

Global Warming

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Crowded landfills, polluted water, and poor air quality are just a few of the environmental problems that affect both industrial and developing nations. Perhaps less obvious but no less ominous a threat to the environment is the general increase in temperatures worldwide and the resulting [climate](#) changes. This phenomenon, known as [global warming](#), could have serious negative effects on humans and all other living things on Earth. Global warming is a complex problem, and governments have had great difficulty deciding how to address it.

Climate Change

The term *climate* refers to the typical weather patterns that an area or region experiences over a period of years. Both natural events and human activity influence climate and can cause it to change. Scientists around the world have been studying [climate change](#) since the 1970s. Most agree that the [temperature](#) of the earth is rising at a rapid pace and that global warming has been caused largely by human activity.

The Greenhouse Effect

The [atmosphere](#) contains various gases that act as a blanket to trap heat from the sun and prevent it from escaping back into space. The trapping of the sun's heat by these gases is known as the "[greenhouse effect](#)," and the gases are called "[greenhouse gases](#)." The main greenhouse gases that occur in nature are [carbon dioxide](#), [methane](#), and [nitrous oxide](#). Without the greenhouse effect, the earth would be too cold to support life.

Over time, the amount of greenhouse gases trapped in the earth's atmosphere has increased significantly, causing worldwide temperatures to rise. Much of this increase is due to natural occurrences, such as gradual shifts in the earth's axis and volcanic activity. Since the last Ice Age ten thousand years ago, average global temperatures have risen about 5°C (9°F). Over the last century, however, the pace of global warming has accelerated, with temperatures worldwide increasing 0.7°C (1.3°F). Some scientists have predicted that temperatures will continue to rise about 0.3°C (0.5°F) or more every ten years. While temperatures continue to rise, scientists observed a slowdown from 2000 to 2010—even though greenhouse gas [emissions](#) rose during this decade. The anomaly puzzled scientists who predicted a steeper temperature increase. Some theorized that oceans absorbed more of the earth's heat, which kept the earth's surface cooler. The most likely explanation for the decrease is natural climate cycles caused by ocean currents. Data from the National Oceanic and Atmospheric Administration (NOAA) has shown that since 2012, global temperatures have resumed their rate of increase from the twentieth century. In 2015, scientists from the National Aeronautics and Space Administration (NASA) and NOAA determined that 2014 was the warmest year on record; a year later, 2015 broke that mark by a .13°C (.23°F) margin.

Natural and Human Causes

Natural processes on Earth constantly create and destroy greenhouse gases. For example, the decay of plant and animal matter produces carbon dioxide, which plants then absorb during photosynthesis. This natural cycle keeps the level of carbon dioxide in the atmosphere fairly stable.

The earth's vegetation releases and absorbs more than two hundred billion metric tons of carbon dioxide each year. Human activities, such as the burning of [fossil fuels](#), add an extra seven billion metric tons per year. This may seem like a small change, yet over time it has had a dramatic effect on the atmosphere. In the past two hundred years, the concentration of carbon dioxide in the atmosphere has risen by more than 30 percent. [Deforestation](#) has also played a role in this increase, eliminating forests that would otherwise absorb tons of carbon dioxide.

Human activities have also increased the levels of other greenhouse gases in the atmosphere. For example, various agricultural and industrial activities, such as the use of certain fertilizers, produce nitrous oxide. Methane emissions come from the production of fossil fuels, from landfills, and from [livestock](#). These gases may cause even more harm than carbon dioxide, even though less of them exist, because they have a much greater effect per pound on the earth's temperature. Methane, for example, is a greenhouse gas twenty-one times as potent as carbon dioxide. For 112 days beginning in October 2015, a methane gas leak from a California plant vented about five billion cubic feet of gas into the atmosphere. The leak was finally capped on 18 February 2016. The incident was the worst accidental discharge of greenhouse gasses in [United States](#) history, releasing the equivalent of the yearly exhaust emissions from almost 600,000 automobiles.

In addition, humans have created and released greenhouse gases that do not occur in nature. These include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). These gases, released during such industrial processes as aluminum production and electrical transmission, have thousands of times the effect on the earth's temperature that carbon dioxide has.

Effects of Global Warming

Most scientists believe that the earth's atmosphere is getting warmer. The consequences of global warming, however, remain an issue of great debate and uncertainty. Some researchers predict dramatic and serious problems for future generations. For example, global warming might affect climate patterns. Warmer oceans could result in stronger and more frequent hurricanes. As temperatures climb, some regions could experience frequent heat waves and devastating droughts and wildfires. During the 1990s and first decade of the twenty-first century, many areas in the United States endured record-breaking heat and drought that might be related to global warming trends. In 2012 severe drought that plagued the Wheat Belt of the United States caused a natural disaster. In the beginning of 2013, Australia experienced a heat wave that caused hundreds of wildfires throughout the country.

If air and water temperatures rise, ice caps and glaciers will melt, causing [sea level](#) to rise as well. As a result, many coastal areas around the world could face severe flooding. Low-lying islands in the Pacific Ocean would eventually become uninhabitable. Within the past century, sea level has risen by four to eight inches worldwide, and some experts estimate a possible increase of nineteen inches by 2100. Some of these effects were felt in 2012 when a super storm known as Superstorm Sandy hit the

Eastern coast of the United States, and a typhoon in the Philippines claimed the lives of more than one thousand people.

Global warming could have a major impact on habitats. Some areas well suited to farming might become too dry or too wet to support agriculture. Long periods of drought could turn fertile lands into deserts with little vegetation. Plants and animals might not be able to survive the rapid changes caused by global warming and could become extinct. Over the long term, such changes would result in a loss of biodiversity on the planet. Some ecosystems, such as coral reefs and coastal mangrove swamps, are likely to disappear completely.

People would also face serious problems. Loss of farmland, for example, would cause disruptions in the [food supply](#), bringing about famine in many areas. Some experts suggest that global warming might lead to the increase or spread of life-threatening infectious diseases. Scientists have noted that various species of disease-carrying mosquitoes have expanded their habitats to areas where they could not have lived before. More frequent and intense heat waves could result in more heat-related deaths, and changes in air quality would also affect human health.

Addressing Global Warming

Despite incomplete evidence to support the theory of global warming, recent events and data indicate that dangerous climate changes have already begun. This raises difficult questions for governments and citizens alike. Some of these are technical problems. It is not obvious what actions are needed to stop global warming. The [science](#) of climate change is so complex that some actions that seem helpful may actually cause damage in the long term. Economic and political issues are also involved. To reduce global warming in years to come, it may be necessary for nations to restrict certain activities that are important to their economies. For this reason, the nations of the world have great difficulty agreeing on a global plan to deal with the earth's changing climate.

Scientific Issues

One difficulty in addressing global warming is the fact that any action can have complicated effects on the environment. For example, it may seem that cutting down trees can only increase the amount of greenhouse gases in the atmosphere. But the true impact of logging is far more complex. Burning the debris left behind after logging produces carbon dioxide. Allowing it to decay naturally, however, releases methane, a far more powerful greenhouse gas.

Moreover, if an area of trees is replanted immediately after logging, it can actually reduce the amount of carbon dioxide in the atmosphere, as growing trees absorb more carbon dioxide. Thus, logging in a responsible way can actually slow the process of global warming. By contrast, the clear-cutting that often occurs in tropical rain forests causes permanent damage. Removing the trees takes away the main source of nutrients from the land, making it impossible for vegetation to grow back. Rainfall strips the remaining nutrients from the soil, leaving it barren within a few years.

Another complication is the risk that reducing global warming may cause other environmental problems. Some of the most potent greenhouse gases, HFCs and PFCs, are commonly used as

replacements for other chemicals called CFCs, which were banned in 1996 because they damaged the [ozone](#) layer. The same process that solved one environmental problem—ozone damage—contributed to another. To avoid a similar situation, governments will need to think ahead and consider the possible consequences of any plan to address global warming.

Political Issues

The wealthier countries of the world have added huge amounts of greenhouse gases to the atmosphere, thus contributing significantly to the process of global warming. By some measurements, the United States produces about 20 percent of the world's greenhouse gases. Therefore, many people believe that industrial nations should take responsibility for reducing emissions of these gases. The leaders of these nations, however, have been very resistant to this idea.

In 1992 representatives met at a United Nations-sponsored conference in Rio de Janeiro, Brazil, to discuss climate change. The industrial nations present at the meeting could not agree on timetables or target goals to stabilize their production of greenhouse gases. They were also unwilling to reduce emissions of these gases from motor vehicles, power plants, and other sources.

Five years later, delegates from many nations gathered in Japan to negotiate an international treaty known as the Kyoto Protocol. It would require industrial countries to reduce emissions of greenhouse gases. The treaty was strongly supported by the European Union and other developed countries. The United States opposed the agreement, however, claiming that it could harm the U.S. economy and was unfair because it did not require huge [developing countries](#) such as [China](#) and India to cut emissions. Other nations continued to negotiate and reached an agreement late in 2001. By 2007, 174 countries had ratified the Kyoto Protocol, with some notable exceptions, like the United States.

Meanwhile, U.S. officials developed their own plan to reduce greenhouse gas emissions gradually over a ten-year period. However, some experts believe that it may already be too late to stop the warming trend and avoid the dangers it may pose. They argue that even if the production of greenhouse gases is dramatically reduced, global warming will continue. If no action is taken, they claim, the problem in the future may become very serious.

International leaders returned to the negotiating table in 2009 for a conference in Copenhagen. Their goal was to reach an agreement to reduce emissions and form a treaty or accord that would replace the Kyoto Protocol. The conference failed to yield an international agreement. One central controversy that impeded an agreement was whether nations should enter into a legally binding treaty that limits each nation's emissions. Some nations did not want their agreement to be legally binding. Others said the agreement must be binding to be effective. Other problems the Kyoto Protocol faced included how to enforce binding international agreements and how to penalize those who did not comply with the agreements.

The Environmental Protection Agency (EPA) reported that greenhouse gas emissions in the United States dropped 1.6 percent from 2010 to 2011 and have dropped about 7 percent since 2005. The United States attributed the drop to automobile fuel efficiency improvements as well the increased use of natural gas throughout the country. President Barack Obama in 2013 pledged to continue reducing the country's greenhouse gas emissions. From 2013 to 2014, however, greenhouse gas emissions in

the U.S. rose by 0.9 percent.

On 12 December 2015, negotiators from almost two hundred nations reached an historic agreement in Paris to begin a coordinated effort to reduce greenhouse gasses. The deal aims to gradually reduce the world's reliance on fossil fuels and promote cleaner forms of energy. It also incorporates a framework of rules to monitor compliance and provides financial assistance to developing countries. The goal of the agreement is to limit the rise in global temperatures to at least 2°C (3.6°F) above the pre-industrial levels of the early nineteenth century.

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