



absolute zero: the lowest achievable temperature, $0\text{ K} = -273^{\circ}\text{C}$.

acid deposition: the depositing of sulfuric or nitric acid in the environment through snow, rain, or dry sediment.

active solar heating: heating a house with a solar collector that uses pumps or fans to transfer the heat into the house.

adiabatic process: a process in which no heat is transferred into or out of the system.

aerosols: solid or liquid matter in the atmosphere, usually smaller than 10 microns.

alcohol fuel: fuel made by distilling grain, wood, or other plant products into alcohol. Ethanol ($\text{C}_2\text{H}_5\text{OH}$) is the most common fuel.

alpha ray: the nucleus of a helium atom; one of the natural radiations.

altitude: elevation or angle of the sun above the horizon.

amorphous silicon: type of solar cell that uses disordered and noncrystalline silicon.

ampere: the unit of measurement of electric current. Amount of current produced by 1 V through a resistance of 1 ohm.

anaerobic digestion: decomposition process by which bacteria convert organic material into methane in the absence of oxygen.

Archimedes' Principle: the buoyant force on an object is equal to the weight of the fluid displaced by that object.

armature: part of an electric motor or generator that revolves between the poles of a magnet. It is made of wire wound around an iron core.

atomic number: the number of protons in the nucleus.

available energy: the maximum amount of work that can be extracted in a particular process.

avoided cost: cost to a utility to generate electricity if it buys the same amount from another source.

azimuth: angle of the sun from true south.

becquerel (Bq): a measure of radioisotope activity. $1\text{ Bq} = 1$ disintegration per second.

beta ray: a positive or negative electron; a natural component of radioactivity.

binding energy: the energy that holds a nucleus together; the difference between the sum of the masses of the individual nucleons and the actual mass of the nucleus.

biomass: organic material in any form: wood, crop residue, animal manure, and so on. Biomass contains energy stored in chemical form.

breeding: the process whereby a fissile nucleus is produced from a nonfissile nucleus in a reactor by neutron absorption.

British Thermal Unit (Btu): the energy required to raise the temperature of 1 lb of water by 1°F .

BWR (boiling water reactor): a nuclear reactor in which the reactor water is allowed to boil to produce steam.

CAFE (Corporate Average Fuel Economy): standards imposed by the EPA on average mpg of all cars or trucks/SUVs sold by an automobile manufacturer.

CANDU: the Canadian natural-uranium, heavy water reactor.

capacity: the maximum electrical power output that would be available from a generating unit; in units of megawatts (MWe) for electrical power.

capacity factor: the ratio of the electrical energy produced in a given time period to the amount that could have been produced at continuous full-power operation during the same time period; a number less than 1.0.

Carnot cycle: a particular cycle for a heat engine that converts heat into work; the cycle that gives the maximum efficiency when operating between two temperatures.

Carnot efficiency: maximum efficiency for converting heat energy into work; given by $(1 - T_c/T_h)$, with the temperatures in absolute units.

caulking: a soft material that can be squeezed into the cracks of a building to reduce the air flow into or out of the building.

CFCs (chlorofluorocarbons): chlorinated compounds contributing to the destruction of stratospheric ozone.

CFL: compact fluorescent light.

China syndrome: reference to a nuclear reactor core melting its way into the ground beneath the reactor in the event of a loss of coolant accident.

co-generation: production of both electricity and useful heat from the same fuel source.

competitive market: an environment that allows many sellers and buyers to buy and sell goods or services from each other. Customers have the choice of buying their energy from more than one provider.

conduction: the process by which heat travels through substances.

convection: the process by which heat is transferred by the movement of fluids.

COP (coefficient of performance): ratio of heat transferred by a heat pump to its electricity input.

CSP (Concentrating Solar Power systems): production of high-temperature fluids for electrical power generation.

cross section: related to the probability for a nuclear reaction to occur.

crude oil: mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs; it remains liquid at atmospheric pressure.

curie: a measure of activity; $1 \text{ Ci} = 3.7 \times 10^{10}$ disintegrations per second.

Darrieus rotor: a vertical eggbeater-type wind turbine machine.

degree-days: the difference between the mean daily temperature and 65°F ; can be summed to create heating degree-days for a specified time period; used as indicator of space-heating requirements.

demand: the amount of electricity that must be generated to meet the needs of all customers; sometimes called the load.

Demand Side Management (DSM): utility programs used to reduce peak electrical demand and help customers use electricity more efficiently.

deregulation: the act or process of removing regulations or other barriers that may restrict an industry.

DHW: domestic hot water.

diffuse radiation: solar radiation received under cloudy skies; cannot be focused by mirrors or lenses.

direct radiation: solar radiation received under clear skies; can be focused.

divestiture: the separation of a utility's generation and transmission functions into smaller, individually owned businesses.

dosimeter: a device to measure the amount of radiation absorbed over time.

doubling time: the time required for a given quantity to double in value; approximately, $DT = 70 \text{ years/percent growth rate}$.

ECCS (emergency core cooling system): a high-pressure water spray system that is used to cool the nuclear reactor core in the event of a loss of coolant accident.

efficiency: the ratio of the useful work or energy output to the total energy input or energy converted.

EGR (exhaust gas recirculation): a system in an auto engine to reduce nitrogen oxide formation; exhaust gases are added to the incoming air to lower the combustion temperature in the engine.

EIA: U.S. Energy Information Administration.

electrolyte: a chemical that, when dissolved in water, will conduct an electrical current.

electrostatic precipitator: a high-voltage device for removing particulates from the combustion gases in a power plant.

EMF (electromagnetic field): usually used in association with high-voltage electrical transmission lines.

emissivity: measure of a material's capability to give off thermal radiation; number between 0 and 1.

enrichment: the process in which the abundance of the fissile isotope, ^{235}U , is increased from 0.7% to 3–4% in the uranium oxide fuel.

entropy: a term used in thermodynamics to measure the disorder of a system. The total entropy of a system always increases in an isolated process.

eutrophication: enrichment of a body of water by the addition of extra nutrients, stimulating algae growth.

eV (electron volt): an amount of energy equal to 1.6×10^{-19} joules.

exponential growth: a process in which the amount of a substance has a fixed growth rate, or the change in the amount of something is proportional to the amount present.

feed in tariff: requirement that utilities buy electricity produced by renewables at a fixed price.

fertile material: nucleus that does not fission but can be used to create fissionable nuclei through neutron absorption, for example, ^{238}U .

first law: conservation of energy; in a thermodynamic system, the heat added plus the work done equals the change in the total energy of a system.

fissile material: nucleus that will undergo fission when absorbing a neutron, for example, ^{235}U and ^{239}Pu .

fission products: unstable radioactive isotopes produced when a uranium nucleus is split after capturing a neutron.

fluidized bed combustion: process by which coal is burned on a moving bed of air; limestone is added to remove SO_2 .

fly ash: minute particles of ash resulting from the burning of coal.

FPC: flat plate collector (for heating water with the sun).

fracking: hydraulic fracturing; use of high pressure water to release natural gas bound in underground rock formations.

FTC (Federal Tax Credit): certain percentage of investment in renewable technologies applied to federal and state taxes for that year.

fuel cell: device that produces electricity from a chemical reaction between hydrogen and oxygen.

fusion: the process of bringing two nuclei together to form one nucleus; energy is released through the loss of mass in the product nucleus.

gamma ray: a high-energy photon of electromagnetic energy released in some radioactive decays.

gas desulfurization: process to remove SO_2 from exhaust gases in a power plant.

gas turbine: a heat engine that produces electricity by using the force of hot, expanding gases to make a turbine revolve. The gases are produced by burning a fuel.

gaseous diffusion: the enrichment of ^{235}U by diffusion of uranium hexafluoride gas through porous barriers.

gauss: a measure of magnetic field strength. Earth's magnetic field is about 0.5 gauss.

generator: a device that changes mechanical energy into electrical energy. It consists of a magnet and a coil of wire rotating relative to the magnet.

geothermal energy: heat energy available in rocks, hot water, and steam beneath the earth's surface.

gray (Gy): a unit of absorbed dose; 1 Gy = 1 J/kg.

green energy: electricity produced by renewable resources.

greenhouse effect: the trapping in the atmosphere, primarily by CO₂, of long wavelength radiation emitted by the earth.

greenhouse gases: gases in the atmosphere that absorb infrared radiation from the earth; CO₂, methane, CFCs, ozone, nitrous oxides.

grid: a system of power lines and generators that is coordinated to provide electricity to customers at various points.

gross domestic product (GDP): total value of all goods and services produced in a country.

half-life: time it takes for one-half of the amount of a radioactive material to decay into another element.

HDI: unit to measure a country's achievements in longevity, knowledge, and standard of living.

head: the height of water behind a dam to the turbine below.

heat capacity: amount of energy needed to raise the temperature of 1 cubic foot of material by 1°F; equal to specific heat multiplied by the object's density.

heat engine: device operating between two temperatures that converts fraction of heat energy into useful work.

heat exchanger: device that is used to transfer heat between two fluids—one loses heat energy and the other gains it.

heat of fusion: heat energy needed to change unit mass of object from solid to liquid at the same temperature.

heat of vaporization: heat energy needed to change unit mass of object from liquid to vapor at the same temperature.

heat pump: a device that operates as a refrigerator and moves heat into the house in the winter from the outside; in the summer, it cools the house, moving the heat to the outside.

HTGC (high-temperature gas-cooled reactor): a reactor that uses graphite as the moderator and gas rather than water for heat transfer.

hydrocarbons: chemical compounds in gaseous, liquid, or solid phases containing only hydrogen and carbon. Gaseous compounds also called volatile organic compounds; for example, benzene and methane.

hydrothermal: the type of geothermal energy in which water heated within the earth flows to the surface as hot water or steam.

independent power producer (IPP): a company, other than a utility, that generates electricity.

independent system operator (ISO): an entity that monitors the reliability of the power system and coordinates the supply of electricity around the state.

inertial confinement: laser-induced fusion in which fuel is heated rapidly before expansion can begin, increasing both temperature and density.

infiltration: process by which cold air leaks into a house through cracks in structure.

insolation: incident solar radiation; measured in Btu/ft²/day or W/m².

insulation: a material that slows heat loss or heat gain.

inverter: device for converting DC to AC electricity.

IPCC: United Nations Intergovernmental Panel on Climate Change.

irradiation: exposure of certain food stuffs to low doses of radiation to control bacterial growth and to increase shelf life.

isotopes: nuclei that have the same atomic number but different numbers of neutrons.

kcal: the energy required to raise the temperature of 1 kg of water by 1°C.

kinetic energy: energy of motion.

Kyoto Protocol: international conference held in Japan in 1997 that dealt with reductions in greenhouse gas emissions. Its treaty took effect in 2005.

latent heat: heat necessary to cause a phase change in a material, for example, going from ice to liquid, or liquid to gas, without a change in temperature.

Lawson criteria: conditions that must be achieved in fusion for energy breakeven (energy output at least as large as energy input).

leachate: liquid resulting from water moving through a landfill (“garbage juice”).

leaching: the process by which water moves through a material (e.g., garbage), picking up substances in the material.

LED (light-emitting diode): solid-state chip that produces light when voltage is applied.

liquefaction: the process of converting coal into usable liquid fuel.

LMFBR (liquid metal fast breeder reactor): a nuclear reactor using liquid sodium as the coolant.

LOCA (loss of coolant accident): a nuclear accident in which a major water coolant pipe breaks, possibly leading to a core meltdown.

Low-e glass: low emissivity coatings on window glass to reduce heat gain and loss.

MAGLEV (magnetic levitation): suspension of an object using repulsive force between two magnets. Used for high-speed trains.

magma: hot material under the earth’s crust and mantle.

magnetic confinement: technique used in fusion reactors to contain the plasma that is being heated.

methane: colorless, odorless gas—CH₄; main component of natural gas.

micron: 1 $\mu\text{m} = 10^{-6}$ m.

moderator: substance used in nuclear reactors to slow down neutrons so they can be more readily captured by ²³⁵U and produce fission; usually water.

mrem (millirem): 1/1000th of a rem (radiation dose).

natural gas (associated): natural gas that occurs in crude oil reservoirs either as free gas or as gas in solution with crude oil.

natural gas liquids (NGLs): general term for all liquid products separated from natural gas in processing plants.

net metering: credit given for electricity generated; billed only for net energy used.

NRC (Nuclear Regulatory Commission): the federal agency responsible for the licensing and operation of nuclear reactors.

nucleon: general term for the proton and neutron.

off-peak period: hours of the day when demand for electricity is low; usually has lower prices for electricity.

Ohm’s law: the empirical relationship among the current, potential difference, and resistance in an electrical circuit: $V = IR$.

oil shale: sedimentary rock containing solid organic material that can be converted to crude oil.

OPEC (Organization of Petroleum Exporting Countries): as of 2011, members are Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

overburden: soil and rock that overlie a buried deposit of coal. In surface mining, the overburden is removed first.

ozone: a molecule made up of 3 atoms of oxygen. In the stratosphere, it provides a protective layer shielding the earth from ultraviolet radiation; near the ground, ozone is a harmful air pollutant and a major component of photochemical smog.

PANs (peroxyacyl nitrates): reactive organic radicals that contribute to formation of smog.

passive solar heating: using the building to collect and store incoming solar energy. It does not use fans or pumps to distribute heat through the building.

pebble-bed reactor: nuclear reactor using fuel encased in glass pebbles with gas as the heat transfer medium.

penstock: a large pipe that carries water to the turbine in a hydroelectric plant.

petroleum: a wide class of liquid hydrocarbon mixtures. Includes crude oil and natural gas plant liquids.

pH: a measure of how acidic or basic a substance is. Distilled water has a pH of 7. A pH of 6 to 0 is increasingly acidic; a pH of 8 to 14 is increasingly alkaline.

photoelectric effect: the release of electrons from a metal by the absorption of light.

photon: a massless particle of electromagnetic energy, moving at the speed of light.

photosynthesis: the production of carbohydrates in a plant from water and carbon dioxide using solar radiation.

plasma: ionized gas, usually at a high temperature.

p–n junction: the region of contact between p-type and n-type semiconductor materials. A depletion region exists at this junction, as well as a potential difference.

potential energy: energy stored; a function of the object's position.

PPA (power purchase agreement): utility's commitment to purchase all electricity produced by a renewable facility.

pumped storage: a technique for storing energy by using excess electricity to pump water to a high reservoir, from which it can be used in a hydroelectric facility to generate electricity during periods of peak demand.

PURPA (Public Utilities Regulatory Policy Act): 1978 federal law requiring competition in the electrical generating industry. Requires utilities to buy power from eligible co-generation sources, small hydro, or waste-fueled facilities, under contracts at an avoided cost rate.

PWR (pressurized water reactor): a nuclear power reactor in which the reactor water is kept under a high pressure and not allowed to boil.

quad: an amount of energy equal to 10^{15} Btu.

quantized value: a discrete value possessed by a physical quantity.

radiation: energy emitted from atoms or molecules in the form of rays, waves, or particles. Radiation from the nucleus can have enough energy to produce ionization and harm living tissue.

radon: a radioactive gas that emits alpha rays; atomic weight is 222, and atomic number is 86.

Rankine cycle: a particular cycle in a turbine power system; the working fluid is both a liquid and vapor in the cycle.

rated speed: the speed for which a given wind turbine is designed to produce maximum power.

rem: a unit for measuring absorbed doses of radiation.

renewable resource: an essentially inexhaustible alternative energy source to oil, gas, coal, or uranium used to produce electricity or heat.

RES (Renewable Electricity Portfolio): see RPS.

reserve: the amount of a resource that is recoverable at current prices and with current technology.

retrofitting: installation of equipment or materials after initial construction.

reversible: a process that can have its direction changed or reversed with no effect on the environment.

Roentgen: an old unit of radiation exposure.

RPS: renewable energy portfolio standard; requirement that certain percentage of electricity be provided by renewable technologies.

R-value: the "resistance" of a substance to heat transfer by conduction; proportional to material thickness and inversely to its thermal conductivity.

SEGS (Solar Electric Generating System): use of parabolic trough concentrating collectors to produce steam to generate electricity.

sequestration (of carbon): capture of CO_2 to nonatmospheric sinks.

shale gas: reserves of natural gas bound in underground rock formations. Also called tight gas.

shale oil: a form of oil trapped within a rock called shale.

sievert: measure of radiation dose: $1 \text{ Sv} = 1 \text{ J/kg}$ (for gammas, betas); $1 \text{ mSv} = 100 \text{ mrem}$.

solar constant: incident solar radiation at top of earth's atmosphere, per unit area; measured in W/m^2 or $\text{Btu/ft}^2/\text{h}$.

somatic effect: an effect on the health of an individual receiving radiation.

specific heat: amount of heat added per unit mass per degree of temperature increase.

stranded costs: costs that a utility has an obligation to pay for, but may not be able to recover from a customer because the customer no longer uses the utility's service.

sustainable development: development that meets needs of the present while protecting the environment for the future.

synergism: action of two or more things to achieve an effect of which each is individually incapable.

tar sands: geologic sands containing viscous asphalt-like oil; also called oil sands.

temperature inversion: event occurring when the temperature of a layer of air increases, trapping rising air pollutants.

tight gas: natural gas deposits trapped within a material. The deposits are removed by explosives or hydraulic fracturing.

therm: a measure of heat energy content; 1 therm equals 100,000 Btu.

thermal mass: a heat storage material, such as water or masonry, used in passive solar heating systems.

thermal neutrons: neutrons in a reactor that have very small energies, about 1/40th of an eV.

thermosiphoning: the circulation of water by natural convection.

time-of-use pricing: rates that are designed to reflect changes in a utility's cost of providing service by time of day or season.

Tokamak: a particular type of fusion reactor using magnetic confinement; doughnut shaped.

total energy: sum of a body's potential, kinetic, and thermal energies.

vapor cycle: cycle in a heat engine in which working fluid changes state from gas to liquid; also called Rankine cycle.

volatile organic compounds (VOCs): compounds consisting of carbon and hydrogen atoms; air pollutants associated with petroleum use. Also known as hydrocarbons.

weather stripping: material made of foam rubber, vinyl, and so on that is used around windows and doors to reduce air infiltration.