Appendix 2: Definitions

This appendix presents the definitions of various terms used in solar engineering. A valuable source of definitions is the ISO 9488:1999 standard, which gives the solar energy vocabulary in three languages.

Absorber Component of a solar energy collector that collects and retains as much of the radiation from the sun as possible. A heat transfer fluid flows through the absorber or conduits attached to the absorber.

Absorptance The ratio of absorbed solar radiation to that of incident radiation. Absorptivity is the property of absorbing radiation, possessed by all materials to varying extents.

Absorption air conditioning Achieves a cooling effect through the absorption–desorption process without the requirement of large shaft work input.

Air mass The length of the path though the earth's atmosphere traversed by direct solar radiation.

Aperture The opening through which radiation passes prior to absorption in a solar energy collector.

Auxiliary system A system that provides a backup to the solar energy system during cloudy periods or nighttime.

Azimuth angle The angle between the north–south line at a given location and the projection of the sun–earth line in the horizontal plane.

Battery An electrical energy storage system using reversible chemical reactions.

Beam radiation Radiation incident on a given plane and originating from a small solid angle centered on the sun's disk.

Brayton cycle A heat engine that uses the thermodynamic cycle used in jet (combustion turbine) engines.

Cadmium sulfide (Cds) A yellow-orange chemical compound produced from cadmium metal. As a semiconductor, Cds is always n-type.

Capital cost The cost of equipment, construction, land, and other items required to construct a facility.

Cavity receiver A receiver in the form of a cavity where the solar radiation enters through one or more openings (apertures) and is absorbed on the internal heat-absorbing surfaces.

Collector Any device that can be used to gather the sun's radiation and convert it to a useful form of energy.

Collector efficiency The ratio of the energy collected by a solar collector to the radiant energy incident on the collector.

Collector efficiency factor The ratio of the energy delivered by a solar collector to the energy that would be delivered if the entire absorber were at the average fluid temperature in the collector.

Collector flow factor The ratio of the energy delivered by a solar collector to the energy that would be delivered if the average fluid temperature in the collector were equal to the fluid inlet temperature.

Collector tilt angle The angle at which the collector-aperture plane is tilted from the horizontal plane.

Concentration ratio The ratio of aperture to receiver area of a solar energy collector.

Concentrating collector A solar collector that uses reflectors or lenses to redirect and concentrate the solar radiation passing through the aperture onto an absorber.

Cover plate Transparent material used to cover a collector–absorber plate so that the solar energy is trapped by the "greenhouse effect".

CPC collector Compound parabolic concentrator, a non-imaging collector consisting of two parabolas one facing the other.

Declination The angle subtended between the earth–sun line and the plane of the equator (north positive).

Diffuse radiation Radiation from the sun scattered by the atmosphere that falls on a plane of a given orientation.

Direct radiation Radiation from the sun received from a narrow solid-angle measured from a point on the earth's surface.

Direct system A solar heating system in which the heated water to be consumed by the user passes directly through the collector.

Efficiency The ratio of the measure of a desired effect to the measure of the input effect, both expressed in the same units.

Emittance The ratio of radiation emitted by a real surface to the radiation emitted by a perfect radiator (blackbody) at the same temperature.

Evacuated tube collector A collector employing a glass tube with an evacuated space between the tube and the absorber.

Evaporator A heat exchanger in which a fluid undergoes a liquid to vapor-phase change.

Extraterrestrial radiation Solar radiation received on a surface at the limit of the earth's atmosphere.

Flat-plate collector A stationary collector that can collect both direct and diffuse radiations and can heat water or air. The two basic designs of water flat-plate collectors are the header and riser type and the serpentine type.

Fresnel collector A concentrating collector that uses a Fresnel lens to focus solar radiation onto a receiver.

Geometric factor A measure of the effective reduction of the aperture area of a concentrator due to abnormal incidence effects.

Glazing Glass, plastic, or other transparent material covering the collector absorber surface.

Global radiation Hemispherical solar radiation received by a horizontal plane, i.e., the total of beam and diffuse radiation.

Greenhouse effect A heat transfer effect where heat loss from the surfaces is controlled by suppressing the convection loss, frequently incorrectly attributed to the suppression of radiation from an enclosure.

Heat exchanger Device used to transfer heat between two fluid streams without mixing them.

Heat pipe A passive heat exchanger employing the principles of evaporation and condensation to transfer heat at high levels of effectiveness.

Heat pump A device that transfers heat from a relatively low-temperature reservoir to one at a higher temperature by the input of shaft work.

Heat removal factor The ratio of the energy delivered by a solar energy collector to the energy that would be delivered if the entire absorber were at the fluid inlet temperature.

Heliostat A device to direct sunlight toward a fixed target.

Hole A vacant electron state in a valence band—behaves like a positively charged electron.

Hour angle The angle between the sun projection on the equatorial plane at a given time and the sun projection on the same plane at solar noon.

Incident angle The angle between the sun's rays and a line normal to the irradiated surface.

Indirect system A solar heating system in which a heat transfer fluid other than the water to be consumed is circulated through the collector and, with a heat exchanger, transfers its heat to the water to be consumed.

Insolation A term applying specifically to solar energy irradiation (J/m^2).

Integrated collector storage A solar heating system in which the solar energy collector also functions as the storage device.

Intercept factor The ratio of the energy intercepted by the receiver to the energy reflected by the focusing device.

Irradiance (**G**) The rate at which radiant energy is incident on a surface per unit area of that surface (W/m^2).

Irradiation The incident energy per unit area on a surface found by integration of irradiance over a specified time (usually, an hour or a day) (J/m^2).

Latitude The angular distance north (+) or south (−) of the equator, measured in degrees.

Line focus collector A concentrating collector that concentrates solar radiation in one plane, producing a linear focus.

Local solar time System of astronomical time in which the sun always crosses the true north–south meridian at 12 noon. This system of time differs from local clock time according to the longitude, time zone, and equation of time.

n-type Semiconductor doped with impurities so as to have free electrons in the conduction band.

Non-imaging collector Concentrating collector that concentrates solar radiation onto a relatively small receiver without creating an image of the sun on the receiver.

Open-circuit voltage Photovoltaic voltage developed on an open circuit, which is the maximum available at a given irradiance.

Optical efficiency The ratio of the energy absorbed by the receiver to the energy incident on the concentrator's aperture. It is the maximum efficiency a collector can have.

p-type Semiconductor doped with impurities so as to have vacancies (holes) in the valence band.

Parabola Curve formed by the locus of a point moving in a plane so that its distances from a fixed point (focus) and a fixed straight line (directrix) are equal.

Parabolic dish reflector Paraboloidal dish, dual axis tracking, solar thermal concentrator that focuses radiant energy onto an attached point focus receiver or engine-receiver unit.

Parabolic trough collector A paraboloidal trough (line focus collector), single-axis tracking, solar thermal concentrator that focuses radiant energy onto an attached linear focus receiver.

Parasitic energy Energy, usually electricity, consumed by pumps, fans, and controls in a solar heating system.

Passive system System using the sun's energy without mechanical systems' support.

Payback period Length of time required to recover the investment in a project by benefits accruing from the investment.

Photovoltaic effect The generation of an electromotive force when radiant energy falls on the boundary between certain dissimilar substances in close contact.

p–n junction Junction of dissimilar semiconductor materials, where electrons move from one type to another under specific conditions.

Point focus collector A concentrating collector that focuses solar radiation on a point.

Present value The value of a future cash flow discounted to the present.

Radiation The emission or transfer of energy in the form of electromagnetic wave.

Radiosity The rate at which radiant energy leaves a surface per unit area by combined emission, reflection, and transmission (W/m^2).

Rankine cycle A closed-loop heat engine cycle using various components, including a working fluid pumped under pressure to a boiler where heat is added, expanded in a turbine where work is generated, and condensed in a condenser that rejects low-grade heat to the environment.

Reflectance The ratio of radiation reflected from a surface to that incident on the surface. Reflectivity is the property of reflecting radiation, possessed by all materials to varying extents, called the *albedo* in atmospheric references.

Selective surface A surface whose optical properties of reflectance, absorptance, transmittance, and emittance are wavelength-dependent.

Silicon cells Photovoltaic cells made principally of silicon, which is a semiconductor.

Solar altitude angle The angle between the line joining the center of the solar disc to the point of observation at any given instant and the horizontal plane through that point of observation.

Solar collector A device designed to absorb solar radiation and transfer the thermal energy so produced to a fluid passing through it.

Solar constant The intensity of solar radiation outside the earth's atmosphere, at the average earth–sun distance, on a surface perpendicular to the sun's rays.

Solar distillation Process in which the sun's energy is utilized for the purification of sea, brackish, or poor quality water. The greenhouse effect is utilized to trap heat to evaporate the liquid. The vapor so formed then condenses on the cover plate and can be collected for use.

Solar energy Energy, in the form of electromagnetic energy, emitted from the sun and generated by means of a fusion reaction within the sun.

Solar fraction Energy supplied by the solar energy system divided by the total system load, i.e., the part of the load covered by the solar energy system.

Solar ponds Ponds of stratified water that collect and retain heat. Convection normally present in ponds is suppressed by imposing a stable density gradient of dissolved salts.

Solar radiation Radiant energy received from the sun both directly as beam component, diffusely by scattering from the sky and reflection from the ground.

Solar noon Local time of day when the sun crosses the observer's meridian.

Solar simulator A device equipped with an artificial source of radiant energy simulating solar radiation.

Solar time Time based on the apparent angular motion of the sun across the sky.

Stagnation The status of a collector or system when no heat is being removed by a heat transfer fluid.

Sun path diagram Diagram of solar altitude versus solar azimuth, showing the position of the sun as a function of time for various dates of the year.

Thermosiphon The convective circulation of fluid occurring in a closed system wherein less-dense warm-fluid rises, displaced by denser cooler fluid in the same fluid loop.

Tracking system The motors, gears, actuators, and controls necessary to maintain a device (usually a concentrator) in a focus position, orientated with respect to the sun.

Transmittance The ratio of the radiant energy transmitted by a given material to the radiant energy incident on a surface of that material, depends on the angle of incidence.

Unglazed collector A solar collector with no cover over the absorber.

Zenith angle Angular distance of the sun from the vertical.