

## WHAT DOES GREEN MEAN?

**GREEN** is a term now widely used to describe buildings designed and constructed with minimal negative impact to the environment and with an emphasis on conservation of resources, energy efficiency, and healthful interior spaces.

**SUSTAINABILITY** refers to the concept that new development must meet the needs of the present without compromising those of the future. Sustainability is measured in three interdependent dimensions: the environment, economics, and society—often referred to as the triple bottom line.

This glossary defines the often-daunting terminology associated with green building. Revised by its original author, engineer Ashok Rajji, P.E., a principal at ARUP, the glossary has been recycled from the book *Big & Green: Toward Sustainable Architecture in the 21st Century*, published in 2002 by Princeton Architectural Press in connection with a pioneering exhibition of the same name at the National Building Museum in Washington, D. C.

**Active Solar** - A solar application, which uses electrical or mechanical equipment (typically pumps and/or fans) to assist in the collection and storage of solar energy for the purpose of heating, cooling (buildings, liquids, or gases), or making electricity.

**Agenda 21** - A comprehensive plan of action to be taken globally, nationally, and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which humans have an impact on the environment. The Program for Further Implementation of Agenda 21 was strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa in 2002.

**Bakeout** - A process used to remove volatile organic compounds (VOC's) in a building by operating a building's HVAC systems at elevated temperatures using 100 percent outside air after all the furniture and finishes (carpeting, ceiling tiles, etc.) have been installed.

**Biomass** - An energy resource derived from organic matter such as wood, agricultural waste and other living cell material.

**Bioremediation** - The use of natural biological processes (microbes, bacteria, plants, etc.) to break down contaminants and restore contaminated land back to productive use.

**Black Water** - Water containing human waste from toilets and urinals. Black water contains pathogens that must be neutralized before the water can be safely reused. Typically black water, after neutralization, is used for non-potable uses such as flushing or irrigation.

**BREEAM** - Building Research Establishment Environmental Assessment Method (BREEAM) is a comprehensive tool for analyzing and improving the environmental performance of buildings through design and operations. This methodology has been developed by the UK based Building Research Establishment.

**Building Envelope** - Elements (walls, windows, roofs, skylights, etc.) and materials (insulation, vapor barriers, siding, etc.) that enclose a building. The building envelope is a thermal barrier between the indoor and outdoor environment and is a key factor in the “sustainability” of a building. A well-designed building envelope will minimize energy consumption for cooling and heating as well as promote the influx of natural light.

**Carbon Dioxide (CO<sub>2</sub>)** - Carbon Dioxide is a colorless, odorless gas that naturally exists in the earth’s atmosphere. The major source of man-made CO<sub>2</sub> emissions is from the combustion of fossil fuels. Carbon dioxide is the primary greenhouse gas and is known to contribute to global warming and climate change. Atmospheric concentrations of CO<sub>2</sub> have been increasing at a rate of about 0.5 percent per year and are now approximately 30 percent above pre-industrial levels.

**Carbon Neutral** - A scenario where the net discharge of carbon dioxide into the atmosphere is zero. Carbon neutrality can be achieved by planting enough trees so that CO<sub>2</sub> emissions as a result of combustion would be offset by CO<sub>2</sub> absorption by the plants. In the presence of water and light, trees convert CO<sub>2</sub> into sugar and oxygen thru the process of photosynthesis. The average tree absorbs 10 kg (22 lbs) of CO<sub>2</sub> per year. Carbon neutral is also referred to as “net zero carbon”.

**Carbon Footprint** - A measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. A carbon footprint is often expressed as tons of carbon dioxide or tons of carbon emitted, usually on an annual basis.

**Climate Neutral** - No net production of greenhouse gases (see also Carbon Neutral).

**Cogeneration** - A process in which power is produced by a gas-fired engine and generator set. Heat produced as part of this process is used as heating and/or cooling media. A cogeneration plant is often referred to as a combined heat and power plant.

**Commissioning** - A process that occurs prior to building occupancy during which the performance of the building systems are checked and adjusted if necessary, in order to ensure that they are operating as intended by the design and that the owner’s operational needs are met.

**Daylighting** - The use of natural light to supplement or replace artificial lighting.

**Displacement Ventilation** - A method of space conditioning where conditioned air is supplied at or near the floor. Since the air is supplied at very low velocities, a cool layer of air collects in the occupied zone resulting in comfortable conditions for the occupants. Buoyant forces remove heat generated by occupants and equipment, as well as odors and pollutants, all of which stratify under the ceiling and are extracted from the space by return or exhaust fans. Displacement ventilation systems were originally used in industrial facilities and subsequently in office buildings, auditoria, performing arts centers and spaces with large interior volumes. These systems are effective in improving indoor air quality as well as providing energy savings when compared to a conventional fully mixed system.

**Eco-friendly** - Little or no impact on the native eco-system.

**Ecological Footprint** - The area of land and water needed to produce the resources to entirely sustain a human population and absorb its waste products with prevailing technology. The concept of an ecological footprint is used as a resource management and community-planning tool.

**Embodied Energy** - Total energy used to create a product, including the energy used in mining or harvesting, processing, fabricating, and transporting the product.

**Energy Efficiency** - Ratio of energy output of a conversion process or of a system to its energy input.

**First Cost** - The total cost of acquiring and installing the item in question. In the context of a building first cost would include land acquisition costs in addition to the cost of construction.

**Fly Ash** - The fine ash waste collected from flue gases from coal burning power plants, smelters, and waste incinerators. Fly ash can be used as a cement substitute in concrete, thereby reducing embodied energy of the concrete.

**Fossil Fuels** - Fuels found in the earth's strata that are derived from the fossilized remains of animal and plant matter over millions of years. Fossil fuels include oil, natural gas, shale, and coal. Fossil fuels are considered to be non-renewable since they are consumed faster than their natural production.

**Fritted Glass** - A special type of glass that utilizes ceramic-enamel coatings in a visible pattern (dots, lines, etc.) to control solar heat gain. The pattern is created by opaque or transparent glass fused to the substrate glass material under high temperatures. The substrate is heat strengthened or tempered to prevent breakage due to thermal stresses.

**Fuel Cell** - An electrochemical device in which hydrogen is combined with oxygen to produce electricity with heat and water vapor as by products. Natural gas is often used as the source of hydrogen with air as the source of oxygen. Since electricity is produced by a chemical reaction and not by combustion, fuel cells are considered to be green power producers. Fuel cell technology is quite old, dating back to the early days of the space program. Commercial use of fuel cells has been sporadic, however, the use of fuel cells in automobiles and buildings is expected to increase in the next decade.

**Gas-Fired Absorption Chiller** - Mechanical equipment that is used to generate chilled water for cooling of buildings. Conventional chillers use electricity as the energy source, whereas gas-fired absorption chillers use clean burning natural gas. While conventional chillers have a compressor and use refrigerants to produce cooling, absorption chillers contain an absorber, generator, pump and heat exchanger, and do not use ozone-depleting substances. The absorption cycle utilizes environmentally friendly working fluids, namely water (refrigerant) and lithium bromide (absorbent). Some absorption chillers use ammonia as the refrigerant and water as the absorbent.

**Global Warming** - An increase in the global mean temperature of the Earth that is (or is thought to be) a result of increased emissions of greenhouse gases that are trapped within the earth's atmosphere. Global warming is believed to have adverse consequences such as climate change and a rise in sea levels. The scientific community is in general agreement that the Earth's surface has warmed by about 1°F in the past 140 years.

**Gray Water** - Wastewater from sinks, showers, kitchens, washers, etc. Unlike black water, gray water does not contain human waste. Typically gray water, after purification, is used for non-potable uses such as flushing, irrigation, etc.

**Green** - A term that is widely used to describe a building and site that is designed in an environmentally sensitive manner, i.e. with minimal impact to the environment.

**Green Building** - A building that minimizes impact on the environment through resource (energy, water, etc.) conservation and contributes to the health of its occupants. Comfortable, aesthetically pleasing and healthful environments characterize green buildings.

**Greenhouse Effect** - Greenhouse gases in the earth's atmosphere permit solar radiation to pass through but prevent most of the reflected infrared radiation from the earth's surface and lower atmosphere from escaping into outer space. This process occurs naturally and has kept the earth's average surface temperature at approximately 60°F. Life on earth would not be possible without the natural greenhouse effect, but environmental scientists are concerned about the increased emissions of greenhouse gases from human activities, leading to climate change and its consequential adverse effects.

**Greenhouse Gases** - Any gas that absorbs infrared radiation in the earth's atmosphere. Common greenhouse gases include water vapor, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrogen oxides (NO<sub>x</sub>), ozone (O<sub>3</sub>), chlorofluorocarbons (CFCs), halogenated fluorocarbons (HCFCs), perfluorinated carbons (PFCs), hydrofluoro-carbons (HFCs) and Sulfur Hexafluoride (SF<sub>6</sub>). Carbon dioxide, methane and nitrogen oxides are of particular concern due to their long residence time in the atmosphere.

**Green Power** - Electricity generated from renewable energy sources (solar, wind, biomass, geothermal, and hydroelectric).

**Grid** - A network of power transmission and distribution facilities used to provide electricity to users (homes, businesses, industry). Large power plants, wind power generating facilities as well as small power producers (such as photovoltaic farms) feed electrical power into the grid for distribution to users. Electrical grids in the USA are both publicly and privately owned.

**Heat Island Effect** - A phenomenon that occurs in developed areas where the replacement of natural land cover with paving, buildings, roads, parking lots, etc. result in an increase in outdoor temperatures. The heat island effect can be mitigated by vegetation, green roofs and light colored materials that reflect heat. Urban heat islands can be as much as 10°F hotter than the surrounding undeveloped areas.

**Indoor Air Quality (IAQ)** - Indoor air that contains no known contaminants at harmful concentrations and with which a substantial majority of the people exposed to the air do not express dissatisfaction. Good indoor air quality inside a building results from:

- Introducing an appropriate amount of outside air into the building through the HVAC systems
- locating outside air intakes so that the outside air introduced into the HVAC systems is of the best possible quality
- proper filtration
- proper air distribution
- proper removal of indoor pollutants
- proper commissioning of the building and its building systems.

**Insolation** - The amount of sunlight (direct, diffuse and reflected) reaching an area exposed to the sky.

**Intelligent Materials** - Materials that are able to adapt to their environment by altering their properties. Example of intelligent materials include liquid crystal glass which changes from transparent to opaque upon application of a current, and thermochromic glazing that changes transparency in response to ambient temperatures.

**Kyoto Protocol** - In December 1997, the United Nations Framework Convention on Climate Change was held in Kyoto, Japan and was attended by delegates from 160 countries. A legally binding agreement, the Kyoto Protocol, was adopted by the countries in attendance, under which the industrialized nations agreed to reduce their greenhouse gas emissions by an average of 5.2 percent below 1990 emissions levels by 2010. The USA pledged a 7 percent reduction. Subsequent to the Kyoto meetings, the US Congress did not ratify the agreement.

**LEED** - An acronym for Leadership in Energy and Environmental Design. LEED is a point-based rating system developed by the US Green Building Council that evaluates the environmental performance from a “whole building” perspective over its life cycle, providing a definitive standard for what constitutes a green building according to six categories:

Sustainable Sites	Water Efficiency
Energy and Atmosphere	Material Resources
Indoor Environmental Quality	Innovation and Design Process

Buildings evaluated by LEED are rated as certified, silver, gold, or platinum. There are a total of 69 LEED credits available in the six categories: 26 credits are required to attain the most basic level of LEED certification; 33 to 38 credits are needed for Silver; 39 to 51 credits for Gold; 52 to 69 credits for the Platinum rating.

**Life-Cycle Cost (LCC)** - The total cost of acquiring, owning, operating and disposing of a building or building system over its entire useful life. LCC includes the cost of land acquisition, construction costs, energy costs, the cost to maintain, service and repair the building and its systems, costs of system replacement, financing costs, and residual or salvage value at the end of the building’s useful life.

**Light Shelf** - A horizontal device positioned (usually above eye level) to reflect daylight onto the ceiling and beyond. The light shelf may project into the room, beyond the exterior wall plane, or both. The upper surface of the shelf is highly reflective, i.e. having 80 percent or greater reflectance. Light shelves are also effective shading devices for windows located below them.

**Low-e Glass** - Low-e (Low emissivity) glass has an invisible thin-film metallic or oxide coating which allows the passage of short-wave solar energy into a building but prevents long-wave energy produced by heating systems and lighting from escaping outside.

**Microclimate** - Localized climate conditions within an urban area or building.

**Net-Zero** - Requiring no additional energy input from outside sources.

**Nitrogen Oxides (NO<sub>x</sub>)** - Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are by-products of combustion processes and are commonly found in the automobile exhaust and emissions from fossil fuel-fired power plants. NO<sub>x</sub> is a greenhouse gas and is an ingredient of acid rain and smog.

**Non-renewable Energy Resources** - Energy resources that cannot be restored or replenished by natural processes and therefore are depleted through use. Commonly used non-renewable energy resources include coal, oil, natural gas, and uranium.

**Orientation** - The position of a building relative to the points of a compass. Energy consumption in a building can be reduced by proper orientation of the building's window areas.

**Ozone (O<sub>3</sub>)** - Ozone is a greenhouse gas present in the stratosphere and the troposphere. In the stratosphere, ozone provides a protective layer shielding the earth from harmful ultraviolet radiation. In the lower atmosphere ozone is a pollutant that causes respiratory problems and is an ingredient of smog.

**Passive Solar** - The use of natural heat transfer processes to collect, distribute, and store useable heat without the help of mechanical devices (pumps or fans). Passive solar systems have few moving parts. Trombe Walls and the use of the thermal mass of building structure to store energy are examples of passive solar systems.

**Photovoltaic Cell** - A device that converts sunlight directly into electricity. Photovoltaic (PV) cells are silicon-based semiconductors and are often referred to as solar cells. PV cells were developed in the mid-1950's and have become cost effective where it is difficult to extend conventional power lines. PV cells are often used for remote motorist call aid boxes, irrigation systems and navigational lights.

**R-Value** - A unit of thermal resistance. A material's R-value is a measure of the effectiveness of the material in stopping the flow of heat through it. The higher a material's R-value, the greater its insulating properties and the slower the heat flow through it.

**Rainwater Harvesting** - The collection, storage, and reuse of rainwater.

**Recycling** - A series of processes that include collection, separation, and processing by which products and raw materials are recovered and reused in lieu of disposal as solid or liquid wastes. Commonly recycled items include cans and bottles, paper and industrial solvents. Recycling can also apply to construction materials, and even to buildings themselves.

**Regeneration** - Renewal of sites or habitats that have become unfit for human, animal, or plant habitation, bringing them back into productive use. The term most commonly refers to urban and industrial land.

**Renewable Energy Sources** - Energy sources that replenish themselves naturally within a short period of time. Sources of renewable energy include solar energy, hydroelectric power, geothermal energy, wind power, ocean thermal energy, wave power, wind power and fuel wood.

**Return On Investment (ROI)** - An economic indicator that is used to evaluate the effectiveness of an investment. It is calculated as the ratio of the amount gained or lost relative to the amount invested. Simple ROI analyses do not take the time value of money into account. On the other hand, dynamic ROI analyses recognize that the value of money does change over time.

**Shading Coefficient** - The ratio of solar heat gain through a glazing system to the solar heat gain through a single layer of clear glass.

**Sick Building Syndrome** - According to the Environmental Protection Agency and National Institute of Occupational Safety and Health, Sick Building Syndrome is defined as “situations in which building occupants experience acute health and/or comfort effects that appear to be linked to time spent in a particular building, but where no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be spread throughout the building.”

**Solar Collector** - A device used to absorb heat from the sun. In the context of buildings, the absorbed energy typically heats water, which is then used for space heating and/or domestic hot water.

**Spectrally Selective Glazing** – Glazing that has a high transmittance of visible light but low transmittance of solar heat gain.

**Superwindow** - A window with a very low U-value achieved through the use of multiple glazings, low-e coatings, and gas fills. A gas fill is the use of an inert gas, usually Argon or Krypton, placed between sealed panes of glazing in order to provide resistance to heat flow.

**Sustainability** - The concept of sustainability can be traced back to President Theodore Roosevelt who stated in 1910, “ I recognize the right and duty of this generation to develop and use the natural resources of our land; but I do not recognize the right to waste them, or to rob, by wasteful use, the generations that come after us. ” In 1987 the United Nations World Commission on Environment and Development (The Brundtland Commission) defined a sustainable development as one that “meets the needs of the present without compromising the

ability of future generations to meet their own needs". Sustainability has three interdependent dimensions relating to the environment, economics and society—often referred to as the triple bottom line.

**Thermal Mass** - A material used to store heat, thereby slowing the temperature variation within a space. Typical thermal mass materials include concrete, brick, masonry, tile and mortar, water and rock.

**Triple Bottom Line** - According to the World Business Council for Sustainable Development, "Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line, but against [this] triple bottom line."

**Value Engineering** - An organized activity in which building systems, equipment, design features and materials are analyzed in order to attain the lowest building life cycle cost while maintaining the stated functional and performance goals including quality, reliability, and safety.

**Ventilated Façade** - A special type of curtain wall consisting of two glazed facades separated by gap through which ambient air is allowed to flow. The flow of air removes a large amount of solar heat gain that would ordinarily enter the building, resulting in a reduction in space cooling needs and energy consumption. These facades are also known as double facades, double-skin facades and ventilated cavity curtain walls.

**Volatile Organic Compounds (VOC)** - Organic compounds that evaporate at room temperatures and are often hazardous to human health, causing poor indoor air quality. Sources of VOC's include solvents and paints. Many materials commonly used in building construction such as carpets, furniture and paints emit VOC's.

**Wind Turbine** - A device that converts the kinetic energy of the wind into mechanical energy that can be used to drive equipment such as pumps. The addition of a generator allows the wind's kinetic energy to be converted into electricity. There are two types of wind turbines, namely: horizontal axis turbines - blades rotate about a horizontal axis; and vertical axis turbines - blades rotate about a vertical axis.