

# Integration of Renewable Energy Sources in Buildings

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**Abstract:** Renewable energy refers to energy that occurs naturally and repeatedly in the environment. This energy can be from waves, wind, the sun and geothermal heat from the ground. Renewable energy can also be produced from plant sources such as wood or crops grown specifically as a fuel. The aim of this paper is to enlighten Renewable energies that are used to create a reliable, clean, safe, sustainable and energy efficient environment by making use of secure local resources, reducing dependence on fossil fuels, helping to reduce the production of carbon dioxide and other greenhouse gases.

The study of renewable energy sources is an important topic in the field of Architecture as it brings together the use of educational, professional and technological know-how. Architects and professionals introduce technical opportunities, means, and methods for incorporating renewable energy technologies to reduce the energy needs of buildings and increase their ability to capture or generate their own energy at the concerned site for building designs and their operations. Renewable energies are integrated, assessed their economic costs, and their environmental benefits are determined before installing them on site. The overview increases the knowledge and technical abilities of users so that maximum advantage can be taken. Some examples have been provided to describe the content.

This paper introduces the main sources of renewable energy and helps to assess whether using renewable energy is a viable option to adopt.

**Keywords:** Renewable energy, sustainable energy, energy efficient, Renewable energy sources, green energy, green house gas.

## 1. INTRODUCTION

Buildings are a major sources of carbon emissions which impacts global warming, our designs should provides space for renewable sources of energy into the building design, besides considering other important factors such as planning, materials, functionality and energy efficiency over the entire life cycle of a building. Renewable energy saves the environment and it is economical. These are also called low carbon techniques such as wind turbines, solar panels and biomass boilers that generate energy, save money and reduce carbon emissions. It is also called 'renewable', 'green energy', 'micro generation' or 'sustainable energy' as these does not release any net greenhouse gases into the atmosphere.

This paper discusses the renewable energy and technologies to meet an increasing global energy demand with zero or near-zero greenhouse gas emissions. Emphasis is given to electricity generation from hydro, wind, solar, and marine energy. The natural environment provides us with a number of renewable energy sources that can be converted into usable energies for buildings or facilities. As Renewable energy provides significant environmental and economic benefits. Releasing greenhouse gases (such as carbon dioxide) into the atmosphere causes climate change across the globe. Around 86% of the UK's carbon dioxide (CO<sub>2</sub>) emissions come from fossil fuels to produce energy. Renewable energy sources can be available on-site (such as wind and solar energy) or produced locally (such as biomass). Currently, the architecture field has become conscious for environmental needs and responds with designs that reflect this conscious approach to sustainable human environments. With this approach in mind, that energy is a very important issue, not only with respect to natural energy sources, but also in the integration of these concepts into buildings.

## 2. RENEWABLE ENERGY SOURCES

Some of the Renewable Energy Sources which provides information on different types of energy resources are described below:

**2.1 Solar:** Solar power is generated from sunlight, which is converted into electricity through solar photovoltaic panels. In Australia, solar power is on tops in the list of renewable energy sources, as it is sustainable, safe, reliable and clean. It is also one of the easiest and cheapest renewable sources of energy to install in your home.



**Figure:1** solar photovoltaic panels

**Source:** <http://listverse.com/2009/05/01/top-10-renewable-energy-sources/>

**2.2 Wind:** Wind power is generated from atmospheric, temperature and pressure changes that force the movement of air, which is captured by wind turbines and converted into electricity. Wind power is safe, reliable and clean, with no greenhouse gases emitted during the generation of electricity. It is becoming a cost effective source of renewable energy, with one wind turbine generating enough electricity to power the home.



Wind Mill

<http://listverse.com/2009/05/01/top-10-renewable-energy-sources/>

**2.3 Geothermal:** Geothermal power is generated from heat or hot rocks buried beneath the Earth's surface. This geothermal heat is used to produce steam and hot water that is converted into electricity. Geothermal power produces no greenhouse gases and is expected to play an increasing role in providing electricity.



Geothermal power : <http://listverse.com/2009/05/01/top-10-renewable-energy-sources/>

**2.4 Biomass:** Biomass power is generated from living or recently dead biological material that is burnt, generating heat and steam that are converted into electricity. Common fuels for biomass power are: wood, waste,

garbage, landfill gases, and alcohol fuels. While greenhouse gases are released during the burning of materials, this release is combated by carbon dioxide absorbed by the same materials during their lifetime. Due to the large-scale availability of suitable materials, Biomass is considered a viable and effective source of renewable energy.



Waste, garbage & landfill : <http://listverse.com/2009/05/01/top-10-renewable-energy-sources/>

**2.5 Hydro:** Hydropower is generated from water flowing downstream, which is converted into electricity using water turbines. Hydropower is a clean energy that has been widely used to generate significant quantities of electricity for hundreds of years.



Hydropower : <http://listverse.com/2009/05/01/top-10-renewable-energy-sources/>

- 2.6 Ocean:**-Ocean power can be generated from a number of different forces: waves and tides can be used to power underwater water turbines, and the heat stored in seawater can be captured and converted into electricity. As the ocean is one of the most powerful forces on earth, it may be one of the most important sources of renewable energy in the future.



Ocean power :

<http://www.renewableenergyworld.com/rea/tech/ocean-energy>

### 3. NEED OF RENEWABLE ENERGY RESOURCES & TECHNOLOGIES:

- 3.1 Renewable energy technologies are needed as they are clean sources of energy and have lower environmental impact than conventional energy technologies.
- 3.2 It is beneficial to the environment as it does not produce greenhouse gases.
- 3.3 As this Energy will remain forever so can be used by our children's children's children
- 3.4 Renewable energy will not run out Ever. Other sources of energy are finite and will Someday be depleted.
- 3.5 New Jobs opportunities and long run Economy is there.

### 4. TYPES OF RENEWABLE ENERGY RESOURCES AND TECHNOLOGIES WHICH ARE USED AND APPROPRIATE FOR BUILDINGS:

- 4.1 Solar hot water panels:**-In this sun's heat is captured and stored by using water storage systems.
- 4.2 Photo-voltaic panels:**-In this method daylight energy is converted into electricity.

- 4.3 Ground source heat pumps** - these extract the heat from the ground by using a refrigerant fluid (or water) and transfer it to a heat sink where it can then be circulated through the building with a heating system, they can also be operated in reverse to provide cooling

- 4.4 Biomass boilers** – these boilers burn organic matter to produce heat and/or electricity; use of biomass is generally considered to be 'carbon-neutral' because the carbon dioxide released during the generation of energy is balanced by that absorbed by plants during their growth.

## 5. CASE STUDTIES

Two buildings from India has been studied which are using Renewable energy sources and technologies and are successfully running and admired by all. We feel proud as these new technologies have positive response and we are thinking for our future by depending on these Renewable energies.

### *Case Study 1: Project: CII- Sohrabji Godrej Green Business Centre, Hyderabad*



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[http://www.solaripedia.com/13/94/godrej\\_green\\_business\\_centre\\_in\\_hyderabad.html](http://www.solaripedia.com/13/94/godrej_green_business_centre_in_hyderabad.html)

It is one of the best examples of renewable energy and technologies. At the time it was the first building in the world outside the US to be awarded the 'platinum rating' under the LEED rating system, making it the greenest building in the world. The most environment-friendly building for use of water, energy efficient technologies, renewable technologies and recycled material has been built as a unique public/private partnership as a demonstration building for the industry in India and other countries of the world. The GBC was built near HITEC City in Hyderabad and is designed as a

demonstration building, as well as research and development center.

The building is also highly energy efficient and uses 55 per cent less energy than a conventional building. It has been constructed in such a way that the intake of natural lighting is high and there is no need for external lighting. The building has used many innovative ideas including a waterless urinal in which the chemicals are used to store and recycle urine without any odour. The site of the building was not at all disturbed for the construction of the building, as per the LEEDs norms.

The unique features of the building had won the highest rating in the world as it has 80 per cent material used in the construction of the building was recycled. i.e. fly ash, a waste material coming out of cement and other industries. The building discharges zero water as all of its used water is recycled. It has a huge capacity for the collection of rain water.

There are two air conditioning towers in which the incoming air is cooled by spraying of water. The pre-cooled water is fed into the air conditioning system further lowering the energy costs.

The 60 per cent of the roof of the building is covered by the roof garden as a good insulating property and to cut down the load on the air-conditioning system.

The balance portion of the roof is covered by **solar photo voltaic** with 24 KW capacity. The 100 to 120 units of power generated per day is fed into the grid meeting 20 per cent of the total energy cost of the building.

Focus areas of GBC include **green buildings, water management, energy efficiency, renewable energy and environment recycling.**



**Water Management**



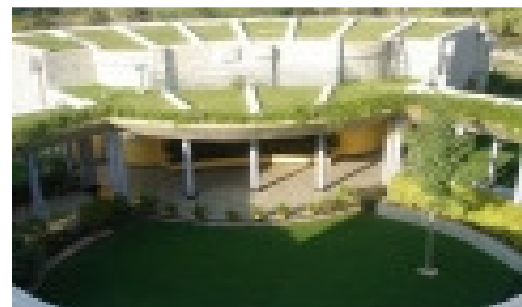
**Energy Efficiency**



**Recycling Materials construction**



**Renewable Energy**



**Roof Garden**



**Air Conditioning Tower**  
Images from:

[http://www.solaripedia.com/13/94/godrej\\_green\\_business\\_centre\\_in\\_hyderabad.html](http://www.solaripedia.com/13/94/godrej_green_business_centre_in_hyderabad.html)

### **Case Study 2: Project: University of Petroleum & Energy Studies, Dehradun**

The UPES campus is located at Bidholi, at the foothills of Mussoorie range mountains. In one part of campus there are clusters of buildings, the main building named Energy House, next important is Chitrakoot Block which has various laboratories and workshops. The University has a R&D Centre for research and development in various fields which comprises various laboratories, behind R&D Centre there is an Oil Rig working model dedicated for the Petroleum Engineering and Earth Sciences students. Due to its proximity in mountain valley, the campus is untouched from the pollution.



**Main entrance of UPES**



**UPES Campus**



**Energy house**



**Oil Rig model**



**River stream behind UPES Campus**

Some achievements of this project based **water management, energy efficiency, renewable energy and environment recycling** on are as follows:

1. **Environment Recycling:** The Top soil is preserved and reused for landscape purpose.
2. **Waste Water Management:** there is reduction in water consumption by 33.16% compared to the base case scenario by adopting necessary water saving measures. Waste water treatment plant (Installed capacity – 200KL/day) on site to promote re-use of waste water and reduce dependency on potable water.
3. **Renewable Energy Resources:** Solar Photo Voltaic plant is installed which meets 30.1% of annual requirement of internal artificial lighting. The building uses of solar hot water system, which has installed capacity is 10KL/day and annual energy saved from it is 95.3%.

4. **Energy Efficient:** The building demonstrates use of low VOC (Volatile Organic Compounds) paints, adhesives and sealants and confirms absence of urea formaldehyde in composite wood products. Use of 100% CFC (chlorofluorocarbon) and HCFC (hydro chlorofluorocarbon) free refrigerant and insulation. All fire extinguishing systems installed in the campus are halon free.
5. The UPES campus has been awarded GRIHA four star rating award on 14th February, 2013. GRIHA (Green Rating for Integrated Habitat Assessment) is the national rating system of India conceived by The Energy and Resources Institute and developed jointly with the Ministry of New and Renewable Energy, Government of India.

## 6. RENEWABLE ENERGY AND ITS FUTURE PROSPECTS IN INDIA

In terms of renewable energy India stands among top 5 countries in the world. The installed base is 9% of total power generation capacity & contributes 3% to the electricity mix. India has 5<sup>th</sup> position in the world in wind energy, hydro projects up to 25MW capacity. Different technologies have been deployed to improve people's lives. More than 4 million people have so far has been benefitted.

## 7. A BRIGHT FUTURE FOR RENEWABLE ENERGY

In the United States and around the world, solar, wind, and other renewable energy sources represent a significant share of the new generating capacity deployed in the coming years and decades. These technologies will also be in demand as the world addresses persistent and emerging local and global environmental challenges and because clean energy will be sought after in the push to achieve greater energy security.

For all these reasons, the future of clean energy is bright.

At this time in the history of the world, the need for energy is at its peak. With the diminishing of non-renewable energy resources and the constantly increasing demand for energy, renewable energy is the only solution. We need more research on renewable energy to make it a viable option for all.

## 8. CONCLUSION

It is well known that energy is the backbone of technology & economic development. Rapid increase in use of energy has created problems of demand & supply. Today, 80, 000 villages are yet to be electrified. Also India has had a negative Energy Balance for decades. Even though, The Ministry of Power has set an agenda of providing Power to All.

whether using renewable energies sources a viable option to adopt? The answer found is Yes, India can meet all energy needs with Renewable Energy Sources. Solution can come only through research, development & implementation of such developments. Energy problem is global problem. Only the governments cannot do everything. However individual & co-operative efforts can do a lot. So let us all work together to execute the agenda of providing Power to All by using safe and reliable techniques.

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