Assessment of Renewable Energy in Green Buildings

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ABSTRACT

Encouraging renewable energy systems in buildings has tremendous potential to contribute to the energy needs of the building by providing a clean source of energy without affecting the environment. The present study aims at assessing renewable energy in green buildings. It focuses on the strategies and technologies used to attain the renewable energy points in green buildings and hindrances and catalysts associated with same (on-site/off-site).

The study was undertaken in green buildings. Case studies were developed for the same. Project managers, chief engineers and consultants associated with the buildings were interviewed to gather data. In addition, green building consultants were interviewed to take their perspective on the hindrances and catalysts associated with renewable energy (on-site/off-site). The study showed catalysts and hindrances behind renewable energy (on-site/off-site). Also, the study helped analysing the commonly and not so often used renewable energy strategies and technologies. The hindrances which have emerged from the study can be worked upon so that more and more buildings can take up renewable energy (on-site/off-site) as compared to the present scenario.

Keywords: Green building, Renewable energy, on-site, off-site, sustainable development

1. INTRODUCTION

Energy is a basic requirement for the existence and development of human life. There has been an excessive reliance on the use of fossil fuel resources like coal, oil and natural gas to meet the power requirement of the country which is not suitable in the long run due to limited availability of fossil fuel as well as the adverse impact that they have on the environment and ecology [1]. Building construction and operation have extensive direct and indirect impacts on the environment.

Buildings use resources such as energy, water and raw materials, generate waste (occupant, construction and demolition) and emit potentially harmful atmospheric emissions [2].

Building rating systems are a popular tool to bring momentum in achieving energy efficiency and sustainability in buildings. Buildings are given ratings of platinum, gold, silver, or certified, and one, two, three, four and five stars based on green building attributes [3].

Development of renewable energy sources, which are indigenous and distributed and have low marginal costs of generation, can increase energy security by diversifying supply, reducing import dependence, and mitigating fuel price volatility [4]. The Government is promoting construction of Energy-efficient solar buildings based on the techniques of solar passive design with a view to provide comfortable living and working conditions, both in winter and in summer. These buildings can be integrated with renewable energy and energy conservation devices and systems, and can save over 30% to 40% of conventional energy that is used for lighting, cooling, or heating [5].

However, if we look at the data, not many buildings have gone for Renewable energy systems. In addition even certified green buildings have not gone in for renewable energy criteria in a big way [6]. The present study will therefore investigate the hindrances and catalysts, towards implementing the renewable energy (on-site/off-site).

Review of literature showed that very few studies of this nature and focus have been carried out. This study therefore would add to the body of knowledge regarding renewable energy (on-site and off-site) and their implementation.

2. OBJECTIVES

- To make a profile of the selected green buildings
- To take a detailed account of the technologies and strategies used to implement the renewable energy in selected green buildings
- To study the catalysts and hindrances related with renewable energy systems in the selected buildings

3. METHODOLOGY

The study was carried out in three green buildings in Capital and National Capital Region selected randomly. These three buildings were developed as case studies. The project manager/chief engineer and consultants associated with these three buildings were interviewed to gather data on strategies and technology used to implement renewable energy and to understand hindrances and catalysts associated with renewable energy credits (on-site/off-site). Apart from this, green building

consultants were taken as the sample to gain insight into the hindrances and catalysts in the implementation of renewable energy.

The data collected from the three buildings was developed in the form of case studies. The data was analyzed quantitatively and qualitatively keeping in mind the objectives of the study. The responses obtained from the consultants were coded and tabulated and inferences were made. Conclusions and inferences were drawn as per the objectives of the research.

4. RESULTS AND DISCUSSION

A. Case studies

Building 1: The first building taken for the study got USGBC LEED platinum rating in 2009.

More than 20% of the building's total energy use is generated from solar photovoltaic cells. Refer to the table 3.1 for renewable energy details of the building.

Table 3.1: Technical data of the solar power

Type	Solar photovoltaic AC (alternate current) Hybrid Power Generating system by Tata BP Solar India
Application	To power AC operated office loads like computer, lights and fans
Total Maximum Load	35 KW
Energy Generation by solar photovoltaic systems	65514 KWh per annum
Total number of solar panels/systems	360 Standard modules:300 BIPV Laminates: 60
Total number of solar thermal systems	2
Cost of renewable energy systems in the building	Rs. 7crore 22lakhs approx

Building 2: It is the first emission neutral office building in Asia which draws 100 percent of its electricity from photovoltaic plant. It needs some 50 percent less power than comparable buildings

in the region. This project has shown that approaches such as combining efficient insulation with renewable energies can help to dramatically reduce a building's energy consumption and, therefore, its CO2 emissions. Refer to the table 3.2 for renewable energy details of the building**.**

Table 3.2: Technical data of the solar power

Type	Crystalline Silicon Grid Connected Solar System by Moser Baer Photo Voltaic Ltd
Application	To power AC operated office loads like computer, lights and fans
Total Connected Load watts	123 KW
Energy Generation by solar photovoltaic systems	88.9 MWh per annum
Total number of solar panels/system	270
Total number of solar thermal system	2
Cost of renewable energy systems in the building	Rs. 81 lakhs

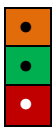
Building 3**:** The US Green Building Council (USGBC) has awarded platinum rating to the project, under LEED certification for the New Construction. It got the certification in the year 2006. It is one of the first buildings in India to get platinum rating under LEED NC category. They did not apply for the renewable energy credit because of space constraint. The building however, is using solar energy for all their hot water needs and water heated by solar thermal technology saves approximately 30,000 kilowatts per hour. Around 40 solar systems (solar panels + solar thermal systems) were installed for the purpose of lighting the Logo and heating the water. More panels could not be installed due to non availability of space, and thus they could not apply for on-site renewable energy credit.

B. Comparative analysis of Strategies and Technologies used/not used by buildings

Under credit Renewable energy, all the three buildings have made use of solar passive design, out of which only two buildings have gone for renewable energy generation via solar photovoltaic cells and solar hot water system. Also, the technologies other than solar have not been used like wind, geothermal, hydro, biomass and technology like solar process heating and cooling system. No building has gone for off grid source renewable energy technologies. Refer to table 3.3 for the technologies and strategies used/ not used by buildings

Table 3.3: Comparative analysis of Strategies and Technologies used/not used by buildings

Renewable Energy	Using renewable energy from solar photovoltaic cells Using solar hot water system Wind, geothermal, biomass, hydro, and bio-gas strategies solar process heating and cooling system off grid source renewable energy technologies



- Technology/Strategy used by all three buildings
- Technology/Strategy used by two buildings
- Technology/Strategy not used by one of the buildings

B. Catalysts and Hindrances in the process of implementation of renewable energy

Mostly all the respondents felt implementation of renewable energy credits (on-site/offsite), results in improving the prestige and image of the organization. All the respondents felt that this acts as a major catalyst for the building owners to go for renewable energy credits.

Half of the respondents also reported that the social responsibility of the organisation is another big catalyst in taking the renewable energy credits. This is because the buildings account for major green house gas emissions, thus encouraging the use of renewable energy systems will help encounter the problem of carbon emissions. All the respondents felt that better rental value is a minor catalyst for the building owners to go for renewable energy credits. The rent value of the building increases by taking RE credits and also renewable energy is one of the most sustainable options present over fossil fuels, which in a way improves organisation value. Apart from the catalysts, there are also some hindrances in this process as per the respondents.

Majority of the respondents felt that the high installation cost and lack of space are the major hindrances for renewable energy credits (on-site/off-site). Cost of the renewable energy system is very high, Building owners, architects and the consultants are not well aware regarding the incentives provided by the government thus, renewable energy credits are very cost intensive. Also, unavailability of space is an issue, as the buildings lack space to install renewable energy systems to get the required energy. All the respondents felt that improper orientation to sun is a minor hindrance. Majority of the respondents felt that the documentation of the renewable energy credits (on-site/off-site) is a complex process, and pose as a hindrance. Some consultants felt that lack of technological advancement in the field of renewable energy technology is also one of the minor hindrances faced by the buildings that limit the implementation of renewable energy credits (on-

site/off-site). Also, most of the consultants felt especially for the green power credit, that hiring of third party to acquire this credit is expensive and is one of the constraints for the building to take up this credit. Refer to the table 3.3 and table3.4 for major and minor catalysts and hindrances.

Table 3.3: Catalysts for Renewable energy credits

MAJOR	MINOR	REASONS
Prestige and image	Cost savings	Prestige and image increases in the market, building's social corporate image is enhanced
	Better rental value	Greater control over the pricing strategy
	Social responsibility	RE systems reduce dependence on fossil fuels, save 30%-40% energy and shows pay back. Buildings want to show their responsibility towards environment

Table 3.4: Catalysts for Renewable energy credits

MAJOR	MINOR	REASONS
Lack of Capacity and Standard Quality Control	Improper orientation to Sun	Lack of capacity and inadequate expertise Inappropriate orientation leads to battery backup which is a conventional source
State Laws	Improper orientation to Sun	Laws that allow green power transmission are not supportive
Lack of Financial and Fiscal Incentives		Real Estate Industry not aware of the incentives
Lack of Capacity and Standard Quality Control		
State Laws		
Lack of Financial and Fiscal Incentives		

5. CONCLUSION

The study focuses on the renewable energy technologies and strategies being used by the green buildings. It gives an insight into the renewable energy technical specifics. It also showed that some of the strategies and technologies were used by all three buildings, giving an impression of them being easier to implement while some were not being used by either of them showing that they were more difficult to implement like offsite renewable energy (green power). The study has also shown light on some of the major catalyst and hindrances faced while going for renewable energy. The study also indicates some of the areas which need to be worked on, to overcome the hindrances highlighted. Some of these are high installation cost, lack of space, state laws, lack of technology and high maintenance cost.

Thus, the hindrances which have been shown through the study can be worked upon so that more and more buildings can take up renewable energy credits (on-site/off-site) as compare to the present scenario where not many buildings have gone for renewable energy systems.

REFERENCES

[1] MNRE. (2010). *Renewable energy in India: progress, vision and strategy*. Delhi: Author

[2] TERI: Sustainable Building- Design Manual, Vol. 1 and 2. The Energy and Resource Institute (TERI), New Delhi, India, 2004

[3] United Nations Environment Programme. (2007). *Buildings and Climate Change – Status, Challenges and Oppurtunities*. Retrieved February 13, 2011, from http://www.unep.fr/shared/publications/pdf/DTIxPA-BuildingsClimate.pdf

[4] Nayak, J., Prajapati, J. (2006). *Handbook on Energy Conscious Buildings*: Solar Energy Centre

[5] Kumar, A., Tripathi, A. (2009). Energy efficient solar/green building scheme. *Akshay Urja*: MNRE\

[6] United Nations Environment Programme. (2011). *The State of Play of Sustainable Buildings in India*. Retrieved March 3, 2011 from, http://www.unep.org/sbci