

# Energy Efficient Buildings, a Sustainable Campus Planning Approach

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**Abstract:** *Sustainable energy initiatives are one of the substantial measures toward achieving environmental sustainability goals and should be adopted by facilities management practices in university. In order to evaluate the potential and capability for energy conservation, a research has been conducted for both newly constructed and existing structures. In order to achieve energy efficiency in buildings while keeping an eye on costs, the research paper discusses the several energy-saving approaches that can be included during the planning, designing, construction, and execution stages. The case study was taken as women's Polytechnic college campus, Indore. This study hypothesizes that achieving the goal of sustainability of a nation starts with a small neighbourhood. At present the green campus initiative is only on papers. But through this research paper, feasible strategies will be given that can be implemented in a small area which can later be translated to big areas.*

**Keywords:** Sustainable Energy; Energy Conservation; Energy Efficiency; Sustainable building; green campus

## I. INTRODUCTION

A green campus is one where eco-friendly activities and education work together to encourage sustainable and eco-friendly campus operations. By generating sustainable answers to the environmental, social, and economic requirements of mankind, an institution can redefine its environmental culture and create new paradigms by implementing the green campus concept. The term sustainability, often known as the triple bottom line (Koukiassa 2011), generally refers to initiatives to embrace or optimize environmental, economic, and social elements as well as practices (Hitchcock & Willard 2006; Petrini & Pozzebbon 2010). These characteristics are centered on reducing current ecological impacts to protect the environment for coming generations, fostering social capital issues for improved living standards, and facilitating good economic growth (Dempsey et al. 2011; Rydin & Holman 2004). This study aims to investigate the significance of sustainable practices in higher education institutions that prioritize sustainable energy initiatives. One possible factor advancing the university's efforts to create a sustainable campus is energy conservation practices. One successful green campus planning will lead to more sustainable campuses. In this paper, Government Women's Polytechnic College campus is taken as the case study to make it an ideal green campus.

## II. REVIEW OF LITERATURE

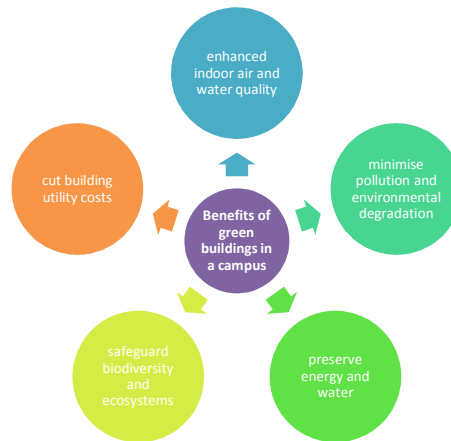
Over the last ten years, there has been increasing awareness globally about environmental sustainability due to the impact of development (Woodruff & Mankoff 2009). Urgent actions and solutions are required to minimize the detrimental impacts of environmental challenges such as climate change, ozone depletion, pollution, soil degradation, and deforestation (Banerjee 2002; Hansen 2006). Moreover, environmental changes due to global warming, carbon dioxide emissions due to climate change can be seen through the ongoing worldwide have concentrated consideration on the earth (Kim, Jung, Seok, & Yang, 2015). Environmental sustainability addresses the impact of activities on the environment by minimizing the use of resources, minimizing the production of waste and pollution, protecting biodiversity and the natural environment, and using energy efficiently. Table 1 illustrates the environmental dimension of sustainable development and the areas of concern.

**Table 1 Areas of concern of the environmental dimension**

Dimension	Environmental
Areas of concern	Climate change
	Resources
	Internal environment
	External environment
	Wildlife
	Biodiversity
	Water
	Energy
	Waste
	Materials and components

Source: Adopted and adapted from Harris 2003; Khalfan 2002; Reffat 2004b

Green buildings are defined as those that, in comparison to conventional buildings, consume less water, maximize energy efficiency, save natural resources, produce less waste, and offer healthier areas for occupants. Clean water, air, and healthy living are further definitions of "green structure." Being somewhat more efficient is not the goal of building green. It's all about designing structures that minimize their impact on the surrounding environment, employ locally sourced materials, and—above all—reduce their energy, water, and material needs. The benefits of green buildings are given in the figure 1.



**Figure1: Benefits of Green building in a campus**

**WHAT IS THE DIFFERENCE BETWEEN GREEN BUILDING AND ORDINARY BUILDING?**

A green building uses as many methods as possible to reduce the use of carbon-based energy. It would contain the highly efficient lighting elements (compact), possibly there would be alternate energy sources like solar units or wind driven units on the building or nearby. Energy efficient design would be built in to a new building, etc.

Design of a building is very important it plays a vital role in reducing the energy requirement of a building during its life. Design has to consider the following:

- i. Optimum use of solar energy.
- ii. Optimum use of renewable energy.
- iii. Selection of energy efficient fitting plants and equipment.
- iv. Adoption of energy efficient fitting plants and equipment.
- v. Adoption energy efficient design and technologies.

Research finding reported in different literatures revealed that buildings with good overall environments quality can reduce the rate of respiratory disease allergy asthma and exchange worker performances choose construction materials and interior finish products with zero or low emissions to improve indoor air quality many building materials and cleaning /maintenances products emit toxic gases such as volatile organic compounds and formaldehyde these gases can have a dramatic and positive impact on indoor air quality provide effective drainage from the roof and surrounding landscape.(chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ijert.org/research/study-of-energy-efficient-building-IJERTV4IS060215.pdf)

**GREEN BUILDING RATING SYSTEM**

GRIHA (Green Rating for Integrated Habitat Assessment), TERI (The Energy and Resources Institute) & SVAGRIHA (Small Versatile Affordable GRIHA) are green building rating system developed for Indian construction sector. GRIHA is a rating system which assesses the environmental performance of buildings on scale of 0-104. On the basis of number of points scored, a building can be rated between 1 & 5stars. GRIHA was developed by TERI and has now been adopted by the Ministry of New and Renewable Energy (MNRE) as the National Rating System for green buildings in India and to promote green buildings in India and to oversee the various activities associated with it, MNRE and TERI jointly established an independently Registered society called ADARSH (Association for Development and Research of Sustainable Habitats). ADARSH functions as a platform for interaction between various stakeholders as well as promotes GRIHA, SVAGRIHA and other similar green building rating systems in India whereas SVAGRIHA is a recently designed system especially for small scale projects i.e. buildings with built up area less than 2500sq.mt

Some of the green materials are

1. Fly ash
2. Green concrete
3. Blast furnace slag
4. Coconut husk
5. Marble dust

**III. METHODOLOGY**

The aim of the study is to implement green building solutions on existing buildings and incorporate green building technologies in new construction. The objectives can be divided into 2 parts. These are short term objectives and long term objectives.

Short term objectives	Long term objectives
To minimize conductive heat loss/gain	To foster a culture of energy-saving behavior among students, professors and residents through seminars
To assess the viability of community solar rooftops	To reduce the reliance on fossil fuels
Use of energy efficient and eco-friendly appliance	To avoid the energy demand with measures of electrification, behavioural change, digitalisation and material efficiency.
To reuse and recycle locally generated waste	
To transfer the knowledge of sustainability among the residents of the campus with the help of workshops	

To fulfill these objectives various strategies will be given. After discussing the objectives it is important to understand the site.

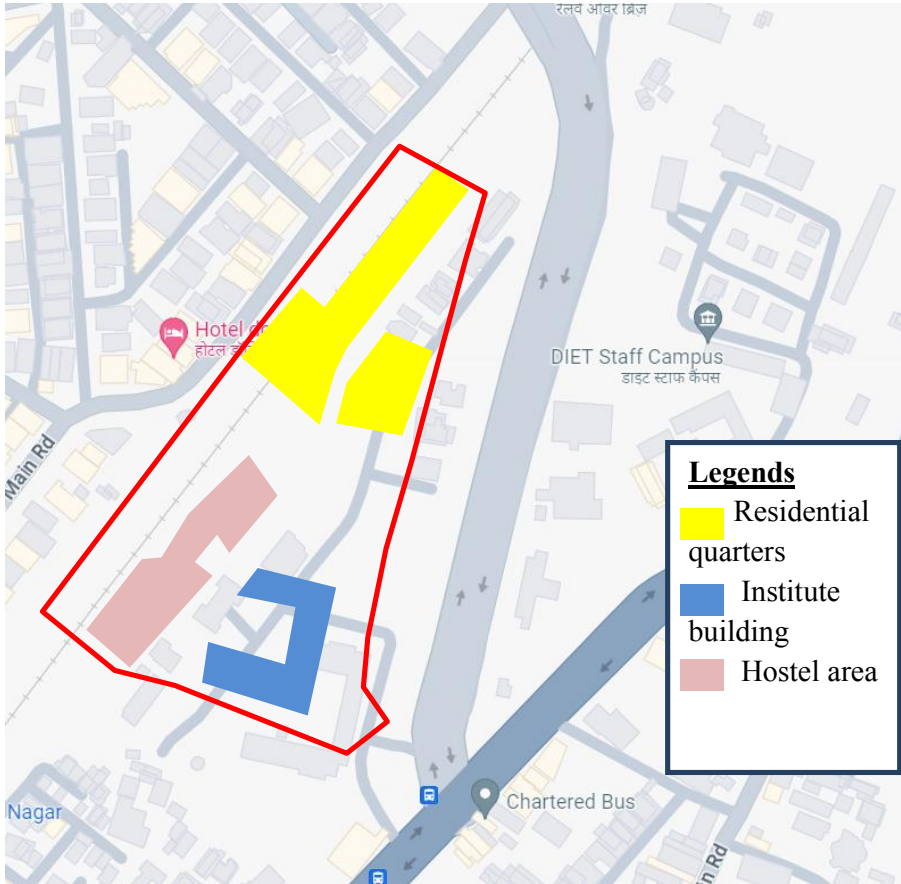
**IV. SITE ANALYSIS**

The site is situated in rajendra nagar. It is a Women’s polytechnic college with an area of approx. 10 acres. It has 4 departments namely Architecture and Interior Design, Fashion Technology, Computer Science and Hotel Management and Catering Technology. It has a student’s hostel inside the campus. Along with the hostel, there are residential buildings for the employees. There is a harmonious relationship between the residents and nature. Although the campus is very green, it still needs awareness regarding the sustainable practices in the campus. The strategies will help in actually implementing them on the campus residents.



**Figure 2: satellite image of the campus**

At present, the college building has solar panels. There are no waterbodies or a dedicated green space inside the campus. The campus also sees no vehicle day once every year.



**Figure3: location of residential and college building in the campus**

Figure 3 shows the planning inside the campus which shows that very little area is under the built-up and the rest of the area is under roads and green area.

**V. RESULTS AND CONCLUSION**

There is a huge potential for the campus to be an ideal green campus and to serve as a model for other institutional campuses to follow the same as well. There are few steps being taken in the direction but there is a huge gap between the current practices and smart campus. Since there are no new construction to be done in the near future for the institute, the strategies has to be given keeping in mind the existing buildings.

Therefore, for the university to embark on improving their sustainable energy practice, they need to implement and invest in the following strategies:

S.No.	Strategy	Benefits of the strategy
1	Micro smart-grid	This will enable the university to generate its electricity using solar panels and biomass.
2	Use of solar energy	Using solar energy for lighting and heating
3	Installing external shading devices	an energy-efficient cooling system, to reduce energy
4	Installation of feasible solar panels, and geothermal installations	This will help in saving loads on those high electricity bills
5	Install Quick Smart System	Install smart lighting systems and energy-efficient

		appliances. This will make the campus ready for the future, not just financially but sustainably as well.
6	Implementation of rainwater harvesting	
7	Making dedicated green space	This will not only help in maintaining the overall temperature of the campus but also create a gathering space for the residents.
8	Webinars and workshops	This will help in spreading the awareness among the residents about the green campus initiative.
9	Learn & Reward	Reward students and staff for adapting to sustainable habits. This shall encourage them to boost their sustainable energy-friendly behaviour.

In a nutshell, these strategies when implemented properly can make a huge impact in making the institute campus green and smart. It is important to spread awareness among the residents of the campus first. Strategies such as providing energy awareness program, using energy-efficient appliances and equipments, managing activities and academic time scheduling, organizing seminars and workshops will help in effectively managing the energy inside a building. Since green building is a relatively novel development, stakeholders in the built environment will need to learn new methods to analyse and advocate for its widespread use. Likewise, those invested in the built environment must adjust to new ways of thinking and acting to support green construction initiatives. It is worth stressing that the negative environmental consequences of building development will not be adequately mitigated so long as green building remains a niche sector (Simphe and Smallwood, 2018).

This study concludes and suggests that, with support from the government and staff, the administration should consider becoming green with their planned building projects or putting green features into their current structures to increase the green performance of university buildings to improve the QoL of its users, which includes students and employees.

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