

Greenhouse Gases and Society

by Nick Hopwood and Jordan Cohen

Greenhouse gases naturally blanket the Earth and keep it about 33 degrees Celsius warmer than it would be without these gases in the atmosphere. This is called the □Greenhouse Effect□. Over the past century, the Earth has increased in temperature by about .5 degrees Celsius and many scientists believe this is because of an increase in concentration of the main greenhouse gases: carbon dioxide, methane, nitrous oxide, and fluorocarbons. People are now calling this climate change over the past century the beginning of □Global Warming.□ Fears are that if people keep producing such gases at increasing rates, the results will be negative in nature, such as more severe floods and droughts, increasing prevalence of insects, sea levels rising, and Earth's precipitation may be redistributed. These changes to the environment will most likely cause negative effects on society, such as lower health and decreasing economic development. However, some scientists argue that the global warming we are experiencing now is a natural phenomenon, and is part of Earth's natural cycle. Presently, nobody can prove if either theory is correct, but one thing is certain; the world has been emitting greenhouse gases at extremely high rates and has shown only small signs of reducing emissions until the last few years. After the 1997 Kyoto Protocol, the world has finally taken the first step in reducing emissions.

The Greenhouse Effect

The "greenhouse effect" is the heating of the Earth due to the presence of greenhouse gases. It is named this way because of a similar effect produced by the glass panes of a greenhouse. Shorter-wavelength solar radiation from the sun passes through Earth's atmosphere, then is absorbed by the surface of the Earth, causing it to warm. Part of the absorbed energy is then reradiated back to the atmosphere as long wave infrared radiation. Little of this long wave radiation escapes back into space; the radiation cannot pass through the greenhouse gases in the atmosphere. The greenhouse gases selectively transmit the infrared waves, trapping some and allowing some to pass through into space. The greenhouse gases absorb these waves and reemits the waves downward, causing the lower atmosphere to warm.(www.eb.com:180)

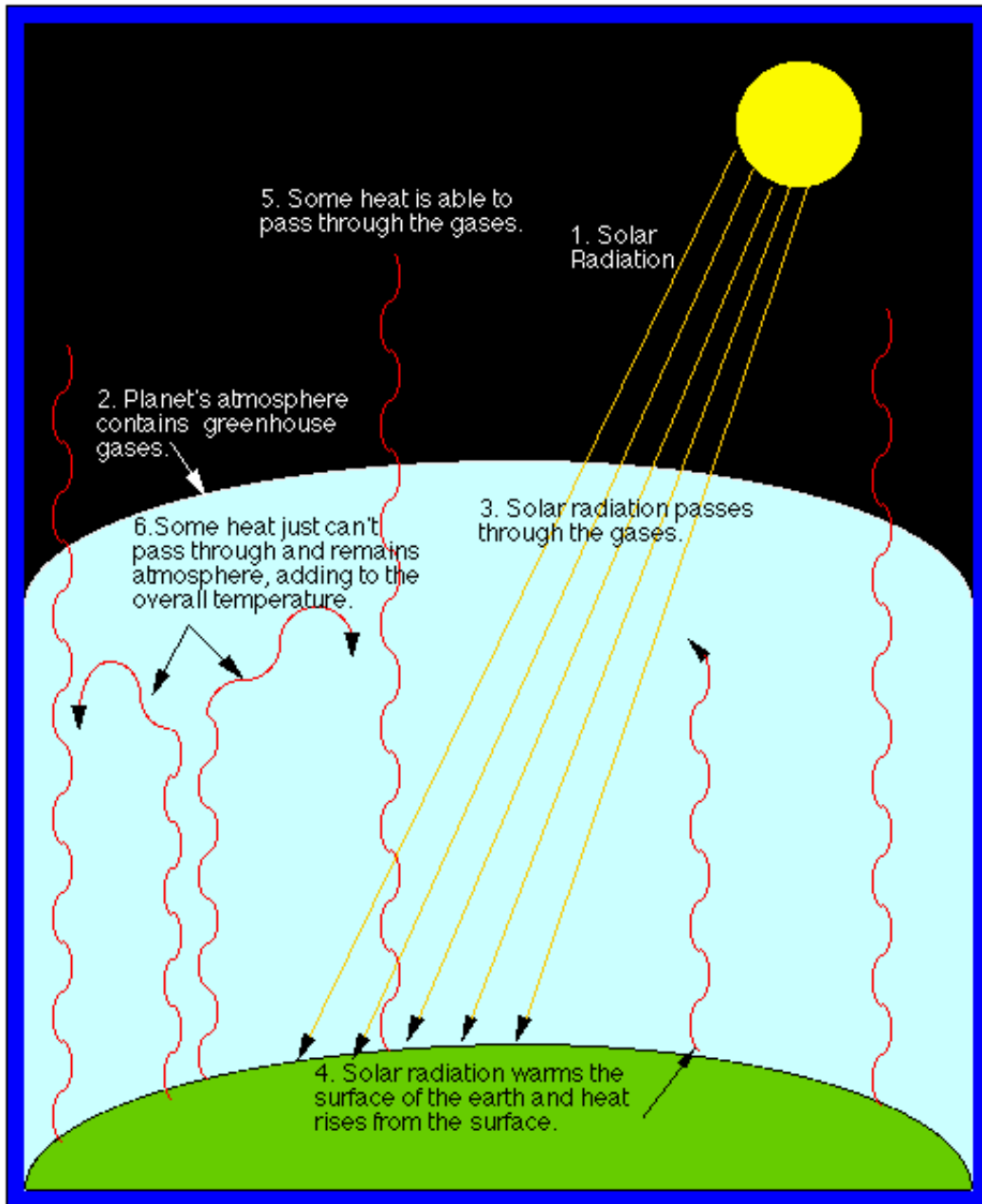
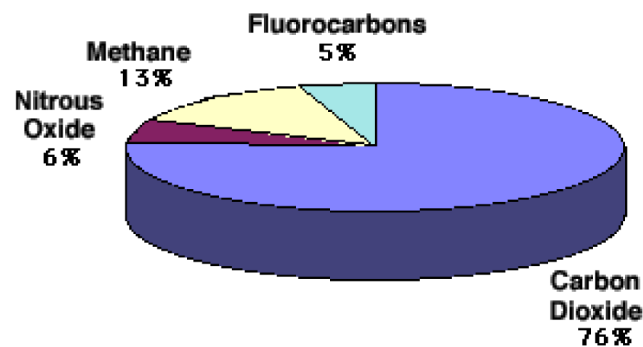


Diagram to help explain the process of global warming and how greenhouse gases create the "greenhouse effect"
www.eecs.umich.edu/mathscience/funexperiments/agesubject/lessons/images/diagrampage.html

Greenhouse Gases



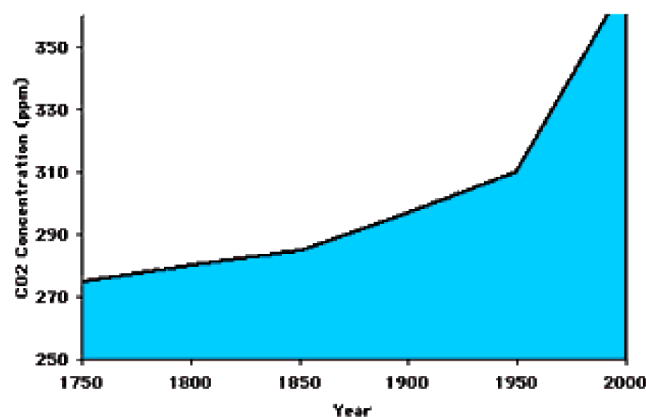
This graph shows the distribution of GHG in Earth's atmosphere. Carbon Dioxide is clearly the majority.

Carbon Dioxide

Carbon Dioxide (CO₂) is a colorless, odorless non-flammable gas and is the most prominent Greenhouse gas in Earth's atmosphere. It is recycled through the atmosphere by the process photosynthesis, which makes human life possible. Photosynthesis is the process of green plants and other organisms transforming light energy into chemical energy. Light Energy is trapped and used to convert carbon dioxide, water, and other minerals into oxygen and energy rich organic compounds. (Encyclopaedia Britannica Volume 25) Carbon Dioxide is emitted into the air as humans exhale, burn fossil fuels for energy, and deforest the planet. Every year humans add over 30 billion tons of carbon dioxide in the atmosphere by these processes, and it is up thirty percent since 1750 (www.envirolink.org/orgs/edf/sitemap.html). An isolated test at Mauna Loa in Hawaii revealed more than a 12% (316 ppm in 1959 to 360 ppm in 1996) increase in mean annual concentration of carbon dioxide. Mauna Loa, located in Hawaii, is the worlds largest volcano at 40,000 cubic km and 4,170 meters above sea level. (Encyclopedia Britannica Volume 27) . Ice core samples have also shown a dramatic increase in carbon dioxide levels. Drilling deep into glaciers and polar ice caps and taking out samples of ice, then melting the ice and capturing the gas has shown an increase in carbon dioxide concentrations over the past 100 years. Ice core samples are essentially "drilling through time", because the deeper the ice is, the older the ice is.

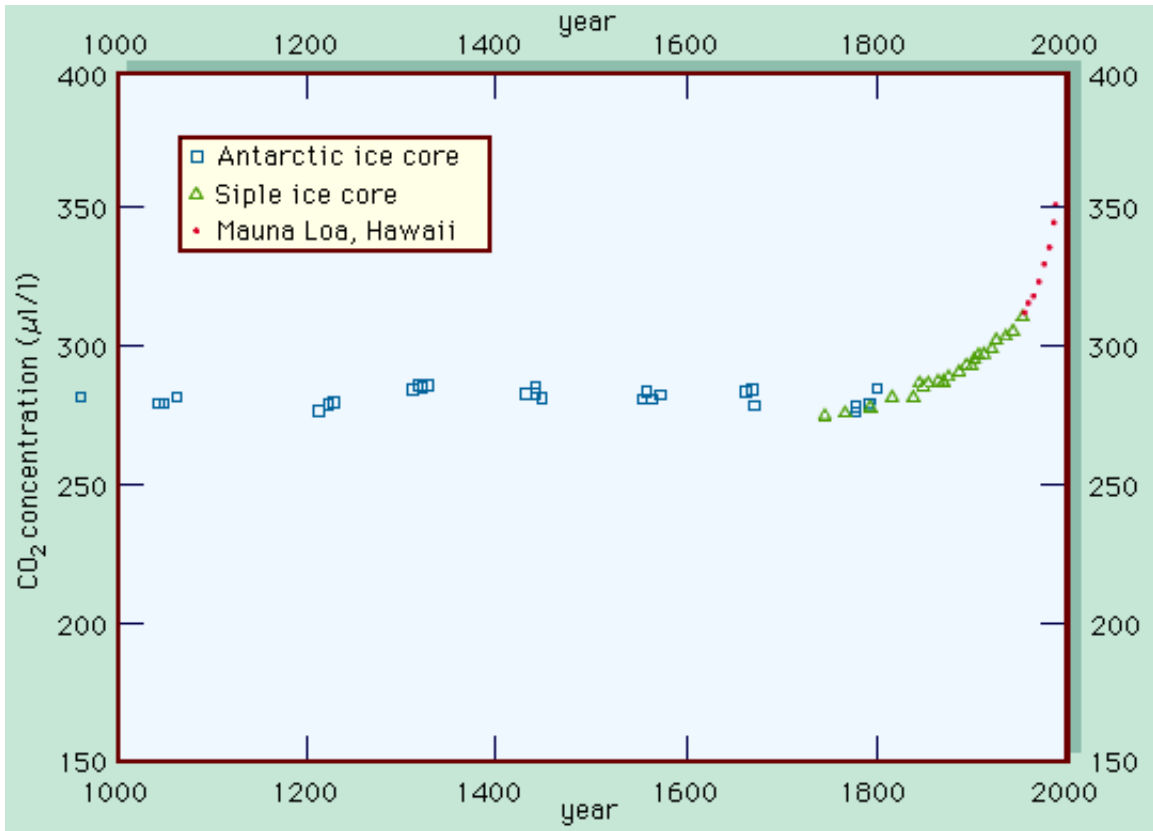
In 1996, carbon dioxide world emissions increased by 2.8%. The U.S. reported a 3.3% increase in CO₂ concentrations. The U.S. continues to emit more than any other country in the world, accounting for 25% of all emissions. The European Union had an increase of 2.2%, much larger than a small increase of 1.1% in 1995. Eastern Europe had a decreasing rate of -2.4%. China's increase in 1996 was 4.7%. (<http://infoweb.magi.com/~dwalsh/wfsesr.html>)

Fossil Fuels were created chiefly by the decay of plants from millions of years ago. We use coal, oil and natural gas to generate electricity, heat our homes, power our factories and run our cars. These fossil fuels contain carbon, and when they are burned, they combine with oxygen, forming carbon dioxide. The two atoms of oxygen add to the total weight. The World Energy Council reported that global carbon dioxide emissions from burning fossil fuels rose 12% between 1990 and 1995. (www.eb.com:180) The increase from developing countries was three times that from developed countries. Middle East carbon dioxide emissions from burning of fossil fuels increased 35%, Africa increased 12%, and Eastern Europe increased rates by 75% from 1990-1995.

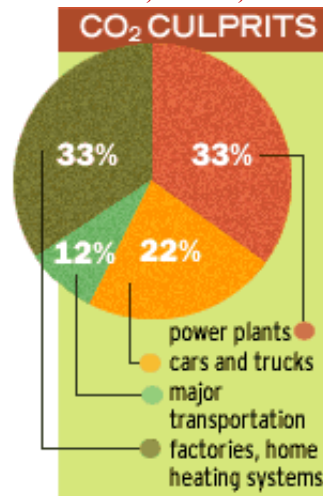


This graph shows the increase of carbon dioxide in the air over the past few centuries

Greenhouse Gases



Ice Core samples and samples at Mauna Loa, Hawaii, reveal an increase CO₂ concentrations



Pie chart shows how CO₂ is produced
www.envirolink.org/orgs/edf/sitemap.html



Cars also contribute to CO₂ in the atmosphere.
www.abcnews.com/sections/us/global106/index.html

Deforestation is another main producer of carbon dioxide. The causes of deforestation are logging for lumber, pulpwood, and fuel wood. Also contributing to deforestation are clearing new land for farming and pastures used for animals such as cows. Forests and wooded areas are natural carbon sinks. This means that as trees absorb carbon dioxide, and release oxygen, carbon is being put into trees. This process occurs naturally by photosynthesis, which occurs less and less as we cut and burn down trees. As the abundance of trees declines, less carbon dioxide can be recycled. As we burn them down, carbon is released into the air and the carbon bonds with oxygen to form carbon dioxide, adding to the greenhouse effect. About 860 acres, the size of Central Park in New York, is destroyed every 15 minutes in the tropics.



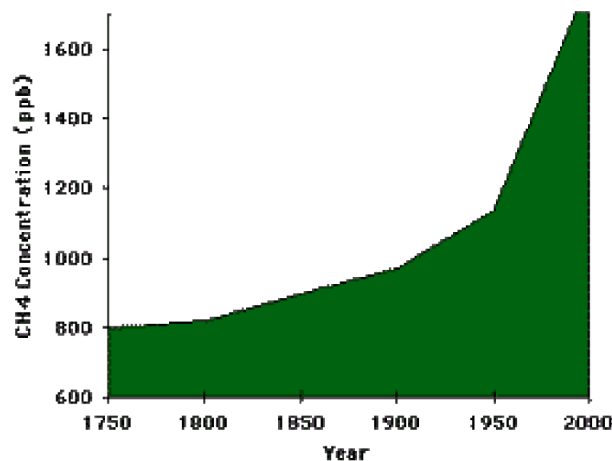
Deforestation and Forest Fires contribute to an increase in CO₂ levels
www.envirolink.org/orgs/edf/sitemap.html



The Amazon Rain Forest, which is in parts of Brazil, French Guiana, Suriname, Guyana, Venezuela, Nicaragua, Costa Rica, Panama, Columbia, Ecuador, Peru, and Bolivia, is subjected to a great deal of deforestation
www.abcnews.com/sections/us/global106.html

Methane

Methane is a colorless, odorless, flammable gas. It is formed when plants decay and where there is very little air. It is often called *swamp gas* because it is abundant around water and swamps. Bacteria that breakdown organic matter in wetlands and bacteria that are found in cows, sheep, goats, buffalo, termites, and camels produce methane naturally. Since 1750, methane has doubled, and could double again by 2050. Each year we add 350-500 million tons of methane to the air by raising livestock, coal mining, drilling for oil and natural gas, rice cultivation, and garbage sitting in landfills. (www.envirolink.org/orgs/edf/sitemap.html) It stays in the atmosphere for only 10 years, but traps 20 times more heat than carbon dioxide.



Methane is on the rise since 1750
www.envirolink.org/orgs/edf/sitemap.html

Rice cultivation has developed into a large business; farmland has doubled in the past 45 years. (www.envirolink.org/orgs/edf/sitemap.html) It feeds 1/3 of the World's population. It grows mostly in flooded fields, where bacteria in waterlogged soil releases methane.

Livestock such as cows, sheep, goats, camels, buffaloes, and termites release methane as well. Bacteria in the gut of the animal break down food and convert some of it to methane. When these animals belch, methane

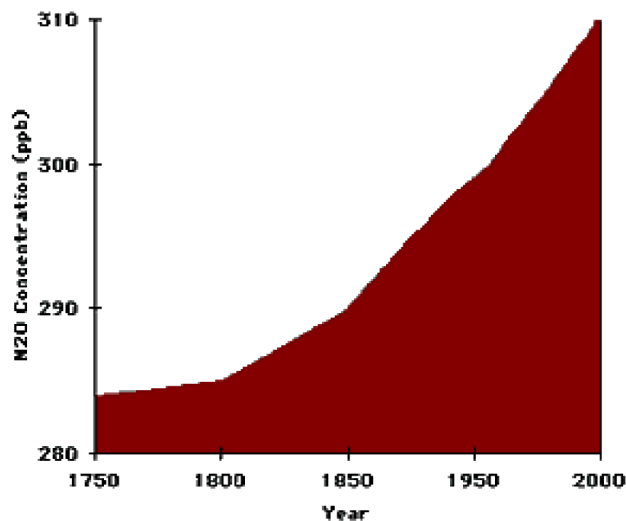
is released. In one day, a cow can emit $\frac{1}{2}$ pound of methane into the air. Imagine 1.3 billion cattle each burping methane several times per minute!



Cows such as these contribute a large amount of methane to the air.
www.envirolink.org/orgs/edf/sitemap.html

Nitrous Oxide

Nitrous oxide is another colorless greenhouse gas, however, it has a sweet odor. It is primarily used as an anesthetic because it deadens pain and for this characteristic is called □laughing gas.□ This gas is released naturally from oceans and by bacteria in soils. Nitrous oxide gas risen by more than 15% since 1750. Each year we add 7-13 million tons into the atmosphere by using nitrogen based fertilizers, disposing of human and animal waste in sewage treatment plants, automobile exhaust, and other sources not yet identified. It is important to reduce emissions because the nitrous oxide we release today will still be trapped in the atmosphere 100 years from now. (World Book Volume 13)



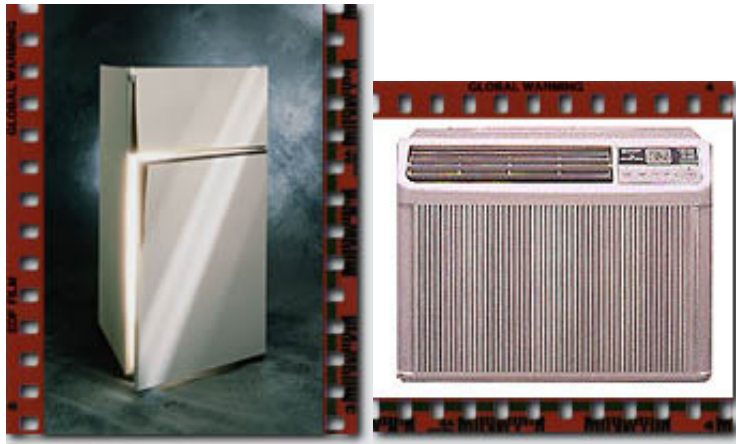
Nitrous Oxide has been on the rise since 1750
www.envirolink.org/orgs/edf/sitemap.html

Nitrogen based fertilizer use has doubled in the past 15 years. These fertilizers provide nutrients for crops; however, when they breakdown in the soil, nitrous oxide is released into the atmosphere. In automobiles, nitrous oxide is released at a much lower rate than carbon dioxide, because there is more carbon in gasoline than nitrogen.

Fluorocarbons

Fluorocarbons is a general term for any group of synthetic organic compounds that contain fluorine and carbon. Many of these compounds, such as chlorofluorocarbons (CFCs), can be easily converted from gas to liquid or liquid to gas. Because of these properties, CFCs can be used in aerosol cans, refrigerators, and air conditioners. Studies in the 1970s showed that when CFCs are emitted into the atmosphere, they break down molecules in the Earth's ozone layer (World Book). Since then, the use of CFCs has significantly decreased and they are banned from production in the United States.

The substitute for CFCs are hydrofluorocarbons (HFC's). HFCs do not harm or breakdown the ozone molecule, but they do trap heat in the atmosphere, making it a greenhouse gas, aiding in global warming. HFCs are used in air conditioners and refrigerators. The way to reduce emissions of this gas is to be sure that in both devices the coolant is recycled and all leaks are properly fixed. Also, before throwing the appliances away, be sure to recover the coolant in each.



Refrigerators and Air Conditioners using CFC's were a huge problem for the ozone layer, but now HFC's are a problem for the climate.

www.envirolink.org/orgs/edf/sitemap.html

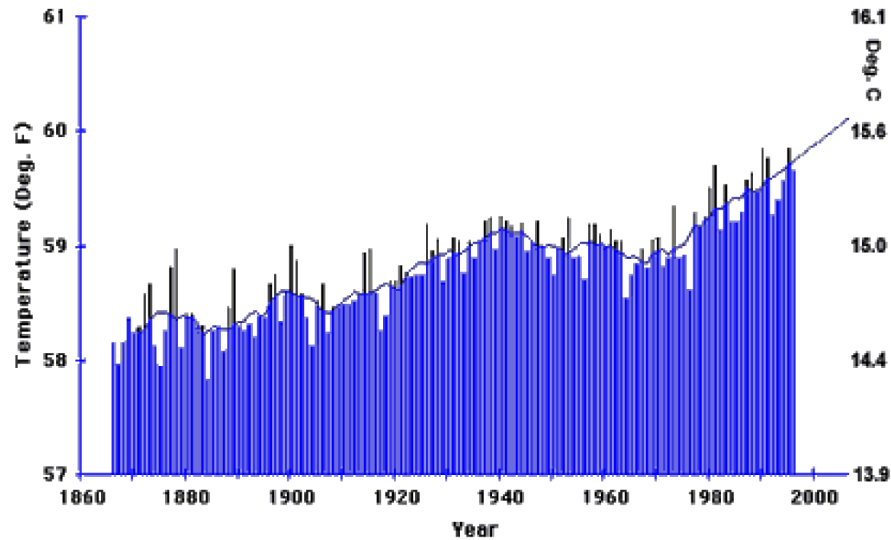
Global Warming is Here

Naturally, if there are more greenhouse gases in the atmosphere, this greenhouse effect will be more significant and raise the temperature of Earth more than if humans didn't emit as much greenhouse gases. Peter Tans, a physicist with National Oceanic and Atmospheric Administrations (NOAA) Climate Monitoring and Diagnostics Lab says, "There is no doubt that both land and ocean surface temperatures have gone up significantly in the last 100 years or so." (www.abcnews.com/sections/us/global106.html) This statement supports the trend of global warming, but does not acknowledge the source. The director of NOAA's Geophysical Fluid Dynamics Lab at Princeton, Jerry Malhan, says, "The Earth's surface temperature has warmed about one degree Fahrenheit in the last 100 years, and there is no credible hypothesis for this, other than the net effect of greenhouse gases." (www.abcnews.com/sections/us/global106.index.html) Jerry Malhan offers a quote supporting the theory of global warming and also states that it is directly related to the increase of greenhouse gases. "The planet is heating up and the evidence suggests that human activities are having a significant impact," Jane Lubchenco said. (www.abcnews.com/sections/us/global106/index.html) Jane was the past President of the American Association for the Advancement of Science, who briefed President Clinton on global warming in July, 1997. The world's leading authority on global warming, the

Intergovernmental Panel on Climate Change (IPCC), is a United Nations sponsored organization made up of 2500 scientists from around the world. They have concluded by consensus that "The balance of evidence suggests a discernible human influence on global climate." They project that global warming will have severe impacts on human health, natural ecosystems, agriculture, and coastal communities.

(www.toowarm.org/factsheets/basfact.html)

This evidence supports the common belief that Global Warming is occurring due to the increased concentration of greenhouse gases in the atmosphere, carbon dioxide, nitrous oxide, methane, and HFCs.



Average yearly temperature rise: 1860-1998

www.evirolink.org/orgs/edf/sitemap.html

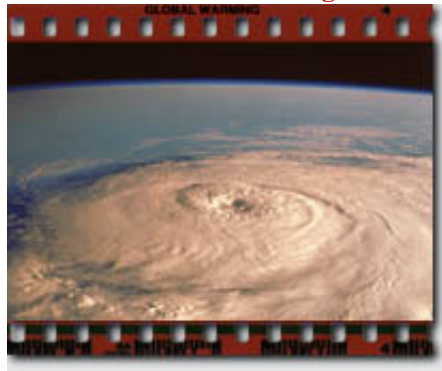
Effects of Global Warming on Environment

There are many environmental problems coming from the increase concentration of greenhouse gases in Earth's atmosphere. As Jeff Rubin of ABC NEWS reported, "Several signs indicate that we've begun changing Earth's climate: increased water vapor in the atmosphere, glaciers and polar ice caps appear to be melting, floods and droughts are becoming more severe, and sea levels have risen, on average, between 4 and 10 inches since 1990." (www.abc.com/sections/us/global106.html) Experts concur, "We are already beginning to see this (global warming) taking place - a lot more flooding, a lot more droughts," Jane Lubchenco said. Jerry Malham added, "By 2100, we might get a 2 foot sea level rise, but the catch is, levels might continue to rise 2 or 3 feet per century, for 1000 years." (www.abcnews.com/sections/us/global106.html) These rises in sea level can increase the salinity of freshwater throughout the world, and cause coastal lands to be washed under the ocean. Warmer water and increased humidity may encourage tropical cyclones, and changing wave patterns could produce more tidal waves and strong beach erosion on the coasts.



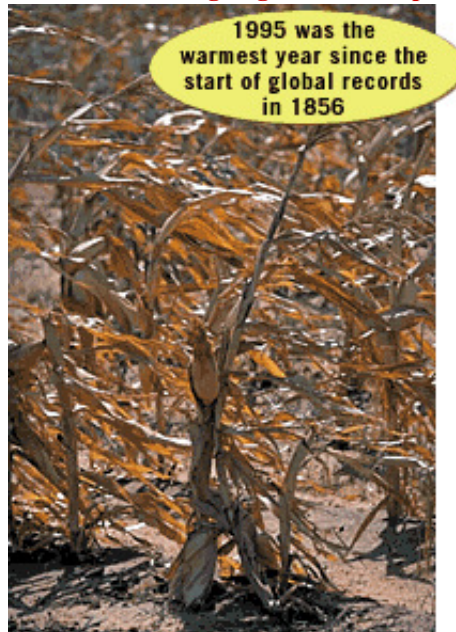
Flooding from global warming may be already happening.

www.abcnews.com/sections/us/global106.html



Picture of a typhoon from space

www.envirolink.org/orgs/edf/sitemap.html



The effects of droughts on crops

www.abcnews.com/sections/us/global106.html

Effects of Global Warming on Society

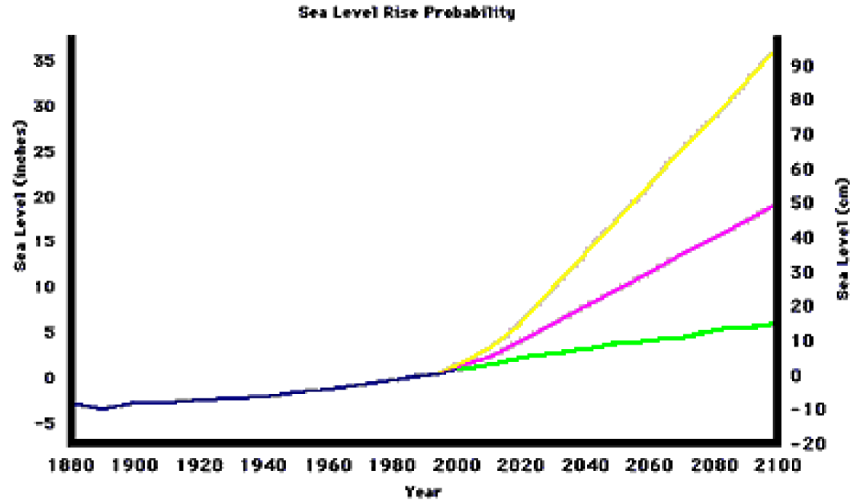
Agriculturally, Dr. Sylvan H. Wittwer believes that global warming is good for the human race, because it helps increase food production. "The most determinant factor in agriculture production is climate. History reveals that for food production, warming is better than cooling." Dr. Wittwer says that carbon dioxide is an essential nutrient for the production of food, and food is one of the most important things in our lives. As the temperature rises, more farmland will be open towards the poles and the length of the growing season will also lengthen. With all the people who go hungry each day, Dr. Wittwer believes food production should be one of our main concerns. Dr. Wittwer is the scientific pioneer who conducted the original studies on atmospheric CO₂ enhancement of the production of food crops. (www.comnett.net/~wit/food.html)

Increasing amounts of greenhouse gases in the atmosphere and global warming could also lead to more health concerns. A statement released from the Intergovernmental Panel on Climate Change (IPCC) said, "Climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life." As temperatures increase towards the poles, similar to farmland, insects and other pests migrate towards Earth's poles. These insects and pests could be allowed to migrate up to 550 Km or 550 miles. Some insects carry diseases such as malaria and dengue fever. Thus, an increase in these particular insects and pests closer to the poles results in an increase in these diseases. This could lead to 50 to 80 million additional cases of Malaria annually, a 10-15% increase. "Malaria and dengue fever are already beginning to spread pole wards", said Jane Lubchenco, past president of American Association for the advancement of science. (www.epa.gov/oppeoeel/globalwarming/impacts/health/index.html) Physician Paul Epstein, of Harvard's School of Public Health, says "Climate change is already a factor in terms of the distributions of malaria, dengue fever, and cholera." (www.aloha.net/~jhanson/page70.htm)

The most obvious health effect is directly from the heat itself. With an increase in heat waves, there will be more people who will suffer from heatstroke, heart attacks and other ailments aggravated by the heat. According to the EPA, "In July 1995, a heat wave killed more than 700 people in the Chicago area alone." (www.epa.gov/oppeoeel/globalwarming/impacts/health/index.html) If this is happening already from heat, imagine what would occur in the future with global warming. Hot conditions could also cause smoke particles and noxious gases to linger in the air and accelerate chemical reactions that generate other pollutants. (www.envirolink.org/orgs/edf/sitemap.html) This leads to an increase in risk of respiratory diseases like bronchitis and asthma.

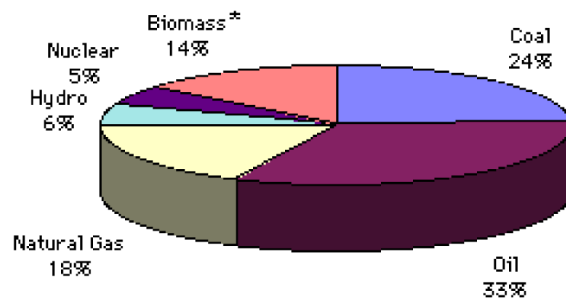
Global warming causes the oceans to warm and expand, inducing a rise in sea level. Eventually, the rising waters could take away land inhabited by people, forcing them to move. Dr. Robert Buddemeir, of the Kansas Geological Survey said, "Bangladesh is massively populated, achingly poor, and something like a sixth of the country is going to go away" (www.envirolink.org/orgs/edf/sitemap.html) Bangladesh cannot afford to build barriers to hold back the sea, so people would have to move inland, increasing the populations density and leading to an increase in hunger and disease. (www.envirolink.org/orgs/edf/sitemap.html) The Maldive Islands in the Indian Ocean have the same problem They are a nation of 1190 islands with an average height of about 1.5 meters above sea level. If the sea level rises, more than 200,000 people will have to abandon their homes. (www.envirolink.org/orgs/edf/sitemap.html) Warming of the oceans could also promote toxic

algae which can lead to cholera.



Graph showing history of sea level and extrapolating possible increases in sea level over the next century
The blue line represents the history of sea level. The yellow line is a high estimate of sea level extrapolated. The red line a central estimate, and the green line is a low projection.
www.envirolink.org/orgs/edf/sitemap.html

The Present ways of Producing Energy



This pie graph shows the breakdown of how the world produces its energy
www.envirolink.org/orgs/edf/sitemap.html

Fossil fuels, chiefly coal, oil and natural gas, now supply most of the world's energy. Only a small amount comes from renewable sources, which do not release gases that trap heat in the atmosphere. If we could get more of our energy from renewable sources, we could reduce the amount of fossil fuels we burn. By the year 2050, renewable sources could provide forty percent of the energy needed in the world. Use of renewable energy can help both to slow global warming and to reduce air pollution.

(www.doc.mmu.ac.uk/aric/gcc/cell.htm#pos6)

These fossil fuels, coal, oil, and natural gas also emit greenhouse gases when burned. Coal emits high amounts of greenhouse gases, and the world may be supplied with enough of it to last over 100 years. Oil emits high amounts of greenhouse gases and also other types of air pollution harmful to the environment. The world's oil supply is also estimated to last over 100 years. Natural Gas is the lowest of all fossil fuels in greenhouse gas emissions; supplies are projected to last over 100 years.

(www.doc.mmu.ac.uk/aric/gcc/cell.htm#pos6)

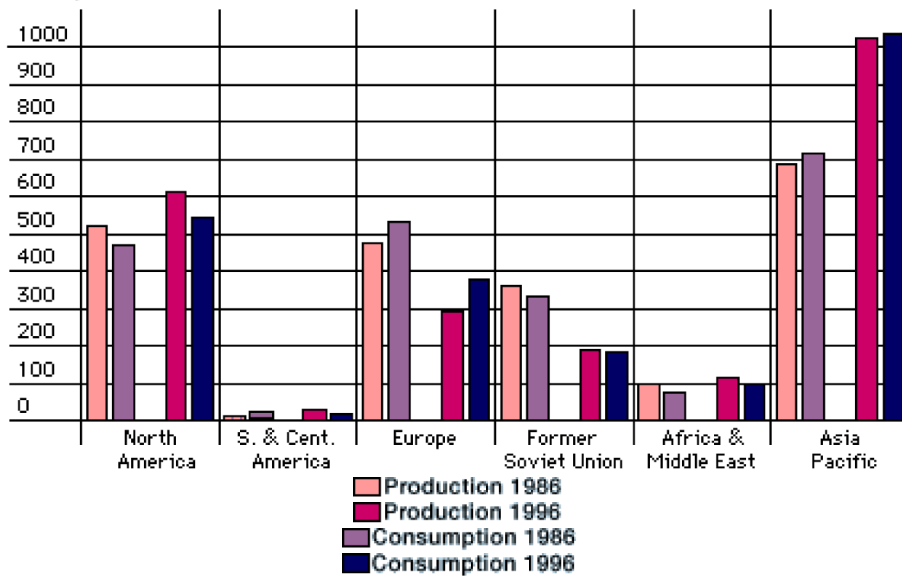
1996 Processes Carbon Dioxide was Produced

Country (region)	OIL	Natural Gas	Coal
World	44.7%	18.4%	36.9%
Canada	51.8%	30%	18.2%
United States	45%	21.3%	33.7%
European Union	56.2%	19%	24.8%
China	17.4%	1.1%	81.5%
Japan	64.6%	9.9%	25.5%

This chart shows what percentage of CO2 comes from Oil, Natural Gas, and Coal. For example, in 1996, 44.7% of the world's CO2 emissions came from the combustion of oil.
<http://infoweb.magi.com/~dwalsh/wfsesr.html>

Area production and consumption 1986 and 1996

Million tonnes oil equivalent



This chart shows how much coal different areas of the world have produced and consumed over time



Coal accounts for 24% of the worlds energy; Natural gas 18%
www.envirolink.org/orgs/edf/sitemap.html

Solutions for Producing "Cleaner" Energy

Hydro power, currently supplying only six percent of the world's energy, is a renewable energy source. Energy is produced by hydraulic turbines that rotate with the force of rushing water (higher to lower elevation). It is one of the most clean and cheapest way of producing energy, but it can also change the flow of rivers and increase sediment which kills fish. It is a large investment for developing countries. (www.abcnews.com/sections/us/global106)



Hydro Power plant on a river
www.envirolink.org/orgs/edf/sitemap.html

Denmark is currently the world leader in **wind power**. By 2030, fifty percent of Denmark's energy could be produced by wind power. Randall Swisher, executive director of the American Wind Energy Association says, "If this country made an aggressive development push, by 2020 eighteen percent of the country's energy could be supplied by wind power." (www.abc.com/sections/us/global106.html) Wind power emits no greenhouse gases, but it takes up large amounts of land. In order for it to be a reliable source, scientists must develop better power storage techniques. Another concern of people is noise pollution that the large windmills produce along with the reliability of wind.



A field of wind mills

www.envirolink.org/orgs/edf/sitemap.html

Solar power uses photovoltaic cells (PV's) to gather thermal energy directly from the sun and use it to produce electricity. One community could be supplied by one field of PV's . Passive solar cells could also be used to heat water, replacing the need for today's hot water heaters. PV's do not emit any greenhouse gases, but they are very expensive and more development is needed in order for this to be realistic energy source for the future. (www.abcnews.com/sections/us/global106.html)



A field of PV's gathering sunlight to produce power

www.abcnews.com/sections/us/global106.html

Nuclear power is strong in Europe with about forty-two percent of their energy produced by **fission**. Nuclear generation provides about 17% of world electricity, avoiding the emission of up to 2.3 billion tonnes of carbon dioxide annually. France produces 76% and Lithuania produces 85.6% of its energy by nuclear fission. (<http://infoweb.magi.com/~dwalsh/wfsesr.html>) In the United States, people are antinuclear because of 3 Mile Island in 1979 and Chernobyl in 1986. However, many experts say that it is a safe, clean, and reliable source of energy. Nuclear Fission produces no greenhouse gases, but does produce highly toxic radioactive wastes.



Nuclear power plants have had success in Europe, but not in the United States
www.envirolink.org/orgs/edf/sitemap.html

Kyoto Protocol

One of the major conventions concerning global warming resulted in the Kyoto Protocol, held in Kyoto, Japan, between December 1-11, 1997. Delegates from all over the world were present in order to find a universal agreement to reduce greenhouse gas emissions. The results had most developed nations doing most of the reducing; the United States must cut emissions 7%, Japan 6%, and the European Union 8% below 1990 levels. (www.state.gov/global/oes/fs_kyoto_climate_980115.html)

The United States proposed a plan to have these levels cut over a five year period between 2008-2013. The United States also said it will not sign the protocol if other developing/undeveloped countries do not sign it as well, fearing the economy will falter. The U.S. was successful in emissions trading with other countries who have less emissions. This means that the U.S. or other developed countries can purchase emission permits from other countries who have extra permits. This stresses the importance of flexibility the U.S. was looking for when it said it cannot lower the emission levels until at least 2008. Again, the U.S. is trying to look out for it's own economy first. If a country shall fail in completing its goal, the country will then not be able to receive joint implementation projects. However, this Protocol is not yet law; it must be ratified by at least 55 countries, accounting for 55% of the world's total greenhouse gas emissions.. It can be signed by countries starting in March of 1998. The next convention is in November 1998, in Buenos Aires. (www.state.gov/global/oes/fs_kyoto_climate_980115.html)

If the Kyoto Protocol becomes the law of the land, there are potential economic problems that may lead to a change in quality of life for many Americans. By reducing greenhouse gas emissions, people will be more healthy due to better air quality and water quality. However, there may be a reduction in the rate of economic development because industries will have to adapt and find different ways of producing goods. People will have to drive smaller, lighter cars, ride bicycles more often, and increase efficiency in many ways.

Opinion

The world's leading scientists project that during our children's lifetimes global warming will raise the average temperature of the planet by 2 to 6 degrees Fahrenheit, or 1-3.5 degree Celsius. In contrast the Earth is only 5 to 9 degrees Fahrenheit or about 3-6 degrees Celsius warmer today than it was 10,000 years ago during the last ice age. Man-made global warming is occurring much faster than at any other time in at least

the last 10,000 years. (www.toowarm.org/factsheets/basfact.html#How) This information would suggest that the warming Earth is experiencing now is not a natural phenomenon, but caused by the increased concentration of greenhouse gases.

While evidence is strong to support the notion of human contribution to the global warming problem, an alternative view is that recent global warming is a natural occurrence. Some theorists believe that the Earth's climate works in a cycle, cooling, and then warming itself. Scientists point out the fact that 75 million years ago, the Earth's average temperature was ten degrees higher than it is today. Conditions were warmer and more humid, but life sustained. (www.enviolink.org/orgs/edf/sitemap.html)

Another phenomenon to take into account is the "little ice age", which occurred from 1550-1850 A.D. Conditions around the world were cooler than usual; many bodies of water froze over. The average global temperature since the little ice age has risen by one degree Fahrenheit! Shouldn't it be expected that after that ice age was over that the temperature on Earth would rise at least one degree?

The bottom line is that it may seem that only human actions are causing global warming, but it is very possible that global warming is nothing to worry about and is just part of the global temperature cycle. Both theories are credible, but neither has yet been proven.

Terms

1. **Carbon Dioxide** - a heavy colorless gas that does not support combustion, dissolves in water to form carbonic acid, is formed especially in animal respiration and in the decay or combustion of animal and vegetable matter, is absorbed from the air by plants in photosynthesis, and is used in the carbonation of beverages.
2. **Methane**- a colorless odorless flammable gaseous hydrocarbon that is a product of decompositions of organic matter and of the carbonization of coal, is used as a fuel and as a starting material in chemical synthesis, and is the simplest of the alkanes.
3. **Photosynthesis**- synthesis of chemical compounds with the aid of radiant energy and especially light; especially formation of carbohydrates from carbon dioxide and a source of hydrogen in the chlorophyll-containing tissues of plants exposed to light
4. **Greenhouse Effect**- warming of the surface and lower atmosphere of a planet that is caused by conversion of solar radiation into heat in a process involving selective transmission of short wave solar radiation by the atmosphere, its absorption by the planet's surface, and reradiation as infrared which is absorbed and partly reradiated back to the surface by atmospheric gases.
5. **Nitrous oxide** - a colorless gas that when inhaled produces loss of sensibility to pain preceded by exhilaration and sometimes laughter and is used as an anesthetic in dentistry and that is an atmospheric pollutant produced by combustion and a suspected contributor to greenhouse warming -- also called laughing gas.
6. **Malaria** - a human disease that is caused by sporozoan parasites in the red blood cells, is transmitted by the bite of anopheline mosquitoes, and is characterized by periodic attacks of chills and fever
7. **Dengue** - an acute infectious disease caused by an arbovirus, transmitted by aedes mosquitoes, and characterized by headache, severe joint pain, and a rash--called also dengue fever.

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