



Global Warming & Climate Change 101

Introduction

In a florist's greenhouse, more energy is being received than is being released so it warms up. Similarly with Earth there is an imbalance between the energy being received and radiated. The greenhouse gases in our atmosphere act as one-way gatekeepers that allow solar energy to reach the Earth's surface, but limit the radiation of the heat energy back into space.

The primary greenhouse gases are water vapor, carbon dioxide (CO₂), methane, nitrous oxide, and tropospheric ozone. CO₂ is notable because it is emitted whenever fossil fuels are burned. Since the Industrial Revolution the amount of CO₂ in our atmosphere has steadily increased and is now higher than it has ever been in the past 800,000 years. In addition, the rate of increase is unprecedented. The annual growth rate of atmospheric carbon dioxide measured at NOAA's [Mauna Loa Observatory](#) in Hawaii jumped by 3.05 parts per million during 2015, the largest year-to-year increase in 56 years of research.

Theory, experiments, and recorded data all show a strong connection between the concentration of CO₂ in the atmosphere and Earth's surface temperature. The average temperatures of the last decade are the highest in the 181-year instrumental record history.

What are the consequences of Global Warming?

Global Warming is not just a benign, incremental rise of temperature, but it gives rise to extreme weather events and Global Climate Change. Heat energy and moisture are the primary determinants of our weather. Warmer temperatures evaporate more water from the oceans and put more energy into the atmosphere. Record-setting heat indexes, severe droughts, devastating floods, fires, and violent weather are some of the harsh results.

The Union of Concerned Scientists summarizes some of the current impacts:

- ✿ Average global sea level has increased eight inches since 1880, but is rising much faster on the U.S. East Coast and in the Gulf of Mexico.
- ✿ Wildfires are increasing and the wildfire season is getting longer in the Western U.S.
- ✿ Dangerously hot weather is already occurring more frequently than it did 60 years ago—and scientists expect heat waves to become more frequent and severe as global warming intensifies.
- ✿ Tens of millions of trees have died in the Rocky Mountains over the past 15 years, victims of a climate-driven triple assault of tree-killing insects, wildfires, and stress from heat and drought.
- ✿ Very heavy precipitation events, defined as the heaviest one percent of storms, now drop 67 percent more precipitation in the Northeast, 31 percent more in the Midwest, and 15 percent more in the Great Plains than they did 50 years ago.
- ✿ As temperatures have warmed, the prevalence and duration of drought has increased in the western U.S. and climate models unanimously project increased drought in the American Southwest.

No single event proves global warming, and similar events have occurred in the past. However, the frequency and intensity of the extreme weather events are the predicted characteristics of prolonged, escalating global warming. As the global climate changes, the altered habitats force the destruction/migration of plants, animals, and humans. The dramatic pictures of the emaciated refugees in Eastern African camps are the real face of the stark consequences of global climate change.

What are some compounding causes?

As the polar ice caps melt during the summer, the incoming solar energy is absorbed by the dark ocean rather than reflected by the ice caps. As the surrounding permafrost melts, it releases methane gas, which is an especially active greenhouse gas. The most dramatic temperature increases have been occurring in the Arctic regions.

The world's population has quadrupled in the last century and many countries are industrializing rapidly. A modern urban dweller uses about ten times more energy than a subsistence farmer. Most of this increased use of energy comes from burning fossil fuels. According to the World Resources Institute, the U.S. bears the most responsibility for greenhouse gas emissions (27%) since 1850, but China's current emissions are almost double those of the U.S. Nevertheless, per capita emissions in the U.S. are almost triple those in China.

Isn't climate change just cyclical, caused by volcanoes, or due to sunspots?

All of the factors above do affect our weather, but they do not account for the progressive temperature trends or the steadily increasing severity of the violent weather events. The fossil fuel industry and skeptics have advertised spurious factors to introduce doubt against the root cause of increased CO₂. Also, political parties have taken opposite sides on the issue, so the evidence, consequences, and necessary actions are buried in deception and political rhetoric.

How is evidence gathered over long time spans?

An examination of tree rings reveals climate history over hundreds of years. Similarly examining glacial ice cores gives evidence of climate history over hundreds of thousands of years. In particular the correlation of CO₂ and temperature is readily apparent. Cross-referencing ice core records with layered rocks, paleontological records, and coral show similar patterns of climate history.

Who are the climate scientists?

Climate scientists gather data and care for the planet just as medical doctors diagnose and care for patients. Climate scientists and medical doctors each have rigorous academic training and are committed to high ethical standards. Most climate scientists are employed by universities or the government and their compensation is a fraction of their medical counterparts. All of us have a personal relationship with our doctors and trust their diagnoses. Climate scientists work in the isolation of the field and labs and communicate primarily with their peers. Skeptics have exploited this seclusion to sow doubt about scientists' findings.

What mitigating measures can be taken to decrease our "carbon footprint"?

Reduce, renew, and recycle is the three-pronged strategy for reducing our dependency on fossil fuels.

The most effective way to **reduce** our carbon footprint is to decrease our energy consumption. A few of many techniques are more insulation, higher mileage cars, more efficient appliances, and simple lifestyle changes. Other countries with comparable lifestyles use only a fraction of the energy we use.

Presently we depend on fossil fuels to supply 80% of our energy whereas only 8% is supplied by **renewable** sources. Fossil fuels are cheap and reliable, but they have many hidden costs (military interventions, balance of payments, climate change) and health hazards (air pollution). These expenses should be incorporated into the price of the fossil fuels and subsidies provided to encourage the expansion of renewable sources.

It is extremely wasteful to mine materials from the earth, process the minerals, and then fabricate a product. **Recycling** requires a fraction of the expense and energy. It also preserves our natural environment and enables us to be more independent.

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