

# Glossary of Renewable Energy

## Terms and Phrases

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**Absorptance:** The ratio of the radiation absorbed by a surface and the total energy falling on that surface measured as a percentage.

**AC or Alternating Current:** Alternating Current (AC) is the electrical power available from household outlets. In the United States AC current oscillates between plus 120 volts and -120 volts sixty times a second (60 hertz).

**Active Solar Heating:** An active solar heating system uses a pump or a fan to move hot air or liquid heated in a solar collector to a storage tank or area of use.

**Adobe:** A sun-dried, unburned brick of clay (earth) and straw used in construction; in the United States, primarily in the Southwest.

**Ambient temperature:** Surrounding temperature, as around a house.

**Ampere (amp) :** An ampere is a measure of electrical current, the amount of electricity that flows in a line.

**Angle of incidence:** The angle that the sun's rays make with a line perpendicular to a surface. The angle of incidence determines the percentage of direct sunshine intercepted by a surface. The sun's rays that are perpendicular to a surface are said to be "normal" to that surface.

**Array:** A group of collectors, modules, or panels.

**ASHRAE:** Abbreviation for the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

**Auxiliary system:** A supplementary heating unit to provide heat when the primary unit cannot, usually occurring during periods of cloudiness or intense cold and the solar system cannot provide enough heat.

**Azimuth:** The angular distance between true south and the point on the horizon directly below the sun.

**Ballast :** A charging device in fluorescent lights which give a "jump start" to the gas inside the tube to make it start glowing steadily.

**Battery:** A source of electric power that has been stored as chemical energy in the battery. Batteries produce direct current when connected to an electrical circuit. A battery supplies power at a given voltage and the current depends on the load in the circuit.

**Bearing angle:** See azimuth.

**Berm:** A manmade mound or small hill of earth.

**Biomass :** Material produced by living organisms (wood, vegetation, manure, etc.).

**Biomass fuels:** Trees and forest residues, animal manure and waste, grains, crops and aquatic plants are some common sources of biomass fuels.

**Black body:** A theoretically perfect absorber of incident radiation with also the highest possible emittance.

**BTU or British Thermal Unit:** A measure of heat energy; the amount needed to raise the temperature of one pound of water by one degree Fahrenheit. One Btu equals 252 Calories.

**Calorie:** The quantity of heat needed to raise the temperature of 12 grams of water 1°C, one kilocalorie equals approximately 4 Btu's.

**Carbon Dioxide :** Carbon Dioxide (CO<sub>2</sub>) is a colorless, odorless gas formed during combustion of fossil and other carbon based fuels. CO<sub>2</sub> is also produced during organic decomposition and respiration. Plants use carbon dioxide during photosynthesis to produce sugars and Oxygen. Carbon dioxide is a greenhouse gas that lets light pass through and traps heat from re-radiating into space.

**Caulking:** Making an airtight seal by filling in cracks around windows and doors.

**Circuit:** electrical path.

**Clerestory:** A window that is placed vertically (or near vertically) in a wall above one's line of vision to provide natural light into a building.

**Coefficient of heat transmission, or U-value:** The rate of heat loss in Btu per hour through a square foot of a wall or other building surface when the difference between indoor and outdoor air temperatures is 1°F.

**Collector Efficiency:** The ratio of heat energy extracted from a collector to the solar energy striking the cover, expressed in percent.

**Collector, solar:** a device for capturing solar energy (usually solar thermal), ranging from ordinary windows to complex mechanical devices.

**Concentrator:** Solar concentrators are lenses, mirrors, or reflectors that concentrate the light onto a small area.

**Conductance(C):** The quantity of heat (Btu's) which will flow through one square foot of material in one hour, when there is a 1°F temperature difference between both surfaces. Conductance values are given for a specific thickness of material, not per inch of thickness. For homogeneous materials, such as concrete, dividing the conductivity (k) of the material by its thickness (x) gives the conductance (C).

**Conduction:** Transfer of heat through a quantity of material due to the molecular motion.

**Conductivity(k):** The quantity of heat (Btu's) that will flow through one square foot of material, one inch thick, in one hour, when there is a temperature difference of 1°F between its surface

**Conservation:** See energy conservation.

**Convection:** Transfer of heat by the movement of liquids and gases.

**Dead air space(still air space):** A confined space of air. A dead air space tends to reduce both conduction and convection of heat. This fact is utilized in virtually all insulating material and systems, such as double glazing, Beadwall, fiberglass batts, rigid foam panels, fur and hair, and loose-fill insulations like pumice, vermiculite, rock wool and goose down.

**DC or Direct Current:** Direct Current (DC) is the flow of electricity through a circuit that doesn't cyclically alternate in polarity. Batteries and solar cells are typical sources of direct current.

**Degree-day(DD):**cooling, see degree day for heating, except that the base temperature is established at 75°, and cooling degree days are measured above that base.

**Degree-day(heating):** An expression of climatic heating requirement expressed by the difference in degree F below the average outdoor temperature for each day and an established indoor temperature of 65°F. (The assumption behind selecting this base is that average construction will provide interior comfort when the exterior temperature is 65°F). The total number of degree-days over the heating season indicates the relative severity of the winter in that area.

**Density(p):** The mass of a substance which is expressed in pounds per cubic foot.

**Design Heat Load:** The total heat loss from a house under the most severe winter conditions likely to occur.

**Design temperature:** A temperature close to the lowest expected for a location, used to determine the design heat load.

**Daylighting:** Allowing the sun to provide direct and non direct light to interior spaces.

**Diffuse radiation:** Radiation that has traveled an indirect path from the sun because it has been scattered by particles in the atmosphere, such as air molecules, dust and water vapor; indirect sunlight comes from the entire skydome.

**Direct methods:** Techniques of solar heating in which sunlight enters a house through the windows and is absorbed inside.

**Direct Radiation Solar:** Radiation that comes straight from the sun, casting shadows on a clear day.

**Double-glazed:** See glazing, double.

**Efficiency:** Efficiency is the ratio of desired energy output to the energy input, often expressed in %. For example a typical solar cell has a 15% efficiency which means that 15% of the incident solar radiation on the solar cell is turned into electricity. In solar energy it pertains to the percentage of the solar energy incident on the face of the collector (glazing), that is used for space heating. In solar application this measure pertains to the percentage of the solar energy incident on the face of the collector(glazing), that is used for space heating.

**Electricity:** Electricity is the flow of electrical energy through a circuit.

**Embodied Energy:** The total amount of energy needed to manufacture a finished product from raw materials, including the energy used to transport the product.

**Emissivity:** The property of emitting heat radiation; possessed by all materials to a varying extent. "Emittance" is the numerical value of this property, expressed as a decimal fraction, for a particular material. Normal emittance is the value measured at 90° to the sample and hemispherical emittance is the total amount emitted in all directions. We are generally interested in hemispherical, rather than normal emittance. Emittance values range from .05 for brightly polished metals to 0.96 for flat black paint. Most non metals have high values of emittance.

**Energy:** The capacity to do work.

**Energy Conservation:** Wise use and careful management of energy resources by reducing wasteful energy use, using energy for a given purpose more efficiently, or reducing energy use altogether.

**Energy Conversion:** The process of changing one form of energy into another. For example, the chemical energy stored in gasoline can be converted into kinetic energy (energy of motion) by an automobile engine.

**Energy Sources :** There are many sources of energy. Among these are:

1. Renewables (solar, wind, geothermal, biomass, hydro, tides).
2. Fossil fuels (coal, oil, gas);
3. Nuclear (fission and fusion);

**Equinox:** Either of two times during a year when the sun crosses the celestial equator and when the length of day and night are approximately equal. These are the autumnal equinox on or about September 22 and the vernal equinox on or about March 22.

**Eutectic salts:** Salts used for storing heat. At a given temperature, salts melt, absorbing large amounts of heat which will be released as the salts freeze. Example: Glauber's salts. The melt-freeze temperatures vary with different salts and some occur at convenient temperatures for thermal storage such as in the range of 80° to 120°F.

**Fluorescent light:** The glow discharge of an electrified gas for illumination rather than the glow of an electrically heated conductive filament. More efficient because they produce the same amount of light (lumens) using less electrical energy than incandescent electric light bulbs. Fluorescent lights produce little heat, and may have reflectors to concentrate or direct the light output.

**Fossil fuels:** Fuels formed eons ago from decayed plants and animals. Oil, coal and natural gas are such fuels. Such devices are usually of the fluorescent type, which produce little heat, and may have reflectors to concentrate or direct the light output.

**Fuel:** A material which is consumed in the process of changing its chemically stored energy into heat or light.

**Fuel cell:** A battery like device which produces electricity more efficiently than normal combustion by having the fuel chemically react with an oxidizer at two separate electrical terminals to produce an electric current.

**Fuel efficiency:** The amount of useful obtained for the amount of fuel consumed. For automobiles, a fuel efficient car travels more miles per gallon of gasoline than a fuel inefficient car.

**Geothermal:** Pertaining to heat energy in the earth's interior.

**Geothermal energy:** Heat generated by natural processes within the earth. Chief energy resources are hot dry rock, magma (molten rock), hydrothermal (water/steam from geysers and fissures) and geopressure (water saturated with methane under tremendous pressure at great depths).

**Glazing:** A covering of transparent or translucent material (glass or plastic) used for admitting light. Glazing retards heat losses from reradiation and convection. Examples: windows, skylights, greenhouse and collector coverings.

**Glazing, double:** A sandwich of two separated layers of glass or plastic enclosing air to create an insulating barrier.

**Global warming:** The gradual warming of the earth due to buildup of greenhouse gases such as methane and carbon dioxide in the earth's atmosphere:

**Greenhouse effect:** Refers to the characteristic tendency of some transparent materials such as glass to transmit radiation shorter than about 2.5 microns and block radiation of longer wavelengths. The greenhouse effect happens with visible light passes through a material and gas and the heat generated by the light can not pass through the material or gas. In cars and buildings the radiant energy is trapped by glass: in the earth's atmosphere the radiant energy is trapped by gases such as carbon dioxide and methane.

**Heat:** Heat is a form of energy related to molecular movement and hence the temperature of an object. Heat can be transferred by conduction, convection, or radiation.

**Heat capacity (volumetric):** The number of Btu's a cubic foot of material can store with a one degree increase in its temperature.

**Heat gain:** An increase in the amount of contained in a space, resulting from direct solar radiation and the heat given off by people, lights, equipment, machinery and other sources.

**Heat loss:** a decrease in the amount of heat contained in a space resulting from heat flow through walls, windows, roof and other building envelope components.

**Horsepower:** A unit of power. One horsepower equals 550 foot-pounds per second or 746 watts.

**Hydrocarbon:** An organic compound containing carbon and hydrogen. Large, heavy hydrocarbons may have up to 90 carbon atoms per molecule while small, light hydrocarbons may have only one to four carbon atoms per molecule. Different types and sizes of hydrocarbons molecules make up crude oil and natural gas.

**Hydro:** A prefix meaning produced by or derived from water or the movement of water, as in "hydroelectricity".

**Hydroelectric Power:** Hydropower or electricity produced by the conversion of kinetic energy from flowing water using a generator.

**Incident light:** The light falling on a surface, such as sunlight shining on a solar panel.

**Infiltration:** the uncontrolled movement of outdoor air into the interior of a building through cracks around windows and doors or in walls, roofs and floors. This may work by cold air leaking in during the winter, or the reverse in the summer.

**Insolation:** The total amount of solar radiation—direct, diffuse and reflected—striking a surface exposed to the sky. This incident solar radiation is measured in langley's per minute, or Btu's per square foot per hour or per day.

**Insulation:** Materials or systems used to prevent loss or gain of heat, usually employing very small dead air spaces to limit conduction and/or convection.

**Inverter:** A device which changes direct current (DC) into alternating current (AC). Direct current is created by photovoltaic modules or batteries and is converted to AC through the use of an inverter.

**Kilowatt:** A unit of power equal to 1,000 watts.

**Kilowatt-hour:** An amount of energy that results from the steady production or consumption of one kilowatt of power for a period of one hour. A kilowatt-hour is a unit of energy equal to 3,413 Btu or 3,600,000 joules.

**Light:** The portion of the electromagnetic radiation that is visible to the eye. Light consists of many different wavelengths. This results in rainbows when the light is scattered by rain clouds or passes through crystal glass. Light from lasers consists of only one wavelength. Other portions of the electromagnetic spectrum are radio waves, infrared radiation, and ultraviolet radiation.

**Lumen:** A measurement of visible light.

**Megawatt:** A unit of power equal to one million watts or 1,000 kilowatts.

**Module:** a photovoltaic panel.

**Night time Insulation:** Movable insulation placed on interior of windows to retain heat

**N-layer:** An N-layer is created by implanting atoms that have an extra valence electron into a crystalline structure, thus turning the material into a semiconductor. The excess valence electrons are free to move about the material as part of an electric current. This material is used in computer chips, transistors, and solar cells.

**Nocturnal cooling:** The cooling of a building by the radiation of the excess heat to the night sky.

**Nonrenewable Energy Resource:** Energy resource that is either replenished very slowly or not replenished at all by natural processes. A nonrenewable resource can ultimately be totally depleted or depleted to the point where it is too expensive to extract and process for human use. Fossil fuels are examples of nonrenewable energy resources.

**Ohm:** A unit quantifying electrical resistance.

**Panel:** a photovoltaic module, or single unit composed of PV cells grouped to provide power at a certain amperage and voltage.

**Passive Solar Heating:** Windows on south wall to allow sun to hit thermal mass and retain heat.

**Parabolic collector:** A polished dish or u-shaped collector that focuses solar thermal energy on a tube or a point (as in heat-troughs and solar cookers).

**Parallel Circuit:** An electrical circuit in which each component of the circuit (e.g., a set of light bulbs) is connected across a voltage source (e.g., a battery) so that an electric current flows through each component along a separate path.

**PV or Photovoltaic:** Pertaining to the production of electricity from light.

**Photovoltaic cell** (see Solar cell)

**P-layer:** A P-layer is created by implanting atoms that are short one valence electron into a crystalline structure, thus turning the material into a semiconductor. The implanted atoms in the P-Layer are looking for electrons to complete bonds with neighboring atoms. This absence of an electron is called a hole and "holes" move about the material much like positive electrons. This material is used in computer chips, transistors, and solar cells.

**P-N Junction:** A P-N Junction is created when a P-layer is brought into contact with an N-layer, the free electrons in the N-layer drift over to fill the holes in the P-layer. This creates an electric field because of the imbalance of charges on one side as compared to the other. In a solar cell, when light from the sun knocks an electron from orbit around an atom in the P-N junction region, the electric field helps separate the resulting electron and hole, and this is how solar cells produce electricity.

**Radiation:** The flow of energy across open space via electronic waves, such as visible light. Radiation can be atomic size or smaller particles, or electromagnetic radiation emitted from a source. Light from the sun, radio waves, and gamma rays are all electromagnetic radiation. Emission of alpha particles, electrons, and other particles from radioactive materials is also called radiation.

**Radiation, infrared:** Electromagnetic radiation, whether from the sun or a warm body, that has wavelengths longer than the red end of the visible spectrum (greater than .75 microns). We experience infrared radiation as heat; 49% of the radiation emitted by the sun is in the infrared band.

**Reflected radiation:** Sunlight that is reflected from surrounding trees, terrain or buildings onto a surface exposed to the sky.

**Reflectance:** The ratio or percentage of the amount of light reflected by a surface to the amount incident.

The remainder that is not reflected is either absorbed by the material or transmitted through it. Good light reflectors are not necessarily good heat reflectors.

**Renewable Energy:** Energy from sources that can be renewed and used on a sustainable basis: sunshine, water flow, wind, waves, and vegetation.

**Renewable Energy Devices:** Solar collectors, wind turbines, hydroelectric turbines, and other devices that produce energy from a sustainable source.

Certain renewable resources will always be available no matter how they are used. (e.g., solar energy), while other renewable resources can be depleted when their rate of use exceeds their rate of replacement (e.g., wood).

**Resistance (R):** R is the reciprocal of conductivity or  $x/k$  (x equals thickness of the material in inches).

**Retrofitting:** Installing solar water heating and/or cooling systems in existing buildings not originally designed for the purpose.

**R-factor:** A unit of thermal resistance used for comparing insulating values of different materials; the reciprocal of the conductivity; the higher the R-factor of a material, the greater its insulating properties. See resistance R.

**Seasonal efficiency:** The ratio of solar energy collected and used to that which strikes the collector, over an entire heating season.

**Selective surface:** An absorber coating that absorbs most of the sunlight hitting it but emits very little thermal radiation.

**Semiconductor:** A substance that is normally an insulator but is changed into a conductor by implanting (or doping) with atoms with a different number of valence electrons. Substances like silicon and gallium arsenide can be made into semiconductors.

**Series:** When batteries or solar cells are linked together so that the positive terminal of one is connected to the negative terminal of the next. This is also used when there is one electrical path in an electric circuit.

**Shading coefficient:** The ratio of the solar heat gain through a specific glazing system to the total solar heat gain through a single layer of clear, double strength glass.

**Shading mask:** A section of a circle that is characteristic of a particular shading device, superimposed on a circular sun path diagram to determine the time of day and the months of the year when a window will be shadowed by the device.

**Skydome (sky vault):** The visible hemisphere of sky, above the horizon, in all directions.

**Skytherm™ system:** A form of movable insulation and a roof pond system developed by Harold Hay. The system involves motor-driven sliding insulation panels.

**Skylight:** A clear or translucent panel set into a roof to admit sunlight into a building.

**Solar altitude:** The angle of the sun above the horizon measured in a vertical plane.

**Solar cell:** Device often made of semiconductor materials that generates electricity when exposed to the sun or other radiant source. Sometimes referred to as a photovoltaic cell. Solar cells are similar to batteries except they use solar energy instead of chemical energy to produce the power.

**Solar collector:** A device or structure used to collect solar energy. This term is most often used for a solar water heating panel that is enclosed in a box with a glass or plastic cover. The term is sometime applied to systems from parabolic troughs to solar greenhouses.

**Solar constant:** The amount of radiation or heat energy that reaches the outside of the earth's atmosphere.

**Solar cooling:** The use of devices that utilize heat from solar collectors to drive cooling systems.

**Solar energy:** Radiant energy from the sun

**Solar electricity:** Electricity produced using solar energy technologies.

**Solar greenhouse:** A conventional greenhouse in which mass is added for heat storage, double glazing is used, and the north side is attached to a house or berm.

**Solar Heater:** A water or space heating system that uses the sun's energy to produce heat.

**Solar heating :** Processes, active or passive, that derive heat directly from the sun.

**Solar house or Solar tempered house:** A dwelling that obtains a large part of its heat from the sun.

**Solar radiation:** Electromagnetic radiation emitted by the sun.

**Solar process heat:** The use of sunlight to produce heat to drive industrial processes.

**Solar thermal energy systems:** Systems using concentrating collectors to focus the sun's radiant energy onto or into receivers to produce heat.

**Solar Window:** Openings that are designed or placed primarily to admit solar energy into a space.

**Specific heat (Cp):** The number of Btu's required to raise the temperature of one pound of a substance 1°F in temperature.

**Stand-Alone system :** A photovoltaic (PV) installation not connected to a utility power line. A 'direct system' uses the PV-produced electricity as it is produced, e.g. a solar-powered water-pumping station. A 'battery storage system' stores the excess PV-produced electricity for use a later time, e.g. at night or on cloudy days.

**Sun path diagram:** A circular projection of the sky vault, similar to a map, that can be used to determine solar positions and to calculate shading.

**Thermal capacity:** The quantity of heat needed to warm a collector up to its operating temperature.

**Thermocirculation:** The convective circulation of fluid which occurs when warm fluid rises and is displaced by denser cooler fluid in the same system.

**Thermal Energy:** The total internal kinetic and potential energy of an object due to the random motion of its atoms and molecules. An object that feels hot has more thermal energy inside it than it does after it has cooled down. Although technically incorrect, the word "heat" is often used to mean thermal energy.

**Thermal mass:** The amount of potential heat storage capacity available in a given assembly or system. Drum walls, concrete floors and adobe walls are examples of thermal mass.

**Thermal radiation:** Electromagnetic radiation emitted by a warm body.

**Thermosiphoning:** An event where heated water in a solar collector becomes lighter and rises to the top and cooler water, that is heavier, sinks to the bottom. Some systems use thermosiphoning to transfer hot water from the collector to the storage container.

**Time lag:** The period of time between the absorption of solar radiation by a material and its release into space. Time lag is an important consideration in sizing a thermal storage wall or Trombe wall.

**Tilt angle:** The angle that a collector surface forms with the horizontal.

**Tracker, flat-plate :** A device upon which one or more photovoltaic panels are mounted that continually rotate the panels at the sun throughout the day.

**Translucent:** the quality of transmitting light but causing sufficient diffusion to eliminate perception of distinct images.

**Transmittance:** The ratio of the radiant energy transmitted through a substance to the total radiant energy incident on its surface. In solar technology, it is always affected by the thickness and composition of the glass cover plates on a collector, and to major extent by the angle of incidence between the sun's rays and a line normal to the surface.

**U Value (coefficient of heat transfer):** The number of Btu's that flow through one square foot of roof, wall or floor in one hour, when there is a 1°F difference in temperature between the inside and outside air, under steady state conditions. The U value is the reciprocal of the resistance or R-factor.

**Ultraviolet radiation:** Electromagnetic radiation, usually from the sun with wavelengths shorter than visible light.

**Utility-Interactive System :** A photovoltaic (PV) installation connected to the utility power grid. This is also referred to as a grid-tied system.

**Vapor barrier:** A component of construction which is impervious to the flow of moisture and air and is used to prevent condensation in walls and other locations of insulation.

**Volt:** A unit of electromotive force. It is electrical pressure analogous to pressure in a garden hose or a bicycle tire. It is also called potential or potential difference.

**Watt:** A unit of power, rate of energy use or flow. A joule per second, a specific amount of work done in a specific amount of time.

**Wind machine:** an electricity driven rotor that moves air to protect orchards from frost.

**Windmill:** a wind-driven rotor that converts wind energy into mechanical energy (as in water pumping, or grinding grain).

**Wind turbine or Generator:** Device powered by the wind that produces mechanical or electrical power. A generator specifically designed to convert the kinetic energy in wind into electrical energy (electricity).