

## EU SCIENTISTS EXPECT 2024 TO BE THE WARMEST YEAR ON RECORD

A year ago, data for 2023 made clear that it was the hottest year since records began in 1850, surpassing by fairly wide margin the previous record-holder, 2016. But it is now expected that 2024 will be even warmer. If this comes true, it will mean that every year of the last decade was one of the 10 hottest years on record, just not in chronological order.<sup>1</sup> This not only confirms that climate change is a present (rather than a future) concern, it demonstrates, too, that our climate models are fairly robust – which, I suppose, is technically good news.

### Why has 2024 been so warm?

In their October bulletin, the European Union's Copernicus Climate Change Service (C3S) states that whilst 2023 was 'the warmest year on record', the 'year-to-date temperatures available at the time of writing [...] indicate that it is likely that 2024 will be warmer than 2023'.<sup>2</sup> What's more, C3S expects that the average global surface temperature for the 2024 calendar year will 'lie within, or very close to, the range 1.5-1.6C warmer than the 1850-1900 pre-industrial average'.<sup>2</sup> Whilst this does not yet amount to a breach of the Paris Agreement's preferred limit on global warming because our multi-year average remains below this threshold, it does suggest that there is now only the slimmest chance of meeting this target.

From within the intricacies of climate monitoring, these historic temperatures appear to be ever-so-slight exaggerations of fundamental climate change, with temperatures slightly over-elevated by an El Nino event between June 2023 and May 2024. To illustrate, consider three different time periods as they are recorded by C3S. Whilst C3S has the average global temperatures of the 2023 calendar year between 1.44 and 1.48 above pre-industrial levels, they estimate that average global temperatures in the 12 months from November 2023 to October 2024 were 1.62C above pre-industrial levels – and then, as already noted, 2024 as a whole is expected to be between 1.5-1.6C. What reveals itself in these figures is an underlying rise in global average temperatures accompanied by a brief but intense heatwave. In support of this observation, let's check our predicted average temperature using the latest estimates for the transient climate response – an estimate for near-term temperature rises upon doubling of pre-industrial atmospheric concentrations of CO<sub>2</sub> (280ppm) – outlined in the IPCC's Sixth Assessment from last year:

*Based on process understanding, warming over the instrumental record, and emergent constraints, the best estimate of TCR is 1.8°C, the likely range is 1.4°C to 2.2°C and the very likely range is 1.2°C to 2.4°C (high confidence).<sup>3</sup>*

Combining this best estimate of 1.8C at 560ppm of CO<sub>2</sub> with the US National Oceanic and Atmospheric Administration's (NOAA) latest Annual Greenhouse Gas Index from 2023, we are currently at 534ppm of carbon-dioxide equivalent (CO<sub>2</sub>e),



i.e. the cumulative global warming potential over 100 years of all atmospheric greenhouse gases (not just CO<sub>2</sub>) expressed as quantities of CO<sub>2</sub>, which suggests that in the near term, average surface temperatures will be between 1.6-1.7C above pre-industrial levels.<sup>4</sup> Quite clearly, then, we're on pace.

A less significant oscillation in average temperatures (in the opposite direction) is expected to kick in over the coming months, as forecasters at the NOAA predict that the ENSO will enter its cooling phase, La Nina, albeit favouring a 'weak event'.<sup>5</sup> So, if 2025 fails to be the new hottest year on record, it could be because of La Nina.

### How close are we to preventing further increases in temperature?

Since the early 2020s, the International Energy Agency has been predicting a peak in global emissions within the decade, with their latest pronouncement naming 2030 as the final year of increasing emissions.<sup>6</sup> Whilst there may be reasons to be skeptical about these predictions (not least the fact that, as the report itself acknowledges, two thirds of the increase in global energy demand in 2023 was supplied by fossil fuels), one thing's for sure: reductions in emissions will not stop temperature increases for the foreseeable future.

Oceans cover 71% of the planet's surface, and they have much higher heat capacity than land or air. As a result, temperatures don't rise simultaneously with increasing atmospheric concentrations of greenhouse gases – in fact, temperatures lag behind concentrations by quite a few years. For example, take the notion of equilibrium climate sensitivity (ECS) from climate science, which is the final, fully-completed change in the climate that results from a doubling of GHG concentrations above pre-industrial levels. Although 50-75% of ultimate warming will arrive

within 100 years at a maximum (but actually, it's more like a few decades), it may take a couple of hundred to a thousand years for that final bit of warming to eke itself out.

Now, this might sound like good news (who really cares if London's underwater in 2300?) - but what it really means is that even if we stopped all emissions today and kept concentrations steady, we may still hit 2C by roughly 2050, which has been widely regarded as the threshold of catastrophe. In other words, if we want to avoid the worst outcomes, what's required is not only massive decarbonisation, but massive, unprecedented carbon sequestration – and within the next decade or so. With the two hottest years on record following each other in quick succession, we face a completely uncertain future.

### References

- 1 World Meteorological Association. Past eight years confirmed to be the eight warmest on record. 2023.
- 2 Copernicus Climate Change Service. Surface air temperature for October 2024.
- 3 The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Forster et al. 2023.
- 4 National Oceanic and Atmospheric Administration. The NOAA Annual Greenhouse Gas Index (AGGI). 2024.
- 5 National Weather Service: Climate Prediction Center. El Nino-Southern Oscillation (ENSO) Diagnostic Discussion, 10 October 2024.
- 6 International Energy Agency. World Energy Outlook 2024.

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