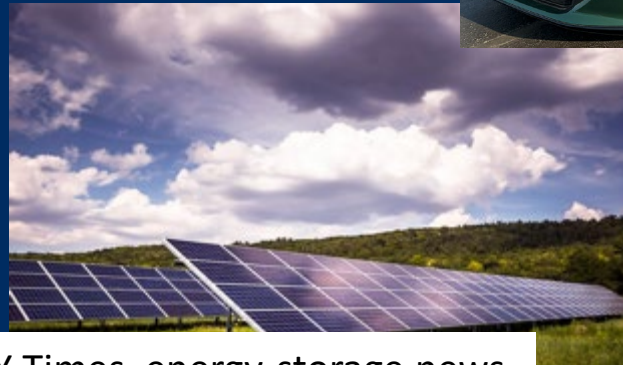


Climate Change 2025: Challenge and Opportunity

Jonathan Overpeck

School for Environment and Sustainability

University of Michigan



Photos: EnergyAsia.org, Earth.org, NY Times, energy-storage.news

Today's talk...

- The **BAD** news (some climate science)
- The **GOOD** news (solutions are known, available and getting cheaper fast)
- BUT... we're not moving fast enough
- What can we each do to help?

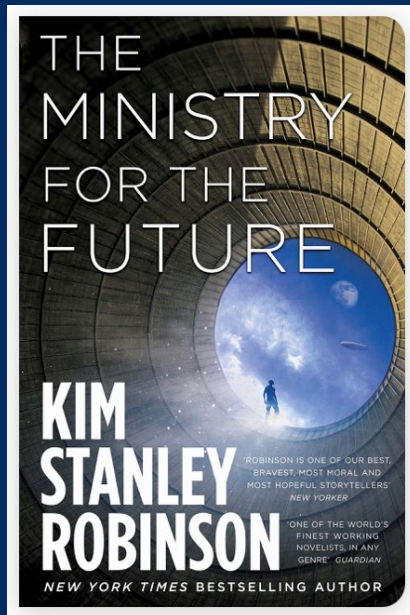
The Bad News...

“the planet is now in a
meltdown phase –
literally and figuratively”

Jonathan Overpeck - *Washington Post*, March 20, 2024

The 2025 Northern
Hemisphere
heatwave season has
begun...

Anyone
read
this
book?



World / Asia

Extended heatwave in India, Pakistan to test survivability limits, with temperatures reaching Death Valley levels

By [Sophia Saifi](#), [Rhea Mogul](#) and [Aishwarya S. Iyer](#), CNN
🕒 4 minute read · Updated 3:51 AM EDT, Tue April 15, 2025

📌 📧 📧 📧

April 15, 2025

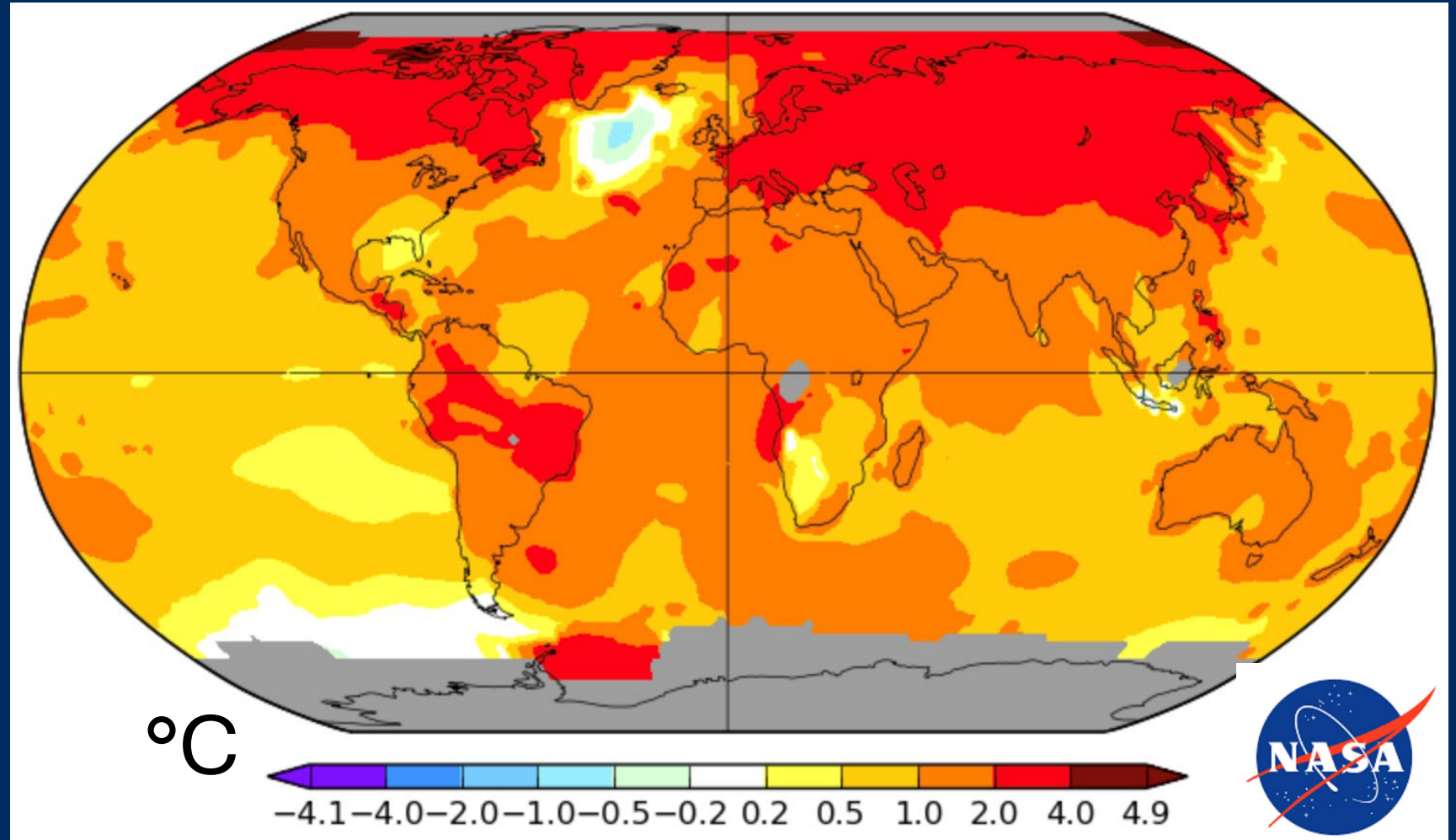


*The globe is warming almost everywhere**

Mean Annual Temperature Trend 1880-2024

2023 Global
Temperature
Smashed Previous
Records

2024 was warmer
& the first year
where the globe
was more than
1.5°C above pre-
industrial – **an
ominous first**



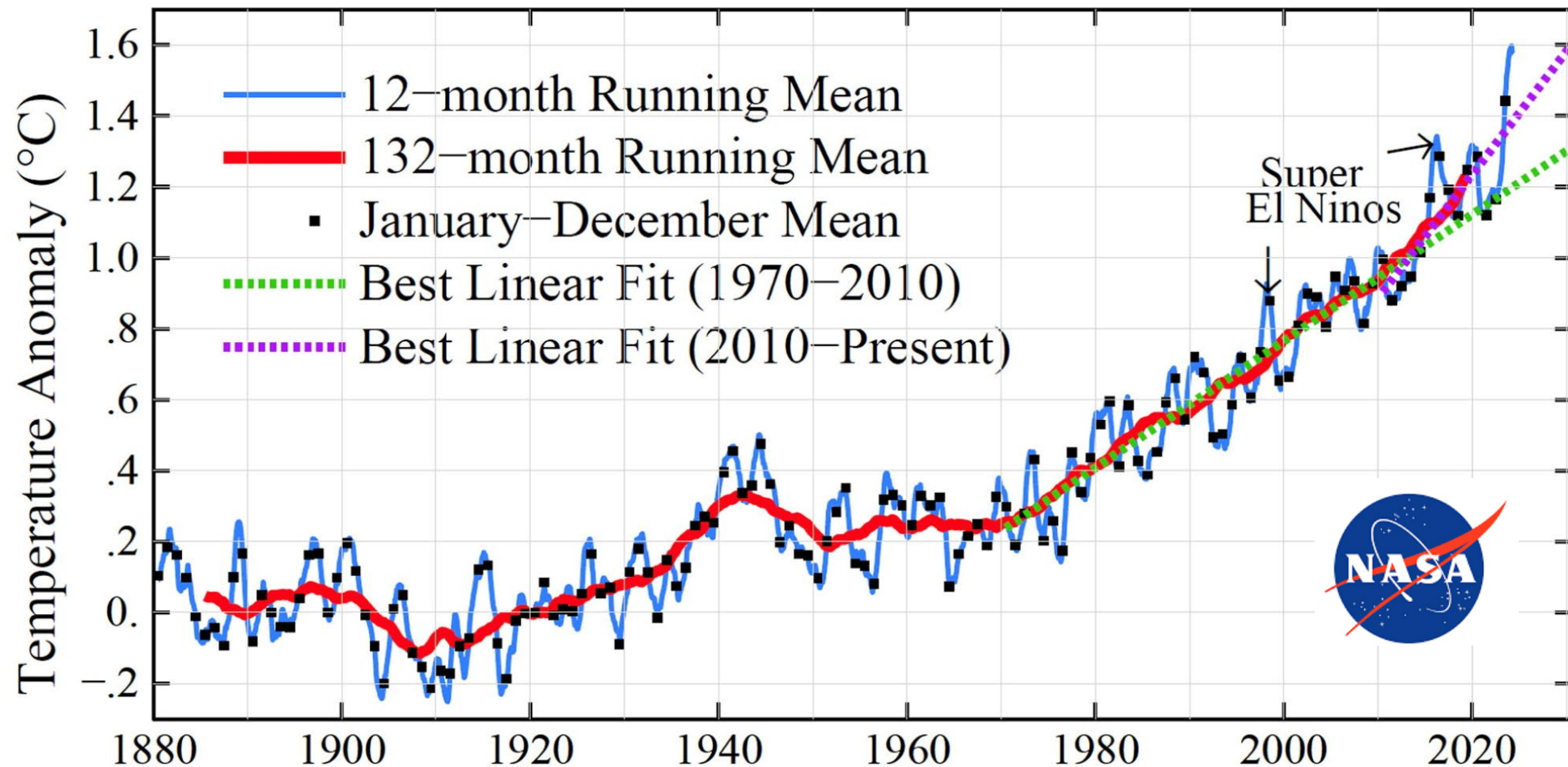
* **NOTE:** North Atlantic cooling as predicted - due to Greenland Ice Sheet melting and precipitation change

Global Warming Has Accelerated: Are the United Nations and the Public Well-Informed?

James E. Hansen, Pushker Kharecha, Makiko Sato, George Tselioudis, Joseph Kelly, Susanne E. Bauer, ...show all

Pages 6-44 | Published online: 03 Feb 2025

Environment (2025) – Science and Policy for Sustainable Development

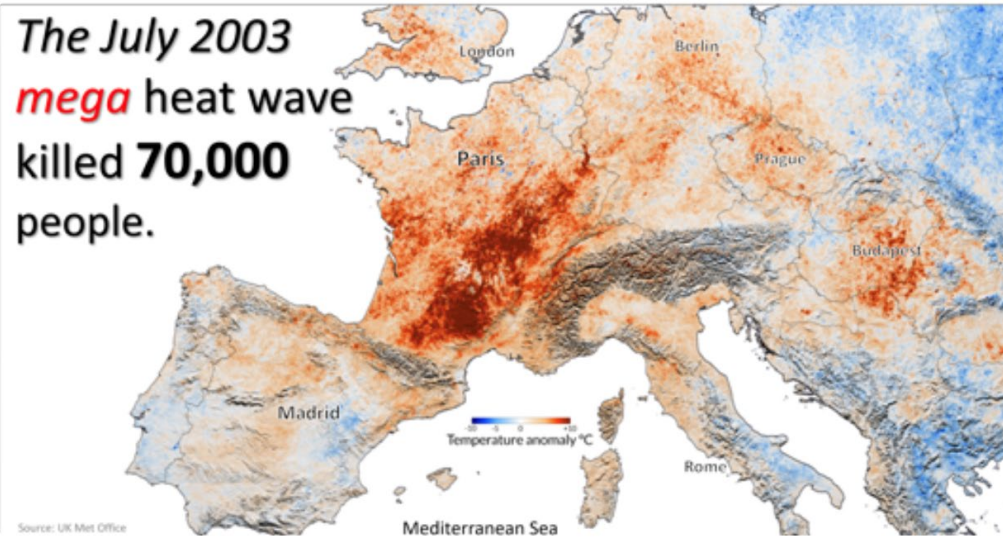


We were on track to $< 3^{\circ}\text{C}$ global warming, but now we are likely on track for greater warming

July 2003

European Heatwave (2003)

The July 2003
mega heat wave
killed **70,000**
people.



European Heatwave (2003)

Climate Change's Number One Killer: Heat Waves

April 2024

Dangerous Heat Wave Strikes Metro Manila and 23 Other Areas

THE MANILA JOURNAL

BY JANIMONOW | APRIL 16, 2024

May-June 2024

AP WORLD U.S. POLITICS SPORTS ENTERTAINMENT BUSINESS SCIENCE FACT CHECK ODDITIES BE WELL NEWSLETTERS ...

Live: Trump administration US Education Department March Madness Heathrow Movie

AP SETS THE STANDARD FOR POLITICAL REPORTING. SUPPORT INDEPENDENT, FACT-BASED JOURNALISM. [DONATE](#)

WORLD NEWS

Extreme heat in India has killed more than 100 people in the past three and a half months

August 2023

As extreme heat hits South Korea and Japan, death toll rises sharply

By Min Joo Kim and Julia Mio Inuma
August 2, 2023 at 5:12 a.m. EDT

The Washington Post



Euronews (English)

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2024 – 335 deaths

Deadly floods, storms and heatwaves: Europe suffered the 'serious impacts' of climate change in 2024

Global climate change *impacts* are continuing to *accelerate*

A record 63 billion-dollar weather disasters hit Earth in 2023

Seven nations had their most expensive weather disaster on record, and the continent of Africa suffered two of its deadliest.



by JEFF MASTERS
JANUARY 18, 2024

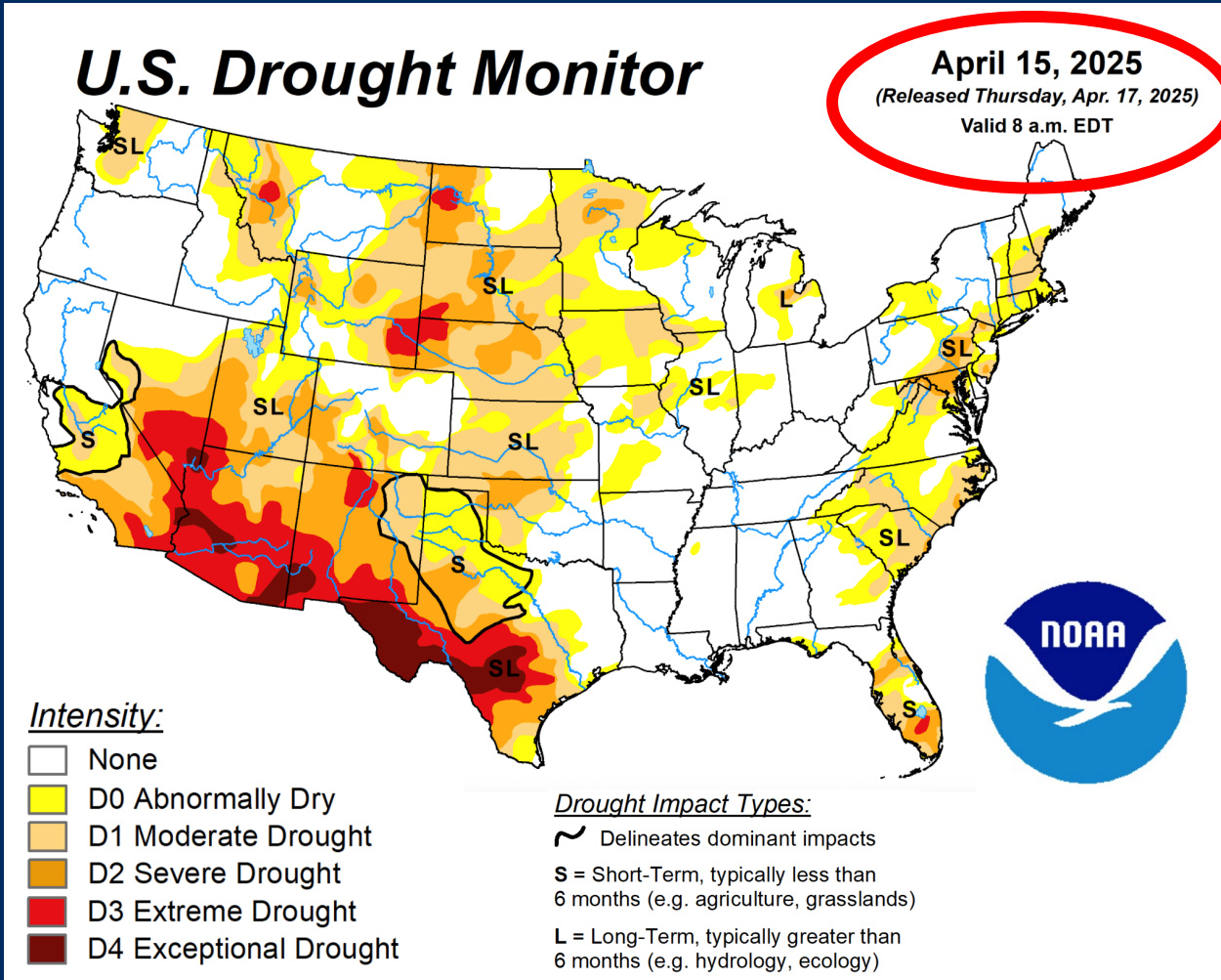


Rescue workers evacuate flood-affected people in Zhuozhou, China, on August 2, 2023, in the wake of Typhoon Doksuri. The typhoon and its remnants caused \$18.5 billion in damage, making it Earth's most expensive weather disaster of the year. (Image credit: China News Service, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=135517949>)

- Extreme heat
- Supercharged hurricanes, typhoons, tropical cyclones
- Extreme rainfall & flooding
- Hot drought & megadrought
- Unprecedented wildfire

Warming supercharges them all

25th year of SW Megadrought is really climate change aridification



Aridification Spreading in North America a New Study Finds

MAY 26, 2020 ARIDIFICATION, CALIFORNIA, DROUGHT,

Share

Tweet



Overpeck and Udall (2020) PNAS

Remember - this is a tale of two hydrologic extremes

An intensified hydrological cycle can also yield increases in:

- **Average Precipitation**
- **Extreme Rainfall**
- **Flooding**

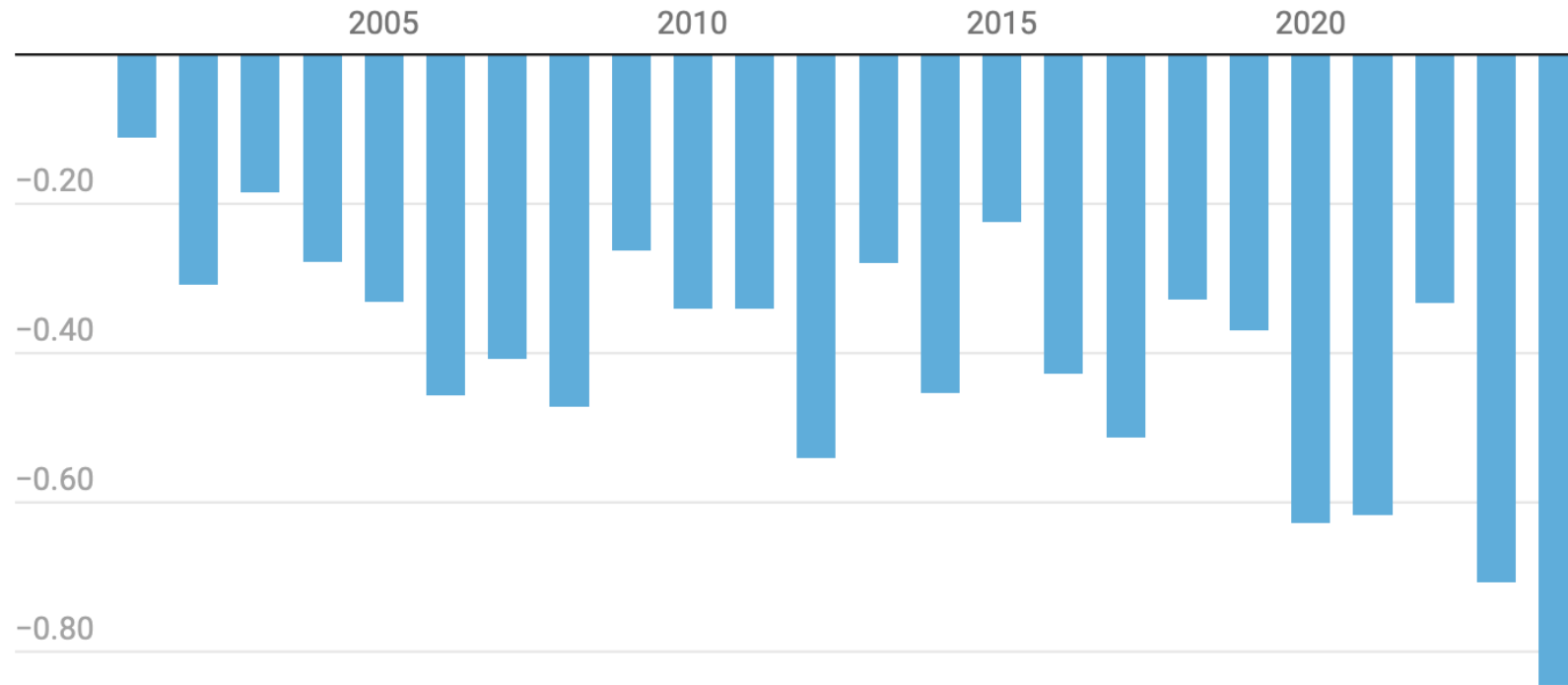


Algae blooms also grow worse with warming

Mountain glacier melting is accelerating

Glacier loss is accelerating around the world

Global glacier loss has increased over the past 25 years. The bars show the annual mass loss of glaciers outside the Antarctic and Greenland ice sheets, in meters of water equivalent per year.



Speeding up
sea level rise

Chart: The Conversation, CC-BY-ND • Source: [GlaMBIE, 2025, Nature](#) • [Get the data](#) • [Embed](#) • [Download image](#) • Created with [Datawrapper](#)



Polar Ice Sheet melting is combining with record ocean expansion due to warming to also cause an acceleration in global sea level rise

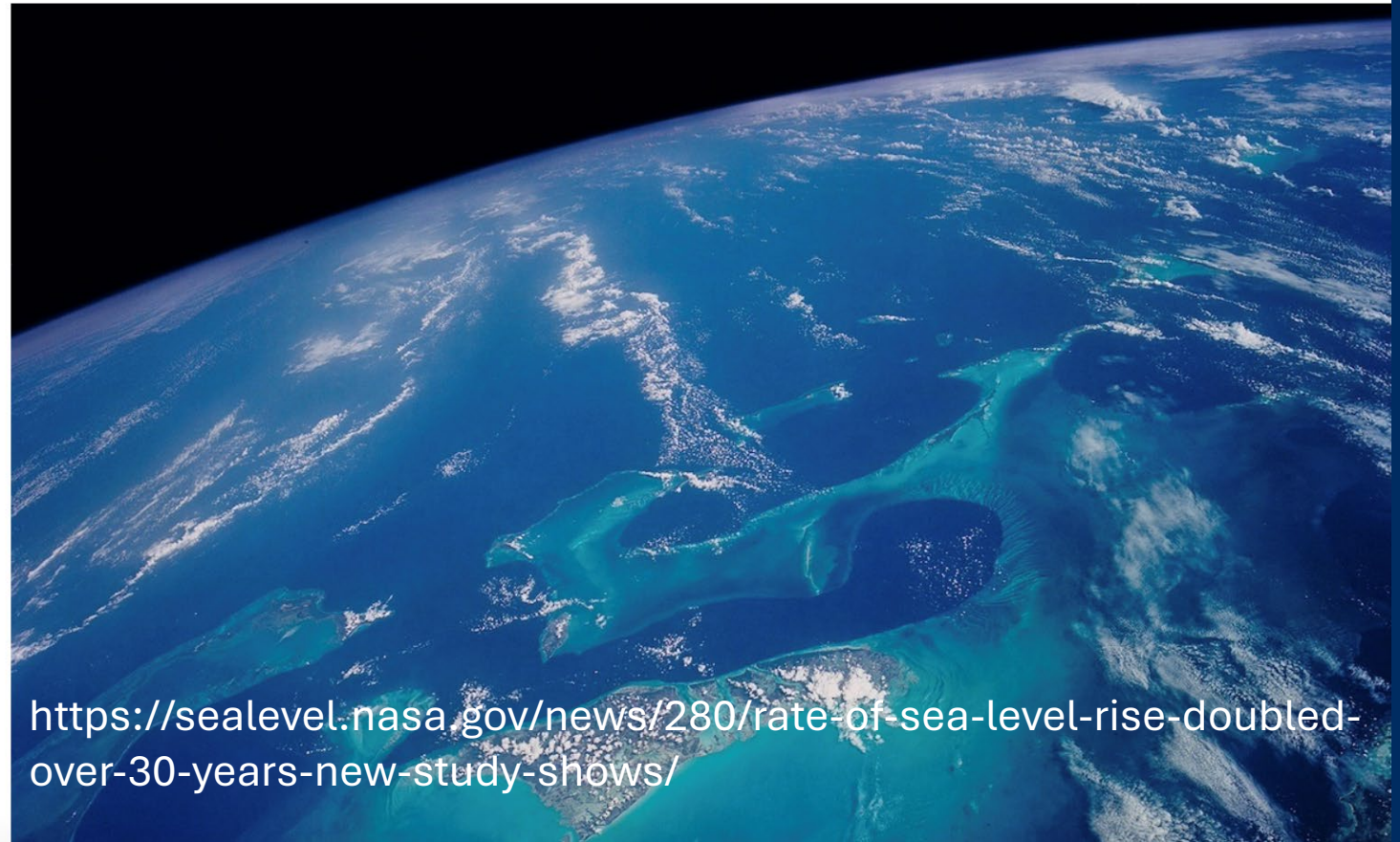
Energy Live News

March 17, 2025

NEWS | February 25, 2025

Rate of Sea Level Rise Doubled over 30 Years, New Study Shows

By Ethan Huang, NASA's Sea Level Change Team



<https://sealevel.nasa.gov/news/280/rate-of-sea-level-rise-doubled-over-30-years-new-study-shows/>

Article

The Paris Climate Agreement and future sea-level rise from Antarctica

Nature (2021)

<https://doi.org/10.1038/s41586-021-03427-0>

Received: 15 October 2018

Accepted: 8 March 2021

Robert M. DeConto^{1✉}, David Pollard², Richard B. Alley^{2,3}, Isabella Velicogna⁴, Edward Gasson⁵, Natalya Gomez⁶, Shaina Sadai¹, Alan Condron⁷, Daniel M. Gilford⁸, Erica L. Ashe⁸, Robert E. Kopp⁸, Dawei Li^{1,9} & Andrea Dutton¹⁰

“These results demonstrate the possibility that rapid and unstoppable sea-level rise from Antarctica will be triggered if Paris Agreement targets are exceeded.”

IPCC (2021):

If 2°C–3°C peak warming → 2-5m sea-level rise possible

If > 3°C peak warming → 6-12m sea-level rise possible

Possibly on century time-scales

A map of the Southeastern United States, including parts of Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, and Virginia. The map shows the Gulf of Mexico to the south and east. A large red rectangular box is overlaid on the map, containing the text "10 meters of Sea Level Rise...". The map uses a color scale to indicate the extent of sea level rise, with red areas representing land that would be submerged. Major cities and state boundaries are labeled. The text "10 meters of Sea Level Rise..." is written in white, bold, sans-serif font. The URL "https://coastal.climatecentral.org/" is written in black, sans-serif font at the bottom of the map.

10 meters of Sea Level Rise...

<https://coastal.climatecentral.org/>

Why I have HOPE

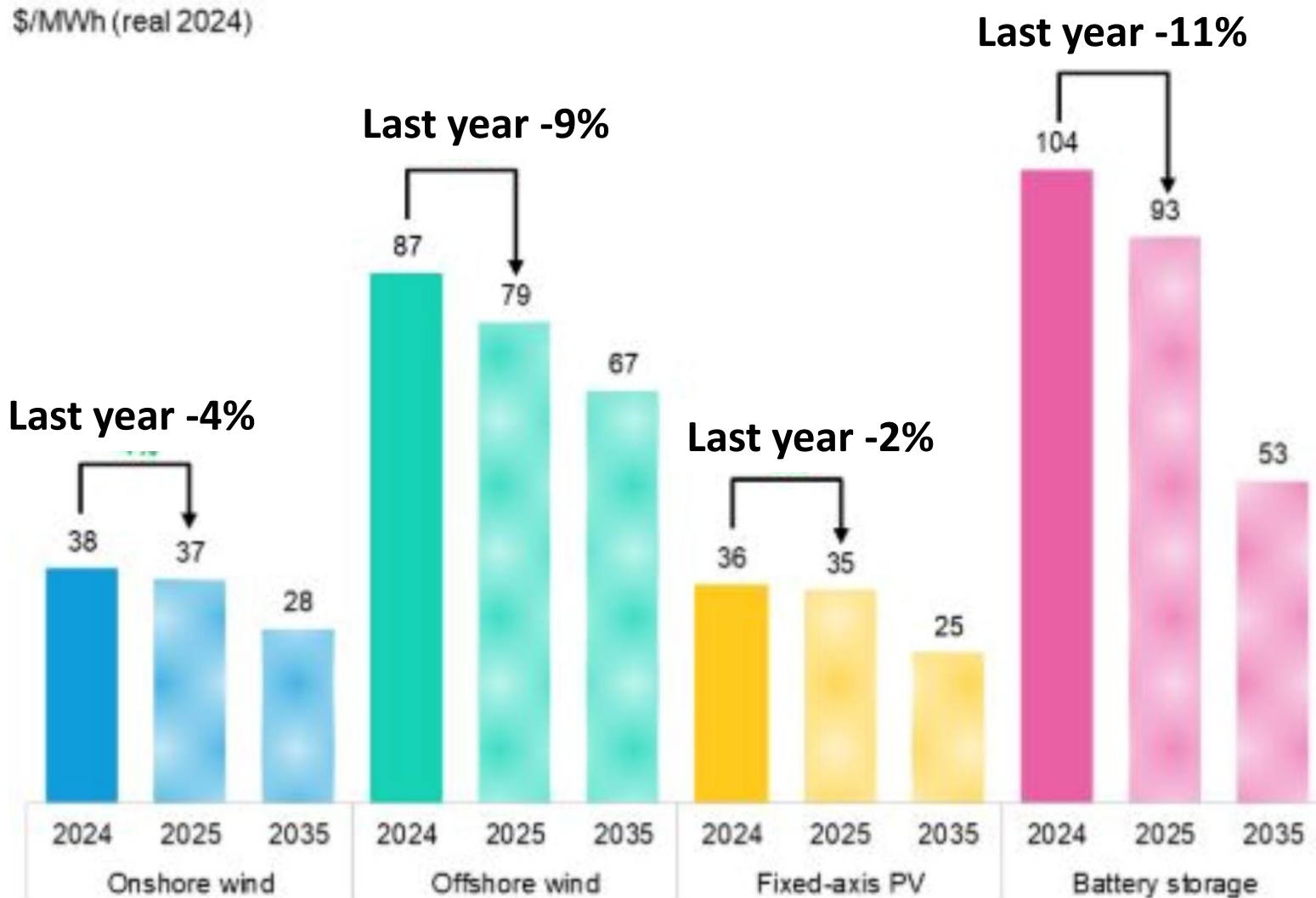


The **Good News** – The **development** and **deployment** of solutions are also accelerating

- To reduce, mitigate, **halt** climate change
- To **build resilience** and **adapt** to the climate change that cannot be avoided or halted
- To **recover** from impacts

Good News: The costs associated with the biggest clean solutions continue to fall, and this is fueling rapid deployment

Figure 1: Global benchmark levelized cost of electricity, 2024, 2025 and 2035

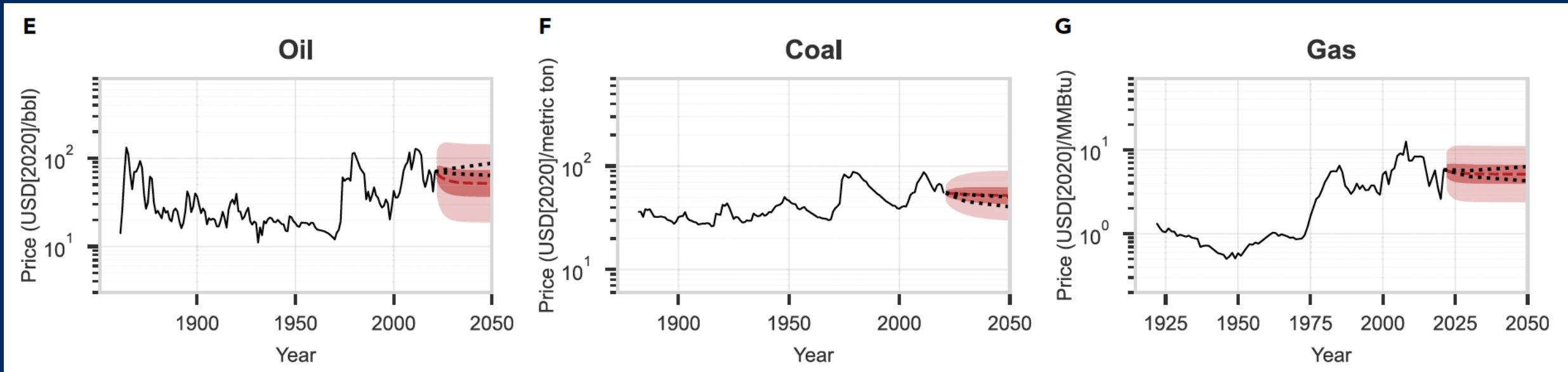


Renewable energy is becoming the least expensive energy around the globe

Source: BloombergNEF.

More reason to feel hopeful: carbon-free solution costs are plummeting and will continue to plummet...

But fossil fuel solution costs will not...



Joule

2022

Article

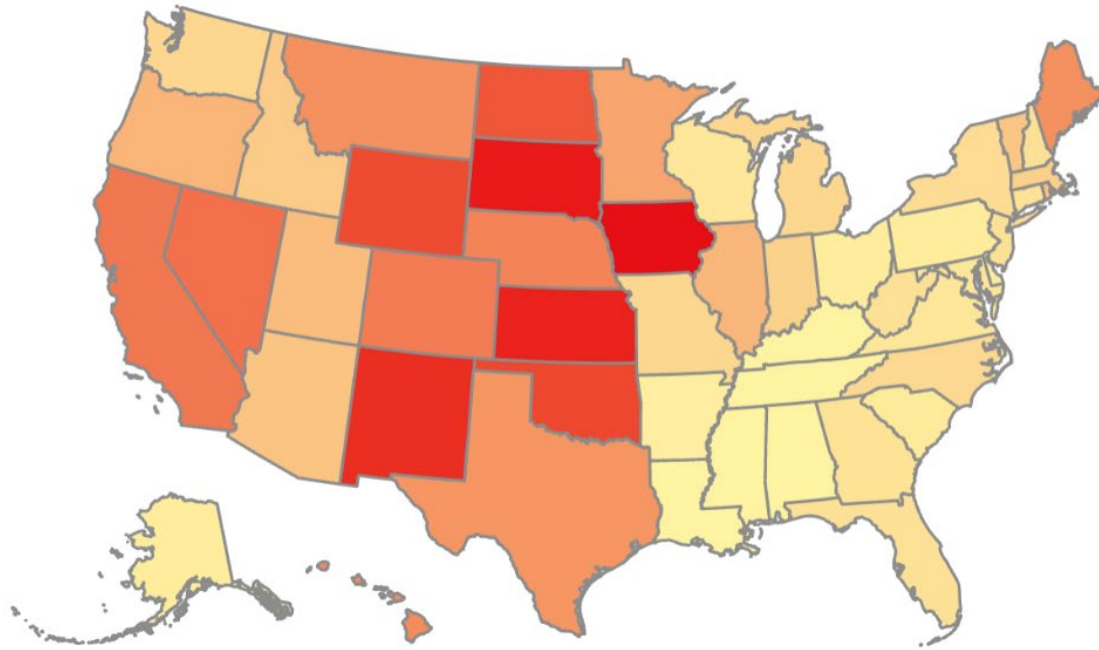
Empirically grounded technology forecasts and the energy transition

Rupert Way,^{1,2,6,*} Matthew C. Ives,^{1,2} Penny Mealy,^{1,2,3} and J. Doyne Farmer^{1,4,5}

Why is this good news?

How much of our energy comes from renewables?

Wind, solar and geothermal energy as a percent of retail electricity sales



2023

In 2024:

~50 GW Solar Installed

20 GW in just 3 states:

Texas – 12GW

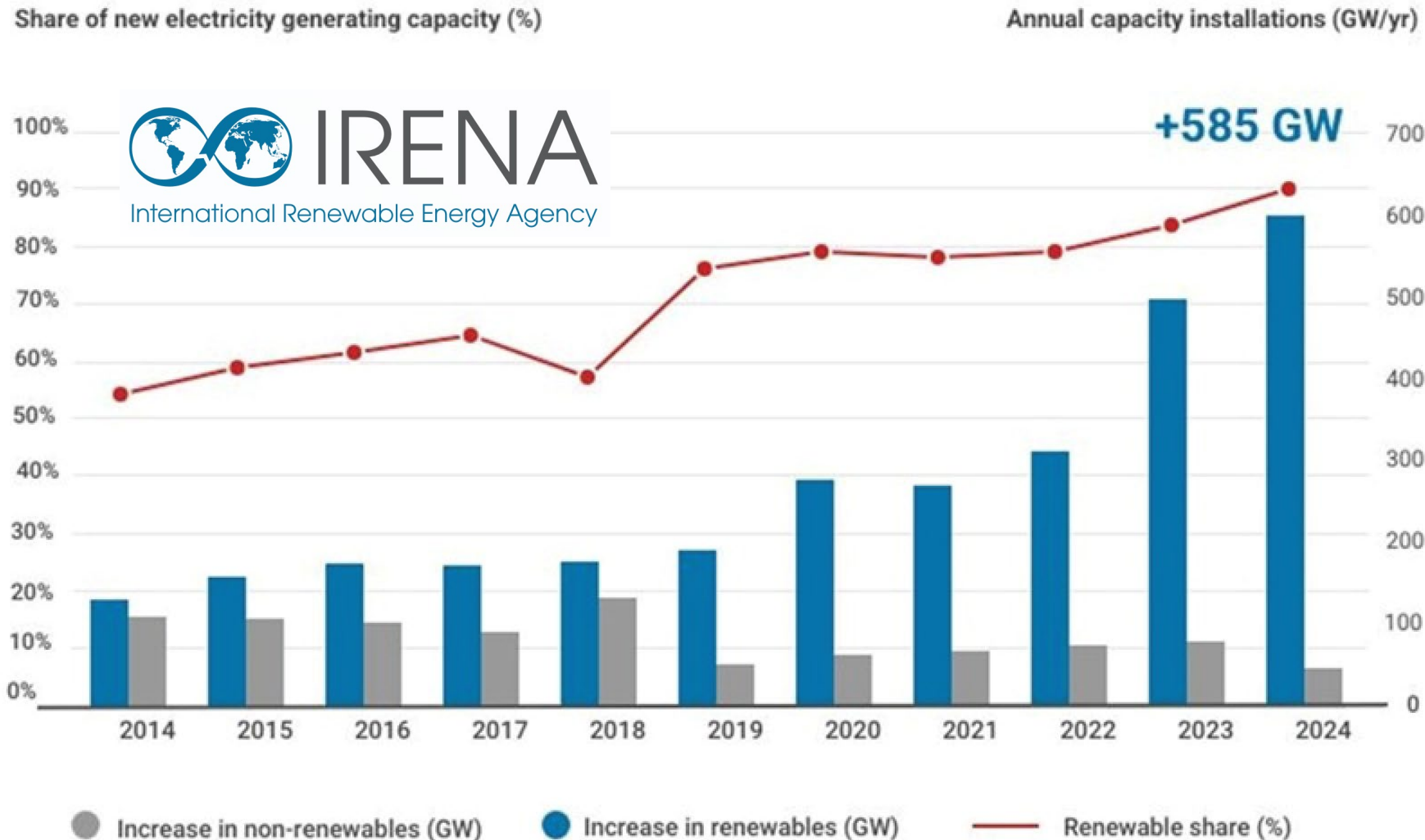
California – 5GW

Florida – 4.7GW

Also, the many states in the **US Climate Alliance** – pledged to hit net-zero by 2050

Good News: The costs associated with the biggest clean solutions continue to fall and deployment continues to rise

Renewables account for more than 92% of total power expansion in 2024



Deployment
is
accelerating
around the
globe
(much faster
than fossil
fuels)

Globally, low-carbon electricity **deployment** is accelerating

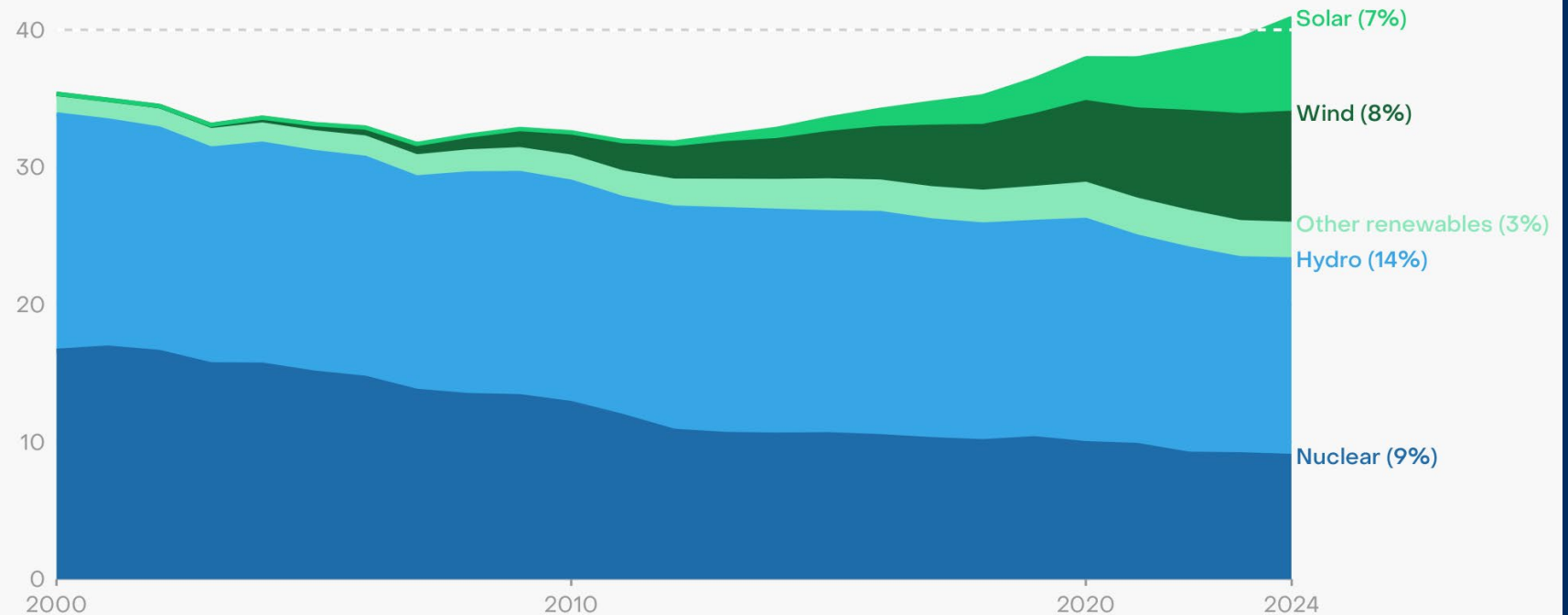
The planet is going carbon-neutral (1.6% growth/year)

April 8, 2025



Solar and wind boom pushes world past 40% clean electricity in 2024

Share of global electricity generation (%)



Source: Yearly electricity data, Ember
'Other renewables' includes bioenergy, geothermal, tide and wave energy

EMBER

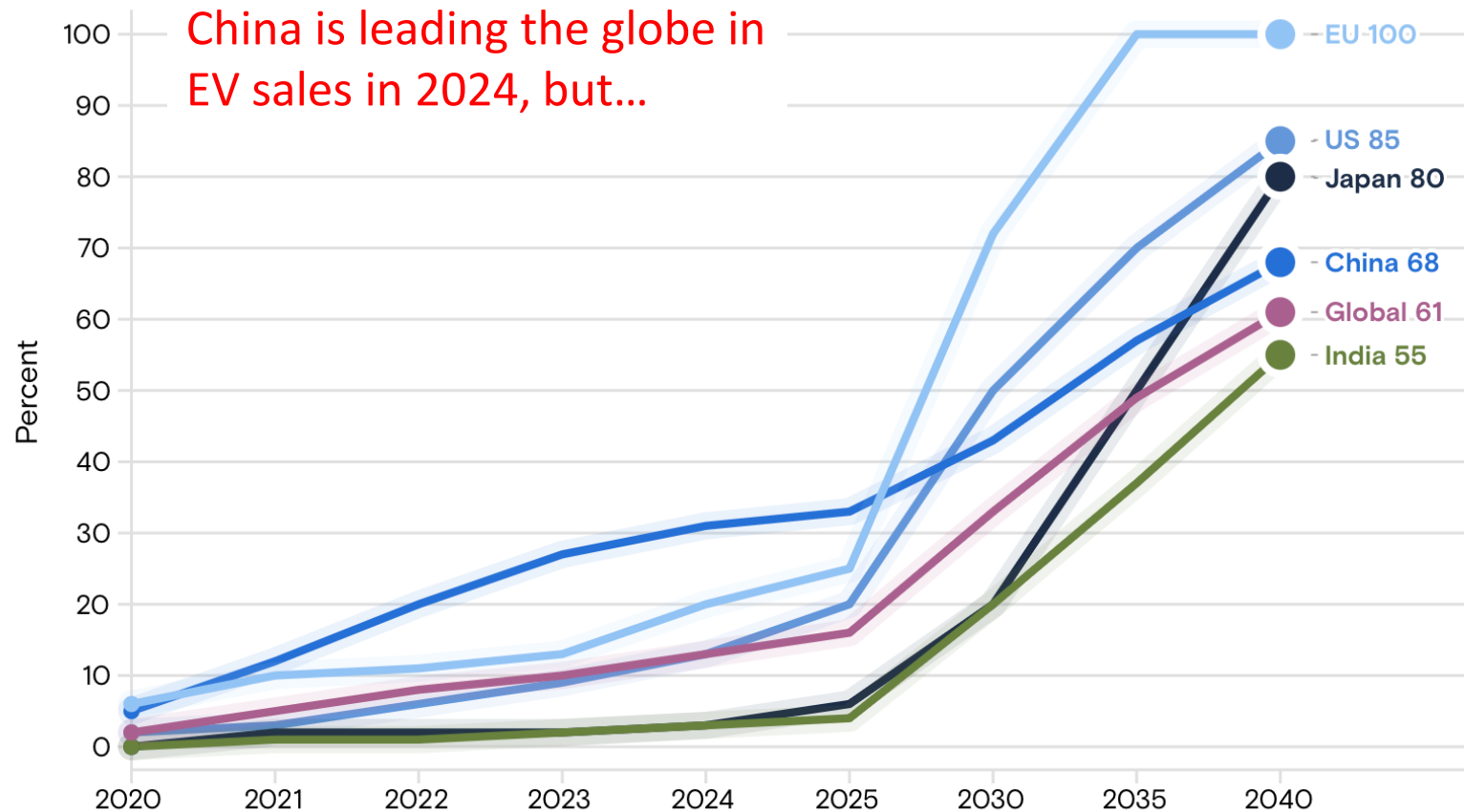
Global solar power is now doubling every 3 years (now at 2000TW!)

Cool updates: EV sales still surging, but...

<https://www.goldmansachs.com/intelligence/pages/electric-vehicles-are-forecast-to-be-half-of-global-car-sales-by-2035.html>

The shift to electric vehicles is forecast to accelerate

Electric vehicle sales ratio (%)



Source: IHS Global Insight, Goldman Sachs Research • 2022-2040 are forecasts

**Goldman
Sachs**

Global EV sales in last two years increased by an average of 25% per year

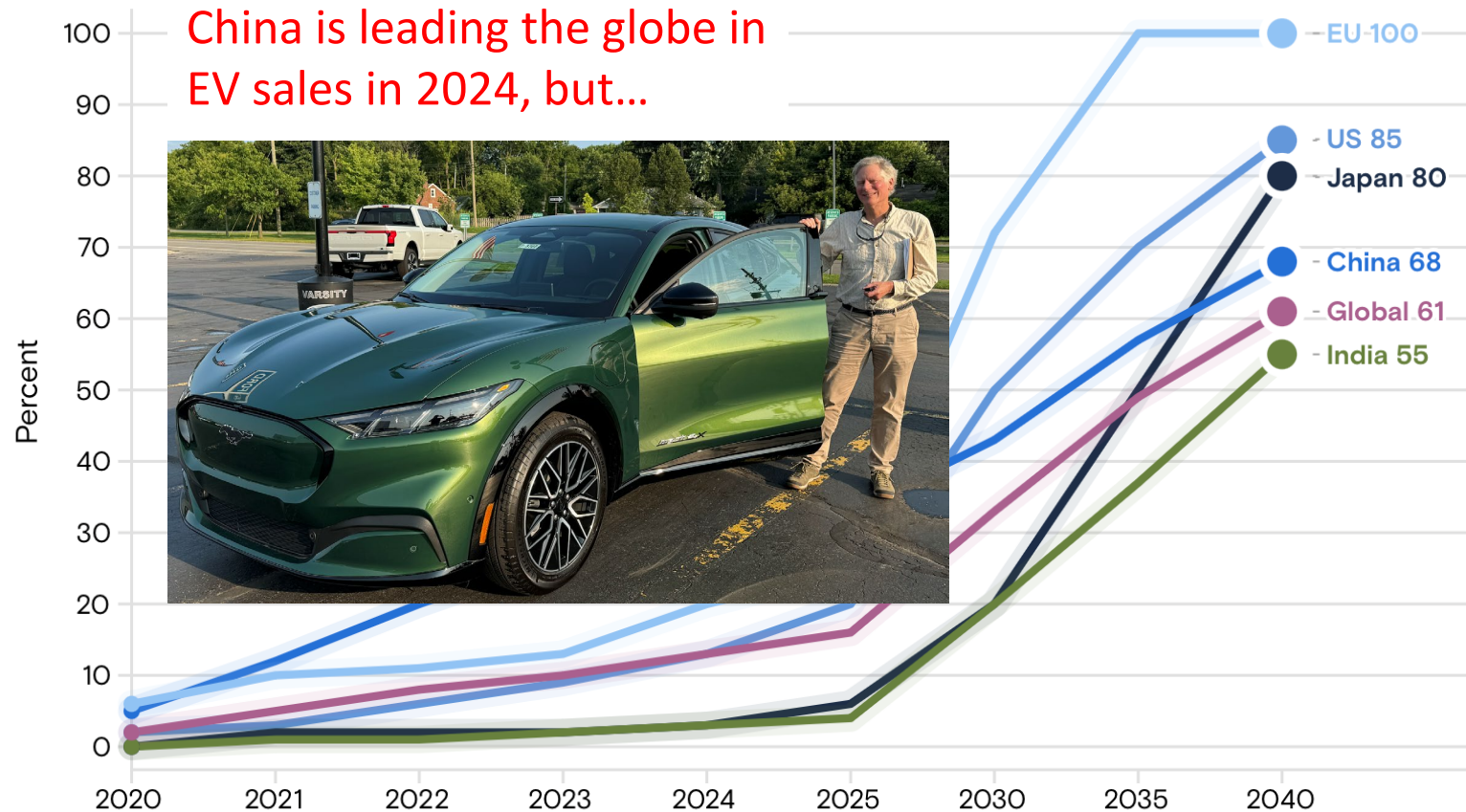
Projected to reach >50% by 2035

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**Goldman
Sachs**

Global EV sales in last two years increased by an average of 25% per year

Projected to reach >50% by 2035

A silhouette of a wind turbine is centered in the frame, set against a background of a cloudy sky. The sky transitions from a lighter, hazy blue on the left to a darker, more uniform grey-blue on the right. The turbine's three blades are clearly visible, extending from a central hub. The overall mood is contemplative and somewhat somber.

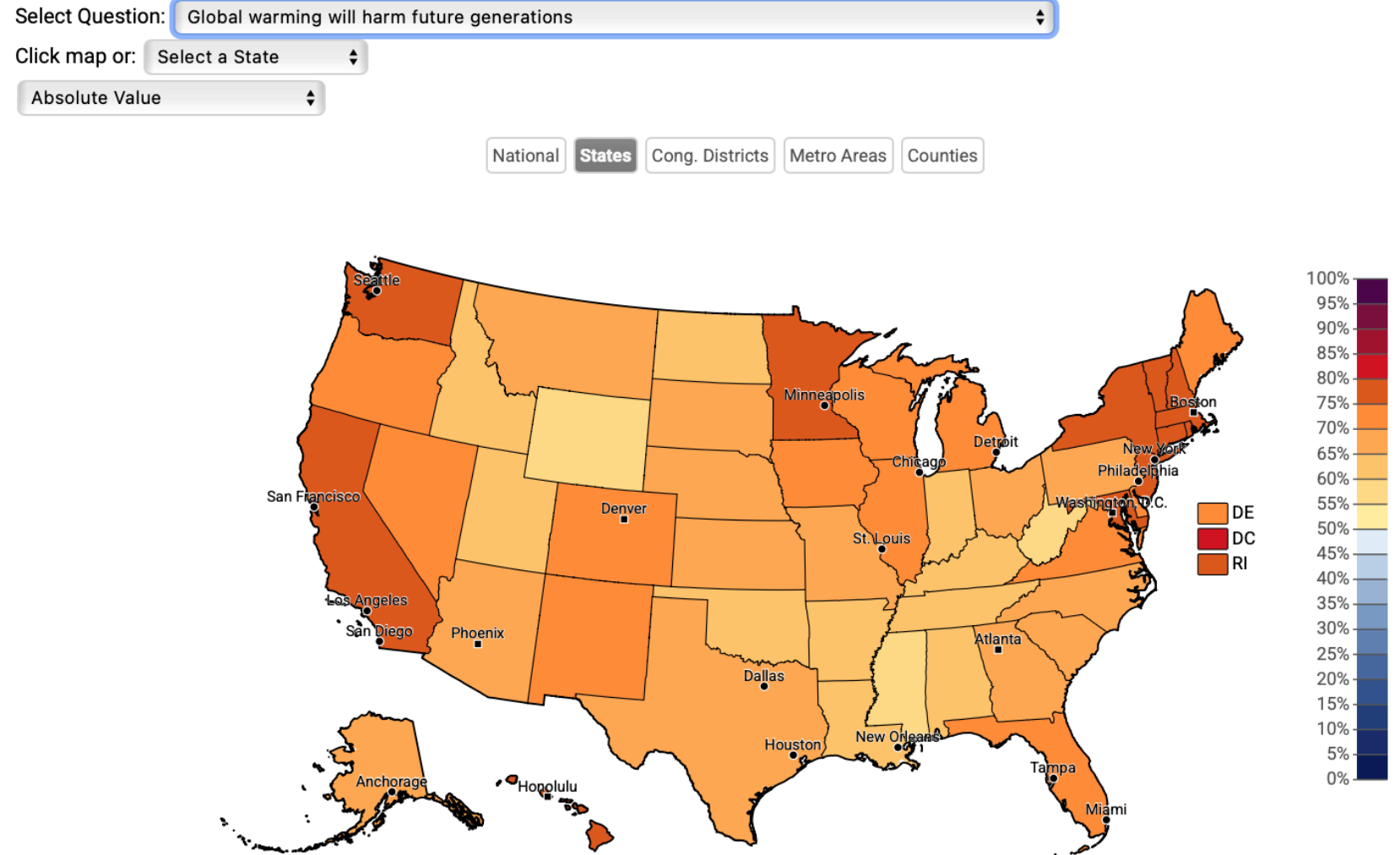
So, what's the problem?

Yet more reason for hope:

Large majority of
Americans know
climate change is
real, and are worried
In 2024:

National average 71%
Michigan steady at 71%
Ohio at 68%
Texas at 70%
Florida at 70%
California at 77%

Estimated % of adults who think global warming will harm future generations
a moderate amount or a great deal (nat'l avg. 71%), 2024



Conclusions...

- Climate change, **impacts** and **costs** are accelerating
- Solution **cost reductions** are accelerating
- Solution **deployment** is accelerating
- BUT solutions are still being deployed too slowly
- “Fairness” not being emphasized enough – if everyone benefits, the energy transition will speed up, in the US and globally
- **We all have to make talking about climate change, and acting on climate change, a higher priority**

Thanks!

Did you know the Great Lakes hold over 20% of the world's unfrozen surface water

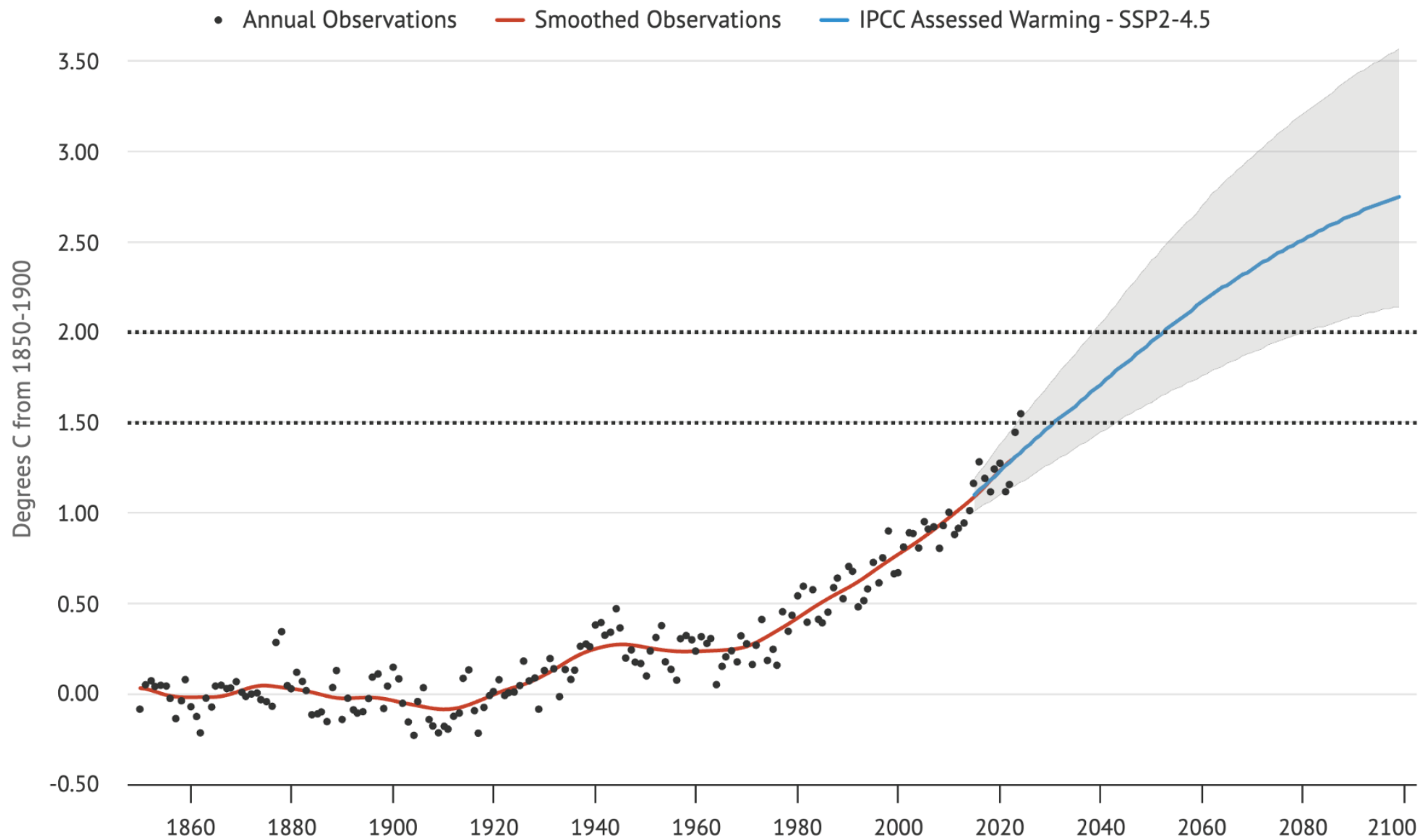


@GreatLakesPeck



@GreatLakesPeckTwo

IPCC Assessed Warming Projections and Observations - SSP2-4.5

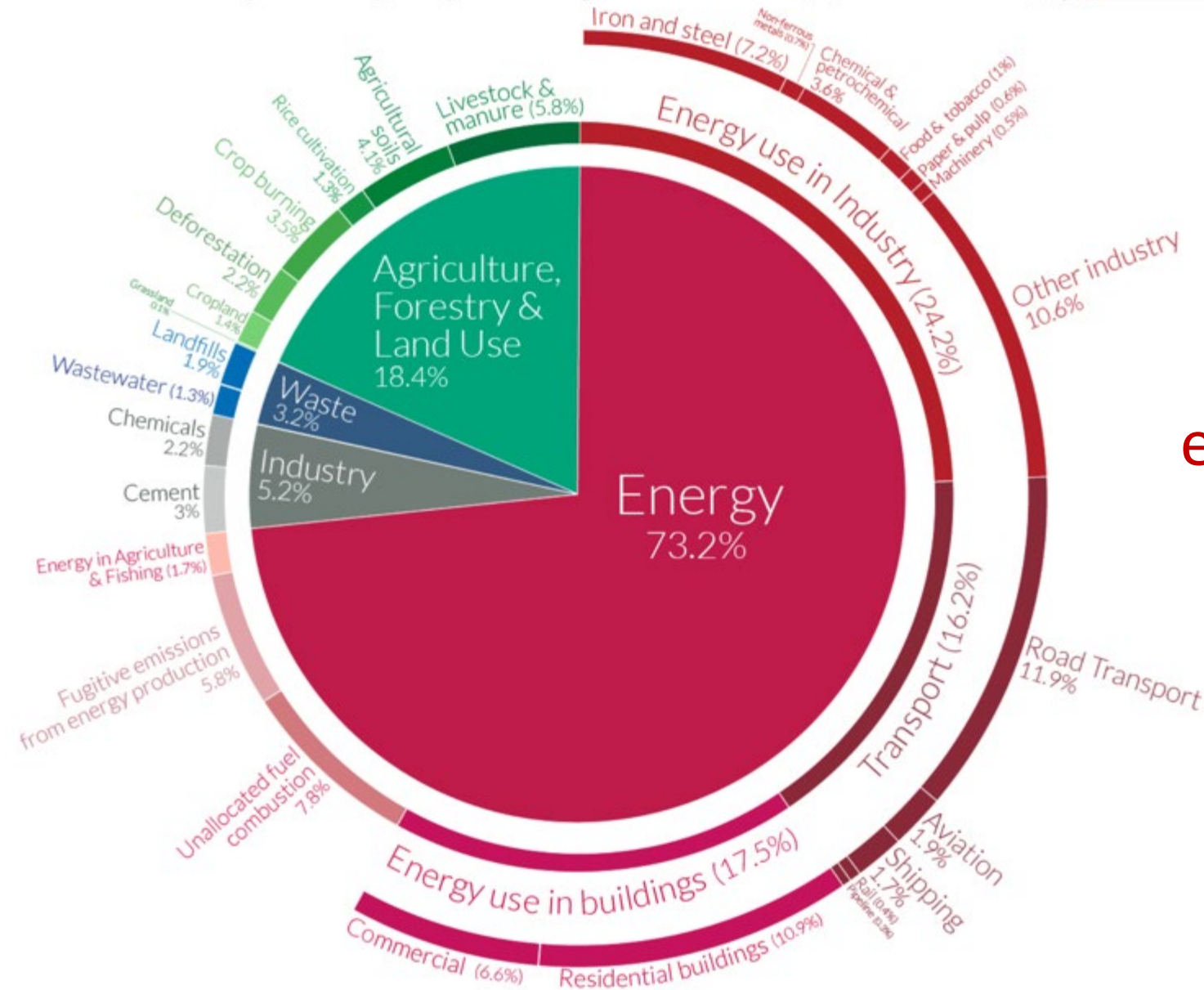


Sources: Berkeley Earth, GISTEMP, NOAA GlobalTemp, HadCRUT5, and IPCC AR6 Assessed Warming Projections for SSP2-4.5

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.

Our World
in Data

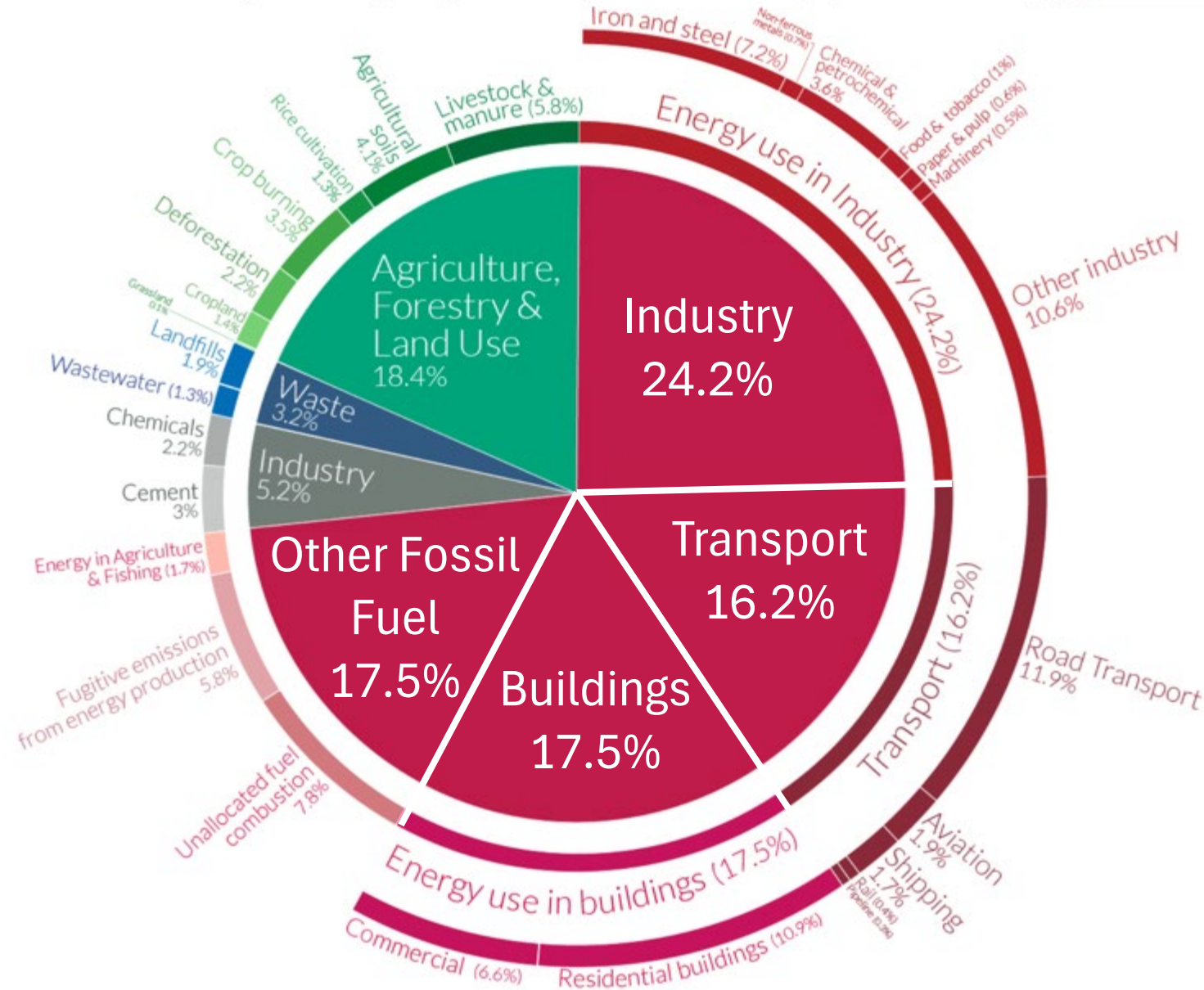


Decarbonizing our
energy systems is the
biggest job

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.

Our World
in Data



Developing and implementing low-carbon solutions = the 21st century new economy requiring a wide range of talents

And justice must be a factor in all solutions