Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/01/jls.htm
2015 Vol.5 (S1), pp. 783-793/Daniel et al.
Research Article

GREEN ARCHITECTURE A STEP TOWARD GREEN LIVING

***Daniel Motallebzadeh[1], Vahid Vaziri[1], Nasim Bagherzadeh[2], and Sahel Shahizare[3]**
[1]*Department of Architecture, Faculty of Engineering University of Mohaghegh Ardabili*
[2]*Department of Architecture, Ardabil Branch, Islamic Azad University*
[3]*Department of Architecture, Shabestar Branch, Islamic Azad University*
**Author for Correspondence*

ABSTRACT
Due to increasing urbanization and the increasing development of inappropriate and excessive use of vehicles to comply with the multiplicity of fossil fuels and pollution from their day-to-day control of environmental instability and problems in urban communities are today. So that in recent years following the construction of inappropriate, non-compliance with the required standards, the urban environment is gradually removed from natural conditions and irreparable effects on the nature of the urban area. Green architecture is perhaps one of the most important contemporary account of human consciousness toward environmental issues and problems that result from cultural, social, and economic. Research methodology in this research with regard to the topic of discussion is descriptive. In today's world due to major problems such as global warming, pollution, climate, energy, and economic costs of excessive consumption, the use of green building technologies, sustainable architecture in particular has become of great importance. In result, we can realize that green building can reduce the load on the environment, shrink energy consumption, and preserve the health of the nation.

Keywords: *Green building, Renewable Energy, Sustainable Architecture*

INTRODUCTION
The world's population has grown exponentially since the Second World War, and there is currently pressure on available land and natural resources. As a society, we will eventually be faced with the depletion of our most widely used source of energy, the non-renewable fossil fuels. Many people and organizations are coming to the conclusion that the average person's daily energy consumption in North America will not be sustainable in the future.

There are many ways in which these organizations are taking steps to reduce consumption such as developing new types of vehicles, energy sources, recycled materials, and designing environmentally friendly buildings. These environmentally friendly buildings are also known as "green" buildings and have been in use for over 30 years in North America since the birth of the environmentalists' movement in the 1960s (Brownstone, 2004).

Scientists believe that buildings construction and maintenance consume up to 50% of the total energy resources. We damage the environment by using non-renewable energy resources. Sustainable development paradigm promotes minimal usage of scarce resources based on the resource-saving technologies, i.e. getting raw materials as a result of recycling processes. Green building makes it possible to preserve natural resources for the next generations by reducing pollution and increasing ecosystem self-recovery. (Pechenkina, 2012)

What Is Green Building?
"Green" or "sustainable" buildings are sensitive to:

- Environment.
- Resource & energy consumption.
- Impact on people (quality and healthiness of work environment).
- Financial impact (cost-effectiveness from a full financial cost-return perspective).
- The world at large (a broader set of issues, such as ground water recharge and global warming, that a government is typically concerned about) (Kats, 2003).

Research Article

Figure 1: Green building (Keung, 2010)

Green buildings make it possible to preserve natural resources for the next generations by reducing pollution and increasing ecosystem self-recovery. Green building is environmentally responsible and resource efficient throughout a building's life-cycle. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. A life cycle assessment (LCA) can help to avoid a narrow outlook on environmental, social and economic concerns by assessing a full range of impacts associated with all the stages of a process from cradle-to-grave (i.e., from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste (Pechenkina, 2012).

For a building to be green, it is essential for the environmental impact of all its constituent parts and design decisions to be evaluated. This is a much more thorough exercise than simply adding a few green elements such as a grass roof or a solar panel. The purpose of the digest is to help designers, specifiers and clients to make relatively objective decisions about the environmental impact of materials, products and building solutions with some reasonably hard facts, at least as far as the current state of the art (or science) permits (Kimmins, 1997).

Green Building Benefits

Benefits of Green Building:

- Reuse of land for an infill development project reduces the impact of additional roads and sewers on the environment and promotes walking and transit use.
- Conscientious construction methods divert tons of waste materials from landfills and minimize site disturbance.
- Informed choice of building materials reduces the demand on natural resources and can improve the quality of the building.
- Storm water reuse reduces the demand for potable water and municipal groundwater withdrawals.
- Smart growth helps protect green and open spaces as well as reduce sprawl which results in occupants not commuting as far, in turn reducing vehicle emissions.
- The use of renewable wood and recycled content materials is encouraged.
- Reduced energy consumption means fewer power plant emissions (Acuff, 2005).

Modern construction causes unwanted environmental impacts and limiting these impacts is within the scope of green building. Perhaps the easiest way to understand green building is to first consider the various environmental impacts that buildings generate and then consider how negative impacts can be reduced or eliminated through more effective planning, design, and construction. Modern American buildings impact the environment in the following areas: site selection, materials and resources, energy use and air pollution, water use and quality, and indoor air quality (Nielson, 2009).

Green buildings make it possible to preserve natural resources for the next generations by reducing pollution and increasing ecosystem self-recovery. Green building is environmentally responsible and resource efficient throughout a building's life-cycle. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. A life cycle assessment (LCA) can help to avoid a narrow outlook on environmental, social and economic concerns by assessing a full range of impacts associated with all the stages of a process from cradle-to-grave (i.e., from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste (Pechenkina, 2012).

MATERIALS AND METHODS

Green Material

Natural materials are generally lower in embodied energy and toxicity than man-made materials. They require less processing and are less damaging to the environment. Many, like wood, are theoretically renewable. When natural materials are incorporated into building products, the products become more sustainable (Kim, 1998).

The performance of green building material, as with conventional building products, depends on the durability, appropriate application, and proper maintenance of the product. Often, green building materials are given more scrutiny than their conventional material counterparts because they tend to be newer with less proven performance. This is when extended warranties are important (Froschle, 1999).

Conditionally Green Materials

The majority of available green products have one or more of the following health and/or environmental attributes:

- Promote good indoor air quality (typically through reduced emissions of VOCs-*Volatile organic compounds*)
- Durable and require little maintenance
- Incorporate recycled content (post-consumer and/or postindustrial)
- Have been recycled from existing or demolished buildings
- Are made using renewable resources
- Have low embodied energy

Do not contain Chlorofluorocarbons, Hydrochloroflurocarbons or other ozone depleting substances

- Obtained from local resources and manufacturers
- For wood or bio-based products, they employ sustainable harvesting practices
- Recyclable
- Biodegradable (Fithian, 2009).

Construction Materials

A crucial part of green buildings is the material that is used in their construction. Although definitions vary, green building materials are generally composed of renewable rather than nonrenewable resources and are environmentally responsible because their impacts are considered over the life of the product. In addition, green building materials generally result in reduced maintenance and replacement costs over the life of the building, conserve energy, and improve occupant health and productivity. Green building materials can be selected by evaluating characteristics such as reused and recycled content, zero or low off-gassing of harmful air emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity, and local production.

Implementing environmental practices during construction is a challenge requiring cooperation with the contractor. In the emerging field of sustainable architecture, it is not always possible to enlist a contractor with prior environmental construction experience. Since it is important that the general contractor and subcontractor understand the environmental specifications, a preconstruction meeting addressing sustainable approaches to construction is beneficial. In facilitating the successful green project. It is crucial that the specified green materials and environmental procedures are monitored and enforced during construction to ensure the products are installed using ecological construction practice (Froschle, 1999).

Life-Cycle Assessment

LCA is a comprehensive methodology whereby all the material and energy flows of a system are quantified and evaluated. Typically, upstream (extraction, production, transportation and construction), use, and downstream (deconstruction and disposal) flows of a product or service system are inventoried. Subsequently, global and regional impacts are calculated based on energy consumption, waste generation and a select series of other impact categories (i.e., global warming, ozone depletion, & acidification). This is often referred to as a "cradle-to-grave" approach. LCA allows the impacts from discrete systems and materials to be weighed against each other (Scheuer, 2002).

The Life-Cycle Assessment (LCA) examines the cradle-to-grave (through production, usage and disposal) environmental impacts of the building materials. The LCA is an important part of the design phase of a project. It is crucial when choosing the building materials. It provides information for the long-term costs of the materials rather than the initial *construction* cost (Kozarova, 2012).

One method to assess the overall environmental impacts is with Life Cycle Assessment; LCA is a tool used to quantify the environmental inputs and outputs from the raw materials extraction and manufacturing of the product through the product's use phase and ultimately, disposal. In a whole-building LCA, environmental impacts can be calculated at all phases: raw materials extraction and processing, product shipment to site, construction, use/maintenance, and demolition/disposal. LCA provides a standardized method for comparing the relative sustainability of similar products or processes. LCA can also identify points in a product or process cycle where environmental impacts are relatively high and changes could be made to improve the sustainability of the overall system (Thiel, 2013).

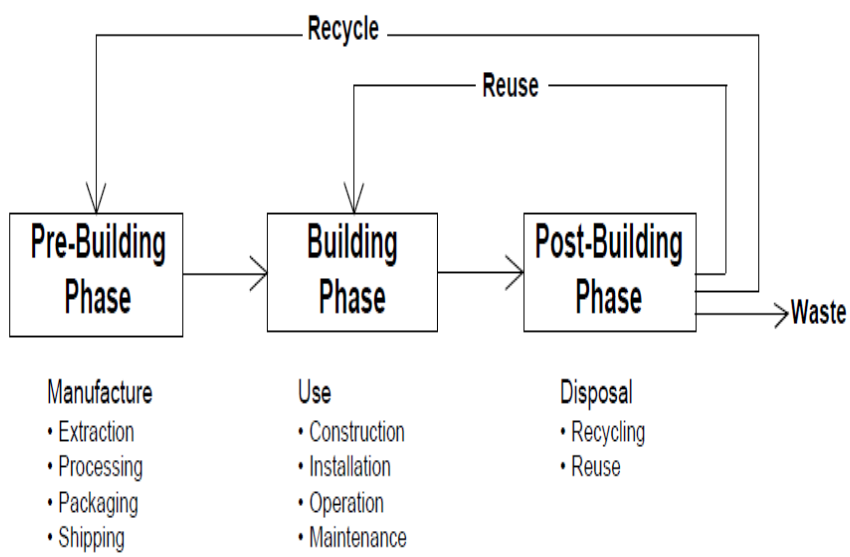

Figure 2: Three Phases of Building Materials life cycle (Kim, 1998)

Pre-building Phase: Manufacture

1. Waste Reduction
2. Pollution Prevention
3. Recycled Content
4. Embodied Energy Reduction
5. Use of Natural Materials

Building Phase: Use

1. Energy Efficiency

2. Water Resistance
3. Use of non- or less-toxic Materials
4. Renewable Energy Systems
5. Longer Life

Post-building Phase – Disposal

1. Biodegradability
2. Recyclability
3. Reusability

Pre-Building

The Pre-Building Phase describes the production and delivery process of a material up to, but not including, the point of installation. This includes discovering raw materials in nature as well as extracting, manufacturing, packaging, and transportation to a building site.

This phase has the most potential for causing environmental damage. Understanding the environmental impacts in the pre-building phase will lead to the wise selection of building materials. Raw material procurement methods, the manufacturing process itself, and the distance from the manufacturing location to the building site all have environmental consequences. An awareness of the origins of building materials is crucial to an understanding of their collective environmental impact when expressed in the form of a building (Kumar, 2012).

Air Pollution mining and harvesting operations contribute to air pollution because their machinery burns fossil fuels and their processes stir up particulate matter. Combustion engines emit several toxic gases: carbon monoxide, which is poisonous to most life carbon dioxide, known as a “greenhouse gas” has been linked to global arming Sulfur dioxide and nitrous oxide, which contribute to “acid rain”: precipitation acidified by atmospheric gases that can damage buildings or kill plants and wildlife (Kumar, 2012).

The waste reduction feature indicates that manufacture has taken steps to make the production process more efficient, by reducing the amount of scrap material that result. This scrap may come from the various modeling, trimming, and finishing processes, or from defective and damaged product. For products with this feature, scrap materials can be reincorporated into the product or removed for recycling elsewhere. Some industries can power their operation by using waste products generated on-site or by other industries. These option reduce the waste that goes into landfills (Hemedia, 2010).

The extraction of raw materials has huge ecological consequences as it may result in loss of wildlife habitat, erosion, shortage of water, water and air pollution and waste generation. The machines used for gathering raw materials burn fossil fuel and produce toxic emissions such as carbon monoxide, carbon dioxide, sulphur dioxide and nitrous oxide that contribute to global warming and acid rains. Fuel from the machinery may get into the ground water thus polluting the drinking supplies. This means that just the process of extraction itself is responsible for air and water pollution (Kozarova, 2012).

Loss of habitat refers to the natural environment in which a species is found; usually, these areas are undeveloped. Cutting forests for lumber or removing vegetation for mining destroys the habitats of animal and plant species. A micro climate may be immediately and severely altered by the removal of a single tree that protectively shaded the plants below (Kumar, 2012).

Building Phase

The Building phase includes the incorporation of the material into the building, its operation and maintenance during the period of use, but it doesn’t include its removal, decomposition or recycling. During this phase, the designer’s choice of the building materials is crucial for the health and well-being of the inhabitations. Furthermore, the appropriate choice may result in lower electrical bills, lower maintenance costs, and rare replacement of the materials that has a positive environmental impact (Kozarova, 2012).

Minimize Site Impact Careful planning can minimize invasion of heavy equipment and the accompanying ecosystem damage to the site. Excavations should not alter the flow of groundwater through the site. Finished structures should respect site topology and existing drainage. Trees and vegetation should only be removed when absolutely necessary for access. For sensitive sites, materials that can be hand-carried to the site reduce the need for excessive road-building and heavy trucks (Kim, Introduction to Sustainable Design, 1998).

To be recycled or "down-cycled" via another industrial process into other products. Most of the times the recycling of salvaged materials requires less energy than the manufacturing of a new product, which makes recycled products more sustainable.

Recycling is the process when the elements can be processed into new similar materials. For instance, aluminum and steel can be recycled into new materials with small amount of energy compared to the energy needed for their extraction and initial production. It is more accurate to say "down-cycling" when the salvaged materials is transformed into a completely different one. For example, discarded plastic products are often "down-cycled" to garden furniture, landscaping elements, drainage media, etc. Here it should be also considered the fact if these materials are salvaged from a demolition site or are dismantled in advance. Even though glass can be recycled, it is hard to handle and separate at a demolition site. On the other hand, steel can be easily separated with magnets (Kozarova, 2012).

Reduction in Construction Waste: Many building materials come in standard sizes, based on the 4' x 8' module defined by a sheet of plywood. Designing a building with these standard sizes in mind can greatly reduce the waste material created during the installation process. Efficient use of materials is a fundamental principle of sustainability. Materials that are easily installed with common tools also reduce overall waste from trimming and fitting (Kumar, 2012).

The biodegradability of a material refers to its potential to naturally decompose when discarded. Organic materials can return to the earth rapidly, while others, like steel, take a long time. An important consideration is whether the material in question will produce hazardous materials as it decomposes, either alone or in combination with other substances.

Post-Building Phase

The Post-Building Phase refers to the building materials when their usefulness in a building has expired. At this point, a material may be reused in its entirety, have its components recycled back into other products, or be discarded. From the perspective of the designer, perhaps the least considered and least understood phase of the building life cycle occurs when the building or material's useful life has been exhausted. The demolition of buildings and disposal of the resulting waste has a high environmental cost. Degradable materials may produce toxic waste, alone or in combination with other materials. Inert materials consume increasingly scarce landfill space. The adaptive reuse of an existing structure conserves the energy that went into its materials and construction. The energy embodied in the construction of the building itself and the production of these materials will be wasted if these "resources" are not properly utilized (Kumar, 2012).

Reuse the Building

The embodied energy of a building is considerable. It includes not only the sum of energy embodied in the materials, but also the energy that went into the building's construction. If the building can be adapted to new uses, this energy will be conserved. Where complete reuse of a building is not possible, individual components can be selected for reuse — windows, doors, bricks, and interior fixtures are all excellent candidates.

Recycling materials from a building can often be difficult due to the difficulty in separating different substances from one another. Some materials, like glass and aluminum, must be scavenged from the building by hand. Steel can easily be separated from rubble by magnets. Concrete can be crushed and used as aggregate in new pours (Kim, Introduction to Sustainable Design, 1998).

Economics of Green Buildings

Buildings account for 40% of the greenhouse gas emissions, 70% of electric consumption, and 12% of water consumed; there is a need to change these trends, and in fact, the green building technology has proven that this is possible. Studies have shown that green buildings save approximately 30% reduction in utility bills over conventional buildings. Besides direct savings in energy costs, green buildings have the potential of lower insurance premiums, lower waste disposal charges, reduced water and sewer fees, and increased rental rates. Green buildings are designed to be environmentally healthy and energy efficient.

However, their initial costs can be 1 to 5% higher than the conventional buildings. These additional initial costs are recouped in energy savings over a few years, and as the number of green buildings increases, the cost of green materials and green design will decrease, thus the initial cost of green buildings will decrease. Implementing the green building concept can result in reduction of carbon emissions by 35%, water usage by 40%, and energy usage by 50% and solid waste by 70% (Chhatri, 2014).

Renewable Energy

Renewable energy is energy that is derived from natural processes that are replenished constantly. Unlike fossil fuel, renewable energy does not pollute the environment because it is a part of nature. Renewable sources most often used are solar, wind, water (hydropower), biomass and geothermal energy. The potential to generate energy from renewable sources is largely dependent on the availability of these natural resources. In Singapore, some of these natural resources (such as wind, geothermal and tidal) are unavailable or not sufficient for us to economically harness energy from it (Keung, 2010).

In contrast to the fossil fuels, renewable energy, as the name suggests, exist perpetually and in abundant quantity in the environment. Renewable energy is ready to be harnessed, inexhaustible, and more importantly, it is a clean alternative to fossil fuels.

The term "renewable energy" has no official or commonly accepted definition. As an example, the renewable energy working party of the international energy agency defines renewable energy as "energy that is derived from natural processes that are replenished constantly.

Typical renewable energy sources are:

(1) Wind, (2) Heat & Light from the Sun, (3) Ocean Wave, (4) Purposely-Growth Energy Crops, (5) Potential Energy of Running Water, (6) Geothermal Energy.

Wind has considerable potential as a global clean energy source, being both widely available, though diffuse, and producing no pollution during power generation. Wind energy has been one of humanity's primary energy sources for transporting goods, milling grain, and pumping water for several millennia. From windmills used in China, India and Persia over 2000 years ago to the generation of electricity in the early 20th century in Europe and North America wind energy has played an important part in our recorded history. As industrialization took place in Europe and then in America, wind power generation declined, first gradually as the use of petroleum and coal, both cheaper and more reliable energy sources, became widespread, and then more sharply as power transmission lines were extended into most rural areas of industrialized countries. The oil crises of the 70's, however, triggered renewed interest in wind energy technology for grid connected electricity production, water pumping, and power supply in remote areas, promoting the industry's rebirth (Herzog, 2000).

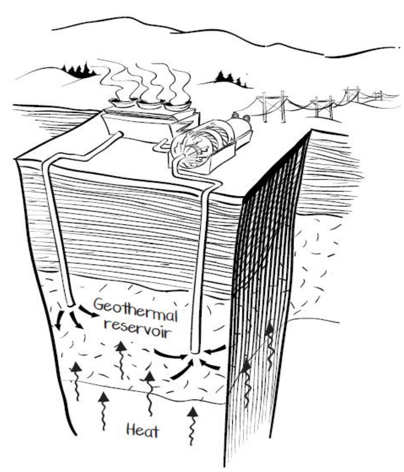

Figure 3: Global Circulation of Wind over the Earth

Geothermal resources are suitable for many different types of uses but are commonly divided into two categories, high and low enthalpy and according to their energy content. High enthalpy resources (>150

°C) are suitable for electrical generation with conventional cycles, low enthalpy resources (<150 °C) are employed for direct heat uses and electricity generation using a binary fluids cycle.

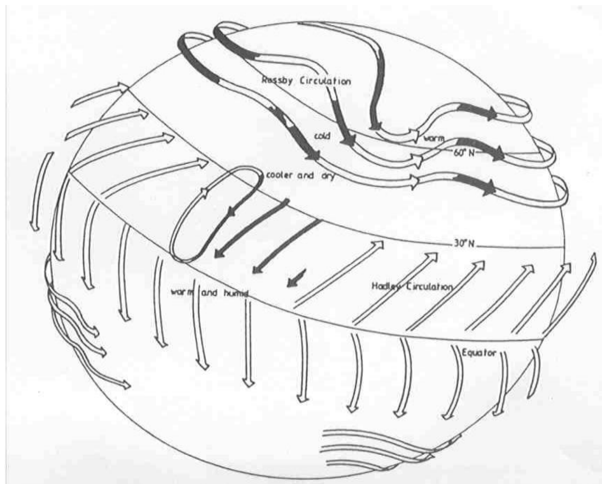

Figure 4: Hot water or steam from deep underground shoots up a geothermal well, spins the turbine generator, and is returned to the reservoir (Nemzer, 2005)

In recent years, significant advances have been made in use of ground source (geothermal) heat pumps for extracting energy from very low temperature resources (<20°C) for both heating and cooling. Other applications also use the seasonal energy storage in shallow formations (>200 m) which make use of the energy storage capacities of the rocks.

These relatively recent uses have multiplied the number of countries and regions that can harness geothermal energy.

Geothermal energy has been produced commercially on the scale of hundreds of MW for over three decades both for electricity generation and direct utilization in many parts of the world. Geothermal energy has a number of positive features which make it competitive with conventional energy sources and some renewables sources. These features include:

- It is a local energy source that can reduce demand for imported fossil fuels.
- It has a large positive impact on the environment by displacing combustion of fossil fuels,
- It is efficient and competitive with conventional sources of energy.

Geothermal plants can operate continuously, without constraints imposed by weather conditions, unlike other renewable sources.

It has an inherent storage capability and is best suited to base-load demand.

It is a reliable and safe energy source which does not require storage or transportation of fuels (Communities, 2001).

Solar Energy is available at any location on earth. The total world average power at the earth's surface in the form of solar radiation exceeds the total current energy consumption by 15,000 times, but its low density and geographical and time variations pose major challenges to its efficient utilization. The solar source is generally assessed on the following criteria:

- Power density or irradiance
- Angular distribution (diffuse or direct components)
- Spectral distribution.

The maximum power density of sunlight on earth is approximately 1 kW/m2 irrespective of location. Solar radiation per unit of area during a period of time is defined as energy density or insolation. Measured in a horizontal plane, the annual insolation varies by a factor of 3 from roughly 800 kW/m2/year in northern Scandinavia and Canada, to a maximum of 2,500 kWh/m2/year in some dry desert areas (Lax, 2004).

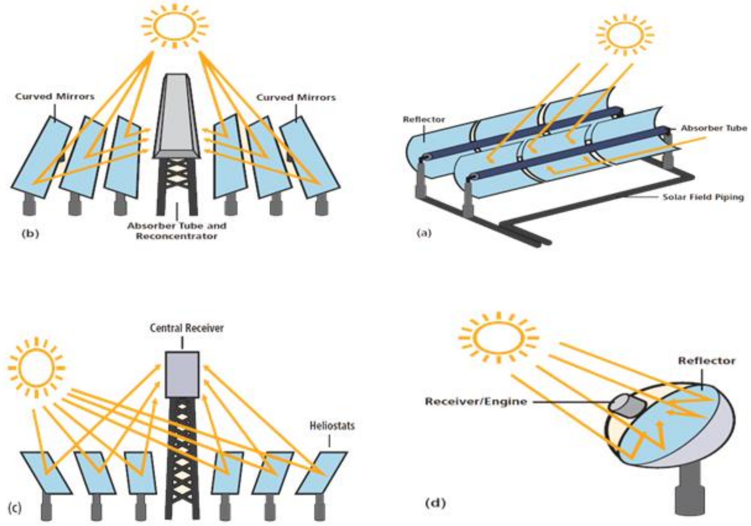

Figure5: Schematic diagrams showing the underlying principles of four basic CSP configurations: (a) parabolic trough, (b) linear Fresnel reflector, (c) central receiver/power tower, and (d) dish systems (Richter *et al*., 2009)

Biomass is a rather simple term for all organic material that stems from plants (including algae), trees, and crops. Biomass sources are therefore diverse, including organic waste streams, agricultural and forestry residues, as well as crops grown to produce heat, fuels, and electricity (energy plantations).

Dominating the traditional use of biomass, particularly in developing countries, is firewood for cooking and heating. Some traditional use is not sustainable because it may deprive local soils of needed nutrients, cause indoor and outdoor air pollution, and result in poor health. It may also contribute to greenhouse gas emissions and affect ecosystems.

The modern use of biomass, to produce electricity, steam, and biofuels, is estimated at 7 exajoules a year. This is considered fully commercial, based on bought biomass or used for productive purposes. That leaves the traditional at 38 ± 10 exajoules a year. Part of this is commercial— the household fuel wood in industrialized countries and charcoal and firewood in urban and industrial areas in developing countries (Beurskens, 2002).

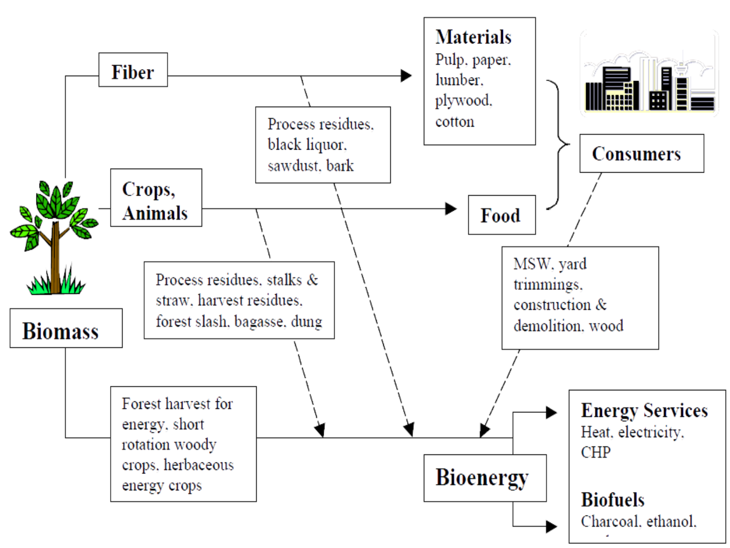

Figure 6: Biomass and bioenergy flow chart (Herzog, 2000)

Hydropower dates back more than 2,000 years to when the Greeks used water wheels to grind grain. Over the centuries, it has played an important role in providing mechanical energy and, more recently, electricity, supporting human and economic development.

Hydropower dams, which provide large-scale water storage, can provide protection from hydrological variability (including floods and droughts) and increase irrigation of agricultural lands, while potentially providing a means of transportation and recreation. Specific applications of hydropower offer significant potential for reducing carbon emissions in the near and long terms. Hydropower is used by electric grid operators to provide base load power and to balance electricity supply and demand, and it plays an increasingly important role in supporting growing shares of variable renewable resources in power systems. (Sawin, 2013)

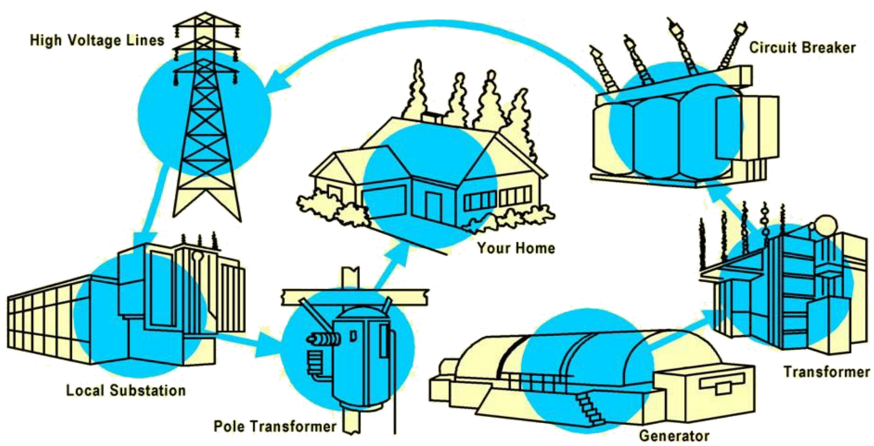

Figure 7: How homes receive hydropower energy (Power, 2005)

Oceans energy cover 70 percent of the earth's surface and represent an enormous amount of energy in the form of wave, tidal, marine current, and thermal resources. Though ocean energy is still in a developmental stage, researchers are seeking ways to capture that energy and convert it to electricity.

Ocean and marine energy refers to various forms of renewable electric energy harnessed from the ocean. There are two primary types of ocean energy: mechanical and thermal. The rotation of the earth and the moon's gravitational pull create mechanical forces. The rotation of the earth creates wind on the ocean surface that forms waves, while the gravitational pull of the moon creates coastal tides and currents. Thermal energy is derived from the sun, which heats the surface of the ocean while the depths remain colder. This temperature difference allows energy to be captured and converted to electric power (Burman, 2009)

CONCLUSION

Building damage include embodied energy, global warming potential, resource use, air pollution, water pollution, and waste. The base of green building will reduce the load on the environment, shrink energy consumption and preserve the health of the nation.

Green building materials encompass a vast area of topics and materials. pay attention to usage solar heat gain, material recycling, the best use of material, using green material and water conservation provides design professionals with many opportunities redound to advance sustainability in our building and our green living.

By understanding the technology and characteristics of solar insulating glass, recycling programs for mineral fiber ceilings, and the environmental benefits of installing water efficient fixtures and valves, architects and building owners can realize short term savings in capital construction costs, and long term savings in annual operational costs.

REFERENCES

Antonia V and Herzog TE (2000). Sources, Renewable Energy. California: Renewable and Appropriate Energy Laboratory.

Cassandra L and Thiel NC (2013). A Materials Life Cycle Assessment of a Net-Zero Energy Building. *Energies* 17 Pittsburgh.

Chhatri J (2014). Green Building Concept. *International Journal of Engineering Technology & Management Research* 5. India.

Chris W and Scheuer GA (2002). Evaluation of LEED Using Life Cycle Assessment Methods. Michigan: National Institute of Standards and Technology Gaithersburg, MD.

Cody Fithian AS (2009). Green Building Materials. Seminar in Sustainable Architecture 13.

Communities E (2001). *Blue book on Geothermal Resources* (Luxembourg:: Commission of the European Communities).

Craig Nielson CB (2009). Green Building Guide Design Techniques, Construction Practices & Materials for Affordable Housing. America: Rural Community Assistance Corporation.

Froschle ML (1999). Environmental Assessment and Specification of Green building Material. Natural Resourses Canada And CANMENT Energy Technology Center (p. 5). California: AIA.

Giaccardo M (2004). The Emissions Reduction & Energy Leadership Summit 2004. Texas: The University of Texas at San Antonio School of Architecture.

Greg Kats CE (2003). The Costs and Financial Benefits of Green Buildings. California: California's Sustainable Building Task Force.

Hemedia FA (2010). Green Nanoarchitecture. Master's Thesis, Alexandria: University of Alexandria.

Jong-Jin Kim BR (1998). Qualities, Use, and Examples, of Sustainable Building Materials. Michigan: National Pollution Prevention Center for Higher Education.

Jos Beurskens AF (2002). Energy and the Challenge of Sustainability. Washington: World Energy Assessment.

Kari Burman AW (2009). Ocean Energy Technology Overview. USA.

Keung J (2010). Building planning and massing. Singapor: The Centre for Sustainable Buildings and Construction.

Kim JJ (1998). Introduction to Sustainable Design. Michigan: National Pollution Prevention Center for Higher Education.

Kim JJ (1998). Sustainable Architecture Module: Introduction to Sustainable Design. Michigan: National Pollution Prevention Center for Higher Education.

Kozarova A (2012). *Building Materials and the Environment*. Dissertation, Denmark: University College Horsens.

Lax M (2004). *Renewable Energy Projects Handbook* (London: World Energy Council).

Marilyn Nemzer DP (2005). Energy for keeps: electricity from renewable energy. California.

Pechenkina V (2012). Green Building Technologies and Environment. *1st International Conference on Architecture & Urban Design, Russia: EPOKA University Department of Architecture* 2.

Rebecca Brownstone PM (2004). Proposed Western Engineering Green Building. Canada: the university of western ontario faculty of engineering.

Richter C, Teske S and Short R (2009). Concentrating Solar Power: Global Outlook 2009 – Why Renewable Energy is Hot. Greenpeace International, Solar PACES (Solar Power and Chemical Energy Storage), and ESTELA (European Solar Thermal Electricity Association) 88.

Sam Kimmins PH (1997). *Green Building Handbook* (Manchester: Queens University of Belfast).

Sandeep Kumar KAM (2012). Life Cycle assessment of sustainable building materials. *International Journal of Advanced Scientific Research and Technology* 8.

Sawin JL (2013). RenewableS 2013 GLOBAL STATUS REPORT. German: REN21.

Zeb Acuff AH (2005). Building Green for the Future. Michigan: Urban catalyst associates.