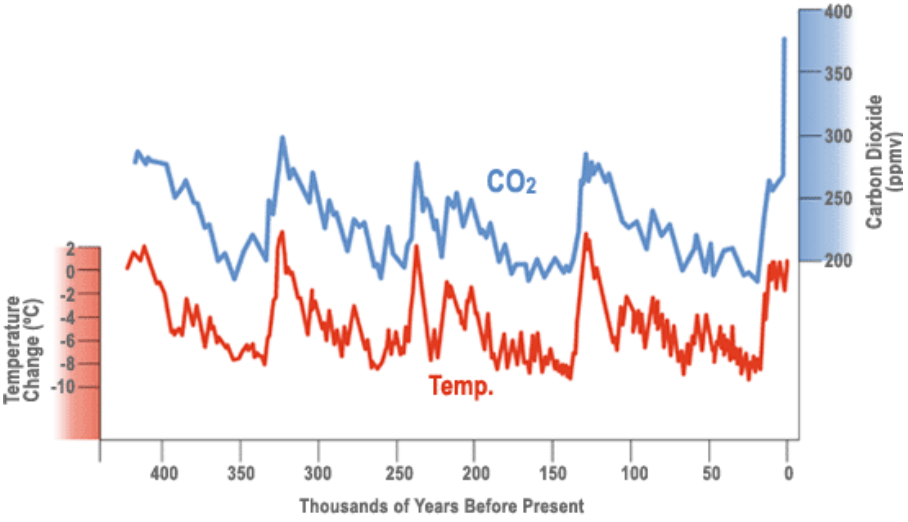
Global Warming - What is it? Why is it happening? What are the consequences?

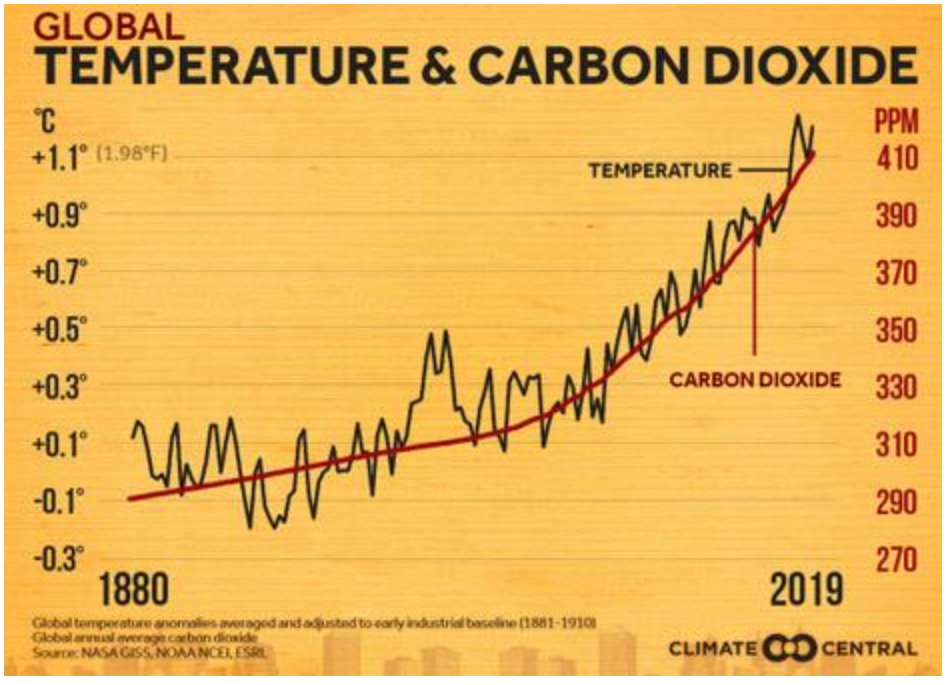
Global warming is the unprecedented high level and rate of increase of global average atmospheric temperature, neither having been seen in at least the last 3 million years. Energy from the sun easily penetrates the earth's atmosphere, but energy radiated from the earth back toward outer space is partially trapped by greenhouse gasses in the atmosphere. More greenhouse gas means more trapped heat and correspondingly more warming.

Carbon dioxide, methane, and nitrous oxide are the primary greenhouse gasses being generated by humans. All persist in the atmosphere for a long time and we add progressively more each year – about 2%. Each gas has a different warming potency, so it is common to refer to their collective effect in terms of carbon dioxide equivalents or CO2e, hereafter simply CO2 or just carbon. Water vapor in the atmosphere is also a potent greenhouse gas, but it is a byproduct of warming and not a direct contribution by man. It can only be reduced by removing enough greenhouse gas to cool the planet.



The connection between CO2 and temperature over the 400,000 years prior to about 1880 is clearly shown by the chart at left. CO2 varied around 250 parts per million (ppm), but never rose above 300 ppm. The repeating patterns vary over periods of 10,000 to 100,000 years and are due to well-known and well understood variations in the earth's orbit around the sun. These are very slow changes compared to what we are now experiencing.

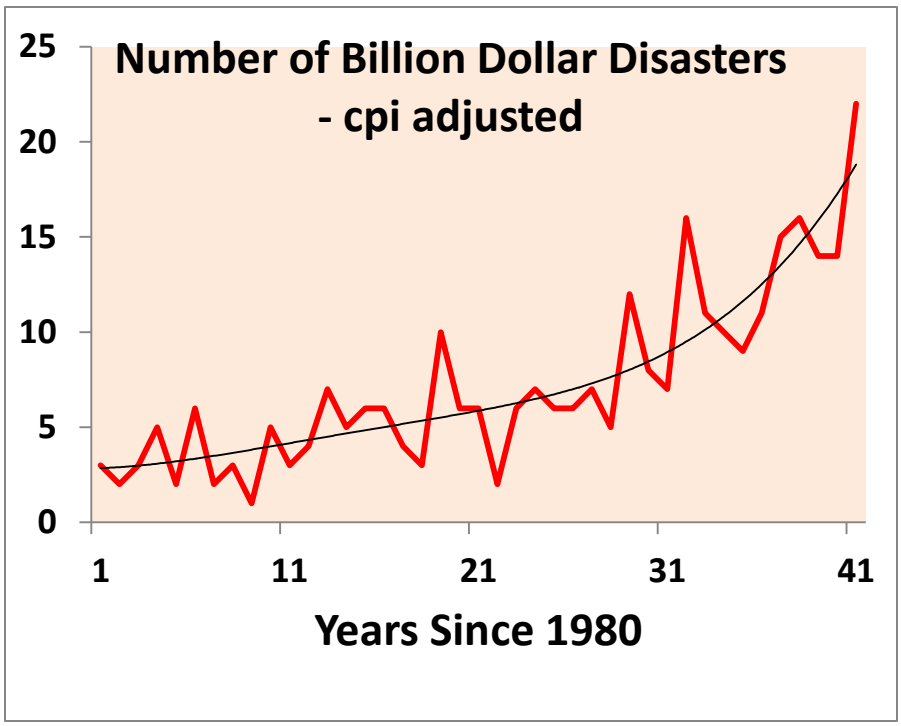
Starting around 1880 with the industrial revolution and the associated use of carbon-based fuels, CO2 in the atmosphere began to rise rapidly. Since then CO2 and temperature have risen together and at an ever increasing rate as shown by the chart below. CO2 is now up to 410 ppm and temperature has increased by 1.2 degrees Celsius or 2.2 degrees Fahrenheit. The CO2 we add doubles about every 32 years. CO2 in the atmosphere has a chemical signature unique to burning of fossil fuels, thus proving that the source of this extra CO2 is human activity.



CO2 comes primarily from combustion of carbon-based fuels (gasoline, coal, diesel, propane, wood, natural gas {methane} and ethanol). Nitrous oxide comes from the same sources, but primarily from internal combustion engines. Methane comes from natural gas leakage, from landfills, and from cow and sheep digestion systems. Yes, cows produce methane and lots of it. Methane is 30 times more potent than CO2 and nitrous oxide is 278 times more potent. In simple terms, we are the problem, so we must be the solution.

Everything we buy has three carbon components; embodied carbon generated by all aspects of producing a product and then disposing of it at the end-of-life, plus that generated during the useful life of the product.

So what are the consequences for us of a 2.2 degree Fahrenheit warmer atmosphere loaded with 130 ppm more CO2e and both still increasing?



1. Local high temperature records occur two times more frequently than low temperature records. This ratio is increasing.
2. Global average temperatures for the past seven years have all been higher than any previous temperature. This pattern is likely to continue.
3. The polar region is warming faster than the global average which is believed to be causing the jet stream to slow, move north, and develop large, meandering north-south loops, all severely impacting weather. Loops can stall weather patterns or release polar air leading to heat waves or extreme cold periods, respectively. If the loops stall these abnormal patterns may persist for days or weeks with similar periods of very dry or very wet weather.
4. Warmer air increases evaporation rates over land and sea, and can hold more water vapor in the atmosphere. Drier areas become drier, wet areas wetter, rain and snow fall can become heavier, and periods with and without precipitation can become longer. Think droughts in the SW, wildfires in the west, severe flooding such as Hurricane Ida, Texas winter storms of 2021, less food production in California's Central Valley, Hurricane Ian in Florida, and the now uninhabitable areas in Africa and Asia.
5. Warmer oceans, higher atmospheric water vapor content and jet stream shifts increase the severity of surface storms and hurricanes – think Katrina, Sandy and Ian.
6. Unprecedented melting of ice and snow packs in polar region adds water to the oceans. Melting exposes darker, more energy absorbing surfaces to further increase warming in a never ending spiral. Melt water plus expansion of ocean water due to heating is raising sea levels to increase storm surges – think the three hurricanes mentioned, and put the 60% of world population near ocean shores at ever increasing risk.
7. Some of the extra CO2 in the atmosphere dissolves in the oceans to increase acidity. This plus higher water temperature is bleaching coral reefs and will eventually kill them causing the loss of a critical habit for juvenile fish species.illion dollar weather disasters (droughts, wildfires, floods, winter storms, freezes, severe storms, cyclones) have gone from 2 to 22/year in just 40 years with more rapid increases after 2000 – chart left.
8. Extinction rates are now 1000 times the normal background level, all because living species cannot evolve fast enough to survive the rapidly rising temperatures. This 6th mass extinction is due solely to man.
9. Global warming does not appear to have increased tornado severity, but there are definite changes in number, location and timing (more at night), with more clusters of tornadoes, probably the result of stalled weather patterns. All these changes make tornadoes more dangerous.
10. Average wind speeds have increased to drive evaporation, wildfires, etc.

None of these man-induced changes is fixed in time. All are getting progressively worse. One goal is to limit total warming to 4 degrees Fahrenheit by 2050. At the moment, this looks like a pipe dream. We are not doing nearly enough to reverse current trends to meet this goal and head off even more dangerous conditions ahead. The reduction goal at the moment is 5% per year which would reduce our carbon emissions by about half by 2030. At some point, the situations we are experiencing will reach tipping points, where no action we can take will reverse the trend. Many scientists are concerned that we are already dangerously close to such points for some conditions.

So what can you as an individual do for this global problem? The answer is that you can do a lot and much of it is easy, all without compromising quality of life. Carbon generation is distributed in roughly equal quarters over four sectors: food, transportation, household energy, and purchases of durable goods. This website will continue to offer suggested actions for all sectors that can be taken by individuals, along with resources to help in doing so.