

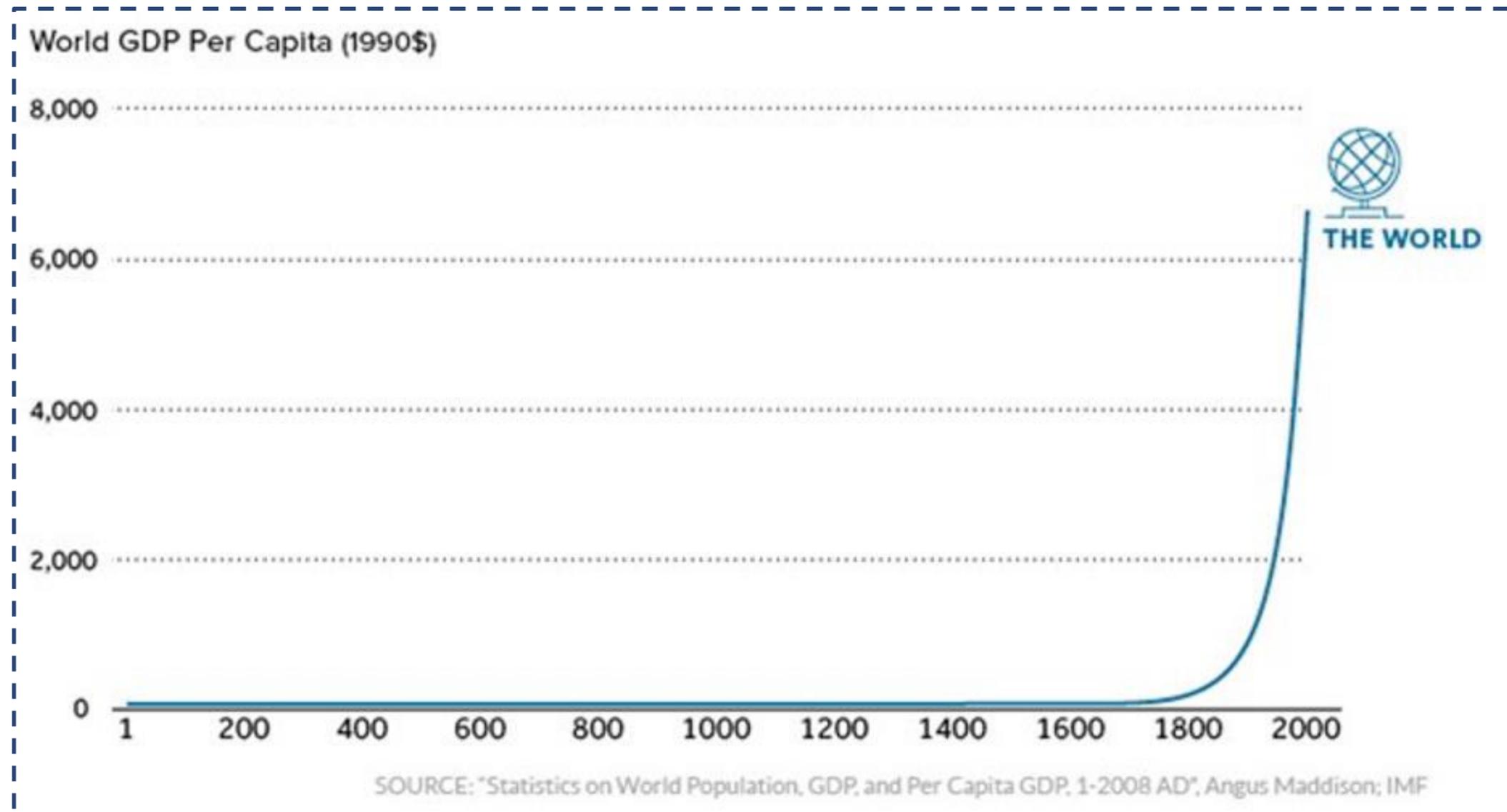
Climate Optimism: Harnessing Innovation and Technology for a Sustainable Future

Fabrice Grinda

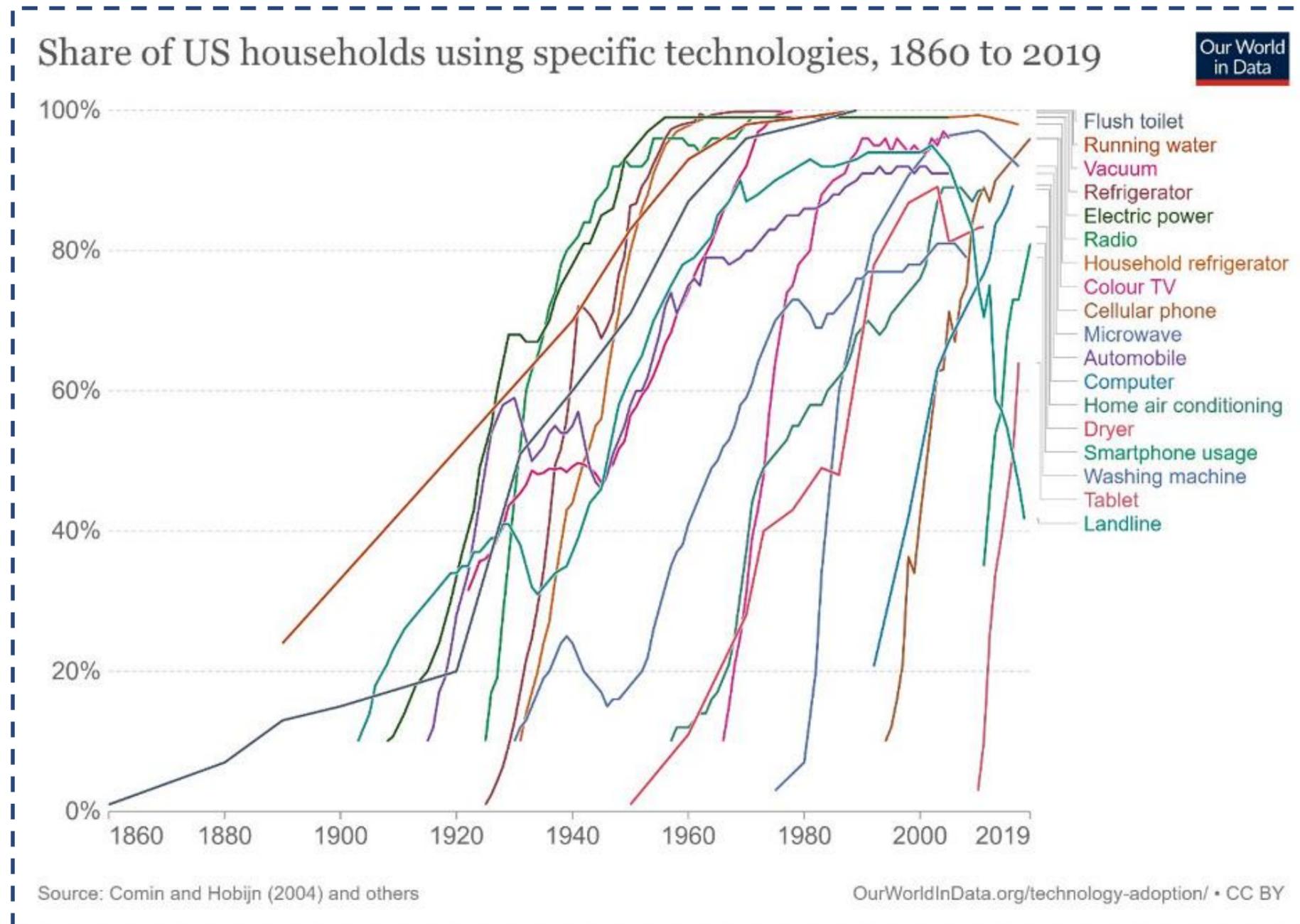
FJ LABS

October 2024

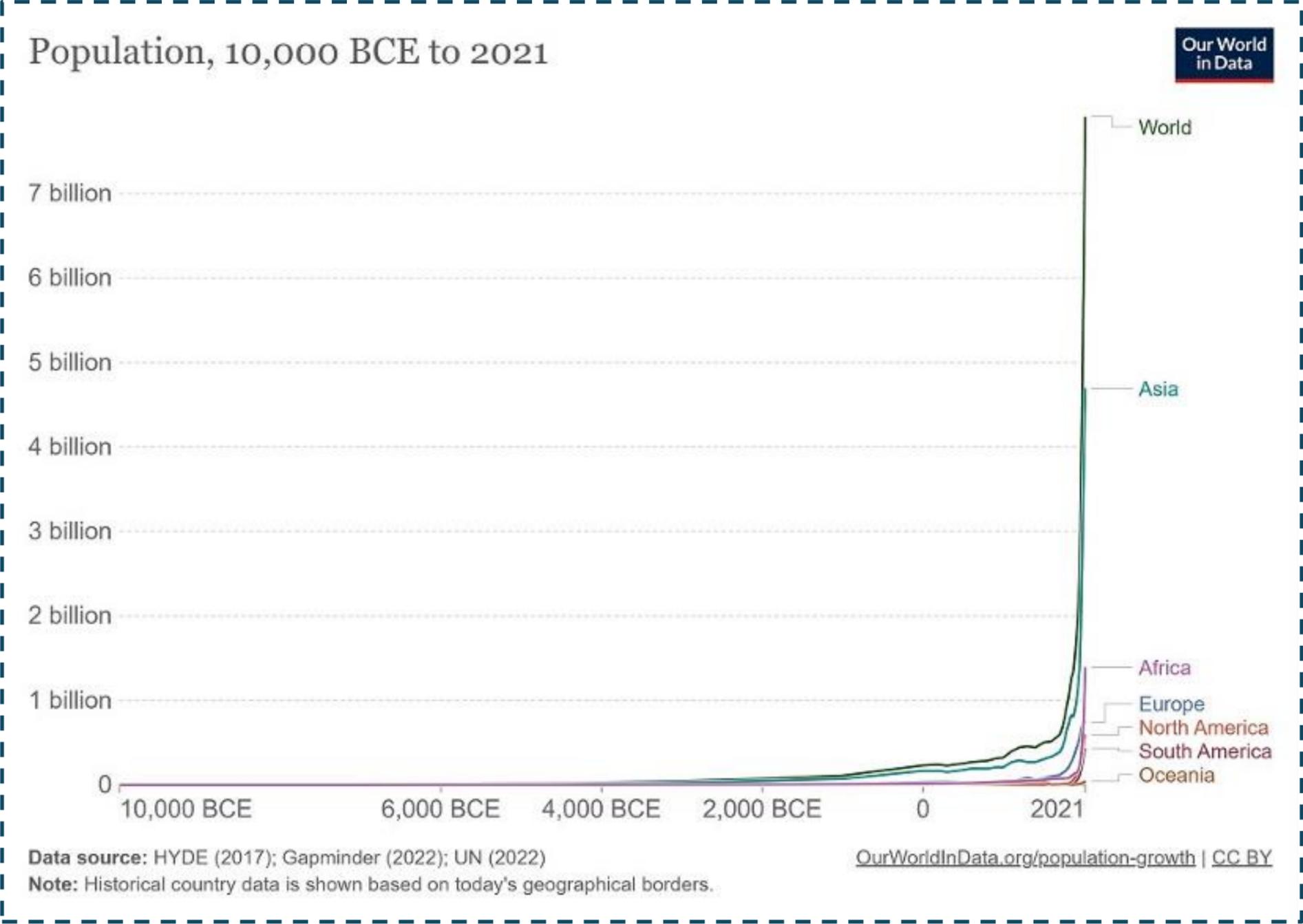
For most of human history, the human condition struggled to survive – only the last 250 years have been exceptional with the industrial revolution.



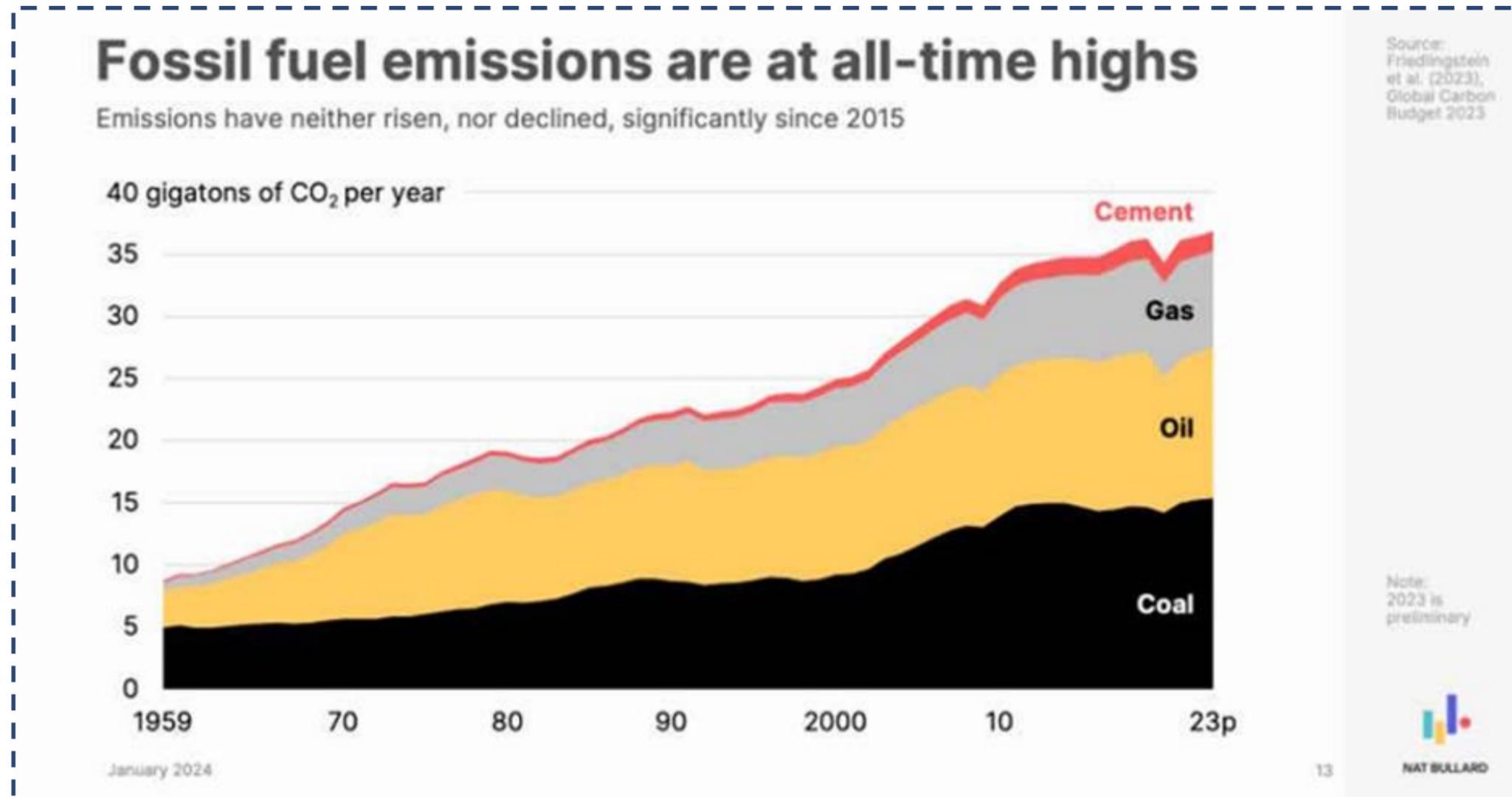
Explosion in human productivity that transformed life as we knew it to that point in the West. We now have a quality of life that would be the envy of kings of yesteryear.



We managed to massively improve quality of life while the world population exploded.



This growth has been powered by massive increase in energy consumption, which has come with consequences.



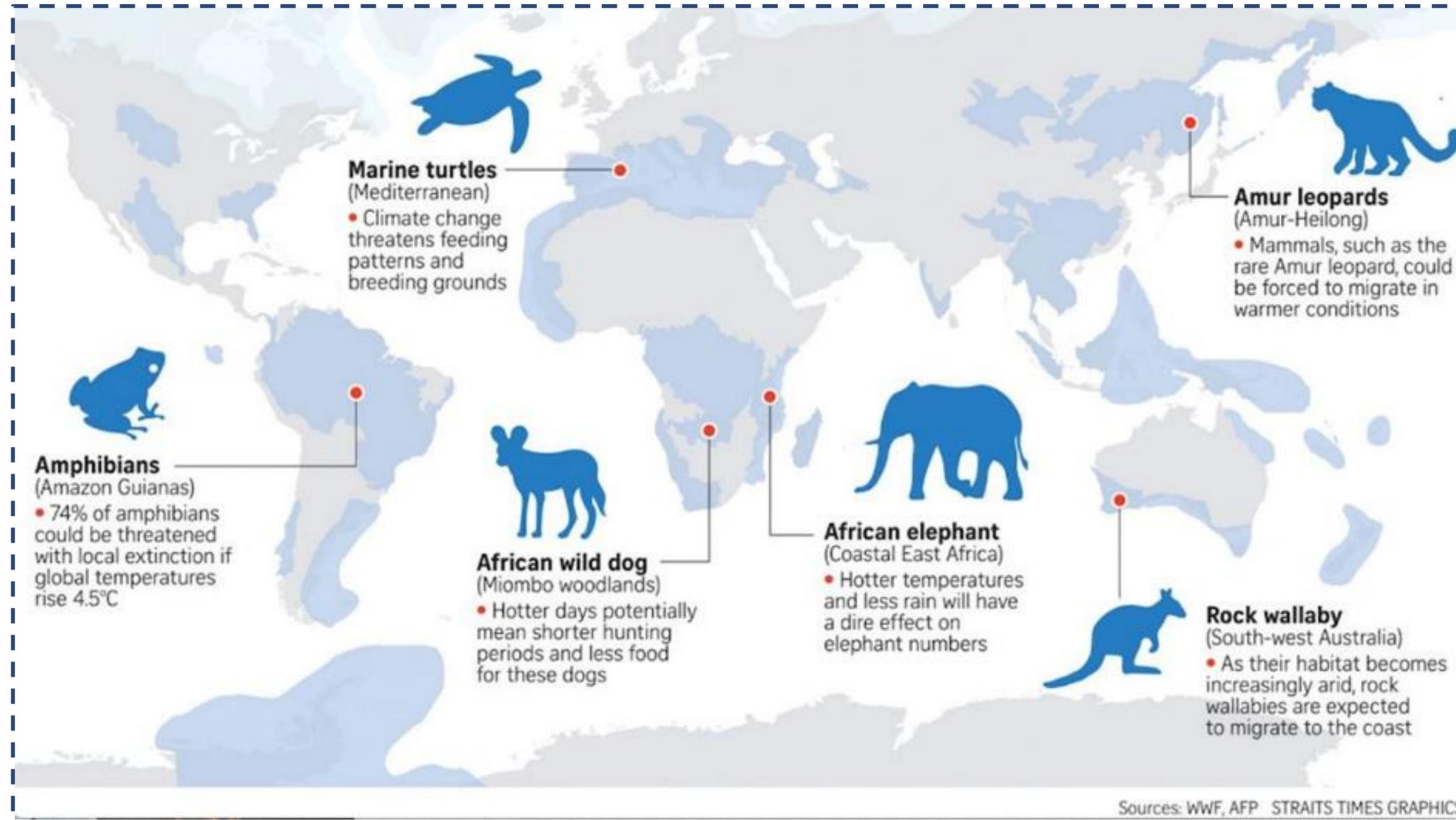
Hydrocarbons (coal, oil,
natural gas)
=
Accumulated
greenhouse gas
emissions
=
Climate change
becoming an existential
threat

Energy accumulating in the oceans is like detonating 5 Hiroshima-sized atomic bombs per second, every second over the past 25 years.

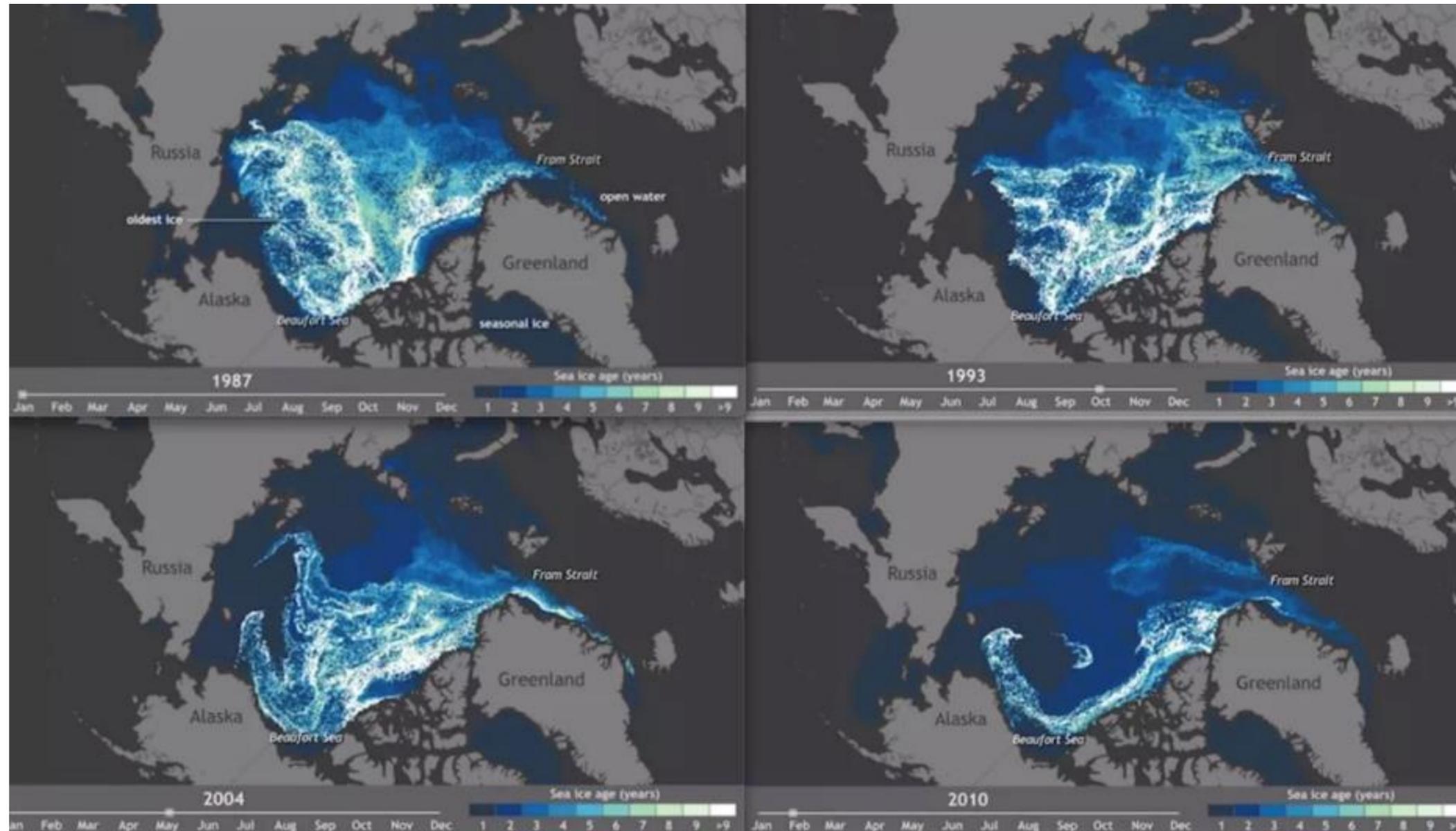


But because this process is largely invisible, we have been complacent.

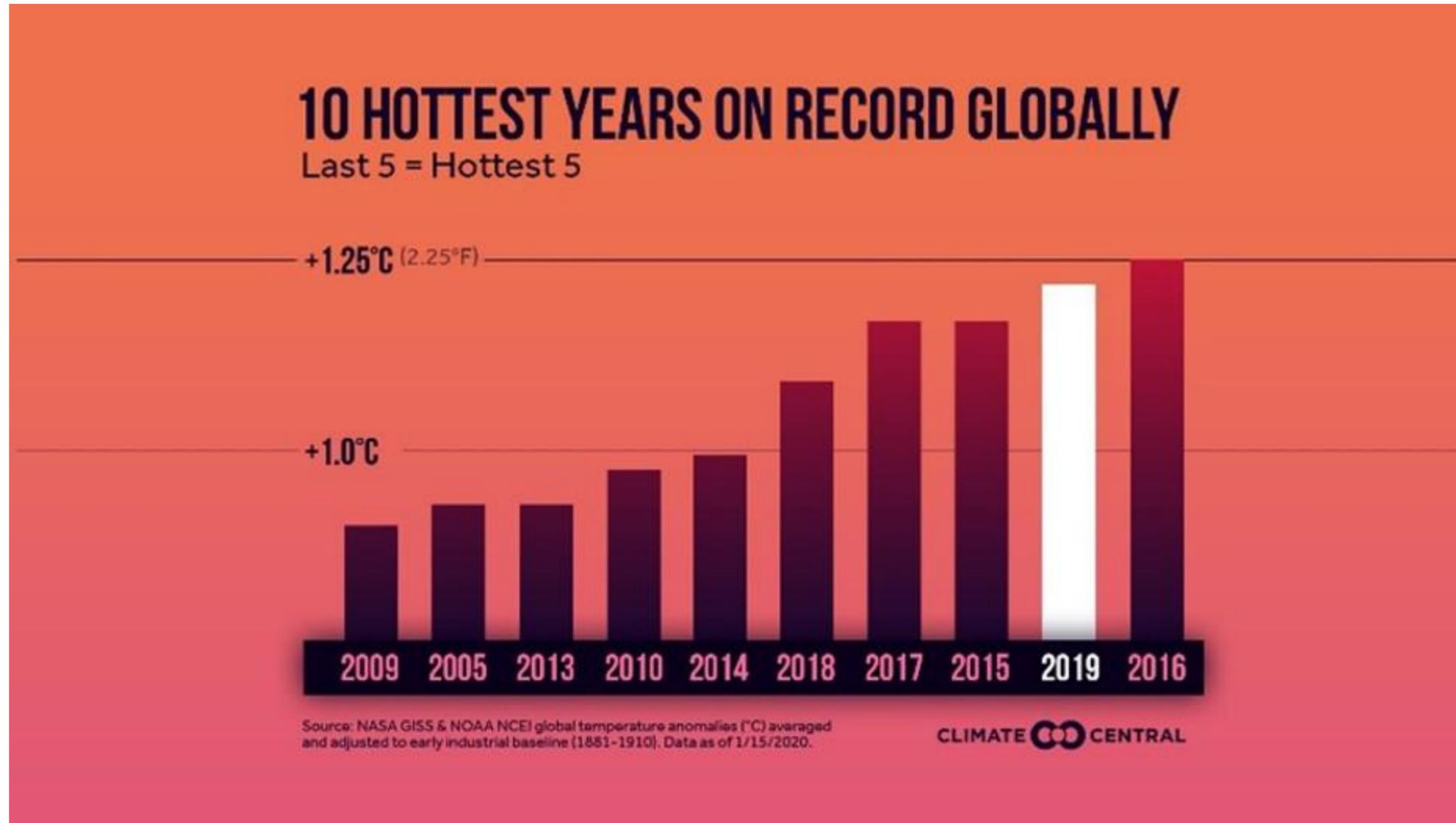
As a result, more than 1 million species are at risk of extinction by climate change.



If greenhouse gases continue to get pumped into the atmosphere at the current rate, most of the Arctic basin will be ice-free by September 2040.

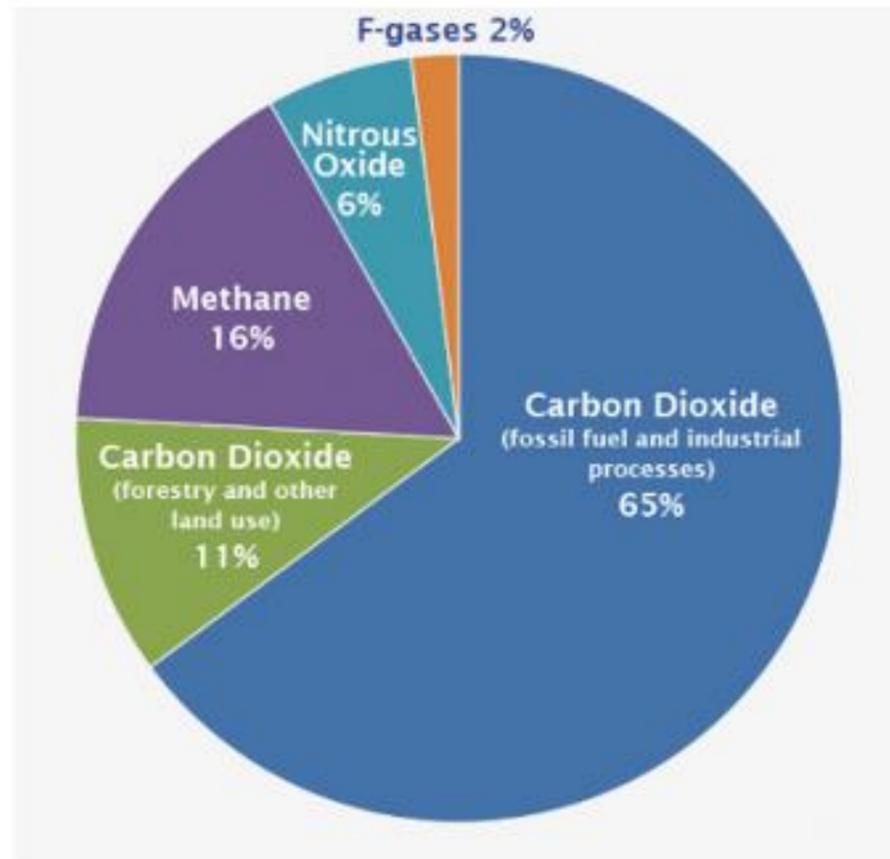


The 20 warmest years on record have been the past 22 years.

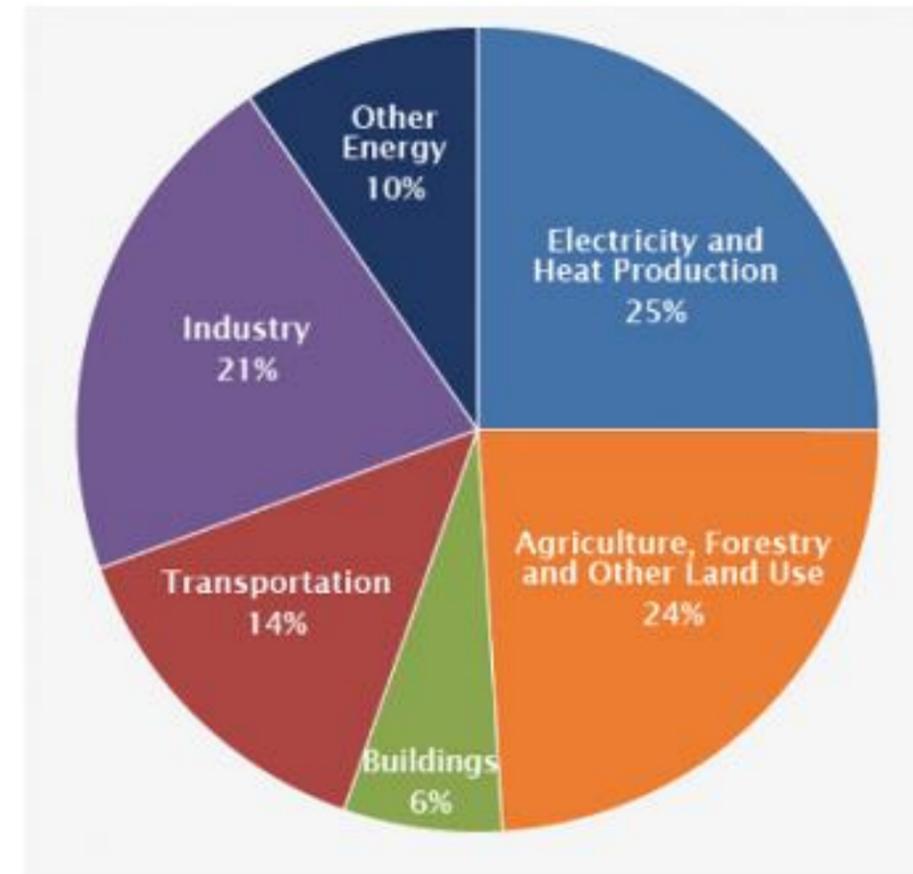


The main greenhouse gases responsible for global warming are **CO2** and **Methane**. 25% of these emissions come from energy production, 25% from agriculture, 21% from industry and 14% from transportation.

Emissions by gas (global, 2018)

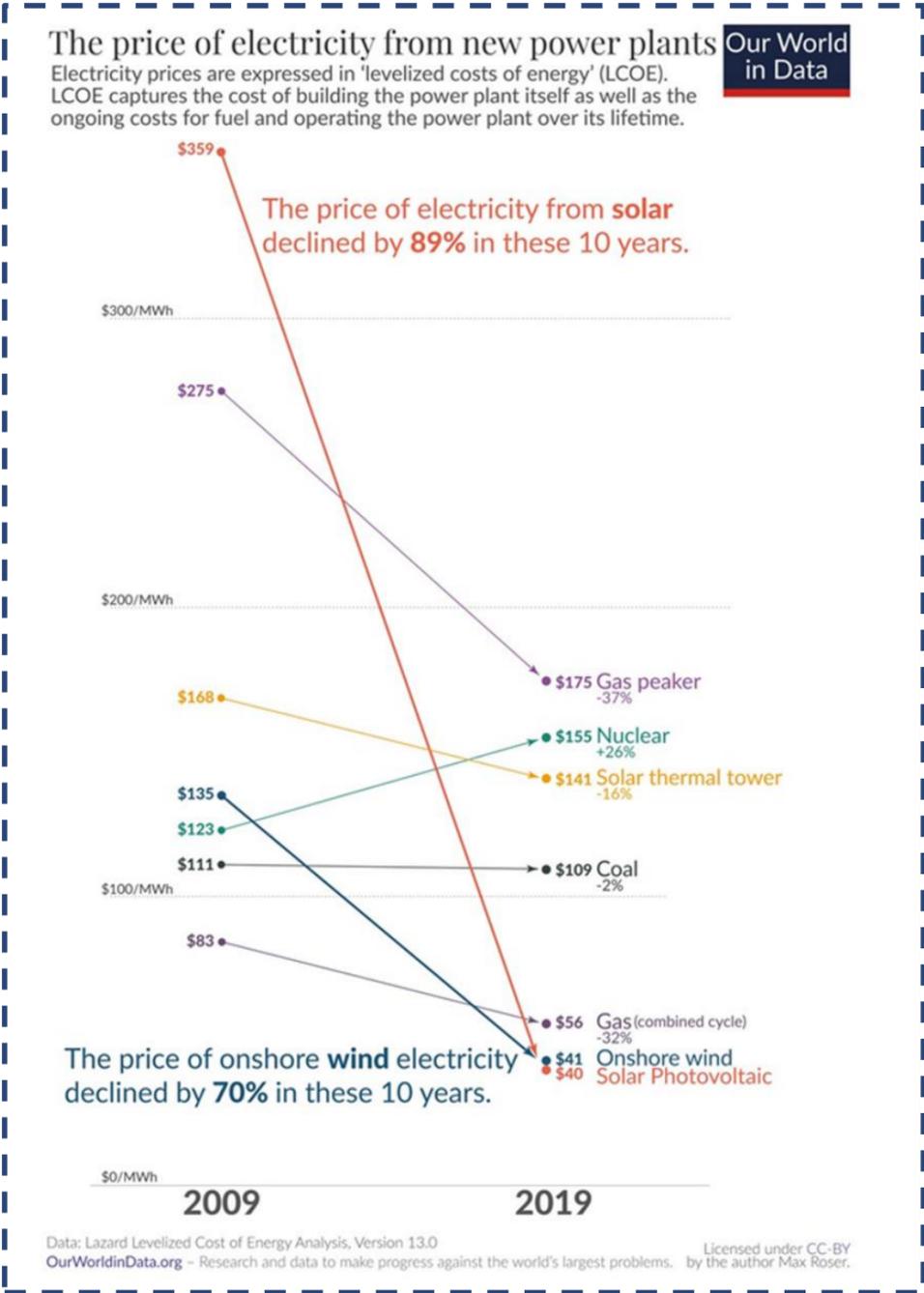


Greenhouse gases by sector (global, 2018)

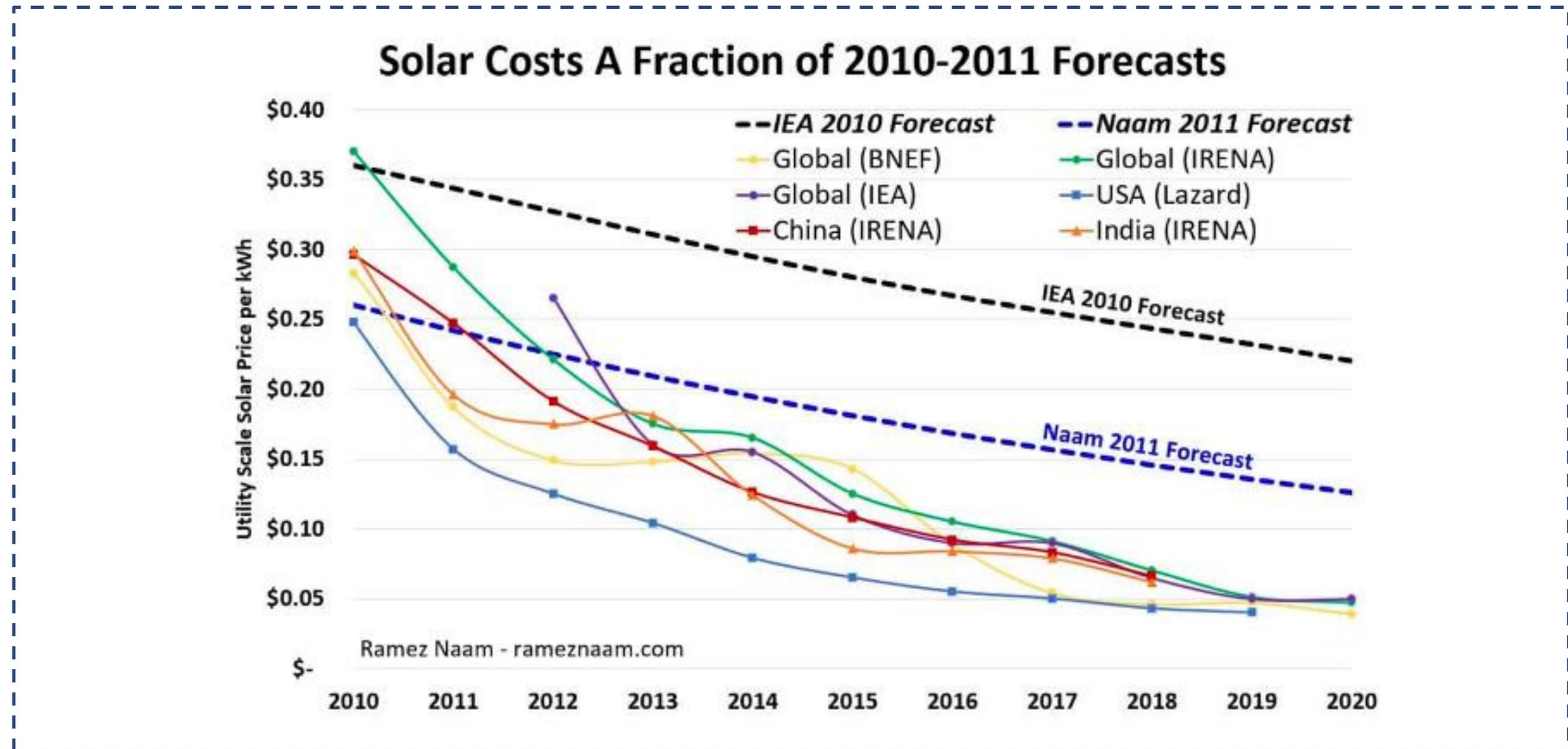


Energy Production

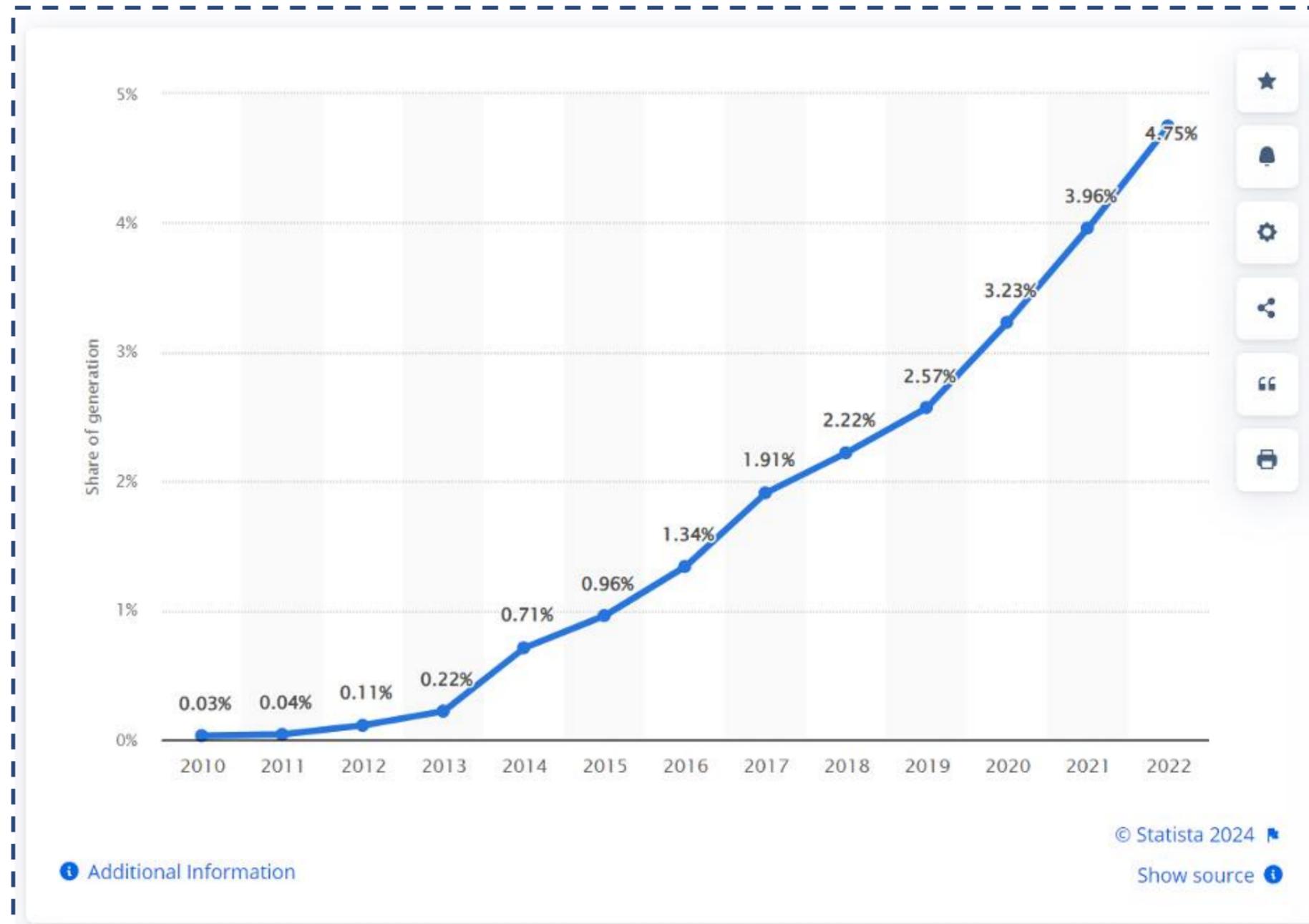
By far the most progress is being made in energy production. Solar is already the cheapest form of energy production.



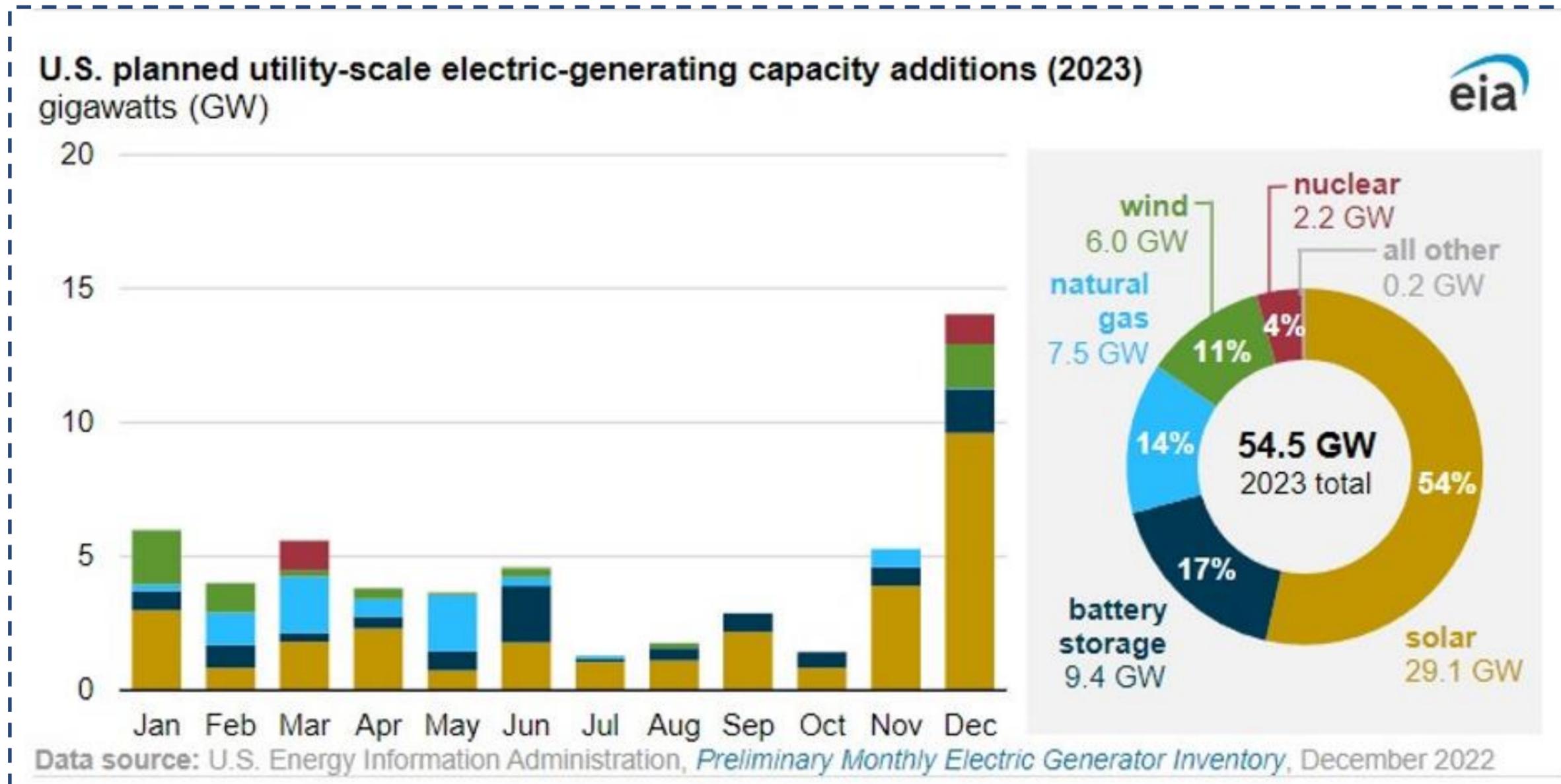
Solar prices have divided by 10 per decade over the last 40 years, a whopping 10,000 decrease in price and continuing to decline.



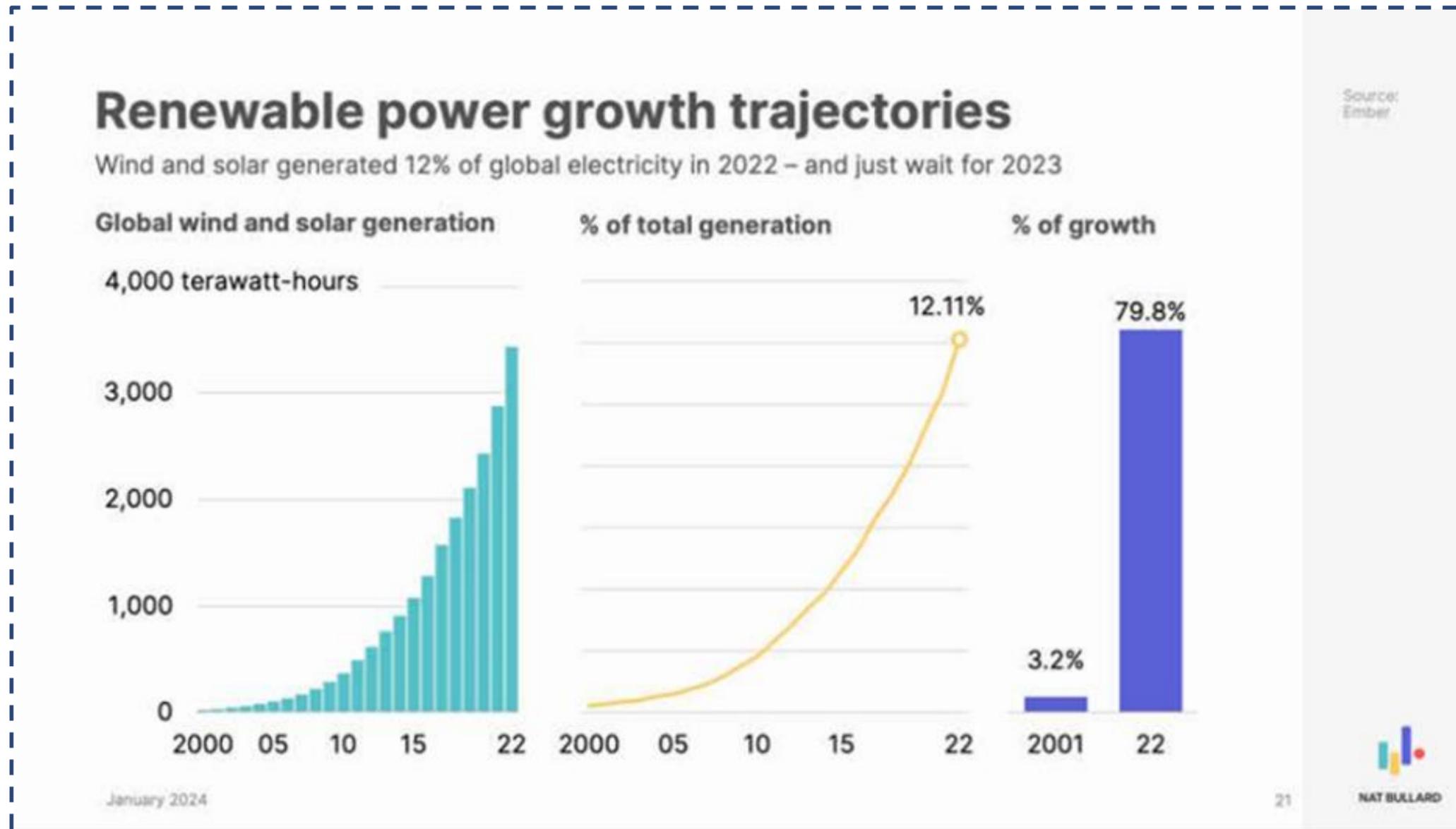
As a result, people have underestimated the increase in penetration of solar energy production → 4.7% of 2022 production up from nothing in 2010.



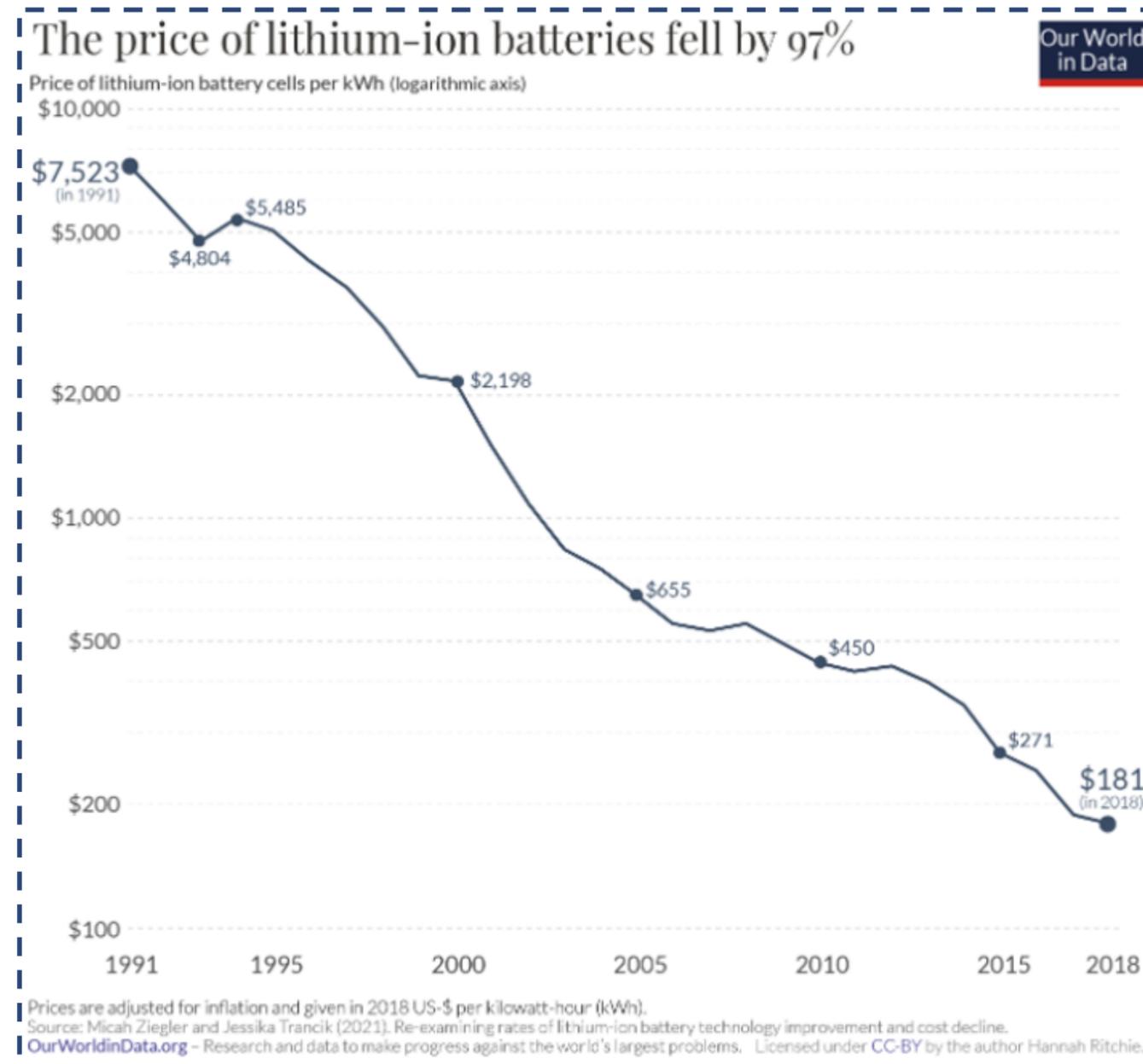
Most of the new electricity capacity added in 2023 in the US is renewable, most of which is solar.



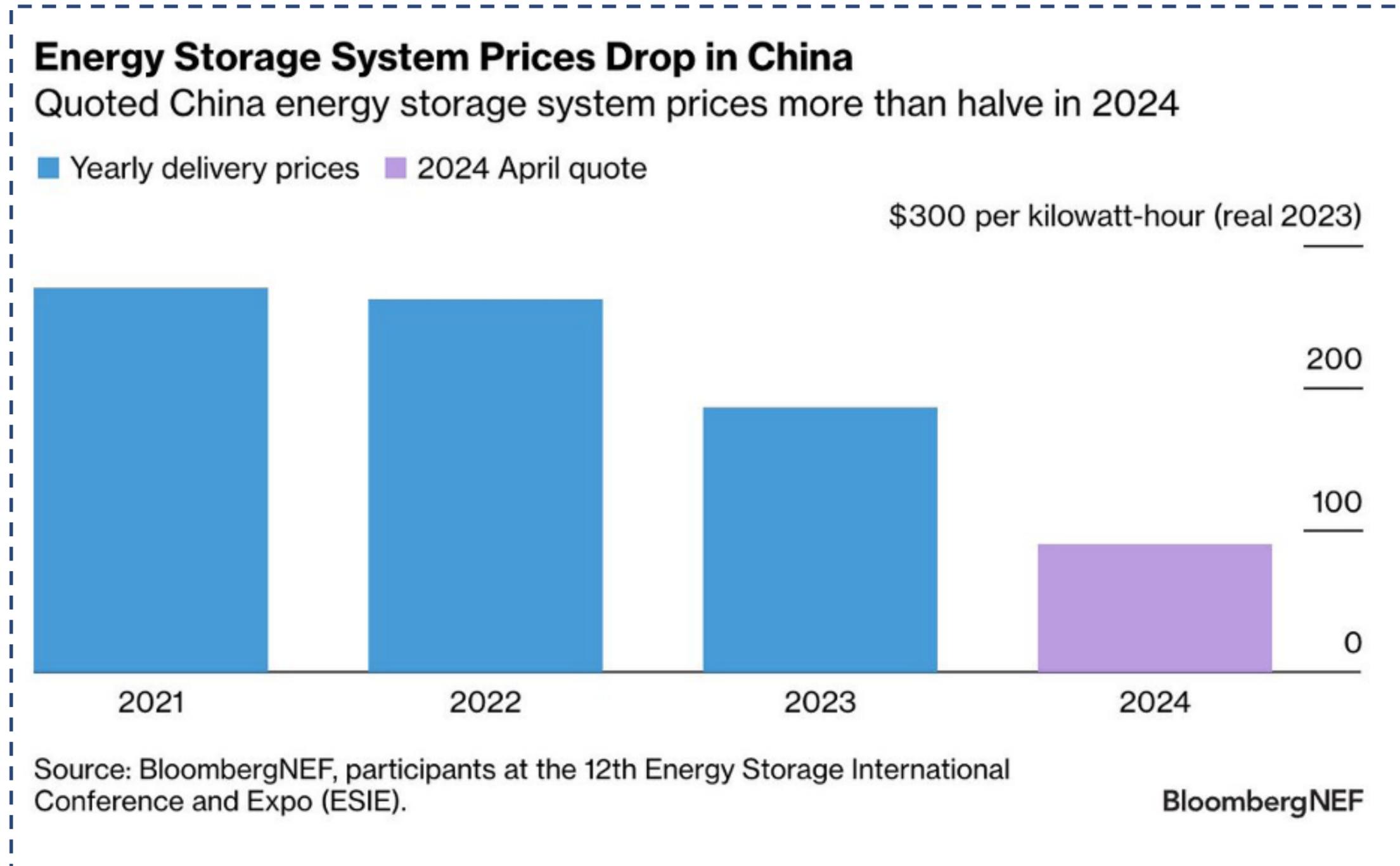
Because solar and wind are so cheap, **utility companies are starting to install them in large quantities.**



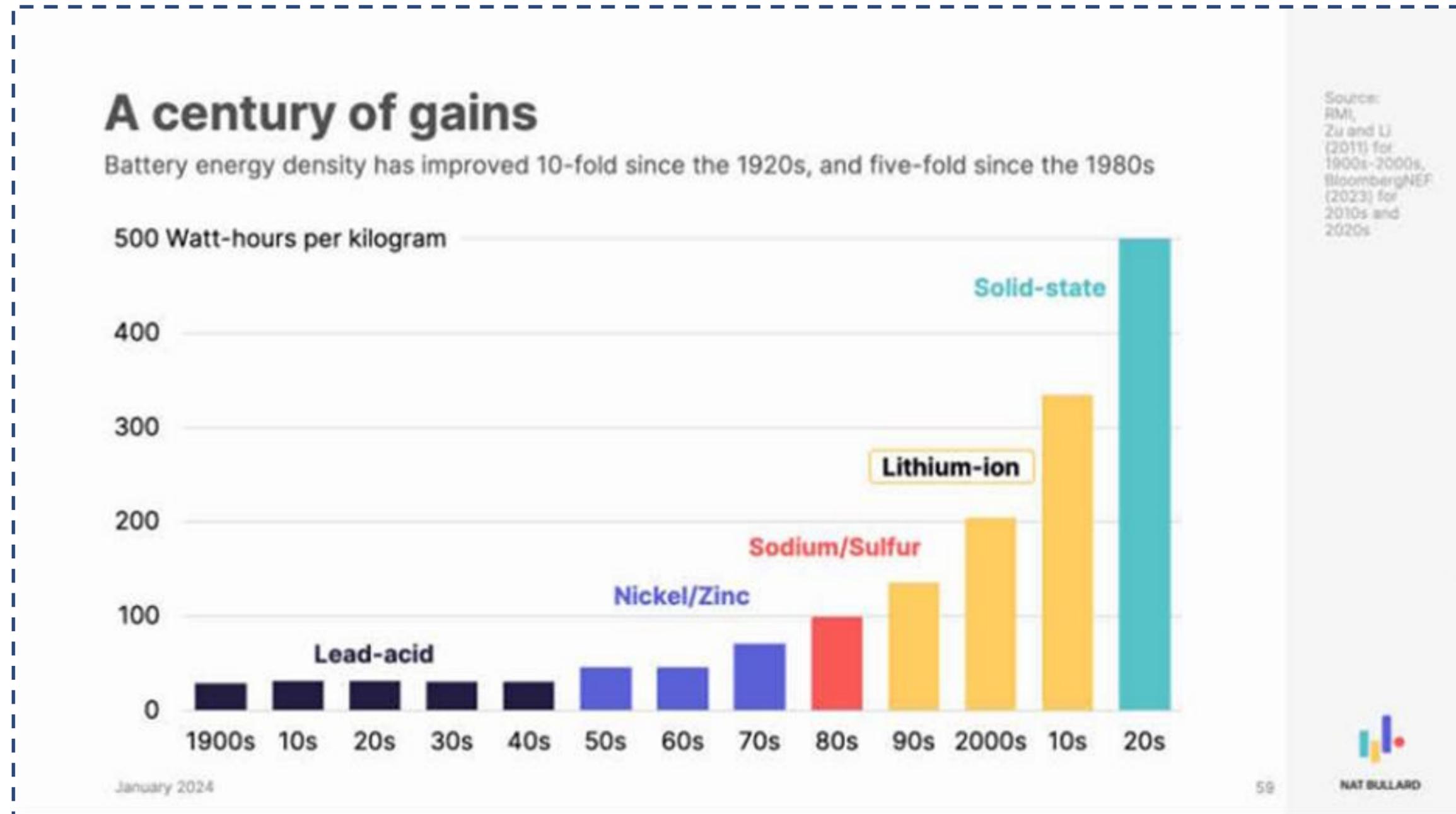
However, when it comes to decarbonizing the grid, **energy production is only half of the solution since we need storage for nighttime use and cloudy days** → battery prices divided by 42 since 1991



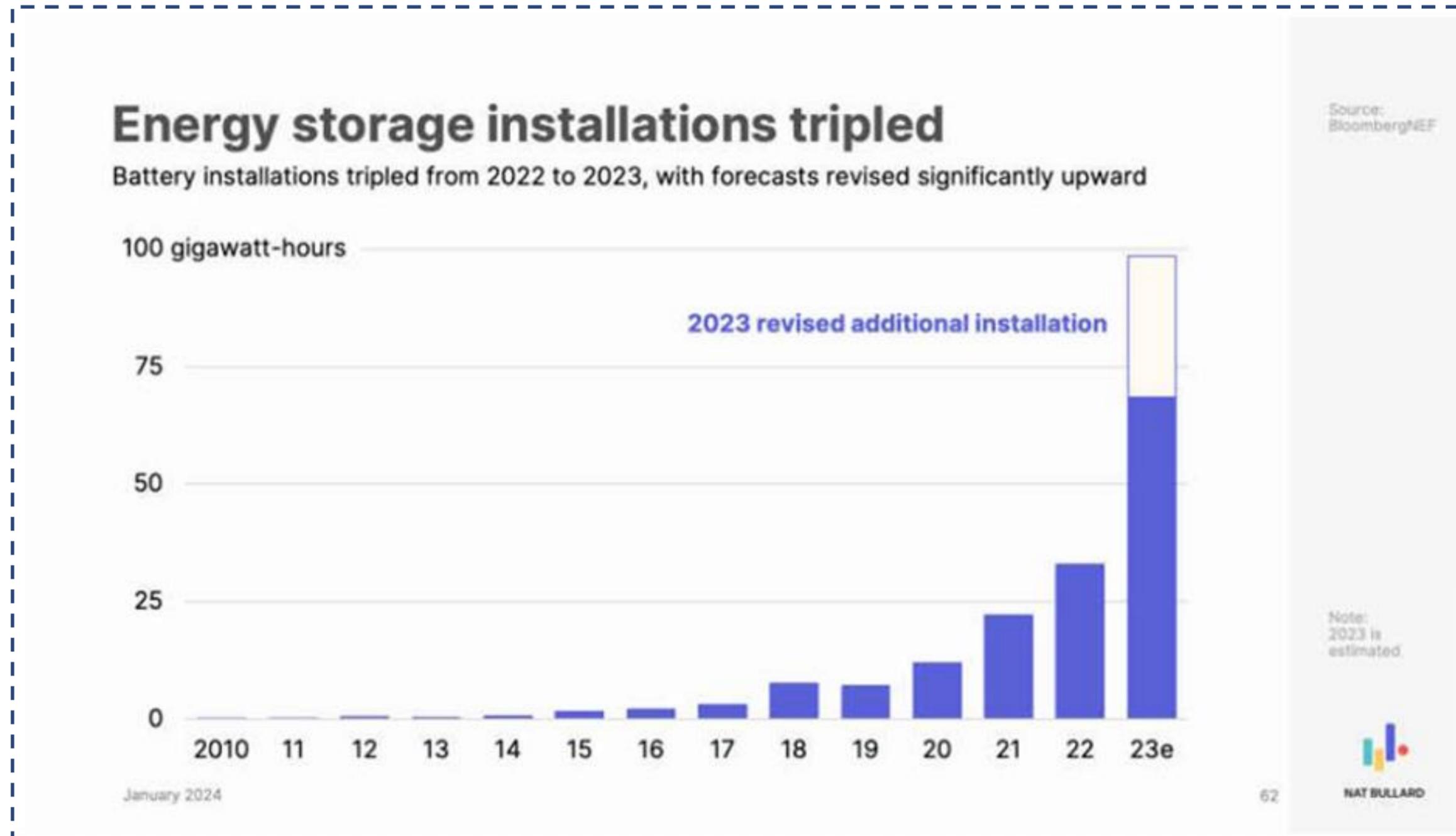
And still dropping rapidly by 50% between 2023 and 2024...



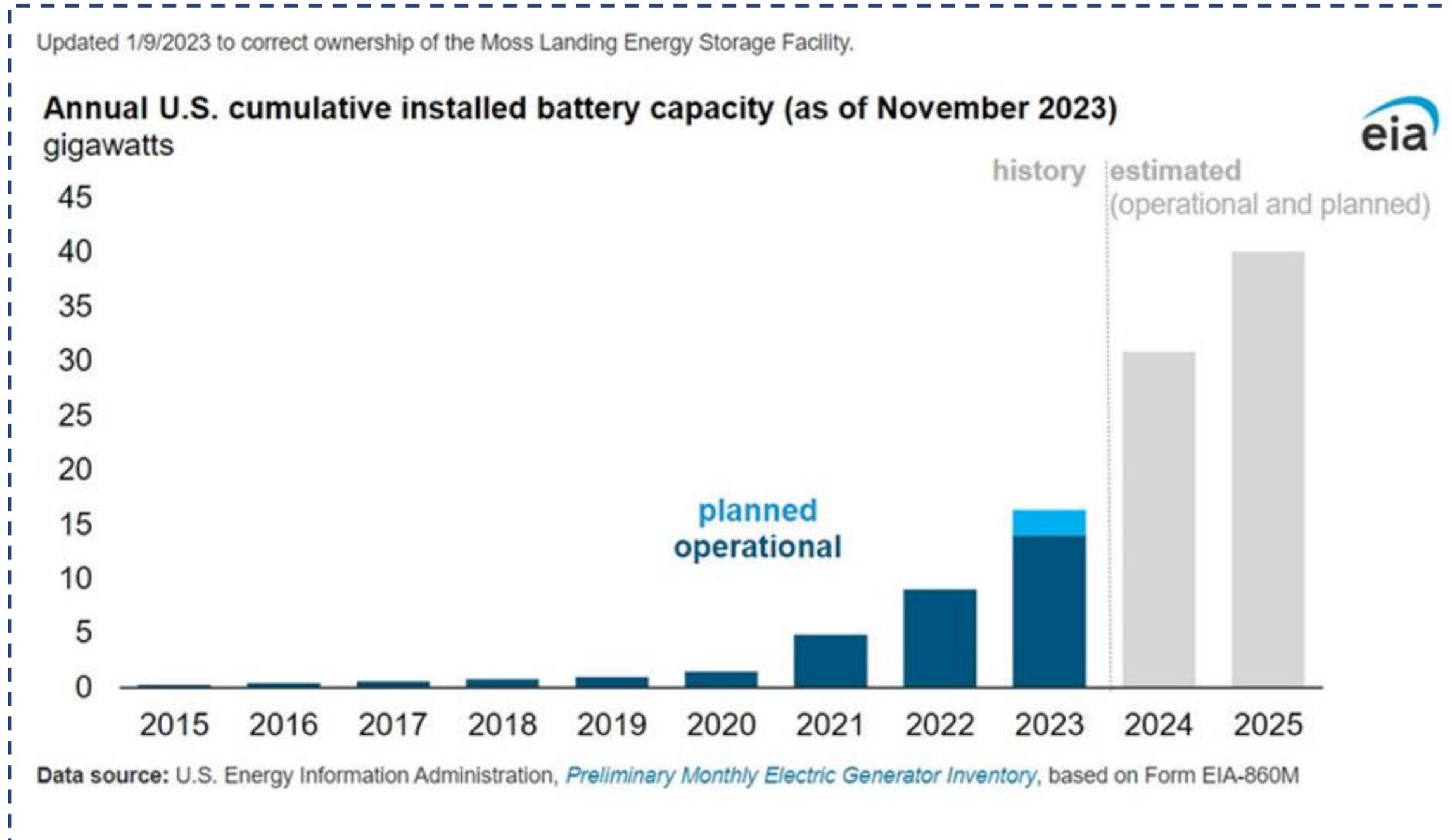
Meanwhile energy density has improved 10-fold since the 1920s, and 5-fold since the 1980s...



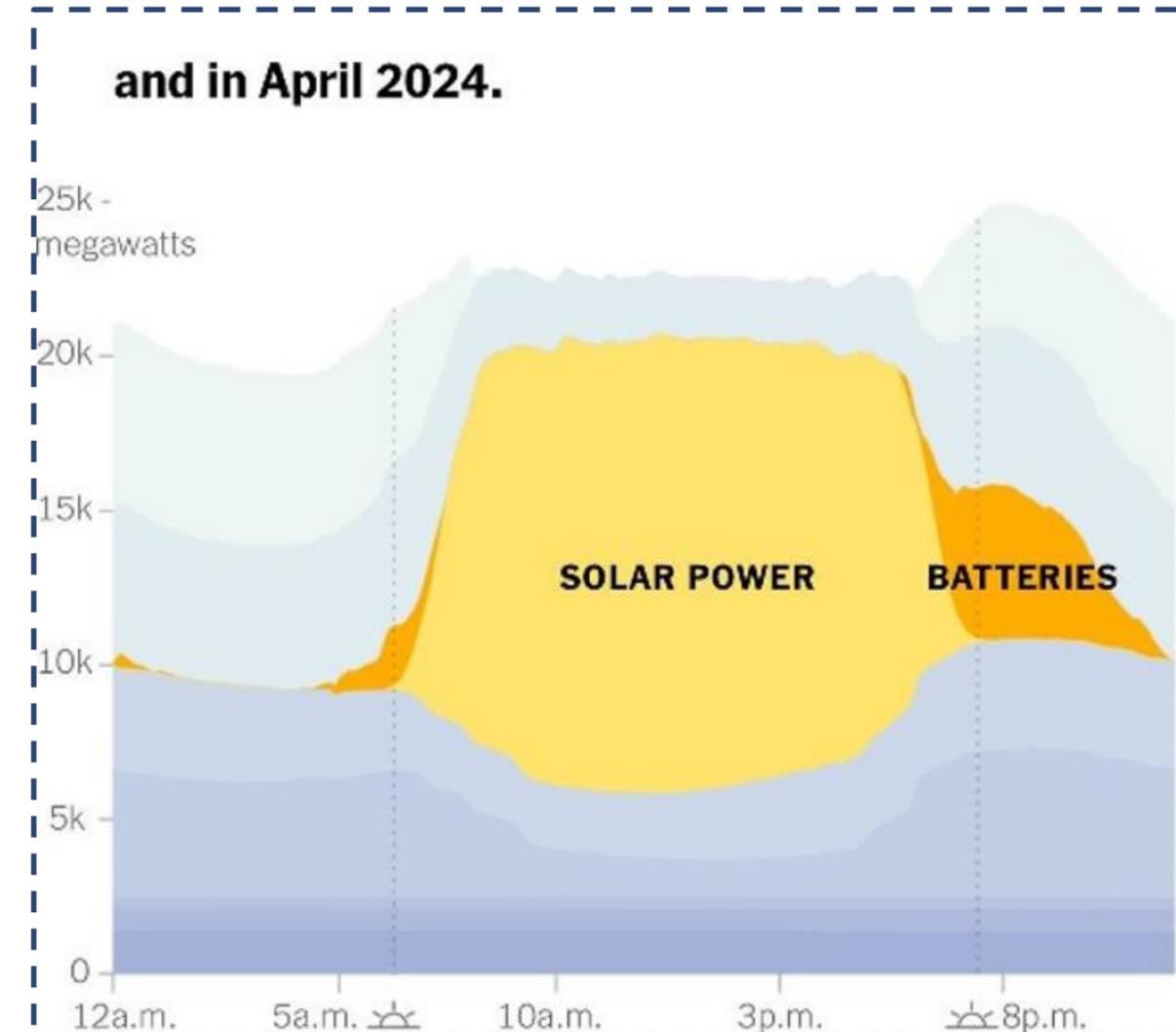
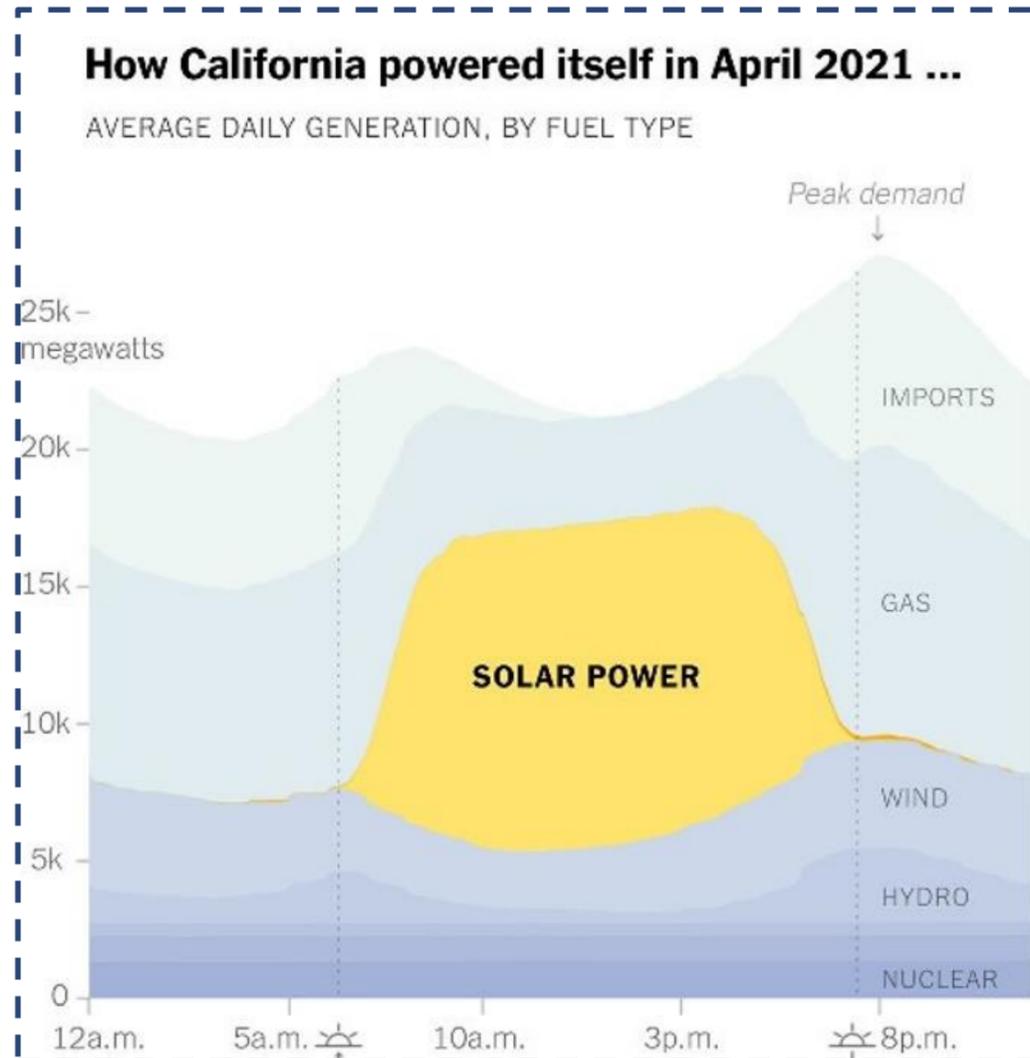
As a result, energy storage installations tripled from 2022 to 2023.



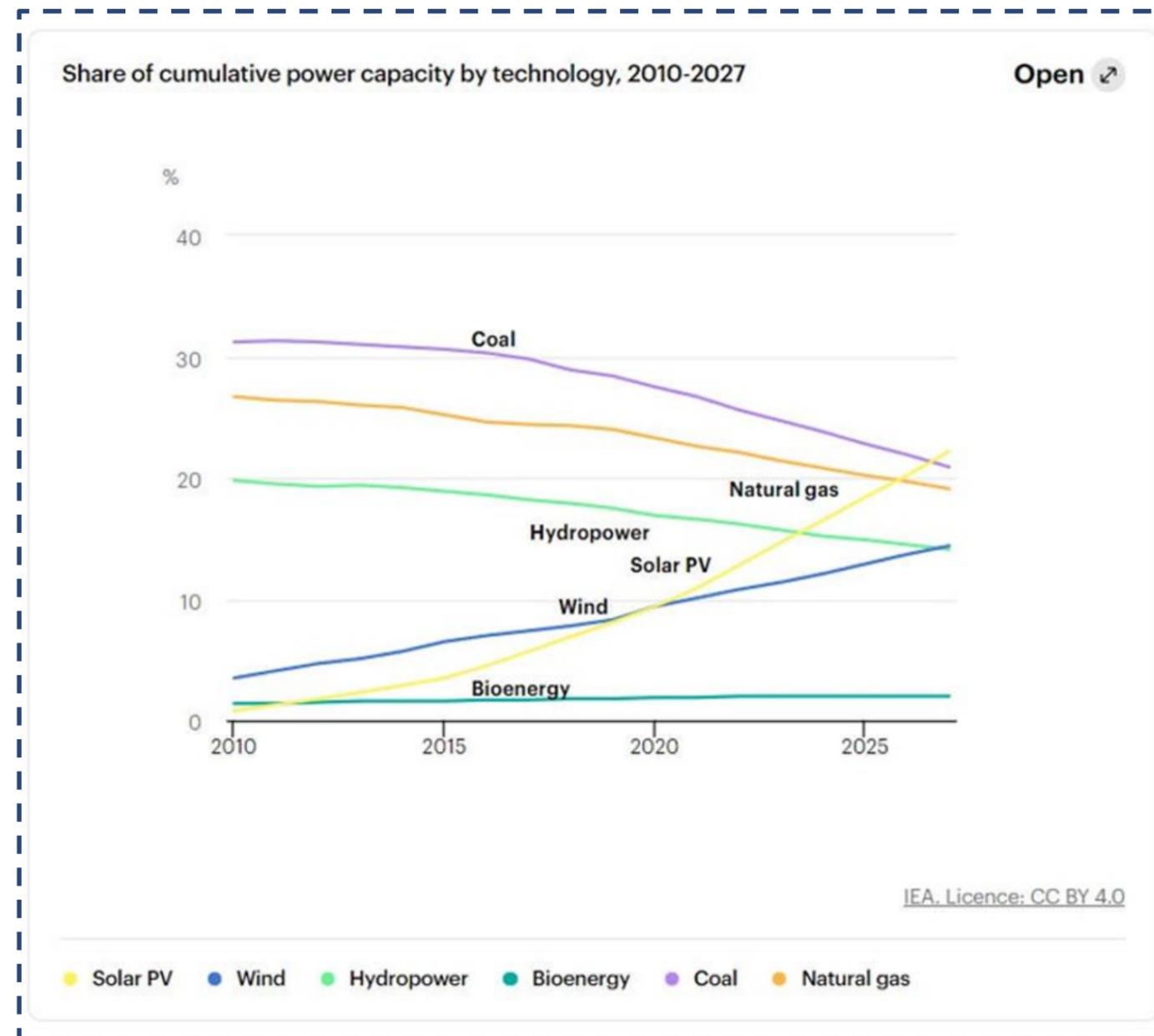
US battery storage capacity is expected to nearly double in 2024.



It's already having an impact on how we power ourselves...



Because of network and scale effects, we are nearing the point that solar + batteries will be cheaper than all other forms of energy production → all new capacity will be carbon free.



You are looking at a true technological revolution in progress, and **it may come faster should fusion or other solutions ever become commercially viable.**

\$100m raised



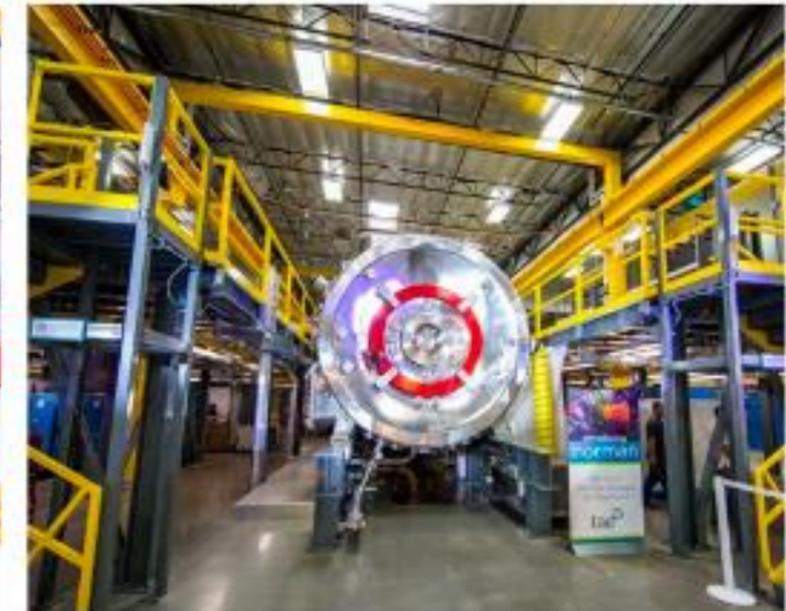
generalfusion

\$200m raised



 **COMMONWEALTH
FUSION
SYSTEMS**

\$600m raised



tae  **TECHNOLOGIES**

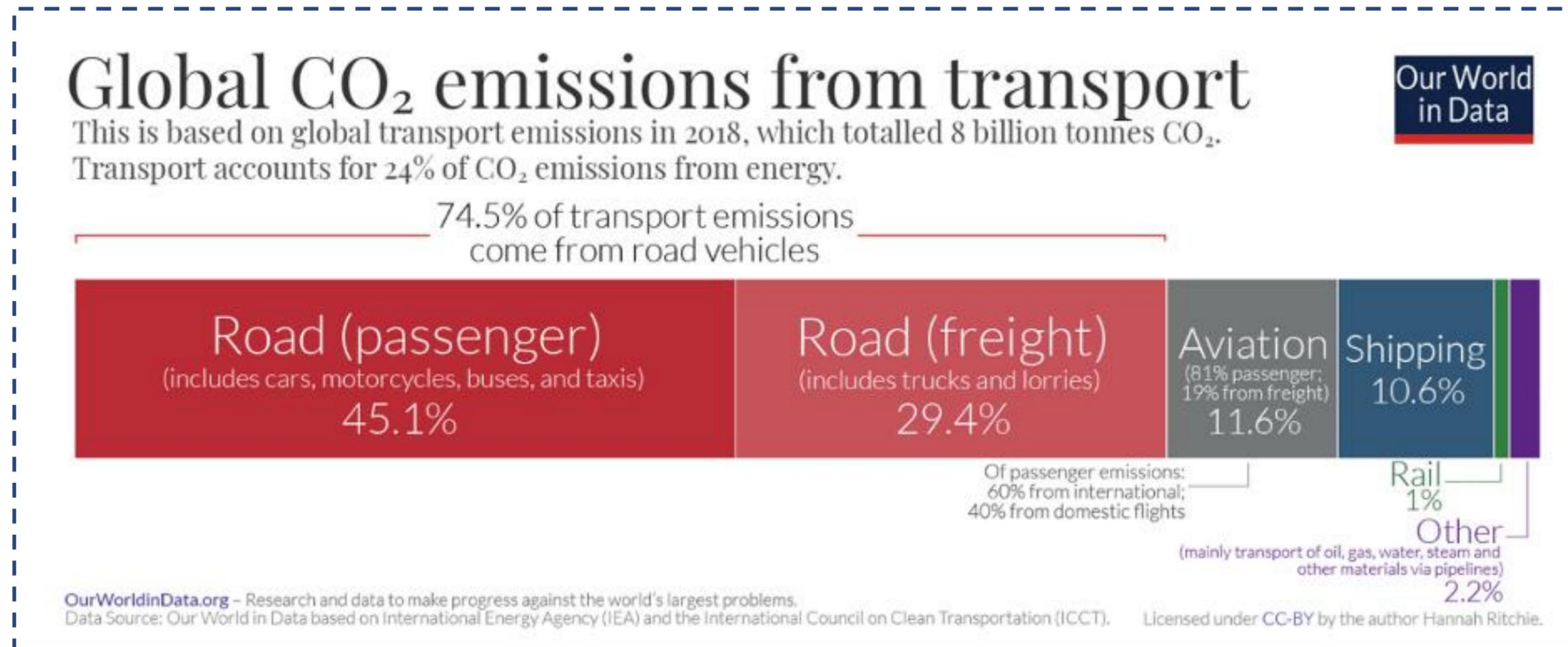
While solar + batteries will be the winning combination with decreasing costs, there are alternatives being worked on like gravity-based energy solutions.



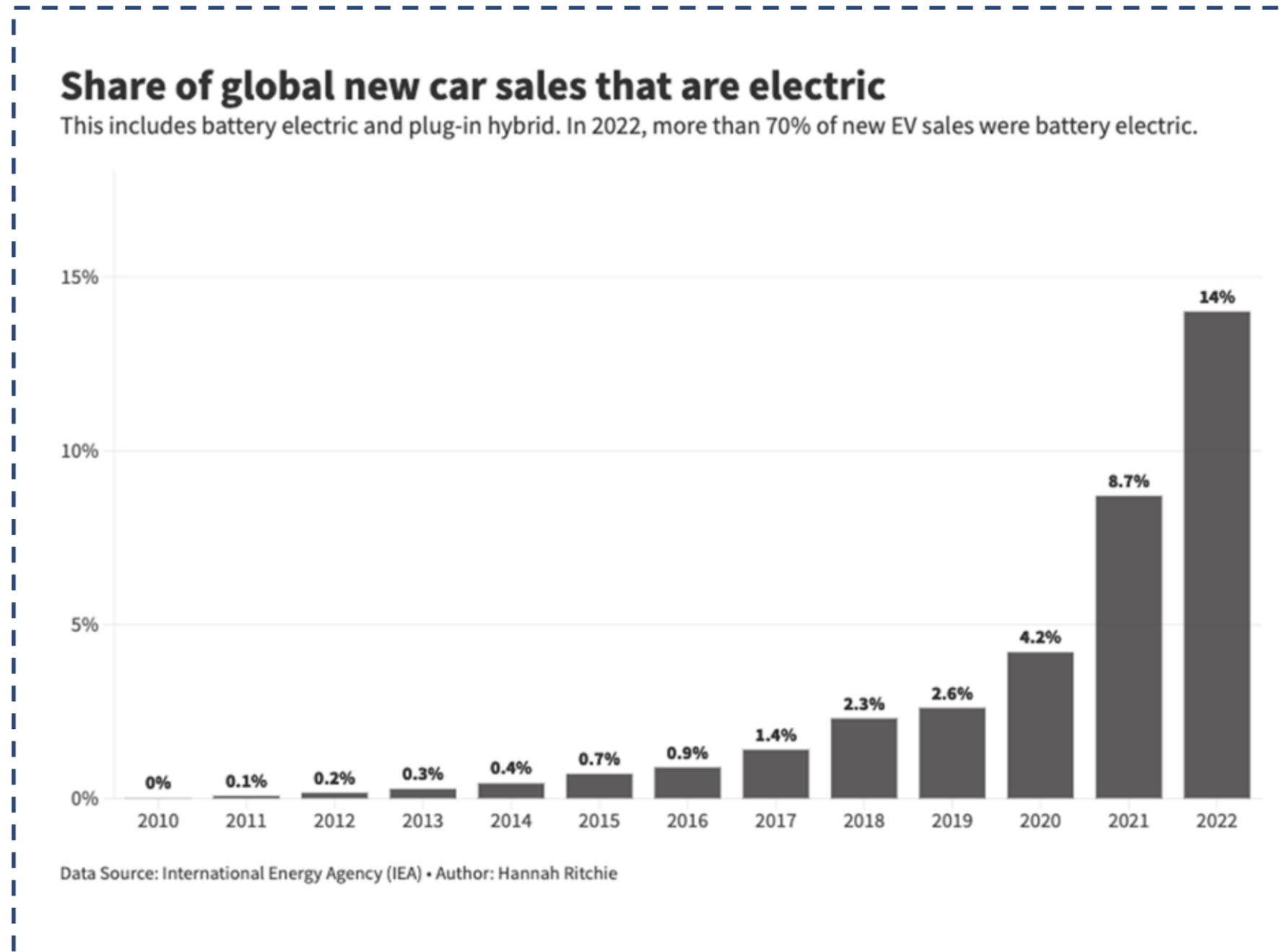
Energy Vault or hydrogen-based grid scale storage

Transportation

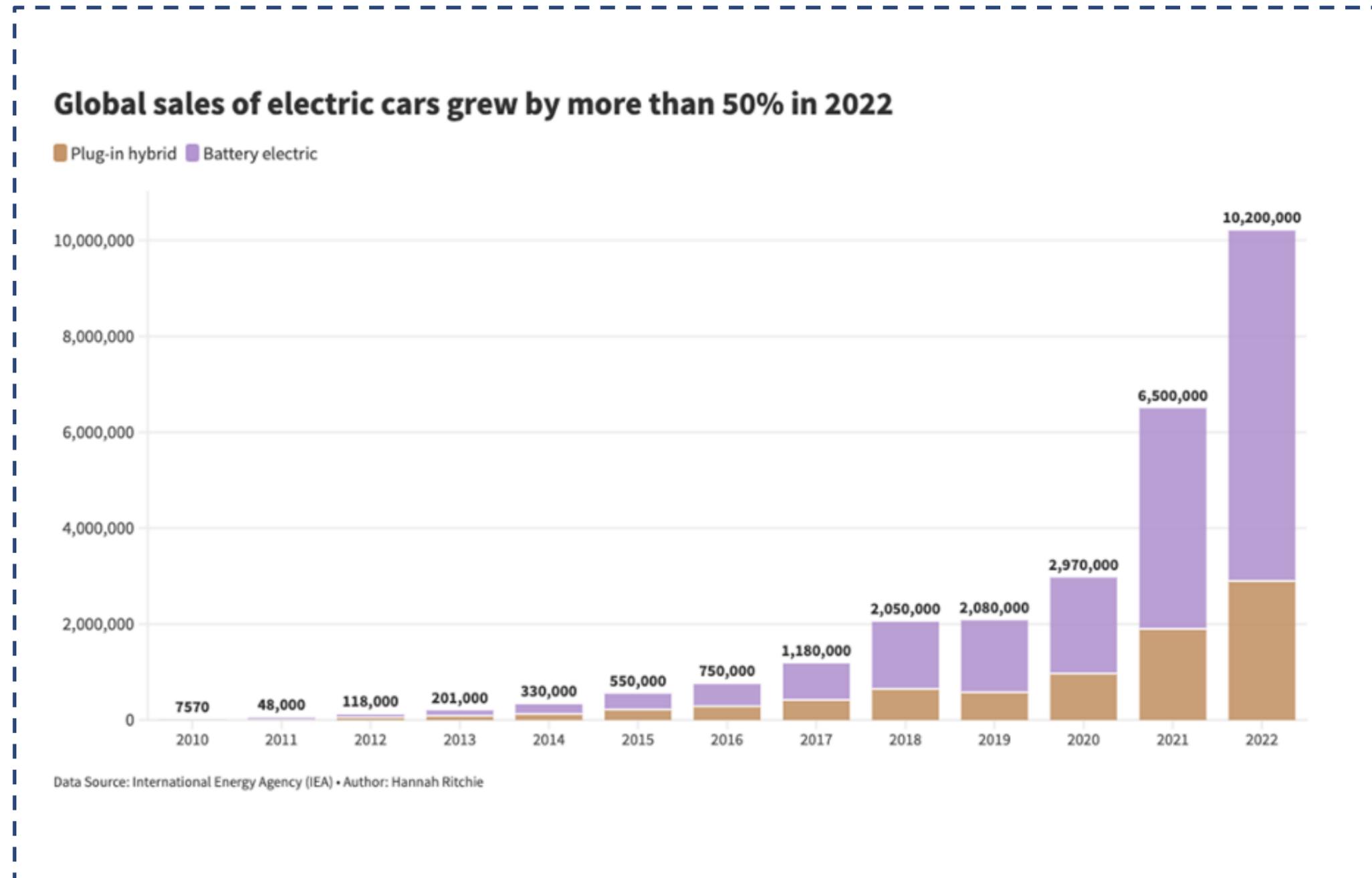
A similar trend is happening in transportation where most emissions come from cars and trucks.



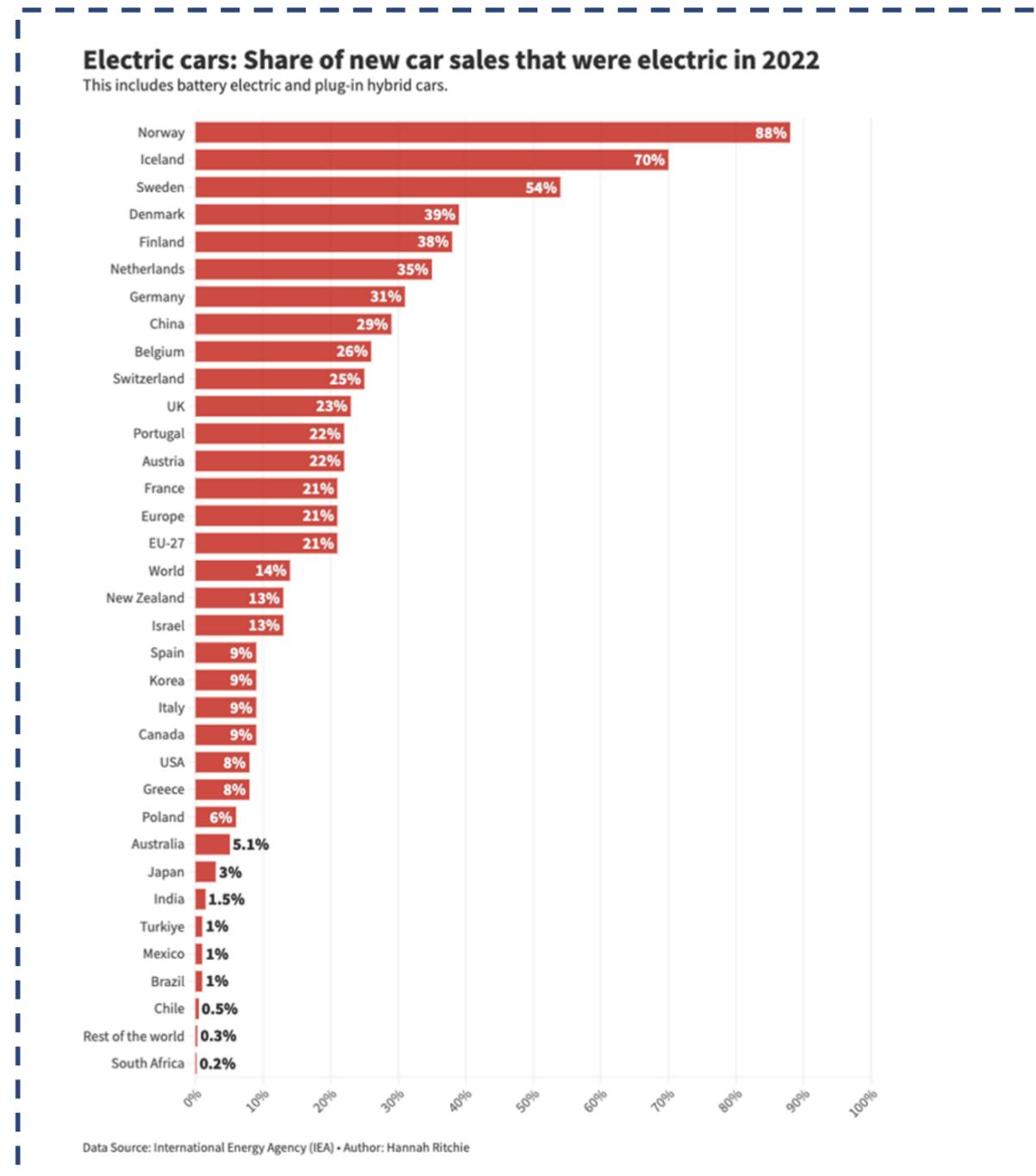
Real progress is being made with global new electric car sales being 14% of all cars sold in 2022, up from 0% in 2010.



Most of these were fully electric, and sales grew 50% in 1 year from 2021 to 2022.



China and Europe are leading the way on electrification → 1 in 3 cars sold in China and 1 in 4 cars sold in Europe are now electric.



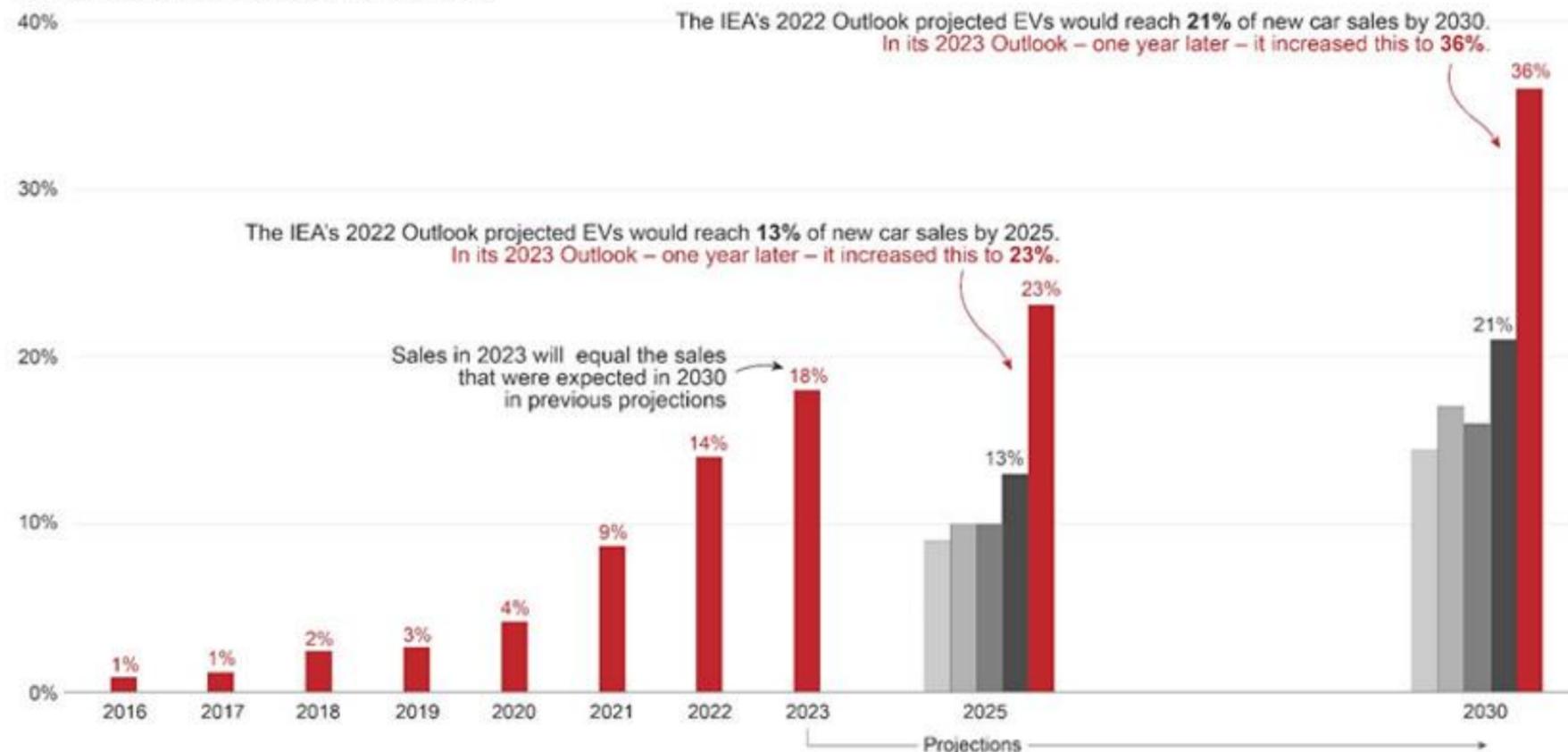
Electric cars are simpler to build and maintain than conventional cars given they don't have transmissions + are becoming cheaper.

Electric cars: explosive growth in sales are beating all previous projections

Each year, the International Energy Agency (IEA) publishes an 'electric vehicle' (EV) outlook, giving the latest global data, and projections of sales to 2030. Over the last few years, these projections have increased because EV sales are growing much quicker than expected. Electric cars are reaching market shares that weren't expected until 2030.



Share of new cars sales that are EVs



Data source: International Energy Agency (IEA)

Author: Hannah Ritchie

While they are not a large source of emissions, **progress is also being made on electrifying aviation.**

Archer's eVOTL will fly 60 miles with four passengers at speeds of 150mph



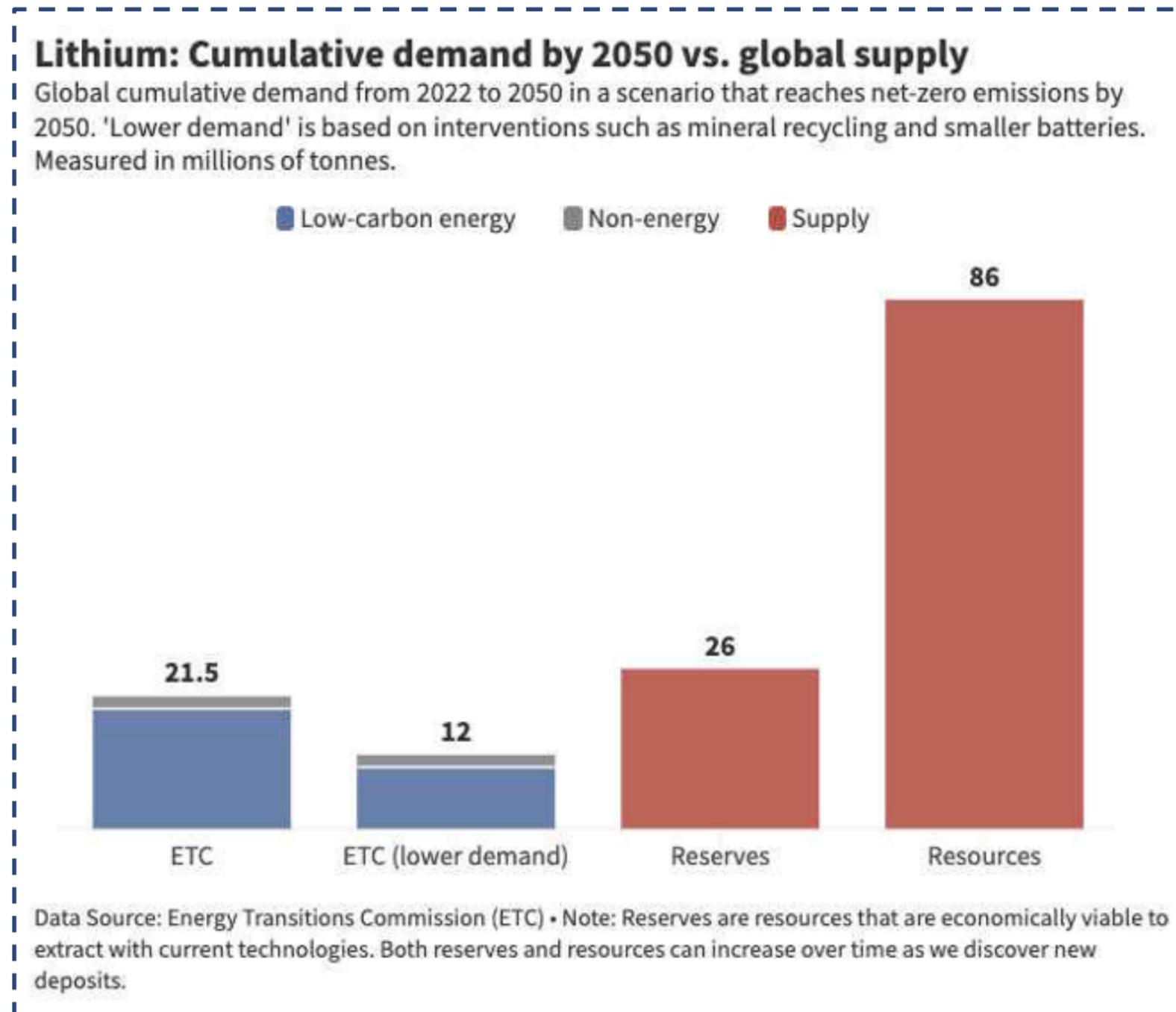
ARCHER*

Developing a 100-seater electric jet.

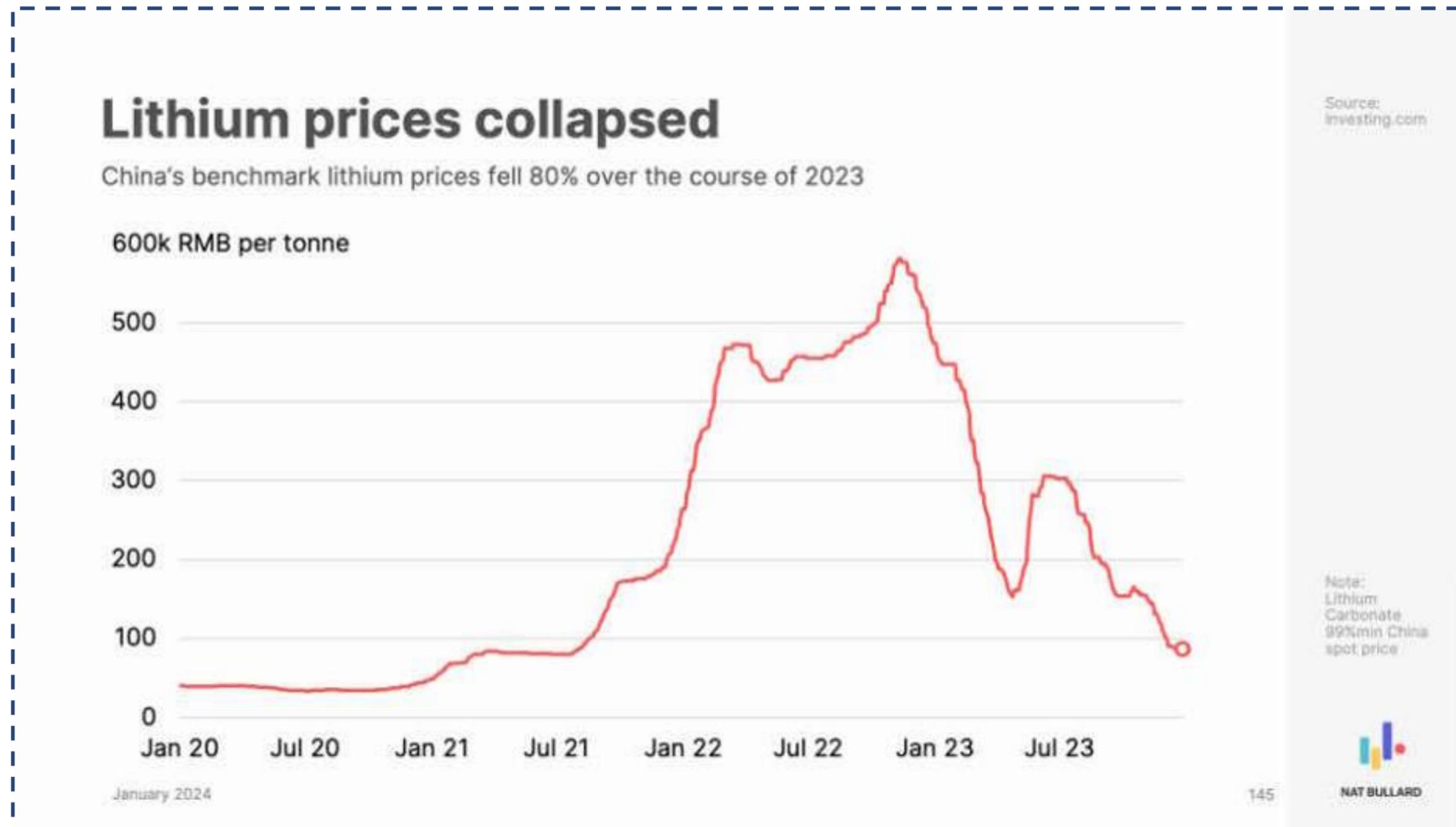


 **Wright**

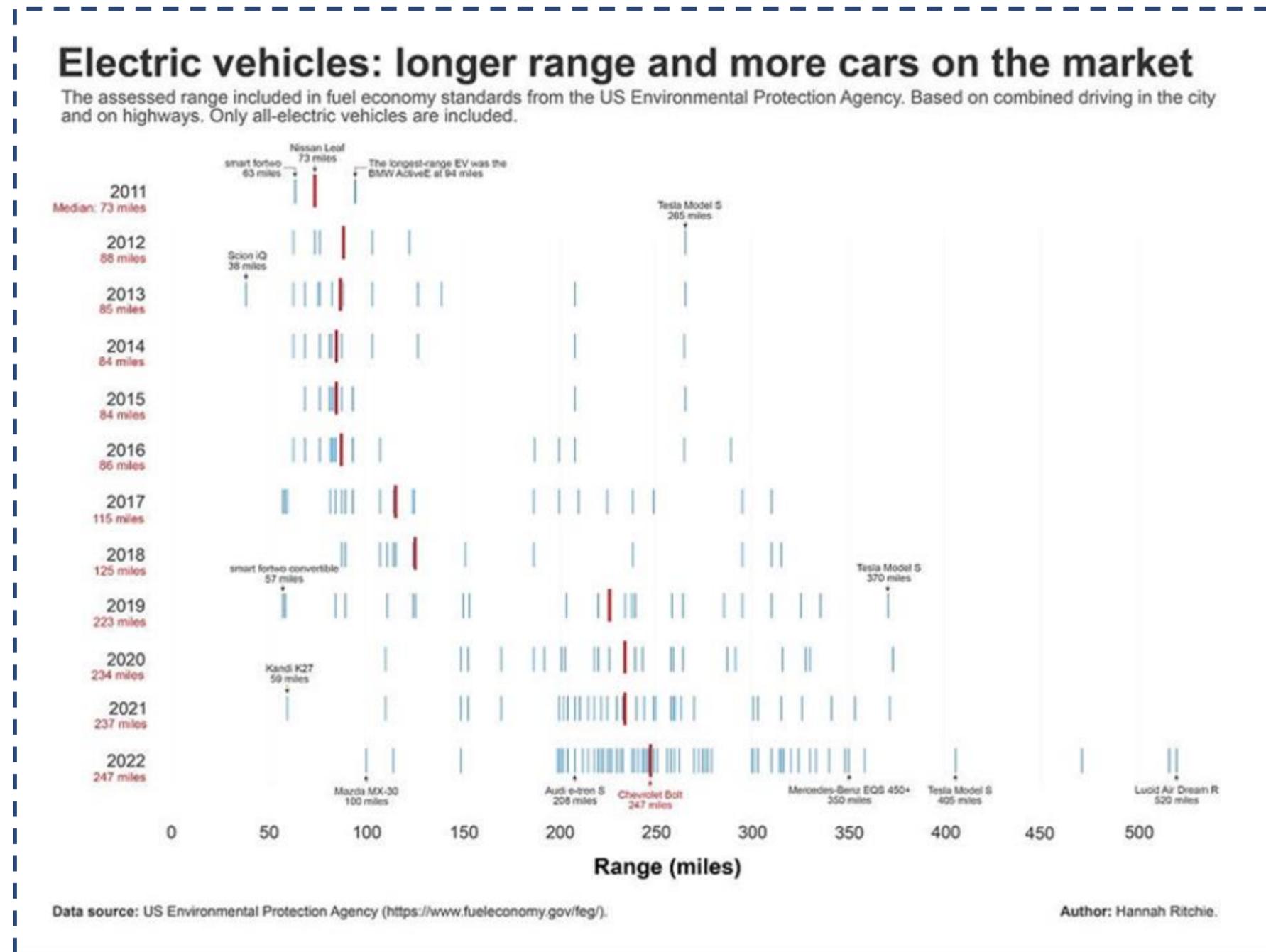
Argument against EVs are wrong → some believe there are not enough recoverable metals to build the batteries, which is extremely unlikely.



Estimated lithium sources has increased over time. We keep finding new lithium deposits, and people are starting to realize the world is full of it, which may have led to prices collapsing.



Range anxiety is becoming a non-issue as range is rapidly increasing, alongside charging stations to the point the chances of being stranded in your EV are very low.



People also worry that mining minerals for EVs exploits poor countries.

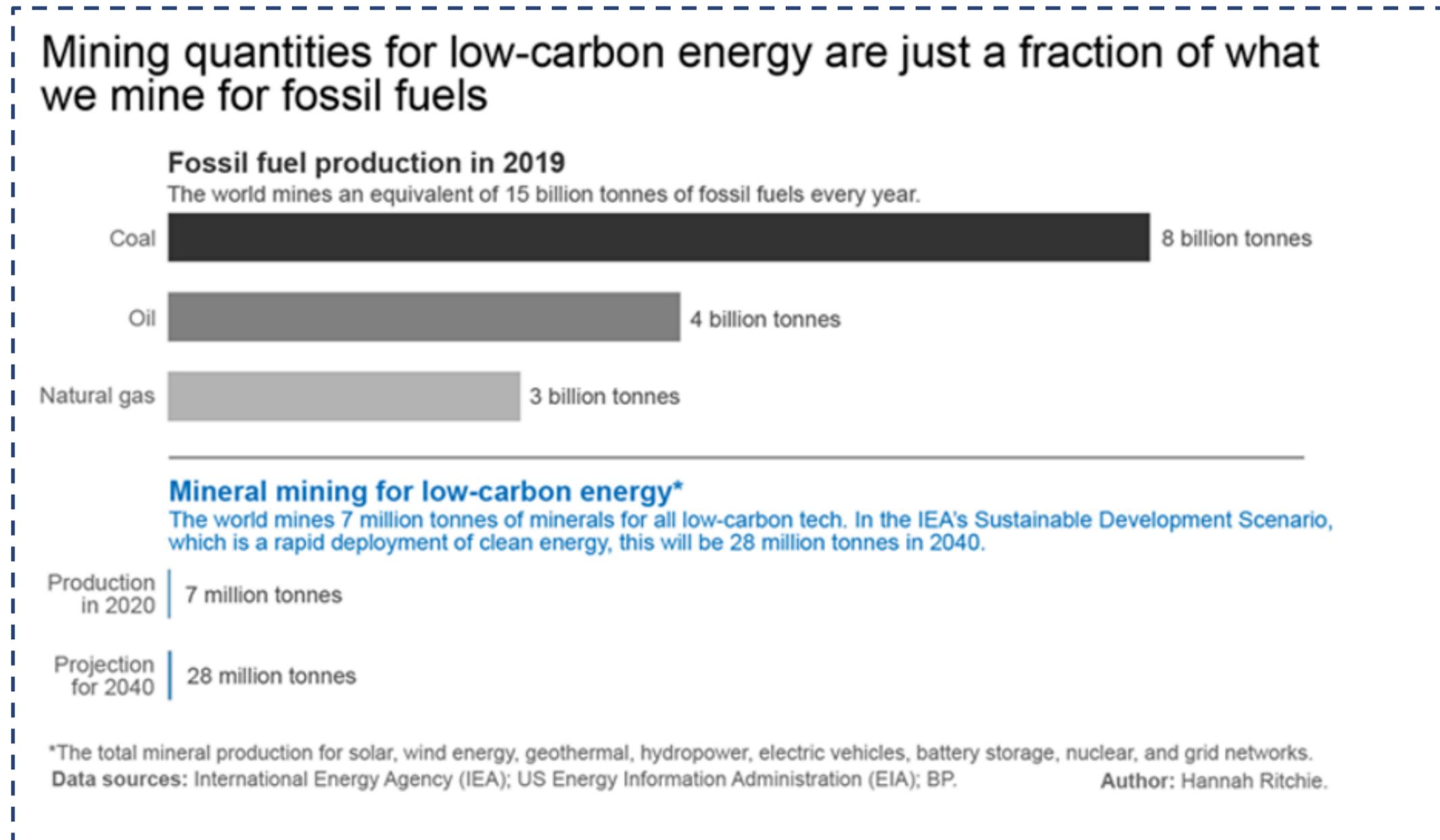
Worries:

- 1 Poor miners will be **exploited**
- 2 Communities near the mines will experience **environmental harm** via industrial runoff

But:

- 1 Extracting and exporting mineral wealth is the main economic activity for many poor countries, so **demanding rich countries refuse to buy from them would just impoverish the countries**
- 2 We shouldn't compare exploitation and pollution of EV mineral mining to an imaginary degrowth utopia where everyone becomes a subsistence farmer with no need for lithium or cobalt → **the system we have set up to extract coal, natural gas, oil is far more exploitative and damaging**

Considering the quadrupling mineral demand necessary for green energy transition, the amount of mining for fossil fuels is orders of magnitude larger than what we'll need to make EVs.



Industry

Emissions from industry have long seemed insoluble because cement and steel required ultra high temperature heat that could only be generated with hydrocarbons
→ **but progress is being made.**



Companies are using concentrated solar to create enough heat and focusing on carbon capture at the factory to prevent emissions during production.

While not directly linked to industrial, there are **amazing applications of solar using hydro panels to transform humidity in the atmosphere into drinking water**, even in dry desert environments → helping refugee camps and remote communities.



Food Production

Progress is the slowest here → increase in meat consumption in the emerging worlds is worsening the issue because sheep and cows belch methane and alternatives are not in their economic interest.



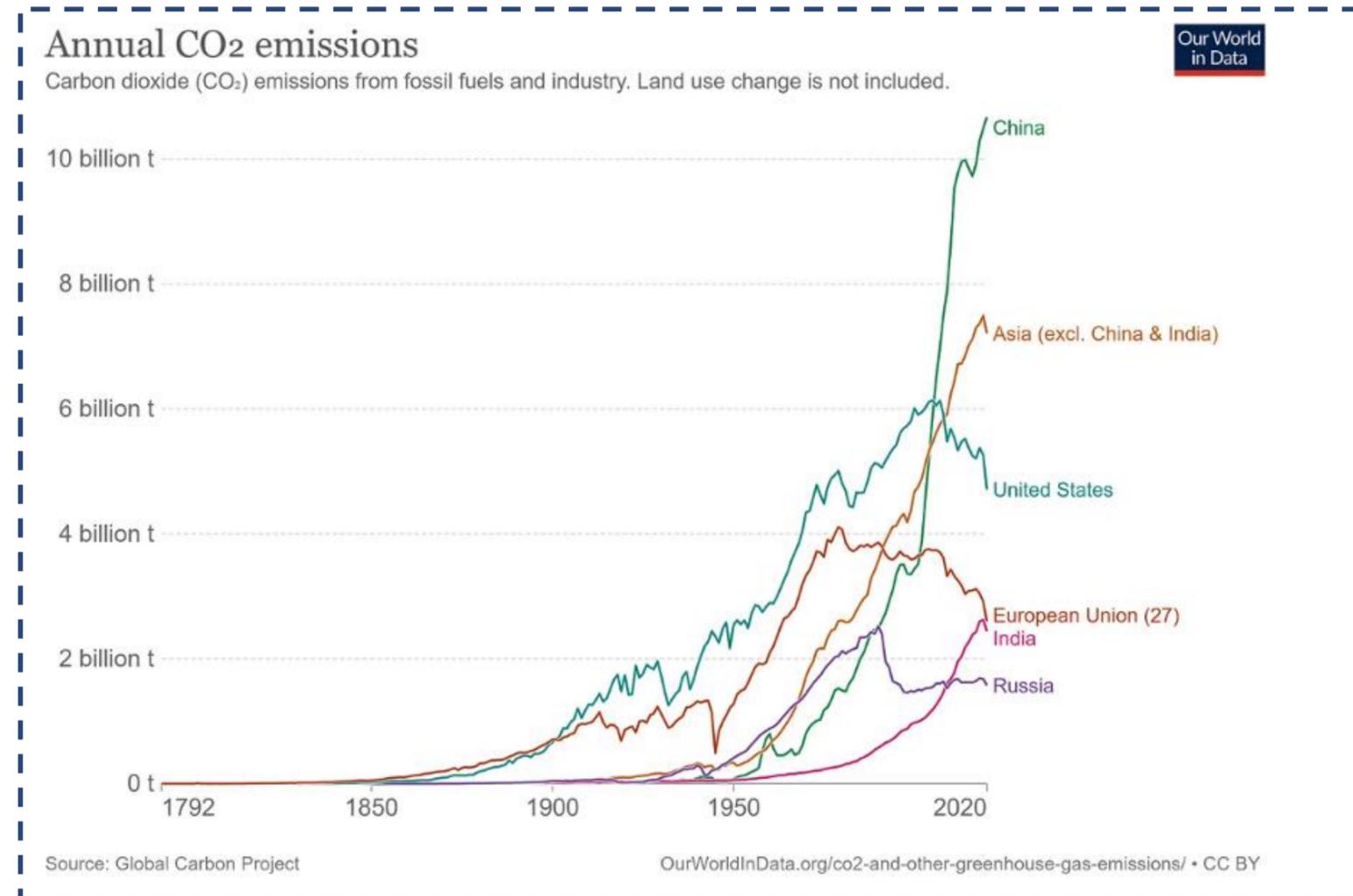
Without industrial food production we could not sustain the 8B people on the planet

- *Impossible Foods of the world will become cheaper, but are highly processed*

Long term solution will come from lab grown meat like Upside Foods, which hopefully **with scale and iteration can have the same nutritional value for cheaper than animal-made**

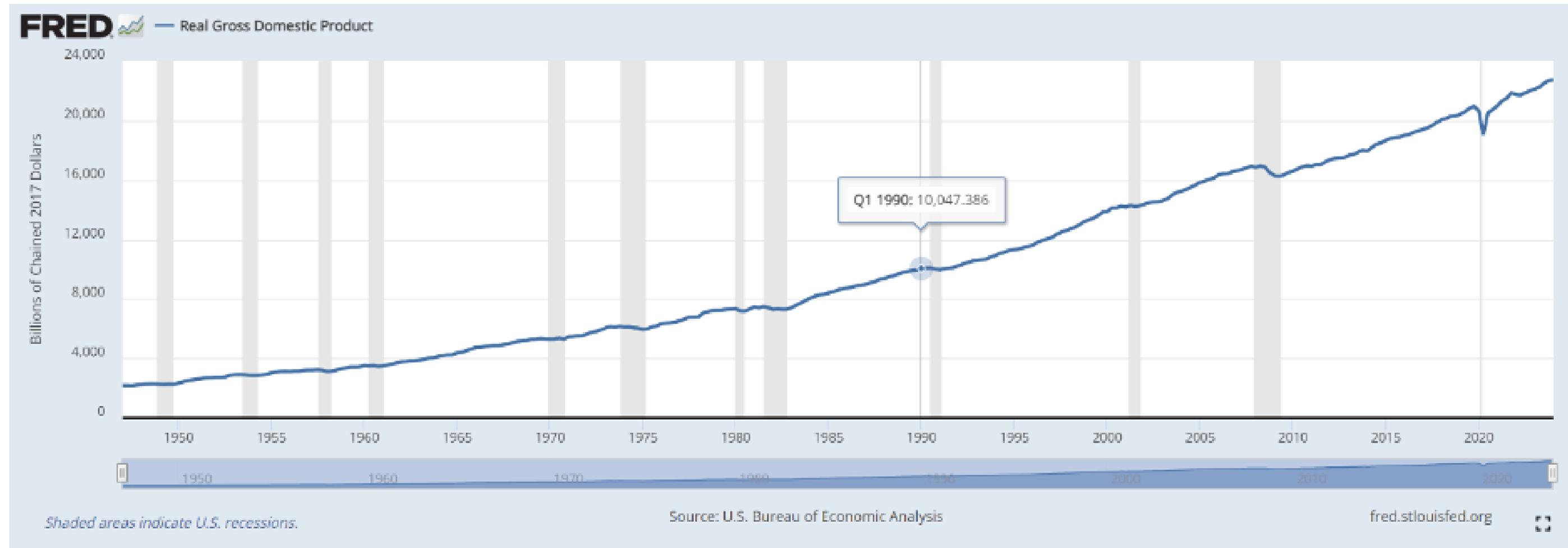
Decarbonization

Despite the daunting facts, **real progress is being made and humanity is rising to the challenge.**



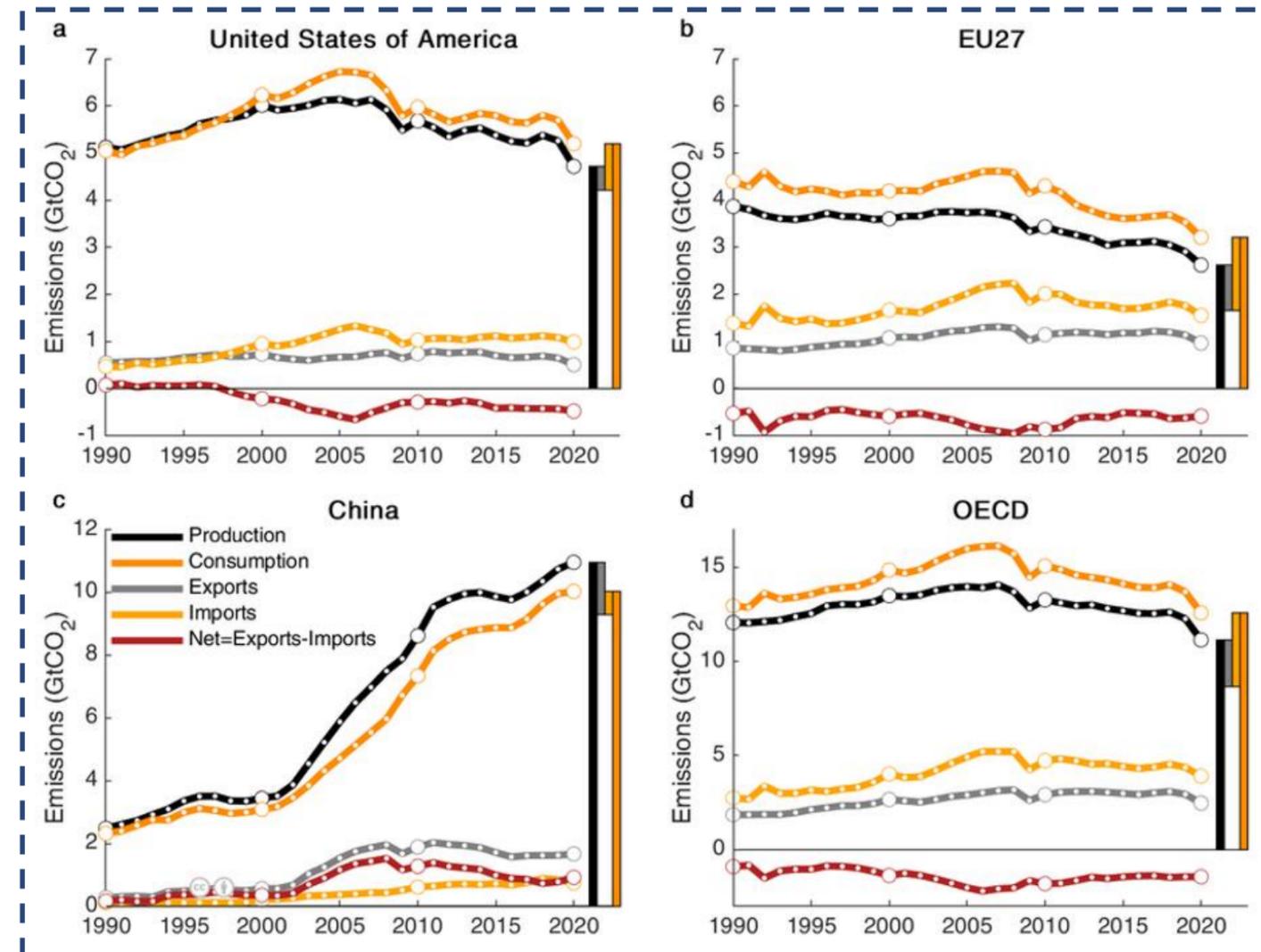
Since 1990 US emissions have fallen by 20%...

Despite the daunting facts, **real progress is being made and humanity is rising to the challenge.**



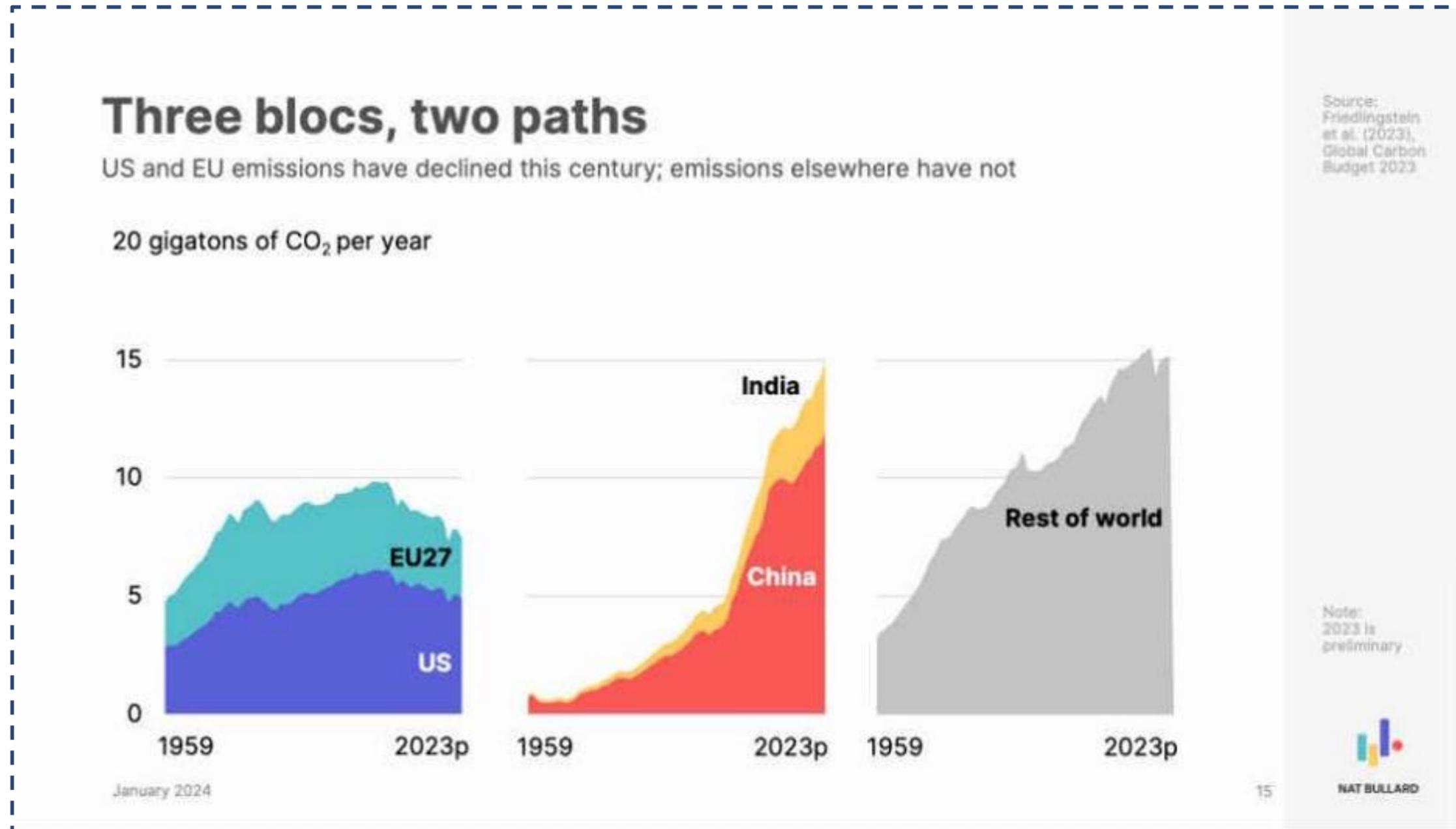
... while the US economy has more than doubled in real GDP.

Consumption-based emissions cannot be offshored. US emissions from consumption are flat over the past 40 years, while most of the increase in emissions in China come from a consumption increase.

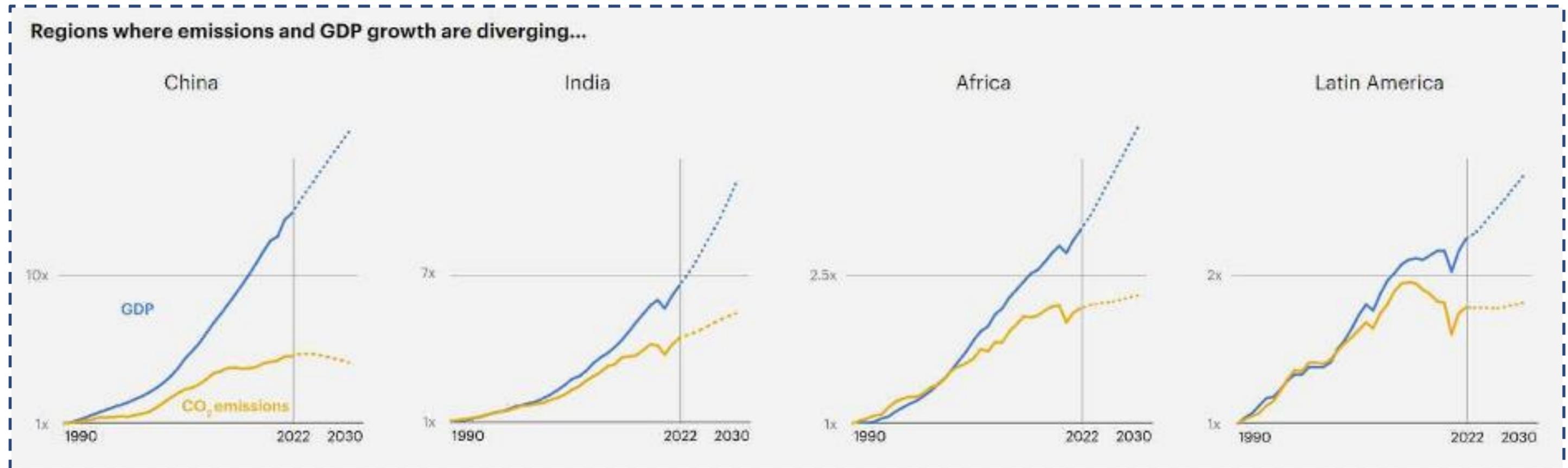


Emissions due to outsourcing and offshoring are negligible.

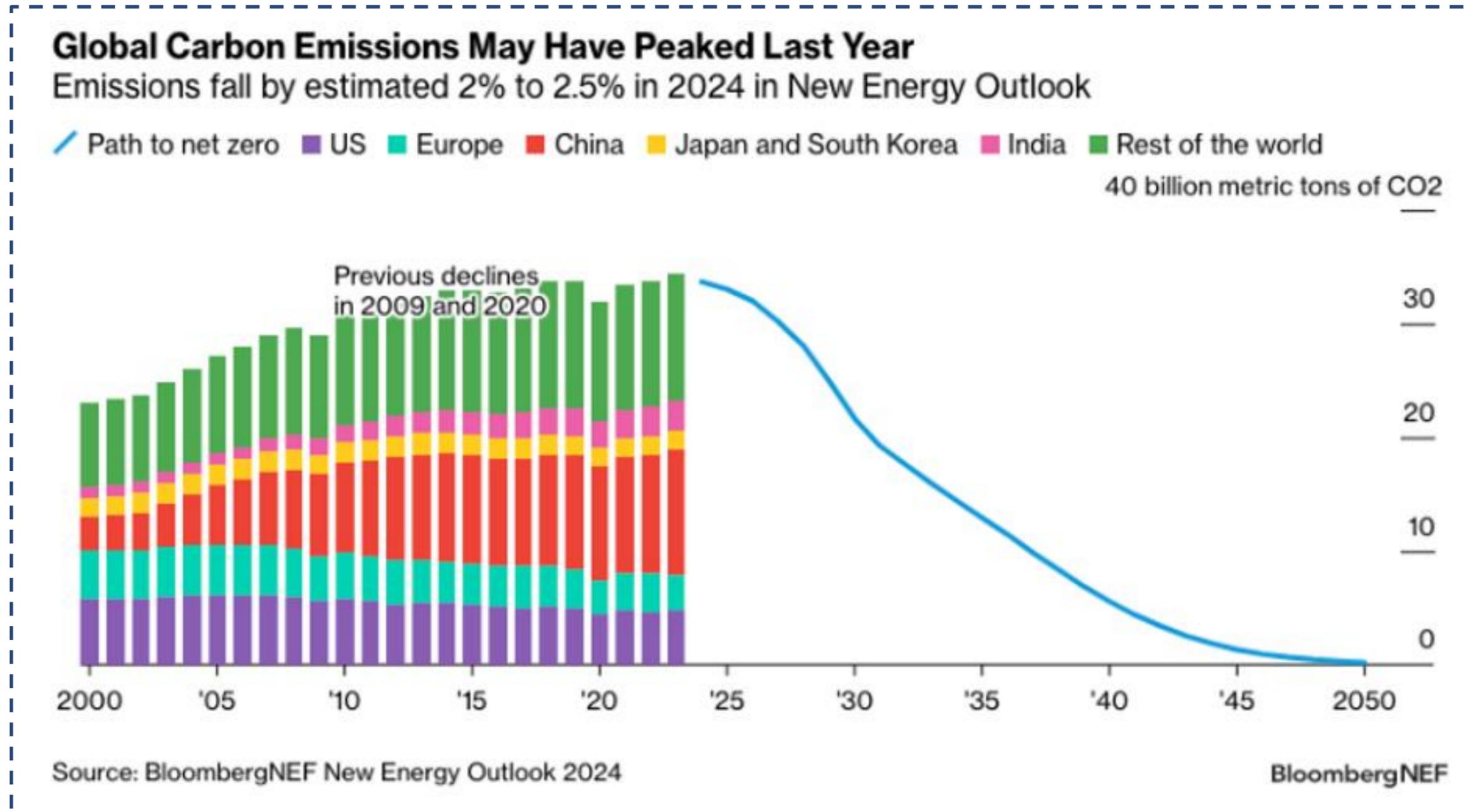
Emissions are still growing in emerging markets and we have enough heat accumulated in the oceans that we can expect temperatures to rise.



Progress is happening as well with **GDP growth decoupling from emissions in China.**

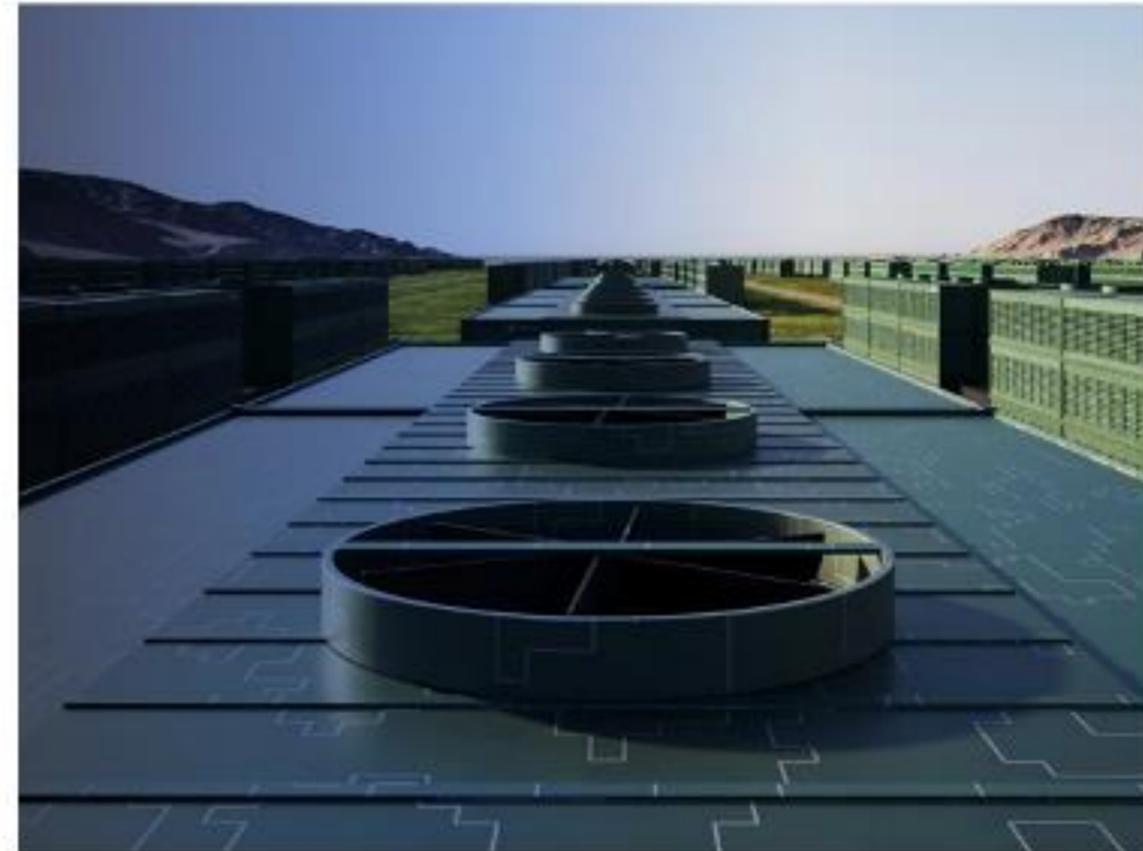


And Bloomberg New Energy Finance thinks **global emissions have peaked and will decline faster from here on in.**



On top of that, **progress is happening on decarbonization...**

New carbon removal technology removes carbon dioxide directly from the atmosphere



Energy abundance leads to overall abundance especially with water and food.



A hand is shown from the bottom, cupping a glowing Earth. The background is a sunset or sunrise over a body of water, with a large, faint globe visible in the upper left. The text is overlaid in the center-left area.

The challenges we face are daunting, but we are rising to the challenge and building a better world of tomorrow, a sustainable world of plenty.