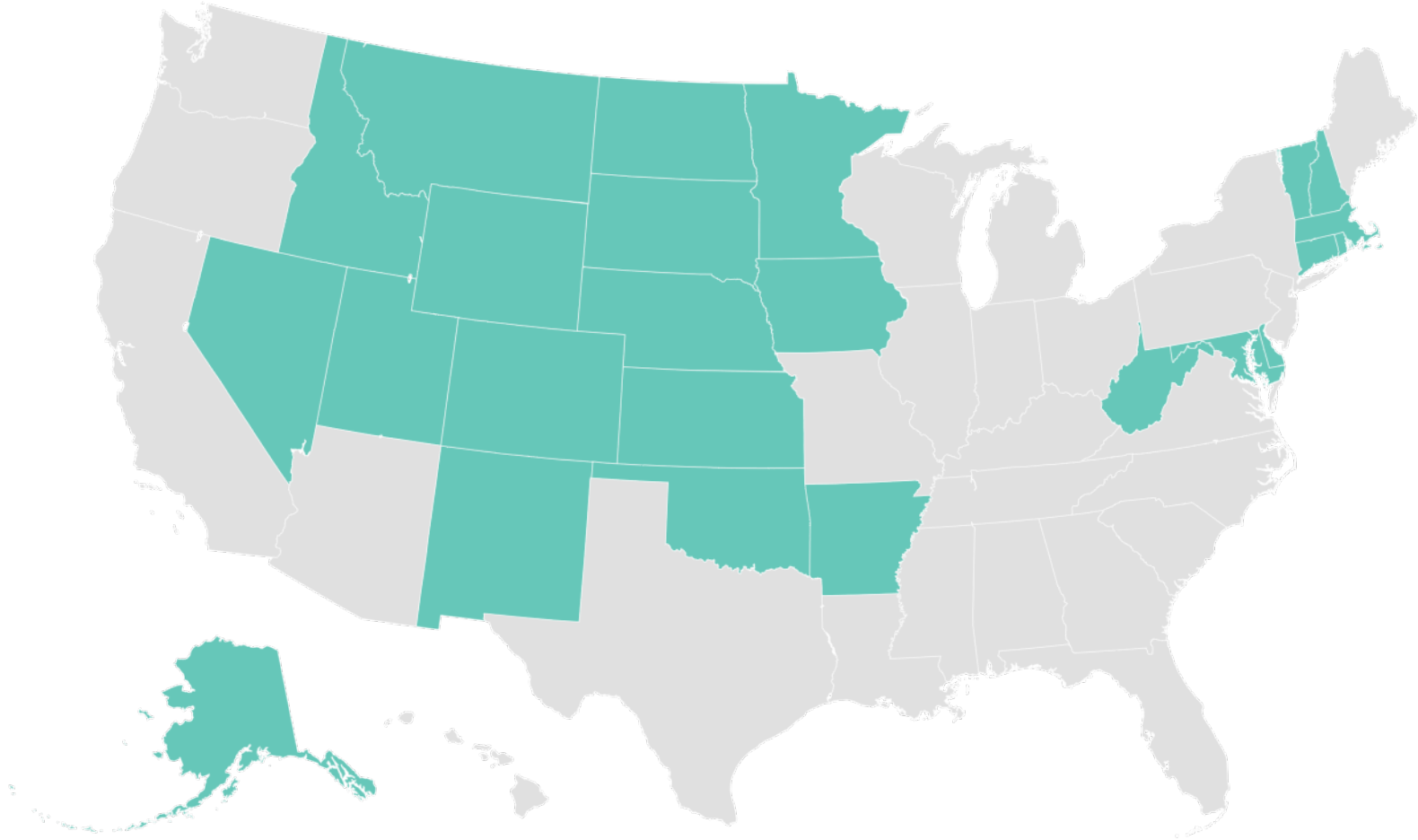


Source: BNEF 1Q 2023 Global PV Market Outlook; Jenny Chase (BNEF)

443 GW is a lot of capacity. And energy.

$$443GW \times 8760\ hrs \times 23\%\ CF = 892{,}556\ GWh$$

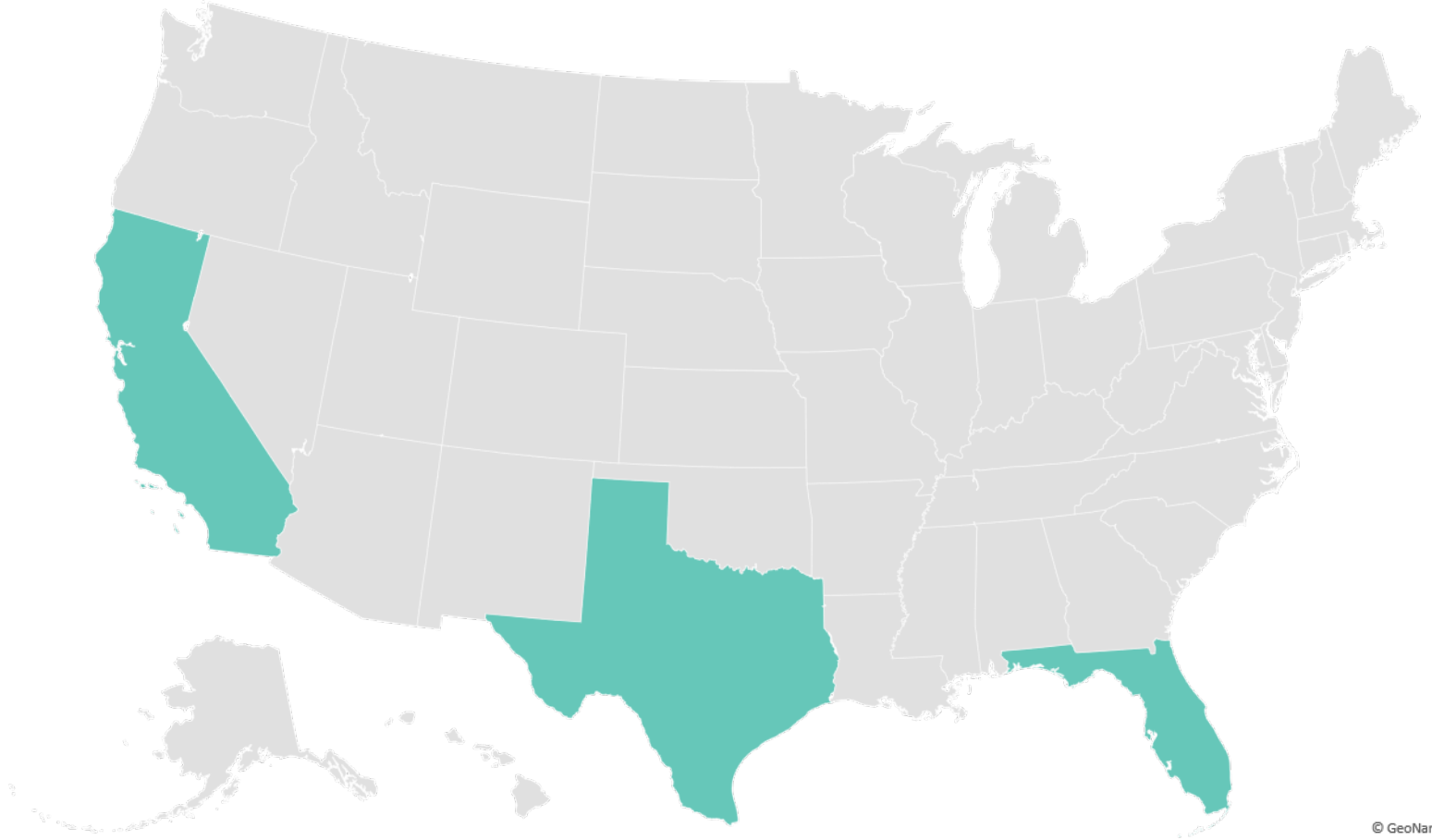
Enough solar was installed in 2023 to satisfy energy (not capacity!) needs of 29 states



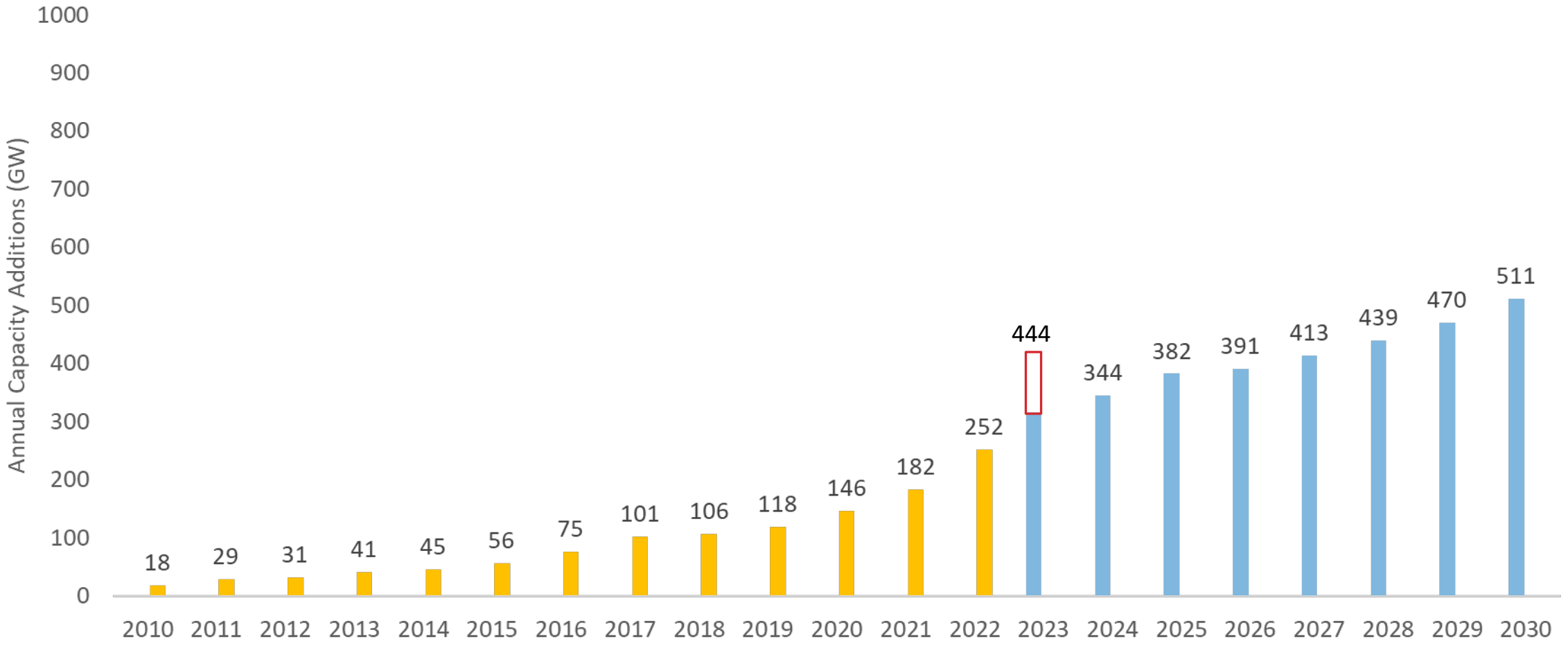
443 GW is a lot of capacity. And energy.

$$443GW \times 8760\ hrs \times 23\%\ CF = 892{,}556\ GWh$$

Enough solar was installed in 2023 to nearly power the 3 largest economies in the US



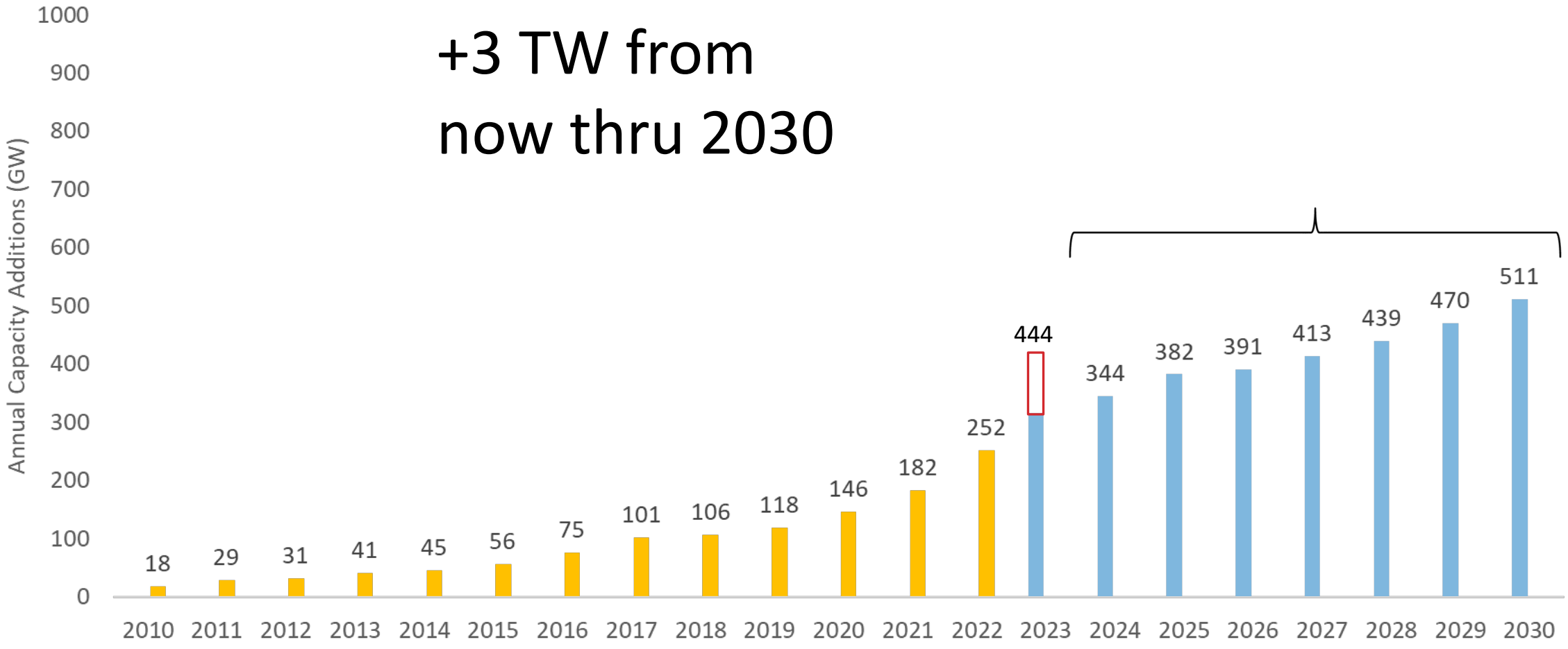
Here's the rest of the forecast (globally).



Source: BNEF 1Q 2023 Global PV Market Outlook; Jenny Chase (BNEF)

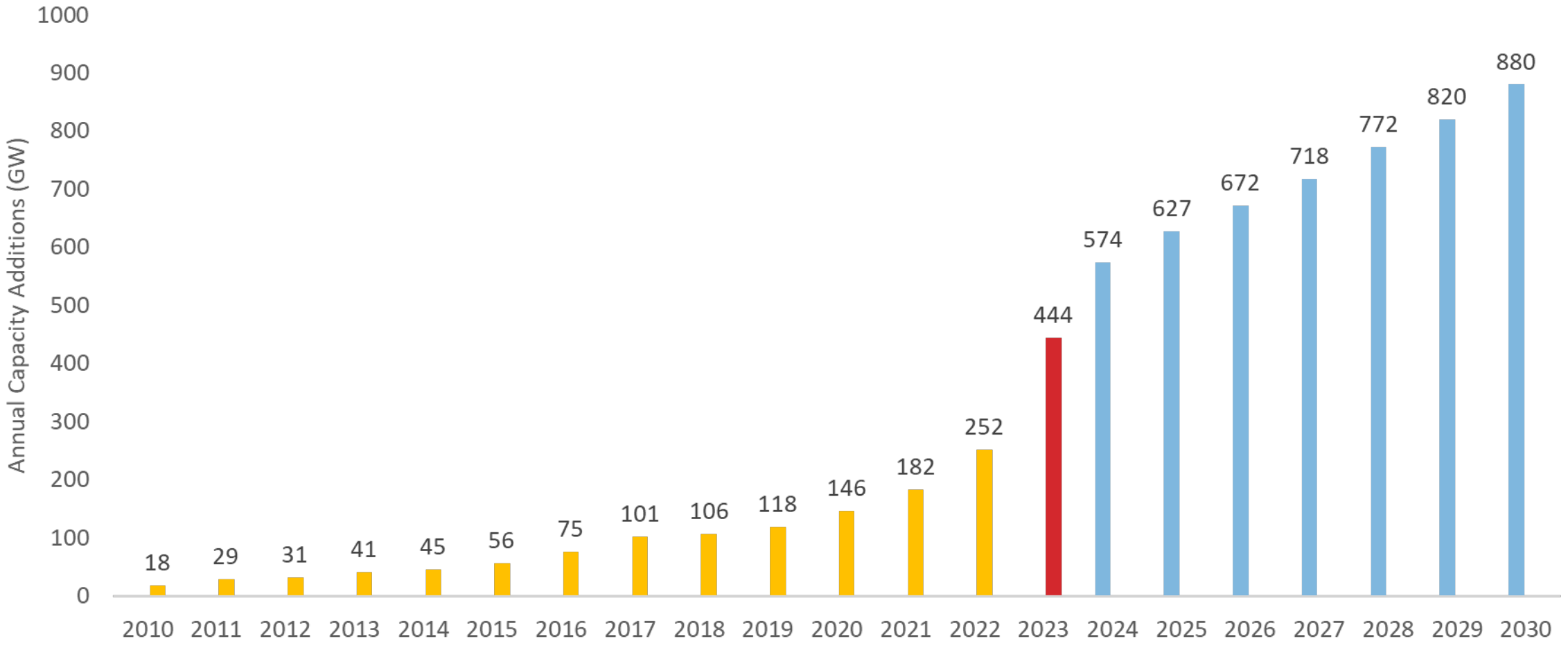
Here's the 2023 forecast (globally).

+3 TW from
now thru 2030



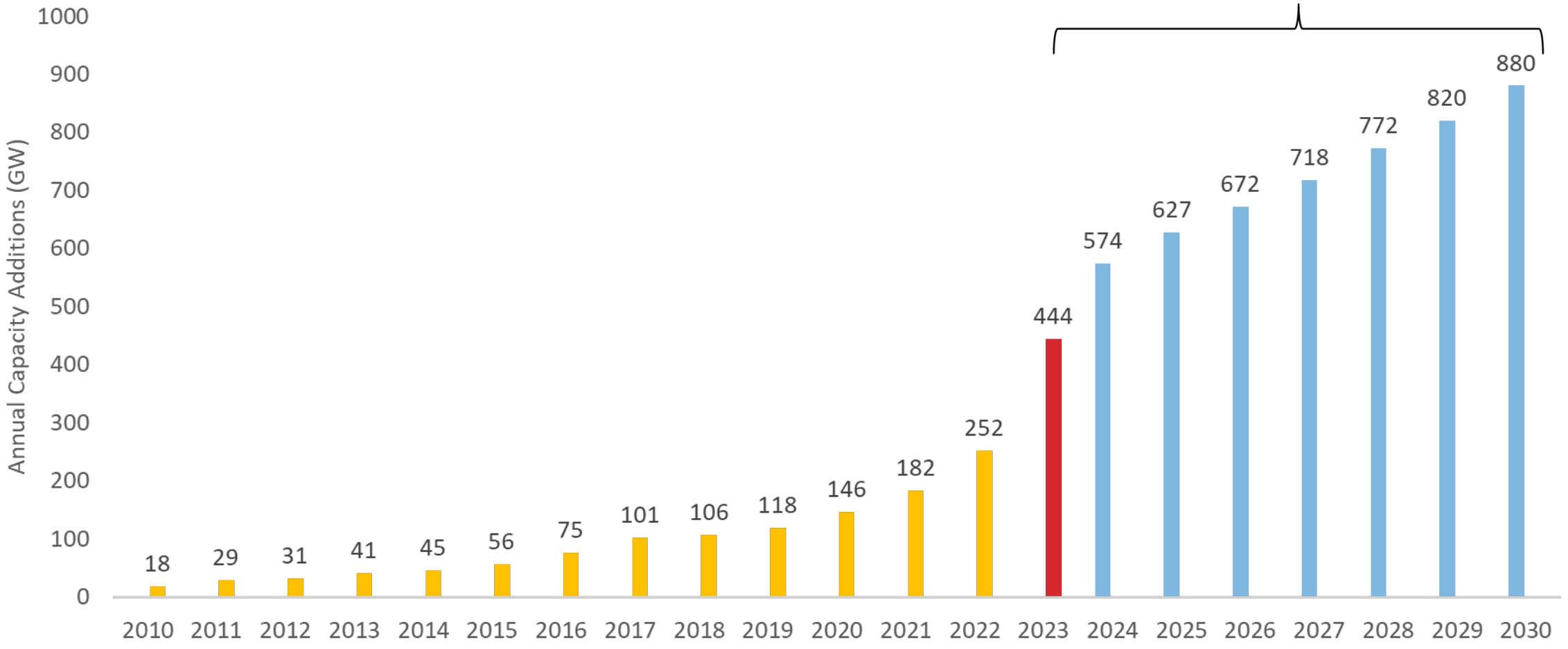
Source: BNEF 1Q 2023 Global PV Market Outlook; Jenny Chase (BNEF)

Now let's compare it to 2024 (globally).



Source: BNEF 1Q 2024 Global PV Market Outlook

Mind boggling annual solar capacity additions (globally)



Source: BNEF 1Q 2024 Global PV Market Outlook

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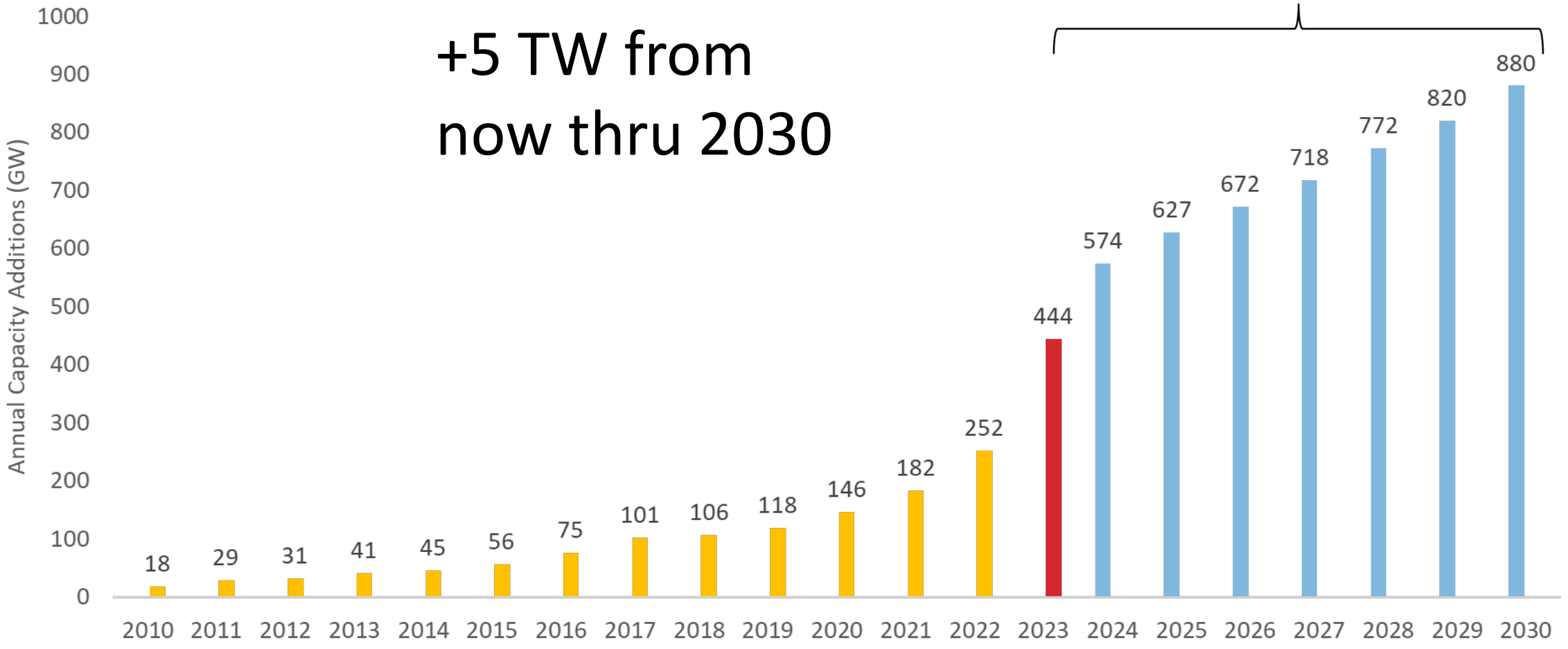
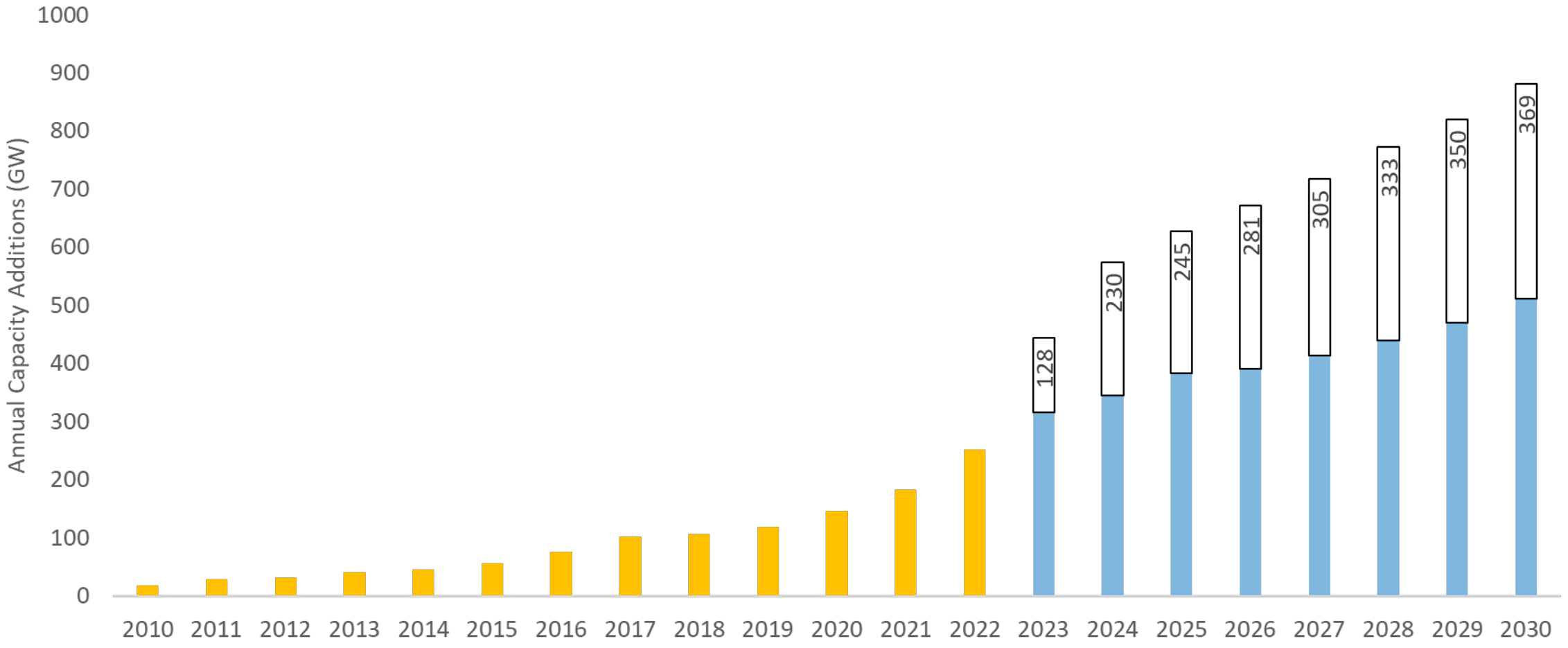


Source: BNEF 1Q 2024 Global PV Market Outlook

What changed in a year? A lot!



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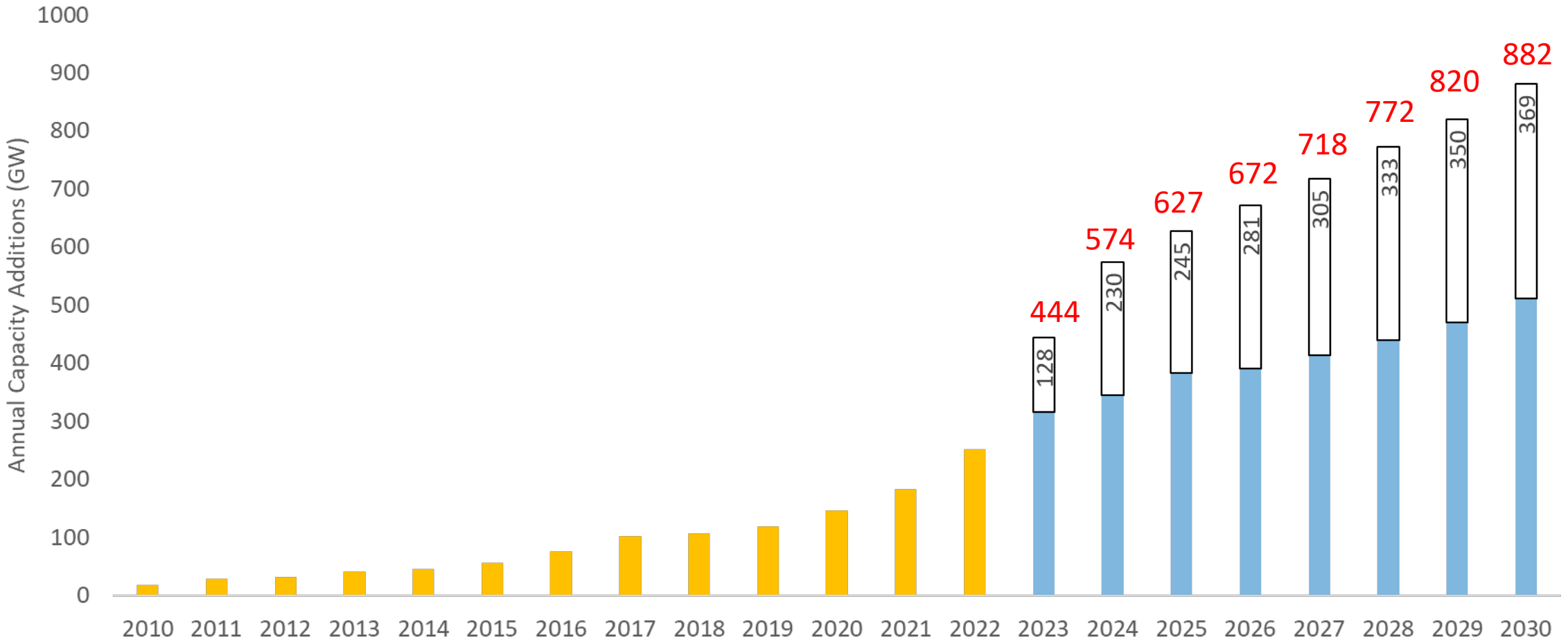

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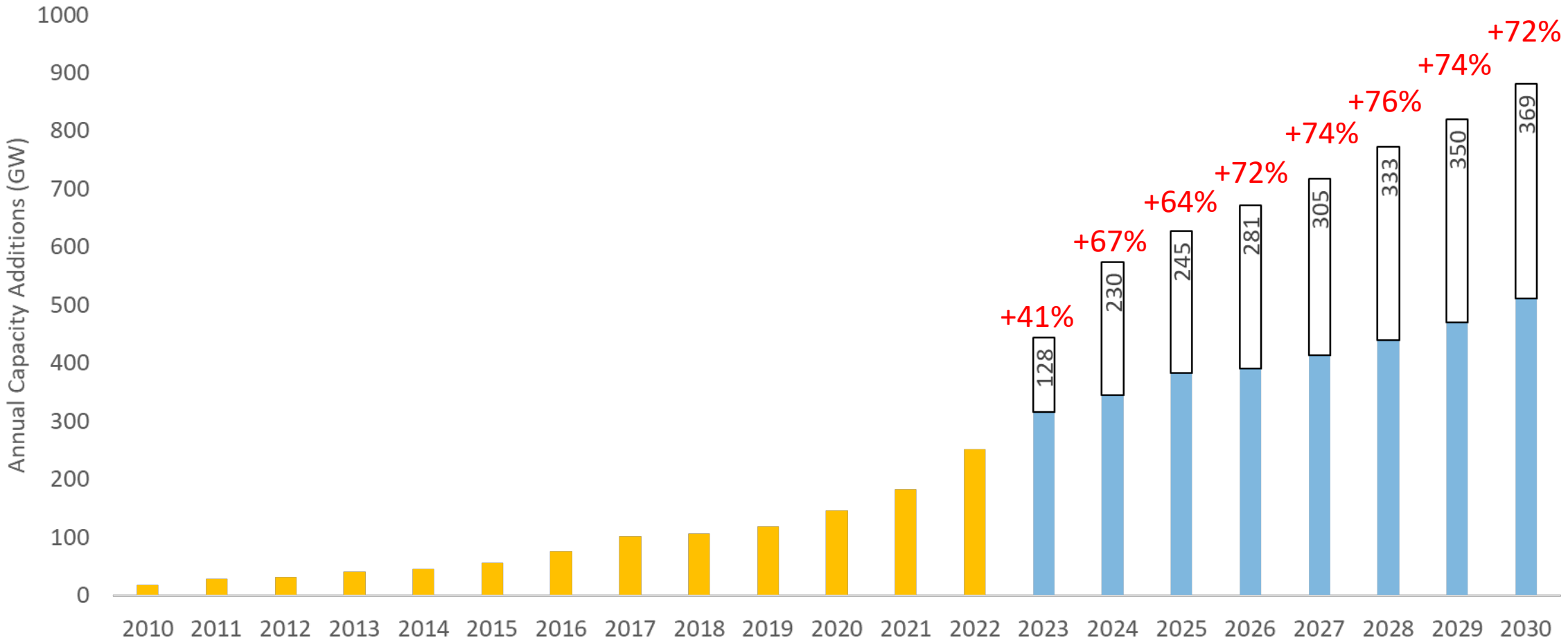
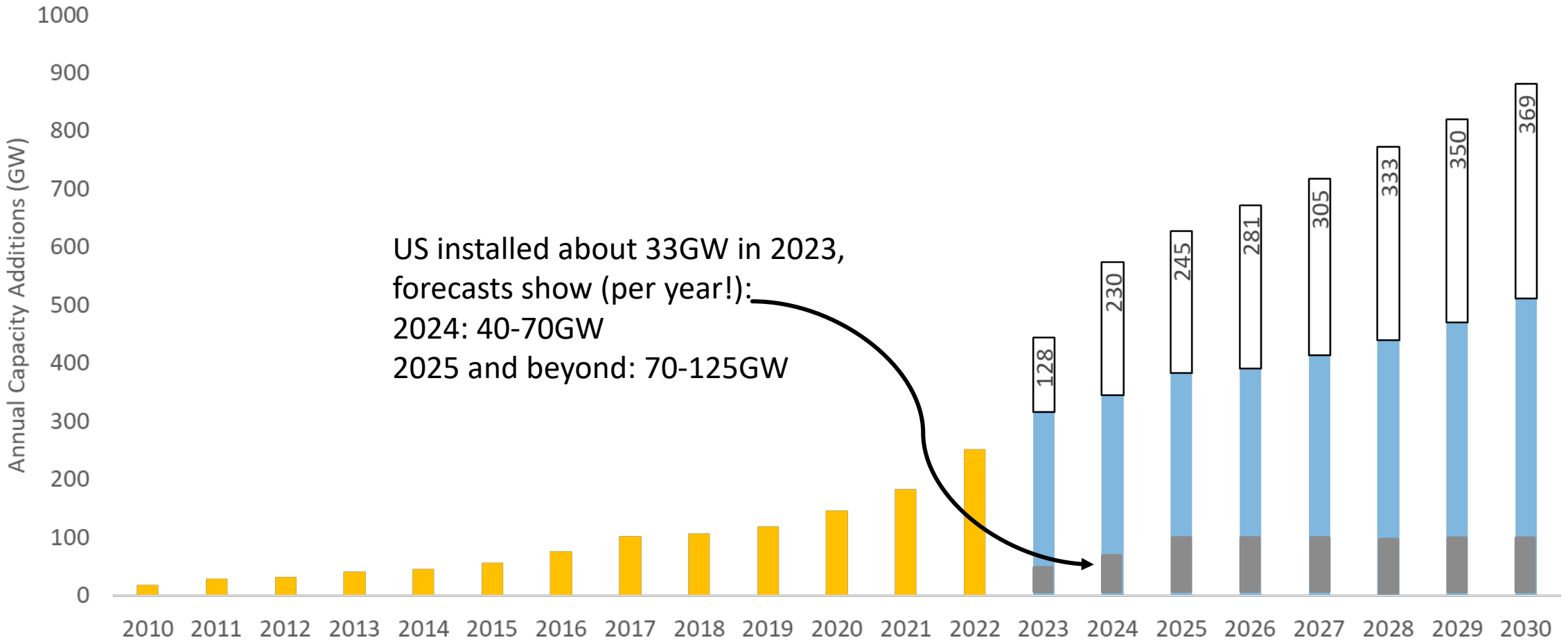
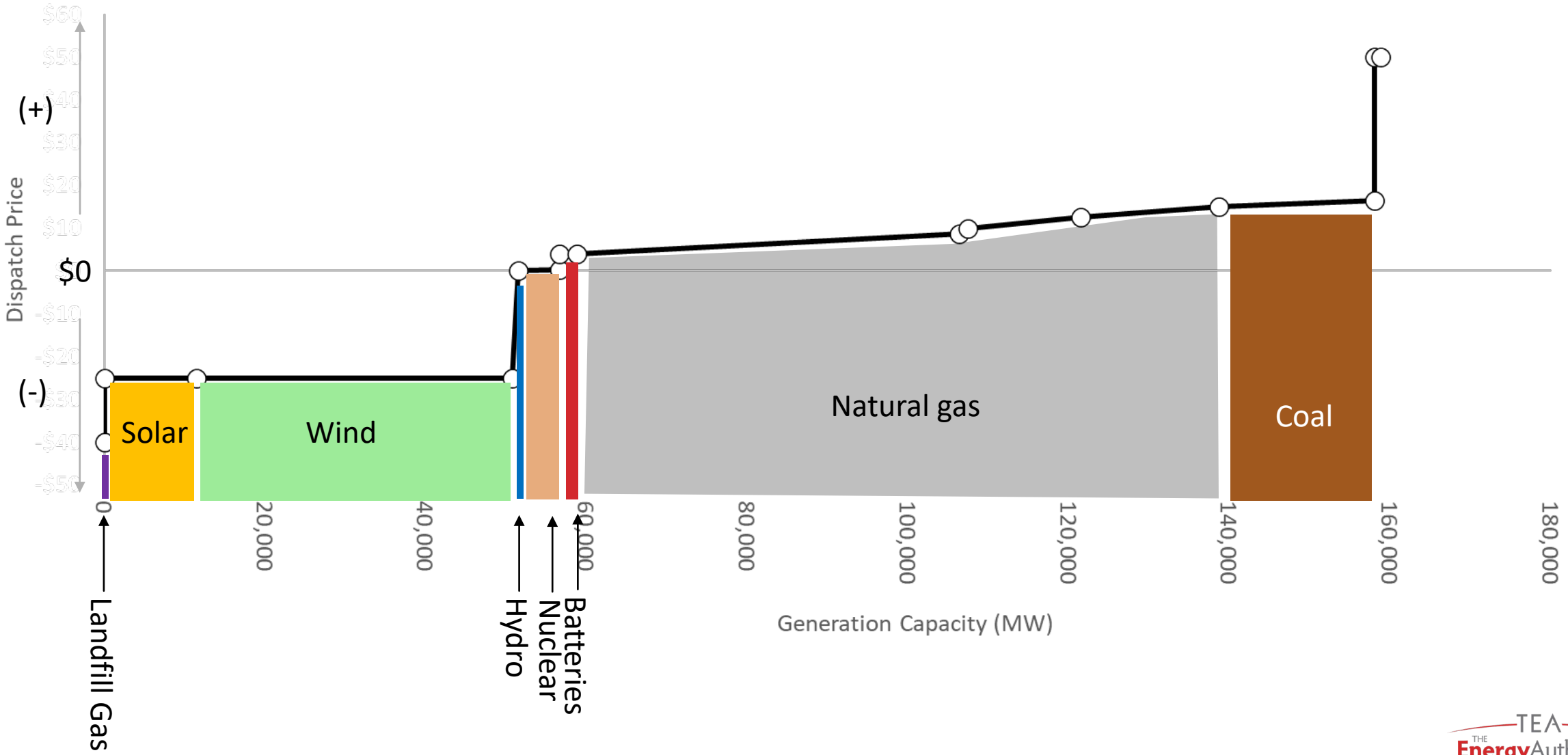


65% upward revision to the forecast!

40% upward revision to the forecast!



The merit order



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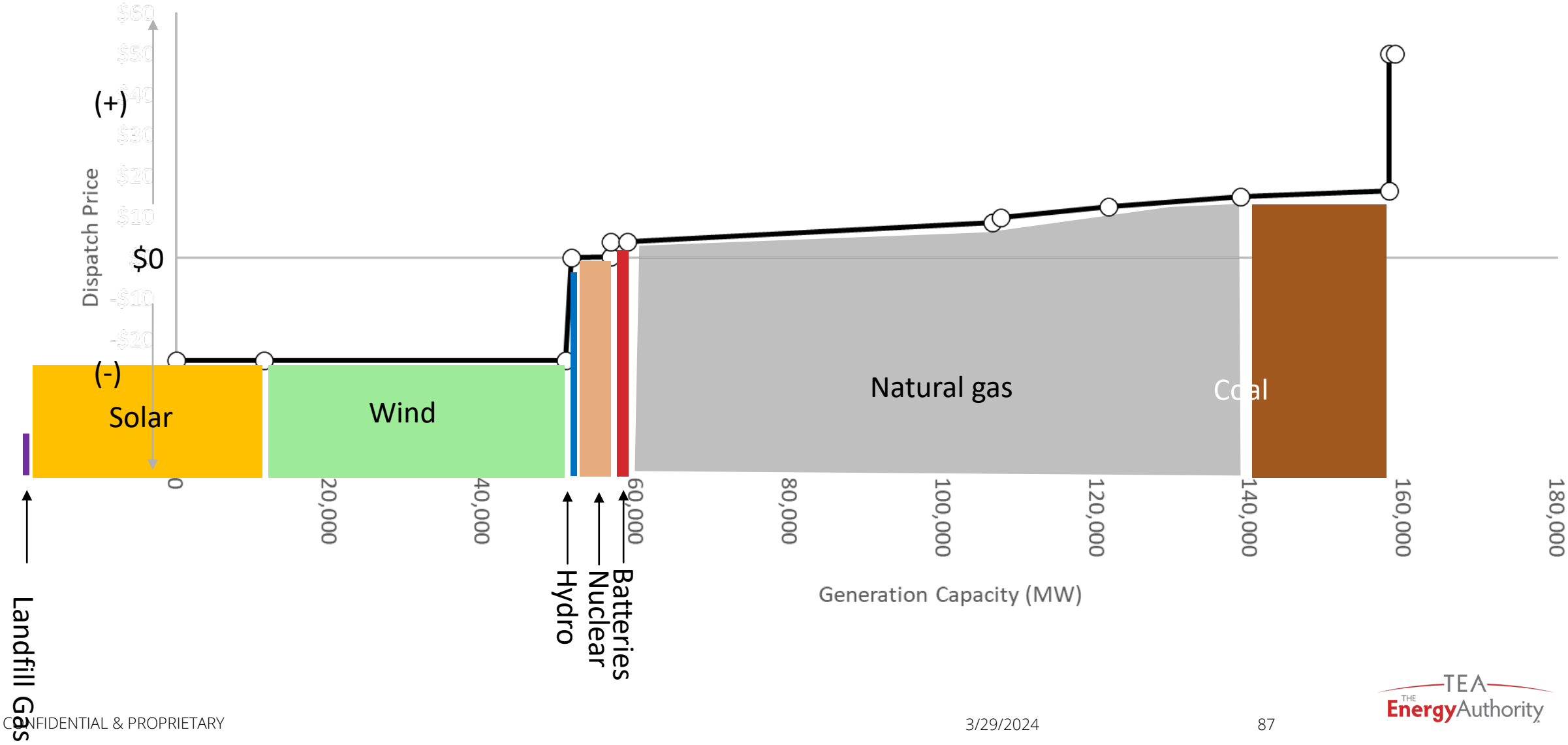
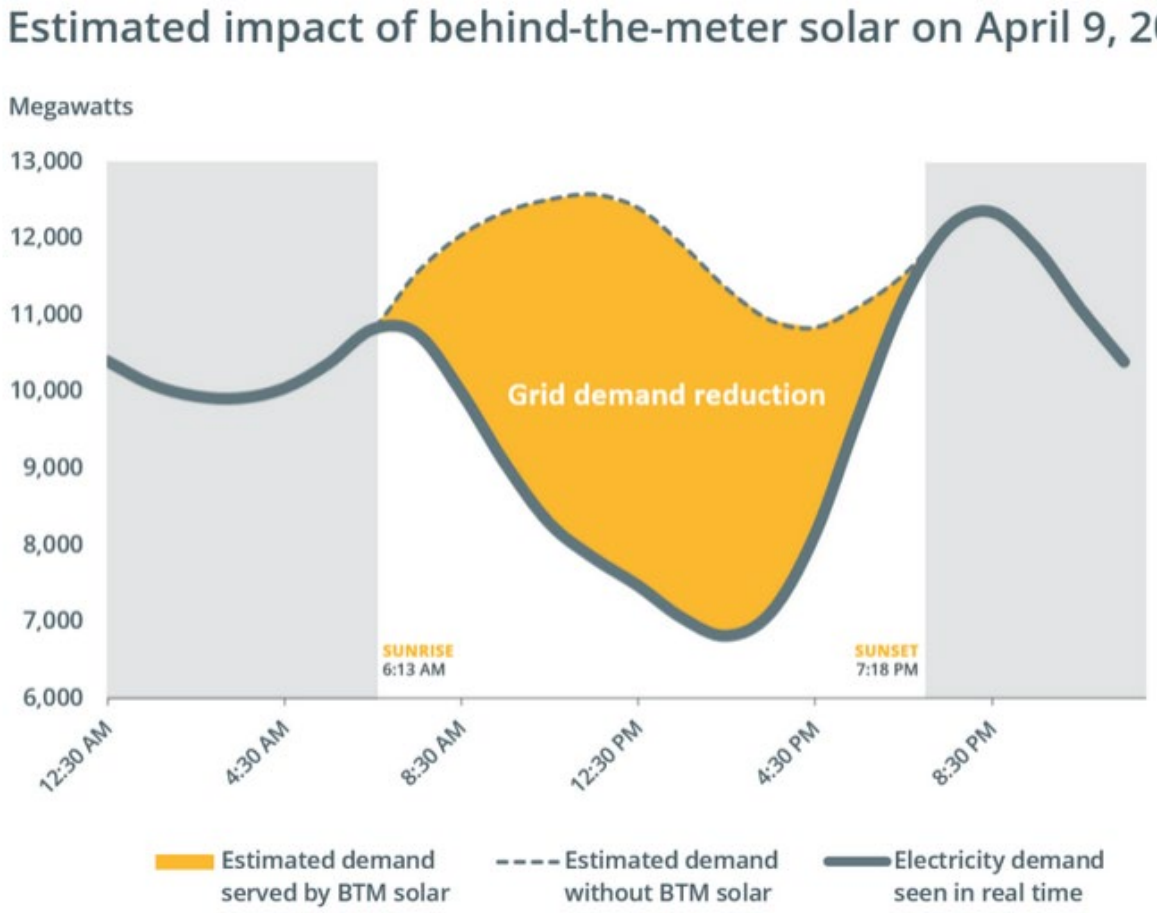


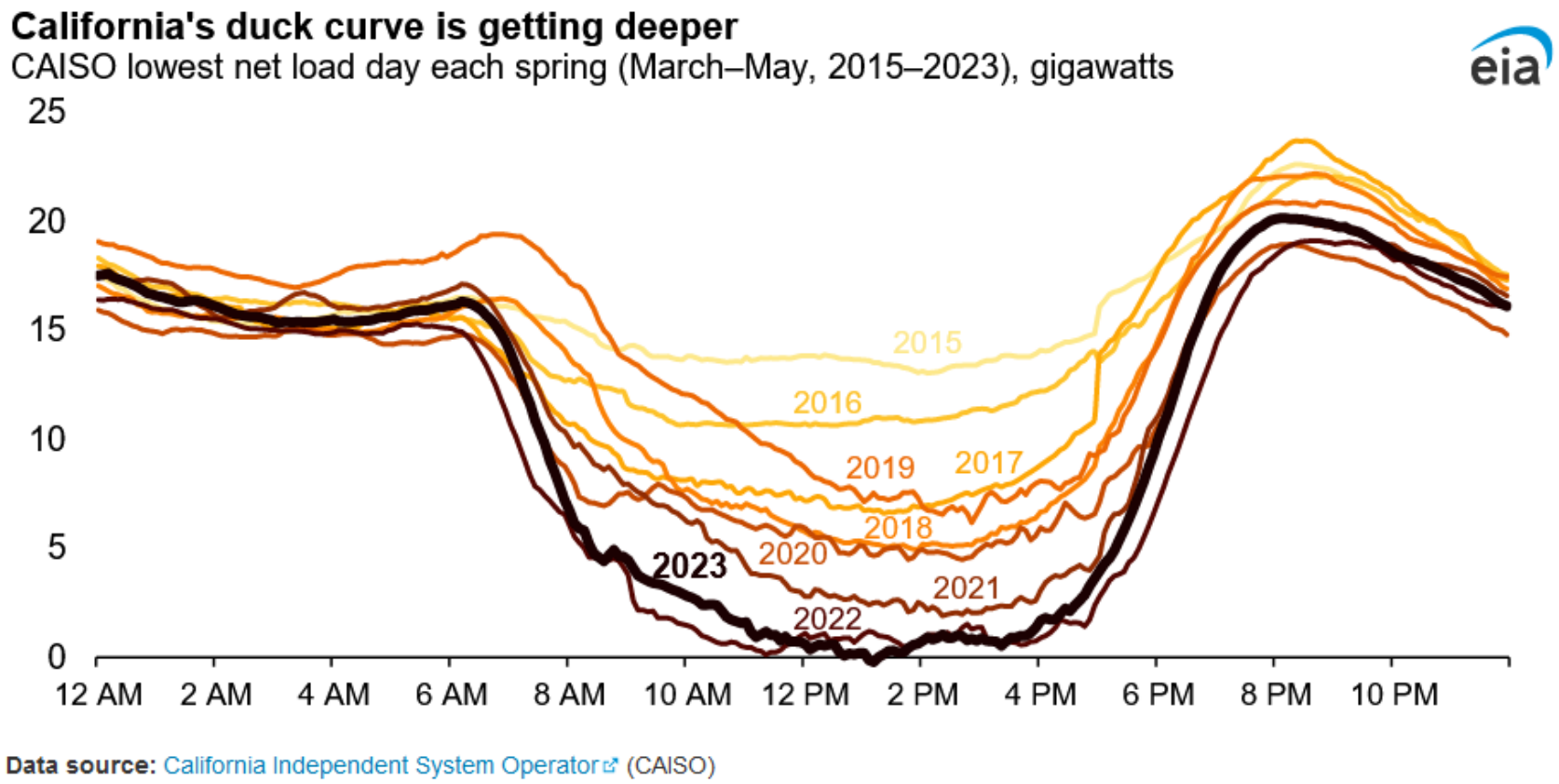
Solar oversupply can cause problems



Source: https://isonewswire.com/2024/02/28/duck-curve-days-becoming-more-frequent-as-solar-power-spreads/

And it’s worse in California

As solar capacity grows, duck curves are getting deeper in California



Source: https://www.eia.gov/todayinenergy/detail.php?id=56880

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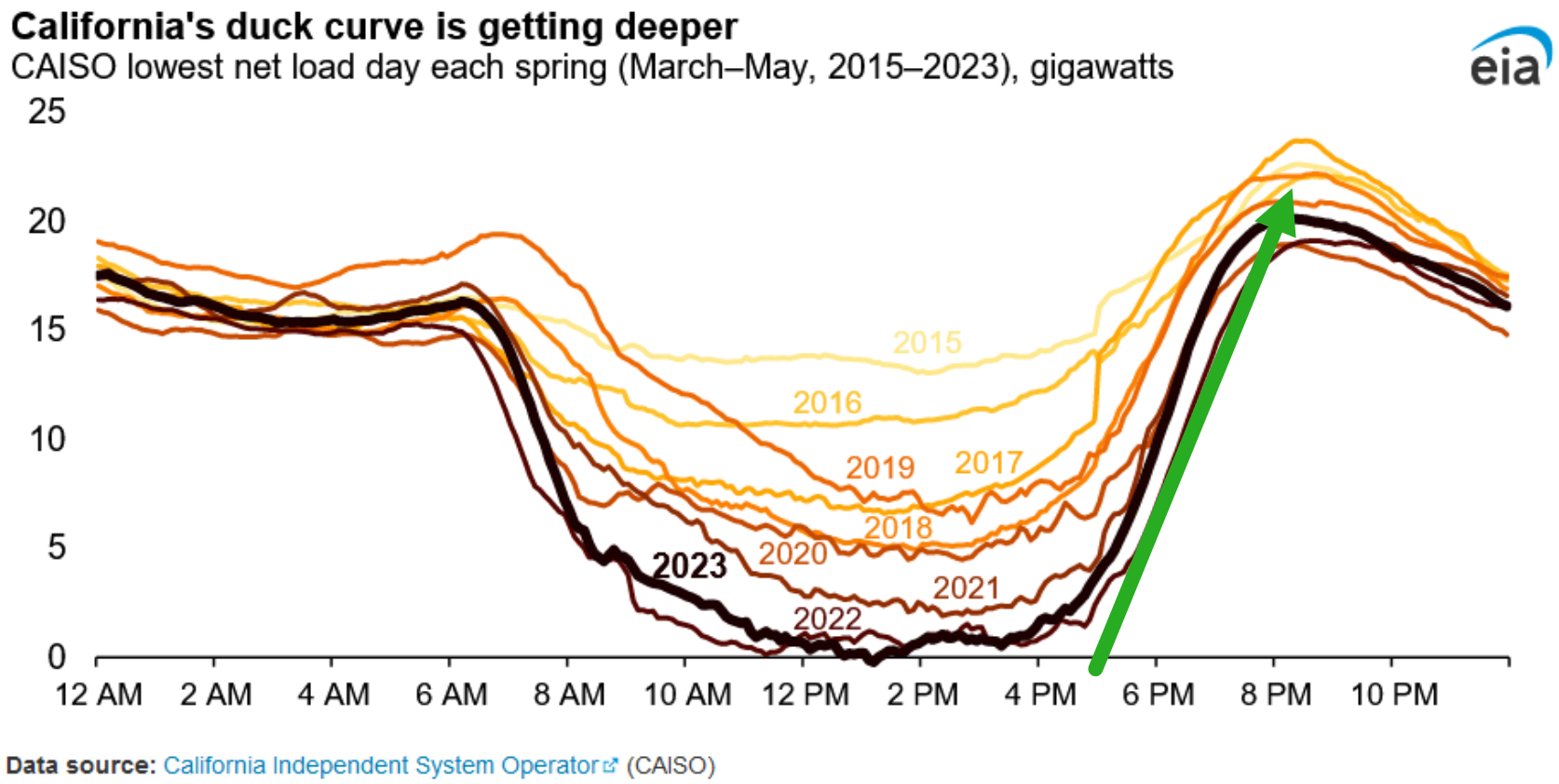

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Batteries to the rescue

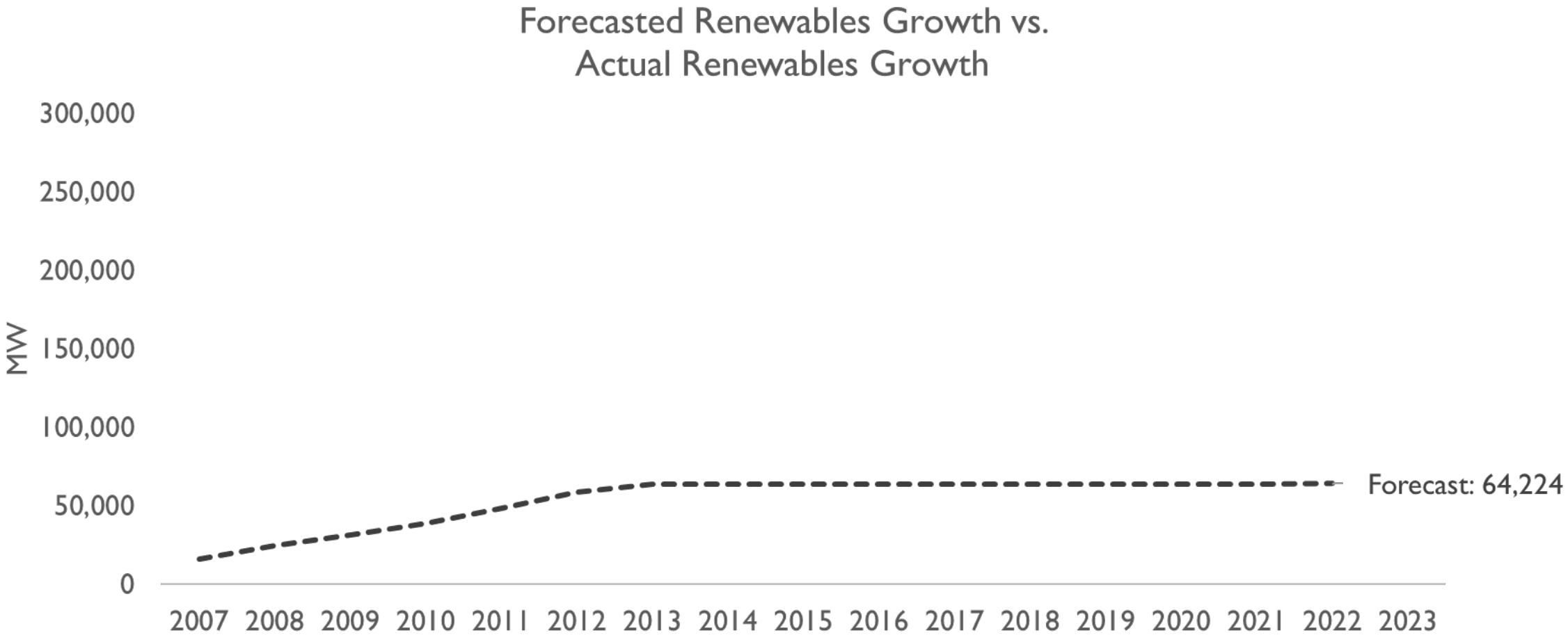
370GW Projected 2023-30 US solar build, nearly three times the total solar capacity installed as of 2022.

128GW Projected 2023-2030 US wind build, nearly doubling total wind capacity installed as of 2022.

121GW Projected 2023-30 US battery storage build, almost 10 times the total storage capacity installed as of 2022.

WHY ARE RENEWABLES DOMINATING NEW RESOURCE BUILDS?

Nobody really saw this coming: 2010 forecast vs. reality



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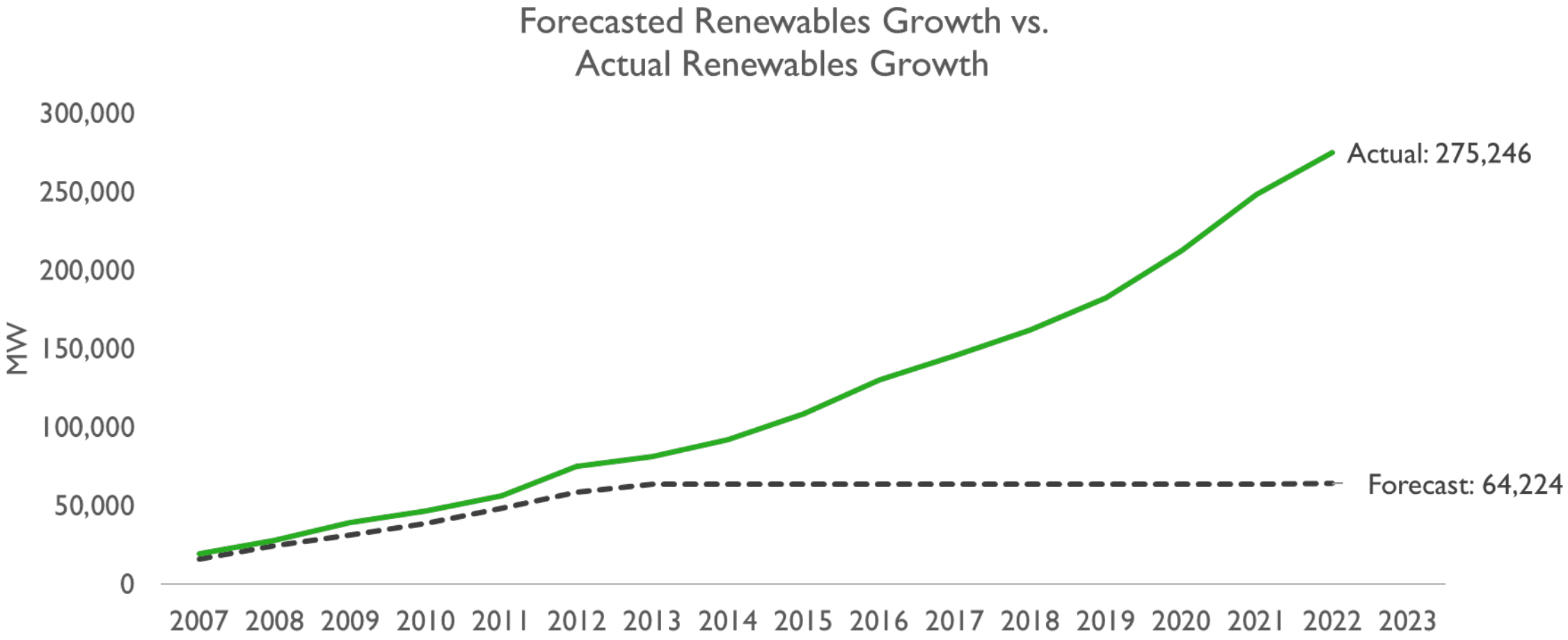

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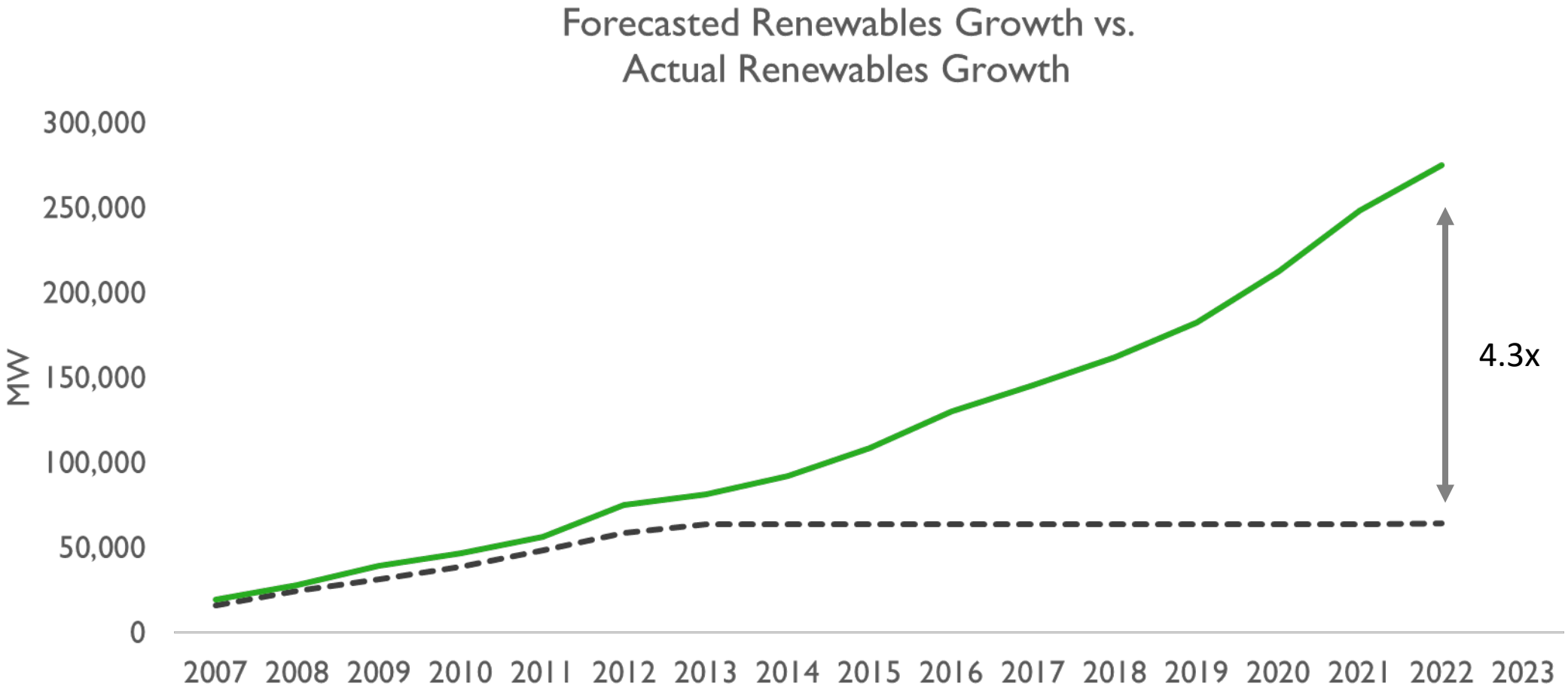

Why are most new resource builds renewables?

1. Politics
2. Economics

Renewable portfolio standards drive renewables procurement

California ISO

Installed renewable resources *(as of 02/01/2024)*

	Megawatts
Solar	18,517
Wind	8,358
Geothermal	1,610
Small hydro	1,180
Biofuels	778
TOTAL	**30,443**

Installed battery capacity[4]
7,261 MW
As of 02/07/24; subject to change.

But Texas, without renewable mandates is still crushing California

ercot
Your Power. Our Promise.

Fact Sheet

February 2024

37,725 MW
of installed wind capacity as of July 2023, the most of any state in the nation

18,364 MW
of utility-scale installed solar capacity as of September 2023

4,048 MW
of installed battery storage as of September 2023

California ISO

Installed renewable resources *(as of 02/01/2024)*

	Megawatts
Solar	18,517
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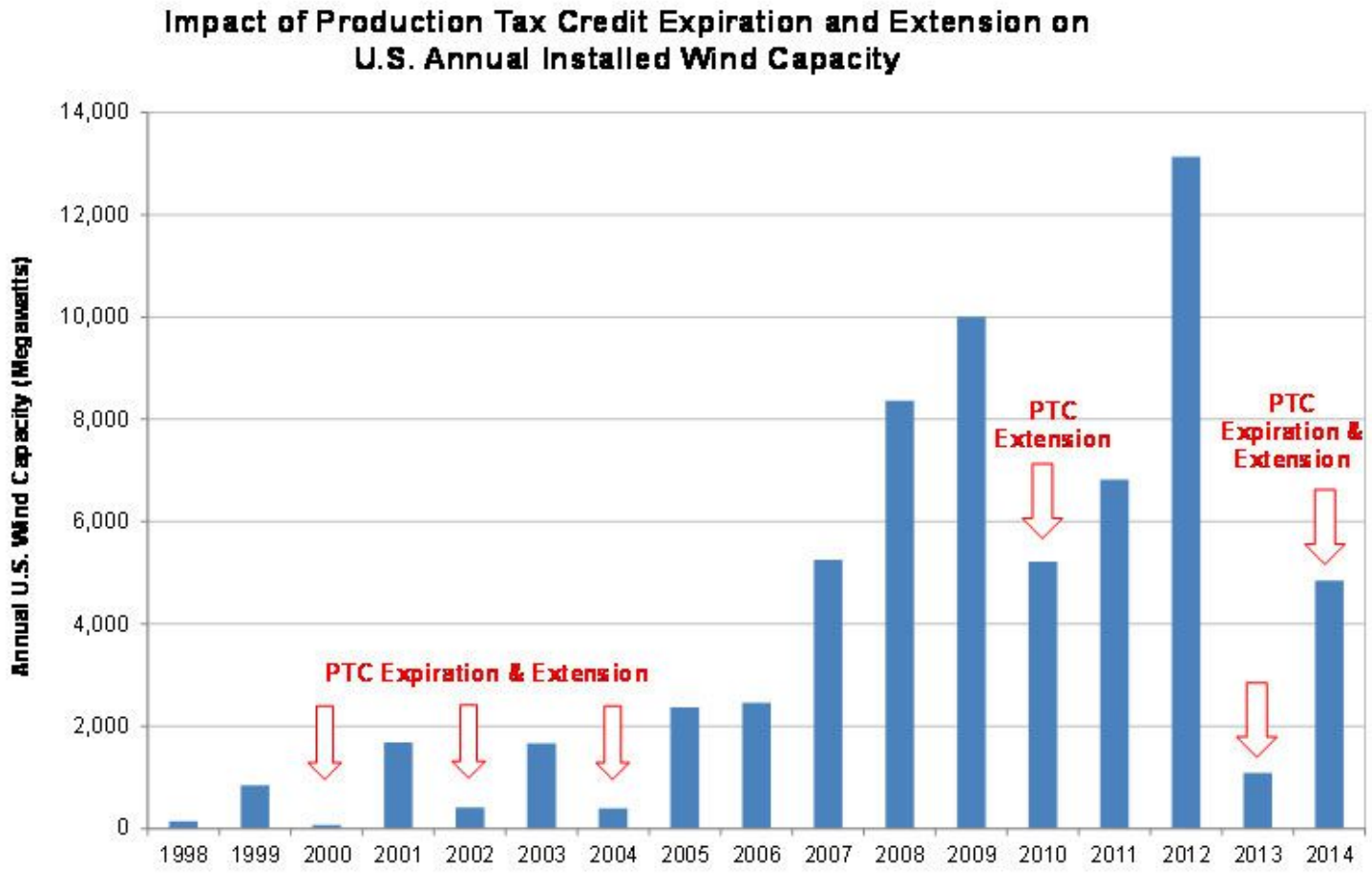
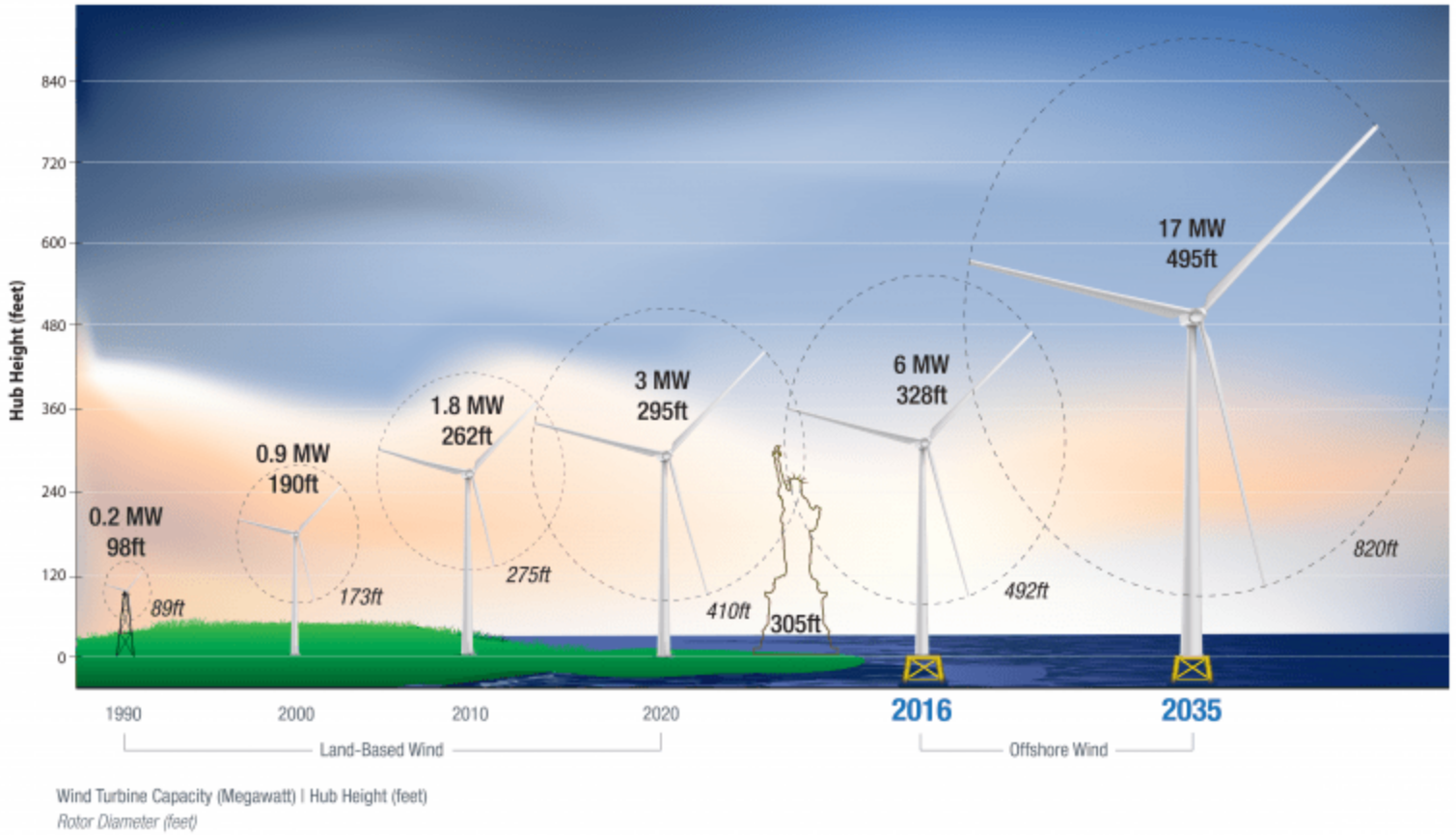
Economics of renewables part 1: subsidies



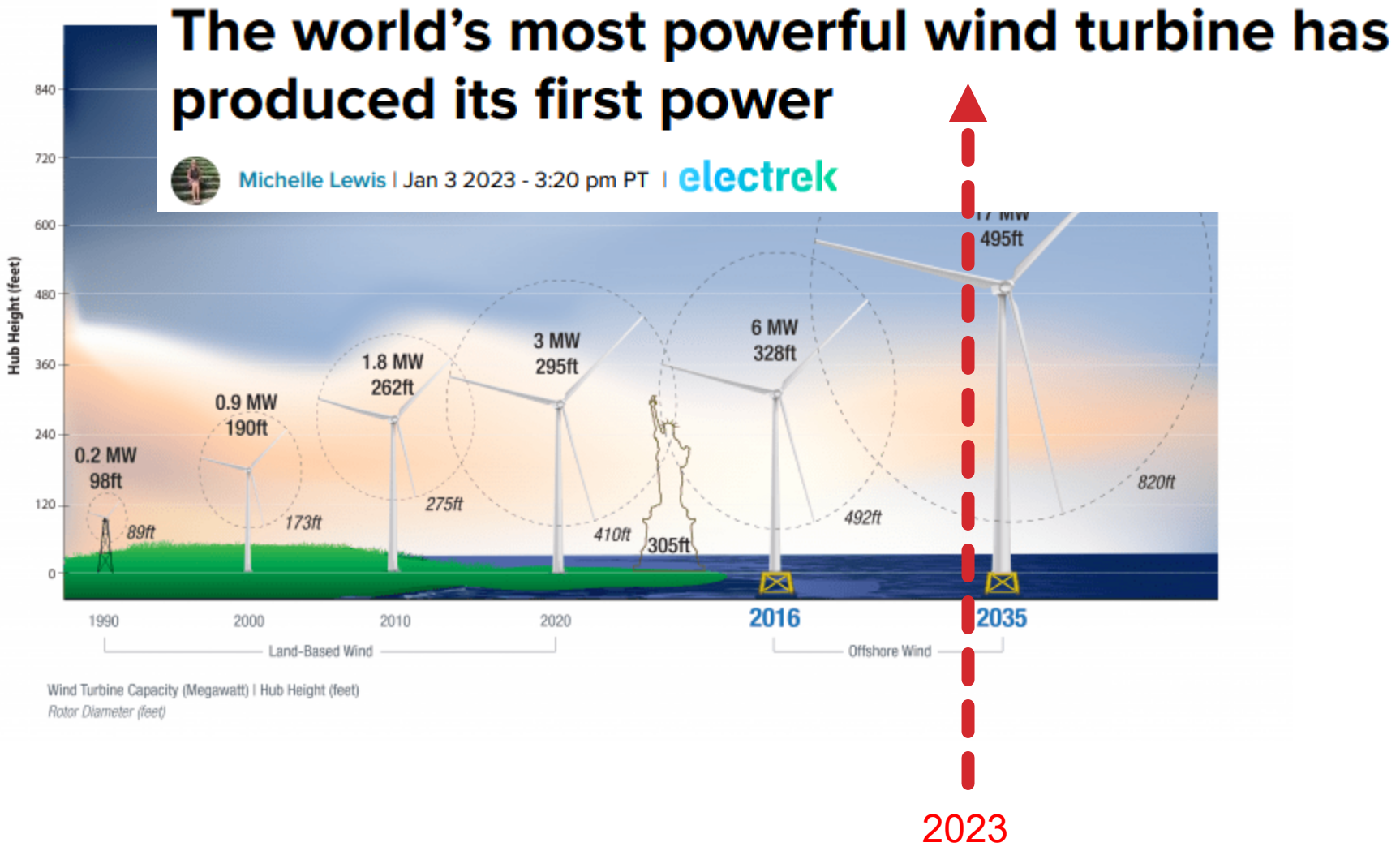
Source: Union of Concerned Scientists, Vox "How big a deal was Congress extending the renewable energy tax credits? A very, very big deal."

Economics of renewables part 2: technology



Source: Wind Turbines : the Bigger, the Better, Department of Energy Office of Energy Efficiency & Renewable Energy

Bigger is better



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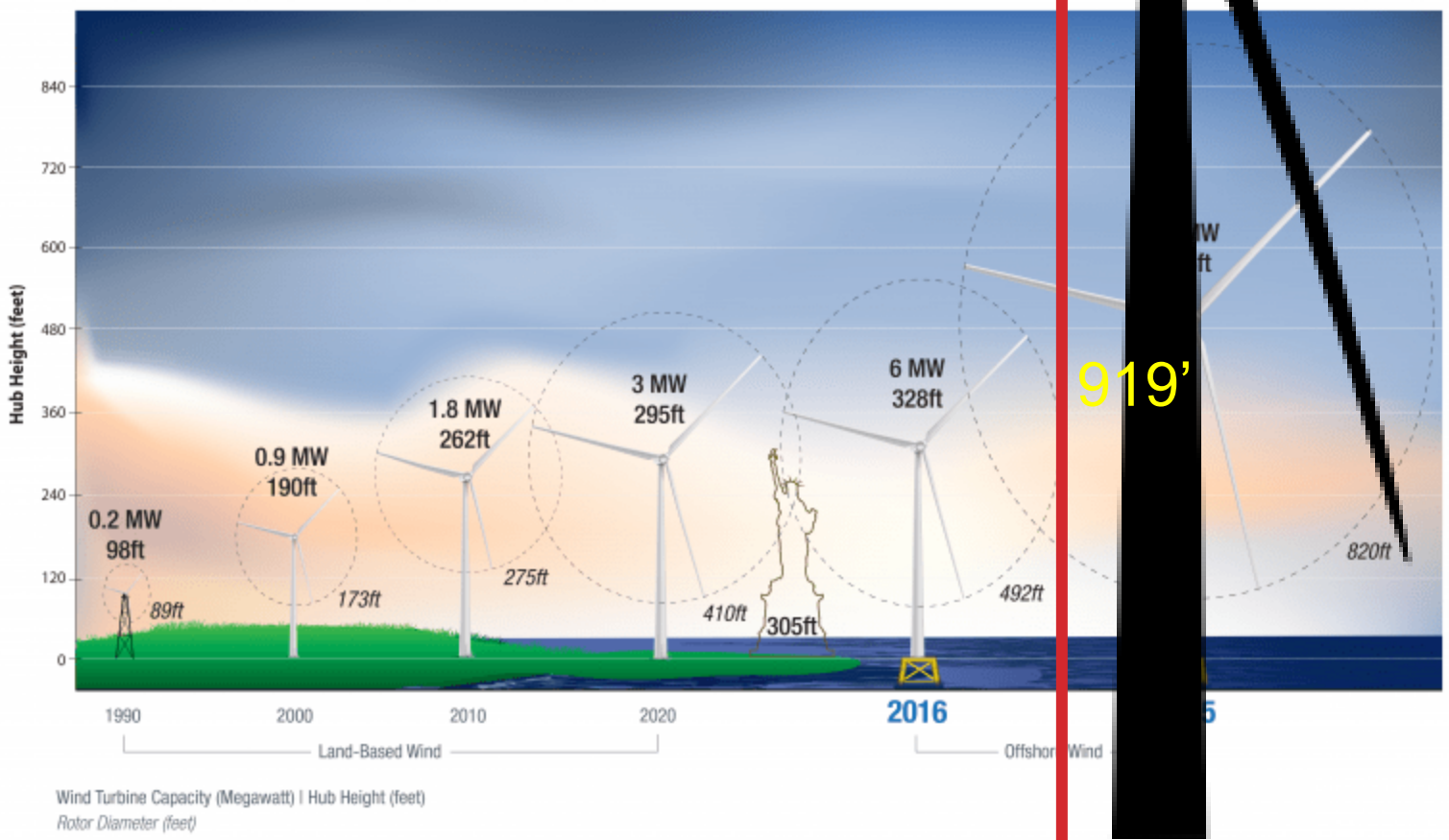

2023

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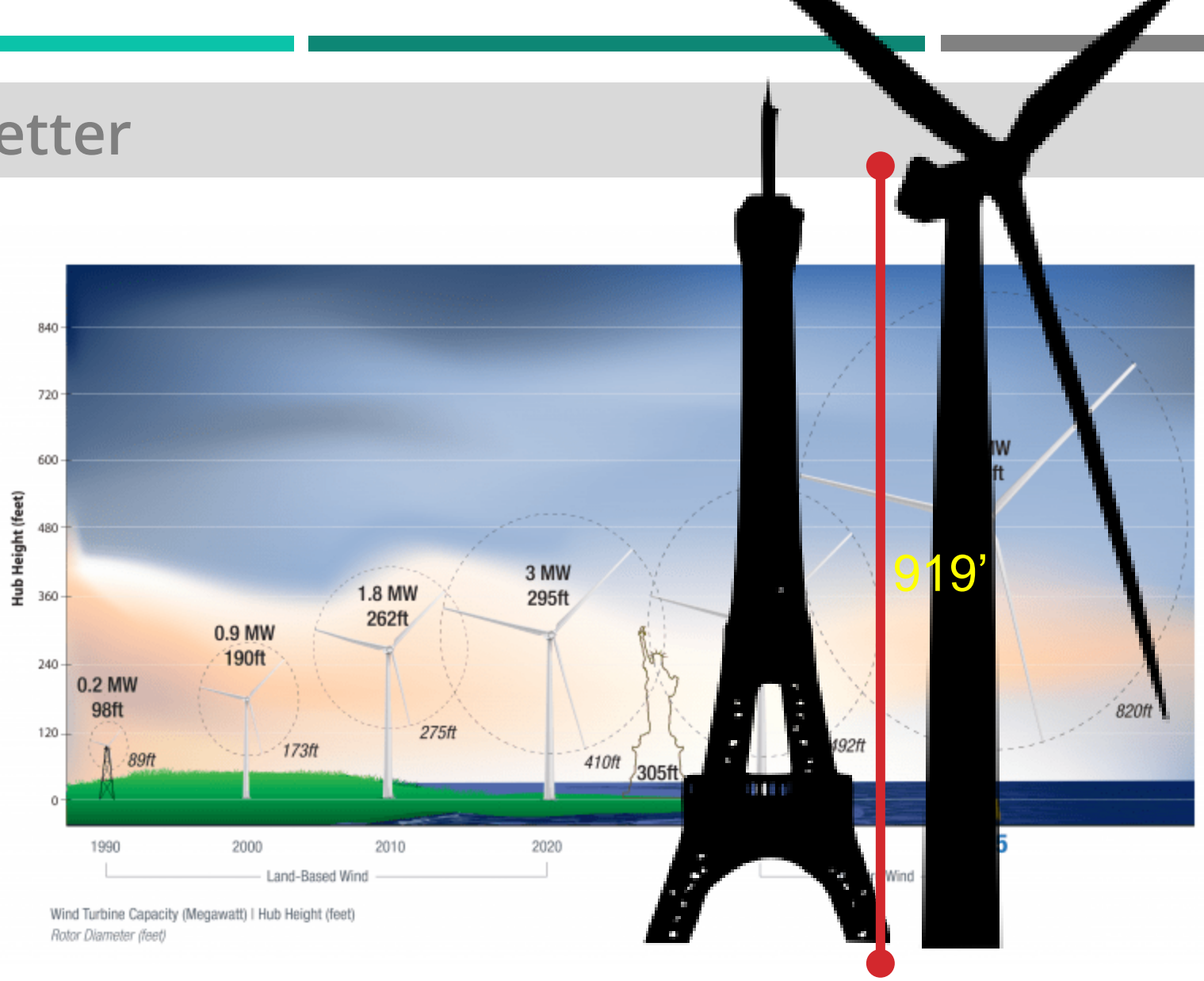

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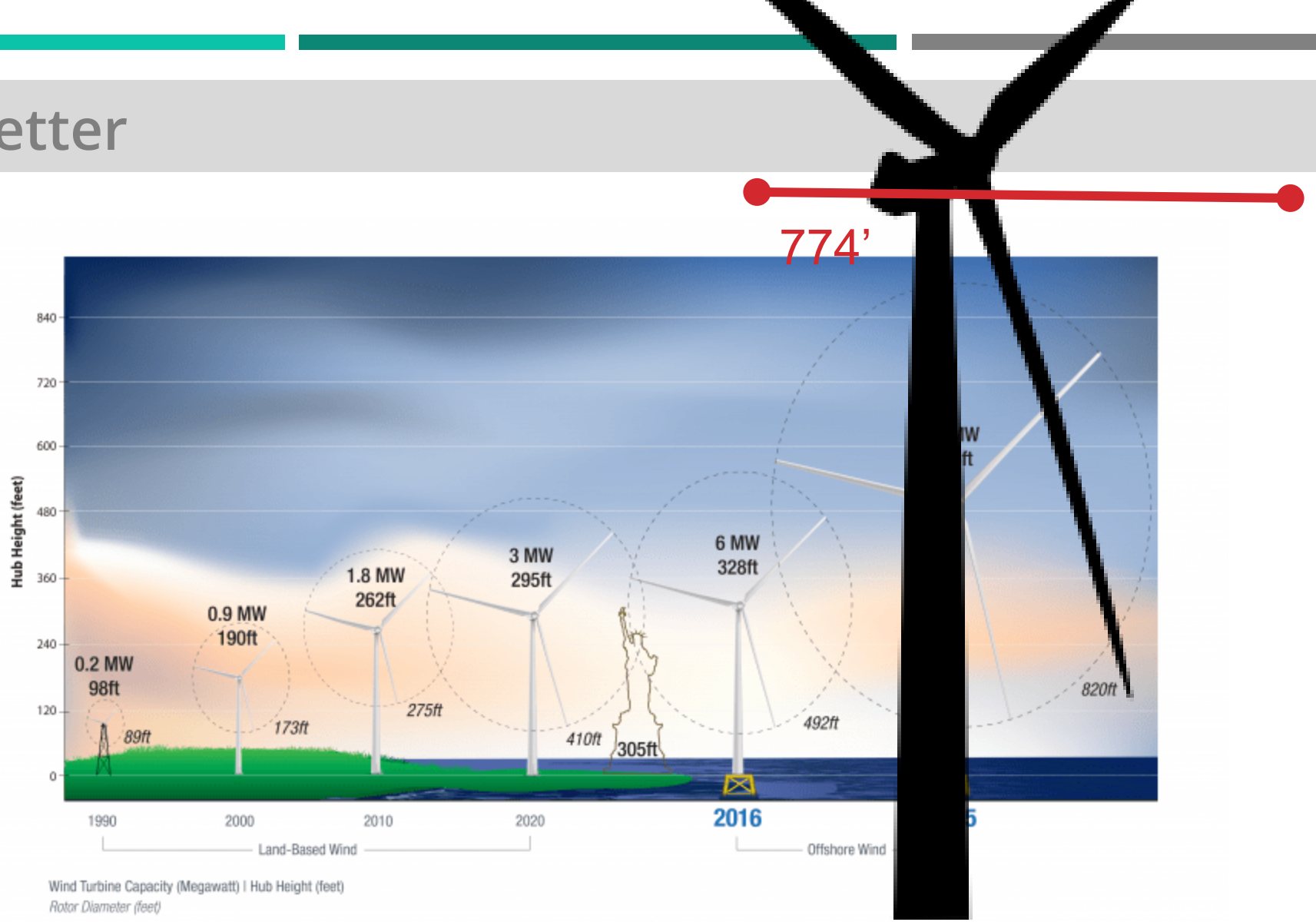

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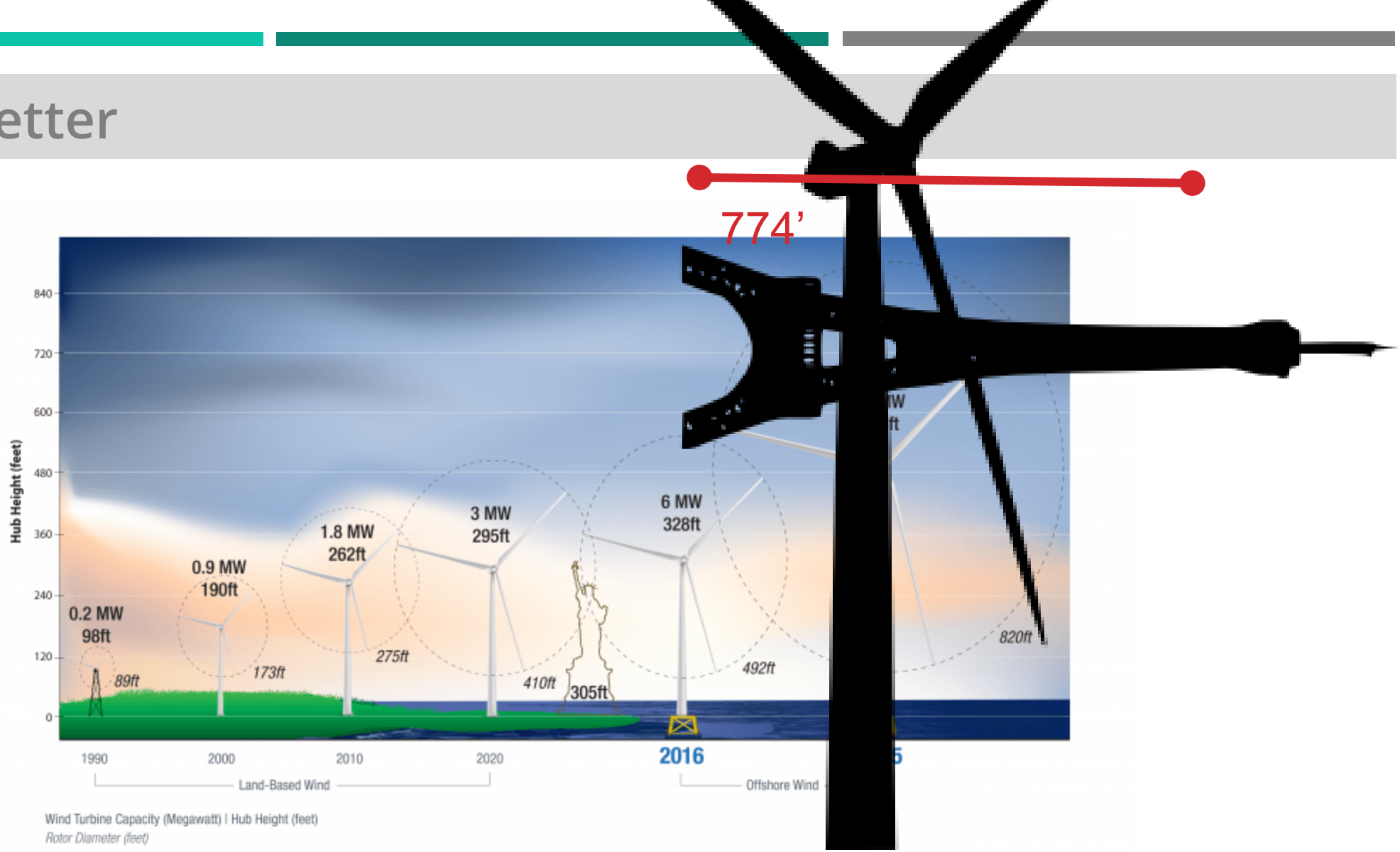

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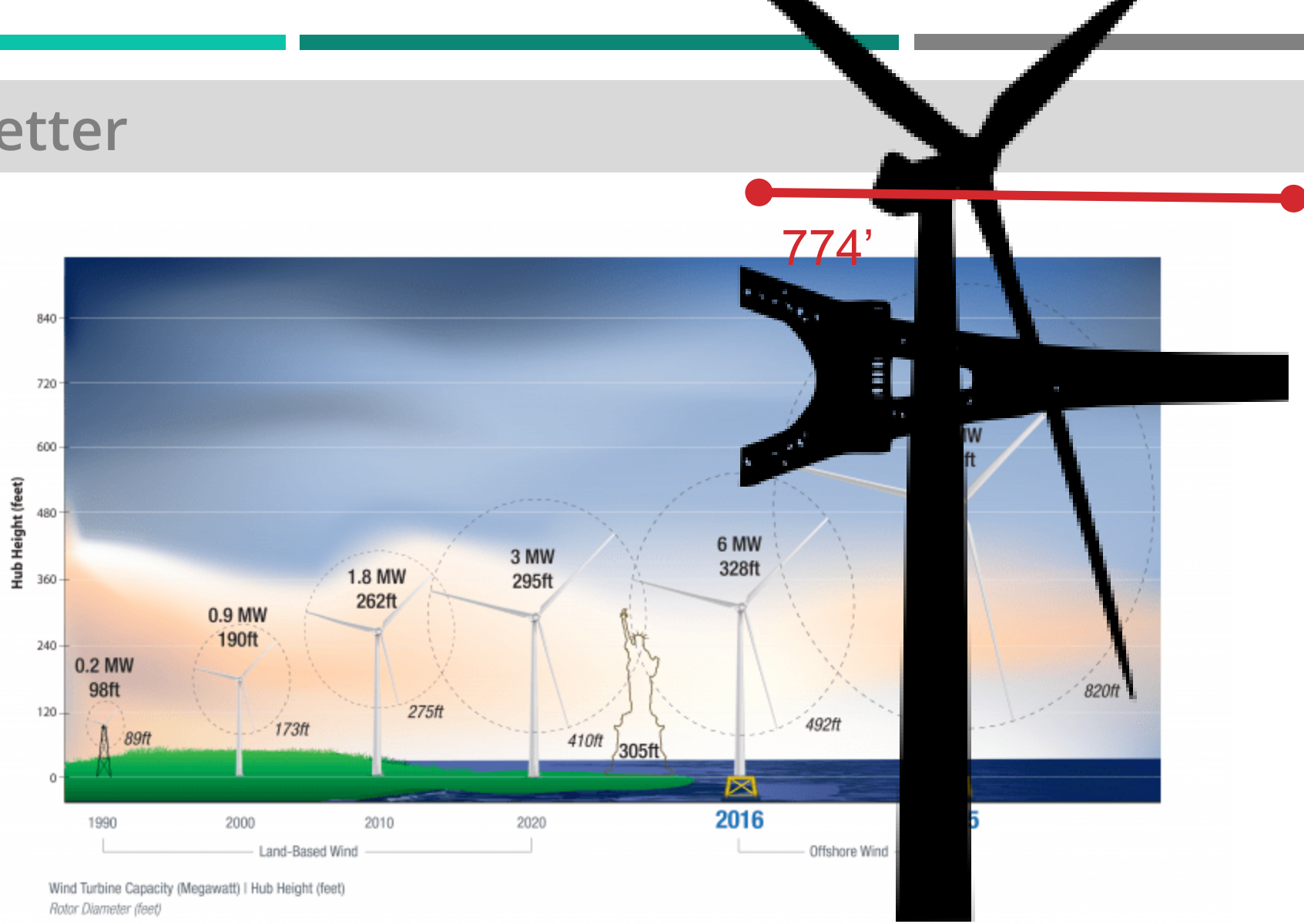


2023

Source: Wind Turbines : the Bigger, the Better, Department of Energy Office of Energy Efficiency & Renewable Energy

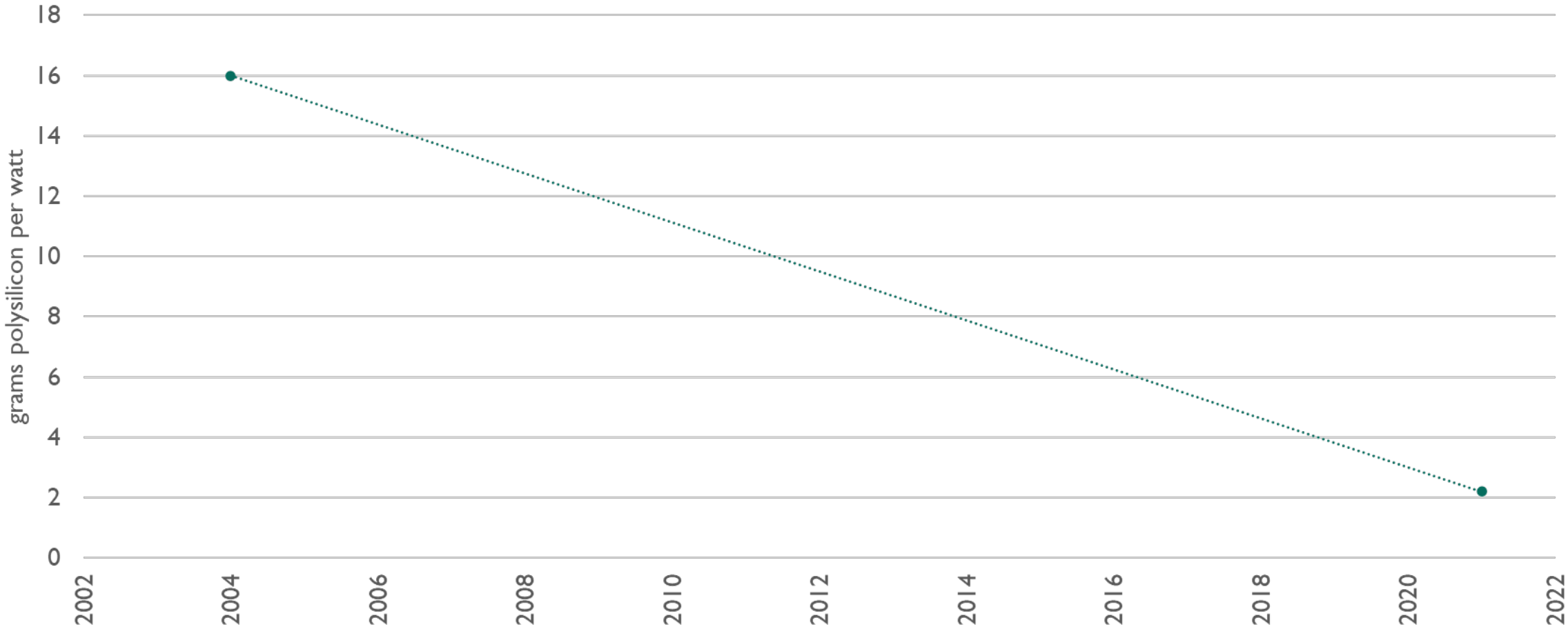
Bigger is better

Source: Vestas

But not too big

Source: Vestas

Solar panels use 85% less silicon today than 20 years ago

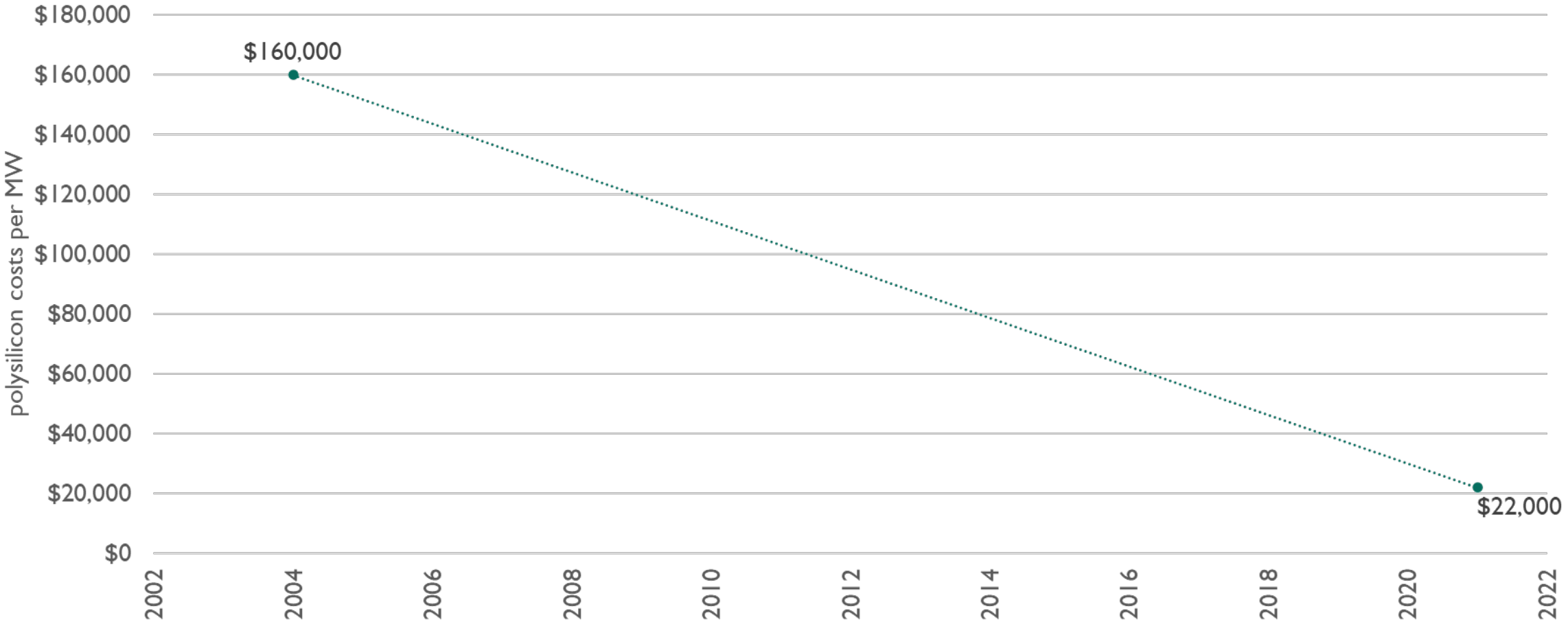


Source: Weaver, Fitzgerald John, "Polysilicon costs have slid by 96% per watt over past two decades." January 11, 2023. Accessed: June 10, 2023.

New silicon demand = new silicon supply = lower silicon prices!

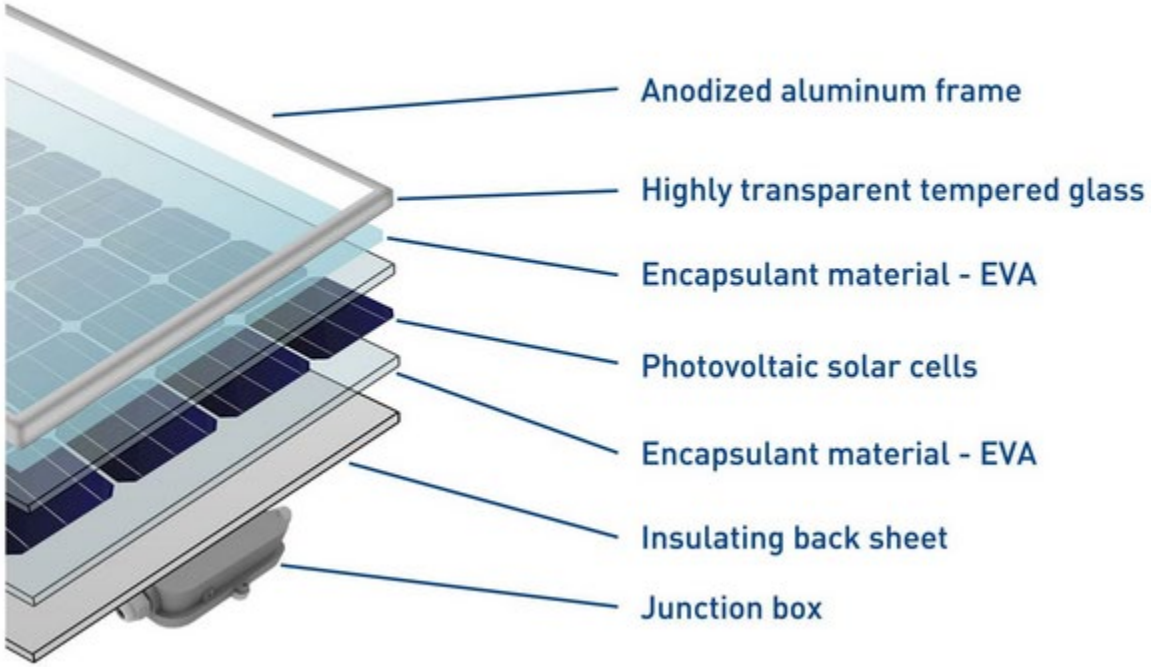
Source: Bloomberg

Silicon inputs drop by 85% too



Source: Weaver, Fitzgerald John, "Polysilicon costs have slid by 96% per watt over past two decades." January 11, 2023. Accessed: June 10, 2023.

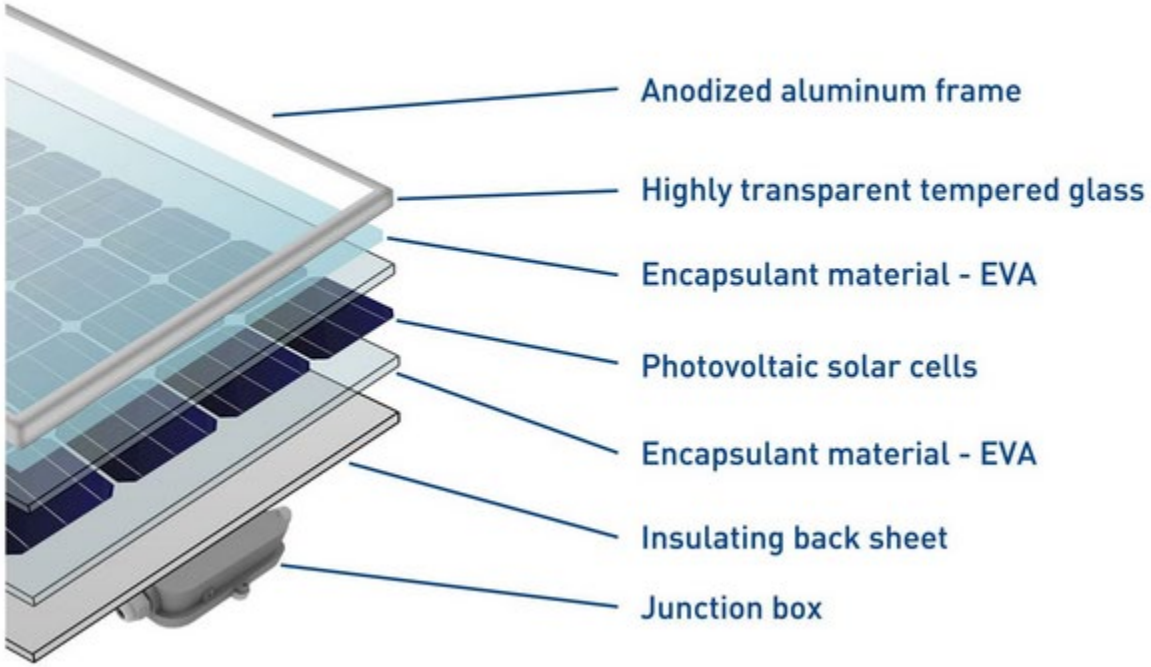
Everything gets better



Source: Weaver, Fitzgerald John, “Polysilicon costs have slid by 96% per watt over past two decades.” January 11, 2023. Accessed: June 10, 2023.

Panels are becoming more efficient at converting sunlight

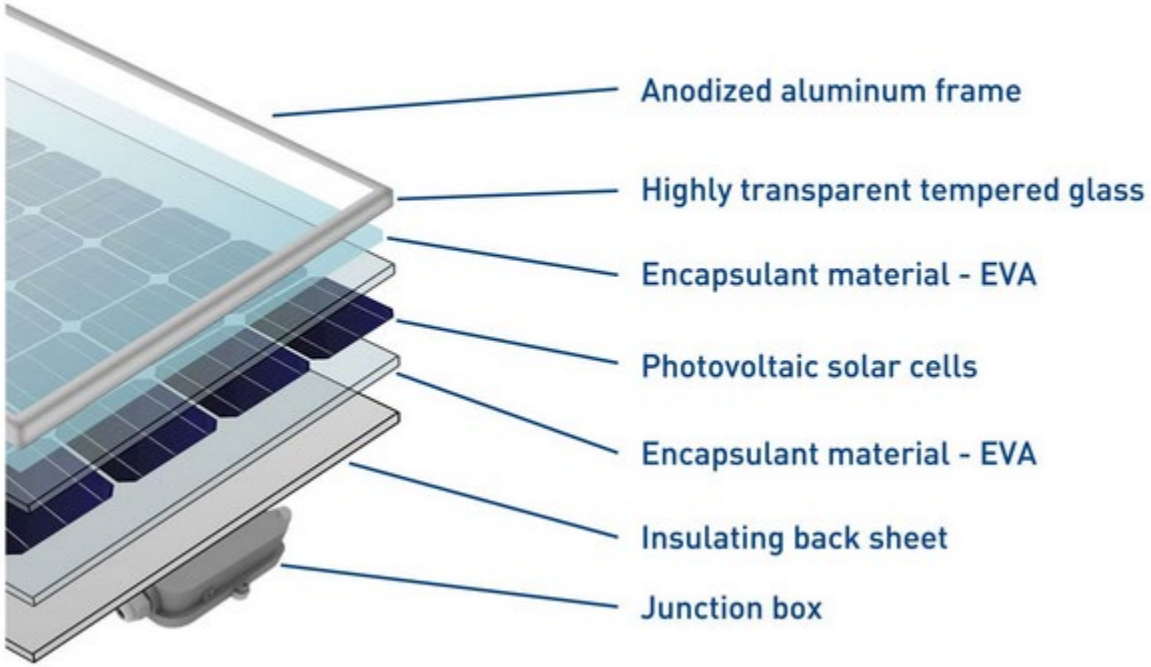
2004: 150 W



Source: Weaver, Fitzgerald John, "Polysilicon costs have slid by 96% per watt over past two decades." January 11, 2023. Accessed: June 10, 2023.

And more energy dense in general

2023: 550 W

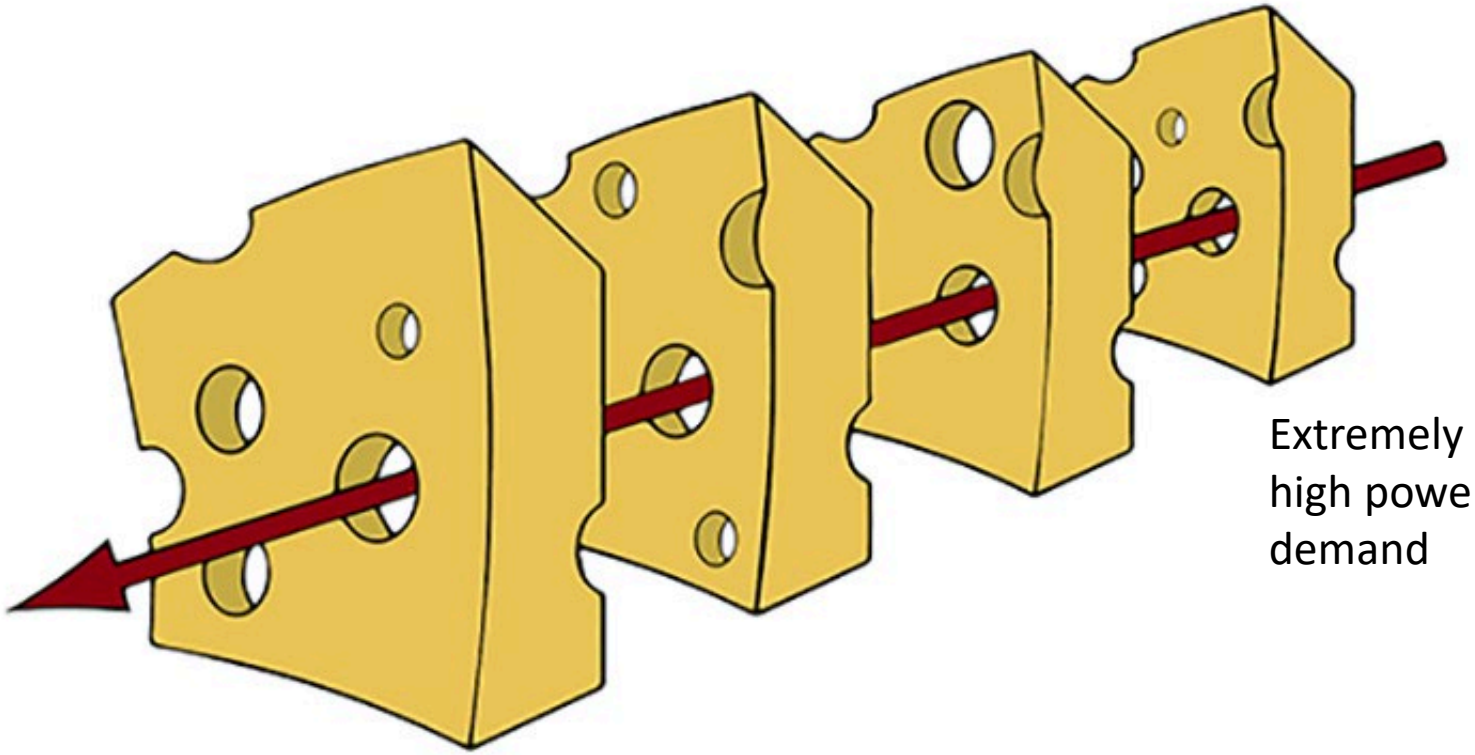


Source: Weaver, Fitzgerald John, “Polysilicon costs have slid by 96% per watt over past two decades.” January 11, 2023. Accessed: June 10, 2023.

Step 3: Lather, rinse, repeat

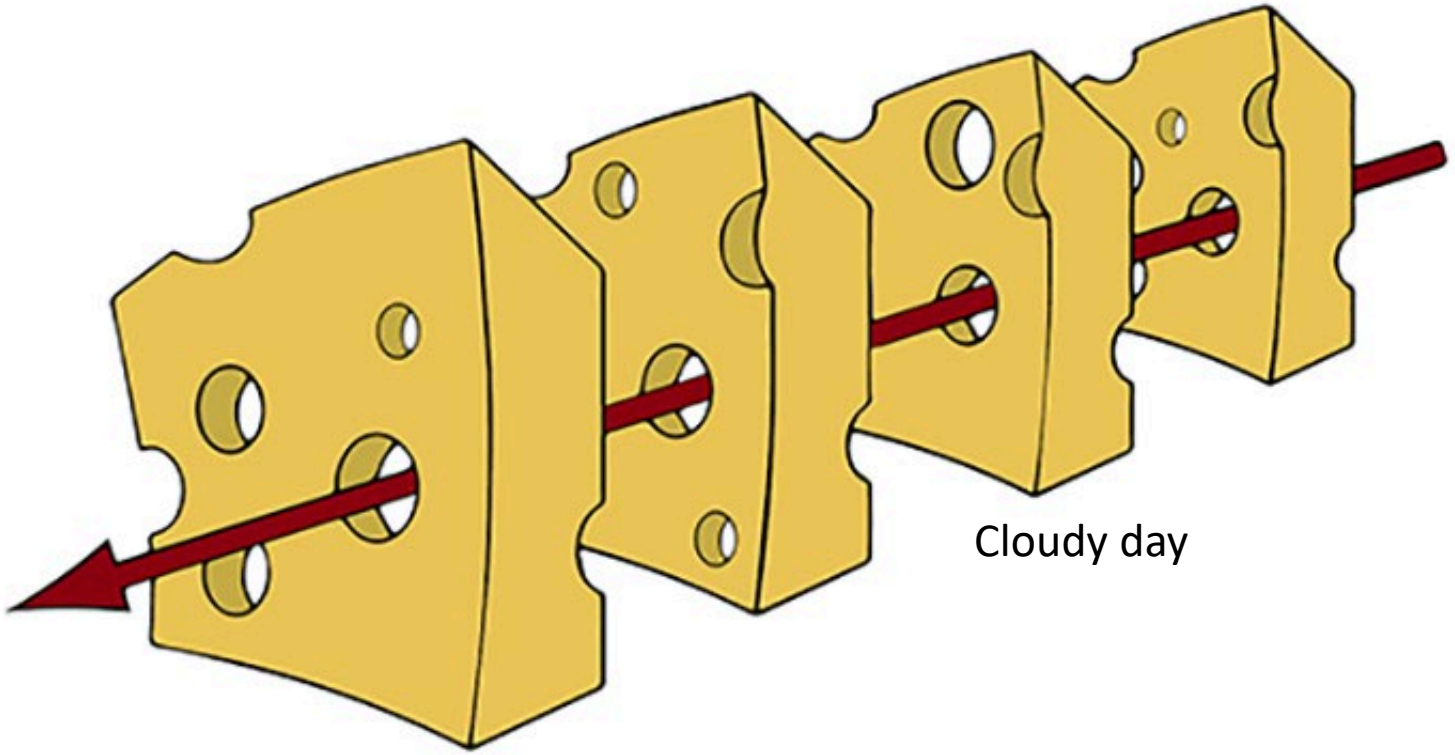
CURRENT GRID CHALLENGES

How extreme weather stresses our grid



Extremely high power demand

How extreme weather stresses our grid



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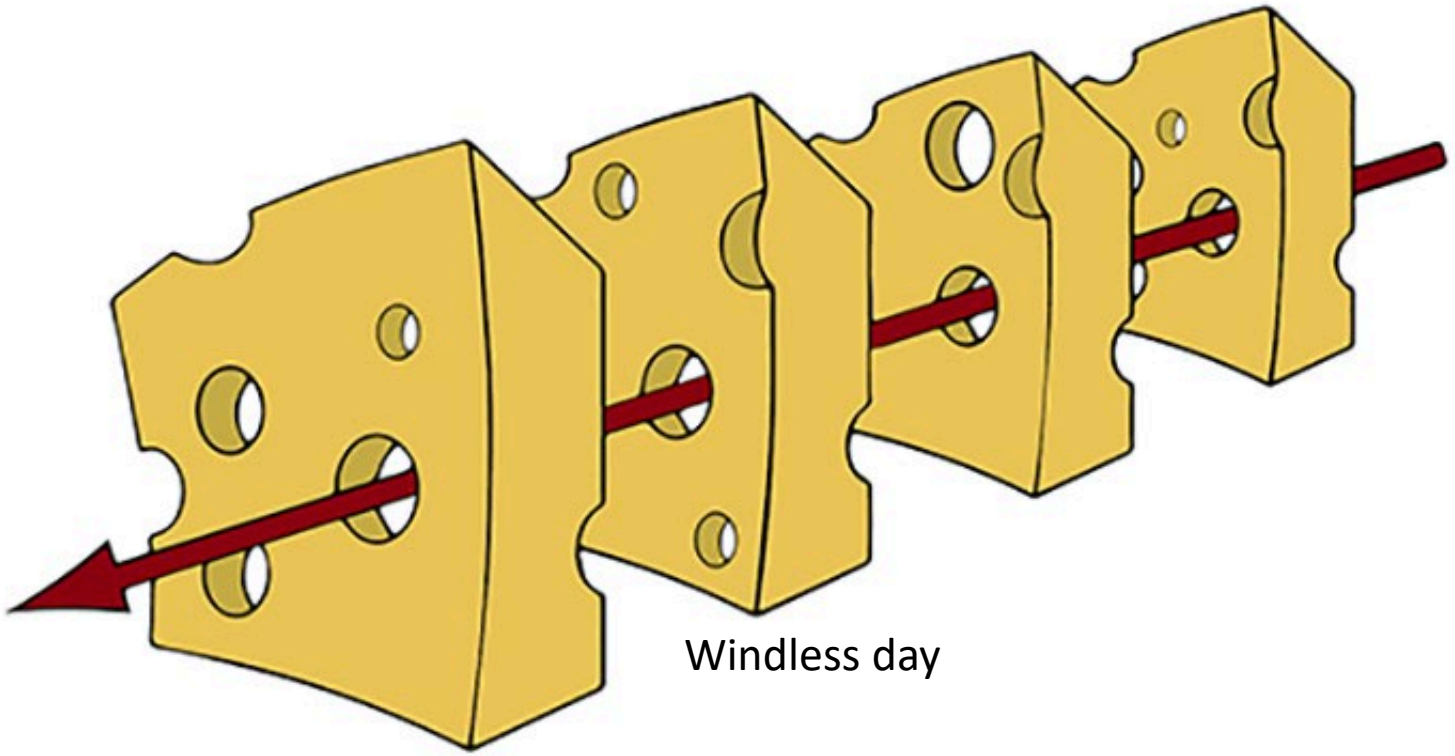

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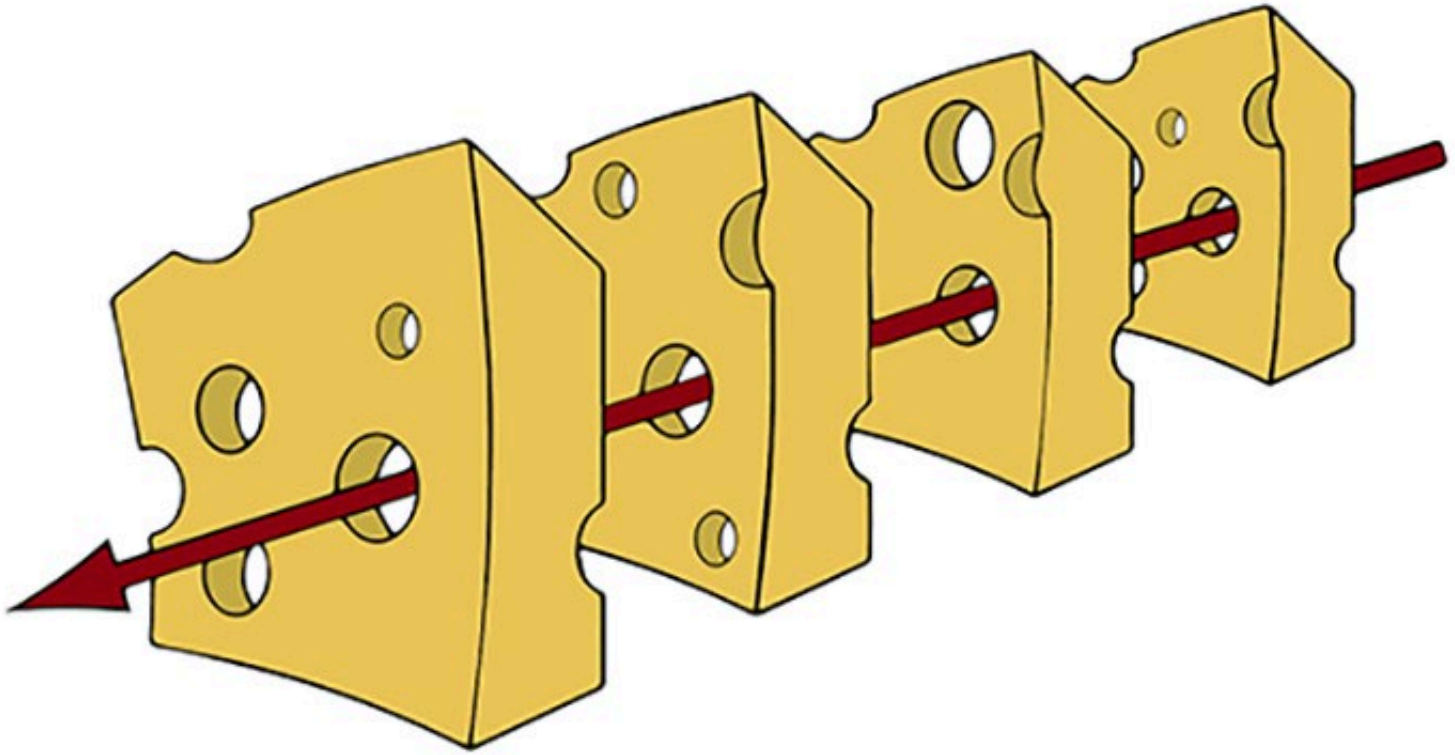
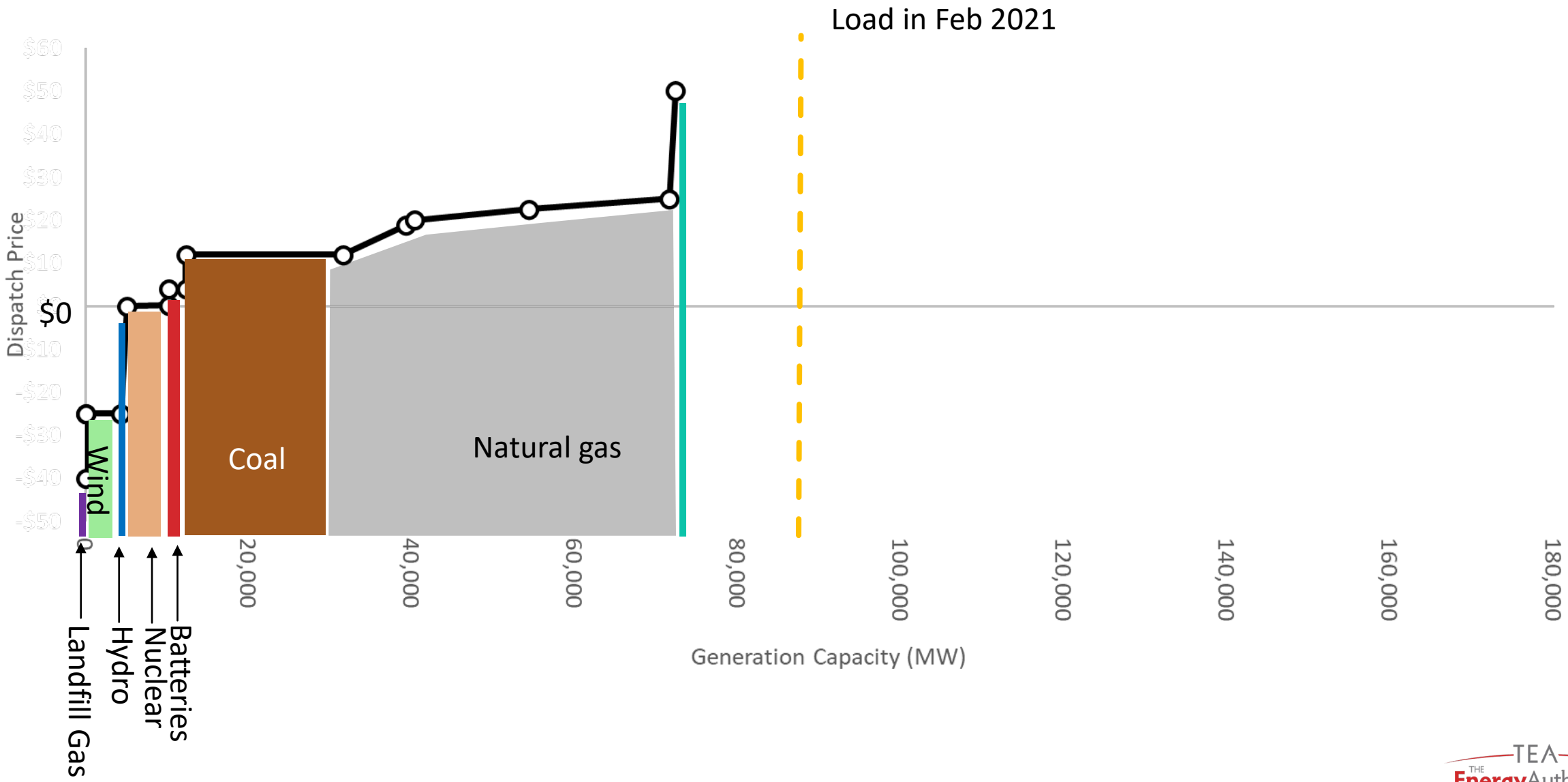
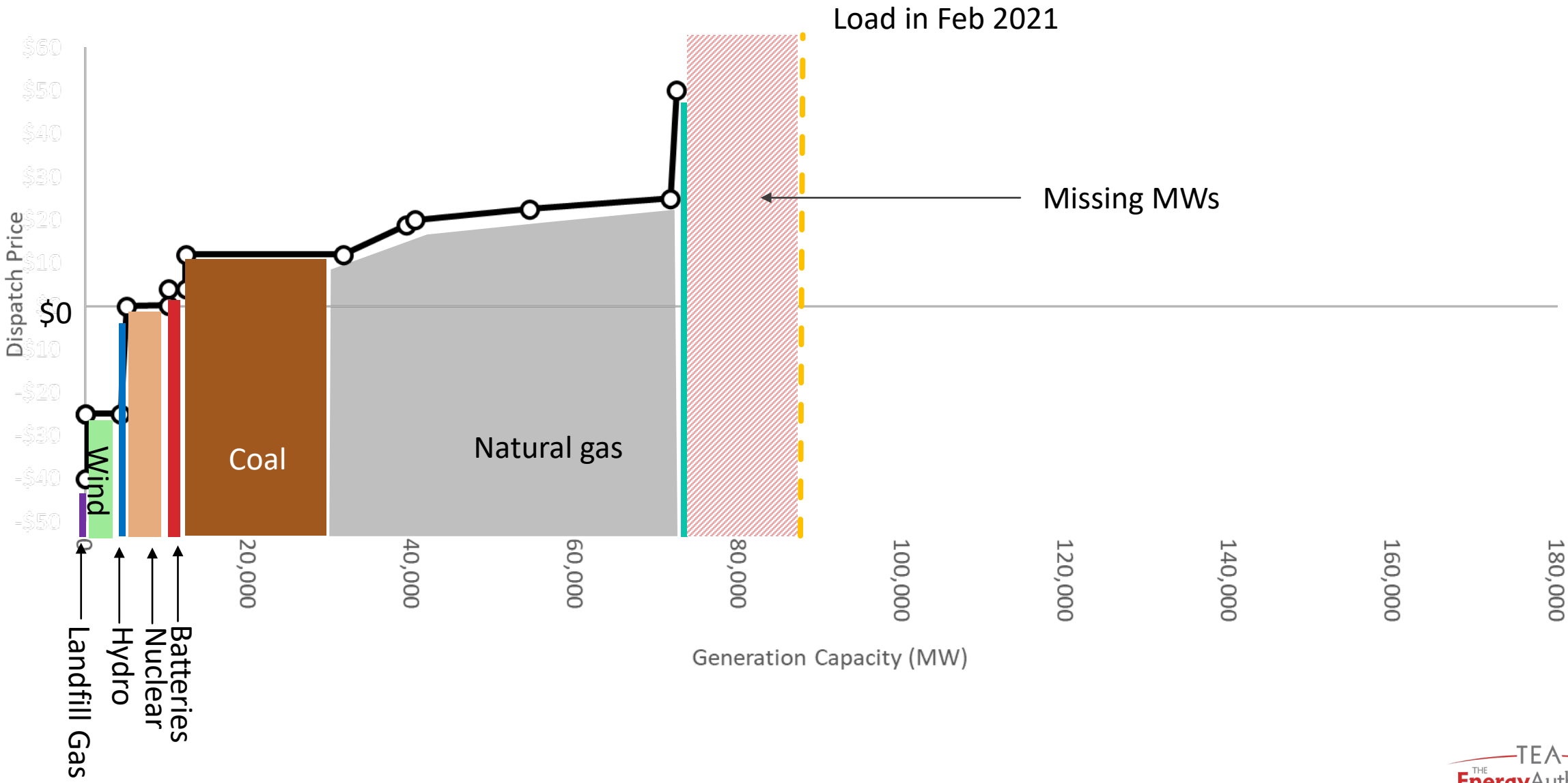


Fuel availability issues

Here's what happened in Texas in February 2021



Here's what happened in Texas in February 2021



Our ability meet load is getting tested more often

Similarities to Past Extreme Cold Weather Events

	2011 Event	2014 Event	2018 Event	2021 Event	2022 Event
Significant levels of incremental unplanned electric generating unit losses with top causes found to be mechanical/electrical, freezing, and fuel issues.	✓	✓	✓	✓	✓
Significant natural gas production decreases occurred, with some areas of the country more severely affected.	✓			✓	✓
Short-range forecasts of peak electricity demands were less than actual demands for some BAs in event area.	✓		✓	✓	✓

This report was prepared by the staff of the Federal Energy Regulatory Commission in consultation with staff from the North American Electric Reliability Corporation and its Regional Entities. This report does not necessarily reflect the views of the Commission.

8

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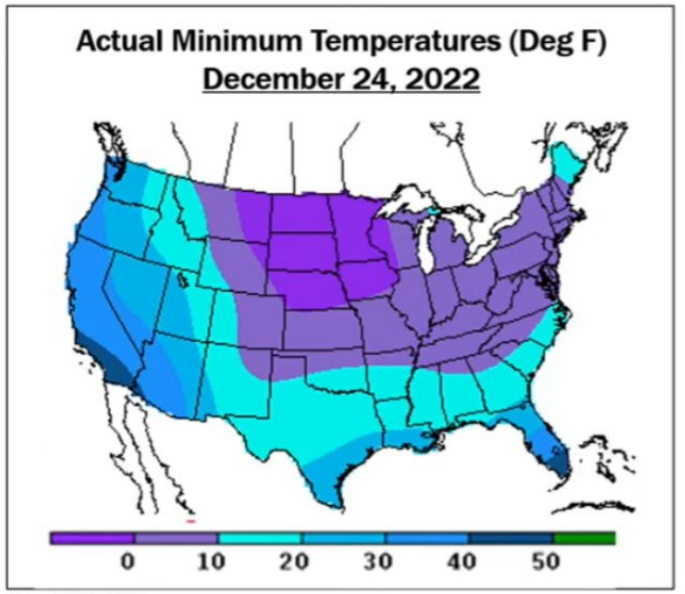
8

Dispatchable resources are also contributing to the problem

Winter Storm Elliott's Effects on the Bulk-Power System*

- **December 21-26, 2022**: Frigid arctic air with strong winds arrived over the eastern half of the country.
- Peak winter electricity demands, coupled with significant unplanned electric generation supply losses exceeding **70,000 MW,** occurred during the coldest weather across the Southeastern, Mid-Atlantic, Midwest, and Northeastern U.S..
- Several southeastern U.S. Balancing Authorities (BAs) ordered firm load shed on December 24, 2022, in total exceeding **5,000 MW.**

* Inquiry team is still gathering and analyzing data on all of these subjects.



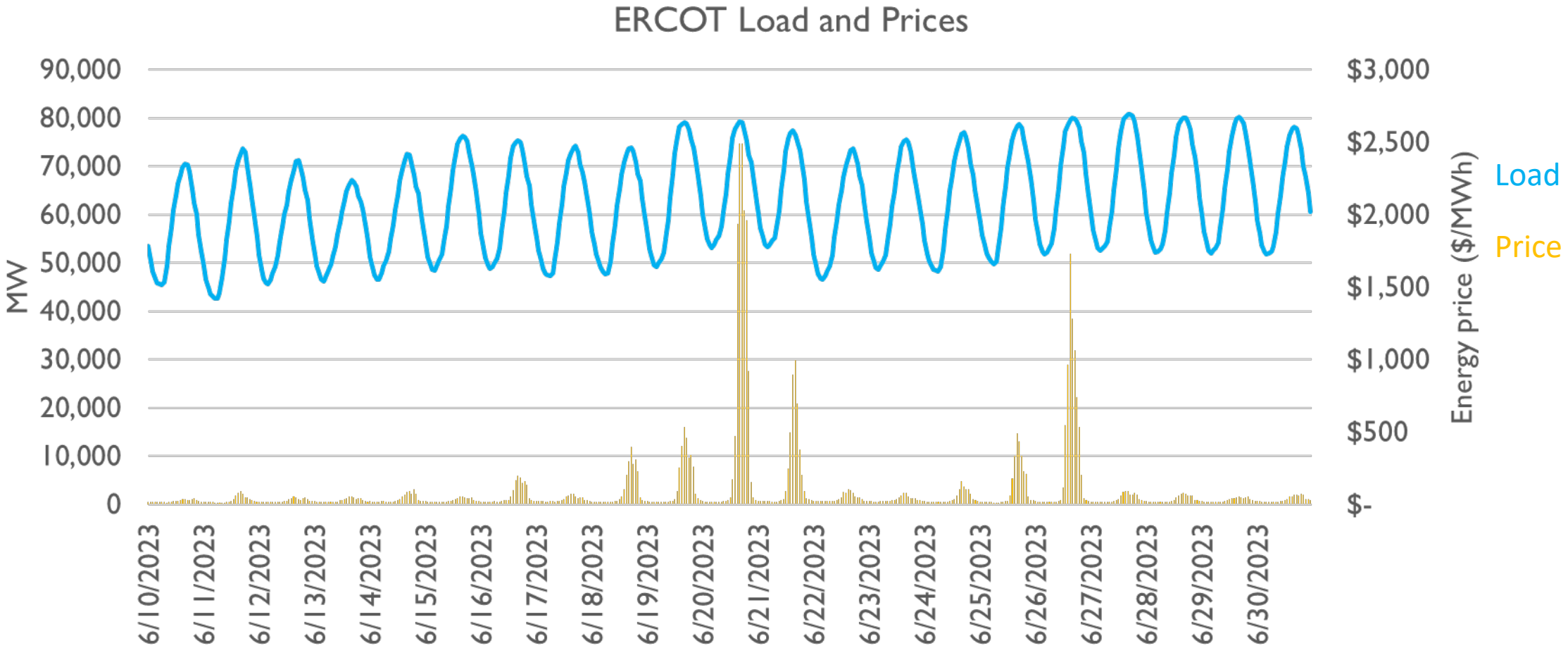
(Source: NOAA)

FERC Commission Meeting | June 2023 Open Meeting

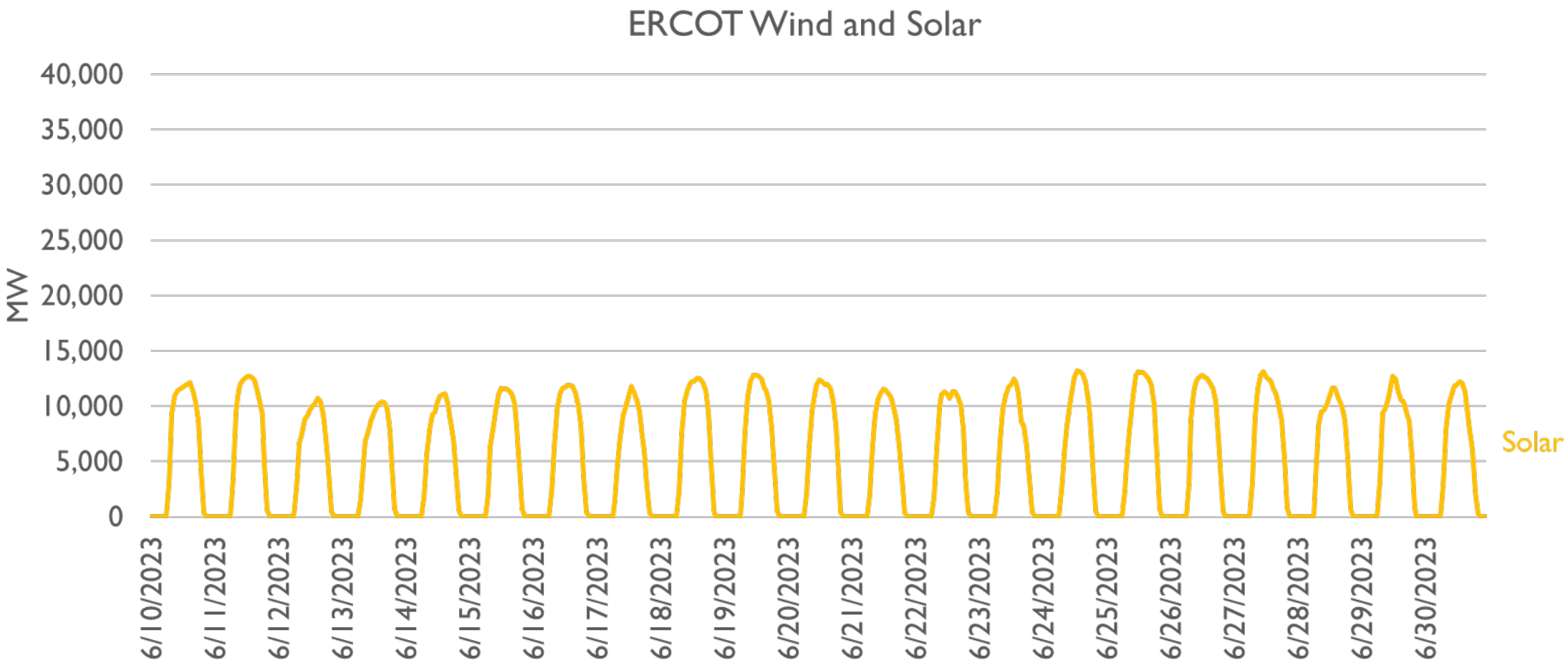
Federal Energy Regulatory Commiss... 1.41K subscribers Subscribe 3 Share Save

Source: June 2023 FERC Commission Meeting

ERCOT prices during the June 2023 heat wave



Reconstructing the event



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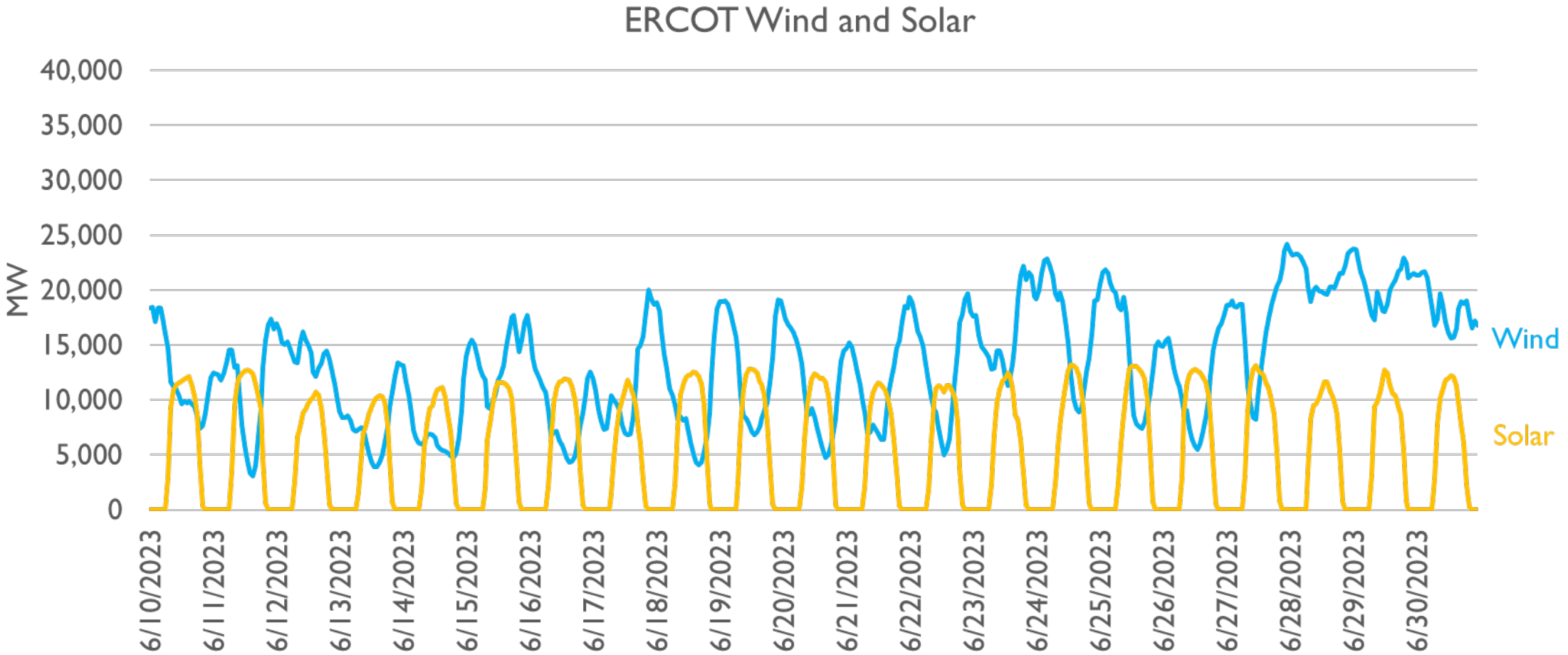

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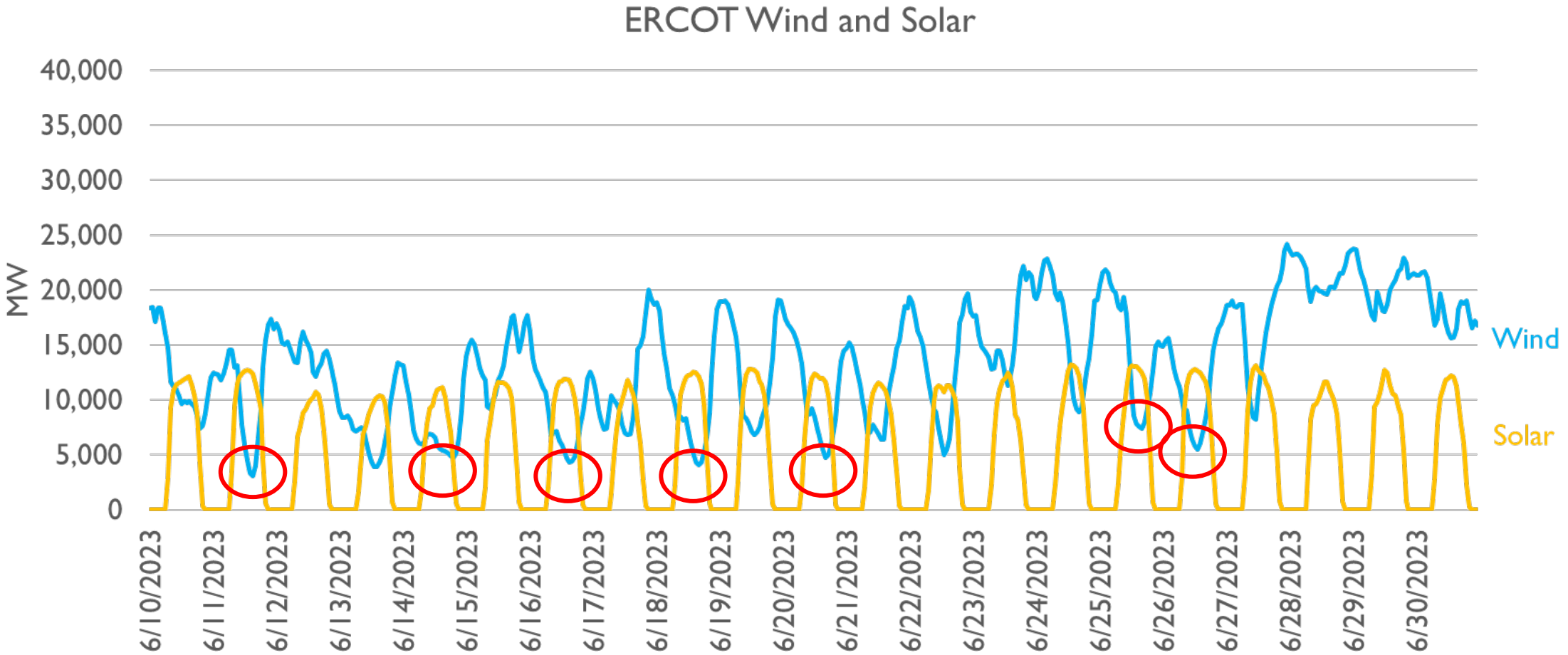

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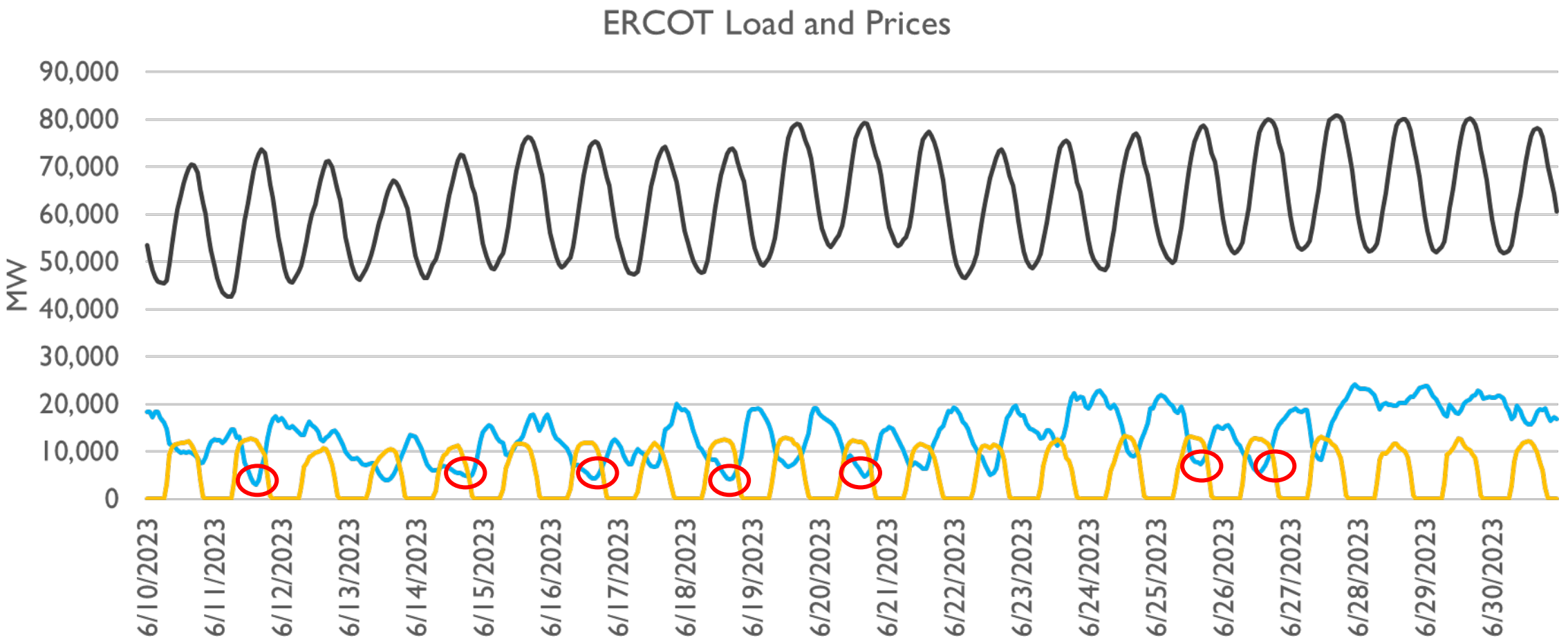

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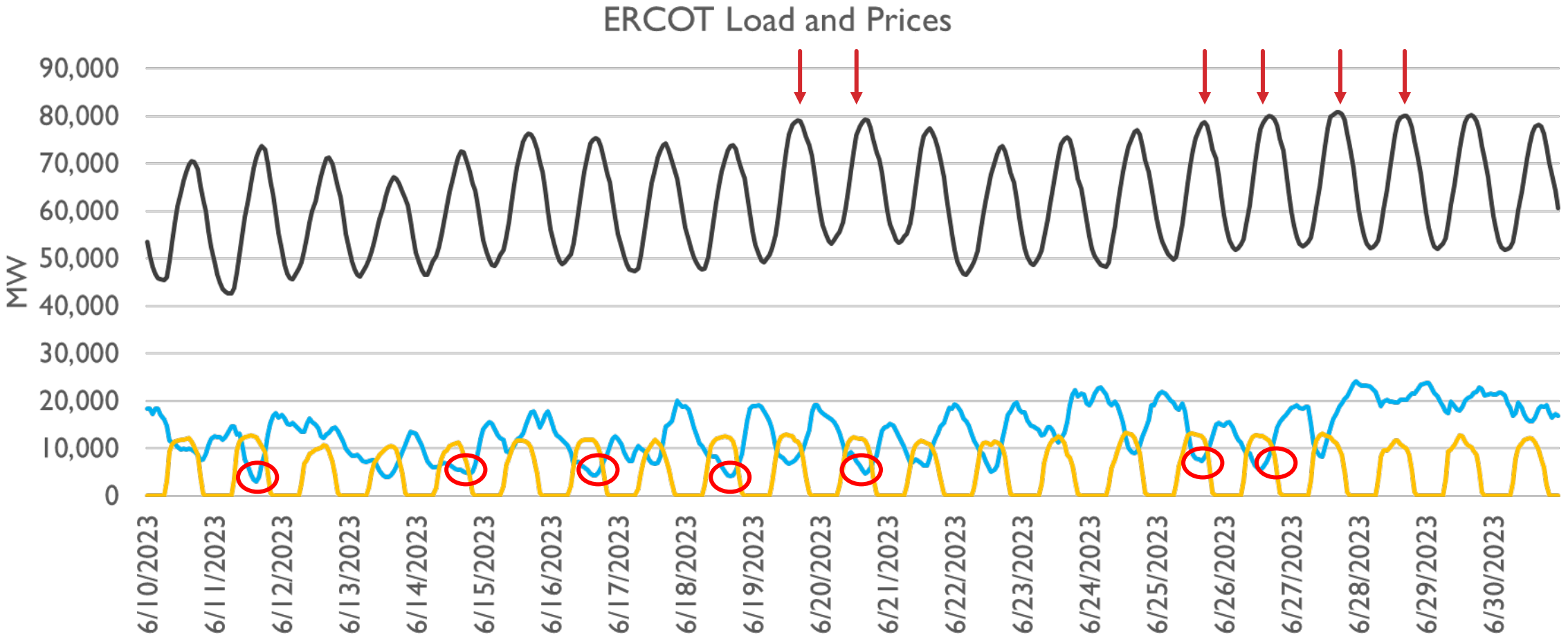

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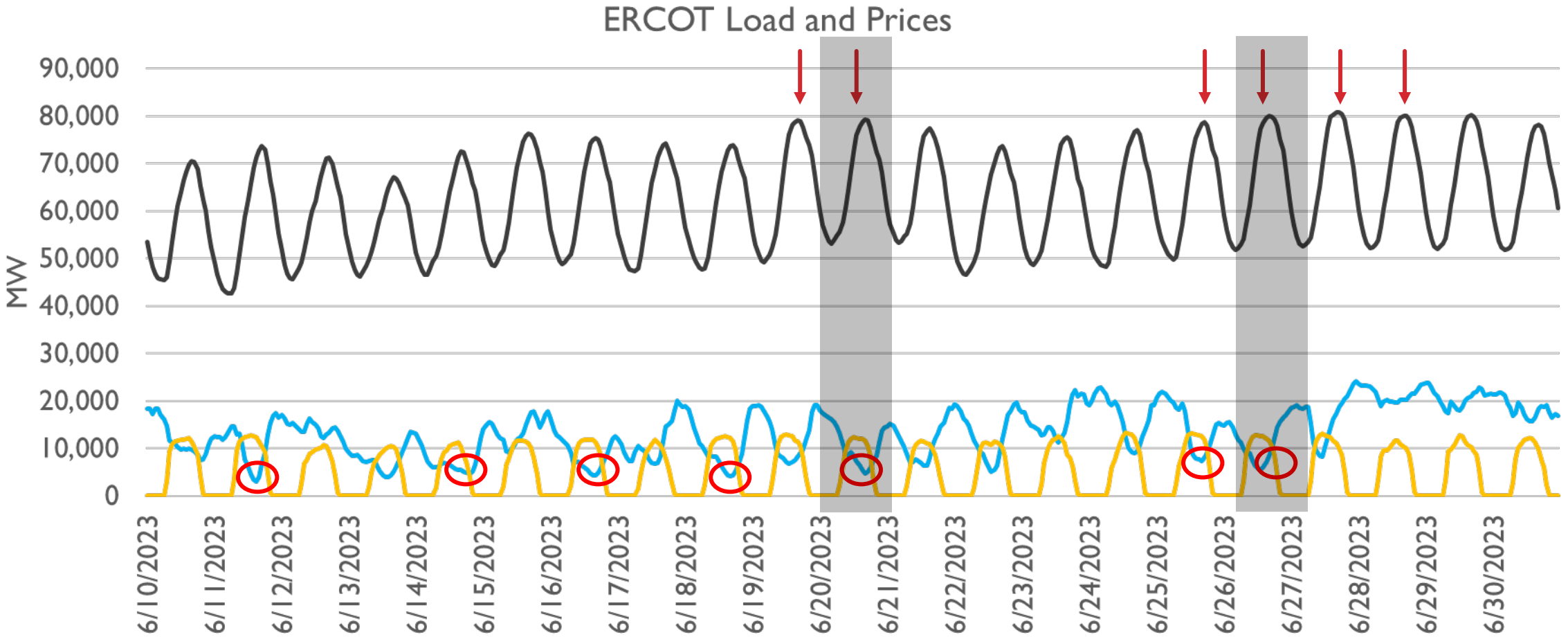

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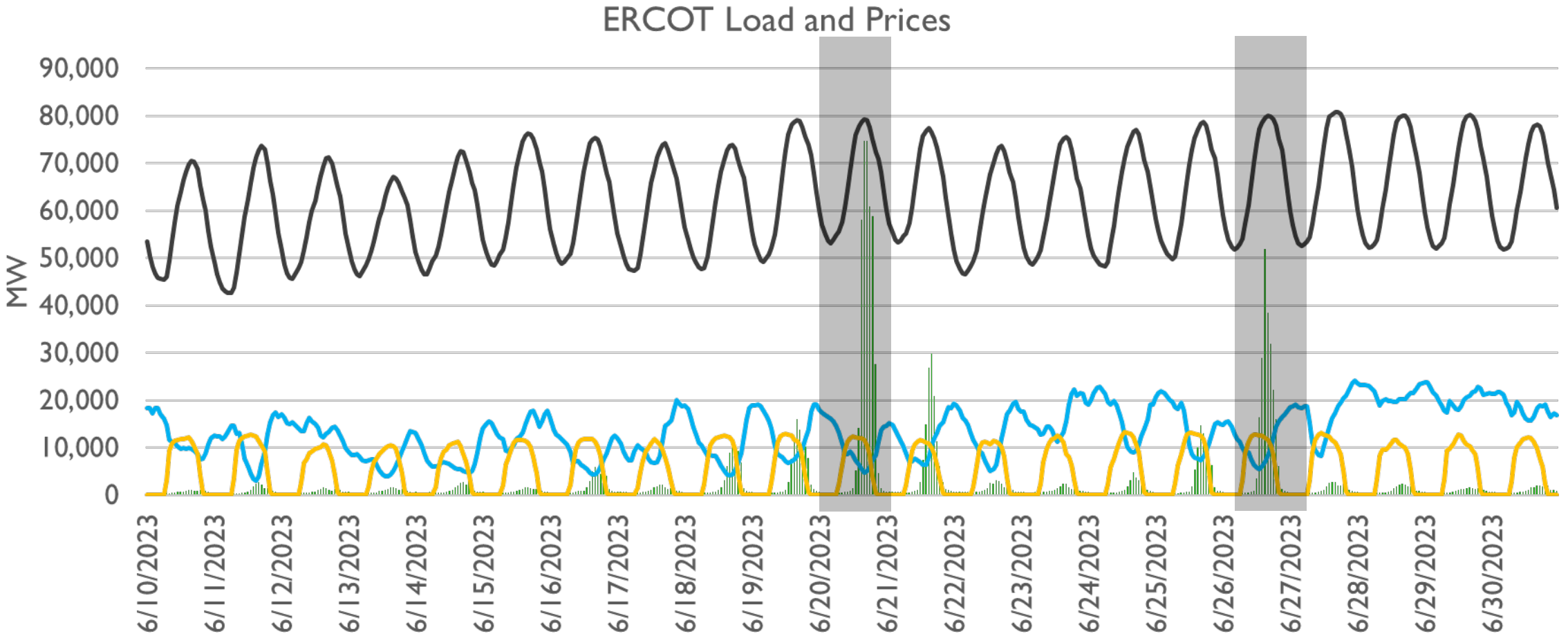

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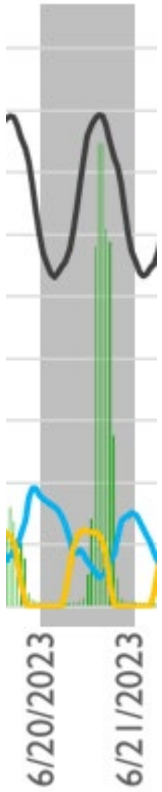

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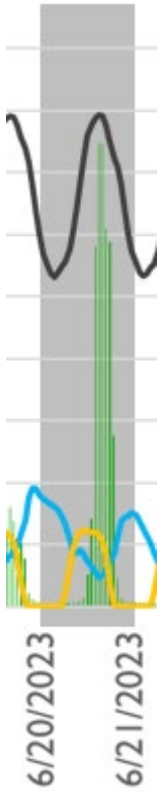
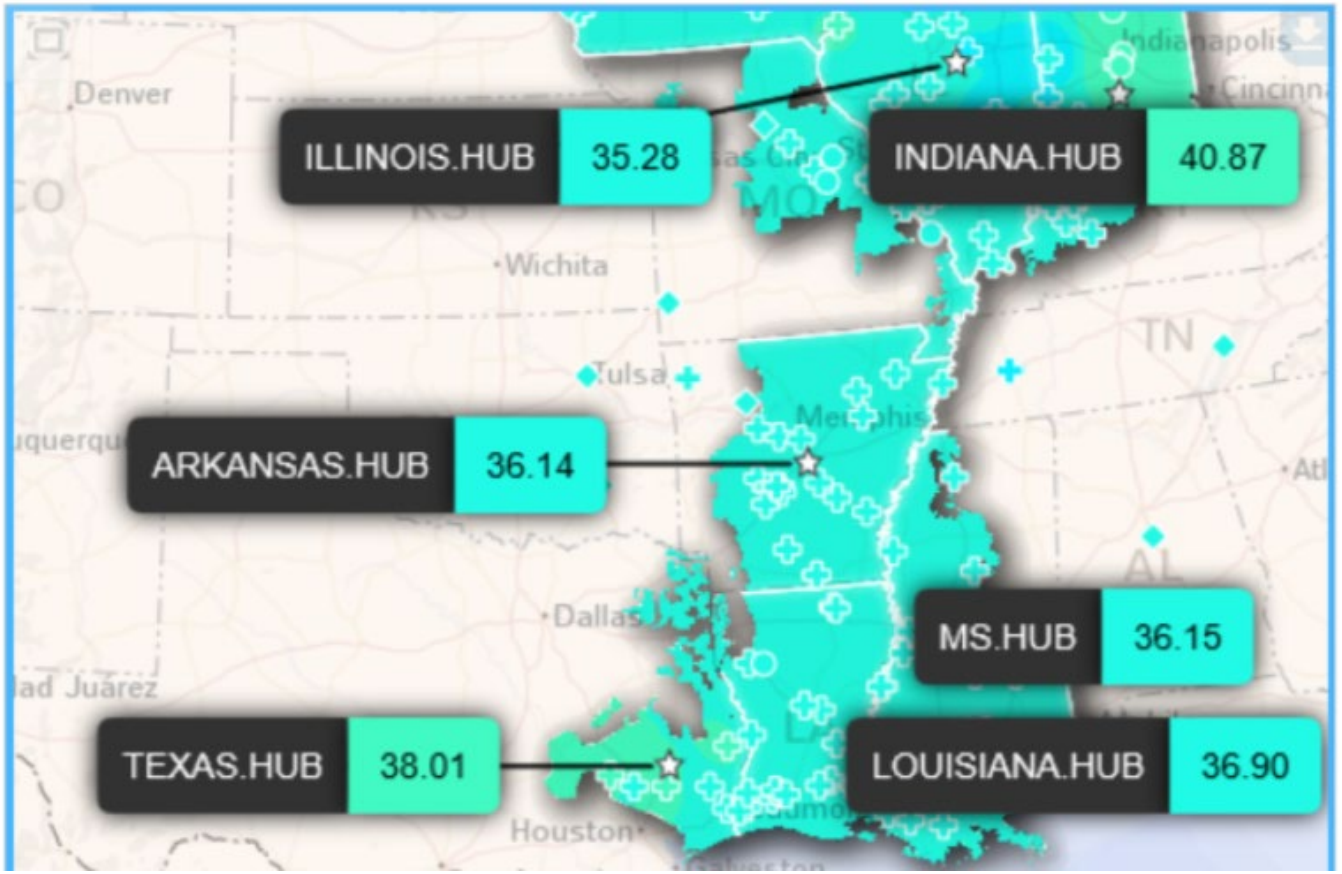


20-Jun-2023 - 19:15 EST



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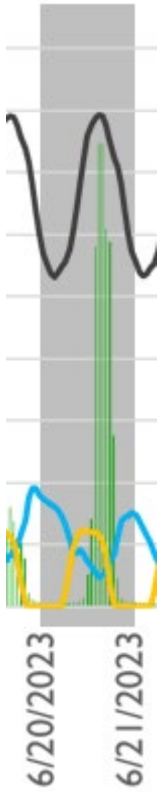
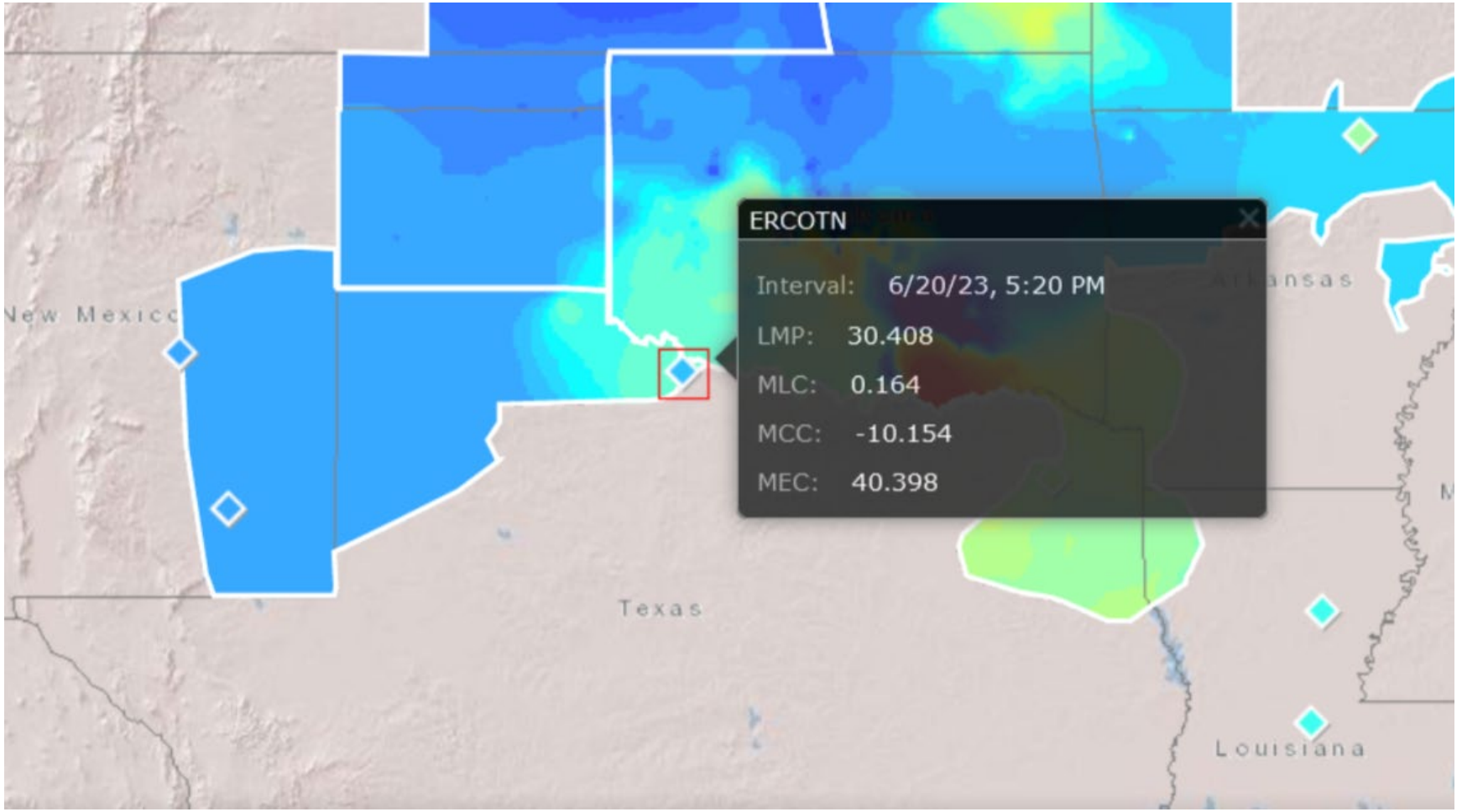




Cost for 5 hours of energy on June 20, 2023

Estimated cost:

$$78{,}000\ MW\ * 5\ hours\ * \frac{\$2{,}180}{MWh} = \$850{,}000{,}000$$

Cost for 5 hours of energy on June 20, 2023

What if there was more transmission capacity between ERCOT and MISO/SPP?

$$78{,}000\ MW\ * 5\ hours\ * \frac{\$40}{MWh} = \$15{,}600{,}000$$

Could’ve built a lot of transmission for that cost!

BLM clears way for $3B TransWest Express transmission project to start construction this year

The 732-mile project is designed to deliver 3,000 MW of wind generation from Wyoming to California and the Southwest.

Ethan Howland Published April 12, 2023 UTILITY DIVE

Takeaways

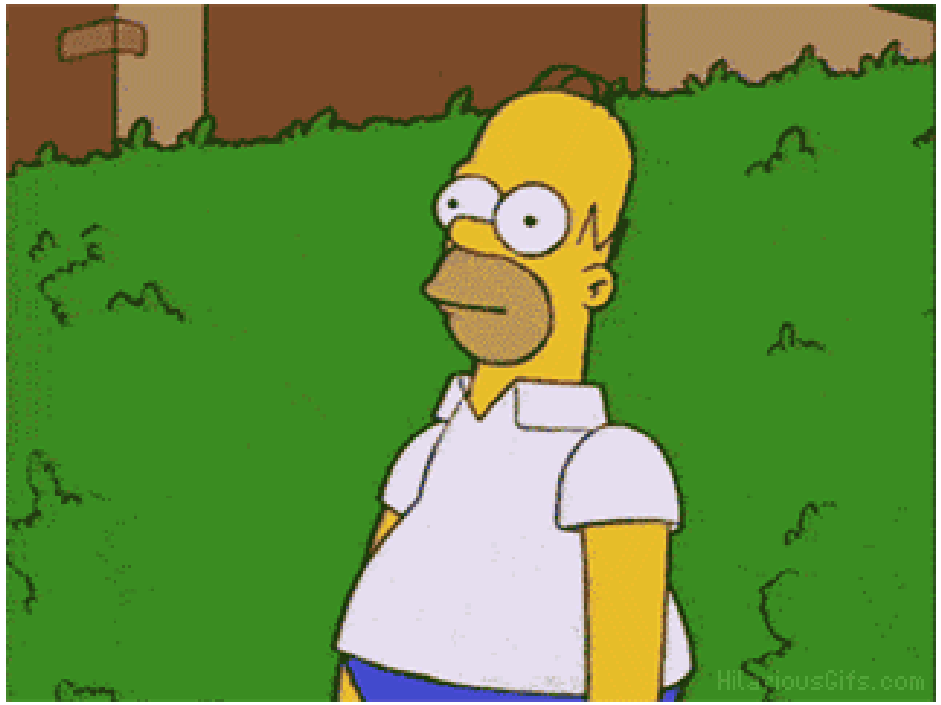
1. Even though they don't have an on/off switch, renewables enhance grid reliability

2. #1 is kind of scary

3. Renewables will continue to grow both due to politics and economics, but mostly economics

4. Load growth is real and will continue

5. #1 and #4 highlight the need for an all-of-the-above approach! We need energy! And we haven't even talked about EVs!



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