

## THE GLOBAL CLIMATE CRISIS: 2024 END OF YEAR UPDATE vers 5 1-6-25

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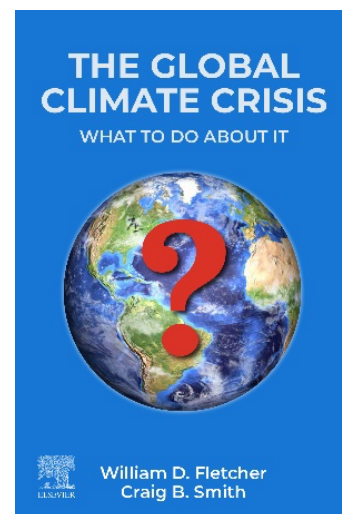
The 2<sup>nd</sup> edition of our global warming book was published in March 2024.

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

### Update reports.

Our last update, “*Update Report: mid-year-end 2024*,” was published in July 2024 and is available on our website. Following is a brief summary of important developments since our last report.

- For the last three years, each year has set a new global temperature record.
- Global warming is **irreversible**; even if we stop greenhouse gas emissions, temperatures will not decrease for decades.
- The world **will not** achieve “net zero” by 2050.
- The current forecast is that the average global temperature rise will reach 2°C (3.6°F) to 4°C (7.2°F) by 2100.
- Rising temperatures will continue to at least 2100, with weather disasters becoming more frequent.



### Greenhouse gas emissions.

Each year in May, the carbon dioxide (CO<sub>2</sub>) levels in the atmosphere reach their highest level, according to the National Oceanic and Atmospheric Administration (NOAA) monitoring station on Mauna Loa, Hawaii. In May 2024, concentration reached 427 ppm. The atmospheric concentration of CO<sub>2</sub> has continued its steady climb, consistent since 1958 when the first measurements were made. But now, it is rising faster.

Global greenhouse gas emissions are estimated to have been 57.4 billion metric tons of CO<sub>2eq</sub> (mtCO<sub>2eq</sub>) in 2022. It is estimated that global greenhouse gas emissions will reach a new record in 2024. Emissions of CO<sub>2</sub> 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 the greater use of natural gas. We expect it to be only a matter of a year or two before global emissions reach 60 billion mtCO<sub>2e</sub>/year.

In the U.S., total emissions are estimated to decline by 1.9% from 5.6 billion mtCO<sub>2eq</sub> in 2022 to about 5.5 billion mtCO<sub>2eq</sub> in 2023, down from a peak of around 7.7 billion mtCO<sub>2eq</sub> in 2007, primarily due to declining use of coal and the sharp rise of in the use of natural gas, and the fact that renewables (wind, hydro, and solar) now surpass coal and nuclear as sources of electricity. It is also significant that this drop in emissions has occurred when the U.S. economy has increased. Also, the cost of solar panels, wind turbines and storage batteries continue to decline.

### Global average temperatures.

According to the latest reports, the summer of 2024 was the hottest ever, and 2024 is likely to exceed 2023 as the warmest year since records have been kept.<sup>1</sup> The global mean temperature in 2023 was 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.<sup>2</sup>



The growth of solar energy continues to surprise even the experts. The world is on track to install 29% more solar capacity this year, a total of almost 600 GW, when compared to last year which was already a record. This trend is being driven by the fact that solar electricity prices have dropped by 89% since 2010 and solar panels have increased in efficiency from 15% to more than 26% over the last 40 years.<sup>6</sup>

Nuclear energy is receiving renewed interest as a source of carbon free energy, to help meet the growing demand of massive new data centers for artificial intelligence. For that reason, there is consideration being given to restarting older plants. The latest example of that is that is shut-down unit at Three-Mile Island may be restarted to supply power for Microsoft Corporation. This is not the damaged plant, (unit two), which was shut down and sealed in concrete; this would be the companion plant (unit one), which has been decommissioned. Although much of the basic infrastructure is still there, the plant would require extensive and expensive retrofitting to be placed back in operation.<sup>7</sup>

However, we must remember that building new nuclear plants is a costly and lengthy process, with licensing taking five years or more. Also, the three fundamental problems of nuclear power are still unresolved. Nuclear plants are the most expensive way to generate electricity, especially compared to solar and wind. Second, there is still no approved system for storing radioactive waste. And finally, siting of nuclear power plants is still a concern of the general public.

### **Other trends of concern:**

#### **Sea level rise/flooding**

Globally sea level rise has averaged about 1.5 mm per year since 1900, and has now risen by 200 millimeters (mm) (10 inches) on average.

In the Southeast U.S., the pace has quickened, increasing from about 1.7 mm/year at the turn of the 20th century, to five times that by 2021, according to a 2023 study published in Nature Communications, based on tidal gauge records from throughout the region. In Pensacola, a beach community on the western side of the Florida Panhandle, the rate soared even more, to roughly 6.5 times that value by the end of 2021. These rates are among the most extreme on earth at the present time. The situation is aggravated by the fact that coastal communities in the south and Florida are only 3 feet above mean sea level. In many areas they have been and will be in the future subjected to massive flooding and destruction by more frequent hurricanes.<sup>8</sup>

The irony of this is that Florida's governor, Ron DeSantis, signed a law in May forbidding the use of the term "climate change" in any state laws or programs. The new law also stops programs designed to encourage renewable energy use and conservation. The governor explained, "this bill will keep windmills off our beaches, gas in our tanks, and China out of our state."<sup>9</sup>

Coastal structures face a growing risk from rising seas and more frequent storms. In the Outer Banks area of Rodanth, homes keep falling into the sea—a total of 11 so far—as a result of higher tides and storms.<sup>10</sup>

Another problem that is increasing in severity is ocean heating. For example, the Gulf of Mexico reached a new maximum on August 22, 2024, making it the hottest it has been in the modern record. This poses a triple threat: the first is that warm water will power hurricanes, making stronger hurricanes that grow faster; warm water expands raising the sea level; and hot water kills corals.<sup>11</sup>

#### **Arctic/Antarctic ice melt.**

Some surprising developments have occurred in Antarctica this summer (Antarctica's winter). A record-breaking heat wave has occurred, raising winter temperatures 10°C (18°F) above the normal winter values, typically between minus 58°F and minus 76°F. The danger of this, of course, is that it magnifies the threat of possible ice melts that would raise the sea level by feet rather than inches.<sup>12</sup>

Already, glaciers are melting everywhere. Sea ice is retreating in the Arctic and the Antarctic. For example, the Thwaites glacier—which spans an area equal to the island of Great Britain—continues to shrink. Over the last 20 years the volume of ice flowing from the glacier and its neighbors

has more than doubled and the rate is accelerating. Much of the 2000 m thick glacier could be lost by the 23<sup>rd</sup> century. This is a truly frightening prospect for much of the global communities located in coastal areas.<sup>13</sup>

In July, we had a preview of just what damage can be caused by melting glaciers. Alaska's Mendenhall glacier's rapid melting this summer caused a nearby lake to overflow, flooding the Mendenhall River and causing it to overflow its banks and flood Alaska's capital streets to a depth of 3 or 4 feet and damaging or destroying more than 100 houses in Juneau.<sup>14</sup> These changes are not limited to Arctic and Antarctic regions. For example, the glaciers found in the Andes from Columbia to Peru and Bolivia are experiencing accelerated melting. Scientists estimate that they are the smallest they have been in the last 11,700 years. It is significant that these glaciers represent an important water supply to the indigenous people who live in the Andean highlands of Bolivia, Chile, and Peru. Obviously, during droughts, these waters are a critical resource.<sup>15</sup>

### **Wildfires and other disasters.**

As in past years, 2024 has seen extensive wildfires around the globe. In the Northwest U.S., over 100 large wildfires in 10 states have burned over 3.5 million acres, destroying thousands of structures. The Park fire in California is now the state's fourth largest on record with over 400,000 acres burned through August.<sup>16</sup> One concern about Western wildfires is that they have been occurring in the summer months before the occurrence of the Santa Ana and Diablo winds that originate in the desert and blow over the mountains and out to sea. These winds more frequently occur in the fall and can amplify the danger of large fires. The occurrence of large fires to date has more to do with the fact that the last two winters have had more rain and therefore produced more fuel to drive the fires.<sup>17</sup>

Another area with serious problems is South America, which is experiencing its worst wildfire season in nearly 2 decades. Millions of acres are burning across 13 countries, Brazil in particular. The fires are made worse by several years of drought and may continue to do severe damage unless the rains come in October.<sup>18</sup> Brazil is enduring its worst drought since nationwide measurements began over seven decades ago. Nearly 60% of the country is suffering from drought, with the effects being felt even in the South. For example, smoky skies cause extreme air pollution in the city of São Paulo, to the extent that residents are advised to stay indoors and keep doors and windows closed.<sup>19</sup>

Other weather-related disasters are being experienced around the world—typhoons and tropical storms have caused heavy flooding and landslides in Asia with a heavy toll in India, China, North Korea, and Pakistan.<sup>20</sup> As we prepared this report, the U.S. was reeling under the impact of 5 major hurricanes. From July to October, hurricanes *Beryl*, *Debby*, *Francine*, *Helene*, and *Milton* caused over \$500 billion in damages and more than 300 deaths in Texas, Florida, Louisiana, Alabama, Georgia, South Carolina, Tennessee, Kentucky, Ohio, Virginia, and West Virginia.

Overall, 2024, with 24 \$1-billion weather and climate disasters, was the second-worst year in U.S. history (2023 was the worst, with 28).<sup>21</sup>

### **Cost of climate change.**

A new study estimates the economic cost of climate change on a global scale. The authors used global temperature increase as a variable to predict gross domestic product damage in 173 countries. They began with historical weather and economic records going back 120 years and then extended the model to continued warming expected by 2100. Their conclusion was that global warming would impact world economies with a social cost of \$1056 per ton of greenhouse gas emitted. "Economic growth would continue," they predicted, but output and consumption would be decreased by 50%—more than the effect of the Great Depression, and continuing on forever.<sup>22</sup>

Recent experience in the U.S. supports this theory. According to a report by insurance rating agency AM Best, U.S. home insurers suffered their worst underwriting losses for a century in 2023, due to natural disasters, inflation, and population growth in at-risk areas. Homeowner insurers suffered a \$15 billion net underwriting loss in 2023, more than double losses since the previous

year.<sup>23</sup> Flood losses in the U.S. are on the rise everywhere but particularly in half a dozen states that are prone to flooding: Texas, Florida, New Jersey, New York, Louisiana, and North Carolina. These states alone account for 86% of the \$42 billion in claims paid by federal flood insurance programs. As FEMA continues to improve its flooding risk maps, and to raise insurance premiums accordingly, the number of insured properties decreases.<sup>24</sup>

Florida represents a classic case. Home insurance rates in Florida are among the highest in the nation, because in the late 1980s the state had roughly one \$1 billion disaster per year, whereas today it can expect 4 such events annually. The consequence is that insurance costs have risen dramatically, and in many areas, policies are not even available. The situation has not been helped by Florida Gov. DeSantis' policy of erasing any reference to climate change from state law.<sup>25</sup>

### **Climate deniers and lawsuits.**

In our midyear report we described how big oil companies were facing more and more legal challenges for consequences related to the use of their products and also for their decades-long withholding of information indicating that they knew about the problems they were causing. Now, California has initiated a new approach to recover the costs of misinformation. A lawsuit has been filed against Exxon Mobil Corporation, one of the largest producers of petroleum-based polymers, for claiming that "plastic recycling was practical." Instead, plastics have become an environmental blight that is costing billions of dollars in cleanup expenses. This is a global problem and will likely lead to a proliferation of similar lawsuits aimed at other oil and natural gas producers. In addition to falsifying the ease and benefit of recycling, oil and natural gas companies have quietly diversified into plants manufacturing plastics as an alternative to the future when the demand for their products as fuels diminishes.<sup>26</sup>

### **China.**

In 2005, China overtook the U.S. as the largest source of greenhouse gas emissions. China now accounts for about 33 percent of global emissions versus 13 percent for the U.S. China is heavily dependent upon coal, its only large domestic energy source, to fuel its rapidly growing industrial economy. China accounts for about half of global coal use.

However, China also leads the world in both the production and use of renewable energy for several reasons. China sees renewables as a major export growth opportunity and is leading the world in the production of solar cells, wind turbines, batteries, electric vehicles and nuclear power plants. China is now the world's largest light vehicle producer, over half of which are electric vehicles. In addition, the use of renewables reduces China's severe air pollution problem and reduces their fossil fuel imports. China's use of renewable energy is accelerating. Over the past year or so, China installed more solar than it had over the past three years and more than the rest of the world combined, about 340 GW.

China is also the U.S.' first near-peer competitor that has the potential and the desire to overtake the U.S. economy and take the lead in important technologies such as AI. China is the world's second largest economy accounting for 18 percent of global GDP compared to 26 percent for the U.S. China's manufacturing capacity already exceeds the U.S. at 32 percent of the world's capacity compared to 18 percent for the U.S. Here is China in numbers, compared to other nations:

<b>Wind Power</b>	Gigawatts	<b>Solar Power</b>	Gigawatts	<b>Electric vehicles</b>	Millions sold
China	442	China	609	China	8.1
U.S.	148	U.S.	139	U.S.	1.4
India	45	Japan	89	Germany	0.7

### **Late Political Developments.**

Ex-President Donald Trump defeated Vice President Kamala Harris in the 2024 U.S. Election with 49.9% of the popular vote versus her 48.3%—hardly the overwhelming mandate he claimed, but he won the Electoral College vote. During the campaign he said he would pull out of the Paris Agreement, reverse Biden’s support for Green Energy, and accelerate fossil fuel production. We’ll have wait until mid-2025 to see what actually happens.

The 2024 U.N. Climate Change Conference (UNFCCC COP 29) convened from 11 to 22 November 2024 in Baku, Azerbaijan. Over 1,770 coal, oil, and gas lobbyists registered, more than the delegates from most countries, including the 10 most affected nations.<sup>27</sup> The U.S. was represented by John Kerry and 30 members of Congress, U.S. Governors, Mayors, and others who had no weight in the deliberations because of the recent election results. It was expected that the meeting would have no positive accomplishments, but the delegates did agree on a \$300 billion fund from developed countries to aid less-developed nations. There were over 6,500 delegates, including the Secretary General of the United Nations.

### **What must be done to stop additional global warming?**

The planet has already reached the IPCC’s warning level of a 1.5°C average global temperature increase. There is no way we can undo the billions of tons of greenhouse gases in the atmosphere at this date. Actions to date have not led to an actual reduction in global greenhouse gas emissions. Population growth and per capita energy use due to rising living standards have offset any reductions. The obvious answer is that the world has to accelerate steps to reduce greenhouse gas emissions across the planet

### **Positive trends.**

There are a number of encouraging developments. However, they are not progressing fast enough to offset future greenhouse gas emission and resulting global warming. The U.S. made a major step forward in 2022 with the passage of President Biden’s “Inflation Reduction Act,” that provides over \$750 billion for energy and climate change programs. Other provisions expand the IRS and have measures to reduce the U.S. deficit. There is also a \$400 billion “Clean energy lending program” for new battery, electric vehicle, and other manufacturing plants to create jobs and reduce imports.<sup>28</sup> Progress is being made with solar and wind energy production, there is increased use of electric vehicles, battery storage is growing, as is hydrogen as a fossil fuel substitute. Technology is moving forward, and economies of scale are improving for renewable energy.

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. Can we accelerate these trends to slow global warming?

History will tell.

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