

GLOSSARY

ALGAE BIOFUEL

Algae can be grown and harvested (algaculture) as a feed stock for the production of alternatives to fossil fuels. Naturally occurring oils within algae (lipids) can be used directly (similar to straight vegetable oil), or they can be refined to burn more cleanly.

Different production methods can result in biodiesel, biobutanol, biogasoline, methane, ethanol, or even jet fuel. The uptake of CO₂ by the algae during cultivation offsets the CO₂ that is emitted during the combustion of the algae-generated fuel. Algae can produce up to 300 times more oil per acre than conventional crops such as jatropha, palm, rapeseed, or soybean, and it can be cultivated in locations where these types of crops are not viable.

ALTERNATING CURRENT (AC)

An electrical system in which the flow of electric charge periodically reverses direction (as opposed to direct current in which the flow is constant). AC was adopted early as the standard for electrical utility distribution due to the fact that transmission losses over great distances were less than with direct current (DC). Contemporary technology has made high voltage DC transmission (HVDC) the preferred solution for some long-distance distribution applications (lower transmission losses) but this requires changing the current from AC and back to AC on either end with expensive conversion equipment.

AMORPHOUS SILICON (A-SI)

The functioning semi-conductor material within a type of photovoltaic system (thin film) that is less expensive and more versatile in its application than crystalline silicon types. Conversion efficiency is generally less than crystalline silicone PV. See “monocrystalline silicon” for more information.

ART OUTSIDE OF THE GALLERY

Art practices that exist outside of the confines of the gallery have a long history that include genres such as land art, eco-art, public art, and social practice art.

BIOGAS AND BIOMASS

Biogas is created through the breakdown of any organic material (biomass) in an oxygen-poor environment. The resulting gas byproduct is mostly methane and carbon dioxide. Biogas is similar in composition to conventional natural gas and as such can be compressed or fed into a municipal gas grid. It can be used for many different purposes including cooking, heating, lighting, transportation, and electricity production. It can be either tapped from

the underground activity in a landfill site, or it can be produced in specially constructed anaerobic digester tanks. Farms with such tanks can process manure into biogas reducing the amount of nitrous dioxide and methane that would otherwise enter the atmosphere. These two gases have a far greater atmospheric warming effect than does carbon dioxide (nitrous dioxide = 310 times greater, and methane = 21 times greater). Biomass is considered a sustainable energy resource because it is a product of organic processes, which naturally regenerate at a rapid cycle (as opposed to fossil fuel energy sources which take millions of years to form naturally). Biomass can be combusted directly as a solid fuel or converted to liquid or gas biofuels. These biofuels can be used in either a combustion engine (conversion to mechanical energy) or in a fuel cell (conversion to electrical energy).

BIOPHILIA

From the 1984 book, “**Biophilia**”, by Edward O Wilson. An innate affinity for the natural world that is universally held by human beings. Biophilic design incorporates natural and organic forms (such as animal shapes and curling, branching lines) that appeal to this human feeling of oneness with and fondness for nature. Biomimicry or biomimetic design refers to design and engineering processes that learn from and are inspired by the workings of natural systems.

CAPACITY FACTOR

A multiplier used to calculate the average output of an energy-generating device over a certain period of time. This factor takes into account conditions that are less than ideal and which contribute to the device operating at below nameplate capacity during certain periods. See “nameplate capacity” for more information.

CARBON DIOXIDE (CO₂)

A naturally occurring chemical compound critical to life on earth, carbon dioxide also functions as a greenhouse gas (GHG) in the Earth’s atmosphere. The emission of CO₂ through fossil fuel combustion by humans has, since modern industrialization, created an increase of 35% in the parts per million (ppm) concentration of the gas in the Earth’s atmosphere. Since 1960, its concentration has risen from 320ppm to 390ppm and further increases threaten rapid shifts upward in global temperature and sea levels. In order to avoid a temperature rise beyond 20 Celsius, between 2/3 and 4/5 of the known reserves of fossil fuel will need to remain unused until such time that proven methods of carbon capture and storage (CCS) can allow their safe combustion (no method of CCS has yet been proven suitable for long-term CO₂ storage). Increased atmospheric concentrations of CO₂ also have a secondary effect on the chemical composition of the oceans, as surface-level carbon dioxide dissolves forming other carbon compounds and leading to acidification.

COMPACT WIND ACCELERATION TURBINE (CWAT)

CWATs are a new acronym that encompasses the class of machines formerly known as DAWTs as they were known in the 1970s and 1980s. This type of horizontal axis wind turbine

uses a cone or series of cones to concentrate the wind, increase the velocity of the wind as it passes through the rotor's swept area, and thus increase the efficiency of the overall system. They are also known as "ducted turbines" or "lens wind turbines."

CONCENTRATED SOLAR POWER

Describes a variety of systems that use mirrors or lenses to concentrate the power of the sun in order to create heat energy that can then be converted into electricity.

COPPER INDIUM GALLIUM SELENIDE (CIGS)

A semiconductor material alternative to silicon used in thin film photovoltaic.

CRADLE-TO-CRADLE

The goal in sustainable design and manufacturing of diverting 100% of the materials from landfill or other waste streams. All materials contained within a cradle-to-cradle product must be compostable, recyclable, or otherwise reusable. This is distinct from conventional design and manufacturing, which is referred to as "cradle-to-grave."

DATA MONITORING

Real-time statistics of how much electricity is being produced. Monitoring can be either on site or remotely accessed and is displayed in an easy-to-understand graphical interface that often simulates analog dials and meters.

DIRECT CURRENT (DC)

An electrical system in which the flow of electric charge is constant (as opposed to alternating current in which the flow periodically reverses direction). See "alternating current" for more information.

DYE-SENSITIZED SOLAR CELL (DSSC)

Techniques for creating dye-sensitized solar cells (DSSC) are simple and the materials are very low cost, but the conversion efficiency is also below that of solid-state semiconductor technologies (DSSC is the most efficient of the "third generation" thin films). This technique was invented in 1991 by Michael Grätzel and Brian O'Regan at EPFL. The DSSC solar cell is alternatively known as the Grätzel cell. They have the characteristic of being semi-transparent, flexible, and they are very durable. They also function comparatively better than other PV technologies in low light levels and indirect light. Because they are so inexpensive to produce they have one of the lowest price/performance ratios, and are therefore potentially competitive with conventional energy in terms of levelized cost (\$ per kWh over the lifetime of the installation) despite their lower conversion efficiency.

ECO-ART

Eco-art is a contemporary art movement that addresses local and global environmental issues. In their work, eco-artists explore a variety of ideas and intentions, which may include environmental ethics, information about ecological systems and the use of natural forms and materials in art. Some eco-art is functional, striving to reclaim, restore or remediate damaged environments. Eco-art can re-envision ecological relationships and even propose new models for sustainability.

ELECTRODE

The electrical conductor that makes contact with a semiconductor or other non-metallic material. Electrodes can be labeled either anode or cathode depending on which direction the electrical charge is flowing.

ELEVATION

In design and architecture, an elevation is a parallel projection view (not in perspective) of an object or building as seen from the front, side, or rear.

EFFICIENCY (ENERGY CONVERSION EFFICIENCY TO ELECTRICITY)

The ratio between the electrical output of a device (such as a solar panel or a wind turbine) and the energy input to the device (the sun or the wind that strikes the device). The efficiency of any device determines its nameplate capacity. See “nameplate capacity” and “capacity factor” for more information.

FEEDSTOCK

In power generation this refers to the source of the energy as it exists in non-electrical form. This could be chemical energy (petroleum and biofuel), radiant or thermal energy (solar), or gravitational (hydro), or mechanical (wind and wave).

FUEL CELL

Any mechanical system that converts the energy stored within a fuel source (e.g. hydrogen, methanol) into electricity through an oxidation process. Fuel cells require the replenishment of the fuel source (reactant) to maintain electrical output. Fuel cell technology has the potential to replace the internal combustion engine for the conversion of fuel into energy for use in transportation and machinery.

HELIOTROPIC (HELIOSTATIC)

The ability to follow the location of the sun in the sky and maintain an object’s consistent relationship to it throughout the diurnal and seasonal shift. In solar energy technology, heliostatic mechanisms can maintain a solar cell perpendicular to the sunlight for ideal absorption and conversion, or mirrors can maintain an angle-of-incidence relationship to the sun so as to consistently reflect sunlight to a central collector.

HIGH-ALTITUDE WIND POWER (HAWP)

The power of the wind at high altitudes is much stronger and more consistent than what is typically available nearer to the ground. However, getting access to this excellent source of energy and harnessing it for electrical use presents obvious challenges. HAWP has the potential to be a cheap and consistent source of energy. There are a wide number of technologies that are presently being developed. Many designs are derivative of kite and sailing technology. Other types of HAWP devices (airborne turbines, or AWT) use light-than-air balloons (aerostats) that rotate between two cables, or small glider-like machines that are designed to fly in a constant circle or figure-eight. In these technologies the conversion of energy to electricity is performed in the sky.

HYDROELECTRIC STORAGE

Excess capacity electricity is used to pump water temporarily into an upstream reservoir. The water can then later be released when there is demand for electricity and by the force of gravity drives hydraulic turbine electrical generators similarly to conventional hydroelectric dams which rely on natural precipitation cycles to provide the water source.

HYDRAULIC TURBINE

A rotary engine that is driven by the force of passing water.

KILOWATT (KW)

Equal to 1,000 watts. See “watt.”

KILOWATT-HOUR (kWh)

Equal to 1,000 watt-hours. See “watt-hour.”

KINETIC HARVESTING

Converting movement into electricity. This can be accomplished using [piezoelectric actuators](#), [linear alternators](#), [wells turbines](#), or other means.

KITE WIND POWER OR WIND KITE

See high-altitude wind power (HAWP).

LAND ART

Land art, also known as earth art, is art in which the landscape or natural elements often form the basis for the artwork. Artists may create artworks directly in the landscape, utilizing their natural surroundings and integrating the landscape itself into their work. Conversely, artists may also incorporate natural elements into works exhibited in gallery spaces. Land Art emerged in the southwestern United States during the late 1960s, and culminated in the mid-1970s. Since the 1970s, much Land Art has been absorbed into the broader realm of Environmental Art, as many artists began working in more urban and public spaces.

LED

Light-emitting diode, a semiconductor light source. OLED is an LED made from organic compounds.

LINEAR ALTERNATOR

A linear motor used as a power generator for alternating current. Linear motors do not rely on torque and rotation but rather on simple linear motion.

MEGAWATT (MW)

Equal to 1,000,000 watts. See “watt.”

MEGAWATT-HOUR (MWh)

Equal to 1,000,000 watt-hours. See “watt-hour.”

MONOCRYSTALLINE SILICON

Silicon (Si) is a semiconductor material that displays the photovoltaic effect. It was the first material to be employed in solar cells and is still the most prevalent. It can be applied for use in either a crystalline (wafer) form, or in a non-crystalline (amorphous) form.

There are two types of crystalline silicon: monocrystalline and polycrystalline (aka multicrystalline). Monocrystalline is very expensive to manufacture (because it requires cutting slices from cylindrical ingots of silicon crystals that are grown with the Czochralski process) but it is the most efficient crystalline silicon technology. Its conversion efficiency is around 23%.

NAMEPLATE CAPACITY

The standard and consistent power that an energy-generating device can output in an ideal environment.

OMNI-DIRECTIONAL PHOTOVOLTAIC

Able to convert sunlight into electricity at any angle in relation to the sun. Most PV technologies either require or work best at an angle perpendicular to the sun's position in the sky.

ORGANIC PHOTOVOLTAIC

Organic PV can be manufactured in solutions that can be painted or rolled onto proper substrate materials. They can be produced at very low cost in comparison with other PV technologies because they can take advantage of roll-to-roll production techniques in which the organic photovoltaic system is "printed" onto a long continuous sheet of substrate material. Current OPV technology has a conversion efficiency of only around 8%. But its low cost of production (and its good performance in lower level and indirect light) makes it an increasingly attractive option in the marketplace.

PARABOLIC TROUGH

A type of concentrated solar power that uses a long mirrored surface with the cross-sectional shape of a parabola. Sunlight that hits the mirror surface (at an angle parallel to the central axis of the parabola) is directed to the focal point of the parabola thus providing energy to a heat transfer fluid that runs continuously along its length. The heated transfer fluid can be used to generate the steam required for turbine generators.

PERSPECTIVE

A rendering or view of an object or building as one might experience it with human sight. The laws of perspective (studied most famously by Filippo Brunelleschi in the 15th Century) allow artists to create photorealistic renderings of the world using one or more vanishing points, a horizon line, and a picture plane onto which the image is formed. A vanishing point exists wherever parallel lines appear to converge at a point in the infinite distance. A one-point perspective can be experienced by looking down a road or railroad track. A two-point perspective can be experienced at the intersection of two streets, and a three-point perspective can be experienced in a downtown intersection while looking up at tall buildings. A complex

shape can have a great number of vanishing points. Artists often play with perspective to create a feeling of disorientation (**Vincent's Bedroom in Arles** by Van Gogh) or to reveal more than that which could be seen while adhering to strict rules of perspective (**Print Gallery** by M. C. Escher).

PLAN VIEW

In design and architecture, plan view is a parallel projection view (not in perspective) of an object or building as seen from above. Often a plan view assumes that a horizontal section plane has cut through an object or building to reveal the internal order within (such as floor plans that reveal what is underneath the roof at each lower level).

PEAK CAPACITY

The highest design output that an energy-generating device can manage under ideal conditions and newly installed components.

PHOTOVOLTAIC (PV)

The photovoltaic effect, first recognized by A. E. Becquerel in 1839, is the ability of a material to produce direct current electricity when exposed to solar radiation. It is related to the photoelectric effect, which is the ejection of an electron from a material substance (usually a more highly conductive metal as opposed to a semiconductor material) by electromagnetic radiation incident on that substance. However, in the photovoltaic effect, the electrons remain within the material (by the nature of the semiconductor material) creating positive and negative bands which can be harnessed by an electrical circuit.

PIEZOELECTRIC GENERATOR

A device that generates electrical power from pressure force. Common application of a piezoelectric device is as the ignition source for gas range and grill "push starters."

PUBLIC ART

Public Art encompasses any work of art that an artist has created to be displayed, heard or performed in a public space. Although the oldest and most common forms of public art are monuments, memorials and statues, contemporary public art comprises a wide range of methodologies, forms and content. Public art ranges in scope from large-scale, commissioned works, which require significant collaboration amongst artists, funders and governmental agencies to implement, to independently executed small-scale works that require little to no funding. Public artworks may be site-specific, exhibited in non-conventional spaces or may alter the common function of a space. Approaches to contemporary public art include interactive art, guerilla art, sound art, community-based projects, and performance.

SEMITRANSSPARENT PHOTOVOLTAICS

Solar cells that are encased in a transparent material in such a way that allows light to pass through partially. The pattern of the photovoltaic material placement can be small or large, patterned or irregular.

SOCIAL PRACTICE ART

Social practice art includes a wide variety of methodologies, strategies and techniques in which social interaction and exchange are the means for the artwork. Social practice art may involve community-based practice, performative aspects, guerilla art, interactive media and social activism. Media such as

video, sound, sculpture, performance, and text are often incorporated. Collaboration between artists and individuals from non-art backgrounds, especially those who are part of the intended audience, is an integral aspect of social practice art.

SOLAR FABRIC

Flexible photovoltaic material integrated into canvas.

SOLAR THERMAL

Solar radiation used to heat a medium such as water or air.

SOLAR UPDRAFT (SOLAR CHIMNEY)

Combines the chimney/stack effect and greenhouse effect with wind turbines located at the base of a very tall tower. The tower is surrounded by a large greenhouse which serves to create superheated air at the ground level. With a sufficiently tall chimney structure, the air temperature at the top of the tower will be cool enough to provide a strong convection movement of air from the greenhouse area, into the bottom of the chimney and out of the top of the chimney (warmer air is higher pressure and moves to the lower pressure system at the top of the tower). At the outside perimeter of the greenhouse, new surface air is constantly taken into the system to be heated. As air passes from the greenhouse area into the base of the tower, it powers wind turbines located there.

STIRLING HEAT ENGINE

Device that converts heat into mechanical energy with high efficiency. This mechanical energy can then be used to power an electrical generator.

TENSEGRITY

Individual structural members (usually metal bars) working in compression are suspended away from each other by means of a continuous tension net (usually comprised of metal cables). The term was coined by Buckminster Fuller as a portmanteau of “tensional” and “integrity.” The structural system has been used in many works of public art, including those by Kenneth Snelson.

THIN FILM

As applied to photovoltaics, any of a variety of non-crystalline solar cell technologies that can be applied in very thin layers thus reducing material costs.

THIRD-GENERATION PHOTOVOLTAIC

Term applied to technological innovations that have allowed conversion efficiencies of solar cells to increase greatly via tandem or multi-junction structures that have varying bandgaps (physical property of the material that pertains to the flow of electrons through it or from it under conditions of excitation such as that provided by solar radiation). In single junction solar cells, there is energy lost when photoexcitation exceeds the limits of the particular semiconductor’s bandgap.

TURBINE ROTOR

The moving part of a turbine engine which consists of a drum or a shaft with blades attached to it.

UTILITY-SCALE

Significant enough power generation so as to warrant the distribution of the energy to the utility grid (as opposed to “on-site” power generation for local use).

VENTURI EFFECT

When a fluid body, such as air, is in motion and is constricted in its path, such as by a funnel, the velocity of the fluid will increase and its static pressure will be reduced. The effect can be felt in urban areas when standing between two tall buildings, which together act as a funnel. This principle is incorporated into the design of compact wind acceleration turbines (CWAT).

VERTICAL-AXIS WIND TURBINE

Any wind turbine in which the rotational axis is vertical in orientation (perpendicular to the ground plane). Types of vertical-axis wind turbines include Savonius, Darrieus (eggbeater), and Giromills.

WASTE TO ENERGY (WtE)

The use of non-recyclable waste for combustion (incineration) to generate electricity, or in a small number of cases for processing into methane or similar fuel.

There are some emerging WtE technologies that do not require incineration:

- Gasification (produces hydrogen, synthetic fuels)
- Thermal depolymerization (produces synthetic crude oil)
- Pyrolysis (produces combustible tar, bio-oil, and biochars)
- Plasma arc gasification, PGP (produces syngas)

Non-thermal technologies:

- Anaerobic digestion (biogas rich in methane)
- Fermentation production (ethanol, lactic acid, hydrogen)
- Mechanical biological treatment (MBT)

Limestone scrubbers can greatly reduce the emission of harmful chemicals from WtE incineration, and while there is CO₂ released, the effect of this is less than the more toxic greenhouse gases that are produced by landfill off-gassing of methane, even if much of that methane is captured.

WATER-SOURCE HEAT SINK LOOP

A geothermal or ground-source heat pump operating in a cooling capacity. Water is passed via coiled tubing through the earth (which maintains a constant temperature between 100 Celsius and 160 Celsius depending on latitude) and then used for cooling interior space via a heat exchanger.

WATT (W)

Unit of measure of electrical power equivalent to 1/746 horsepower.

$W = \text{Volts} \times \text{Amperes}$

WATT-HOUR

A measure of electrical energy equivalent to one watt of power used or produced for a one-hour duration.

WELLS TURBINE

Usually a small turbine that maintains its rotation with fluid movement coming from either direction. Wells Turbines are often used inside wave energy devices.

WIND MICROTURBINE

A small wind turbine with less than 3,000 watt peak capacity.

WINDROSE

A graphic representation of the wind at any one location as measured over a long period of time. The windrose diagram shows the frequency of wind speed and cardinal direction.