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Net Zero Energy Building Movement in India - An Overview

V. Sumateja Reddy

Student of Architecture, IGBC Accredited Professional, AU College of Engineering, Andhra University, Andhra Pradesh, India

ABSTRACT

Worldwide Buildings consume up to 40% of the total global energy and 36% of carbon dioxide emissions. By the year 2030, the consumption is expected to increase up to 50%. In India building sector consume a total of 70% of the electricity generated in the country. Studies indicate more than 50% of energy is used in buildings for occupants comfort like cooling and lighting. Energy consumption in the building sector will continue to increase until buildings can be designed to produce enough energy to compensate the growing energy demand of these buildings. Toward this end, many governments promote zero energy buildings. A zero-energy building is a building with zero net energy consumption; it means the total amount of energy used by the building on an annual basis is equal to the amount of energy produced on the site or off the site. These buildings do not increase the amount of greenhouse gases and less impact on climate. This paper aimed at reviewing some literature on zero energy buildings in India and suggests ways of improving the energy usage by the occupants.

Keywords: Net zero Energy Building, Design, Energy reduction strategies, Foot print, barriers, Advantages, Goals.

I. INTRODUCTION

In India most of the energy used today is produced from fossil fuels like coal, oil, natural gas, and a direct consequence of using these fuels is that greenhouse gasses are released into the atmosphere, with one of the most significant being carbon dioxide (CO_2). These gasses emitting infrared radiation, contribute to global warming and climate change. In response to this threat, governments across the world have committed to reducing greenhouse gas emission and increasing renewable energy production. India is the sixth largest CO_2 emission country (6.6%) in the world and continued to increase by 7.8%. The increase in CO_2 emission was mainly caused due to consumption of energy which is primary demand of building sector. Buildings have a significant impact on energy use and the environmental impact. Buildings use almost 40% of the primary energy and approximately 70% of the electricity. The energy used by the building sector continues to increase, primarily because new buildings are constructed faster than old ones are demolished. Power consumption doubled in the building sector between 1980 and 2000, and is expected to increase another 50% by 2025. Energy consumption in the commercial building sector will continue to increase until buildings can be designed to produce enough energy to offset the growing energy demand of these buildings. Toward this end, Indian government promotes Zero Energy Buildings concept, which greatly reduced energy needs through efficiency gains such that the balance of the energy needs can be supplied by renewable technologies. A building may be considered a ZEB if 100% of the energy it purchases comes from renewable energy sources, even if the energy is generated off the site.

II. METHODS AND MATERIAL

1. Definitions of Net Zero Energy Building (NZEB)

All NZEBs must have common in reduce energy consumption through energy efficiency measures such as passive design, daylighting, efficient appliances, insulation, passive solar heating, high-efficiency heating, ventilation and air conditioning (HVAC) equipment, natural ventilation etc. They are...

A. Net Zero Energy Cost Building: The electricity bill is covered every year by virtue of design and production of energy at the site.

B. Net Zero Energy Emission Building: The energy emission is measured in mass of carbon- equivalent greenhouse gas emissions related to energy use in the building.

C. Net Zero Source Energy Building: A building that purchases or produces as much energy for a year by accounting the energy produced at the source.

D. Net Zero Site Energy Building: A building that produces at least as much renewable energy as it uses the energy, over the course of a year.

2. Deference between Zero Energy Building and Green Building

The main goal of green building is to use resources efficiently and reduce a negative impact on the environment. NZEB's achieve one key green-building goal of significantly reducing energy use and greenhouse gas emissions for the life of the building. Zero energy buildings may or may not be considered green in all areas, such as using recycled building materials, such as reducing waste etc. However, zero energy buildings do tend to have a much lower ecological impact over the life of the building compared with other green buildings that require imported energy and/or fossil fuel to be habitable and meet the needs of occupants.

3. Towards Net Zero Energy Buildings

With a modest beginning of 9565m^2 project area in the country in the year 2014 today (as on August 2016) more than 7 NZEB projects (Table:1)with a footprint of over 33,777 m^2 projected area is certified and fully functional in India. They are…

Table 1. NZEBS foot print in India

Sno	Name of the Premises	Location	Climate type	Project area	Occupancy type	Typology	Grid connectivity	EPI
1	Indira Paryavaran Bhawan	New Delhi	Composite	9565m^2	Office &Educational	New	Connected	44kWh/m^2/yr
2	CEPT	Ahmadabad	Hot & dry	498m^2	Office &Educational	New	Connected	58kWh/m^2/yr
3	Akshay urja bhawan	Haryana	Hot &Dry	5100m^2	Office	New	Connected	30Wh/m^2/yr
4	ECB	Noida,UP	Composite	891m^2	Lab	New	Connected	71Wh/m^2/yr
5	Sun Carrier Omega	Bhopal	Hot &Humid	918m^2	Office-Private	New	Off grid	-
6	GRIDCO	Bhubaneswar	Warm & Humid	15793 m^2	Office	New	Connected	90Wh/m^2/yr
7	Malankara Tea Plantation	Kerala	Warm &humid	-	Office-Private	Old	Connected	-

4. Design Stratagy For Net Zero Energy Buildings

The key to designing net zero energy buildings are first reducing energy demand as much as possible, and then choosing good energy sources. Here is a simple order of operations.

A. Passive Design

Passive design maximizes the use of natural sources of heating, cooling and ventilation to create comfortable conditions inside buildings. It harnesses environmental conditions such as solar radiation, cool night air and air pressure differences to drive the internal environment. Passive measures do not involve mechanical or electrical systems. An NZEB will only be cost-effective if all the passive strategies Like Form & Orientation, Shading, Cool Roofs, Fenestration, Insulation, Daylighting, Windows, Natural Ventilation, Thermal

Mass, Evaporative Cooling, Thermal Comfort and Vegetation are adopted in its design and construction.

B. Lighting

Lighting energy accounts for more than a quarter of total energy consumption in buildings. It is therefore important to optimize lighting energy used to achieve net zero goals. Energy efficient lighting fixtures like Light Emitting Diodes (LEDs) are now readily available in the market. These must work in conjunction with day lighting. Building form, orientation, and fenestration design must take channel daylight into the building. Day lighting controls as well as occupancy sensors could further reduce lighting energy use.

C. Efficient appliances

Selecting the right appliances and good usage practices is reducing half energy load. **Solar Appliances, Solar Lighting,** Tubular Fluorescent Lamps (TFLs), Ceiling Fans, Electric Geysers and Color Television are the right alternative to conventional appliances.

D. Renewable energy

Renewable energy systems are the final step to attaining zero energy goals. Once all possible measures to reduce energy demand are deployed, renewable energy systems must step in to balance residual energy demand. Performance of renewable energy systems determines the success of the net-zero buildings. Total grid connected renewable power capacity in India is 45,065 MW as of August 2016(Ministry of New and Renewable Energy-MNRE) i.e.; wind power: 27,674 MW (61.3%), Solar power: 8,083MW (18%), Bio-power: 4,882 MW (10.9%), small hydro: 4,310MW (9.6%) and Waste-to-Power: 115MW (0.3%). Economical Comparison shows that Wind Energy is most economical among all renewable resources. India target 5 time (175MW) increasing renewable energy capacity by 2020.

E. Heating, Ventilation and Air Conditioning (HVAC)

Comfort systems contribute to nearly 40% of the energy used by commercial buildings in India. Many types of HVAC systems are available in market ranging from low energy comfort systems to conventional systems. Design of a building, climatic zone and operational parameters governs the energy requirement for the comfort system. Reducing heating and cooling loads through passive design and enhancing the efficiency of HVAC systems are steps that are imperative for any building energy efficiency policy. Apart from selecting energy efficient equipment, it is important to select the correct system type, size, and design for optimized energy efficiency.

III. RESULTS AND DISCUSSION

1. Advantages and Disadvantages Of NZEB

A. Advantages of zero energy buildings are

- Client buildings Isolation for building owners from future energy price increases.
- Increased comfort due to more uniform interior temperatures.
- Reduced total cost of ownership due to improved energy efficiency.
- Extra cost is minimized for new construction compared to an afterthought retrofit.
- Higher resale value as potential owners demand more ZEBs than available supply.
- The value of a ZEB building relative to similar conventional building should increase every time energy costs increase
- Isolation for building owners from future energy price increases
- Increased comfort due to more-uniform interior temperatures
- Reduced requirement for energy austerity
- Reduced total cost of ownership due to improved energy efficiency
- Reduced total net monthly cost of living
- Reduced risk of loss from grid blackouts

B. Disadvantages of zero energy buildings are

- Initial costs can be higher than conventional buildings
- Very few designers have the experience to build NZEBs.
- Challenge to recover higher initial costs on resale of building.
- Without an optimized thermal envelope the embodied energy, heating and cooling energy and resource usage is higher than needed.

2. Barriers/Challenges

The following are some of the barriers

- Regulation and lack of political will
- Business case and financing
- Lack of awareness and familiarity for design professionals
- Difficulty in finding trained contractors
- Insufficient knowledge base
- Lack of suitable variety and competitive market for high performance products
- Lack of awareness of passive design and benefits
- Lack of experts capable of doing quality assurance

IV. CONCLUSION

Worldwide acceptance of zero energy building technology may require more government incentives or building code regulations, the development of recognized standards, or significant increases in the cost of conventional energy. The zero energy building concepts has been a progressive evaluation from other low energy building designs. Difficulty in finding trained contractors and builders, lack of public awareness, regulation and political agenda, financing are not the barrier to achieve goal. .NZEB's are the good solution to significantly reducing energy use and greenhouse gas emissions for the life of the building. In 2007 UK Government introduced a policy stating that from 2016 all new homes constructed must meet a Zero Carbon Standard.

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