
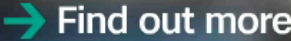


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Climate Crisis

Global warming, explained for everyone: a coffee-time guide to its reality and causes

Amid ongoing scepticism, here is a layman's summary of why scientists are convinced that global warming is both real and human-caused

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US president Donald Trump holds up a signed executive order in the Roosevelt Room of the White House on Friday, directing the interior department to begin a review of restrictive drilling policies for the outer-continental shelf. Photograph: Pablo Martinez/AP

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of global warming is always a challenge to explain in layman's terms just why scientists are convinced the phenomenon is both real and man-made. This is my best coffee-time summary:

1. The warming. It is now established beyond doubt that the world has been gradually warming since the industrial revolution, a trend that is accelerating as the years progress. This phenomenon is measured as a perceptible change in many different observables, from an increase in the average surface temperature of land and water to a rise in bulk ocean temperature, from a loss of land and sea ice at the poles to a shrinking of glaciers worldwide. The warming is already having a destabilising effect on global climate, with a discernible increase in the frequency and severity of storms, flash floods and wildfires around the world. Worse, some nations of the Third World that have traditionally struggled to sustain their populations now face the possibility of permanent drought with consequent large-scale emigration on an unprecedented scale.

2. The cause. It is well known that Earth's climate underwent dramatic changes in the past due to natural phenomena such as changes in solar cycles or perturbations in Earth's orbit (these changes usually occurred over timescales of the order of hundreds of thousands of years). A vast amount of scientific research has failed to find any correlation between any such natural cycles and the warming we have observed in recent times.

On the other hand, it is also well known that Earth's temperature is regulated by the presence of certain trace gases in the atmosphere. Although these "greenhouse gases" constitute only a tiny component of our atmosphere, they play a crucial role in keeping Earth warm by trapping some of the heat radiated outward by the planet (our home would be a great deal colder without the greenhouse effect).

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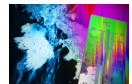
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Measurements show a marked increase in the concentration of atmospheric greenhouse gases over the past century, an increase that is associated with human activities such as agricultural practices, deforestation and the burning of fossil fuels. For any scientist, it's very hard to see how an increase in greenhouse gas concentration would not affect global climate and sure enough, direct measurements of the rise in greenhouse gas concentration correlate tightly with the increase in surface temperature observed over the same time period.

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3. The smoking gun. Ever more convincing evidence has emerged in recent years. For example, satellite measurements of the heat radiated outward by the Earth into space show clear absorption bands at exactly the wavelengths associated with big greenhouse gases such as carbon dioxide, methane and nitrous oxide. Indeed, satellite monitoring of outbound radiation shows a steady increase in absorption in these bands over time that correlates well with the measured increase in atmospheric greenhouse gas concentration.

Satellite measurements also show a noticeable cooling in the uppermost layers of the atmosphere over recent decades, in contrast with the warming of Earth's surface. This finding deserves to be more widely known, as it is the unmistakable signature of an enhanced greenhouse effect and effectively rules out external causes of global warming.

4. The fix. With all this in mind, it may seem surprising that very little progress has been achieved in curbing the rise of greenhouse gas emissions worldwide. This is particularly worrisome given the likely existence of climate tipping points, ie, critical points beyond which the global climate may be irreversibly changed. The main reason for this lack of progress is an entrenched pushback from the fossil fuel industry, which has used its immense wealth and power to influence politicians and the media, to sow doubt and confusion about the issue and to maintain business as usual.

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For example, the open promise of US presidential candidate [Donald Trump](#) to industry executives to enhance fossil fuel extraction and to cut all federal initiatives to combat [climate change](#) is greatly alarming. This programme would result in a significant increase in greenhouse gas emissions from the world's largest economy and could also scupper international agreements to reduce emissions. In this context, the world can only hope vice-president [Kamala Harris](#) will triumph in [November](#).

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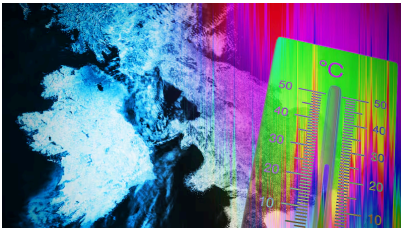
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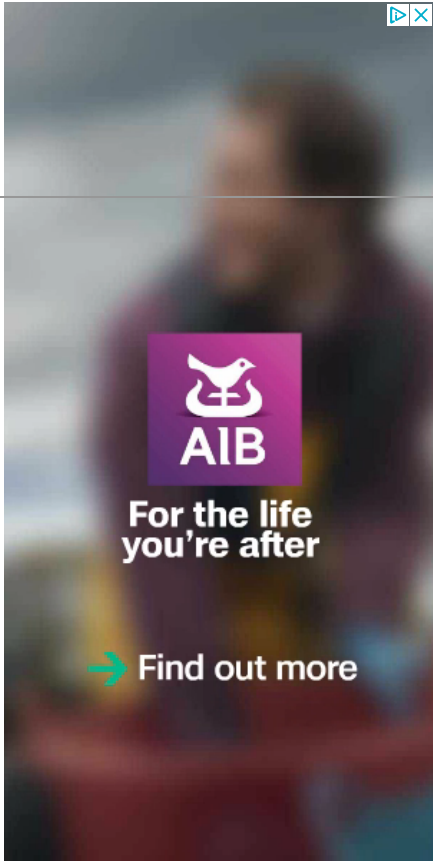
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