

A Review Paper on Net Zero Energy Building

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Abstract – The main objective of this paper is to study and analysis the existing building and also to give an overview on an existing building to make it a perfect Net Zero Energy Building. It is much difficult to understand the overall concept of a net zero energy building. As all we know that the building has significant impact on the energy use and the environment which is turn effect on the development of the present era. In present the lack of conventional energy sources encourages in developing the NZEBs. According to the survey a major effect of building on the total worldwide energy consumption level i.e. around 40% of the total energy is consumed by only buildings and becoming a major primary energy consumptive part of the worldwide structure. The ZEB definition can be describing significantly the demand and fuel supply strategies and conversion accounting are appropriate to meet a ZEB goal.

Keywords: Energy Consumption, Energy Resources, Non-Renewable Energy Resources, Renewable Energy Resources, PV Solar Module

INTRODUCTION

The term of Net Zero Energy Residential building is defined as the building with zero net energy consumption i.e., the total amount of energy used by the building on annual basis is roughly equal to the total amount of renewable energy created on the site. The concept of a Net Zero Energy Building (NZEB), one which produces as much energy as it uses over the course of a year, recently has been evolving from research to reality. Currently, there are only a small number of highly efficient buildings that meet the criteria to be called "Net Zero". As a result of advances in construction technologies, renewable energy systems, and academic research, creating Net Zero Energy buildings is becoming more and more feasible.

1. Mansi Jain et al. (August 2017)

They studied the concept of zero energy building and implemented this at New Delhi under Niche Development. This paper aims to assess the governance context for adoption and uptake of NZEBs through niche formation in India by addressing the research question: **What is the**

state of governance in New Delhi regarding NZEB niche development? The results reveal that the governance context is only marginally supportive towards NZEB niche formation due to qualities of moderate extent, flexibility and intensity. The Governance Assessment Tool (GAT) and Strategic Niche Management (SNM) are used to analyze the New Delhi case. Data collection involved in-depth interviews with fourteen key stakeholders. Data were analyzed using the qualitative data analysis software (ATLAS).

2. Ming Hu et al. (June 2016)

They studied the art of Zero Energy Building. His work motivates us about the concept of ZEB. According to him, Net-positive design is one of the frontiers of architecture in the 21st century. The paper will begin with an overview of net-zero building's current status and explain the importance of promoting net-positive institution building. The author addresses the differences and similarities between net-zero and net-positive building. The paper uses net-positive design as defined by a European Commission 2012 report. There are three major drivers driving the rapid increase of net-zero building development. The first is energy saving incentives and economic return building owners can gain through the setting up high standard at the beginning. The second is the potential increased market value, the recognition of increased market value through green building practice and attention to a label such as net-zero energy building." (European Union, 2009). The third is the educational function, which is particularly valuable for institutional clients. They did the case study at Rochester Institute of Technology (RIT) that has constructed a new 88,000 gross square foot educational and research building on its Rochester, NY campus. The four-story building includes office, laboratory, classroom and meeting space. The building was constructed with levels of insulation and glazing-performance characteristics that exceed the minimum prescriptive requirements of the Energy Conservation Construction Code of New York State (ECCC) and ASHRAE Standard 90.1-2007 – Energy Standard for Buildings Except Low Rise Residential Buildings.

3. V. Sumateja Reddy et al. (September 2016)

They mainly focus on the net zero energy building movement in India. With a modest beginning of 9565 m² project area in the country in the year 2014 today (as on August 2016) more than 7 NZEB projects with a footprint of over 33,777 m² projected area is certified and fully functional in India. 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.

4. Reshmi Banerjee et al. (May 2015)

Wide 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 concept has been a progressive evaluation from other low energy building designs. Among these, the Canadian R-2000 and the German passive house standards have been internationally influential. India's first net zero building is Indira Paryavaran Bhawan, located in New Delhi. Using standard building techniques and energy cost modelling, zero energy homes can be very affordable to build.

5. Santosh D Jadhav et al. (June 2015)

As there is dramatic increase in global population, energy use has increased drastically. Today, buildings use approximately 40% of all energy consumed in the world. If we continue on this path of energy use in conjunction with population growth projections, with few new sources of fossil fuels, we could deplete all-natural resources within few years. The buildings sector has major opportunity to reduce environmental impact by incorporating energy efficient technologies in design, construction and operation of both new and existing buildings. Net zero energy buildings are more effective and advantageous, making up applications likely to expand and permitting better and more sustainable energy systems.

6. Elena Perlova et al. (May 2014)

They provide the concept of net zero energy building at 25th DAAAM International Symposium on Intelligent Manufacturing and Automation, DAAAM 2014. The acute problem of carbon dioxide emissions reduction into the atmosphere becomes more important due to the fact of the global climate change. Housing stock consumes 30 to 40% of all energy resources, according to various estimates. As the result, it is possible to get carbon dioxide atmosphere emissions reduction due to energy consumption reduction. The problem of housing stock energy efficiency improvement becomes very important. Transition to low energy consumption buildings construction becomes a trend which in the nearest future will transform to the task of Applied Research in the field of design and construction. Such exploration object is to design buildings with zero energy consumption or close, which is planned construct on the site of the Polytechnic University. The novelty of the project consists in an integrated approach of the house design, which will be entirely autonomous and independent from the urban networks.

7. F. Garde et al. (October 2014)

The International Energy Agency (IEA), through the Solar Heating and Cooling program (SHC) Task 40 and the Energy Conservation in Buildings and Community Systems program (ECBCS, now named EBC) Annex 52, works towards developing a common understanding and setting up the basis for an international definition framework for Net Zero Energy Buildings (Net ZEBs). One of the subtasks of this program –Sub Task C focuses benchmarking the Net ZEBs around the world to identify the innovative solutions sets that makes up this new type of building. The overview of the Net ZEBs carried out in the framework of Subtask C of the IEA Task 40/Annex 52 has led to the identification of new ways of design for this innovative type of building. The building of the future must be bioclimatic with a passive design approach [6]; its width is shorter (12m max) compared to conventional buildings in order to improve cross natural ventilation and daylighting. Its envelope should be not only dedicated to thermal insulation but becoming multi-functional to protect from the outside environment while drawing from free sources of energy such as wind, sun, etc. Ceiling fans play a crucial role and can be used whatever the climate in non-residential buildings for ensuring summer thermal comfort conditions up to temperature around 30°C.

8. Bhavin K. Kashiyan et al. (February 2013)

They studied about the concept of Zero Energy Building. His work elaborated that the buildings consume approximately 40% of the world's primary energy use. The energy performance is an important issue in the context of climate change, scarcity of energy resource and reduction of global energy consumption. An energy consuming as well as producing building, labeled as the Zero Energy Building (ZEB) concept, is seen as one of the solutions that could change the picture of energy consumption in the building sector, and thus contribute to the reduction of the global energy use.

9. Joshua Kneifel et al. (September 2012)

The purpose of this report is to create a whole building energy simulation that will replicate the NZERTF (Net Zero Energy Residential Test Facility) design to estimate its energy performance, both in aggregate as well as at the individual occupant and equipment level. The National Institute of Standards and Technology (NIST) received funding through the American Recovery and Reinvestment Act (ARRA) to construct a Net Zero Energy Residential Test Facility (NZERTF). The initial goal of the NZERTF is to demonstrate that a net-zero energy residential design can "look and feel" like a typical home in the Gaithersburg area.

10. Karsten Voss et al. (May 2010)

They studied about the zero-energy building. Taking into account the energy exchange with a grid overcomes the limitations of energy-autonomous buildings with the need for seasonal energy storage on-site. This paper reports on the background and the various effects influencing the energy balance approach. The zero-energy building is often presented as a maximum goal in the political context. In this framework, the net zero-energy building concept also describes the balance for a single building. There is no question that there can also be "net zero-energy building quarters" or "net zero-energy towns". They do not consist of a collection of net zero-energy buildings but profit from the compensation of supply and demand between individual buildings and from the economy of scale.

11. A.J. Marszal et al. (December 2010)

They studied about the concept of Zero Energy Building. His Studies elaborated that the most important issues that should be given special attention before developing a new ZEB definition are: (1) the accepted renewable energy supply options. (2) the balancing period. (3) the

connection to the energy balance. This paper focuses on the review of the most of the existing ZEB definitions and the various approaches towards possible ZEB calculation methodologies. It presents and discusses possible answers to the above-mentioned issues in order to facilitate the development of a consistent ZEB definition and a robust energy calculation methodology. Based on the literature review, the paper identified and presented a set of parameters that differ between ZEB definitions and which should be elaborated before defining a harmonized ZEB understanding. The study indicated that the metric, the period and the types of energy included in the energy balance together with the renewable energy supply options, the connection to the energy infrastructure and energy efficiency, the indoor climate and the building-grid interaction requirements are the most important issues. Moreover, this paper discussed possible solutions for the implementation of the listed parameters and indicated their advantages and disadvantages.

12. Zheng O'Neill et al. (July 2009)

As part of the World Business Council for Sustainable Development's (WBCSD) energy efficiency in building project, the authors have been involved in modelling various technology options for different building market segments to reach net-zero energy goal. This paper describes the modelling of single-family residence in US southeast as a case-in point to illustrate the most common strategies that are considered during net-zero energy building (NZE) design stage, ease of modelling these strategies using different tools, and issues of input/output quality control. The paper has shown that it is possible to reach the net zero energy building goal with existing technologies and looking at the energy consumption of the building holistically. A considerable reduction in energy consumption is achieved by using high efficiency technologies and the remainder of the energy (about 30%) is provided by the renewable technology options.

13. Patxi Hernandez et al. (December 2009)

They provide the concept of zero energy building. Their work explains concept of 'net energy' as used in the field of ecological economics, which does take into account the energy used during the production process of a commodity, is widely applied in fields such as renewable energy assessment. A definition of life cycle zero energy buildings (LC-ZEB) is proposed, as well as the use of the net energy ratio (NER) as a factor to aid in building design with a life

cycle perspective. This paper has provided a model and definition of a simplified methodology to account for embodied energy together with energy use in operation and reclaims the original concept of 'net energy' to define a life cycle zero energy building. A LC-ZEB (Low cost zero energy building) is defined here as a building whose primary energy use in operation plus the energy embedded in materials and systems over the life of the building is equal or less than the energy produced by renewable energy systems within the building.

14. Masa Noguchi et al. (July 2008)

They studied the concept of Zero Energy Building. Their work aimed to bring "the public and private sectors together to develop homes that combine resource and energy efficient technologies in order to reduce their environmental impact". In this paper, a net zero-energy home is defined as a house that consumes as much energy as it produces over a year. The Eco Terra housing prototype presented in this paper was designed to be energy-efficient to minimize negative impact on environment. Moreover, the house provides its occupants with comfortable and healthy indoor living environment and produces as much energy as it consumes on an annual basis. The analysis indicates that the house experiences nearly net-zero energy consumption when it comes into operation.

15. George A. Mertz et al. (June 2007)

They impart the concept of zero energy building. He describes the method of method of performing and comparing lifecycle costs for standard, CO₂-neutral and net zero energy buildings. Costs of source energy are calculated based on the cost of photovoltaic systems, tradable renewable certificates, CO₂ credits and conventional energy. The paper identifies the least-cost net-zero energy house, the least-cost CO₂ neutral house, and the overall least-cost house. The methodology can be generalized to different climates and buildings. They have done a case study of University of Dayton student housing, the results show that all new houses built by the University of Dayton should include energy efficient water heaters, 6-inch thick SIPs with a Heat Recovery Ventilator, and double-pane, low-e, argon-filled, windows. Solar water heating and efficient HVAC equipment (AFUE = 0.966, SEER = 16) are cost-effective for a net-zero energy house and net-zero CO₂ house with TRCs, but not for a house that is purchasing conventional energy or conventional energy and CO₂ credits. Six-inch thick SIP walls with a Heat Recovery Ventilator and double-pane, low-e, argon filled windows are cost effective for all energy and CO₂ constraints. Energy

efficient refrigerators and clothes washers are cost-effective for a net-zero energy house, but not for a house with TRCs, carbon credits or conventional energy.

16. P. Torcellini et al. (June 2006)

They furnish the concept of Zero Energy Building. His work suggested that the four well-documented definitions – net zero energy sites, net zero source energy, net zero energy cost, and the net zero emissions- are studied, Pluses and minuses of each are discussed. This study shows the design impact of the definitions used for ZEB and the large definitions between these definitions. A source ZEB definition can emphasize gas end uses over the electric counterparts to take advantage of fuel switching and source accounting to reach a source ZEB goal. Conversely, a site ZEB can emphasize electric heat pumps for heating end uses over the gas counterpart. For a cost ZEB, demand management and on-site energy storage are important design considerations, combined with selecting a favorable utility rate structure with net metering. An emissions ZEB is highly dependent on the utility electric generation source. Off-site ZEBs can be reached just by purchasing off-site renewable energy—no demand or energy savings are needed.

CONCLUSION

In conclusion, we decided that for making Zero Energy Building, use of solar energy is the best energy source in regards to saving energy and cost efficiency. After brainstorming and researching we came to an agreement that photovoltaic solar panels are the best solution for generation of the electricity in a residential building. The installation of the solar panels initially would be costly, but in the long run the owner of the building would save money on their energy bill. More importantly, in the scarcity of natural resources we would be providing a self-sufficient, energy saving, non-polluting, Zero Energy building. The hollow bricks to be used for the construction of the building walls because they are, they are environmentally friendly, are good thermal and sound insulator which maintains comfortable inside temperature. High reflectance terrace tiles and rock wool insulation of outer walls may be used in order to maintain the inside temperature. UPVC windows with hermetically sealed double glass have to be used in order to achieve the Net Zero Energy concept. Grass paver blocks to be used for the pavement around the building. Reduction in water have been achieved by the use of low-discharge water fixtures, recycling of waste water through sewage treatment plant, rainwater harvesting, use of geothermal cooling for HVAC System.

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