Managing Increasing Atmospheric CO_2 Concentrations and a Rapidly Changing Climate with Exponentially Increasing Demand for Electricity

WPAC Conference, Sept. 17-18,
Delta Hotel, Victoria BC

FutureMetrics LLC ™

FutureMetrics - Consultants to Many of the World's Leading Companies with Interests in the Wood Pellet Fuel Sector

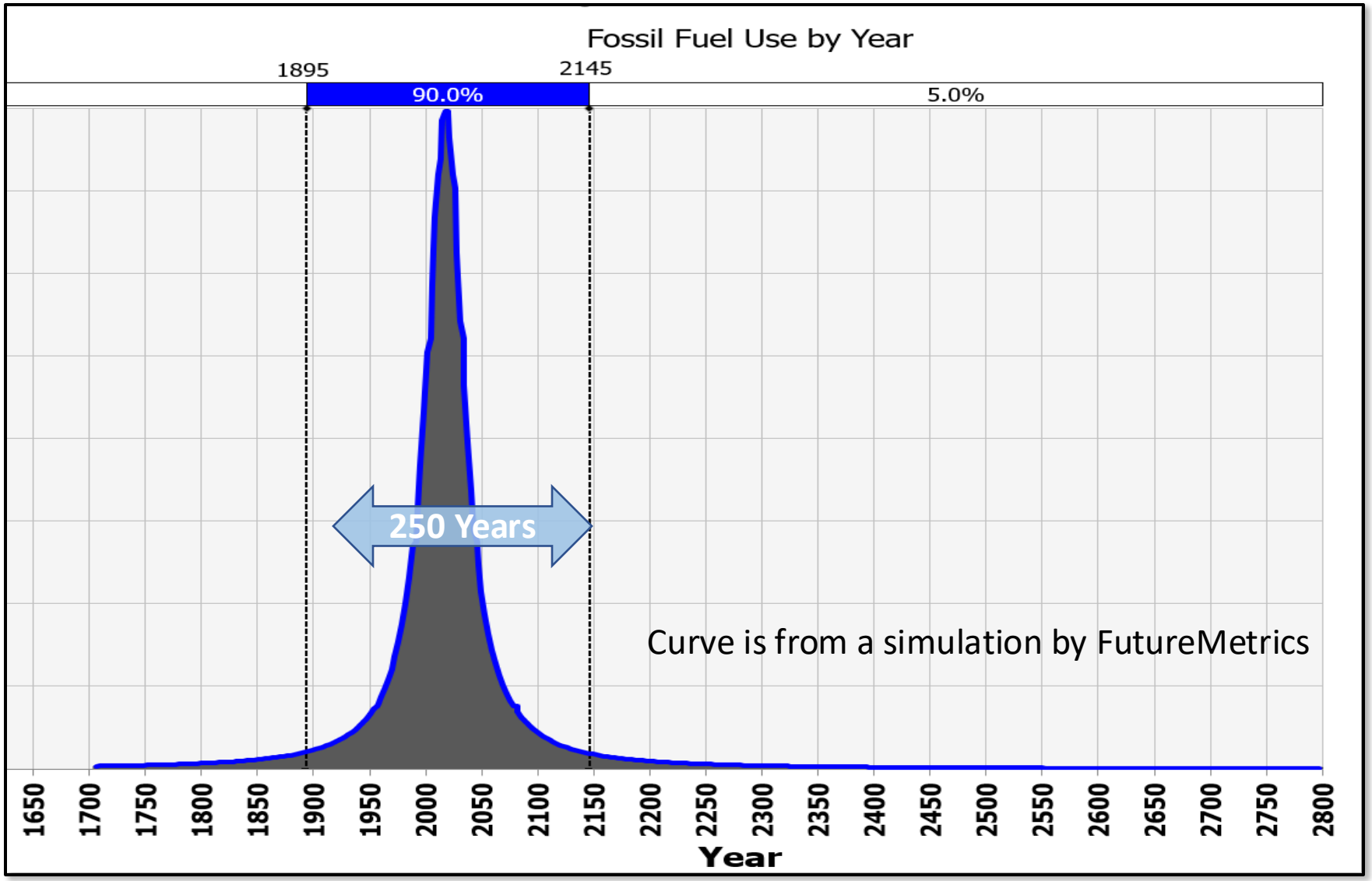
First:

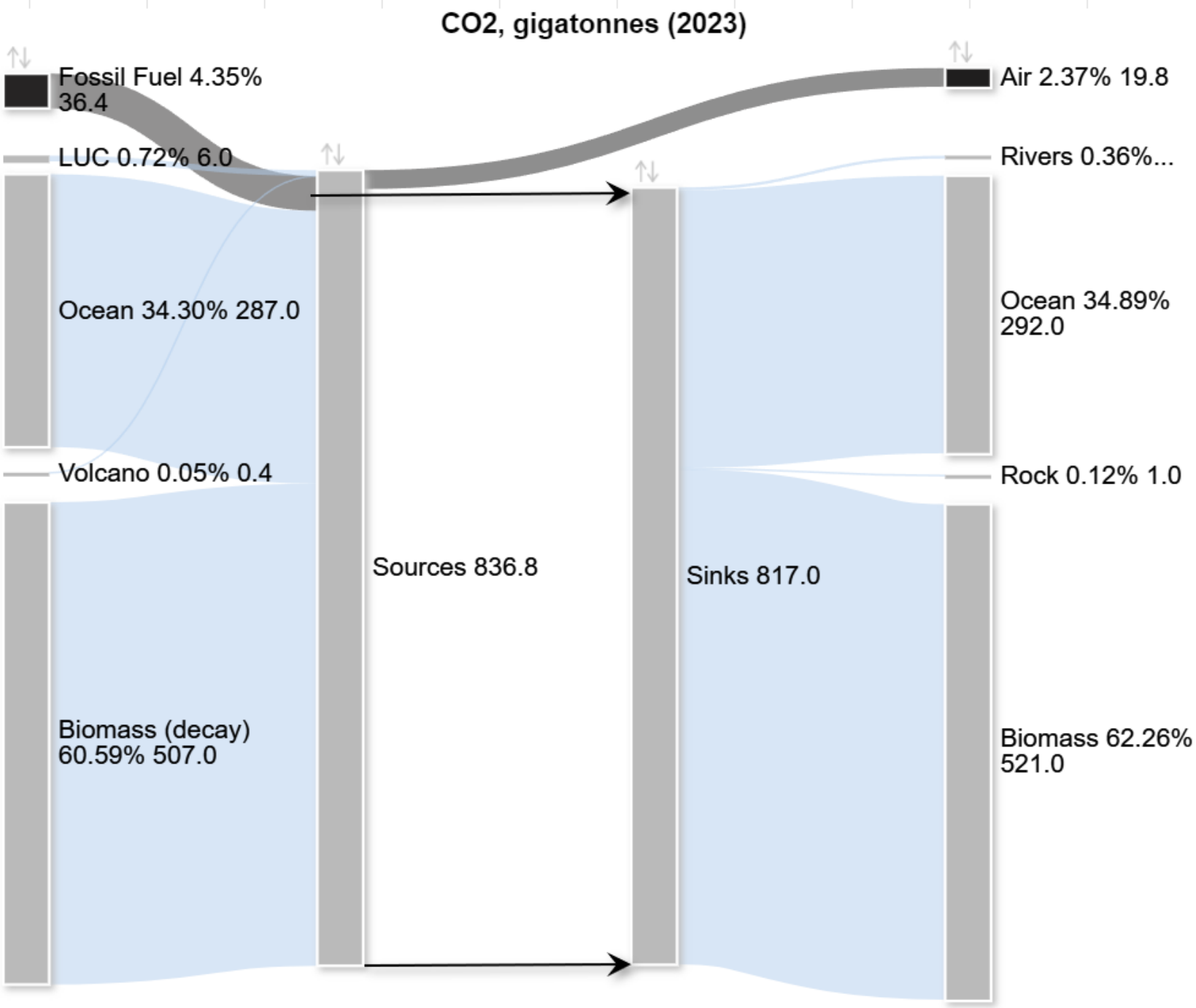
The reason that the industry exists….

CO_2 Emissions and Climate Change!

Fossil Fuel Depletion and CO_2 Emissions are Linked.

We will release most of the geologic carbon sequestered over hundreds of millions of years over a span of about 250 years.





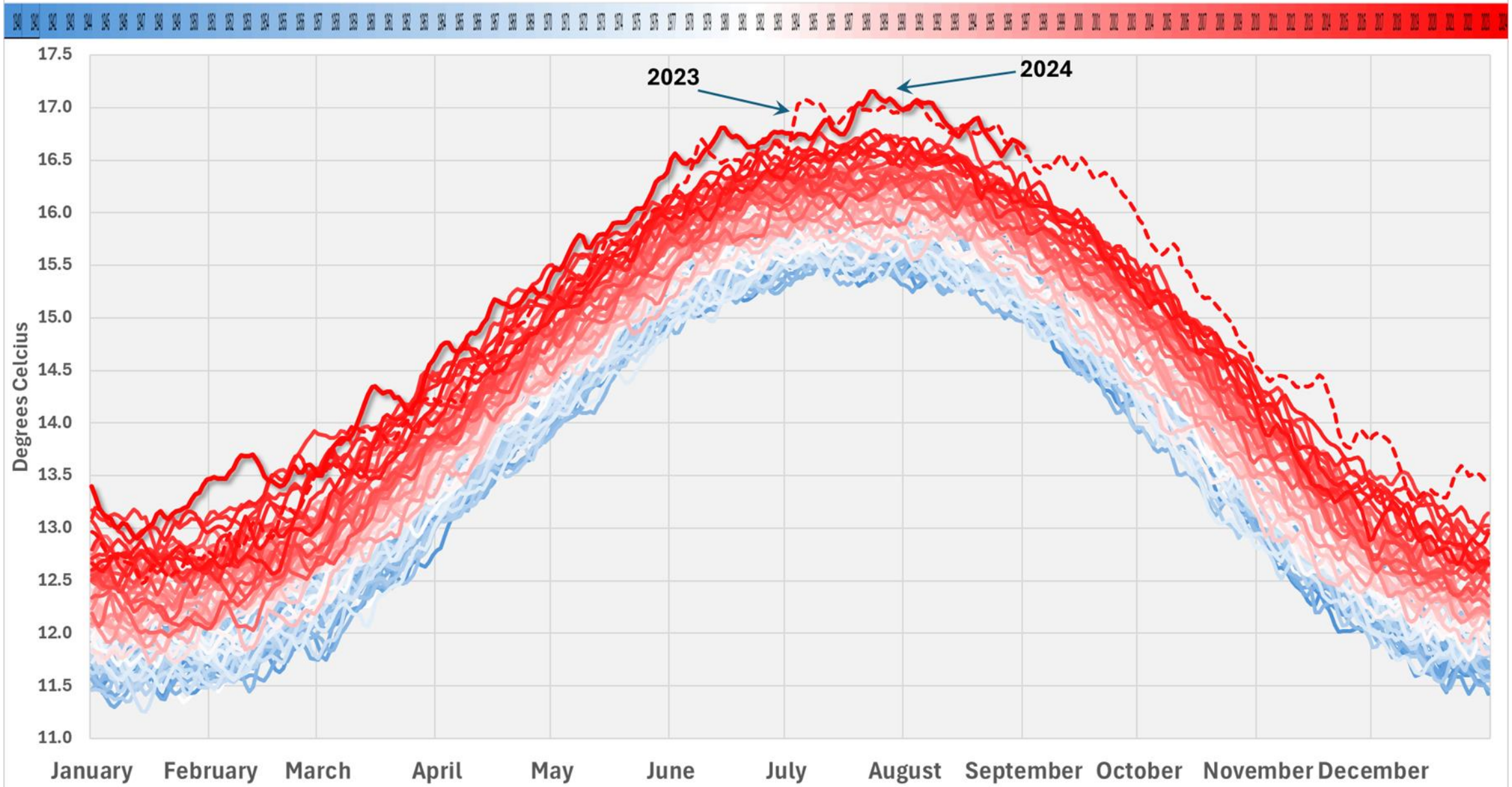
Sources are greater than sinks.

Earth's systems are out of balance.

Daily Air Surface Temperatures, World

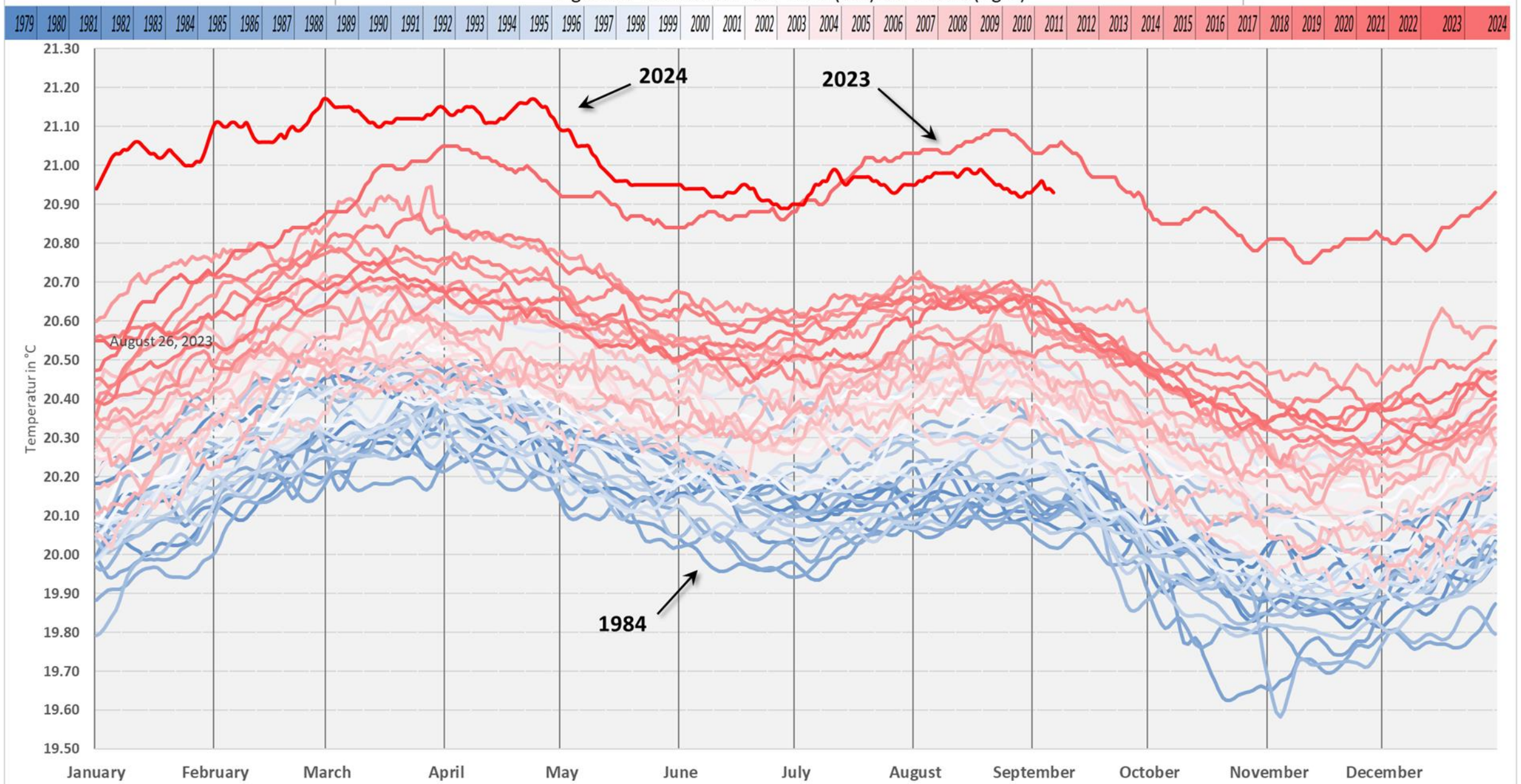
<== from 1940 to present ==>

[color code by year from dark blue=1940 to dark red = present]



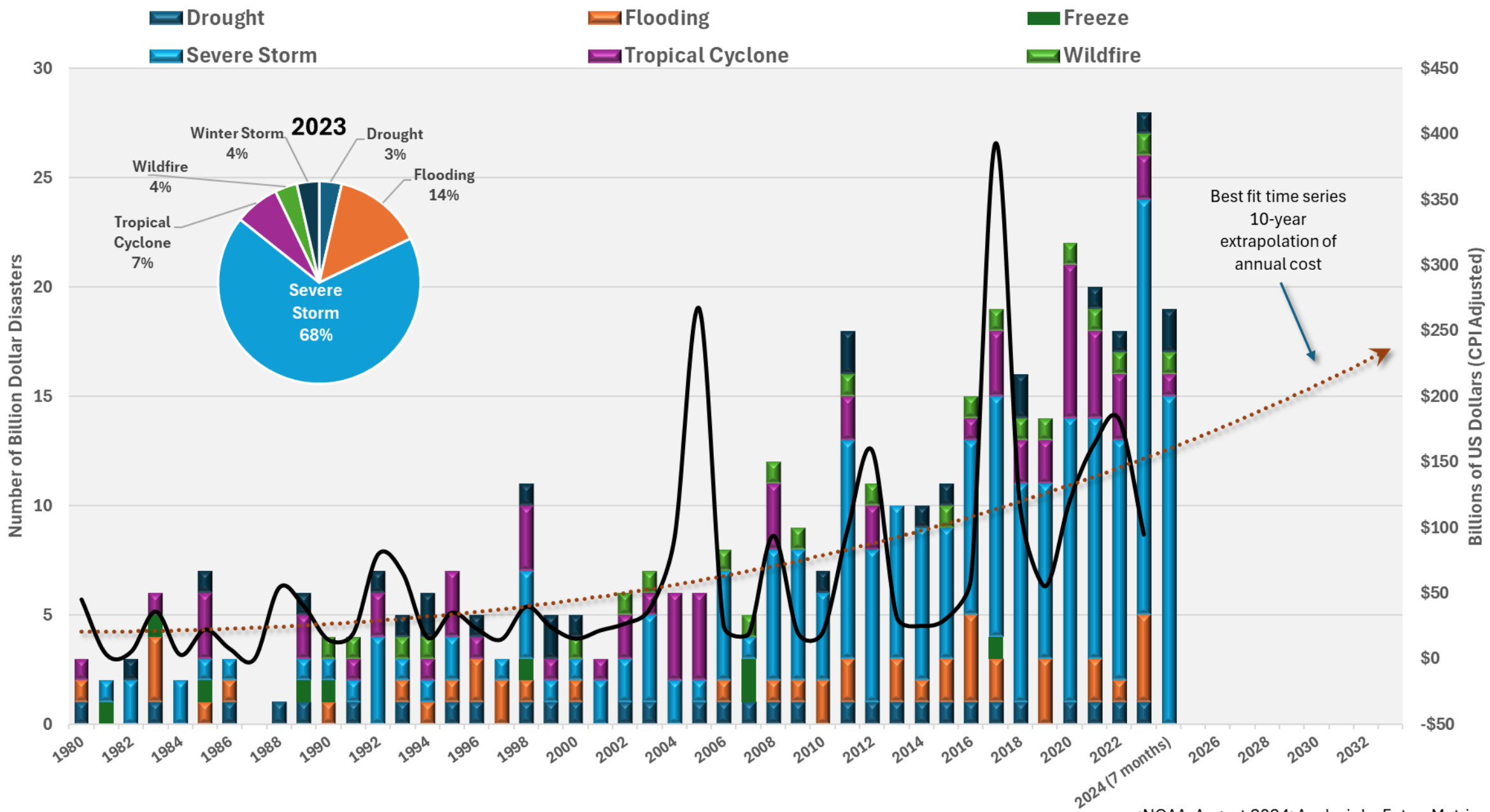
Source: https://climatereanalyzer.org/clim/t2_daily/?dm_id=world#info; Analysis by FutureMetrics

Daily global sea surface temperature; 60°S–60°N



source: https://climatereanalyzer.org/clim/sst_daily/; Analysis by FutureMetrics

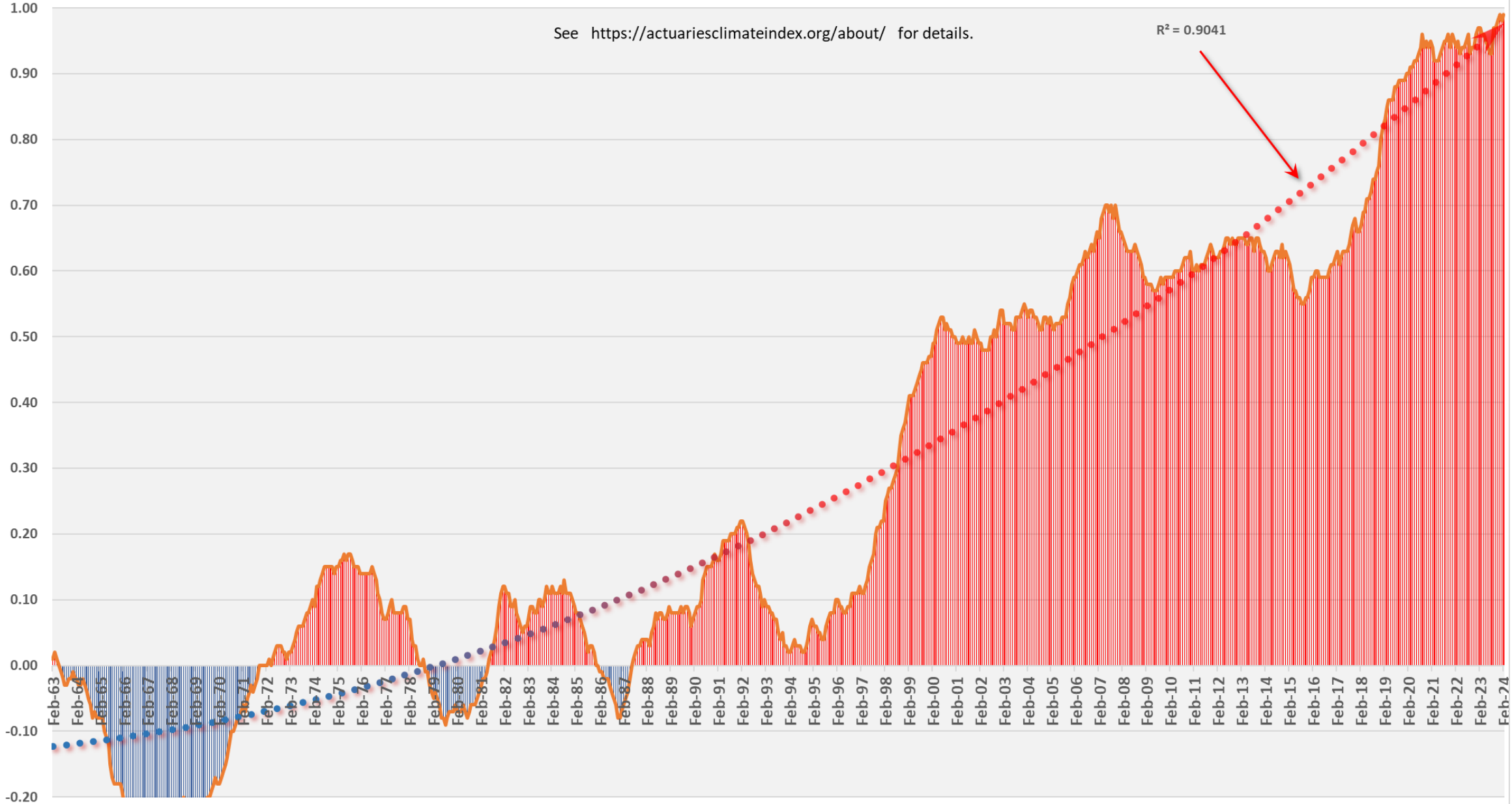
United States Billion Dollar Disasters



source:NOAA, August 2024; Analysis by FutureMetrics

Actuaries' Climate Risk Index - Monthly 1962 to Most Recent Data

Index is combined result of the average of [High Temperatures minus Low Temperatures plus Rainfall Data plus Extreme Winds plus Water Temperatures plus Sealevel]



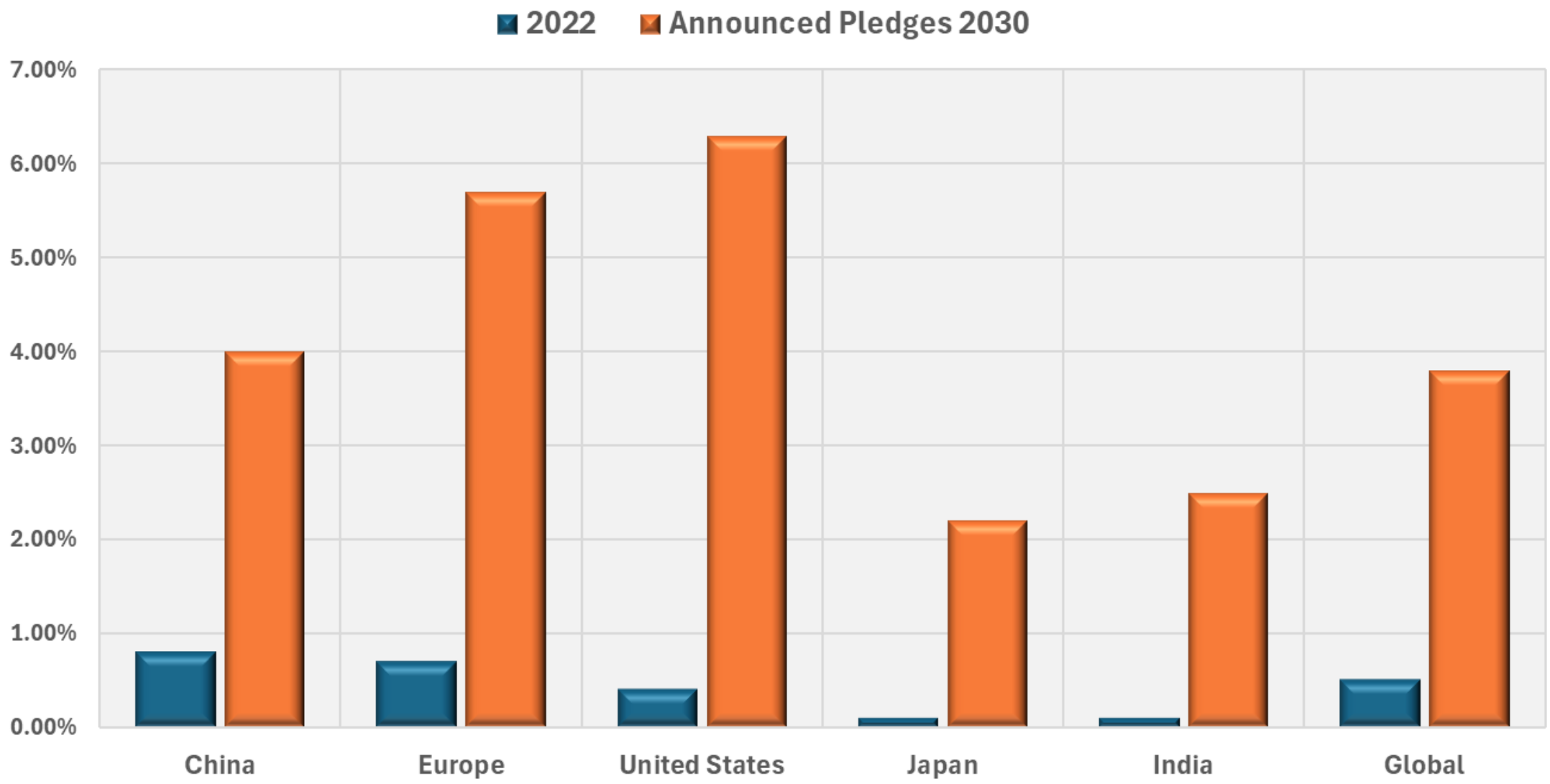
The increasing frequency and severity of the consequences of climate change will accelerate decarbonization policies in most nations.

The challenge is how to manage increasing CO_2 and a rapidly changing climate with rapidly increasing demand for electricity.

The current and forecast rapid increase in demand is from three primary sources:

- The rapid transition to the electrification of vehicles,
- the rapid growth of data centers and artificial intelligence (AI) (crypt mining is also stressing grids in certain locations),
- and the rapid growth of heat pumps in cold climates.

Share of electricity consumption from EV's relative to final electricity demand by region, 2022 and 2030



source: IEA - https://www.iea.org/reports/global-ev-outlook-2023/prospects-for-electric-vehicle-deployment; Analysis by FutureMetrics

One advantage of EV's is the potential to act an energy storage buffer if EV owners allow some power to be taken back during peak demand hours. This will support grid resilience and can complement intermittent generation (wind and solar).

This will reduce but not eliminate <u>the need for significant baseload/on-demand generation capacity</u> to cover gaps between EV energy storage, EV power demand, and the ability of wind and solar generation to supply sufficient power to keep the lights on 24x7x365.

Data centers are very different. There is no energy buffer scenario for data centers. They only consume power.

According to an International Energy Agency (IEA) report, an AI search consumes about 9 times more power than a typical Google search (2.9Wh versus 0.3 Wh)*.

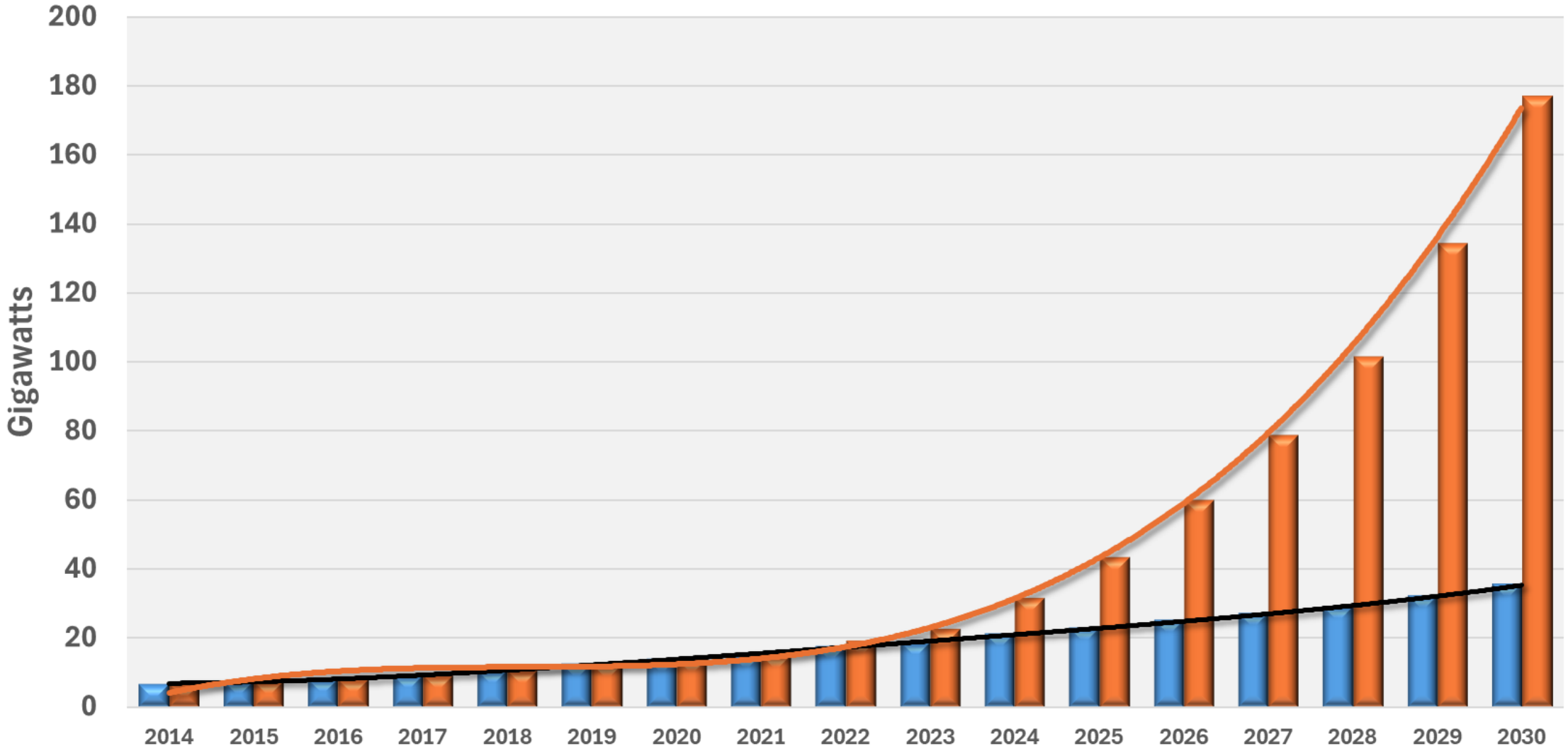
And with the relatively new and rapid growth of AI, forecasts for data center demand from a year ago have been revised significantly upward.

*See HERE, page 34.

Actual and Estimated Data Center Power Consumption - with and without AI

CAGR 2023 to 2030 based on pre-AI outdated forecast = 8.2%

With AI increaseing data center power demand by a factor of 4 by 2030, CAGR = 29.4%



source: early foreast at https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/investing-in-the-rising-data-center-economy: Analysis by FutureMetrics

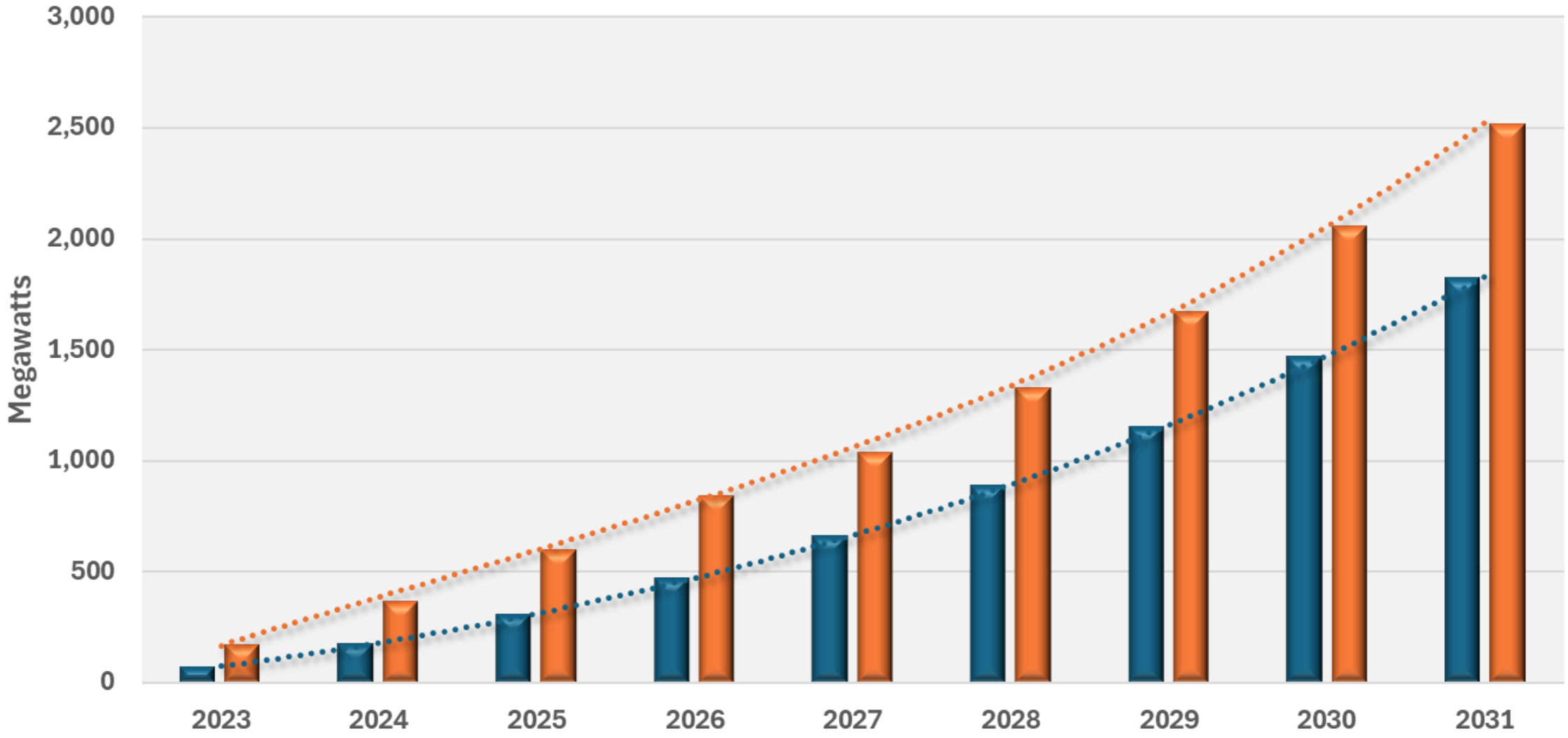
The third source of dramatic growth effects jurisdictions that experience winter cold.

<u>Heat pumps are everywhere!</u>

The rate of deployment was not expected just a few years ago.

As the next slide shows, the forecast for power demand for heating in the US northeastern region served by grid operator ISO-NE has changed dramatically in just one year.

New England Heating Electrification Demand Projections



source: https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2023.pdf, page 19; Analysis by FutureMetrics

The transition to a fully decarbonized power sector will take many decades and is challenged by accelerating growth in the demand for electricity!

The critical foundation for relying on intermittent and variable wind and solar generation is energy storage and transmission interconnectivity.

Energy storage at the scale needed to keep the power grids energized and stable is decades away.

A 2020 white paper by FutureMetrics* estimated how long the lights would stay on in the northeast US if all the battery storage expected to be deployed in the entire US by 2030 were put into the northeast US grid and if all fossil fuel generated power was switched off:

If all of that battery capacity were dedicated to PJM and required to keep the lights on if there were no fossil fuel generated power, it would last about 2.6 or 4.3 minutes at current peak and off-peak demand.

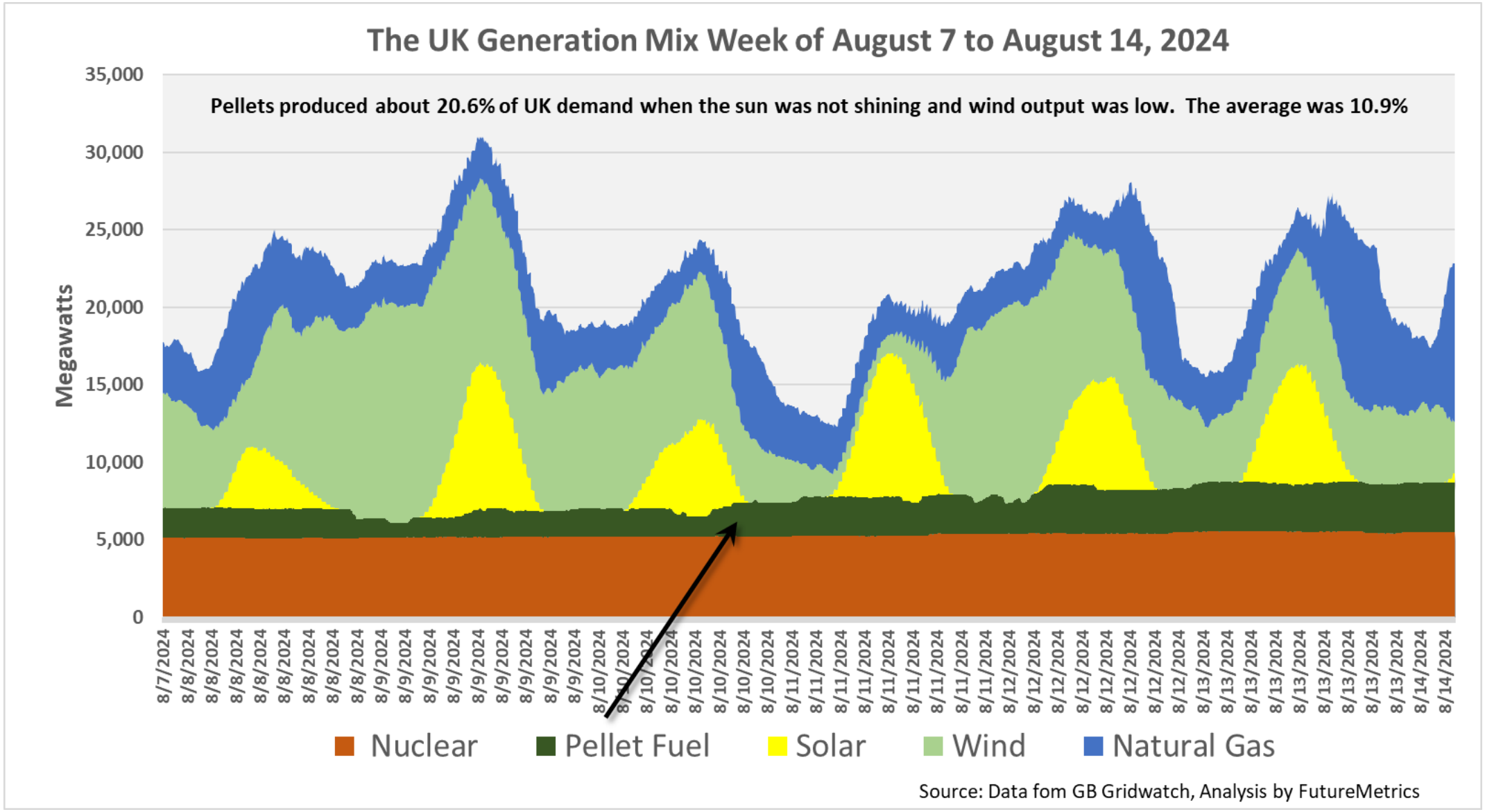
This is assuming that nuclear continues to generate at around 30,000 MWs and wind and solar are generating at the average output that they produce now.

*The white paper is HERE.

Sustainably sourced and upgraded bioresource derived solid fuel can significantly support baseload and load-following power generation by replacing coal in selected power stations with carbon emissions benefits that are well documented.

As the electrification of the transportation sector and the growth in power demand from AI and heat pumps continues, the need for more fossil fueled power generation (and the CO_2 pollution that they produce) can be mitigated with green power that is literally produced from green fuel.

This is the foundation of strategies in the UK, Japan, and parts of Western Europe and should be the foundation of decarbonization strategies in every nation



The Drax and Lynemouth power stations in the UK will be highly carbon negative by the early 2030's.

Biomass carbon capture and storage (BECCS) is being deployed at scale in the UK and western Europe.

BECCS is the ONLY pathway to significant negative carbon emissions while producing baseload and load following power.

Thank you!

WilliamStrauss@FutureMetrics.com

FutureMetrics LLC ™