ZERO ENERGY BUILDINGS IN INDIA

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ABSTRACT-

A zero energy home or a building is a structure which gives almost as much energy back to the power grid as it takes. The main principle is to reduce power consumption of the structure by efficient design and on-site renewable energy generation. The paper discusses primarily, the advantages and disadvantages of a ZEB, the scenario of zero energy buildings in India. The problems facing the development of such structures in our country revolve around economic considerations and lack of awarneness and skill. There is no proper policy in place for acknowledging these structures. Individuals and builders are scared to invest in these projects due to high capital investments. Monitoring and corrective actions can also be very complicated. The most important concern and barrier is the harnessing of renewable energy resources which is expensive as compared to conventional resources. Based on the case study of the Paryavaran Bhavan, Delhi, the paper tries to state the various ways in which this novel structure can be brought to the forefront in the times of fuel and economic crises. It also shows a simple stepwise way in which these buildings can be built. The most important points to be considered are the insulation of the house and maximum utilization of sunlight and other resources. In India, it is essential to educate the masses regarding long-term benefits of a ZEB like exemption from future carbon emission taxes and also low ownership cost.

Keywords: Zero energy buildings, zero energy homes, on-site renewable energy generation, Paryavaran Bhavan.

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I. Introduction

This is an age where fuel reserves are fast depleting. It is essential to switch to new and better options like smart grid, smart metering, zero energy buildings that will help to reduce dependency on these reserves by reducing energy consumption and improving use of renewable energies.

A zero energy home will produce as much or more energy than what it consumes, thus reducing ones bills and also the strain on energy resources. This paper focuses mainly on the ZEBs in India. The barriers faced and the solutions to deal with these barriers so that such structures can be build in India are also discussed.

The next few paragraphs discuss the basics of a zero energy building.

What is a zero energy building? A net zero energy home or a building is the one with zero net energy consumption, meaning that the total energy used by the building on an annual basis is roughly equal to the renewable energy created on site. Hence these buildings don't increase the amount of greenhouse gases in the air. At peak times they may take power from the grid, but return to it at other times. Buildings that produce surplus of energy over the year are called "Energy-plus buildings" and those which consume slightly more than they produce are called "ultra low energy houses".

On site energy is harvested by various means like solar and wind energy producing technologies and also efforts are made to reduce the on site consumption of energy simultaneously.

Such buildings or houses are a part of the grid. Many approaches can be applied for constructing such a building which includes cost, energy or carbon-emissions.[4]

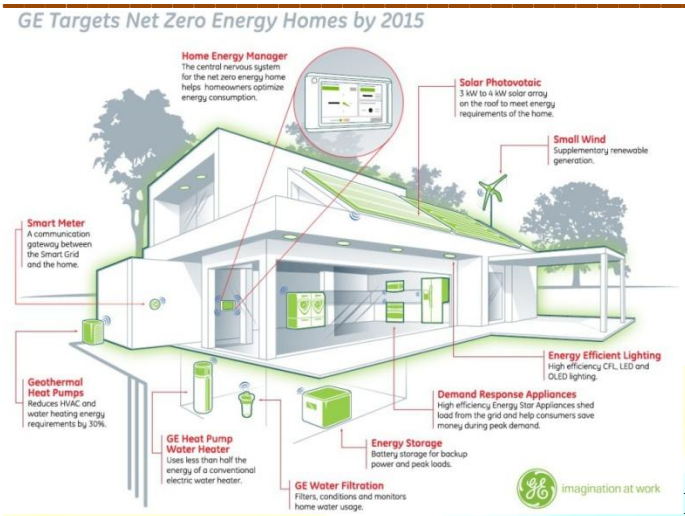

Fig 1: Features of a zero energy building or home as proposed by G.E.

The advantages of a ZEB are now discussed.

ZEBs will provide isolation for building owners when future energy prices increase. These homes give increased comfort due to more uniform interior temperatures. There is a reduced requirement for energy austerity. Total cost of ownership reduces due to improvement in energy efficiency.

Net monthly cost of living will reduce for owners. These houses are more reliable and have high resale value. As energy costs increase, these homes become more valuable,

They will also be exempted from future legislative restrictions and carbon emission taxes or penalties.[4]

The disadvantages of a ZEB are that the initial costs are very high. It is a challenge to recover these costs during resale. Few designers have the skill to build these homes. A ZEB may require energy from the grid during peak hours so it does not reduce plant capacity. Such homes are only feasible where renewable energy resources are available during a major part of the year.

How do these houses differ from green buildings? The goal of green building is to reduce a building's negative impact on the environment and to use resources in a better way. Zero energy building's significantly reduce energy usage and greenhouse gas emissions. ZEB may not be considered "green" in all areas such as reducing waste, recycling, etc., but they tend to have lesser ecological impact.[4]

The following section discusses the barriers or hurdles that India faces on the path to building zero energy homes. The fourth section sheds light on the various solutions that can be devised to make ZEBs more practical in India. The paper then moves on to the factors to be considered while building a zero energy home on a basic level. The sixth section describes the case study of Paryavaran Bhavan, Delhi. The paper concludes in the seventh section.

II. Barriers on ZEB path in India

Implementation of ZEBs in India poses a few problems which will have to be addressed in order to successfully build such homes in our country. If these problems are solved, India will have an answer to the energy crisis which is the side effect of the growing population.[1]

The concept of ZEB is gaining importance and recognition in developed countries. For promoting it in India, we first need to define specifically ZEB for our country. Though initiatives to improve energy efficiency have been taken in the form of ECBC and Energy Star Rating Program, there is no program or policy that is well defined for zero energy buildings in India.
The builders in India have short term goals. The high capital cost required for ZEBs doesn't't provide an incentive for builders. Financial benefits of ZEBs are only for the users.[1]

Individuals are not aware of energy efficient architectural guidelines and renewable energy techniques that can be implemented when building their homes.
Though several fiscal incentives have been provided by the government, integration of high end renewable energy in the design techniques is very complicated and costly.
The lack of specialized skills required to integrate energy efficient and design techniques for a ZEB is a major barrier. There are also very few set of people with skills required to simulate designs of ZEBs considering all the parameters.[1]

Construction of ZEB requires lot of monitoring. Corrective actions can be very complex. This can cause functional and communicational gaps between managing partners. Achieving common goals and objectives then becomes very difficult.

Vendors integrate their products on site individually thus hindering holistic integration of the project site.

It is difficult to evaluate product efficiencies, whether they suit their claims, because such facilities are practically non-existent in our country. This will also require extensive financial support and human resource development.[1]

The section that follows chalks out various ways in which ZEBs can be made feasible in India.

III. Making a ZEB practical in India

To make ZEBs more practical in India, the following measures can be applied:

The government should formulate definite policies for the propagation of this technology in the country. It can provide incentives and tax redemptions to individuals, builders and designers who take up such projects. It can also conduct programs to impart awareness and skills to people and craftsmen.

It is important to acknowledge long term benefits of a ZEB. Thus people and builders should be made aware of the future advantages a ZEB proposes. The initial costs of such buildings are overcome during its lifespan. Case studies in New Zealand show that initial costs incurred where recovered within the first year itself.

Special aide can be provided to individuals who wish to implement zero energy homes with respect to skills and specifications of design.

It is essential that we develop cost efficient renewable energy technologies in a country like India where economy is the most important factor considered. Also research and development in this area can be used for on-site monitoring and troubleshooting, holistic integration of the project and testing and simulation of models.

Colleges and government programs can impart the required set of skills to interested individuals, professionals and technicians.

In the next section it has been discussed how a zero energy building can be built and what factors have to be accounted for.

IV. Building a zero energy home

Roof overhangs, windows and their placement should be such that solar gain is maximum. Solar collectors should be placed such that they face true south.

Most of the energy is spent in heating and cooling a home. Insulating the home properly will be a great achievement. Use high R-value insulation that gives a continuous unbroken layer around the building envelope. Seal all cracks and holes. Build walls with concrete as it minimizes temperature swings. Use airtight walls, triple glazed windows and well insulated doors. Make sure adequate ventilation is maintained

Buy high efficiency equipments. Use alternative cooling methods like ventilation only or evaporative coolers. Design the space accordingly to optimize earth temperature.

Use fluorescent bulbs throughout. Install only five star rated appliances. Turn off lights, showers, appliances when not in use. Uninstall old and inefficient home appliances. These steps can eliminate 'wasted' energy.[3]

Install solar panels. Use photovoltaic cells to generate solar electricity. Rain water can be harvested in the monsoons. Generating energy on site using waste (biogas) is also a very good way of meeting energy demands of the house.[3]

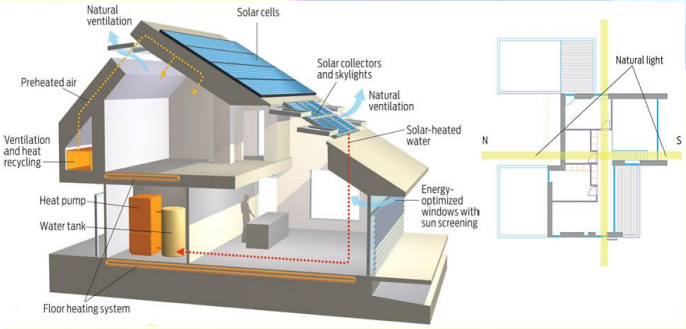

FIG 2: How to build a zero energy home.

www.eventbrite.com

The case study of Paryavaran Bhavan in New Delhi will now be studied.

V. Case study

Paryavaran Bhavan in Delhi is India's first on site zero energy building. It uses innovative solar mechanisms for energy generation and is built by using energy efficient building materials. It is India's highest green rated building i.e. GRIHA 5 STAR and LEED India platinum.

Following are the features of this building:

- Effective ventilation is achieved by orienting the building in the east- west direction.
- 75% of the daylight is utilized.
- The building is disabled friendly.
- Peak power is 930 KW which makes it the largest rooftop solar systems among multi-storeyed buildings in India.
- Chilled beam system of air conditioning- 40% savings in energy consumption.
- Green materials (fly ash, or material with high recycled content) are used and outer walls have been insulated.
- Bamboo jute composite material which is rapidly renewable is used for window and door frames.
- Calcium silicate ceiling tiles having high recycled content and paver blocks in pavements and roads.
- Low discharge water fixtures, recycling of waste water, low water demand plants, and rainwater harvesting have led to low water consumption and demand.
- This building is also earthquake resistant. More than 50% area outside the building has grass and plantation.
- Power generated is fed back to the NDMC grid.
- Roadways and paths are soft areas to enable ground water recharge.[2]

Time taken for completion of project: 2011-2014

Cost of the project: Around 201.49 crore rupees.[2]

The next section provides a conclusion to the paper.

VI.Conclusion

It is essential that energy resources be saved. The only way to do this is by reducing consumption and simultaneously switching to more efficient and renewable energy generation techniques.

A ZEB is one step closer to this goal. It integrates these two principles very well. It is thus essential that people are made aware of this new technology and skills are imparted to them. Incentives and policies should be made available. Commercial and residential builders should opt for ZEB in every project.

Right now the first step would be to focus on development of renewable energy generation technologies and make them available to the masses in a cost-effective way.

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