

The Greenhouse Effect

What Is the Greenhouse Effect?

The “greenhouse effect” is so called because it is analogous to the process that keeps the air inside greenhouses (and parked cars) warmer than the air outside. The glass in greenhouse windows is transparent to visible light radiated from the sun. This light heats the surface of materials inside the greenhouse, which emit longer wavelength infrared radiation. Infrared radiation cannot penetrate the glass and is trapped, causing the inside air to warm up.

Water vapor, clouds, carbon dioxide, and other gases in our atmosphere act like the greenhouse glass by preventing some of the infrared radiation emitted by the earth to escape into space. Because the levels of carbon dioxide and other "greenhouse gases" in the atmosphere are increasing, more and more of the heat radiated by the earth's surface may become trapped in the atmosphere. This may result in "global warming," or the gradual warming of the atmosphere around the world.

From Where Do Greenhouse Gases Come?

Some greenhouse gases come from natural sources, such as volcanoes and forest fires. Because of the ability of these naturally formed gases to trap heat in the atmosphere, the Earth's surface is about 53°F (29°C) warmer than it would be without this trapping. This atmospheric heating makes the surface of the Earth warm enough for life.

Certain human activities can cause air pollution that magnifies the greenhouse effect in the atmosphere. The most important air pollutants that act as greenhouse gases are carbon dioxide, methane, nitrogen oxides, and chlorofluorocarbons. Methane is a product

of natural decay from living (or once-living) things. Carbon dioxide and nitrogen oxides generally are a result of man-made burning, automobiles, and other internal combustion engines. Nitrogen oxides also can enter the atmosphere from fertilizers spread on fields. Chlorofluorocarbons (“CFCs”) are a class of chemicals once commonly used in air conditioners and refrigerators and as the pressurizing gas in aerosol spray cans.

While all of these pollutants contribute to the greenhouse effect and other air pollution problems, such as smog, carbon dioxide is the most important of the greenhouse gases because there is more of it in the atmosphere. Also, carbon dioxide levels have risen over 25% during the past century.

Another source of carbon dioxide is the clearing of rain forests in countries near the equator. The burning of tropical trees to clear land for crops releases carbon dioxide to the atmosphere. At the same time, trees that use carbon dioxide for photosynthesis are being destroyed.

What Will the Greenhouse Effect Do?

No one can predict for certain the impacts of the increasing levels of greenhouse gases in the atmosphere. Researchers think that the average temperature of the lower atmosphere will increase by 3°F to 9°F (1.6°C to 5°C) over the next 30 or so years. This may not seem like much, but the average world temperature during the last Ice Age was only 5.4°F (3°C) lower than it is now.

Researchers have attempted to predict the effects of increased global temperatures using sophisticated computer models. Most predict that warmer temperatures will be greater in winter than in summer and greater at higher latitudes than the equator. One thing seems certain, global warming of a

few degrees Celsius will cause major shifts in global weather patterns. Tropical storms may become more severe or hit land in different places. Areas that now receive plenty of rain for crops may suffer more droughts. One area where rainfall is predicted to decrease is the central U.S., which produces much of our food crops.

Global warming also may cause sea level to rise. The oceans are storehouses of heat. By storing some of the increased heat, ocean temperatures will rise, causing them to expand. In addition, warmer temperatures may melt the polar ice caps to some degree. A rise in sea level will flood low-lying areas where many people now live, for example low-lying parts of the state of Florida, many major cities around the world, and the country of Bangladesh.

The increased temperatures, changes in weather patterns, and sea level rise will have disastrous effects on many natural habitats and the plants and animals that live in them.

While most scientists believe that the greenhouse effect will gradually warm up the Earth's climate; some believe that warmer temperatures will increase cloud cover, reflecting more sunlight away from the Earth and eventually lowering the average temperature. This increased reflectivity is called the Earth's albedo.

How Do We Detect the Greenhouse Effect?

During this century, the average global temperature has increased 1°F (just over 0.5°C). During the 1980s, the Earth experienced four of the hottest years ever recorded.

Governments and scientists around the world have been recording temperatures and levels of greenhouse gases in the atmosphere for years. Measurements are taken at the ground and aloft by airplanes and balloons. Remote sensing instruments in satellites also can be used to provide data on temperatures, winds, and other atmospheric and oceanic conditions.

How Do We Reduce Its Effects?

We can reduce the effects of global warming by reducing or stopping the activities that cause greenhouse gases to enter the atmosphere. We should do our best to burn less fossil fuels by switching to alternative, cleaner sources of energy and ban the use of CFCs* and other chemicals that increase the greenhouse effect. Protecting the world's forests and planting more trees also will help. A growing tree can take in more than 20 kilograms of carbon dioxide a year.

* The use of CFCs has been drastically reduced in the past couple of years due to the Montreal Protocol, which called for a global reduction in CFC production. Although CFCs are no longer used in the production of new refrigerators and air conditioners, a few manufacturing processes still use them.

Source: Project A.I.R.E. (Air Information Resources for Educators), Air Quality Curriculum, U.S. Environmental Protection Agency, <http://www.epa.gov/region01/students/teacher/airqual.html>