

REACHING NET ZERO: 2022 MID-YEAR UPDATE

Craig B. Smith and William D. Fletcher

July 7 2022

Our outlook for future efforts to fight global warming is included as the last section of this report. This outlook is based upon our assessment of currently available information.

EXECUTIVE SUMMARY

Our last report, "Reaching Net Zero: 2021 Year End Update," was published December 16, 2021 and is available on our website, www.reachingnetzero.com. The following is a brief summary of important developments since our last report. Additional details are found following this summary.

1. The Intergovernmental Panel on Climate Change (IPCC) conclude that it is **unlikely** that the world will keep global warming under 1.5°C or even 2.0°C. The world will not achieve net zero by 2050.
2. February 24, 2022: Russia invaded Ukraine, triggering a global wave of economic concern and the prospect of rising energy costs and fuel shortages in Europe and elsewhere.
3. Greenhouse gas concentrations in the atmosphere hit a new record. Emissions are likely to set a new record in 2022.
4. The earth's average temperature continues to increase. 2021 was the sixth hottest year on record. The earth's average temperature rise could exceed 2.4 to 3.5°C (4.3-6.3°F) by the end of this century.
5. Sea level rise is accelerating, more flooding is occurring, and the oceans are warming.
6. Arctic, Antarctic, and glacial ice melt is accelerating.
7. Deforestation has slowed but remains a serious problem. Drought and heat are increasing the number and intensity of wildfires
8. The transition to renewables: there is growing recognition that electrification of the economy for power production and new uses, such as charging electric vehicles and replacing natural gas and oil for building heating and power production, requires investments in electricity storage and in expanding transmission and distribution systems.
9. Public health is being affected by drought and heat waves.
10. Government actions, misinformation, and a fee on carbon have made headlines.

DETAILS

1. IPCC says reaching net zero by 2050 is doubtful.

When the Intergovernmental Panel on Climate Change (IPCC) issued its latest report (AR-6, its sixth assessment report), in April 2022, the language was much blunter than previous reports. The new report, titled "*Mitigation of Climate Change, Working Group III Contribution to the Sixth Assessment Report*," stated unequivocally that current actions to reduce greenhouse gas emissions **will not** keep the global temperature rise to be less than 1.5°C, and probably not less than 2°C, by 2050. The report went on to say that unless countries make even greater commitments to reduce greenhouse gas emissions, the average Earth temperature rise will be 2.4 to 3.5°C (4.3 to 6.3°F) warmer by the end of the century. Such a temperature increase will beyond a doubt cause severe impacts for much of the world's population, particularly in poorer countries.

The report stated that temperatures on earth are going to surpass a danger point unless immediate and concerted action is taken by all the major emitting countries. United Nations Secretary-General Antonio Guterres did not use the measured language of scientists in his remarks. He stated that the IPCC report revealed a "litany of broken climate promises by governments and corporations," and accused them of stoking global warming by clinging to harmful fossil fuels. "It is a file of shame, cataloguing the empty pledges that put us firmly on track towards an unlivable world." The report leaves little doubt that in the mind of scientists,

reducing emissions to keep the average temperature of the earth rise less than 1.5°C is no longer possible, and even 2°C is questionable, by 2050. In other remarks, the Secretary-General stated that ***“investing in new fossil fuels infrastructure is moral and economic madness.”***

The Secretary-General was not alone in his blunt comments. Columnists, editors and climate activists spoke out, condemning the inaction and even ignoring of repeated warnings that has been the response of government officials. Headlines expressed frustration and irony: “The end of the world is coming, one more time;” “Quit fiddlin,’ while earth burns:” “Little time left to save earth.”

2. War in Ukraine

One immediate consequence of the war in Ukraine is that the fighting in the war zone will increase emissions and will virtually stop any positive efforts by Ukraine and Russia to reduce emissions. It is impossible to determine whether this setback will be months or years, since the outcome or end of the war cannot be predicted. However, a positive consequence may be that Europe will recognize the danger of depending on Russia for critical energy sources.

Within days of the Russian invasion, climate activists around the world held rallies. These worldwide protests demanded that government leaders take stronger action against global warming. Young people in Germany were critical of their government spending millions of dollars a day to buy fossil fuels from Russia. These are funds that support Moscow’s war aims and at the same time bring about greater global emissions. In the U.S., activists repeated a request that President Biden declare a national climate emergency.

In March, U.S. President Biden announced that the U.S. would ban imports of Russian oil and gas. This was one aspect of a broad range of economic sanctions imposed on Russia by the U.S. and the European Union as a consequence of the Ukraine invasion.

In response to Russian threats to cut off natural gas and oil supplies to Europe, the United States has bolstered its oil and gas production to help make Europe independent of Russian supplies. The U.S. is likely to become the world’s largest liquefied natural gas (LNG) supplier. This will be critical to avoid a worldwide shortage and provide an alternative energy source for Europe. Of course, expanding U.S. fossil fuel production, while having short-term benefits to Europe, has long-term negative effects on reducing greenhouse gas emissions in the world. A better solution is to move faster on clean energy, providing support for renewable energy projects in Europe or in adjacent countries where power can be generated and transmitted by undersea transmission lines to European countries.

An immediate result of the Russian invasion of Ukraine has been shortfalls of petroleum and petroleum products, resulting in higher prices. Russian revenues have actually increased. Price hikes have shown that the public has a low tolerance for price increases. Politicians will be under pressure to keep prices low and avoid shortages. In the U.S. and other countries, gasoline prices have soared to highs not seen for several decades. There are some indications that high fuel prices will increase sales of electric vehicles, which potentially would be a further blow to Russian exports. But this is not a certain outcome. High fuel prices could have an opposite effect, discouraging voters from supporting clean energy programs and putting pressure on the government to expand fossil fuel production.

3. Greenhouse gas increase

As noted in Figure 1, global emissions of carbon dioxide continue their inexorable rise and are even rising at a faster rate. In April 2022, the atmospheric concentration of CO₂ was over 420 parts per million (ppm).

4. Earth’s average temperature increase

The earth’s average temperature continued to increase (Figure 2). Globally, 2021 was the sixth hottest year on record. It was the fourth hottest year on record in the contiguous U.S., where many extreme effects were felt in the Western states. Global warming has many subtle

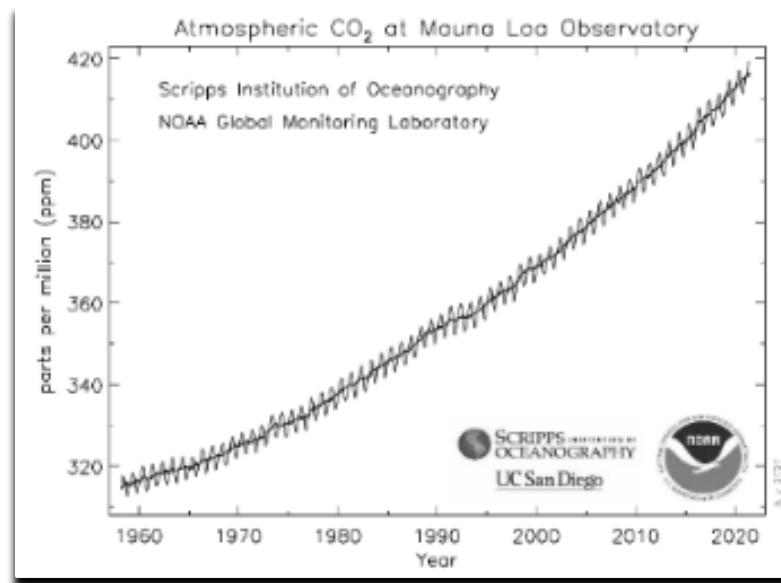


Figure 1 CO₂ Concentration in Atmosphere

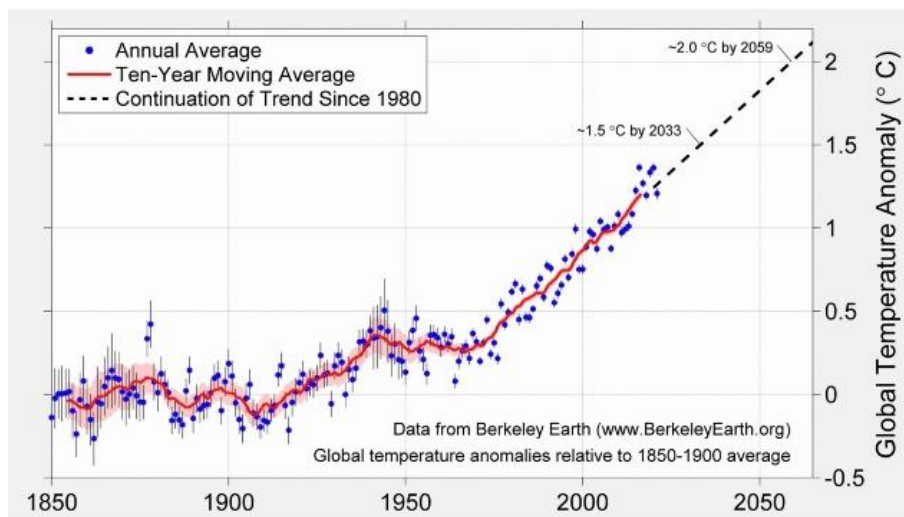


Figure 2 Global Temperature Rise

consequences that communities are just now beginning to recognize. One of them is lakes are freezing later and less, as a consequence of global warming. The first visible result of this is a reduction in recreational activities that depend on lake ice, such as hockey and fishing. A more serious threat is that warming waters can lead to a die-off of cold-water fish.

Unusual warm weather is being felt around the world from Siberia to Asia. It is estimated that one in eight people on earth are enduring a relentless, lethal heat wave with triple digit temperatures. India and Pakistan experienced an extraordinary heat wave in April and May that has caused deaths and crop damage. High power demand in India has caused outages in about two-thirds of Indian homes. The unusual heat is also accelerating the melting of glaciers, which is causing flooding in Pakistan.

5. **Sea level rise, flooding, and ocean warming**

A new report issued by NOAA is warning of a major rise in sea level and the potential economic consequences. The report indicates a potential rise of as much as 30 cm (12 inches)

by 2050 in some parts of the U.S. On the East Coast the rise could reach 36 cm (14 inches) and the Gulf Coast could reach as much as 46 cm (18 inches), by 2050. Rising seas pose a risk to critical infrastructure, not just ports and harbors, but coastal roads, rail lines, pipelines and coastal communities. In California, flooding of coastal communities could lead to damage or abandonment of \$100 billion worth of property. Two beachside homes in North Carolina Outer Banks recently collapsed from high water levels and beach erosion.

The World Meteorological Organization (WMO) said “Global mean sea level reached a new record high in 2021, after increasing at an average 4.5 mm per year over the period 2013-2021. This is more than double the rate of between 1993 and 2002 and is mainly due to the accelerated loss of ice mass from the ice sheets. This has major implications for hundreds of millions of coastal dwellers and increases vulnerability to tropical cyclones.” The intensive flooding reported in India and Bangladesh during the month of June is an example.

The WMO also reported that ocean heat was at a record high in 2021. “The upper 2,000 meters depth of the ocean continued to warm in 2021 and it is expected that it will continue to warm in the future—a change that is irreversible on centennial to millennial time scales.” All data sets agree that the ocean warming rates show a particularly strong increase in the past two decades. The warmth is penetrating to ever deeper levels. “Much of the ocean experienced at least one ‘strong’ marine heat wave at some point in 2021.” The WMO report also described the vulnerability of coral reefs to climate change. “Coral reefs are especially vulnerable to climate change. They are projected to lose between 70% and 90% of their first former coverage area at 1.5°C of warming, and over 99% at 2°C. Between 20 and 90% of current coastal wetlands are at risk of being lost by the end of this century, depending on how fast sea levels rise. This will further compromise food provision, tourism, and coastal protection.”

6. Arctic Ice, Antarctic ice, and glaciers

Earlier we reported that the Larson C ice shelf in Antarctica had broken free. This was the third section that has broken off and the break created one of the largest icebergs ever, approximately as large as the state of Delaware and weighing a trillion tons. After breaking free, this mammoth iceberg was caught in a current called the Weddell Gyre and began drifting towards South Georgia Island. However, near the end of 2020, warmer seawater began to take effect and it fractured into many smaller pieces. During its more than four-year journey, it has been shedding pieces of ice and melting. While near South Georgia Island, the iceberg released roughly 150 billion tons of freshwater and nutrients into the ocean over a period of several months. While this will not raise sea level, there was concern it could affect wildlife in this vicinity.

In an event unprecedented in human history, an ice shelf the size of New York City collapsed in east Antarctica in April. This ice shelf has been the restraint that keeps the Conger and Glenzer glaciers from reaching the warmer ocean water. Scientists say that the ice shelf has been there for thousands of years. This raises new concerns, because if continued melting takes place in East Antarctica, **it will have** a definite effect on sea level rise.

In the European Alps, temperatures have risen by 2°C (3.6°F) over the course of the 20th century. This rise is greater than the French average rise of 1.4°C (2.5°F) and double the increase recorded in the northern hemisphere. The rate of this warming, observed since the beginning of the Industrial Revolution, has increased since the 1980s to 0.5°C (0.9°F) per decade. In terms of temperature conditions, 0.5°C represents about a 100-meter (328 ft) difference in elevation. That means, in order for species be able to stay in the same temperature condition, they would need to move 100 meters upslope. Herein lies the challenge for biodiversity: how to keep pace with this rapid evolution in the climate?

Warming is amplified in mountain environments because the increase in temperature leads to a decrease in the size of zones covered with ice and snow that reflect the sun’s rays.

These zones are replaced by areas of dark rock and later vegetation, which instead, absorb the sun's heat, increase ground temperature and contribute to more melting.

2020 was the warmest year ever recorded in the Swiss Alps. At this rate, scientists predict that around two-thirds of the mountains' ice volume will be lost by the end of the century. In June, Bill Fletcher flew over the alps. He was surprised to see the tall peaks without snow and ice. Efforts are now underway to slow the melting of the ice. Cooling blankets have been installed at the Rhone Glacier and other locations popular to visitors to insulate the ice from warmer temperatures. While the blankets ("polyester fleece") reduce melting by up to 50%, they can also cause pollution.

As we noted in our last report, Glacier National Park is losing glaciers to climate change. In the mid-1800s, this Montana landscape was covered by 150 glaciers—today the number is shrinking and only 25 remain. By some estimates, by 2030 no glaciers will be left in the park.

7. Wild fires, drought, and deforestation

A new United Nations report predicts that the number of extreme wildfires could increase by 50% globally by the end of the century. Even the Arctic is not considered immune due to warming and fires due to methane leaks. Massive wildfires will exacerbate global warming by releasing carbon dioxide and other pollutants into the atmosphere. In addition, smoke poses a health hazard. The UN report urges governments to start planning for additional measures and funding to respond to fires.

It appears that no longer is there a wildfire "season." Instead, we now experience a full year of wildfires. 2022 began as one of the worst wildfires ever experienced in Colorado was finally put out by a snowfall on New Year's, 2022, after killing 3 residents and destroying nearly 1,000 homes. The "Marshall" fire in Boulder suburbs was a rare winter fire, made possible by drought-induced dry forests and 100+ mph winds. Then in January, California experienced high winds in the southern portion of the state and near Monterey. This fire, ironically named the "Colorado" fire, jumped Highway 1 and caused it to be shut down in both directions for 21 miles. Mandatory evacuations were announced. But this was just the beginning...

By early spring two large fires in New Mexico joined together to burn a 45-mile-long path, destroying hundreds of homes. The Calf Canyon/Herman's Peak fire, as it is now known, became the largest fire burning in the United States. By early May it had burned over 235,000 acres and still was only 40% contained. Strong winds were expanding the fire and threatening the Taos area. In the southwest area of the United States there were more than 12 fires burning, most uncontained, with over 320,000 acres burned in the states of New Mexico, Arizona, Texas, Colorado and Utah. In Arizona, the San Rafael fire was only 12% contained in mid-May, after having burned 11,000 acres. The Cooks fire and Tunnel fire in Arizona had burned approximately 30,000 acres, but were nearly 100% contained by mid-May.

Siberia is experiencing wildfires, unusual for springtime. With approximately 4,000 fires in an area of 270,000 hectares (667,000 acres), many homes destroyed and at least 8 deaths, this was considered so important that Russian President Vladimir Putin went on national TV to state that "there should be no repeat of last year's fires." The 2021 fire season was Russia's largest ever, with 18 million hectares (44 million acres) of forest destroyed by blazes. The fire spread rapidly when Siberia experienced high temperatures caused by global warming. The origin of a number of the current fires in Russia is unexplained and some are thought to be intentionally set fires protesting the war in Ukraine.

Global warming has led to droughts around the world. The effects are particularly noticeable in the western United States, where climate experts now refer to a "mega drought." Lack of rainfall in this area has produced the driest 22-year period in at least the last 1,200 years. These conclusions are based on studies made from sampling thousands of trees. In addition to the lack of rainfall, hydrologists are concerned about the depletion of groundwater in the West.

In our last report we discussed the effects of the extended drought and warming on Joshua Tree National Park and other portions of the Mojave Desert. This has led some biologists to recommend endangered species status for Joshua trees. Now, symptoms of similar problems are appearing in the vast Colorado Desert, located in eastern San Diego County and extending into the Imperial Valley and up to Joshua Tree National Park. Waterholes and streams in this part of the desert are drying up. Residents state that the changes are so visible that climate change is undeniable. Native vegetation is declining and animal species are threatened.

Long-term droughts in the western United States are leading to calls for water conservation and cutbacks. Reservoirs on the Colorado River are at record lows. The Colorado River basin serves seven states and Mexico. Future cutbacks are going to impact California, Arizona, and Nevada, as well as other states to a lesser degree. Experts are saying that across the region it is necessary to reduce water use by 20%. Despite the urgency, reduction so far in 2022 has been minor. Within California, the state's two largest reservoirs (Shasta Lake and Lake Oroville) are at critically low levels. In 2022, California experienced the driest January, February, and March ever recorded. Measurements of the snowpack—the source of water that feeds major reservoirs during the driest months of the year—turned out to be one of the 10 lowest in recorded history. Streamflow and groundwater are also well below averages across much of the state with the expectation that additional heat waves will determine how quickly the landscape dries.

Global deforestation slowed slightly in 2021. Efforts to slow the pace of the destruction of tropical forests was hampered by both wildfires and increased clearing of land for agriculture. The tropics lost 11.1 million hectares (27 million acres) of tree cover in 2021, according to new data from the University of Maryland. Of particular concern are the 3.75 million hectares (9.3 million acres) of loss that occurred within tropical primary rainforests—areas of critical importance for carbon storage and biodiversity—equivalent to a rate of 10 football fields a minute. Tropical primary forest loss in 2021 resulted in 2.5 Gt of carbon dioxide emissions, equivalent to the annual fossil fuel emissions of India. And it's not just tropical forests that are of concern. Boreal forests—mainly those in Russia—experienced unprecedented tree cover loss in 2021, largely driven by fires.

Brazil remains the world leader in deforestation of tropical forests. In April 2022, the Amazon lost nearly 400 square miles of tropical forests, the highest figure for any April in seven years of recordkeeping and 74% more than last April, the previous record. As we have previously reported, there is widespread concern that destruction of the Amazon will not only release massive amounts of carbon into the atmosphere, but could also push it past a tipping point where much of the forest degenerates into a tropical savanna. The former president of Brazil's environmental agency was quoted as saying, "The Amazon is controlled by landowners, illegal loggers, and miners. Crime is the reality."

8. **The transition to renewables**

Ironically, at a time when solar and wind power generation costs have dropped to the point where they are now competitive with even the cheapest forms of fossil fuel generation, a number of the American utilities have banded together to try to reduce the cost effectiveness of rooftop solar in order to enhance their own revenues. There is been a widespread industry lobbying effort from California to Florida by the utilities to defeat the measure commonly known as "net metering" which has provided an incentive for millions of homeowners to invest in rooftop solar. This measure, widely touted in California back even in the days of Arnold Schwarzenegger as governor, had led to exceeding a goal of 1 million homes in California with rooftop solar. After a huge public outcry in California, the Public Utilities Commission removed the utilities' proposed regulation changes from its docket for "further evaluation." However, in other states, particularly Florida, it appears that the measure is headed towards approval.

In January 2022, California's governor Gavin Newsom announced a \$37 billion plan to deal with climate change in California. Newsom's plan involved eight major categories, with top priority being transportation related projects. Also included were measures to replace natural gas with electricity, make improvements in the electrical grid, invest in new efficient affordable housing, develop California's resources for producing lithium, and additional funds for fire prevention and drought. Unfortunately, Newsom's plan was silent on support for rooftop solar (see discussion above). There is a growing awareness that the transition to renewables will require massive investments in electrical storage capacity and transmission system expansion.

Solar and wind energy continue to power electricity production around the world. California and Texas are among the leading states in the U.S. California noted several milestones in recent times. For a brief moment in May, solar and wind power provided 100% of the electricity demand in California. Another important milestone is that coal-fired power plants in the Western states are disappearing. In the eight-state area encompassing Idaho to Nevada, there are now less than 10 coal-fired power plants that do not have a planned retirement date. Dozens of plants have been shut down already and more are scheduled to close within the next decade. However, coal use is increasing in China, India, and Germany.

The state agency with primary responsibility for California's efforts to reduce greenhouse gas emissions is California Public Utilities Commission (PUC). The California Independent Systems Operator (the agency responsible for meeting electrical demand within the state) recently projected a need for \$30 billion dollars' worth of new transmission lines over the next 20 years, to connect renewable energy facilities with the cities that need power. The PUC has been criticized by developers and activists for being too slow and too hesitant to allow utilities to spend money building these systems. Securing permits and environmental approvals is a lengthy process and needs to have a new streamlined approval method for urgently needed projects.

9. Public Health

With the release of the IPCC AR-6 report, United Nations Secretary-General Antonio Guterres has urged all nations to take greater actions to reduce emissions. He called the report "an atlas of human suffering," and "an indictment of failed leadership. The world's biggest polluters are guilty of arson of our only home." The release of the latest AR-6 report has led to increased concern about public health and has stimulated a strengthening dialogue concerning the need for more rapid action to reduce emissions. To respond to a potential public health crisis, medical professionals feel there is a need for specially trained doctors to deal with the range of sickness, injuries, and disease caused by warming climate.

Another new development is that the U.S. Environmental Protection Agency (EPA), is proposing new stricter emissions for trucks, school buses and other heavy vehicles. The new regulations follow on the revised regulations for motor vehicles released in December 2021, that mandated average fleet mileage standards of 55 miles per gallon. (This revoked the earlier standard set during the Trump administration.) The proposed heavy vehicle standard will reduce nitrous oxide emissions from diesel engines a major constituent of smog. Soot and toxic gases are major public health menaces along main transportation corridors used by trucks.

10. Government Actions, misinformation, and a fee on carbon

The combined effect of the IPCC AR-6 Report, with its dire conclusions, and Russia's invasion of Ukraine, has been to spark many calls for increased government action. Recommendations include banning U.S. imports of Russian oil and then dramatically accelerating the construction of clean energy projects. Congress is urged to make renewed efforts to pass some part of the Biden administration "Build Back Better" agenda, focusing on those parts that relate to climate change and renewable energy.

On June 30, in a landmark decision, the U.S. Supreme Court ruled that the U.S. Environmental Protection Agency (EPA) had no authority to regulate greenhouse gas emissions. This is a huge setback for American efforts to fight climate change.

As part of the United Nations AR-6 Working Group report released in March, for the first time there was a detailed description concerning misinformation about climate change and the “deliberate undermining of science” financing organized by “vested economic and political interests.” The report makes it clear that the fossil fuel industry and politicians who advance its agenda are responsible for an ongoing misinformation effort. This effort has been particularly successful in the United States with groups that have been willing to accept false claims. For example, fossil fuel companies talk about “clean coal,” “green natural gas,” and “carbon capture technology” that will magically suck carbon dioxide out of the atmosphere. Fossil fuel advocates are the reason why the U.S. Congress has failed time after time to enact significant federal climate legislation including President Biden’s “Build Back Better” bill that includes \$550 billion to spur growth in renewable energy and clean transportation.

In a surprising and abrupt reversal of policy, the American Petroleum Institute (API) has come out favoring a carbon tax. The Citizens’ Climate Lobby (CCL), which has long supported a fee on carbon, responded positively to the API initiative: “CCL is encouraged to see this powerful industry player taking steps to advance this major climate policy. The basic structure of API’s proposal includes a starting price of \$35 to \$50 per ton of carbon dioxide emissions, with annual adjustments for inflation and other factors (presumably increasing the price). They propose using the revenue for rebates to households and investments in new technology, and they call for border tariffs to keep U.S. businesses competitive. These ideas are in line with the policy Citizens’ Climate Lobby has supported for years.”

Our Outlook

Regrettably, we do not find much to report that is positive, based on developments in the first half of 2022.

- With the impact of the Covid-19 pandemic lessening, travel and economic activity is surging with a concomitant rise in emissions.
- The coming period is certain to experience inflation, rising interest rates, and rising energy costs. It is unclear whether these changes will stimulate or retard a greater use of renewable energy for electricity generation and transportation.
- The war in Ukraine is unlikely to end in the near term. Ongoing tensions will exacerbate uncertainty concerning energy supplies, possibly delaying new renewable energy projects.
- In the very near term, possibly by 2025 to 2030, Earth’s average temperature increase will exceed 1.5°C.
- Global greenhouse gas emissions will set a new record in 2022.

In summary, with conquest, war, famine, and death now very much in the news, our analogy of global warming to the biblical prophecy of the “*Four Horsemen of the Apocalypse*,” seems more relevant than ever.

Craig B. Smith and William D. Fletcher

Bill Fletcher and Craig Smith are coauthors of *Reaching Net Zero: What It Takes To Solve The Global Climate Crisis*, Elsevier, July 2020. (<https://reachingnetzero.com/book/>)