

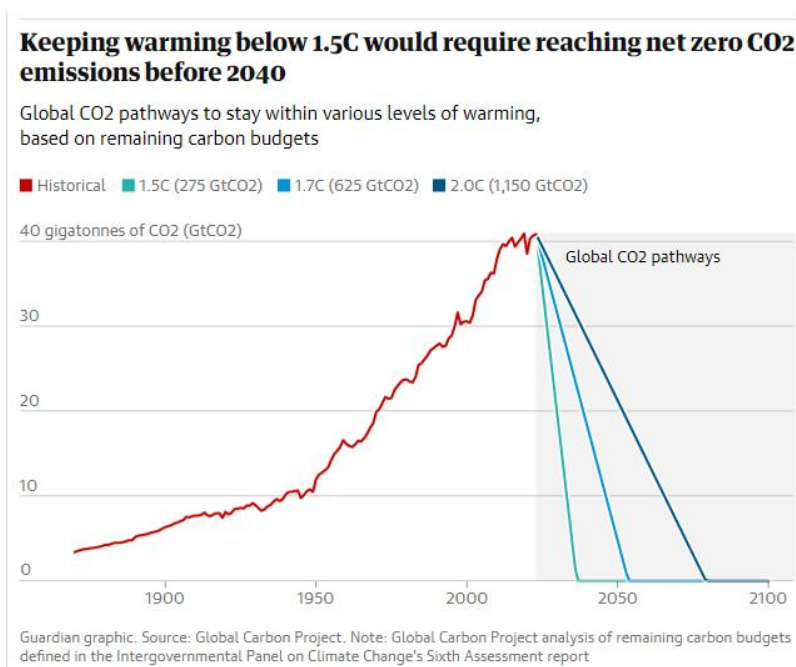


## **A Positive Tipping Point among many Dangerous Ones**

**PAUL SOMERVILLE**

## A POSITIVE TIPPING POINT IN FOSSIL CO<sub>2</sub> EMISSIONS

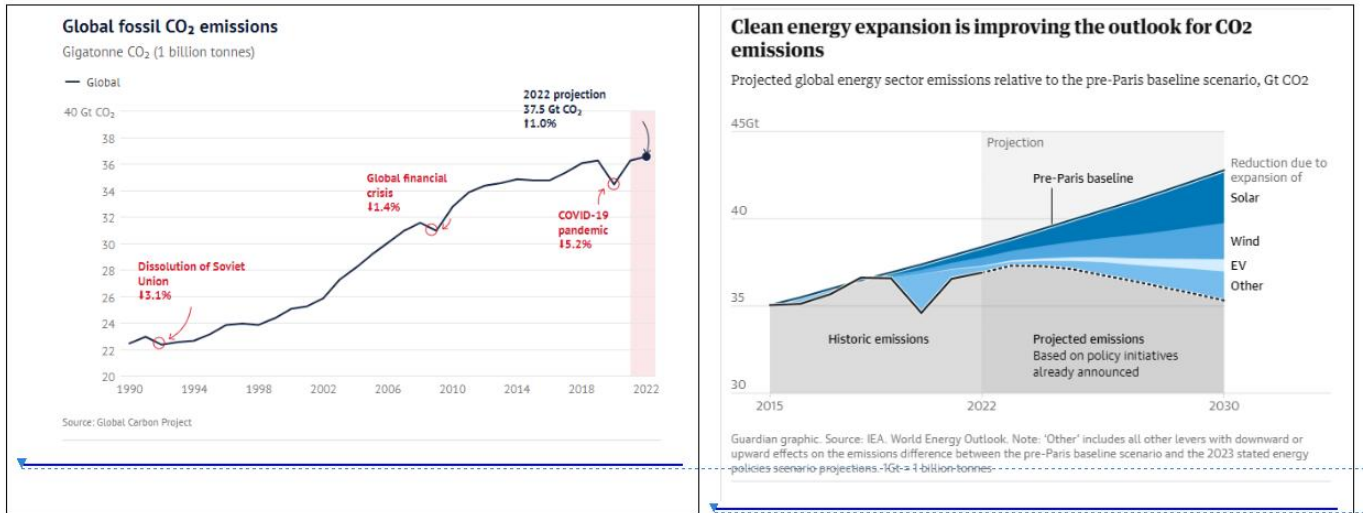
A growing number of climate analysts believe that 2023 may be recorded as the year in which annual emissions reached a peak before the global fossil fuel economy begins a terminal decline (Figure 1; Ambrose, 2023). The milestone is considered a crucial tipping point in the race to drive emissions to net zero. But for many climate experts it is an inflexion point that was due years ago and which, although encouraging, falls far short of the rapid reduction the world needs. It is critical to drive down emissions before 2030 to keep global warming to a maximum of 1.5C above pre-industrial levels. The rate at which emissions would need to be reduced (Figure 1) would require global transformation on a scale that has not yet been planned, let alone implemented.



**Figure 1.** Peaking of global fossil CO<sub>2</sub> emissions and reductions required to limit warming to various thresholds. Source: Ambrose, 2023.

The International Energy Agency (IEA) raised hopes earlier in 2023 of an end to the fossil fuel era when it predicted that the consumption of oil, gas and coal would peak before 2030 and begin to fall as climate policies took effect (IEA, 2023). Wiatros-Motyka (2023) reported that emissions from generating electricity had plateaued over the first half of 2023 and could fall from next year. The rollout of electric vehicles globally is expected to start eroding the demand for road fuels, which makes up about 50% of the oil demand in developed countries. These trends have accelerated since Russia's invasion of Ukraine, which triggered a surge in the commodity price for gas and oil in 2022 and incentivised a renewed focus on securing domestic sources of clean energy instead.

Even in a world of declining fossil fuels and carbon emissions, there is a clear risk of failing to move quickly enough to prevent global warming of 1.5C above pre-industrialised levels (Morton, 2023). The United Nations Environment Programme estimates that for the world to have a chance of keeping global warming below the 1.5C target set out in the Paris agreement, emissions will need to fall by about 9% every year. This is twice the rate of 5.4% at which emissions fell when the Covid-19 pandemic brought global economies to a standstill in 2020 before starting to rise again (Figure 2).



**Figure 2.** Variation in global fossil CO<sub>2</sub> emissions since 1990 (left; source: Global Carbon Project, 2002) and since 2015 (right; source Ambrose, 2023) showing contribution of Covid-19 and renewables to reduction.

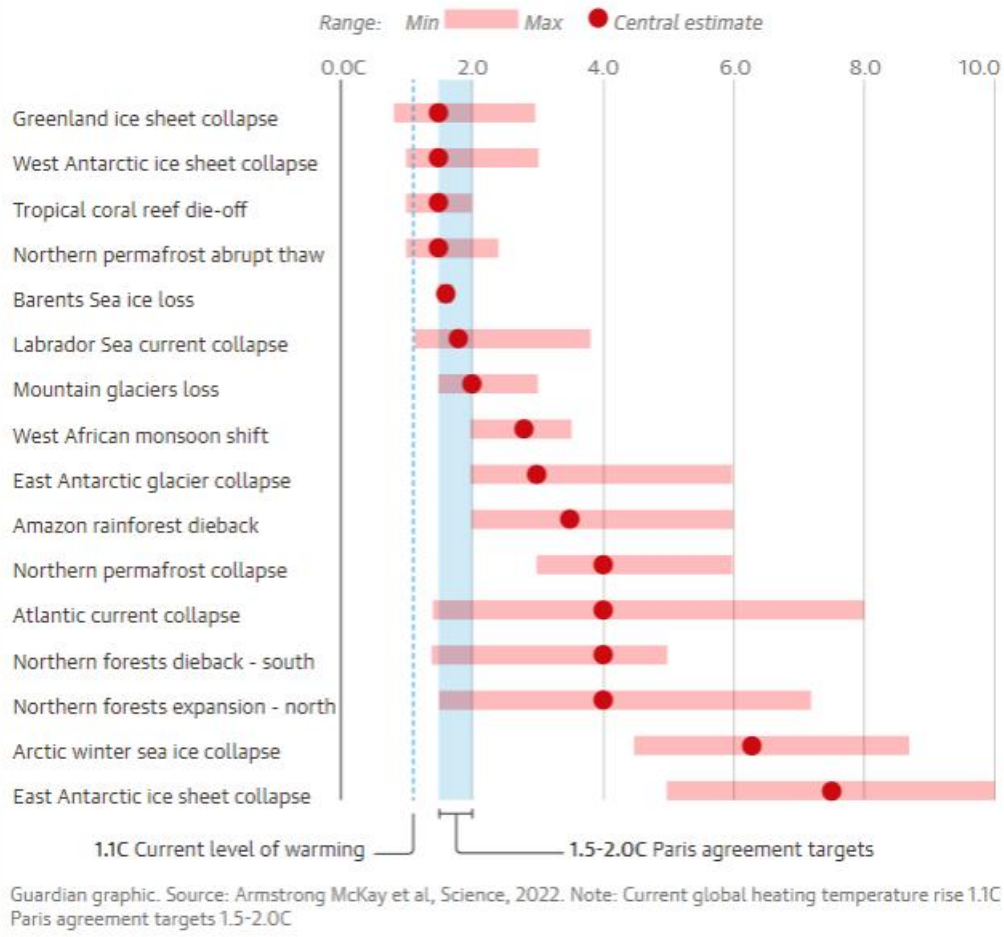
Although the prospect of declining fossil fuels and carbon emissions may be cause for celebration, the world may look back at 2023 as the year when humanity exposed its inability to tackle the climate crisis, due to the enormous gulf between scientific warnings and political action. It has taken almost 30 years for world leaders to acknowledge that fossil fuels are to blame for the climate crisis, yet this year's United Nations Cop28 summit in Dubai ended with a vague call for a "transition away" from them, even as evidence grows that the world has already warmed to dangerous levels.

## DANGEROUS TIPPING POINTS

Armstrong McKay et al. (2022) concluded that the world is on the brink of five 'disastrous' climate tipping points and may already have passed the point of irreversible change due to the 1.1C of global warming caused by humanity to date. These include the collapse of Greenland's ice cap, eventually producing a huge sea level rise; the collapse of the Atlantic Meridional Overturning Circulation (AMOC; Risk Frontiers, 2022); disruption of rainfall upon which billions of people depend for food; and an abrupt melting of carbon-rich permafrost. At 1.5C of warming, the minimum rise now expected, four of the five tipping points move from being possible to likely, and an additional five tipping points become possible, including changes to vast northern forests and the loss of almost all mountain glaciers (Figure 3). The nine global tipping points identified are: the collapse of the Greenland, west Antarctic and two parts of the east Antarctic ice sheets; the partial and total collapse of AMOC; Amazon dieback; permafrost collapse; and winter sea ice loss in the Arctic. In total, the researchers found evidence for 16 tipping points, with the final six requiring global warming of at least 2C to be triggered. The tipping points would take effect on timescales varying from a few years to centuries.

## The risk of climate tipping points is rising rapidly as the world heats up

Estimated range of global heating needed to pass tipping point temperature



**Figure 3.** Estimated ranges of global warming needed to pass 16 tipping point temperatures. Source: Armstrong McKay et al., 2022; Carrington, 2022.

Armstrong McKay et al. (2022) conclude that the Earth may have left a 'safe' climate state below 1°C global warming, within which human civilization evolved. Passing one tipping point may help trigger others, producing cascades (Wunderling et al., 2021), which were not evaluated by Armstrong McKay et al. (2022), indicating that their results may underestimate the dangers, heightening the sense that the Earth's vital signs may be entering uncharted conditions. The authors state that to maintain liveable conditions on Earth and enable stable societies, everything possible must be done to prevent crossing tipping points, because reduction by every fraction of a degree beyond 1.5°C reduces the likelihood of encountering more tipping points.

## IMPACTS ON THE EARTH'S VITAL SIGNS

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Over the past 100,000 years, the Earth has probably never been as warm as it was in 2023 (1.40 +/- 0.12°C above the 1850-1900 average; WMO, 2023; see also Rohde, 2023). Ripple et al. (2023) reported that Earth's vital signs have worsened beyond anything humans have seen to the point that life on Earth is imperiled. They conclude that 20 of 35 identified planetary vital signs are at record extremes. They also outline policies needed to address the underlying issue of ecological overshoot. They conclude that the trends indicate the need to drastically speed and scale up efforts globally to combat climate change while more generally reducing the ecological footprint, with all climate-related actions grounded in equity and social justice, because extreme weather and other climate impacts are disproportionately felt by the poorest people, who have contributed the least to climate change. The report comes four years after the "World Scientists' Warning of a Climate Emergency" (Ripple et al., 2020), which was co-signed by more than 15,000 scientists in 161 countries.

Ripple et al. (2023) conclude that without actions that address the root problem of humanity taking more from the Earth than it can safely give, there looms the potential partial collapse of natural and socioeconomic systems and a world with unbearable heat and shortages of food and freshwater. They state that policies are needed to address the underlying issue of ecological overshoot, which occurs when human demand on the Earth's resources is too large, resulting in an array of environmental crises, including biodiversity decline. Specific recommendations include phasing out fossil fuel subsidies, transitioning toward plant-based diets, scaling up forest protection efforts and adopting international coal elimination and fossil fuel non-proliferation treaties. They conclude that if humanity continues to put extreme pressure on the planet, any strategy that focuses only on carbon or climate will merely redistribute the pressure. They consider that it is a moral duty of scientists and their institutions to alert humanity of potential existential threats and to show leadership by taking action.

## THE CHANGING ROLE OF CLIMATE SCIENTISTS

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Despite their best efforts, many climate scientists are frustrated that it has taken almost 30 years of diligent research to get world leaders to acknowledge that fossil fuels are to blame for the climate crisis, during which time the harmful effects of climate change have become evident and are verging on escaping human control. This has caused a gradual transition from climate scientists focusing mainly on reporting scientific research results in the hope that world leaders would listen, to advocacy for change based on concern over a global existential threat to the planet's occupants and environment. A similar transition in the role of scientists occurred after the development of nuclear weapons, which pose an existential threat to this day.

## GLOBAL RANKING OF RISKS TO HUMAN SURVIVAL

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Ord (2020; see also Snyder-Beattie et al., 2019) rated the risks of both climate change and nuclear war to human survival as having annual probabilities of 1:100,000 (Risk Frontiers, 2020). The most obvious risk to human survival would seem to be that of nuclear war, and we have come near it, mainly by accident, on several occasions. However, Ord doubts that even nuclear winter would lead to total human extinction or the global unrecoverable collapse of civilisation. Similarly, Ord considers that while climate change has the capacity to be a global calamity of unprecedented scale, it similarly would not necessarily lead to human extinction, and considers that environmental damage does not show a direct mechanism for existential risk.

Nevertheless, he concludes that each of several anthropogenic risks has a higher annual probability than that of all natural risks put together, which sum to 1:1,000,000. His highest anthropogenic risks are unaligned AI, engineered pandemic, and unforeseen anthropogenic risks at 1:1,000 to 1:3,000.

## TIPPING POINTS TO TRIGGER FAST CLIMATE ACTION

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Lenton et al. (2022) suggest that the only way to get anywhere near global targets on carbon emissions and biodiversity is through positive tipping points. They assert that business leaders and policy makers know what needs to change, but although it is starting to happen, it is not proceeding quickly enough. Their study examines how small interventions, once triggered, can grow into systemic changes. Rather than focusing directly on cutting emissions, this approach leads to green choices becoming the most attractive. The study combines theories of critical mass, social contagion, economies of scale, and others, with knowledge of how changes in policy, investment and social attitudes had promoted change. For example, people putting solar panels on their roofs has been shown to grow across communities from small initial groups via social contagion. Examples of preconditions needed for tipping points include the plunging cost of LED light bulbs, and the change in attitudes to single-use plastic after the television show Blue Planet II. The waiving of road tolls, saving on petrol costs and social desirability have augmented the adoption of electric cars beyond simple considerations of reducing emissions (Carrington, 2022b).

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Paul is Chief Geoscientist at Risk Frontiers. He has a PhD in Geophysics, and has 45 years experience as an engineering seismologist, including 15 years with Risk Frontiers. He has had first hand experience of damaging earthquakes in California, Japan, Taiwan and New Zealand. He works with Valentina Koschatzky in the development of QuakeAUS and QuakeNZ.

