THE GLOBAL CLIMATE CRISIS: 2024 MID-YEAR UPDATE

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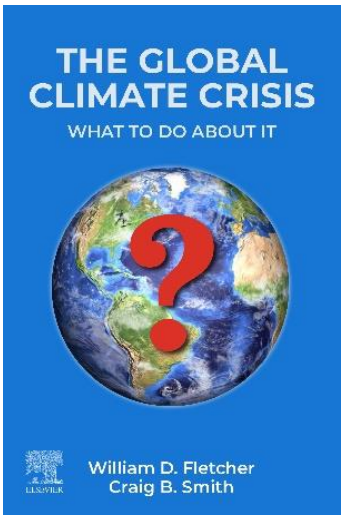
The 2nd edition of our global warming book was published in March 2024.



It reflects the many changes that have occurred in the 3 years since the 1st edition was published.

Update reports.

Our last update, "*Update Report: Year-end 2023,* was published in January 2024 and is available on our website. The following is a brief summary of important developments since our last report. In a 2021 article, *A Climate Change Code Red*, a number of indicators of global warming were flashing red. In 2019, for example, the average global temperature increase was 1.07 degrees centigrade (°C) and CO_2 in the atmosphere was 410 parts per million (ppm).Today, five years later, these and other indicators are much brighter.

Greenhouse gas emissions.

In May, 2024, according to the NOAA monitoring station on Mauna Loa, Hawaii, CO_2 concentration in the atmosphere reached an average of 427 parts per million (ppm). The atmospheric concentration of CO_2 continues its steady climb, consistently since 1958 when the first measurements were made.

Global greenhouse gas emissions are estimated to have been 57.4 billion tons of CO_{2eq} in 2022. It is estimated that global greenhouse gas emissions will reach a new record in 2023. Emissions of CO_2 will likely exceed 40+ billion metric tons. Coal use has been declining globally except for China and India. Emissions of methane have been increasing with greater use of natural gas. We expect it to be only a matter of a year or two before global emissions reach 60 $GmtCO_{2e}$/year.

In the U.S., total emissions are estimated to 5,600 million metric tons in 2022, down from a peak of around 7,700 million metric tons in 2007, primarily due to declining use of coal and the sharp rise of natural gas, and the fact that renewables (wind, hydro, and solar) now surpass coal and nuclear as sources of electricity. The cost of solar panels, wind turbines and storage batteries continue to decline. Renewable energy now accounts for 21% of U.S. electricity generation and 30% of global electricity generation.

Global average temperatures.

According to Berkeley Earth,[1] "We conclude that 2023 was the warmest year on Earth since 1850, exceeding the previous record set in 2016 by a clear and definitive margin." The global mean temperature in 2023 is estimated to have been about 1.54°C (2.77°F) above the pre-industrial average temperature from 1850-1900. The 1850-1900 average temperature is the baseline for measuring the Earth's average temperature. Although the exact temperature estimate may vary somewhat, other authoritative sources also confirm that 2023 was the hottest year on record by a wide margin.[2]

For the first time, the land average temperature exceeded 2.0°C (3.7°F) in 2023 and the ocean average temperature exceeded 1.0°C (1.8°F).

According to NASA, "The 10 warmest years in the 174-year record have all occurred during the last decade (2014-2023)."[3] So far, 2024 is starting out to be even hotter. May 2024 was the 12th month in a row to set a new monthly temperature record (See Figure 1).[4] The ocean average temperature in 2024 is also setting new records.

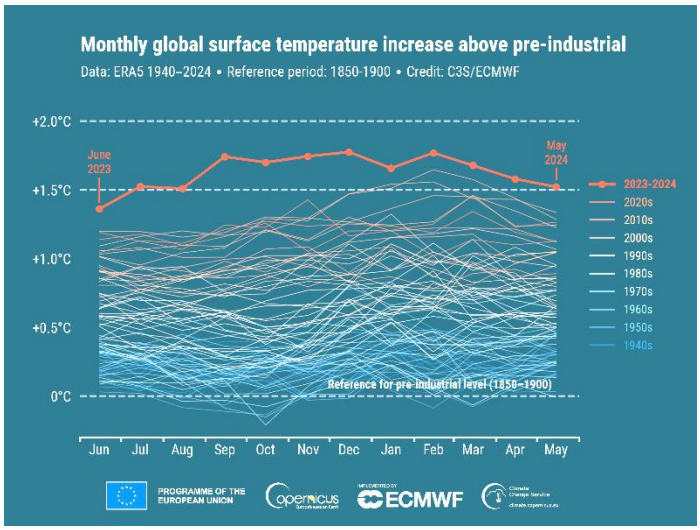


Figure 1: Monthly global Surface temperatures through May 2024 (Ref: (4) Copernicus, op cit.)

Global warming is irreversible!

We should understand that global warming is irreversible. We can speed up global warming by discharging more greenhouse gases into the atmosphere, but we can't slow down or reverse global warming. Carbon dioxide discharged into the atmosphere stays there for hundreds of years until it slowly dissipates by natural forces. In effect, we are driving a vehicle that can go faster by pressing the accelerator, but we can't slow down or stop. There are no brakes and no reverse.

If we stop greenhouse gas emissions at some future date the Earth's temperature will not go down. It will stabilize at some higher temperature consistent with greenhouse gases in the atmosphere at that time.

Latest global temperature forecast.

We will not be able to reach net-zero emissions by 2050 to keep global warming to under 2.0°C, the objective set by the United Nation's Intergovernmental Panel on Climate Change (IPCC) and accepted by the U.S. and most other countries. The 2.0°C (3.6°F) limit is a best estimate of the maximum temperature rise beyond which the effects of global warming are unpredictable. According to NASA, "Without major action to reduce emissions, global temperature is on track to rise by 2.5°C to 4.5°C (4.5°F to 8°F) by 2100, according to the latest estimates."[5]

Other effects of global warming.

Rising temperatures contribute to other significant problems. For example, in the northern hemisphere, the snowpack that follows each winter has been shrinking over the last 40 years. A reduction in the snowpack is a predecessor to drought conditions in many different areas in the Southwest and Northeast U.S. as well as central and Eastern Europe.[6] The world is already seeing reduced ground water levels in many different geographies from California to Iran. As a side effect of less rainfall and more frequent drought conditions, farmers have been increasing use of groundwater over more than four decades. In many parts of the western United States, India, South America, Spain and parts of the Middle East ,shrinking ground waters pose a threat to global food supplies.[7]

Another problem is that as extreme heat becomes more frequent, its impact will be uneven. It will have more drastic effects on most of the world's poor or disadvantaged populations who are unable to find shelter or medical assistance when required, or out of the necessity of poverty, are obligated to work outdoors during periods of high temperature.[8]

Other trends of concern:

Sea level rise.

Sea levels are rising faster. Sea levels have risen an average of about 10 inches so far. The rate of increase has increased to about 1.8 inches every 10 years. This is due to melting ice and thermal expansion of water in the warmer ocean. The National Oceanic and Atmospheric Administration (NOAA) forecast is for a sea level rise of about 2 feet by 2100.[9] In part, the sea level rise is due to increased ocean temperatures—water expands as it becomes warmer. Another problem with increased ocean temperatures is that warmer water increases the intensity of hurricanes and storms. Warmer water also alters fish migration patterns and causes bleaching of coral reefs globally.[10]

Arctic/Antarctic ice melt.

Glaciers are melting everywhere. Sea ice is retreating in the Arctic and the Antarctic. And, the massive ice caps in Greenland and Antarctica are melting. What does this mean? For one thing, sea level rise is accelerating as glaciers and ice caps melt. In the Arctic, the number of ice-free days in the Arctic Ocean is increasing. It is been said that the ice-covered white Arctic is changing into a "blue Arctic."[11] another problem is that warmer ocean surface currents could reach a tipping point that would alter the Atlantic Meridional Overturning Circulation (AMOC), "a system of ocean currents that circulate water in the Atlantic Ocean like a conveyor belt, helping to redistribute heat and regulate global and regional climates." One risk is that temperatures in Europe could drop by 10°C or more, while other parts of the world might see reduced precipitation.[12]

Wildfires and other disasters.

As the effect of rising temperatures are being felt around the world, from Asia to the Americas, climate disasters are increasing. Examples include heat waves in India, Mexico, Greece, Saudi Arabia (Mecca) and the U.S. West and Southeast that have caused the deaths of thousands of people. In other locations, including China (heat, drought, and floods); Chile, (heavy rain and fires); and the western United States (wildfires), the pace of climate disasters is increasing.[13] Indonesia is another example. There, continued deforestation has left the country "vulnerable to the impact of climate effects including forest fires, landslides, floods and drought." Floods have been a particular problem, washing away streets and entire villages. [14]

Climate deniers and lawsuits.

Exxon is at it again, advocating that the government stop wasting money on inefficient clean energy incentives. Instead, Exxon Chief Executive Darren Woods stated that the government should put more money into emerging technologies such as carbon capture and green hydrogen. These are initiatives which Exxon and others—Occidental Petroleum for example—are spending a token amount of capital on constructing expensive and largely unproven carbon capture projects. Essentially, these installations will suck carbon dioxide out of the atmosphere and enable the oil companies to pump it underground where some will be stored and the rest will be used to stimulate more oil production. Woods went on to say that Pres. Biden's Inflation Reduction Act allocates too much money for electric vehicle subsidies, ignoring the fact that transportation is one of the largest sources of greenhouse gas emissions. Also, he makes no mention of the renewable energy sources that are rapidly growing and are not only cheaper than fossil fuels, but emit no emissions.[15]

There are countless lawsuits against the oil companies and other emitters of greenhouse gases, as well as government agencies that are failing to take steps to reduce emissions. With their vast financial resources, the oil companies keep delaying and trying to block these lawsuits. However, every now and then one succeeds and a notable one recently occurred in Hawaii when 13 children in Hawaii took on the state government and won a settlement that includes a plan for decarbonizing Hawaii's transportation system in the next 20 years.[16]

How do we stop global warming?

To stop additional global warming, we have to reach net-zero emissions. Net zero is when no additional man-made greenhouse gases are added to the atmosphere. Emissions that can't be eliminated have to be offset by natural means (such as planting billions of trees) or by removing carbon dioxide from the atmosphere. To date there are no man-made means to remove greenhouse gases from the atmosphere that could function on a large enough scale or are economical. Actions to date have not led to a reduction in global greenhouse gas emissions. Population growth and per capita energy use due to rising living standards have offset any reductions.

Where are we headed?

There are a number of positive trends. However, they are not progressing fast enough to offset future greenhouse gas emission and resulting global warming. Encouraging progress is being made with solar and wind energy production, electric vehicles, battery storage, hydrogen as a fossil fuel substitute and in other areas. Technology is moving forward, and economies of scale are improving for renewable energy.

In 2023 global energy investment was $2.8 trillion. Over 60 percent was already spent on renewable energy projects. Renewables will increasingly displace fossil fuels as they are doing today, but it could be a slow process. Renewable energy, solar and wind, is now the cheapest form of energy in most parts of the world due to improving technology and economies of scale.

Battery technology and costs are improving to facilitate short-term energy storage. Auto producers are transitioning to electric vehicles. And, many large projects around the world are demonstrating that renewable energy is a practical alternative to fossil fuels for electricity generation. Energy efficiency is improving. Per capita GDP is growing faster than per capita greenhouse gas emissions.

Finally, as we have cautioned previously, we have to keep in mind that ***failure is an option.*** There is no guarantee that the world will ever achieve net zero and we will have to live with increasing global warming and other climate change consequences.

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