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

The Unique Climate Beneficial Characteristics of Using Sustainably Sourced Bioresources for Baseload Powering our Future

May 5, 2024

By William Strauss, PhD

We can't solve problems by using the same kind of thinking we used when we created them.

Albert Einstein

As readers of a recent FutureMetrics white paper know[1], it is clear to us that the planet is in a climate crisis.

There are many crises these days. If the worst happens, CO_2 emissions issues may self-correct as they decline along with civilization!

But a prudent strategy today must discount that potential future and include a recognition of the urgent need to change business as usual in the energy sector. We have discussed this in some detail in earlier white papers (all available for free download at the FutureMetrics website).

This white paper reiterates points made in early papers with added urgency in the context of the accelerating consequences of carbon emissions AND the accelerating need for electricity.

Regarding the consequences of the increasing concentration of CO_2 in the atmosphere, readers of FutureMetrics papers and those that have seen presentations by William Strauss have seen the chart on the next page (Figure 1). It is updated with data to May 2, 2024. On April 26, 2024, a new record high in atmospheric CO_2 levels was set: 428.59 ppm[2].

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

[1] See "**Have we Passed the Tipping Point for Climate Change? Charts Tell the Story",** Updated May 2, 2024 at the FutureMetrics website HERE.
[2] See the interactive chart on the FutureMetrics homepage.

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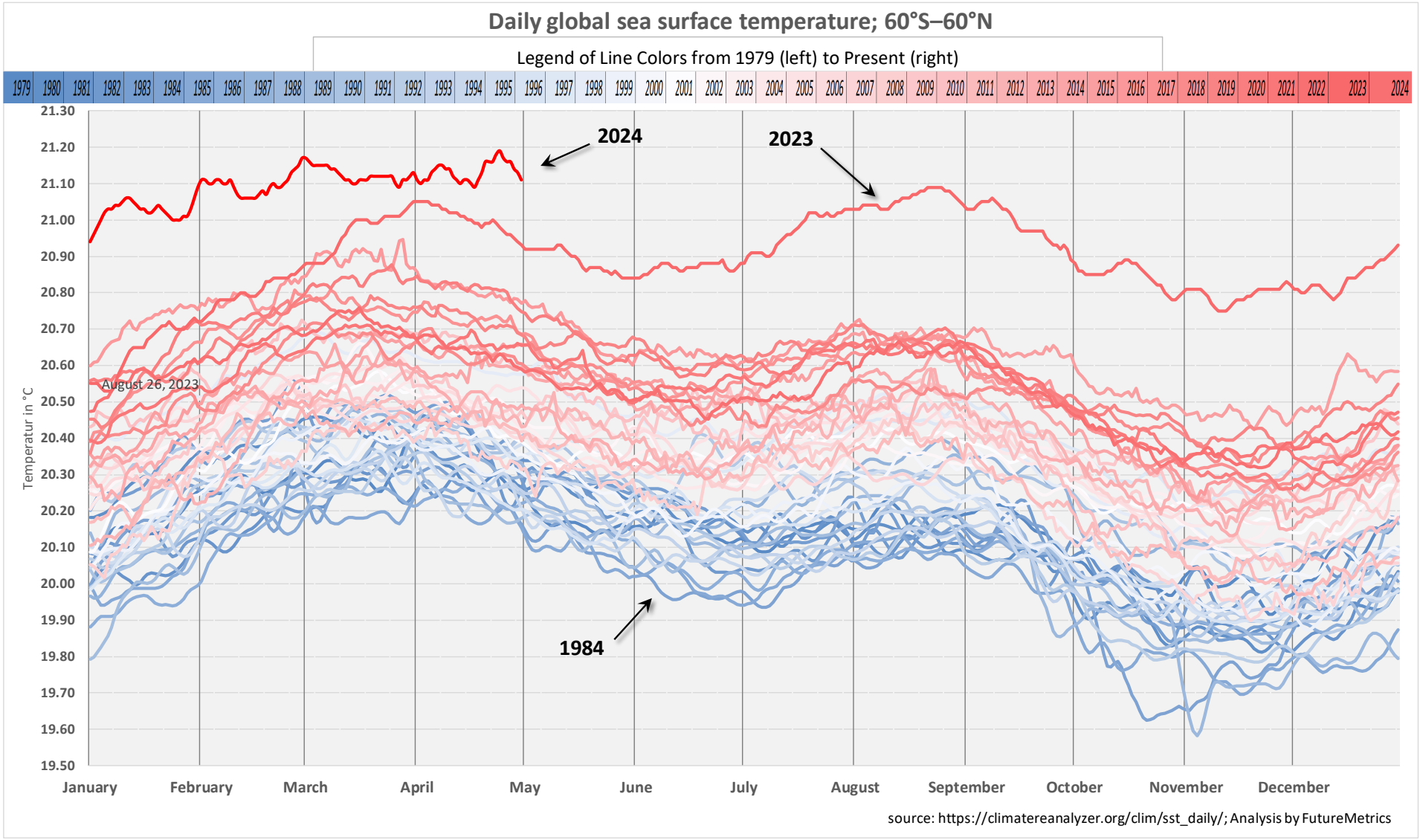

Figure 1 - Daily Global Sea Surface Temperatures 1979 to Today

The explosive increase in power demand is nicely summarized in a Washington Post story, "Amid explosive demand, America is running out of power". While the story is about America, the challenges described in the story are common to many regions of the world.

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),
- and the rapid growth of heat pumps in cold climates.

As electric vehicles (EV's) replace combustion engine vehicles, demand for power will increase. 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 the need for significant baseload/on-demand generation capacity 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.

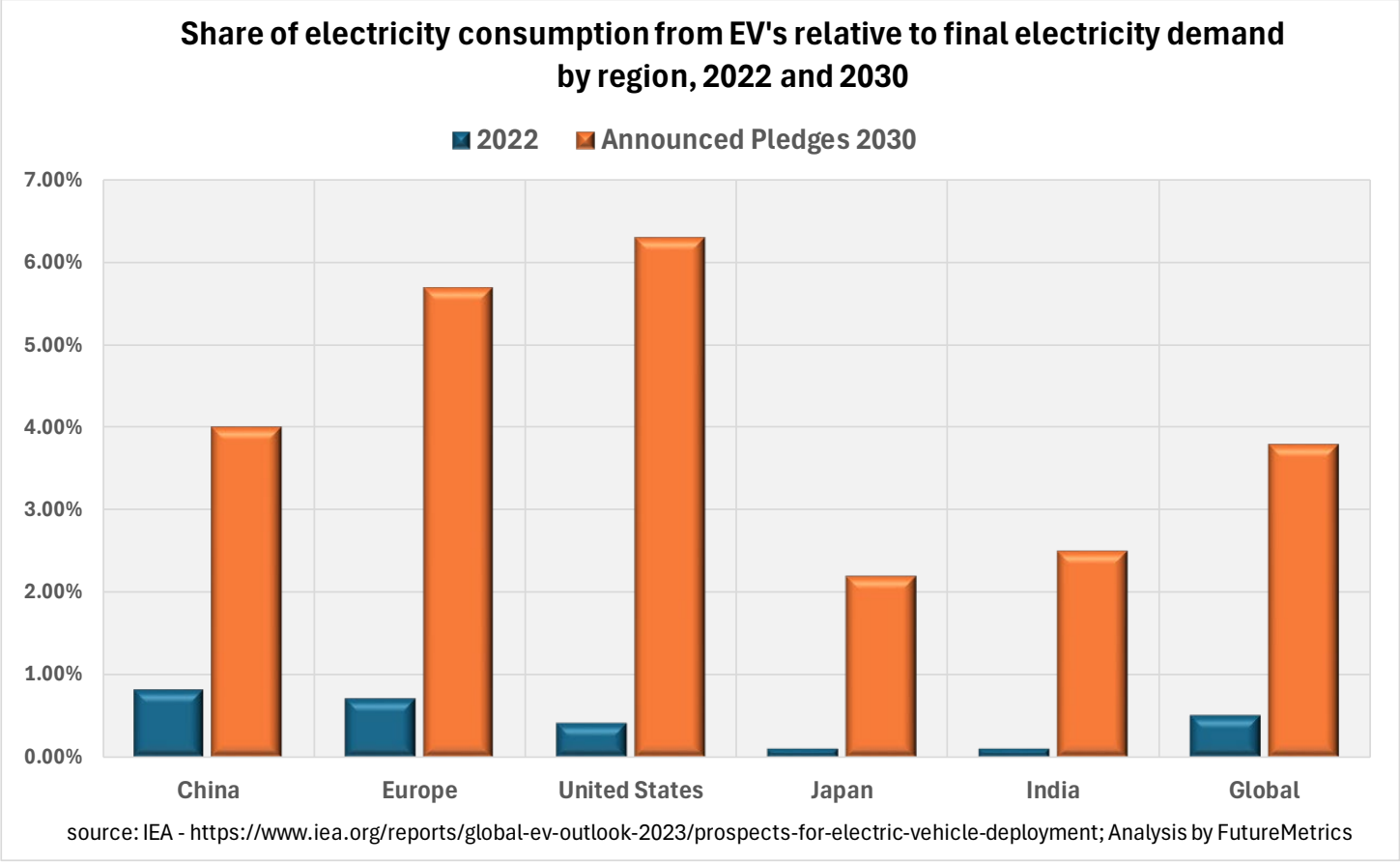

Figure 2 - Forecast Share of Electricity Demand from EV's

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Data centers are very different. There is no energy buffer scenario for data centers. They only consume power. And with the relatively new and rapid growth of AI, forecasts for data center demand from a year ago have been revised significantly upward. According to an International Energy Agency (IEA) report, an AI search can consume about 9 times more power than a typical Google search (2.9Wh versus 0.3 Wh)[3].

A report in early 2023 suggested a doubling of power demand from 2023 to 2030 by data centers. Using that data and running a scenario that increases total data center demand by a factor of four by 2030 over that outdated forecast yields the extreme outcome shown below in Figure 3.

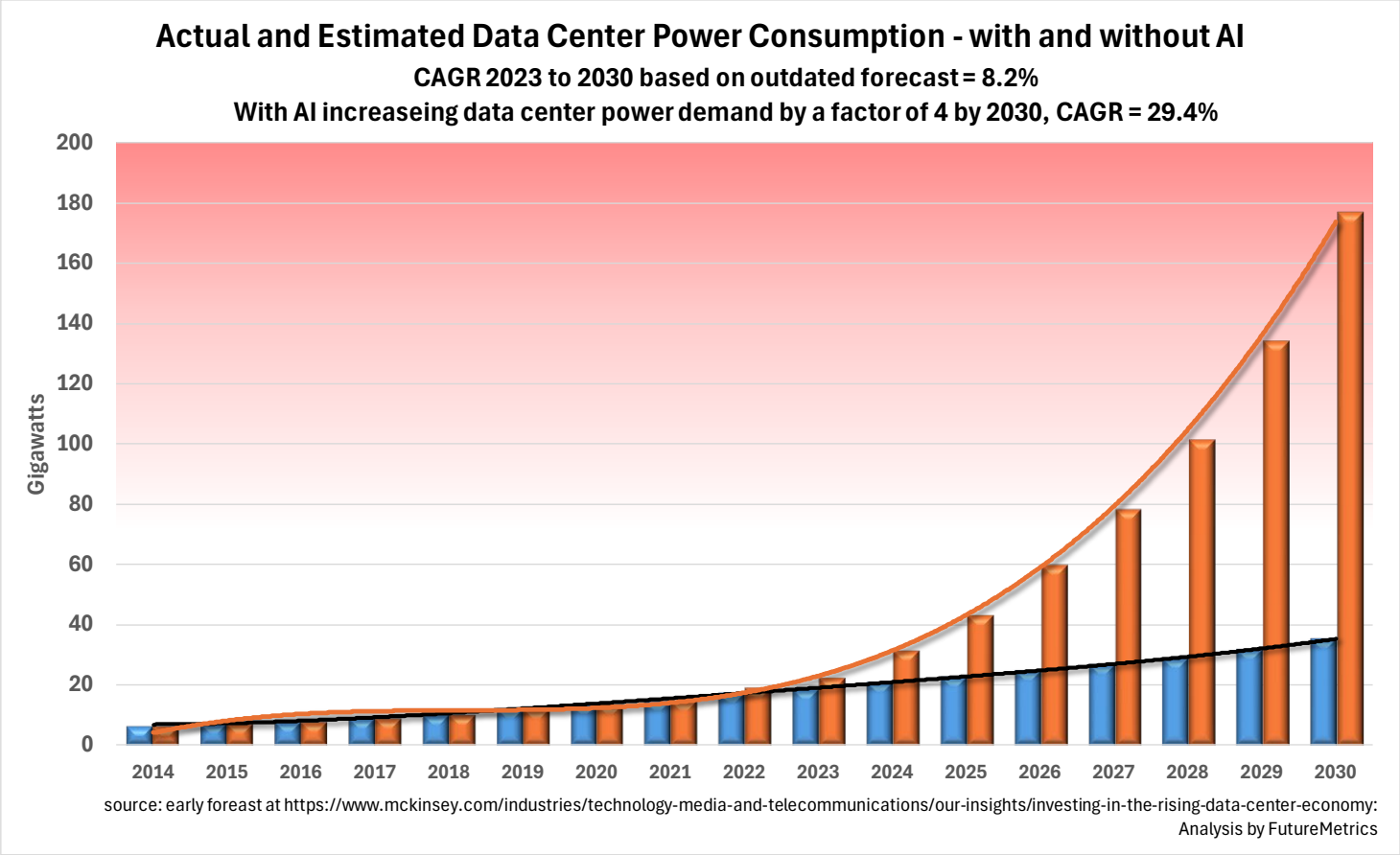

Figure 3 - Data Center Power Consumption with an Increased Demand from AI Scenario

While Figure 3 possibly overstates what may happen, the rapid increase in AI usage and the very frequent and significant upward revisions of power demand growth due to AI suggests that the scenario in Figure 3 is possible!

[3] See HERE, page 34.

The third source of dramatic growth effects jurisdictions that experience winter cold. Heat pumps are everywhere[4]! The rate of deployment was not expected just a few years ago[5]. As Figure 4 below 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.

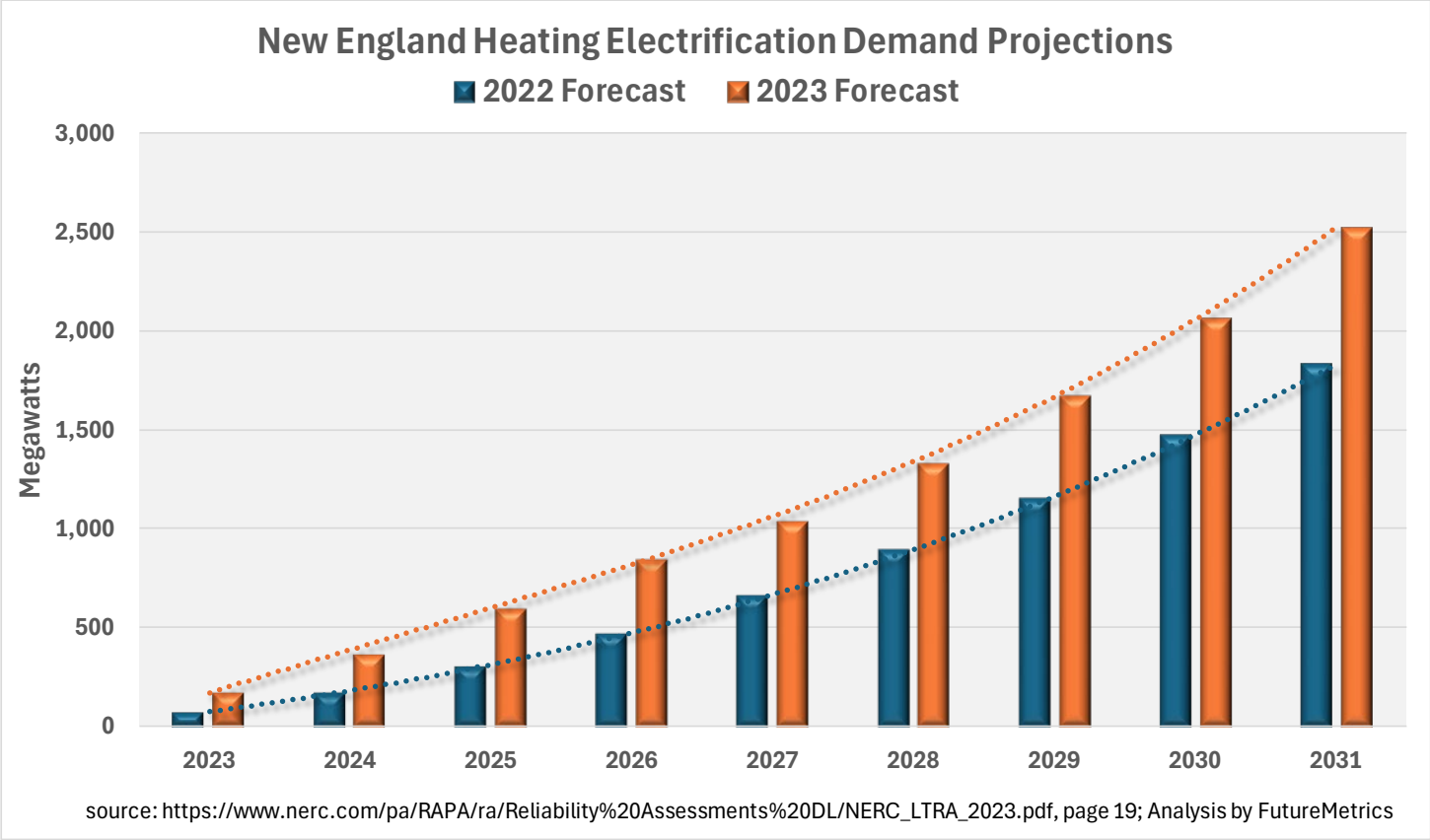

Figure 4 - New England Power Demand Forecast for Heating

Some Load Increases can be Matched with Power Generated from Renewable Sources

The transition to a fully decarbonized power sector will take many decades. 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.

[4] See the FutureMetrics white paper on this topic HERE.
[5] See HERE for example.

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A 2020 white paper by FutureMetrics estimated how long the lights would stay on in the northeast US if all of the battery storage expected to be deployed 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. [6]

It seems likely that fossil fueled generation (natural gas and coal) will be needed for some time. And moving off of fossil fuel generation to renewables will be challenging as power demand increases.

As an example, Figure 5 below shows Japan's mix of generation sources over the last few decades. Note the impact of the tsunami disaster on nuclear generation!

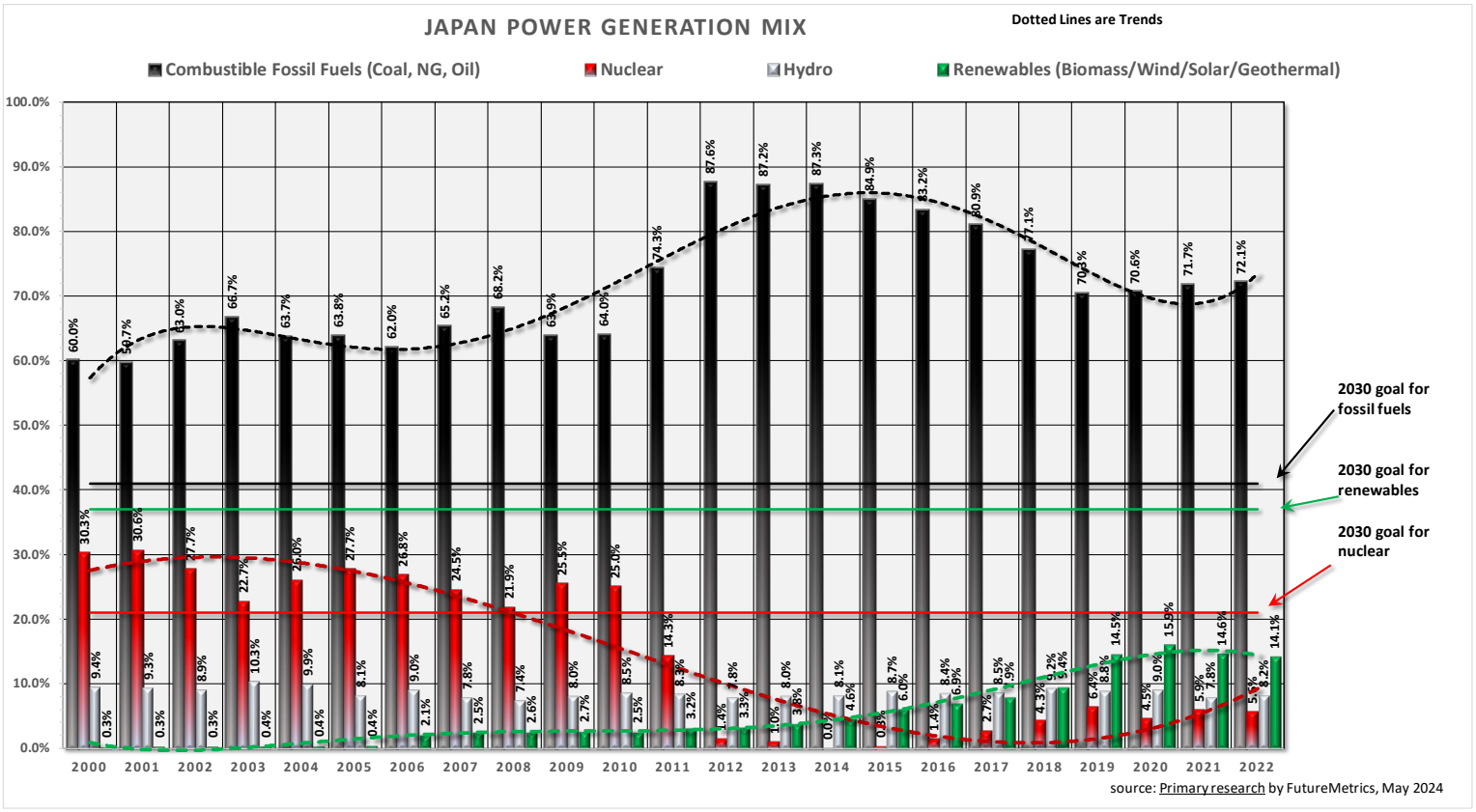

Figure 5 - Japan Power Generation Mix

[6] The white paper is HERE.

Because of these challenges, Japan has joined the UK, some western European countries, and South Korea as one of the leading nations in its strategy for decarbonizing its reliance on fossil fueled power generation.

There are several previous FutureMetrics white papers discussing the efficacy of using sustainable sourced and upgraded bioresources to replace coal. Figure 6 and Figure 7 below illustrate the degree to which Japan and the UK are doing this.

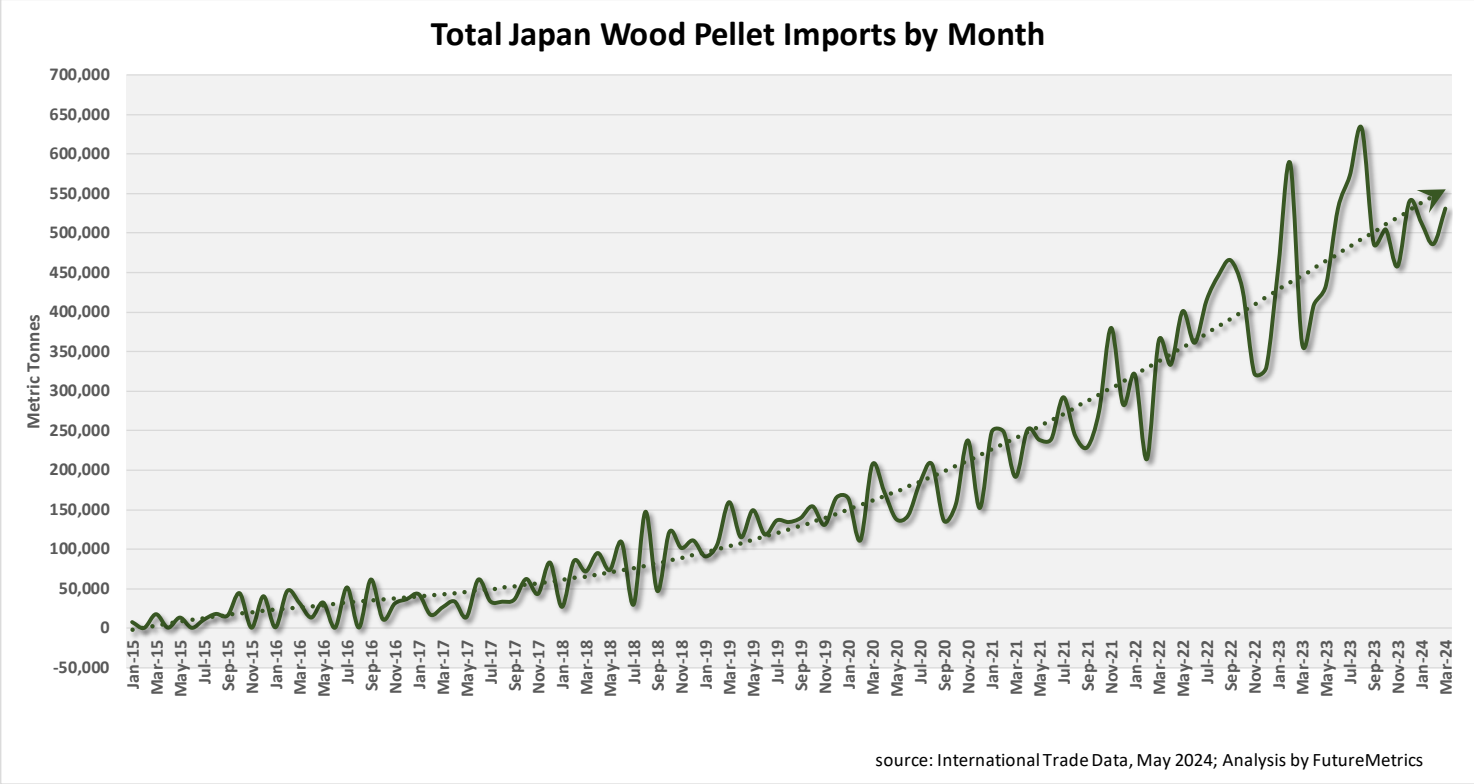

Figure 6 -Japan Pellet Fuel Imports

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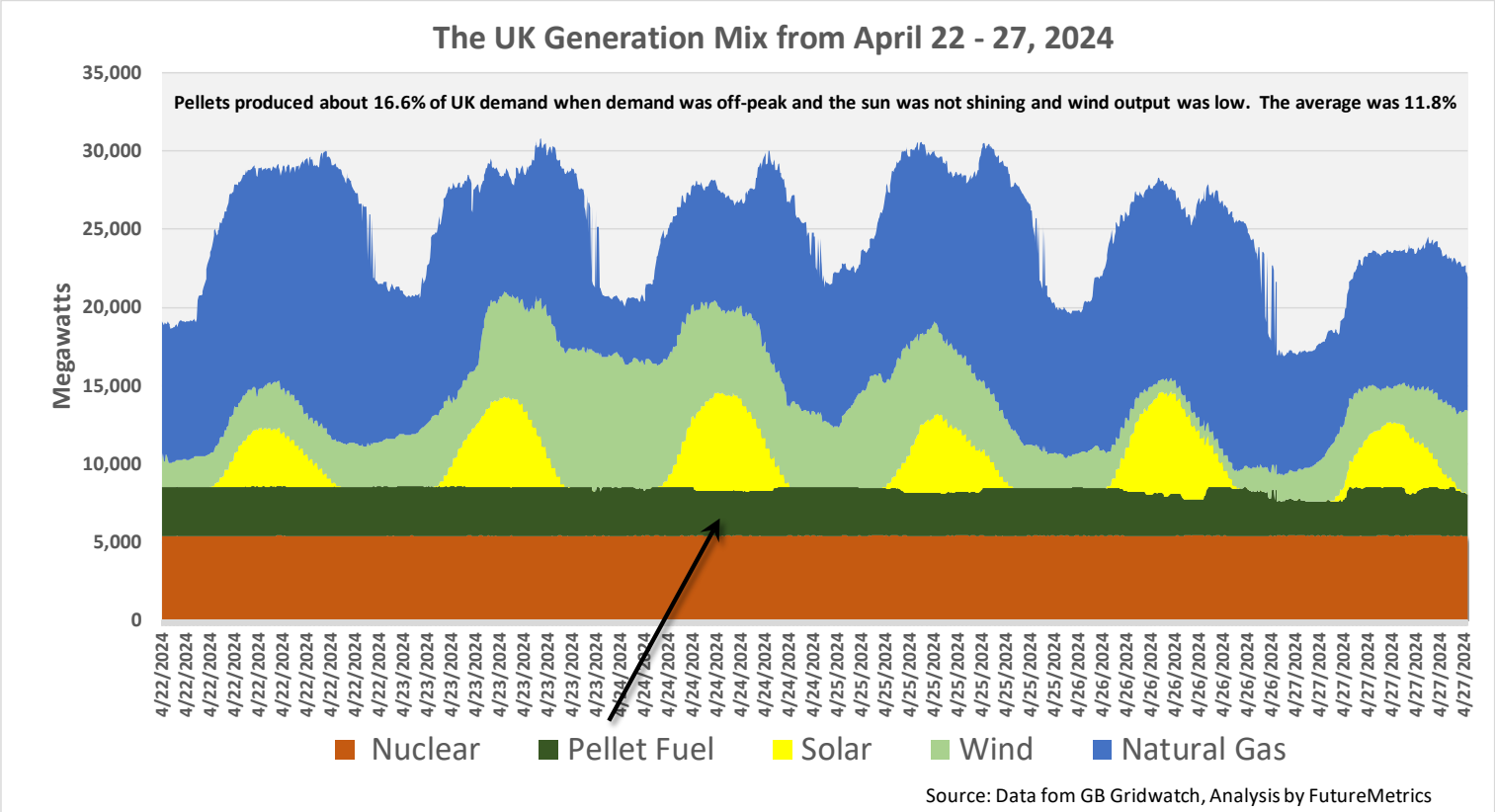

Figure 7 - UK Generation Mix (exclude pump storage and power from foreign interconnections)

Sustainably sourced[7] and upgraded bioresource derived solid fuel can significantly support baseload power generation by replacing coal in selected power stations with carbon emissions benefits that are well documented in previous FutureMetrics papers.

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

[7] Sustainability is the essential foundation for the use of woody bioresources. The stock of carbon held in the forests managed for the production of lumber, furniture, flooring, cabinets, cardboard, tissue, pellet fuels, etc. must not be depleted. The basic constraint is that the rate of removal can never exceed the rate of growth. This requirement must be proven for these fuels to receive policy support and be recognized as carbon emissions beneficial.