IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

From Vision To Reality: Implementing Net Zero Energy Buildings In The Built Environment

SRUSHTI A NAYAK, 5th-year, B.Arch Student of Architecture PES University, Bangalore 560085, India

Abstract: As global levels of greenhouse gases keep rising, the temperature of the planet increases, causing ice caps to melt and drastic changes in global weather patterns. Today, it is approximated that the world's-built environment accounts for about one-third of all global greenhouse gas emissions and uses 40% of the world's energy. The dilemma for environmental architecture is how to satisfy increasing demand for creative architectural solutions with less strain on the ecosystem. The paper discusses studies of user experience in different categories of energy-efficient buildings with emphasis on indoor climate and overall satisfaction. Energy users have varying concerns. Two key solutions are suggested to minimize CO2 emissions and combat climate change by substituting fossil fuels with renewable ones whenever feasible. Zero energy buildings can exchange energy with the grid, having a net energy balance of zero each year. The paper discusses zero energy buildings in detail.

I. KEY WORDS

Ecological Design, Sustainable Development, Green Architecture, Zero energy building, materials, Ecosystem, Green design, Passive houses, Energy resources, Carbon emission, and Energy conservation.

II.INTRODUCTION

A zero-energy building is a building which produces as much or even more energy as it consumes. A zero-energy building generates as much or even more energy than it uses. That is, you can utilize the electricity of the building for free and cut down your electricity bills. With the level of pollution worldwide taking its toll, it is not surprising that the resources of planet are dwindling fast while the earth is plagued by climate change. zero energy buildings give you a cleaner place to live; they consume much less electricity than normal homes and contribute to less carbon footprint

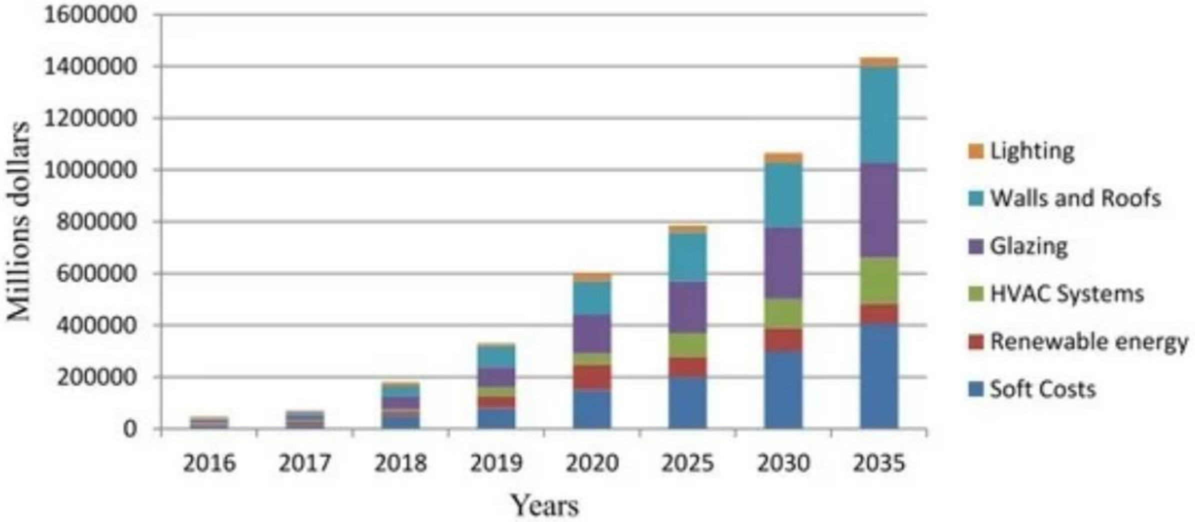
What does a net zero energy building means?

A zero-energy house, or zero net energy (ZNE) building, net-zero energy building (NZEB), or net-zero home, is a building that every year generates as much energy as it uses from renewable means. The aim is to end up in balance, where the level of energy use is matched with the level of generation, leading to a sustainable and green building.

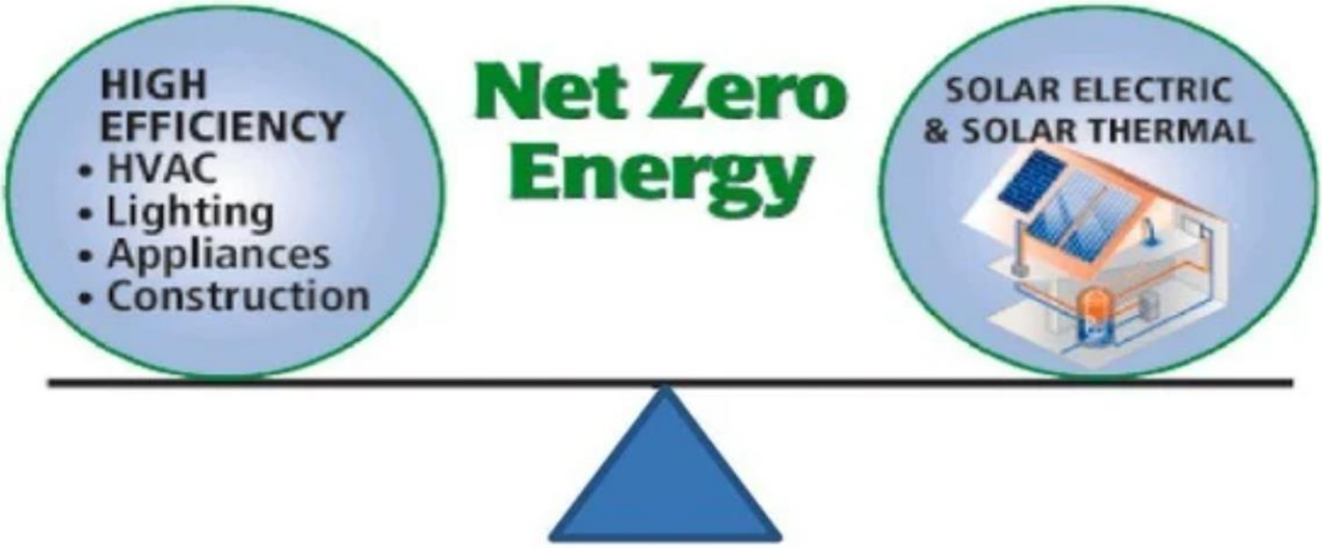
Aim and Methodology:

The objective of the paper is to examine the literature on the current NZEB to make them self-sufficient and net zero in a bid to enhance energy efficiency of the buildings. Due to the aspiration to minimize the utilization of non-renewable sources of energy, the paper operates on three major objectives using theoretical perspectives which are outlined below:

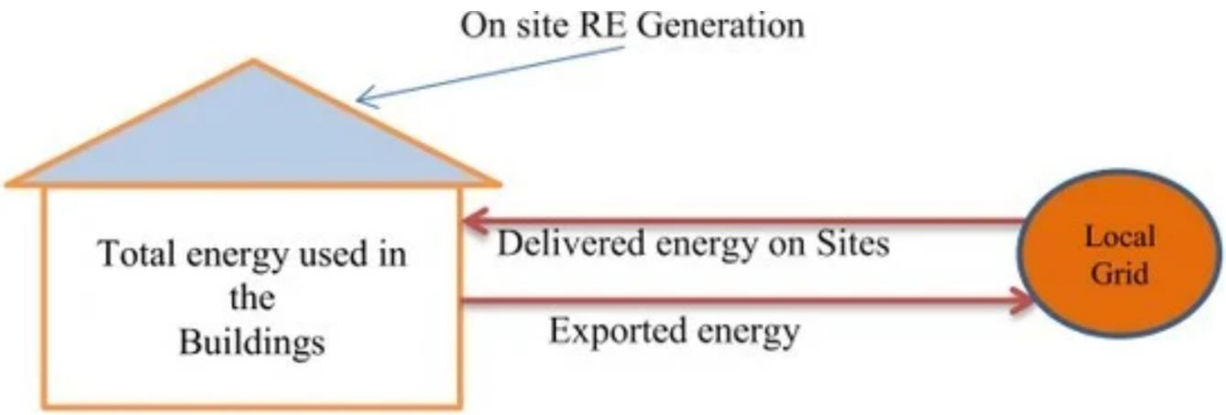
- Energy supply from various sources of renewable energy.
- Enhance energy efficiency of the building.



Two major design approaches propel Net Zero Energy Buildings (NZEBs): adopting Energy-Efficient Measures (EEMs) to lower energy requirements and integrating Renewable Energy Technologies (RETs) to supply demands. The research procedure initiated by collecting material from diverse reliable sources. Terms such as "net zero energy building, energy analysis of NZEB, and performance of NZEB under different climatic conditions" were utilized. 2982 results were then reduced to 170 peer-reviewed publications from 2002 to 2022, which were relevant and most recent and informative.



Balance in Energy produced in energy consumed.



NZEB's idea

Case Study: The Bullit Center

Abstract:
This paper investigates net-zero building architecture using a critical case study of the Bullitt Center in Seattle, Washington. The Bullitt Center, finalized in 2014, was constructed to utilize net-zero energy and water. This paper deconstructs the architectural techniques the Bullitt Center used to deliver its ambitious green objectives, centering on passive design, incorporation of renewable energies, material procurement, and functional efficiency.

Introduction:
The built environment is a key source of greenhouse gases and resource consumption. Net-zero buildings are an essential leap towards sustainable development by reducing their environmental footprint. They strive to be net-zero energy consumers by producing as much renewable energy on-site as they use, and net-zero water use by harvesting and treating rainwater for non-potable applications.

The Bullitt Center, which was designed by Miller Hull Partnership and named after Denis Bullitt, a developer who was a front-runner in sustainable development, is a six-story living laboratory for sustainable building techniques. The office space, conference center, and education facilities within the building advocate environmental stewardship.

Achieving Net-Zero Goals:
The Bullitt Center utilizes a comprehensive approach to achieve its net-zero goals, incorporating various architectural strategies:
***Passive Design:** The orientation of the building is designed to take advantage of natural light and ventilation, thereby decreasing the need for artificial lighting and heating/cooling. Deep overhangs block sunlight from direct exposure, cutting down on summer heat gain.
***Renewable Energy Integration:** The Bullitt Center includes a rooftop solar photovoltaic (PV) system that produces enough electricity to power it for a year. The building also includes a rainwater collection system that harvests and treats rainwater for toilet flushing, irrigation, and other non-potable purposes.
***Material Choice:** Locally sourced and sustainable materials are chosen throughout the building process. The building uses low-carbon concrete and wood that is FSC-certified to reduce embodied environmental effects.
***Operational Efficiency:** The building has energy-efficient appliances, lighting, and water fixtures. Building occupants are actively involved in reducing resource usage through educational initiatives and building automation systems.
Success and Impact:
The Bullitt Center has attained its net-zero ambitions with ease, becoming a model for sustainable construction. The project has proven the viability of attaining high-performance buildings with limited environmental impact

Bullitt Center has won several awards and accolades for its innovative design and sustainable success. It has motivated many architects and developers around the globe to adopt net-zero building practices, significantly advancing the way of sustainable development of the built environment.

Conclusion:

The Bullitt Center is a compelling case study demonstrating the promise of net-zero building design. By embracing a comprehensive strategy that combines passive design, renewable power, green materials, and operational effectiveness, structures can radically minimize their environmental impact and help to support a sustainable tomorrow. In an era where the world is confronting climate change, the Bullitt Center is a symbol of the creativity and dedication needed to find a sustainable built environment.

Need of net-zero buildings.

Limiting building emissions is still an extremely cost-effective way to tackle climate change, with different levels of regulations having a vital part to play. Net-zero building not only helps the environment but also drives the economy. The Zero Energy Building (ZEB) principle focuses on providing energy entirely from on-site, renewable resources. A Zero Net Energy Building (ZNEB) takes it a step further, being super-efficient and generating onsite renewable energy greater than or equal to its yearly usage.

Literature Review:

Paul Torcellini, Shanti Pless, and Michael Deru,et.al, (2006) This paper introduced the ZEB definition may highlight demand-side or supply strategies and whether fuel switching and conversion accounting are suitable to achieve a ZEB target. Four well documented definitions—net-zero site energy, net-zero source energy, net-zero energy costs, and net-zero energy emissions—are investigated; pros and cons of each are discussed. These definitions are used on a sample of low-energy buildings for which extended energy data are available. This research indicates the design implications of the definition employed for ZEB and the great variation between definitions. It also examines sample utility rate structures and how they affect the zero energy scenarios. Peter O. Akadiri,et.al, (2012) herein introduced a conceptual framework designed to applying sustainability principles for the construction sector. The suggested framework on the sustainable triple bottom line approach, consists of conservation of resources, cost efficiency and human adaptation design. After conducting a comprehensive literature review, each principle comprising strategies and procedures to be executed throughout the life cycle of construction projects is described and a couple of case studies are included for clarity on the process.

AmirHosein GhaffarianHoseini1,et.al,(2013) this work compared the important advancements of smart building design as a major component of eco-city development to enable greener and efficient built environments. Existing effort in this work is also aimed towards significant and practical implementations which were implemented to establish buildings with zero energy use. Stress is laid upon discussing the recent theories, attempts, implementations, and challenges towards the development of zero energy intelligent buildings (ZEIB).

Elena Perlova,et.al,(2014) talked about object is to design buildings with zero energy consumption or close, which is projected construct on the Polytechnic University site. The innovation of the project lies in an inclusive strategy of the house design, which will be completely autonomous and independent of the urban networks.

Mr. Nitin U Thakare1, Mr. Utkarsh Manwar2,et.al,(2020) based on the study a principal impact of constructing on the overall global energy feasting level i.e. approximately 40% of the entire energy is spent by just buildings and becoming a significant main energy consumptive element of the international structure.

Eleni S. Vergini,et. al,(2015) introduced the idea of ZEB and detail a modeling methodology of its functioning. Setting parameters that must be considered and categorizing ZEBs makes such an attempt. Energy management and smart control are having a significant role to play in a ZEB's smooth functioning, enhancing its performance and minimizing its consumption. The Fuzzy Cognitive Maps (FCMs) method is suitable for multi-parameter problems, for which mathematical modeling and computation have hard or sometimes impossible to solve.

Rizwan Bashir,et.al,(2017) introduced Smart buildings with the Internet of Things capabilities. They are becoming more popular. In this research, 22 pertinent papers were discovered and assessed through the SLR method. The findings of these studies were examined to identify the issues and possible solutions. Scholars and professionals will utilize this study article to conduct more study and development in this vital area.

Joud Al Dakheel,et.al,(2020) In this literature review proposed above, the concept and characteristics of such buildings are yet to be explicitly and not already defined. Meanwhile, an energy retrofit idea of the presently available buildings has been developed in order to assist in realizing the nearly Zero- Energy Building. as well as define the challenges of smart retrofit application in the future. The second component of the research focuses on the existing Key Performance Indicators for measuring smart building performance and goals. Smartness in buildings is grounded on the need for a quantitative measure to increase energy efficiency and technological innovation. Consequently, a list of nine common smart building performance indicators has been developed. The article identifies existing literature gaps as well as areas for future research.

Paul A. Torcellini and Sammy Houssainy,et.al,(2020), This paper examines simple metrics to assess the alignment of storage and renewable sources with building loads. This procedure can give insight into building design considerations, such as the application of flexible loads and best resource management and will become better with improved data and analysis methods.

Conclusion:

Finally, Net Zero Energy Buildings (NZEBs) are a critical response to addressing climate change. The incorporation of Energy-Efficient Measures (EEMs) and Renewable Energy Technologies (RETs) not only reduces energy consumption but places NZEBs at the center stage of sustainability pillars. This study highlights their interdisciplinarity, impacting policies and promoting innovations. Towards a sustainable tomorrow, NZEBs serve as guiding lights, transforming the built environment and leading the charge towards resilient, energy-efficient construction practices.

REFERENCES

- www.researchgate.net/publication/365132122_Concept_of_net_zero_energy_buildings_NZEB worldgbc.org/advancing-net-zero/what-is-a-net-zero-carbon-building/
- www.energy.gov/eere/buildings/articles/common-definition-zero-energy-buildings
- Energy Assessment guide for buildings, USAID ECOIII project, January 2010