

I POL 8512 Glossary

Abiotic components (also known as abiotic factors) = non-living chemical and physical factors in the environment which affect ecosystems.

Acid rain = a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH). It can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxides, which react with the water molecules in the atmosphere to produce acids.

Active solar = technologies to convert solar energy into another more useful form of energy. This would normally be a conversion to heat or electrical energy. Inside a building this energy would be used for heating, cooling, or offsetting other energy use or costs. Active solar uses electrical or mechanical equipment for this conversion.

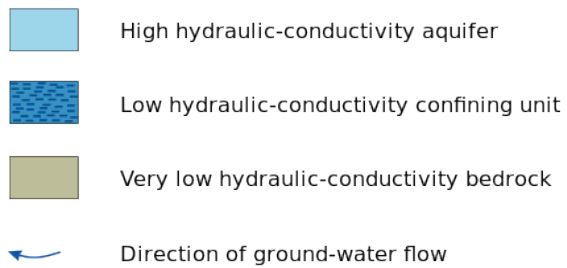
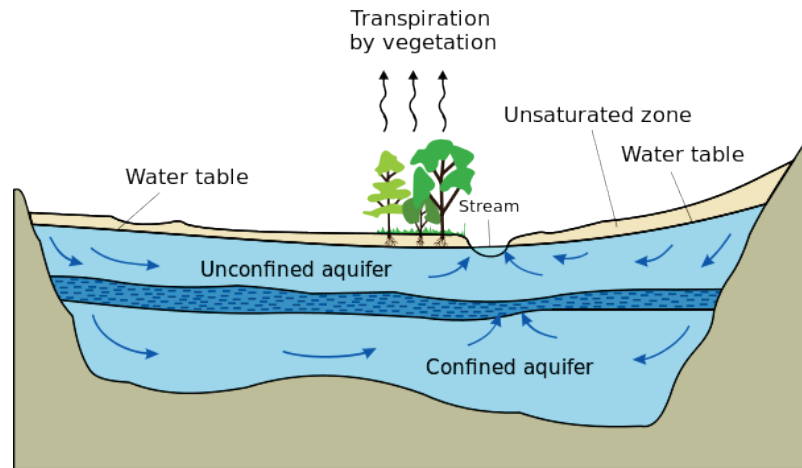
Albedo = the ratio of reflected radiation from the surface to incident radiation upon it. It is measured on a scale from zero for no reflecting power of a perfectly black surface, to 1 for perfect reflection of a white surface. It may also be expressed as a percentage.

Alkanes (Paraffins) = hydrocarbons with the general formula C_nH_{2n+2} . They are straight-chain or branched-chain hydrocarbons with all of the carbon-carbon bonds single bonds.

Alpha decay = a type of radioactive decay in which an atomic nucleus emits an alpha particle (two protons and two neutrons) and thereby transforms (or 'decays') into an atom with a mass number 4 less and atomic number 2 less.

Anthracite = the highest rank of coal...harder, glossy black coal used primarily for residential and commercial space heating.

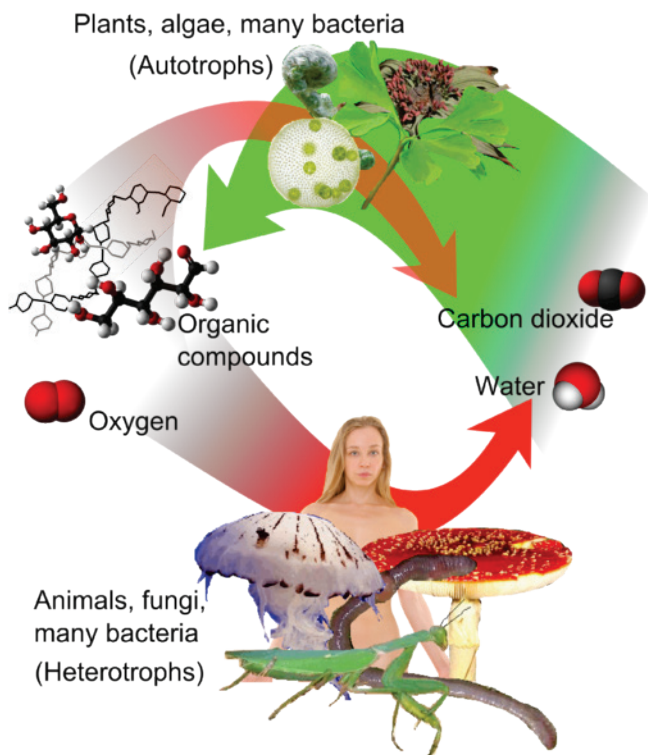
Aquifer = an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be usefully extracted using a water well.



Arenes (Aromatics) = hydrocarbons that contain a benzene ring.

Atmosphere = a layer of gases surrounding a planet that is retained by gravity.

Autotroph (*self-feeding*) or **producer** = an organism that produces complex organic compounds (such as carbohydrates, fats, and proteins) from simple substances present in its surroundings, generally using energy from light (by photosynthesis) or inorganic chemical reactions (chemosynthesis). They are the producers in a food chain, such as plants on land or algae in water. They are able to make their own food, and do not need a living energy or carbon source.



Barrel of oil equivalent (BOE) = a unit of energy based on the approximate energy released by burning one barrel (42 US gallons or 158.9873 liters) of crude oil. The US Internal Revenue Service defines it as equal to 5.8×10^6 BTU.

Beta decay is a type of radioactive decay in which a beta particle (an electron or a positron) is emitted from an atom. There are two types of beta decay: *beta minus* and *beta plus*. Beta minus (β^-) decay results in the emission of an electron and an electron antineutrino, and beta plus (β^+) decay results in the emission of a positron (antielectron) and an electron neutrino.

Binding energy = the amount of energy released when a nucleus is formed.

Biodiversity = the degree of variation of life forms within a given species, ecosystem, biome, or an entire planet.

Biogeochemical cycle or **substance turnover** or **cycling of substances** = a pathway by which a chemical element or molecule moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth. A cycle is a series of change which comes back to the starting point and which can be repeated.

Biogeochemistry = the scientific discipline that involves the study of the chemical, physical, geological, and biological processes and reactions that govern the composition of the natural environment (including the biosphere, hydrosphere, pedosphere, atmosphere, and lithosphere). In particular, biogeochemistry is the study of the cycles of chemical elements, such as carbon and nitrogen, and their interactions with and incorporation into living systems.

Biofuel = a type of fuel whose energy is derived from biological carbon fixation. Biofuels include fuels derived from biomass conversion, as well as solid biomass, liquid fuels and various biogases.^[1] Although fossil fuels have their origin in ancient carbon fixation, they are not considered biofuels because they contain carbon that has been "out" of the carbon cycle for a very long time.

Biogas = a gas produced by the biological breakdown of organic matter in the absence of oxygen. Organic waste such as dead plant and animal material, animal feces, and kitchen waste can be converted into a gaseous fuel called biogas. Biogas originates from biogenic material and is a type of bio fuel.

Biomass = a renewable energy source, is biological material from living, or recently living organisms. As an energy source, biomass can either be used directly, or converted into other energy products such as biofuel.

Biomes = A major regional or global biotic community, such as a grassland or desert, characterized chiefly by the dominant forms of plant life and the prevailing climate. They are often called ecosystems.

Biosphere = the global sum of all ecosystems. It can also be called the zone of life on Earth, a closed (apart from solar and cosmic radiation) and self-regulating system. From the broadest point of view, the biosphere is the global ecological system integrating all living beings and their relationships, including their interaction with the elements of the lithosphere, hydrosphere, and atmosphere.

Biotic = of or having to do with life or living organisms...produced or caused by living organisms.

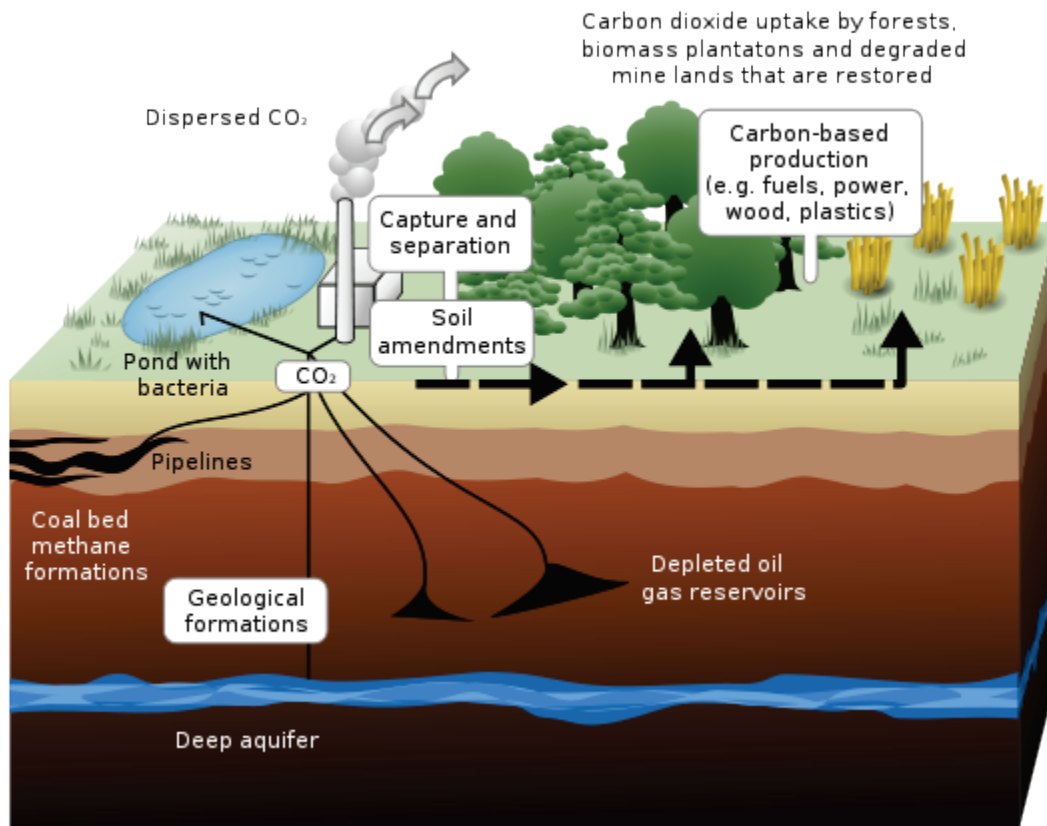
Bituminous coal = a dense sedimentary rock, usually black but sometimes dark brown often with well-defined bands of bright and dull material, used primarily as fuel in steam-electric power generation, with substantial quantities used for heat and power applications in manufacturing.

Boreal forest (Taiga) = a biome characterized by coniferous forests consisting mostly of pines, spruces and larches. Taiga is the world's largest terrestrial biome.

Boundary (for thermodynamics) = the border between the system and its surroundings.

Buffer solution = an aqueous solution consisting of a mixture of a weak acid and its conjugate base or a weak base and its conjugate acid. Its pH changes very little when a small amount of strong acid or base is added to it and thus it is used to prevent any change in the pH of a solution.

Carbon capture and storage (CCS), (carbon capture and sequestration) = technology attempting to prevent the release of large quantities of CO₂ into the atmosphere from fossil fuel use in power generation and other industries by capturing CO₂, transporting it and ultimately, pumping it into underground geologic formations to securely store it away from the atmosphere. It is a potential means of mitigating the contribution of fossil fuel emissions to global warming.



Carbon credit = any tradable certificate or permit representing the right to emit one metric ton of carbon dioxide or the mass of another greenhouse gas with a carbon dioxide equivalent (tCO₂e) equivalent to one metric ton of carbon dioxide.

Carbon dioxide equivalent (CDE) = a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO₂) as the reference. The carbon dioxide equivalency for a gas is obtained by multiplying the mass and the global warming potential (GWP) of the gas. For example, the GWP for methane over 100 years is 25 and for nitrous oxide 298. This means that emissions of 1 million metric tons of methane and nitrous oxide respectively is equivalent to emissions of 25 and 298 million metric tons of carbon dioxide. The following units are commonly used:

By the UN climate change panel IPCC: billion metric tons of CO₂ equivalent (GtCO₂eq).

In industry: million metric tons of carbon dioxide equivalents (MMTCDE).

For vehicles: g of carbon dioxide equivalents / km (gCDE/km).

Carrying capacity = the number of individuals an environment can support without significant negative impacts to the given organism and its environment.

Chain reaction = a sequence of reactions where a reactive product or by-product causes additional reactions to take place.

Catalyst = a substance that speeds a chemical reaction without being permanently altered itself.

Cheap oil = The expression “cheap oil” has not exact boundaries. Generally, in the oil literature it is used in reference to the cheap oil prices prevailing over the second half of the 20th Century, when oil price in real terms (2000 U.S. dollars) ranged between \$20-30 per barrel, with some noteworthy exception (such as during the period of the oil shocks in the 1970s and early 1980s, when the price of oil largely exceed \$100 per barrel in real terms).

Chemosynthesis = the biological conversion of one or more carbon molecules (usually carbon dioxide or methane) and nutrients into organic matter using the oxidation of inorganic molecules (e.g. hydrogen gas, hydrogen sulfide) or methane as a source of energy, rather than sunlight, as in photosynthesis.

Clean technology includes recycling, renewable energy (wind power, solar power, biomass, hydropower, biofuels), information technology, green transportation, electric motors, green chemistry, lighting, greywater, and many other appliances that are now more energy efficient. It is a means to create electricity and fuels, with a smaller environmental footprint and minimize pollution.

Climate = the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological elemental measurements in a given region over long periods. Climate can be contrasted to weather, which is the present condition of these elements and their variations over shorter periods.

Chlorofluorocarbon = a compound that contains only carbon, chlorine, and fluorine. Sometimes the term is used to refer to compounds that are composed of only carbon, hydrogen, chlorine, and fluorine (hydrochlorofluorocarbons)

Closed system (for thermodynamics) = a system that can exchange energy but not matter with its surroundings.

Cofactor = a non-protein compound that is bound to a protein and is required for the protein's biological activity. These proteins are commonly enzymes.

Concentrated solar power (also called **concentrating solar power**, **concentrated solar thermal**, and **CSP**) = systems that use mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electrical power is produced when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator.



Control Rods (in a nuclear reactor) = substances, such as cadmium or boron, that absorb neutrons. They control rate of chain reaction and are dropped at first sign of trouble to stop the fission reaction.

Critical (for a fission reaction) = situation in which each fission event causes, on average, exactly one other. This causes a self-sustaining fission chain reaction.

Cycloalkanes (naphthenes) = alkanes that have one or more rings of carbon atoms.

Deforestation = the conversion of forest to another land use or the long-term reduction of the tree canopy cover below a 10 percent threshold. Deforestation implies the long-term or permanent loss of forest cover and its transformation into another land use.

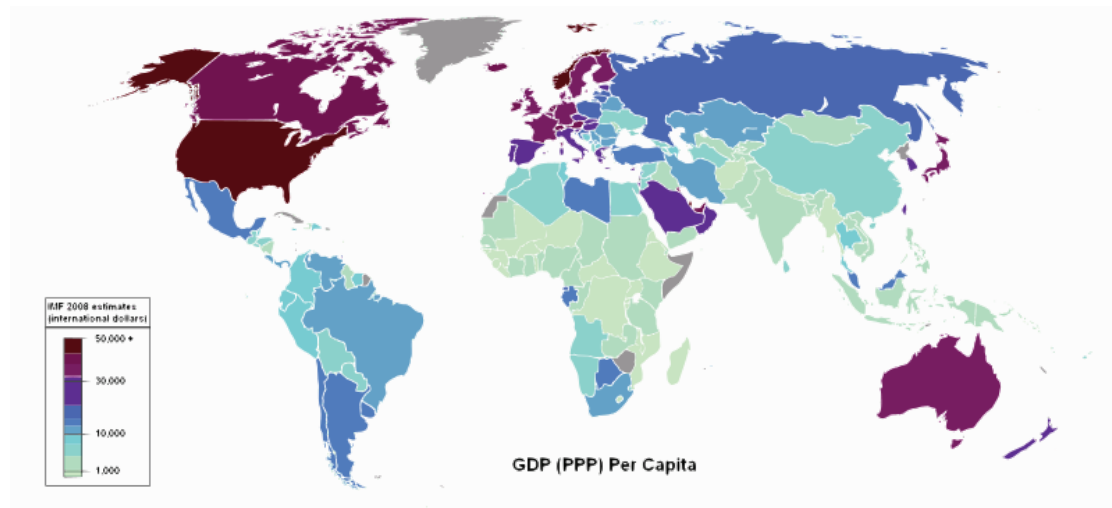
Denitrification = a microbially facilitated process of nitrate (NO_3^-) reduction that may ultimately produce molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen oxide products.

Depletion rate = The natural decline of an oilfield's output after years of production. It could be partially offset by reserve growth.

Desertification = the process of fertile land transforming into desert typically as a result of deforestation, drought or improper/inappropriate agriculture

Developed country or "**more developed country**" (MDC) = a sovereign state which has a highly developed economy relative to other nations. Most commonly the criteria for evaluating the degree of economic development is gross domestic product (GDP), the per capita income, level of industrialization, amount of widespread infrastructure and general standard of living.

Developing country, also known as a **less-developed country** (LDC) = a nation with a low living standard, undeveloped industrial base, and low Human Development Index (HDI) relative to other countries.



Diazotrophs = bacteria and single-cell microorganisms that fix atmospheric nitrogen gas into a more usable form such as ammonia.

Diversity index = a quantitative measure that increases when the number of types into which a set of entities has been classified increases, and obtains its maximum value for a given number of types when all types are represented by the same number of entities.

Dobson unit (DU) = a layer of gas that would be 10 μm thick under standard temperature and pressure. It is a unit of measurement of the columnar density of a trace gas in the Earth's atmosphere. It originated, and continues to be widely used, as a measure of total-column ozone, which is dominated by ozone in the stratospheric ozone layer. For example, 300 DU of ozone brought down to the surface of the Earth at 0 °C would occupy a layer only 3 mm thick. One DU is 2.69×10^{16} ozone molecules per centimeter. This is 0.4462 millimoles of ozone per square meter.

Ecology = the scientific study of the relations that living organisms have with respect to each other and their natural environment.

Ecosystem = an ecological community together with its abiotic environment, interacting as a system.

Electromagnetic force = the force that causes opposite electrical charges to attract each other and like charges to repel.

Endangered species = a population of organisms which is facing a high risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predation parameters.

Entropy (S) = a measure of unusable energy. (As usable energy decreases and unusable energy increases, entropy increases.) Entropy is also a measure of the number of equivalent ways that particles and energy can be arranged. Because there are more ways to arrange particles and energy in a more dispersed system, entropy can be seen as a measure of the dispersal of matter and energy.

$$S = k \ln W$$

k = a constant

W = the number of equivalent ways that that particles and energy can be arranged

Equivalent CO₂ (CO₂e) = the concentration of CO₂ that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas. Examples of such greenhouse gases are methane, perfluorocarbons, and nitrous oxide. CO₂e is expressed as parts per million by volume, ppmv.

Equivalent effective stratospheric chlorine (EESC) = an estimate of the total effective amount of halogens (chlorine and bromine) in the stratosphere. It is calculated from emission of chlorofluorocarbon and related halogenated compounds into the troposphere (lower atmosphere) and their efficiency in contributing to stratospheric ozone depletion (ozone depletion potential, ODP), and by making assumptions on transport times into the upper atmosphere (stratosphere). This parameter is used to quantify man-made ozone depletion and its changes with time. As a consequence of the Montreal Protocol and its amendments phasing out ozone-depleting substances (ODS), the EESC reached maximum in the late 1990s and is now slowly decreasing.

Eutrophication or more precisely **hypertrophication**, = the ecosystem response to the addition of artificial or natural substances, such as nitrates and phosphates, through fertilizers or sewage, to an aquatic system. One example is the "bloom" or great increase of phytoplankton in a water body as a response to increased levels of nutrients. Negative environmental effects include hypoxia, the depletion of oxygen in the water, which induces reductions in specific fish and other animal populations. Other species may experience an increase in population that negatively affects other species.

Evapotranspiration (ET) = the sum of evaporation and plant transpiration from the Earth's land surface to the atmosphere.

Exponential growth (including exponential decay when the growth rate is negative) = when the growth rate of the value of a mathematical function is proportional to the function's current value.

Fauna = animals

Flora = plants

Flux = the rate of flow of fluid, particles, or energy, e.g. solar flux can be described as the rate of flow of solar energy described in W/m².

Flue-gas desulfurization = a technology that enables SO₂ to be removed in power plants burning sulfur-containing coal or oil.

Free radicals = atoms, molecules, or ions with unpaired electrons. Free radicals may have positive, negative, or zero charge. With some exceptions, these unpaired electrons cause radicals to be highly chemically reactive.

General Circulation Model (GCM) = a mathematical model of the general circulation of a planetary atmosphere or ocean and based on the Navier–Stokes equations on a rotating sphere with thermodynamic terms for various energy sources (radiation, latent heat). These equations are the basis for complex computer programs commonly used for simulating the atmosphere or ocean of the Earth.

Global-warming potential (GWP) = a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100 or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). For example, the 20 year GWP of methane is 72, which means that if the same mass of methane and carbon dioxide were introduced into the atmosphere, that methane will trap 72 times more heat than the carbon dioxide over the next 20 years.

Greenhouse effect = a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions. Since part of this re-radiation is back towards the surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases.

Greenhouse gas (sometimes abbreviated **GHG**) = a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Gross primary production (GPP) = the rate at which an ecosystem's producers capture and store a given amount of chemical energy as biomass in a given length of time. Some fraction of this fixed energy is used by primary producers for cellular respiration and maintenance of existing tissues (i.e., "growth respiration" and "maintenance respiration"). The remaining fixed energy (i.e., mass of photosynthate) is referred to as *net primary production* (NPP)

$$\text{NPP} = \text{GPP} - \text{respiration [by plants]}$$

Half-life = the time it takes for one-half of a sample to disappear.

Heat capacity, C = the heat energy (kJ or kcal or Btu) necessary to raise the temperature of an object by 1 °C (or 1 K or 1 °F).

Heat engine = a system that converts heat to mechanical work.

Heat of fusion (or latent heat of fusion or enthalpy of fusion) = the amount of heat energy necessary to convert an amount of solid to liquid, often expressed in kJ/mol or kJ/kg.

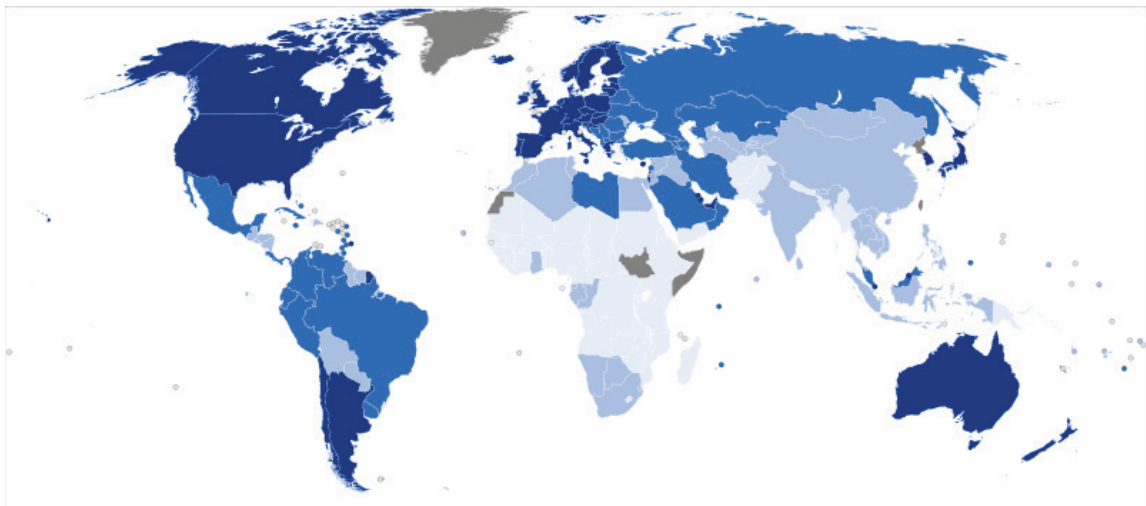
Heat of vaporization (or latent heat of vaporization or enthalpy of vaporization) = the amount of heat energy necessary to convert an amount of liquid to gas, often expressed in kJ/mol or kJ/kg.

Heavy crude oil or extra heavy crude oil = any type of crude oil which does not flow easily. It is referred to as "heavy" because its density is higher than that of light crude oil.

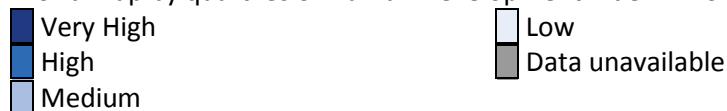
Henry's law = at a constant temperature, the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid.

Heterotroph = an organism that cannot fix carbon and uses organic carbon for growth.

Human Development Index (HDI) = a composite statistic used to rank countries by level of "human development", taken as a synonym of the older terms (the standard of living and/or quality of life), and distinguishing "very high human development", "high human development", "medium human development", and "low human development" countries.



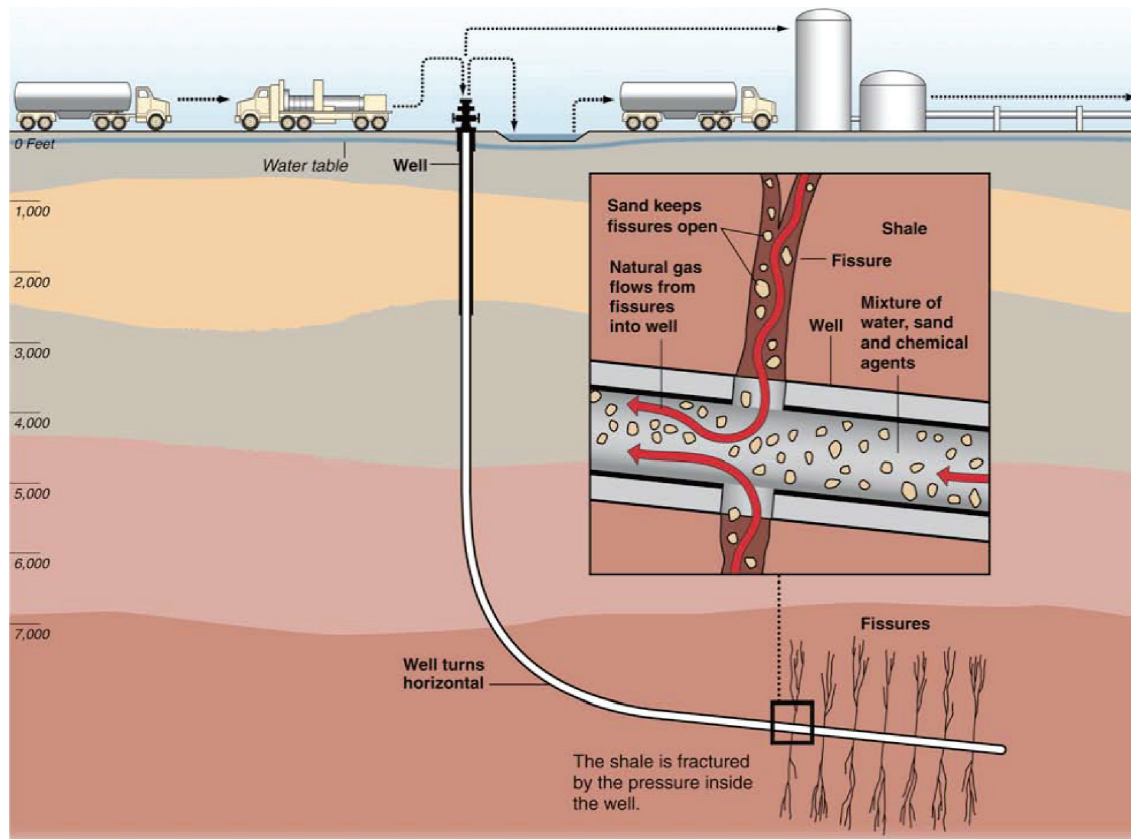
World map by quartiles of Human Development Index in 2011.



Hydroelectricity = the term referring to electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water.

Hydrochlorofluorocarbon = a compound that contains only carbon, hydrogen, chlorine, and fluorine

Hydraulic fracturing = the propagation of fractures in a rock layer caused by the presence of a pressurized fluid. Some hydraulic fractures form naturally, as in the case of veins or dikes, and are a means by which gas and petroleum from source rocks may migrate to reservoir rocks. **Induced hydraulic fracturing** or **hydrofracking**, commonly known as **fracking**, is a technique used to release petroleum, natural gas, or other substances for extraction. This type of fracturing creates fractures from a wellbore drilled into reservoir rock formations.



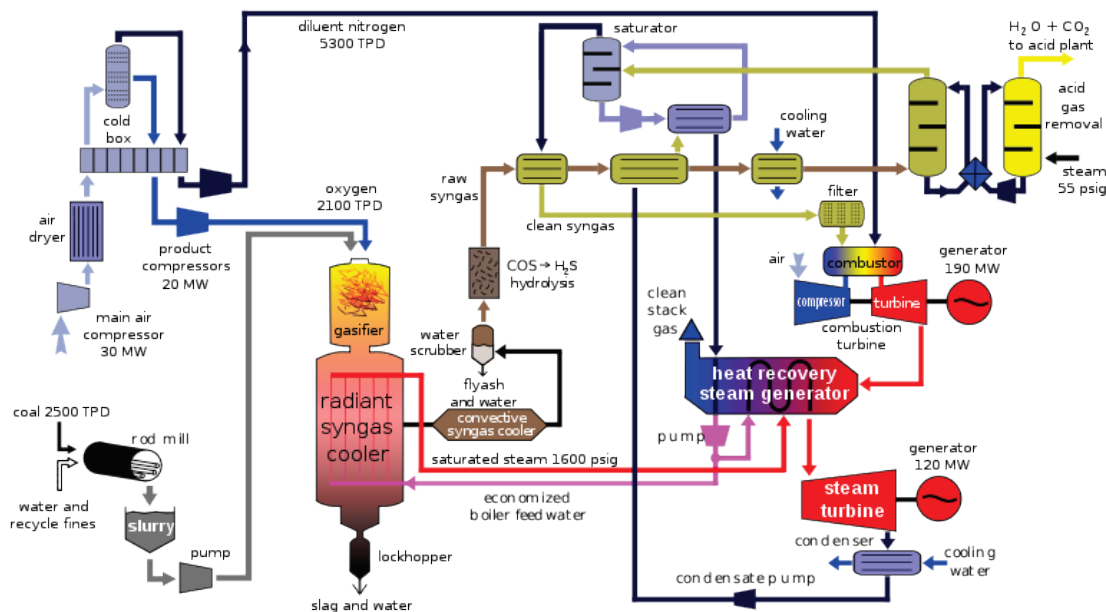
Hydrologic cycle = the transfer of water from the oceans to the atmosphere to the land and back to the oceans

Hydrosphere = the combined mass of water found on, under, and over the surface of a planet.

Ionizing radiation = radiation composed of particles that individually carry enough energy to liberate an electron from an atom or molecule, leading to the formation of ions (charged Particles).

Insolation is a measure of solar radiation energy received on a given surface area and recorded during a given time. It is also called solar irradiation and expressed as hourly irradiation if recorded during an hour, daily irradiation if recorded during a day,

Integrated gasification combined cycle (IGCC) = a technology that uses a gasifier to turn coal and other carbon based fuels into gas—synthesis gas (syngas). It then removes impurities from the syngas before it is combusted. Some of these pollutants, such as sulfur, can be turned into re-usable byproducts. This results in lower emissions of sulfur dioxide, particulates, and mercury. With additional process equipment, the carbon in the syngas can be shifted to hydrogen via the water-gas shift reaction, resulting in nearly carbon free fuel. The resulting carbon dioxide from the shift reaction can be compressed and permanently sequestered.



Kerogen is a mixture of organic chemical compounds that make up a portion of the organic matter in sedimentary rocks. When heated to the right temperatures in the Earth's crust, some types of kerogen release crude oil or natural gas, collectively known as hydrocarbons (fossil fuels). Shales rich in kerogens that have not been heated to warm temperature to release their hydrocarbons may form oil shale deposits.

Light crude oil = liquid petroleum that has a low density and flows freely at room temperature due to the presence of a high proportion of low molecular mass hydrocarbons

Lignite (brown coal) = the lowest rank of coal and used almost exclusively as fuel for electric power generation.

Legume = (1) a pod, such as that of a pea or bean, that splits into two valves with the seeds attached to one edge of the valves or (2) a plant that has such a pod.

Limiting nutrient = Nutrient that constrains the productivity of biomass in any particular environment.

Lithosphere = the rigid outermost shell of a rocky planet.

Moderator = a substance that slows neutrons until their kinetic energy approaches the average kinetic energy of the surrounding particles.

Natural Gas Liquids (NGL) = Hydrocarbons other than methane that are found in natural gas deposits, such as ethane, C_2H_6 , propane, C_3H_8 , butane, $CH_3CH_2CH_2CH_3$, 2-methylpropane, $CH_3CH(CH_3)CH_3$, pentanes, and even higher molecular mass hydrocarbons. When processed and purified into finished by-products, all of these are collectively referred to as NGL (Natural Gas Liquids).

Net primary production (NPP) = the rate at which all the plants in an ecosystem produce net useful chemical energy; it is equal to the difference between the rate at which the plants in an ecosystem produce useful chemical energy (GPP) and the rate at which they use some of that energy during respiration. Some net primary production goes toward growth and reproduction of primary producers, while some is consumed by herbivores.

Nitrification is the biological oxidation of ammonia, NH_3 , with oxygen, O_2 , into nitrite, NO_2^- , followed by the oxidation of these nitrites into nitrates, NO_3^- .

Nitrogen fixation = the process by which free nitrogen, N_2 , in the atmosphere is converted by biologic or chemical means to ammonia, NH_3 , and to other forms usable by plants and animals.

Nucleon number or mass number = the number of nucleons (protons and neutrons) in the nucleus of a nuclide.

Nuclide = a particular type of nucleus, characterized by a specific atomic number and nucleon number

Oil sands, tar sands (bituminous sands) = a type of unconventional petroleum deposit. The oil sands are loose sand or partially consolidated sandstone containing naturally occurring mixtures of sand, clay, and water, saturated with a dense and extremely viscous form of petroleum technically referred to as bitumen.

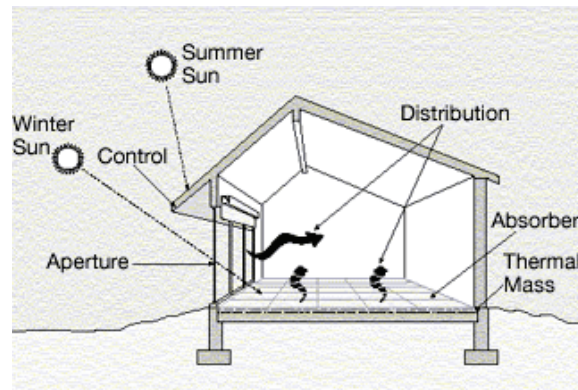
Open system (for thermodynamics) = a system that can exchange energy and matter with its surroundings.

Ozone depletion potential (ODP) = the relative amount of degradation to the ozone layer a chemical compound can cause, with trichlorofluoromethane (R-11 or CFC-11) being fixed at an ODP of 1.0. Chlorodifluoromethane (R-22), for example, has an ODP of 0.055.

Ozone-depleting substance (ODS) = a chemical substance, usually consisting of some combination of chlorine, fluorine, or bromine plus carbon, such as chlorofluorocarbons and hydrochlorofluorocarbons that has been shown to destroy stratospheric ozone.

Paraffin = hydrocarbons with the general formula C_nH_{2n+2} . They are straight-chain or branched-chain hydrocarbons with all of the carbon-carbon bonds single bonds.

Passive solar heating = building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design or climatic design because, unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices.



Peat = partially decayed vegetation...a precursor of coal.

Pedosphere = the outermost layer of the earth that is composed of soil and subject to soil formation process. It exists at the interface of the lithosphere, atmosphere, hydrosphere, and biosphere.

Petroleum or **crude oil** = a naturally occurring flammable liquid consisting of a complex mixture of hydrocarbons and other liquid organic compounds, that are found in geologic formations beneath the Earth's surface. A fossil fuel, it is formed when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and undergo intense heat and pressure.

Photosynthate = A chemical product of photosynthesis.

Photosynthesis = a process used by plants and other organisms to capture the sun's energy to split off water's hydrogen from oxygen. Hydrogen is combined with carbon dioxide (absorbed from air or water) to form glucose and release oxygen.

Photovoltaic systems (PV system) use solar panels to convert sunlight into electricity.

Population growth rate (PGR) = in demographics and ecology, the rate at which the number of individuals in a population increases in a given time period as a fraction of the initial population. Specifically, PGR ordinarily refers to the change in population over a unit time period, often expressed as a percentage of the number of individuals in the population at the beginning of that period. The most common way to express population growth is as a percentage, not as a rate.

Primary forest = a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age.

Primary productivity = the production of organic compounds from atmospheric or aquatic carbon dioxide. It may occur through the process of photosynthesis, using light as a source of energy, or chemosynthesis, using the oxidation or reduction of chemical compounds as a source of energy. Almost all life on earth is directly or indirectly reliant on primary production.

Productivity (or production) refers to the rate of generation of biomass in an ecosystem. It is usually expressed in units of mass per unit surface (or volume) per unit time, for instance grams per square meter per day. The mass unit may relate to dry matter or to the mass of carbon generated. Productivity of autotrophs, such as plants, is called **primary productivity**, while that of heterotrophs such as animals is called **secondary productivity**

Prompt critical = situation in which for each nuclear fission event, one or more of the immediate or prompt neutrons released causes an additional fission event. This causes a rapid, exponential increase in the number of fission events. Prompt criticality is a special case of supercriticality.

Radiative forcing = the change in net irradiance between different layers of the atmosphere. Typically, radiative forcing is quantified at the tropopause in units of watts per square meter. A positive forcing (more incoming energy) tends to warm the system, while a negative forcing (more outgoing energy) tends to cool it. Sources of radiative forcing include changes in insolation (incident solar radiation) and in concentrations of radiatively active gases and aerosols.

Relative biological effectiveness (often abbreviated as **RBE**) = the ratio of biological effectiveness of one type of ionizing radiation relative to another, given the same amount of absorbed energy. The RBE is an empirical value that varies depending on the particles, energies involved, and which biological effects are deemed relevant.

Reserve growth = The estimated increases in crude oil, natural gas, and natural gas liquids that could be added to existing reserves through extension, revision, improved recovery efficiency, and the discovery of new pools or reservoirs connected with a reservoir that is already producing oil. In other words, it refers to the upgrading of already discovered reservoirs, and not to the discovery of brand-new fields.

Secondary forests = forests regenerating largely through natural processes after significant human or natural disturbance, and which differ from primary forests in forest composition and/or canopy structure.

Solar Flux = the rate of flow of solar energy. For earth, it can be described in terms of the power of solar energy per unit area of Earth, e.g. described in W/m^2 .

Spare capacity = The difference between the total oil production capacity (usually referred to a country, or the world) that can be reached within 30 days – and sustained for 90 days – and the actual production. As a consequence, it represents an unused oil capacity that can be activated in a very short period of time.

Specific heat (capacity), c = the heat energy (kJ or kcal or Btu) necessary to raise the temperature of 1 g (or kg or lb) of a substance (such as water) by 1 °C (or 1 K or 1 °F).

Stratosphere = the second major layer of Earth's atmosphere, just above the troposphere, and below the mesosphere.

Stochastic effects = effects that occur randomly, such as radiation-induced cancer.

Strong force = the force between nucleons (protons and neutrons).

Supercritical fluid = any substance at a temperature and pressure above its critical point, where distinct liquid and gas phases do not exist. It can effuse through solids like a gas, and dissolve materials like a liquid.

Supercritical Pulverized Coal Combustion (SC) Plant = Coal electrical generating plant that operates at very high temperature and pressure (580 °C and 23 MPa), resulting higher heat efficiencies (46%) than sub-critical coal-fired plants, which are about 40% efficient.

Supercriticality (for fission reactions) = situation in which each fission event causes, on average, more than one other.

Surrounding (thermodynamic surroundings) = the portion of the universe that can exchange matter and/or energy with the system.

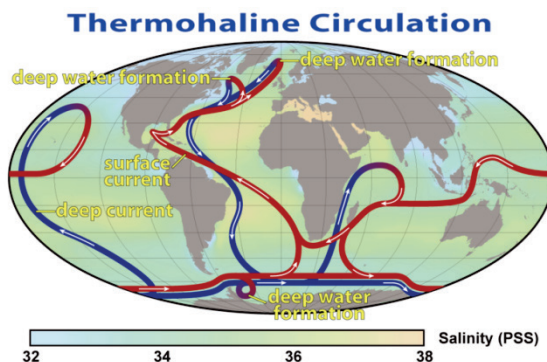
System (thermodynamic system) = the portion of the universe upon which attention is focused. (For example, it could be the ocean, a lake, or the reaction vessel in a coal-fired power plant.)

Thermal Infrared = Long-wavelength infrared with wavelengths 8-15 μm and photon energies of 80-150 MeV.

Thermal power plant = a power plant in which water is heated and turned into steam, which expands and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is cooled, condensed back to a liquid, and recycled to where it was heated.

Thermal nuclear reactors = nuclear reactors that use slowed or thermal neutrons. Almost all current reactors are of this type.

Thermohaline circulation (THC) = a part of the large-scale ocean circulation that is driven by global density gradients created by surface heat and freshwater fluxes. The adjective thermohaline derives from *thermo-* referring to temperature and *-haline* referring to salt content, factors which together determine the density of sea water.



Threatened species = any species which are vulnerable to endangerment in the near future.

Transpiration = the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves.

Troposphere = the lowest portion of Earth's atmosphere. It contains approximately 80% of the atmosphere's mass.

Unconventional oil = According to the EIA definition, conventional crude oil and natural gas production refers to oil and gas “produced by a well drilled into a geologic formation in which the reservoir and fluid characteristics permit the oil and natural gas to readily flow to the wellbore”. By converse unconventional hydrocarbon production doesn’t meet these criteria, either because geological formations present a very low level of porosity and permeability, or because the fluids have a density approaching or even exceeding that of water, so that they cannot be produced, transported, and refined by conventional methods.

Volcanism is the phenomenon connected with volcanoes and volcanic activity. It includes all phenomena resulting from and causing magma within the crust or mantle of a planet to rise through the crust and form volcanic rocks on the surface.

Weather = the present condition of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological elemental measurements and their variations over shorter periods.

Wetland = a land area that is saturated with water, either permanently or seasonally