Please see [EPA's Climate Change site](http://yosemite.epa.gov/oar/globalwarming.nsf/content/Glossary.html) for current information on climate change and global warming. EPA no longer updates EPA's Global Warming Site, but is maintaining this archive for historical purposes. Thank you for visiting the archive of EPA's Global Warming Site.

### Glossary of Climate Change Terms

**A**  
- **Abiotic**  
  Nonliving. Compare [biotic](#).

- **Absorption of radiation**  
  The uptake of radiation by a solid body, liquid or gas. The absorbed energy may be transferred or re-emitted. See [radiation](#).

- **Acid deposition**  
  A complex chemical and atmospheric process whereby recombined emissions of sulfur and nitrogen compounds are redeposited on earth in wet or dry form. See [acid rain](#).

- **Acid rain**  
  Rainwater that has an acidity content greater than the postulated natural pH of about 5.6. It is formed when sulfur dioxides and nitrogen oxides, as gases or fine particles in the atmosphere, combine with water vapor and precipitate as sulfuric acid or nitric acid in rain, snow, or fog. The dry forms are acidic gases or particulates. See [acid deposition](#), [sulfur dioxide](#), [nitrogen oxides](#).

- **Acid Solution**  
  Any water solution that has more hydrogen ions (H+) than hydroxide ions (OH-); any water solution with a pH less than 7. See [basic solution](#).

- **Acidic**  
  See [acid solution](#).

- **Adiabatic Process**  
  A thermodynamic change of state of a system such that no heat or mass is transferred across the boundaries of the system. In an adiabatic process, expansion always results in cooling, and compression in warming.

- **Aerobic**  
  A life or process that occurs in and is dependent upon oxygen. See [methanotrophic](#), [anaerobic](#).
Particulate matter, solid or liquid, larger than a molecule but small enough to remain suspended in the atmosphere. Natural sources include salt particles from sea spray, dust and clay particles as a result of weathering of rocks, both of which are carried upward by the wind. Aerosols can also originate as a result of human activities and are often considered pollutants. Aerosols are important in the atmosphere as nuclei for the condensation of water droplets and ice crystals, as participants in various chemical cycles, and as absorbers and scatterers of solar radiation, thereby influencing the radiation budget of the Earth's climate system. See climate, particulate matter, sulfate aerosols.

**Afforestation**

Planting of new forests on lands that have not been recently forested.

**Air carrier**

An operator (e.g., airline) in the commercial system of air transportation consisting of aircraft that hold certificates of, Public Convenience and Necessity, issued by the Department of Transportation, to conduct scheduled or non-scheduled flights within the country or abroad.

**Air pollutant**

See air pollution.

**Air pollution**

One or more chemicals or substances in high enough concentrations in the air to harm humans, other animals, vegetation, or materials. Such chemicals or physical conditions (such as excess heat or noise) are called air pollutants.

**Albedo**

The fraction of the total solar radiation incident on a body that is reflected by it. Albedo can be expressed as either a percentage or a fraction of 1. Snow covered areas have a high albedo (up to about 0.9 or 90%) due to their white color, while vegetation has a low albedo (generally about 0.1 or 10%) due to the dark color and light absorbed for photosynthesis. Clouds have an intermediate albedo and are the most important contributor to the Earth's albedo. The Earth's aggregate albedo is approximately 0.3. See radiation, radiative forcing, photosynthesis.

**Alliance of Small Island States (AOSIS)**

The group of Pacific and Caribbean nations who call for relatively fast action by developed nations to reduce greenhouse gas emissions. The AOSIS countries are concerned by the effects of rising sea levels and increased storm activity predicted to accompany global warming. Its plan is to hold Annex I Parties to a 20 percent reduction in carbon dioxide emissions by the year 2005. See Annex I Parties.

**Alkalinity**

Having the properties of a base with a pH of more than 7. A common alkaline is baking soda.

**Alternative energy**

Energy derived from nontraditional sources (e.g., compressed natural gas, solar, hydroelectric, wind).

**Anaerobic**

A life or process that occurs in, or is not destroyed by, the absence of oxygen.

**Anaerobic decomposition**

The breakdown of molecules into simpler molecules or atoms by microorganisms that can survive in the partial or complete absence of
oxygen.

**Anaerobic lagoon**
A liquid-based manure management system, characterized by waste residing in water to a depth of at least six feet for a period ranging between 30 and 200 days. Bacteria produce methane in the absence of oxygen while breaking down waste.

**Anaerobic organism**
An organism that does not need oxygen to stay alive. See [anaerobic](http://yosemite.epa.gov/oar/globalwarming.nsf/content/Glossary.html).

**Annex I Parties**
Industrialized countries that, as parties to the Framework Convention on Climate Change, have pledged to reduce their greenhouse gas emissions by the year 2000 to 1990 levels. Annex I Parties consist of countries belonging to the Organization for Economic Cooperation and Development (OECD) and countries designated as Economies-in-Transition.

**Antarctic "Ozone Hole"**
Refers to the seasonal depletion of stratospheric ozone in a large area over Antarctica. See [ozone](http://yosemite.epa.gov/oar/globalwarming.nsf/content/Glossary.html), [ozone layer](http://yosemite.epa.gov/oar/globalwarming.nsf/content/Glossary.html).

**Anthracite**
A hard, black, lustrous coal containing a high percentage of fixed carbon and a low percentage of volatile matter. Often referred to as hard coal. See [coal](http://yosemite.epa.gov/oar/globalwarming.nsf/content/Glossary.html).

**Anthropogenic**
Human made. In the context of greenhouse gases, emissions that are produced as the result of human activities.

**Arable land**
Land that can be cultivated to grow crops.

**Aromatic**
Applied to a group of hydrocarbons and their derivatives characterized by the presence of the benzene ring.

**Ash**
The mineral content of a product remaining after complete combustion.

**Asphalt**
A dark-brown-to-black cement-like material containing bitumen as the predominant constituent. It is obtained by petroleum processing. The definition includes crude asphalt as well as the following finished products: cements, fluxes, the asphalt content of emulsions (exclusive of water), and petroleum distillates blended with asphalt to make cutback asphalt.

**Atmosphere**
The mixture of gases surrounding the Earth. The Earth's atmosphere consists of about 79.1% nitrogen (by volume), 20.9% oxygen, 0.036% carbon dioxide and trace amounts of other gases. The atmosphere can be divided into a number of layers according to its mixing or chemical characteristics, generally determined by its thermal properties (temperature). The layer nearest the Earth is the troposphere, which reaches up to an altitude of about 8 km (about 5 miles) in the polar regions and up to 17 km (nearly 11 miles) above the equator. The stratosphere, which reaches to an altitude of about 50 km (31 miles) lies atop the troposphere. The mesosphere which extends up to 80-90 km is atop the stratosphere, and finally, the thermosphere, or ionosphere, gradually diminishes and forms a fuzzy border with outer space. There is relatively little mixing of gases between layers.
Atmospheric lifetime
See lifetime.

Atomic weight
The average weight (or mass) of all the isotopes of an element, as determined from the proportions in which they are present in a given element, compared with the mass of the 12 isotope of carbon (taken as precisely 12.000), that is the official international standard; measured in daltons.

Atoms
Minute particles that are the basic building blocks of all chemical elements and thus all matter.

Aviation gasoline
All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range, which will be used for blending or compounding into aviation gasoline.

Bacteria
One-celled organisms. Many act as decomposers that break down dead organic matter into substances that dissolve in water and are used as nutrients by plants.

Barrel
A liquid-volume measure equal to 42 United States gallons at 60 degrees Fahrenheit; used in expressing quantities of petroleum-based products.

Baseline Emissions
The emissions that would occur without policy intervention (in a business-as-usual scenario). Baseline estimates are needed to determine the effectiveness of emissions reduction programs (often called mitigation strategies).

Basic solution
Water solution with more hydroxide ions (OH-) than hydrogen ions (H+); water solutions with pH greater than 7. See acid solution, alkalinity.

Berlin Mandate
A ruling negotiated at the first Conference of the Parties (COP 1), which took place in March, 1995, concluding that the present commitments under the United Nations Framework Convention on Climate Change are not adequate. Under the Framework Convention, developed countries pledged to take measures aimed at returning their greenhouse gas emissions to 1990 levels by the year 2000. The Berlin Mandate establishes a process that would enable the Parties to take appropriate action for the period beyond 2000, including a strengthening of developed country commitments, through the adoption of a protocol or other legal instruments. See United Nations Framework Convention on Climate Change, Conference of the Parties.
**Biodegradable**
Material that can be broken down into simpler substances (elements and compounds) by bacteria or other decomposers. Paper and most organic wastes such as animal manure are biodegradable. See [nonbiodegradable](#).

**Biofuel**
Gas or liquid fuel made from plant material (biomass). Includes wood, wood waste, wood liquors, peat, railroad ties, wood sludge, spent sulfite liquors, agricultural waste, straw, tires, fish oils, tall oil, sludge waste, waste alcohol, municipal solid waste, landfill gases, other waste, and ethanol blended into motor gasoline.

**Biogeochemical Cycle**
Natural processes that recycle nutrients in various chemical forms from the environment, to organisms, and then back to the environment. Examples are the carbon, oxygen, nitrogen, phosphorus, and hydrologic cycles.

**Biological oxygen demand**
Amount of dissolved oxygen needed by aerobic decomposers to break down the organic materials in a given volume of water at a certain temperature over a specified time period. See [BOD5](#).

**Biomass**
Total dry weight of all living organisms that can be supported at each tropic level in a food chain. Also, materials that are biological in origin, including organic material (both living and dead) from above and below ground, for example, trees, crops, grasses, tree litter, roots, and animals and animal waste.

**Biomass energy**
Energy produced by combusting biomass materials such as wood. The carbon dioxide emitted from burning biomass will not increase total atmospheric carbon dioxide if this consumption is done on a sustainable basis (i.e., if in a given period of time, regrowth of biomass takes up as much carbon dioxide as is released from biomass combustion). Biomass energy is often suggested as a replacement for fossil fuel combustion. See [biomass](#).

**Biosphere**
The living and dead organisms found near the earth's surface in parts of the lithosphere, atmosphere, and hydrosphere. The part of the global carbon cycle that includes living organisms and biogenic organic matter.

**Biotic**
Living. Living organisms make up the biotic parts of ecosystems. See [abiotic](#).

**Bitumen**
Gooey, black, high-sulfur, heavy oil extracted from tar sand and then upgraded to synthetic fuel oil. See [tar sand](#).

**Bituminous coal**
A dense, black, soft coal, often with well-defined bands of bright and dull material. The most common coal, with moisture content usually less than 20 percent. Used for generating electricity, making coke, and space heating. See [coal](#).

**BOD5**
The biochemical oxygen demand of wastewater during decomposition occurring over a 5-day period. A measure of the organic content of wastewater. See [biological oxygen demand](#).

**Boreal**
Of or relating to the forest areas of the northern North Temperate Zone, dominated by coniferous trees such as spruce, fir, and pine.

**Borehole**
Any exploratory hole drilled into the Earth or ice to gather geophysical data. Climate researchers often take *ice core* samples, a type of borehole, to predict atmospheric composition in earlier years. See *ice core*.

**British thermal unit**
The quantity of heat required to raise the temperature of one pound of water one degree of Fahrenheit at or near 39.2 degrees Fahrenheit.

**Bunker fuel**
Fuel supplied to ships and aircraft for international transportation, irrespective of the flag of the carrier, consisting primarily of residual and distillate fuel oil for ships and jet fuel for aircraft.

**Bus**
A rubber-tired, self-propelled, manually steered vehicle that is generally designed to transport 30 individuals or more. Bus types include intercity, school and transit.

**Carbon black**
An amorphous form of carbon, produced commercially by thermal or oxidative decomposition of hydrocarbons and used principally in rubber goods, pigments, and printer's ink.

**Carbon cycle**
All carbon reservoirs and exchanges of carbon from reservoir to reservoir by various chemical, physical, geological, and biological processes. Usually thought of as a series of the four main reservoirs of carbon interconnected by pathways of exchange. The four reservoirs, regions of the Earth in which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). Each of these global reservoirs may be subdivided into smaller pools, ranging in size from individual communities or ecosystems to the total of all living organisms (biota).

**Carbon dioxide**
A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion. Although carbon dioxide does not directly impair human health, it is a greenhouse gas that traps terrestrial (i.e., infrared) radiation and contributes to the potential for global warming. See *global warming*.

**Carbon dioxide equivalent**
A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents (MMTCDE)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP.

\[ \text{MMTCDE} = (\text{million metric tons of a gas}) \times \text{(GWP of the gas)} \]

See *greenhouse gas*, global warming potential, carbon equivalent.
Carbon Equivalent
A metric measure used to compare the emissions of different greenhouse gases based upon their global warming potential (GWP). Greenhouse gas emissions in the U.S. are most commonly expressed as "million metric tons of carbon equivalents" (MMTCE). Global warming potentials are used to convert greenhouse gases to carbon dioxide equivalents - they can be converted to carbon equivalents by multiplying by 12/44 (the ratio of the molecular weight of carbon to carbon dioxide). The formula for carbon equivalents is:

\[ \text{MMTCE} = (\text{million metric tons of a gas}) \times (\text{GWP of the gas}) \times (12/44) \]

See greenhouse gas, global warming potential, metric ton, carbon dioxide equivalent.

Carbon intensity
The relative amount of carbon emitted per unit of energy or fuels consumed. See energy, energy-efficiency.

Carbon pool
The reservoir containing carbon as a principal element in the geochemical cycle.

Carbon sequestration
The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned. See carbon sinks, fossil fuel.

Carbon sinks
Carbon reservoirs and conditions that take-in and store more carbon (i.e., carbon sequestration) than they release. Carbon sinks can serve to partially offset greenhouse gas emissions. Forests and oceans are large carbon sinks. See carbon sequestration.

Carbon tetrachloride
A compound consisting of one carbon atom and four chlorine atoms. It is an ozone depleting substance. Carbon tetrachloride was widely used as a raw material in many industrial applications, including the production of chlorofluorocarbons, and as a solvent. Solvent use was ended in the United States when it was discovered to be carcinogenic. See ozone depleting substance.

Chemical reaction
Interaction between chemicals in which there is a change in the chemical composition of the elements or compounds involved.

Chlorofluorocarbons
Organic compounds made up of atoms of carbon, chlorine, and fluorine. An example is CFC-12 (CCl2F2, used as a refrigerant in refrigerators and air conditioners and as a foam blowing agent. Gaseous CFCs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by strong ultraviolet radiation, release chlorine atoms, and then react with ozone molecules. See ozone depleting substance, fluorocarbons.

Climate
The average weather, usually taken over a 30 year time period, for a particular region and time period. Climate is not the same as weather, but rather, it is the average pattern of weather for a particular region. Weather describes the short-term state of the atmosphere. Climatic elements include precipitation, temperature, humidity, sunshine, wind velocity, phenomena.
such as fog, frost, and hail-storms, and other measures of the weather. See weather.

Climate change
The term "climate change" is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, climate change has been used synonymously with the term, global warming; scientists however, tend to use the term in the wider sense to also include natural changes in climate. See climate, global warming, greenhouse effect, enhanced greenhouse effect, radiative forcing.

Climate feedback
An atmospheric, oceanic, terrestrial, or other process that is activated by direct climate change induced by changes in radiative forcing. Climate feedbacks may increase (positive feedback) or diminish (negative feedback) the magnitude of the direct climate change. See climate, climate change, radiative forcing.

Climate lag
The delay that occurs in climate change as a result of some factor that changes only very slowly. For example, the effects of releasing more carbon dioxide into the atmosphere may not be known for some time because a large fraction is dissolved in the ocean and only released to the atmosphere many years later. See climate, climate change.

Climate model
A quantitative way of representing the interactions of the atmosphere, oceans, land surface, and ice. Models can range from relatively simple to quite comprehensive. See General Circulation Model.

Climate modeling
The simulation of the climate using computer-based models. See climate model, General Circulation Model.

Climate sensitivity
The equilibrium response of the climate to a change in radiative forcing, for example, a doubling of the carbon dioxide concentration. See climate, radiative forcing.

Climate system (or Earth system)
The atmosphere, the oceans, the biosphere, the cryosphere, and the geosphere, together make up the climate system.

Coal
A black or brownish black solid, combustible substance formed by the partial decomposition of vegetable matter without access to air. The rank of coal, which includes anthracite, bituminous coal, subbituminous coal, and lignite, is based on fixed carbon, volatile matter, and heating value. Coal rank indicates the progressive alteration, or coalification, from lignite to anthracite. See anthracite, bituminous coal, subbituminous coal, lignite.

Coal coke
A hard, porous product made from baking bituminous coal in ovens at temperatures as high as 2,000 degrees Fahrenheit. It is used both as a fuel and as a reducing agent in smelting iron ore in a blast furnace.

Coal gasification
Conversion of solid coal to synthetic natural gas (SNG) or a gaseous mixture that can be burned as a fuel.
Coal liquefaction
Conversion of solid coal to a liquid fuel such as synthetic crude oil or methanol.

Coalbed methane
Methane that is produced from coalbeds in the same manner as natural gas produced from other strata. Methane is the principal component of natural gas.

Co-control benefit
The additional benefit derived from an environmental policy that is designed to control one type of pollution, while reducing the emissions of other pollutants as well. For example, a policy to reduce carbon dioxide emissions might reduce the combustion of coal, but when coal combustion is reduced, so too are the emissions of particulates and sulfur dioxide. The benefits associated with reductions in emissions of particulates and sulfur dioxide are the co-control benefits of reductions in carbon dioxide.

Cogeneration
Production of two useful forms of energy such as high-temperature heat and electricity from the same process. For example, while boiling water to generate electricity, the leftover steam can be sold for industrial processes or space heating.

Combustion
Chemical oxidation accompanied by the generation of light and heat.

Commercial sector
An area consisting of non-housing units such as non-manufacturing business establishments (e.g., wholesale and retail businesses), health and educational institutions, and government offices.

Compost
Partially decomposed organic plant and animal matter that can be used as a soil conditioner or fertilizer. See decomposition.

Composting
Partial breakdown of organic plant and animal matter by aerobic bacteria to produce a material that can be used as a soil conditioner or fertilizer. See compost.

Compound
Combination of two or more different chemical elements held together by chemical bonds. See element, inorganic compound, organic compound.

Concentration
Amount of a chemical in a particular volume or weight of air, water, soil, or other medium. See parts per billion, parts per million. See parts per billion, parts per million.

Conference of the Parties
The supreme body of the United Nations Framework Convention on Climate Change (UNFCCC). It comprises more than 170 nations that have ratified the Convention. Its first session was held in Berlin, Germany, in 1995 and it is expected to continue meeting on a yearly basis. The COP's role is to promote and review the implementation of the Convention. It will periodically review existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programs. See United Nations Framework Convention on Climate Change, Berlin Mandate.
Conifer
See coniferous trees.

Coniferous trees
Cone-bearing trees, mostly evergreens, that have needle-shaped or scale-like leaves. They produce wood known commercially as softwood. See deciduous trees.

Criteria pollutant
A pollutant determined to be hazardous to human health and regulated under EPA's National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require EPA to describe the health and welfare impacts of a pollutant as the "criteria" for inclusion in the regulatory regime. Emissions of the criteria pollutants CO, NOx, NMVOCs, and SO2.

Crop residue
Organic residue remaining after the harvesting and processing of a crop.

Crop rotation
Planting the same field or areas of fields with different crops from year to year to reduce depletion of soil nutrients. A plant such as corn, tobacco, or cotton, which remove large amounts of nitrogen from the soil, is planted one year. The next year a legume such as soybeans, which add nitrogen to the soil, is planted.

Crude oil
A mixture of hydrocarbons that exist in liquid phase in underground reservoirs and remain liquid at atmospheric pressure after passing through surface separating facilities. See petroleum.

Cryosphere
The frozen part of the Earth's surface. The cryosphere includes the polar ice caps, continental ice sheets, mountain glaciers, sea ice, snow cover, lake and river ice, and permafrost.

D

Deciduous trees
Trees such as oaks and maples that lose their leaves during part of the year. See coniferous trees.

Decomposition
The breakdown of matter by bacteria and fungi. It changes the chemical composition and physical appearance of the materials. See composting.

Deforestation
Those practices or processes that result in the change of forested lands to non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons: 1) the burning or decomposition of the wood releases carbon dioxide; and 2) trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present and contributing to carbon storage.

Degradable
See biodegradable.
Desertification
The progressive destruction or degradation of existing vegetative cover to form desert. This can occur due to overgrazing, deforestation, drought, and the burning of extensive areas. Once formed, deserts can only support a sparse range of vegetation. Climatic effects associated with this phenomenon include increased albedo, reduced atmospheric humidity, and greater atmospheric dust (aerosol) loading.

Distillate fuel oil
A general classification for the petroleum fractions produced in conventional distillation operations. Included are products known as No. 1, No. 2, and No. 4 fuel oils and No. 1, No. 2, and No. 4 diesel fuels. Used primarily for space heating, on and off-highway diesel engine fuel (including railroad engine fuel and fuel for agricultural machinery), and electric power generation.

Economy
System of production, distribution, and consumption of goods.

Ecosystem
The complex system of plant, animal, fungal, and microorganism communities and their associated non-living environment interacting as an ecological unit. Ecosystems have no fixed boundaries; instead their parameters are set to the scientific, management, or policy question being examined. Depending upon the purpose of analysis, a single lake, a watershed, or an entire region could be considered an ecosystem.

Electrons
Tiny particle moving around outside the nucleus of an atom. Each electron has one unit of negative charge (-) and almost no mass.

Element
Chemicals such as hydrogen (H), iron (Fe), sodium (Na), carbon (C), nitrogen (N), or oxygen (O), whose distinctly different atoms serve as the basic building blocks of all matter. There are 92 naturally occurring elements. Another 15 have been made in laboratories. Two or more elements combine to form compounds that make up most of the world's matter. See compound.

El Niño
A climatic phenomenon occurring irregularly, but generally every 3 to 5 years. El Niños often first become evident during the Christmas season (El Niño means Christ child) in the surface oceans of the eastern tropical Pacific Ocean. The phenomenon involves seasonal changes in the direction of the tropical winds over the Pacific and abnormally warm surface ocean temperatures. The changes in the tropics are most intense in the Pacific region, these changes can disrupt weather patterns throughout the tropics and can extend to higher latitudes, especially in Central and North America. The relationship between these events and global weather patterns are currently the subject of much research in order to enhance prediction of seasonal to interannual fluctuations in the climate.

Emission inventory
A list of air pollutants emitted into a community's, state's, nation's, or the Earth's atmosphere in amounts per some unit time (e.g. day or year) by type of source. An emission inventory has both political and scientific applications.
**Emissions**
The release of a substance (usually a gas when referring to the subject of *climate change*) into the *atmosphere*.

**Emissions coefficient/factor**
A unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g., grams of carbon dioxide emitted per barrel of fossil fuel consumed).

**Endemic**
Species characteristic of or prevalent in a particular or restricted locality or region.

**Energy conservation**
Reduction or elimination of unnecessary energy use and waste. See *energy-efficiency*.

**Energy intensity**
Ratio between the consumption of energy to a given quantity of output; usually refers to the amount of primary or final energy consumed per unit of gross domestic product.

**Energy quality**
Ability of a form of energy to do useful work. High-temperature heat and the chemical energy in fossil fuels and nuclear fuels are concentrated high quality energy. Low-quality energy such as low-temperature heat is dispersed or diluted and cannot do much useful work.

**Energy**
The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks. In the United States, electrical energy is often measured in kilowatt-hours (kWh), while heat energy is often measured in British thermal units (Btu).

**Energy-efficiency**
The ratio of the useful output of services from an article of industrial equipment to the energy use by such an article; for example, vehicle miles traveled per gallon of fuel (mpg).

**Enhanced greenhouse effect**
The concept that the natural greenhouse effect has been enhanced by anthropogenic emissions of greenhouse gases. Increased concentrations of carbon dioxide, methane, and nitrous oxide, CFCs, HFCs, PFCs, SF6, NF3 and other photochemically important gases caused by human activities such as fossil fuel consumption, trap more infra-red radiation, thereby exerting a warming influence on the climate. See *greenhouse gas*, *anthropogenic*, *greenhouse effect*, *climate*, *global warming*.

**Enhanced oil recovery**
Removal of some of the heavy oil left in an oil well after primary and secondary recovery. See *primary oil recovery*, *secondary oil recovery*.

**Enteric fermentation**
A digestive process by which carbohydrates are broken down by microorganisms into simple molecules for absorption into the bloodstream of
an animal.

**Environment**
All external conditions that affect an organism or other specified system during its lifetime.

**Ethanol (C₂H₅OH)**
Otherwise known as ethyl alcohol, alcohol, or grain spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100), blended with gasoline (E85), or as a gasoline octane enhancer and oxygenate (10 percent concentration).

**Evapotranspiration**
The loss of water from the soil by evaporation and by transpiration from the plants growing in the soil, which rises with air temperature.

**Exponential growth**
Growth in which some quantity, such as population size, increases by a constant percentage of the whole during each year or other time period; when the increase in quantity over time is plotted, this type of growth yields a curve shaped like the letter J.

**Feedback Mechanisms**
A mechanism that connects one aspect of a system to another. The connection can be either amplifying (positive feedback) or moderating (negative feedback). See climate feedback.

**Feedlot**
Confined outdoor or indoor space used to raise hundreds to thousands of domesticated livestock. See rangeland.

**Fertilization**
A term used to denote efforts to enhance plant growth by increased application of nitrogen-based fertilizer or increased deposition of nitrates in precipitation.

**Fertilization, Carbon Dioxide**
An expression (sometimes reduced to fertilization) used to denote increased plant growth due to a higher carbon dioxide concentration.

**Fertilizer**
Substance that adds inorganic or organic plant nutrients to soil and improves its ability to grow crops, trees, or other vegetation. See organic fertilizer, fertilization.

**Flaring**
The burning of waste gases through a flare stack or other device before releasing them to the air.

**Fluidized bed combustion (FBC)**
Process for burning coal more efficiently, cleanly, and cheaply. A stream of hot air is used to suspend a mixture of powdered coal and limestone during
combustion. About 90 to 98 percent of the sulfur dioxide produced during combustion is removed by reaction with limestone to produce solid calcium sulfate.

**Fluorocarbons**
Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). See chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, ozone depleting substance.

**Forcing Mechanism**
A process that alters the energy balance of the climate system, i.e. changes the relative balance between incoming solar radiation and outgoing infrared radiation from Earth. Such mechanisms include changes in solar irradiance, volcanic eruptions, and enhancement of the natural greenhouse effect by emission of carbon dioxide. See radiation, infrared radiation, radiative forcing.

**Forest**
Terrestrial ecosystem (biome) with enough average annual precipitation (at least 76 centimeters or 30 inches) to support growth of various species of trees and smaller forms of vegetation.

**Fossil fuel**
A general term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years. See coal, petroleum, crude oil, natural gas.

**Fossil fuel combustion**
Burning of coal, oil (including gasoline), or natural gas. This burning, usually to generate energy, releases carbon dioxide, as well as combustion by products that can include unburned hydrocarbons, methane, and carbon monoxide. Carbon monoxide, methane, and many of the unburned hydrocarbons slowly oxidize into carbon dioxide in the atmosphere. Common sources of fossil fuel combustion include cars and electric utilities.

**Freon**
See chlorofluorocarbons.

**Fugitive emissions**
Unintended gas leaks from the processing, transmission, and/or transportation of fossil fuels, CFCs from refrigeration leaks, SF6 from electrical power distributor, etc.

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**G**

**Gasohol**
Vehicle fuel consisting of a mixture of gasoline and ethyl or methyl alcohol; typically 10 to 23 percent ethanol by volume.

**General Aviation**
That portion of civil aviation, which encompasses all facets of aviation except
air carriers. It includes any air taxis, commuter air carriers, and air travel clubs, which do not hold Certificates of Public Convenience and Necessity. See air carrier.

**General Circulation Model (GCM)**
A global, three-dimensional computer model of the climate system which can be used to simulate human-induced climate change. GCMs are highly complex and they represent the effects of such factors as reflective and absorptive properties of atmospheric water vapor, greenhouse gas concentrations, clouds, annual and daily solar heating, ocean temperatures and ice boundaries. The most recent GCMs include global representations of the atmosphere, oceans, and land surface. See climate modeling.

**Geosphere**
The soils, sediments, and rock layers of the Earth's crust, both continental and beneath the ocean floors.

**Geothermal energy**
Heat transferred from the earth's molten core to under-ground deposits of dry steam (steam with no water droplets), wet steam (a mixture of steam and water droplets), hot water, or rocks lying fairly close to the earth's surface.

**Global warming**
The progressive gradual rise of the earth's surface temperature thought to be caused by the greenhouse effect and responsible for changes in global climate patterns. An increase in the near surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases. See climate change, greenhouse effect, enhanced greenhouse effect, radiative forcing.

**Global Warming Potential (GWP)**
The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a greenhouse gas to that from emission of one kilogram of carbon dioxide over a period of time (usually 100 years). The chart below shows the original GWPs (assigned in 1990) and the most recent GWPs (assigned in 1996) for the most important greenhouse gases.

<table>
<thead>
<tr>
<th>GAS</th>
<th>GWP 1990</th>
<th>GWP 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Methane</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>270</td>
<td>310</td>
</tr>
<tr>
<td>HFC-134a</td>
<td>1,200</td>
<td>1,300</td>
</tr>
<tr>
<td>HFC-23</td>
<td>10,000</td>
<td>11,700</td>
</tr>
<tr>
<td>HFC-152a</td>
<td>150</td>
<td>140</td>
</tr>
<tr>
<td>HCF-125</td>
<td>NA*</td>
<td>2,800</td>
</tr>
<tr>
<td>PFCs**</td>
<td>5,400</td>
<td>7,850</td>
</tr>
<tr>
<td>SF6</td>
<td>NA*</td>
<td>23,900</td>
</tr>
</tbody>
</table>

* Not Applicable. GWP was not yet estimated for this gas.
**This figure is an average GWP for the two PFCs, CF4 and C2F6.

See radiative forcing, carbon equivalent, carbon dioxide equivalent.
Grassland
Terrestrial ecosystem (biome) found in regions where moderate annual average precipitation (25 to 76 centimeters or 10 to 30 inches) is enough to support the growth of grass and small plants but not enough to support large stands of trees.

Greenhouse effect
The effect produced as greenhouse gases allow incoming solar radiation to pass through the Earth's atmosphere, but prevent part of the outgoing infrared radiation from the Earth's surface and lower atmosphere from escaping into outer space. This process occurs naturally and has kept the Earth's temperature about 59 degrees F warmer than it would otherwise be. Current life on Earth could not be sustained without the natural greenhouse effect.

Greenhouse Gas
Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs). See carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons, ozone, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.

H
Halocarbons
Chemicals consisting of carbon, sometimes hydrogen, and either chlorine, fluorine bromine or iodine.

Halons
Compounds, also known as bromofluorocarbons, that contain bromine, fluorine, and carbon. They are generally used as fire extinguishing agents and cause ozone depletion. Bromine is many times more effective at destroying stratospheric ozone than chlorine. See ozone depleting substance.

Heat
Form of kinetic energy that flows from one body to another when there is a temperature difference between the two bodies. Heat always flows spontaneously from a hot sample of matter to a colder sample of matter. This is one way to state the second law of thermodynamics. See temperature.

Heat content
The amount of heat per unit mass released upon complete combustion.

Higher heating value
Quantity of heat liberated by the complete combustion of a unit volume or weight of a fuel assuming that the produced water vapor is completely condensed and the heat is recovered; also known as gross calorific value. See lower heating value.

Histosol
Wet organic soils, such as peats and mucks.

Hydrocarbons
Substances containing only hydrogen and carbon. Fossil fuels are made up
of hydrocarbons. Some hydrocarbon compounds are major air pollutants. See fossil fuel.

**Hydrochlorofluorocarbons** (HCFCs)
Compounds containing hydrogen, fluorine, chlorine, and carbon atoms. Although ozone depleting substances, they are less potent at destroying stratospheric ozone than chlorofluorocarbons (CFCs). They have been introduced as temporary replacements for CFCs and are also greenhouse gases. See ozone depleting substance.

**Hydroelectric power plant**
Structure in which the energy of fading or flowing water spins a turbine generator to produce electricity.

**Hydrofluorocarbons** (HFCs)
Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 (HFC-152a) to 11,700 (HFC-23).

**Hydrologic cycle**
The process of evaporation, vertical and horizontal transport of vapor, condensation, precipitation, and the flow of water from continents to oceans. It is a major factor in determining climate through its influence on surface vegetation, the clouds, snow and ice, and soil moisture. The hydrologic cycle is responsible for 25 to 30 percent of the mid-latitudes' heat transport from the equatorial to polar regions.

**Hydropower**
Electrical energy produced by falling or flowing water. See hydroelectric power plant.

**Hydrosphere**
The part of the Earth composed of water including clouds, oceans, seas, ice caps, glaciers, lakes, rivers, underground water supplies, and atmospheric water vapor.

**Ice core**
A cylindrical section of ice removed from a glacier or an ice sheet in order to study climate patterns of the past. By performing chemical analyses on the air trapped in the ice, scientists can estimate the percentage of carbon dioxide and other trace gases in the atmosphere at that time.

**Industrial sector**
Construction, manufacturing, agricultural and mining establishments.

**Infrared radiation**
The heat energy that is emitted from all solids, liquids, and gases. In the context of the greenhouse issue, the term refers to the heat energy emitted by the Earth's surface and its atmosphere. Greenhouse gases strongly absorb this radiation in the Earth's atmosphere, and radiate some back
towards the surface, creating the greenhouse effect. See radiation, greenhouse effect, enhanced greenhouse effect, global warming.

**Inorganic compound**
Combination of two or more elements other than those used to form organic compounds. See organic compound.

**Inorganic fertilizer**
See synthetic fertilizer.

**Intergovernmental Panel on Climate Change (IPCC)**
The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its capacity for reporting on climate change, its consequences, and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories.

**Irreversibilities**
Changes that, once set in motion, cannot be reversed, at least on human time scales.

**Jet fuel**
Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity.

**Joint implementation**
Agreements made between two or more nations under the auspices of the United Nations Framework Convention on Climate Change to help reduce greenhouse gas emissions.

**Joule**
The energy required to push with a force of one Newton for one meter.
gasoline, heating oil, and other products. See oil shale, shale oil.

Kerosene
A petroleum distillate that has a maximum distillation temperature of 401 degrees Fahrenheit at the 10 percent recovery point, a final boiling point of 572 degrees Fahrenheit, and a minimum flash point of 100 degrees Fahrenheit. Used in space heaters, cookstoves, and water heaters, and suitable for use as an illuminant when burned in wick lamps.

Kyoto Protocol
This is an international agreement struck by 159 nations attending the Third Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (held in December of 1997 in Kyoto Japan) to reduce worldwide emissions of greenhouse gases. If ratified and put into force, individual countries have committed to reduce their greenhouse gas emissions by a specified amount. See United Nations Framework Convention on Climate Change, Conference of the Parties, Berlin Mandate.

Landfill
Land waste disposal site in which waste is generally spread in thin layers, compacted, and covered with a fresh layer of soil each day.

Lifetime (Atmospheric)
The lifetime of a greenhouse gas refers to the approximate amount of time it would take for the anthropogenic increment to an atmospheric pollutant concentration to return to its natural level (assuming emissions cease) as a result of either being converted to another chemical compound or being taken out of the atmosphere via a sink. This time depends on the pollutant's sources and sinks as well as its reactivity. The lifetime of a pollutant is often considered in conjunction with the mixing of pollutants in the atmosphere; a long lifetime will allow the pollutant to mix throughout the atmosphere. Average lifetimes can vary from about a week (sulfate aerosols) to more than a century (CFCs, carbon dioxide). See residence time, greenhouse gas.

Light-duty vehicles
Automobiles and light trucks combined.

Lignite
A brownish-black coal of low rank with high inherent moisture and volatile matter content, used almost exclusively for electric power generation. Also referred to as brown coal. See coal.

Liquefied natural gas (LNG)
Natural gas converted to liquid form by cooling to a very low temperature.

Liquefied petroleum gas (LPG)
Ethane, ethylene, propane, propylene, normal butane, butylene, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate new natural gas plant liquids.

Litter
Undecomposed plant residues on the soil surface. See decomposition.
**Longwave radiation**
The radiation emitted in the spectral wavelength greater than 4 micrometers corresponding to the radiation emitted from the Earth and atmosphere. It is sometimes referred to as terrestrial radiation or infrared radiation, although somewhat imprecisely. See [infrared radiation](#).

**Low Emission Vehicle (LEV)**
A vehicle meeting the low-emission vehicle standards.

**Lower heating value**
Quantity of heat liberated by the complete combustion of a unit volume or weight of a fuel assuming that the produced water remains as a vapor and the heat of the vapor is not recovered; also known as net calorific value. See [higher heating value](#).

**Lubricant**
A substance used to reduce friction between bearing surfaces or as a process material, either incorporated into other materials used as aids in manufacturing processes or as carriers of other materials. Petroleum lubricants may be produced either from distillates or residues. Other substances may be added to impart or improve useful properties. Does not include by-products of lubricating oil from solvent extraction or tars derived from de-asphalting. Lubricants include all grades of lubricating oils from spindle oil to cylinder oil and those used in greases. Lubricant categories are paraffinic and napthenic.

**Manure**
Dung and urine of animals that can be used as a form of organic fertilizer. See [fertilizer](#), [organic fertilizer](#).

**Mass balance**
The application of the principle of the conservation of matter.

**Mauna Loa**
An intermittently active volcano (elevation: 13,680 feet; 4,170 meters) on the island of Hawaii.

**Methane** (CH₄)
A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 21. Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion. The atmospheric concentration of methane as been shown to be increasing at a rate of about 0.6 percent per year and the concentration of about 1.7 per million by volume (ppmv) is more than twice its pre-industrial value. However, the rate of increase of methane in the atmosphere may be stabilizing.

**Methanol** (CH₃OH)
A colorless poisonous liquid with essentially no odor and little taste. It is the simplest alcohol with a boiling point of 64.7 degrees Celsius. In transportation, methanol is used as a vehicle fuel by itself (M100), or blended with gasoline (M85).
**Methanotrophic**
Having the biological capacity to oxidize methane to CO₂ and water by metabolism under aerobic conditions. See aerobic.

**Methyl bromide (CH₃Br)**
An effective pesticide; used to fumigate soil and many agricultural products. Because it contains bromine, it depletes stratospheric ozone when released to the atmosphere. See ozone depleting substance.

**Meteorology**
The science of weather-related phenomena. See weather, climate.

**Metric Ton**
Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs or 1.1 short tons. See short ton.

**Mineral**
Any naturally occurring inorganic substance found in the earth's crust as a crystalline solid.

**Model year**
Refers to the "sales" model year; for example, vehicles sold during the period from October 1 to the next September 31 is considered one model year.

**Molecule**
Chemical combination of two or more atoms of the same chemical element (such as O₂) or different chemical elements (such as H₂O).

**Montreal Protocol on Substances that Deplete the Ozone Layer**
The Montreal Protocol and its amendments control the phaseout of ozone depleting substances production and use. Under the Protocol, several international organizations report on the science of ozone depletion, implement projects to help move away from ozone depleting substances, and provide a forum for policy discussions. In the United States, the Protocol is implemented under the Clean Air Act Amendments of 1990. See ozone depleting substance, ozone layer.

**Motor gasoline**
A complex mixture of relatively volatile hydrocarbons, with or without small quantities of additives, obtained by blending appropriate refinery streams to form a fuel suitable for use in spark-ignition engines. Motor gasoline includes both leaded and unleaded grades of finished gasoline, blending components, and gasohol. See hydrocarbons.

**Mount Pinatubo**
A volcano in the Philippine Islands that erupted in 1991. The eruption of Mount Pinatubo ejected enough particulate and sulfate aerosol matter into the atmosphere to block some of the incoming solar radiation from reaching Earth's atmosphere. This effectively cooled the planet from 1992 to 1994, masking the warming that had been occurring for most of the 1980s and 1990s.

**Municipal solid waste (MSW)**
Residential solid waste and some non-hazardous commercial, institutional, and industrial wastes. This material is generally sent to municipal landfills for disposal. See landfill.
N

Naphtha
A generic term applied to a petroleum fraction with an approximate boiling range between 122 and 400 degrees Fahrenheit.

Natural gas
Underground deposits of gases consisting of 50 to 90 percent methane (CH₄) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C₃H₈) and butane (C₄H₁₀).

Natural gas liquids (NGLs)
Those hydrocarbons in natural gas that are separated as liquids from the gas. Includes natural gas plant liquids and lease condensate.

Nitrogen cycle
Cyclic movement of nitrogen in different chemical forms from the environment, to organisms, and then back to the environment.

Nitrogen fixation
Conversion of atmospheric nitrogen gas into forms useful to plants and other organisms by lightning, bacteria, and blue-green algae; it is part of the nitrogen cycle.

Nitrogen Oxides (NOₓ)
Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are produced, for example, by the combustion of fossil fuels in vehicles and electric power plants. In the atmosphere, nitrogen oxides can contribute to formation of photochemical ozone (smog), impair visibility, and have health consequences; they are considered pollutants.

Nitrous Oxide (N₂O)
A powerful greenhouse gas with a global warming potential most recently evaluated at 310. Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Nonbiodegradable
Substance that cannot be broken down in the environment by natural processes. See biodegradable.

Nonlinearities
Occur when changes in one variable cause a more than proportionate impact on another variable.

Non-methane volatile organic compounds (NMVOCs)
Organic compounds, other than methane, that participate in atmospheric photochemical reactions.

Non-point source
Large land area such as crop fields and urban areas that discharge pollutant into surface and underground water over a large area. See point source.

Nuclear electric power
Electricity generated by an electric power plant whose turbines are driven by steam generated in a reactor by heat from the fissioning of nuclear fuel. See nuclear energy.

Nuclear energy
Energy released when atomic nuclei undergo a nuclear reaction such as the
spontaneous emission of radioactivity, nuclear fission, or nuclear fusion.

Oil shale
Underground formation of a fine-grained sedimentary rock containing varying amounts of kerogen, a solid, waxy mixture of hydrocarbon compounds. Heating the rock to high temperatures converts the kerogen to a vapor, which can be condensed to form a slow flowing heavy oil called shale oil. See kerogen, shale oil.

Oil
See crude oil, petroleum, fossil fuel, hydrocarbons.

Ore
Mineral deposit containing a high enough concentration of at least one metallic element to permit the metal to be extracted and sold at a profit.

Organic compound
Molecule that contains atoms of the element carbon, usually combined with itself and with atoms of one or more other element such as hydrogen, oxygen, nitrogen, sulfur, phosphorus, chlorine, or fluorine. See inorganic compound.

Organic fertilizer
Organic material such as manure or compost, applied to cropland as a source of plant nutrients.

Oxidize
To chemically transform a substance by combining it with oxygen. See chemical reaction.

Oxygen cycle
Cyclic movement of oxygen in different chemical forms from the environment, to organisms, and then back to the environment.

Ozone (O3)
A colorless gas with a pungent odor, having the molecular form of O3, found in two layers of the atmosphere, the stratosphere (about 90% of the total atmospheric loading) and the troposphere (about 10%). Ozone is a form of oxygen found naturally in the stratosphere that provides a protective layer shielding the Earth from ultraviolet radiation's harmful health effects on humans and the environment. In the troposphere, ozone is a chemical oxidant and major component of photochemical smog. Ozone can seriously affect the human respiratory system. See atmosphere, ultraviolet radiation.

Ozone depleting substance (ODS)
A family of man-made compounds that includes, but are not limited to, chlorofluorocarbons (CFCs), bromofluorocarbons (halons), methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons (HCFCs). These compounds have been shown to deplete stratospheric ozone, and therefore are typically referred to as ODSs. See ozone.

Ozone layer
The layer of gaseous ozone (O3) in the stratosphere that protects life on
earth by filtering out harmful ultraviolet radiation from the sun. See stratosphere, ultraviolet radiation.

**Ozone precursors**
Chemical compounds, such as carbon monoxide, methane, non-methane hydrocarbons, and nitrogen oxides, which in the presence of solar radiation react with other chemical compounds to form ozone, mainly in the troposphere. See troposphere.

**Particulate matter (PM)**
Solid particles or liquid droplets suspended or carried in the air (e.g., soot, dust, fumes, mist). See aerosol, sulfate aerosols.

**Particulates**
See particulate matter.

**Parts per billion (ppb)**
Number of parts of a chemical found in one billion parts of a particular gas, liquid, or solid mixture. See concentration.

**Parts per million (ppm)**
Number of parts of a chemical found in one million parts of a particular gas, liquid, or solid. See concentration.

**Pentanes plus**
A mixture of hydrocarbons, mostly pentanes and heavier fractions, extracted from natural gas. See hydrocarbons.

**Perfluorocarbons (PFCs)**
A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF4 and C2F6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases: CF4 has a global warming potential (GWP) of 6,500 and C2F6 has a GWP of 9,200. See ozone depleting substance.

**Petrochemical feedstock**
Feedstock derived from petroleum, used principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics. The categories reported are naphtha (endpoint less than 401 degrees Fahrenheit) and other oils (endpoint equal to or greater than 401 degrees Fahrenheit).

**Petrochemicals**
Chemicals obtained by refining (i.e., distilling) crude oil. They are used as raw materials in the manufacture of most industrial chemicals, fertilizers, pesticides, plastics, synthetic fibers, paints, medicines, and many other products. See crude oil.

**Petroleum**
A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oils, petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum
Petroleum coke
A residue that is the final product of the condensation process in cracking.

Photosynthesis
Complex process that takes place in living green plant cells. Radiant energy from the sun is used to combine carbon dioxide (CO2) and water (H2O) to produce oxygen (O2) and simple nutrient molecules, such as glucose (C6H12O6). See carbon sequestration.

Photovoltaic and solar thermal energy
Energy radiated by the sun as electromagnetic waves (electromagnetic radiation) that is converted into electricity by means of solar (i.e., photovoltaic) cells or useable heat by concentrating (i.e., focusing) collectors.

Point source
A single identifiable source that discharges pollutants into the environment. Examples are smokestack, sewer, ditch, or pipe. See non-point source.

Pollution
A change in the physical, chemical, or biological characteristics of the air, water, or soil that can affect the health, survival, or activities of humans in an unwanted way. Some expand the term to include harmful effects on all forms of life.

Polyvinyl chloride (PVC)
A polymer of vinyl chloride. It is tasteless, odorless and insoluble in most organic solvents. A member of the family vinyl resin, used in soft flexible films for food packaging and in molded rigid products, such as pipes, fibers, upholstery, and bristles.

Population
Group of individual organisms of the same species living within a defined area.

Precession
The tendency of the Earth's axis to wobble in space over a period of 23,000 years. The Earth's precession is one of the factors that results in the planet receiving different amounts of solar energy over extended periods of time.

Prescribed burning
Deliberate setting and careful control of surface fires in forests to help prevent more destructive fires and to kill off unwanted plants that compete with commercial species for plant nutrients; may also be used on grasslands.

Primary oil recovery
Pumping out the crude oil that flows by gravity into the bottom of an oil well. See enhanced oil recovery, secondary oil recovery.

Quad
Quad stands for quadrillion, which is, 10^{15}.
Radiation
Energy emitted in the form of electromagnetic waves. Radiation has differing characteristics depending upon the wavelength. Because the radiation from the Sun is relatively energetic, it has a short wavelength (ultra-violet, visible, and near infrared) while energy radiated from the Earth’s surface and the atmosphere has a longer wavelength (e.g., infrared radiation) because the Earth is cooler than the Sun. See ultraviolet radiation, infrared radiation, solar radiation, longwave radiation, terrestrial radiation.

Radiative Forcing
A change in the balance between incoming solar radiation and outgoing infrared radiation. Without any radiative forcing, solar radiation coming to the Earth would continue to be approximately equal to the infrared radiation emitted from the Earth. The addition of greenhouse gases traps an increased fraction of the infrared radiation, radiating it back toward the surface and creating a warming influence (i.e., positive radiative forcing because incoming solar radiation will exceed outgoing infrared radiation).

Rail
Includes "heavy" and "light" transit rail. Heavy transit rail is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). Light transit rail may be on exclusive or shared rights of way, high or low platform, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

Rangeland
Land, mostly grasslands, whose plants can provide food (i.e., forage) for grazing or browsing animals. See feedlot.

Recycling
Collecting and reprocessing a resource so it can be used again. An example is collecting aluminum cans, melting them down, and using the aluminum to make new cans or other aluminum products.

Reforestation
Replanting of forests on lands that have recently been harvested.

Renewable energy
Energy obtained from sources that are essentially inexhaustible, unlike, for example, the fossil fuels, of which there is a finite supply. Renewable sources of energy include wood, waste, geothermal, wind, photovoltaic, and solar thermal energy. See hydropower, photovoltaic.

Residence Time
The average time spent in a reservoir by an individual atom or molecule. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere. See lifetime.

Residential sector
An area or portion consisting only of housing units.

Residual fuel oil
The heavier oils that remain after the distillate fuel oils and lighter
hydrocarbons are distilled away in refinery operations and that conform to ASTM Specifications D396 and D975. Included are No. 5, a residual fuel oil of medium viscosity; Navy Special, for use in steam-powered vessels in government service and in shore power plants; and No. 6, which includes Bunker C fuel oil and is used for commercial and industrial heating, electricity generation, and to power ships. Imports of residual fuel oil include imported crude oil burned as fuel. See crude oil, hydrocarbons.

**Respiration**
The process by which animals use up stored foods (by combustion with oxygen) to produce energy.

**Secondary oil recovery**
Injection of water into an oil well after primary oil recovery to force out some of the remaining thicker crude oil. See enhanced oil recovery, primary oil recovery.

**Sector**
Division, most commonly used to denote type of energy consumer (e.g., residential) or according to the Intergovernmental Panel on Climate Change, the type of greenhouse gas emitter (e.g. industrial process). See Intergovernmental Panel on Climate Change.

**Septic tank**
Underground tank for treatment of wastewater from a home in rural and suburban areas. Bacteria in the tank decompose organic wastes and the sludge settles to the bottom of the tank. The effluent flows out of the tank into the ground through a field of drainpipes.

**Sewage treatment** (primary)
Mechanical treatment of sewage in which large solids are filtered out by screens and suspended solids settle out as sludge in a sedimentation tank.

**Shale oil**
Slow-flowing, dark brown, heavy oil obtained when kerogen in oil shale is vaporized at high temperatures and then condensed. Shale oil can be refined to yield gasoline, heating oil, and other petroleum products. See kerogen, oil shale.

**Short Ton**
Common measurement for a ton in the United States. A short ton is equal to 2,000 lbs or 0.907 metric tons. See metric ton.

**Sink**
A reservoir that uptakes a chemical element or compound from another part of its cycle. For example, soil and trees tend to act as natural sinks for carbon.

**Sludge**
Gooey solid mixture of bacteria and virus laden organic matter, toxic metals, synthetic organic chemicals, and solid chemicals removed from wastewater at a sewage treatment plant.

**Soil**
Complex mixture of inorganic minerals (i.e., mostly clay, silt, and sand),
decaying organic matter, water, air, and living organisms.

**Soil carbon**
A major component of the terrestrial biosphere pool in the carbon cycle. The
amount of carbon in the soil is a function of the historical vegetative cover
and productivity, which in turn is dependent in part upon climatic variables.

**Solar energy**
Direct radiant energy from the sun. It also includes indirect forms of energy
such as wind, falling or flowing water (hydropower), ocean thermal gradients,
and biomass, which are produced when direct solar energy interact with the
earth. See solar radiation.

**Solar Radiation**
Energy from the Sun. Also referred to as short-wave radiation. Of importance
to the climate system, solar radiation includes ultraviolet radiation, visible
radiation, and infrared radiation. See ultraviolet radiation, infrared radiation,
radiation.

**Source**
Any process or activity that releases a greenhouse gas, an aerosol, or a
precursor of a greenhouse gas into the atmosphere. See point source, non-
point source.

**Special naphtha**
All finished products within the naphtha boiling range that are used as paint
thinner, cleaners, or solvents. Those products are refined to a specified
flash point.

**Still gas**
Any form or mixture of gases produced in refineries by distillation, cracking,
reforming, and other processes. Principal constituents are methane, ethane,
ethylene, normal butane, butylene, propane, propylene, etc. Used as a
refinery fuel and as a petrochemical feedstock.

**Stratosphere**
Second layer of the atmosphere, extending from about 19 to 48 kilometers
(12 to 30 miles) above the earth's surface. It contains small amounts of
gaseous ozone (O3), which filters out about 99 percent of the incoming
harmful ultraviolet (UV) radiation. Most commercial airline flights operate at a
cruising altitude in the lower stratosphere. See ozone layer, ultraviolet
radiation.

**Stratospheric ozone**
See ozone layer.

**Strip mining**
Cutting deep trenches to remove minerals such as coal and phosphate found
near the earth's surface in flat or rolling terrain. See surface mining.

**Subbituminous coal**
A dull, black coal of rank intermediate between lignite and bituminous coal.
See coal.

**Sulfate aerosols**
Particulate matter that consists of compounds of sulfur formed by the
interaction of sulfur dioxide and sulfur trioxide with other compounds in the
atmosphere. Sulfate aerosols are injected into the atmosphere from the
combustion of fossil fuels and the eruption of volcanoes like Mt. Pinatubo.
Recent theory suggests that sulfate aerosols may lower the earth's
temperature by reflecting away solar radiation (negative radiative forcing). General Circulation Models which incorporate the effects of sulfate aerosols more accurately predict global temperature variations. See particulate matter, aerosol, General Circulation Models.

Sulfur cycle
Cyclic movement of sulfur in different chemical forms from the environment, to organisms, and then back to the environment.

Sulfur dioxide (SO2)
A compound composed of one sulfur and two oxygen molecules. Sulfur dioxide emitted into the atmosphere through natural and anthropogenic processes is changed in a complex series of chemical reactions in the atmosphere to sulfate aerosols. These aerosols are believed to result in negative radiative forcing (i.e., tending to cool the Earth's surface) and do result in acid deposition (e.g., acid rain). See aerosol, radiative forcing, acid deposition, acid rain.

Sulfur Hexafluoride (SF6)
A colorless gas soluble in alcohol and ether, slightly soluble in water. A very powerful greenhouse gas used primarily in electrical transmission and distribution systems and as a dielectric in electronics. The global warming potential of SF6 is 23,900. See Global Warming Potential.

Surface mining
Removal of soil, sub-soil, and other strata and then extracting a mineral deposit found fairly close to the earth's surface. See strip mining.

Synthetic fertilizer
Commercially prepared mixtures of plant nutrients such as nitrates, phosphates, and potassium applied to the soil to restore fertility and increase crop yields. See organic fertilizer.

Synthetic natural gas (SNG)
A manufactured product chemically similar in most respects to natural gas, resulting from the conversion or reforming of petroleum hydrocarbons. It may easily be substituted for, or interchanged with, pipeline quality natural gas.

Tailings
Rock and other waste materials removed as impurities when minerals are mined and mineral deposits are processed. These materials are usually dumped on the ground or into ponds.

Tar sand
Swamp-like deposit of a mixture of fine clay, sand, water, and variable amounts of tar-like heavy oil known as bitumen. Bitumen can be extracted from tar sand by heating. It can then be purified and upgraded to synthetic crude oil. See bitumen.

Temperature
Measure of the average speed of motion of the atoms or molecules in a substance or combination of substances at a given moment. See heat.

Terrestrial
Pertaining to land.

**Terrestrial radiation**
The total infrared radiation emitted by the Earth and its atmosphere in the temperature range of approximately 200 to 300 Kelvin. Terrestrial radiation provides a major part of the potential energy changes necessary to drive the atmospheric wind system and is responsible for maintaining the surface air temperature within limits of livability.

**Trace Gas**
Any one of the less common gases found in the Earth's atmosphere. Nitrogen, oxygen, and argon make up more than 99 percent of the Earth's atmosphere. Other gases, such as carbon dioxide, water vapor, methane, oxides of nitrogen, ozone, and ammonia, are considered trace gases. Although relatively unimportant in terms of their absolute volume, they have significant effects on the Earth's weather and climate.

**Transportation sector**
Consists of private and public passenger and freight transportation, as well as government transportation, including military operations.

**Troposphere**
The lowest layer of the atmosphere and contains about 95 percent of the mass of air in the Earth's atmosphere. The troposphere extends from the Earth's surface up to about 10 to 15 kilometers. All weather processes take place in the troposphere. Ozone that is formed in the troposphere plays a significant role in both the greenhouse gas effect and urban smog. See ozone precursors, stratosphere, atmosphere.

**Tropospheric ozone** (O₃)
See ozone.

**Tropospheric ozone precursors**
See ozone precursors.

**U**

**Ultraviolet radiation** (UV)
A portion of the electromagnetic spectrum with wavelengths shorter than visible light. The sun produces UV, which is commonly split into three bands of decreasing wavelength. Shorter wavelength radiation has a greater potential to cause biological damage on living organisms. The longer wavelength ultraviolet band, UVA, is not absorbed by ozone in the atmosphere. UVB is mostly absorbed by ozone, although some reaches the Earth. The shortest wavelength band, UVC, is completely absorbed by ozone and normal oxygen in the atmosphere.

**Unfinished oils**
All oils requiring further refinery processing, except those requiring only mechanical blending. Includes naphtha and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum.

**United Nations Framework Convention on Climate Change** (UNFCC)
The international treaty unveiled at the United Nations Conference on Environment and Development (UNCED) in June 1992. The UNFCCC commits signatory countries to stabilize anthropogenic (i.e. human-induced)
greenhouse gas emissions to "levels that would prevent dangerous anthropogenic interference with the climate system." The UNFCCC also requires that all signatory parties develop and update national inventories of anthropogenic emissions of all greenhouse gases not otherwise controlled by the Montreal Protocol. Out of 155 countries that have ratified this accord, the United States was the first industrialized nation to do so. See Conference of the Parties, Berlin Mandate, Kyoto Protocol, Montreal Protocol.

V

Vehicle miles traveled (VMT)
One vehicle traveling the distance of one mile. Thus, total vehicle miles is the total mileage traveled by all vehicles.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the atmosphere at normal temperatures. VOCs contribute significantly to photochemical smog production and certain health problems. See non-methane volatile organic compounds.

W

Wastewater
Water that has been used and contains dissolved or suspended waste materials. See sewage treatment.

Water Vapor
The most abundant greenhouse gas; it is the water present in the atmosphere in gaseous form. Water vapor is an important part of the natural greenhouse effect. While humans are not significantly increasing its concentration, it contributes to the enhanced greenhouse effect because the warming influence of greenhouse gases leads to a positive water vapor feedback. In addition to its role as a natural greenhouse gas, water vapor plays an important role in regulating the temperature of the planet because clouds form when excess water vapor in the atmosphere condenses to form ice and water droplets and precipitation. See greenhouse gas.

Waxes
Solid or semisolid materials derived from petroleum distillates or residues. Light-colored, more or less translucent crystalline masses, slightly greasy to the touch, consisting of a mixture of solid hydrocarbons in which the paraffin series predominates. Included are all marketable waxes, whether crude scale or fully refined. Used primarily as industrial coating for surface protection.

Weather
Weather is the specific condition of the atmosphere at a particular place and time. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. Climate is the average of weather over time and space. A simple way of remembering
the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard). See climate.

**Wetland**
Land that stays flooded all or part of the year with fresh or salt water.

**Wetlands**
Areas regularly saturated by surface or groundwater and subsequently characterized by a prevalence of vegetation adapted for life in saturated-soil conditions.

**Wood energy**
Wood and wood products used as fuel, including roundwood (i.e., cordwood), limbwood, wood chips, bark, sawdust, forest residues, and charcoal.

**Reference**


United Nations Framework Convention on Climate Change. [See http://www.unfccc.de]

