



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 8.699**

**Volume 14, Issue 4, April 2025**

# Concept of Zero Energy Building

**Soham Bhandwalkar, Sahil Harne, Yash Kokare, Atharava Khadsare, Saurabh Jawalkar,  
Saurabh Jadhav, A.N.Ansari**

Student, Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

Student, Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

Student, Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

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Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

**ABSTRACT:** A zero energy building (ZEB) is designed to produce as much energy as it consumes over a year, achieving a net-zero energy balance. This concept integrates energy-efficient design, renewable energy sources, and advanced technologies to minimize energy use. Key strategies include optimized building orientation, high-performance insulation, energy-efficient appliances, and the incorporation of solar panels or wind turbines. The goal is to reduce reliance on fossil fuels, lower greenhouse gas emissions, and promote sustainability in the built environment. ZEBs contribute to climate resilience and provide economic benefits through reduced energy costs.

**KEYWORDS:** Zero Energy ,Good Efficiency, Solar pannel efficiency

## I. INTRODUCTION

- Building have significant impact on energy use and the environment commercial and residential building use almost 40% of the primary energy and approximately 70% of the electricity in the india

### OBJECTIVES:

1. **Energy Efficiency:** Design and construct buildings that use as little energy as possible through efficient architectural design, insulation, and energy-efficient systems for heating, cooling, lighting, and appliances.
2. **Renewable Energy Generation:** Ensure that the energy required by the building is produced from renewable energy sources such as solar panels, wind turbines, or geothermal systems.
3. **Minimized Carbon Footprint:** Reduce the carbon emissions associated with energy consumption by decreasing reliance on fossil fuels and non-renewable energy sources.
4. **Cost Savings:** Lower operational energy costs for building occupants over the long term by using energy-efficient systems and generating renewable energy on-site.

## II. LITERATURE SURVEY

**1<sup>ST</sup> PAPER(2018) by Saravan Devraj and N Kapilan Concluded that :-**

The zero energy concept will reduce global warming and helps to retain the nature. The specialty of the zero energy building, Prana project, is that the whole building is made keeping sustainability and green building in mind.

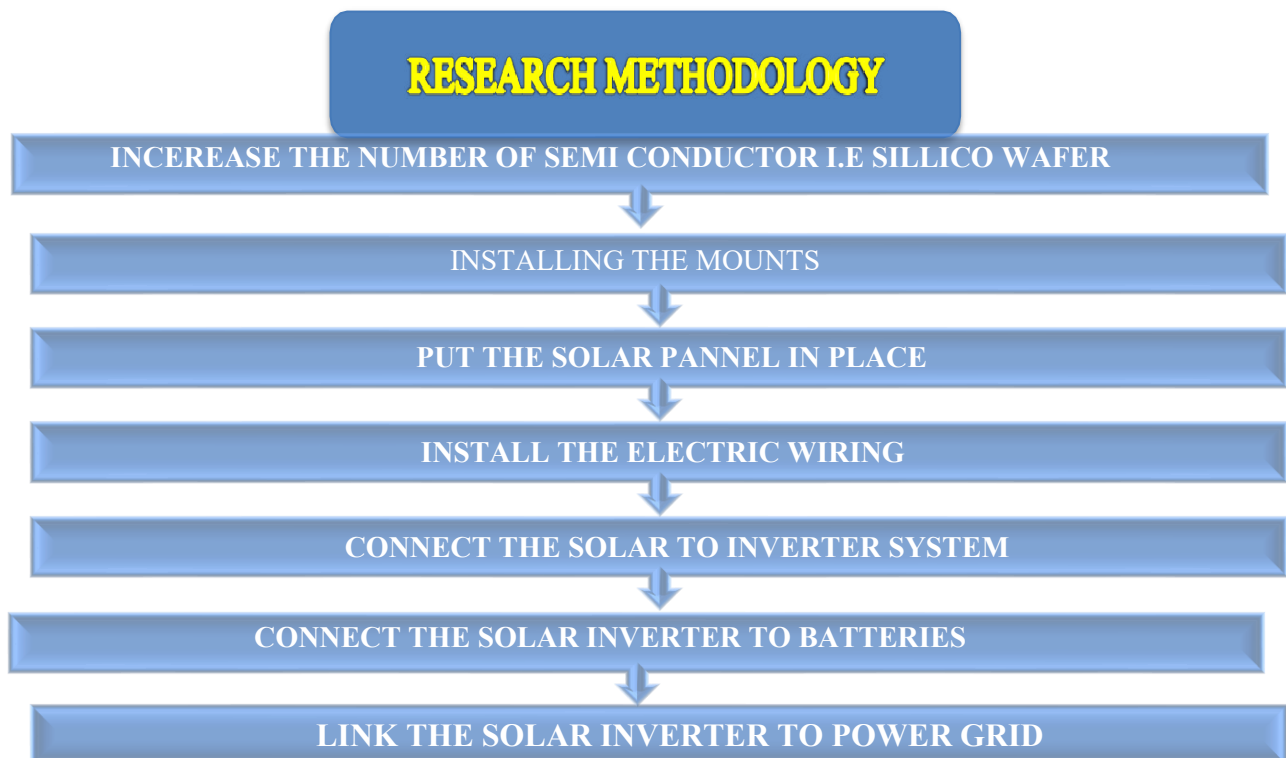
**2<sup>ND</sup> PAPER(2023) by Tabbi Wilberforce concluded that :-**

Zero energy structures are designed to limit the energy consumption of a building as well as improve the energy efficiency of the entire structure. This novel construction evolution is perceived by the scientific community as the future for sustainable buildings. The concept is currently under various developmental stages subject to the country being considered

3<sup>rd</sup> PAPER (2023) by LAP LAMBERT Academic Publisher concluded that :-

Zero energy Buildings are dynamic environments that respond to their occupants' changing needs and lifestyles. "Zero Energy building" can be achieved using intelligent technology and that this "energy building" will provide a tangible and significant return on investment.

### III. METHODOLOGY



Selection of semi conductors was carried out on the basis of the literature review Silicon wafers are by far the most widely used semiconductors in solar panels and other photovoltaic modules. investigations into nearly zero energy building started around the 2000 Presently, many analytical and numerical investigations are being championed mainly to ascertain the prospects of nearly zero energy building [Key challenge that must be critically evaluated is an in-depth investigation into recent buildings from their energy consumption to economic perspective in tandem to their impact on the environment This investigation with the aid of science direct and Scopus thoroughly searched the latest trends in zero energy buildings and zero energy buildings between 2000 and 2020. The investigation from the over 2000 articles gathered focused on the impact of zero energy buildings as well as climate change, holistic assessments of buildings and technical evaluation of buildings considering their energy requirements. The scope of search was however narrowed than to 215 articles after series of screening. The factors considered during the screening process were the characteristics of the buildings, its sources of energy generation as well as the location. It is important to have a fair idea of a global interpretations to zero energy buildings. Principle of zero energy structures was first presented in 1976. Zero energy buildings was first developed at the Technical University of Denmark by Esbensen and Korsgaard during an investigation into the utilization of solar energy for domestic purposes during the cold season Several definitions for zero – energy buildings have been presented in many articles since 1977 A detailed explanation to the various definitions for zero energy buildings was captured in literature but it failed to show consistency in the definition of zero energy buildings by various authors . Not only does the absence of a comprehensive definition impact the ability to create an incontrovertible profile for the wider economy and, ultimately, a mutual goal for a global energy-efficient construction strategy, but it also poses serious problems in evaluating various strategies from different backgrounds . Among countries, regions as well as communities, both descriptors as well as criteria of the zero energy structures differ, such as almost the zero energy building in the Europe [, net ZEB in the United States of America zero



emission building in Australia and zero carbon emission building of the C40 Cities Climate Leadership Group While these concepts differ, their intended objectives are to reduce fossil commodities usage, make maximum utilization of sustainable energy and exert energy-saving capacity for construction. On the basis of the European Union European Data Protection Board (EPBD), near- zero energy building energy efficiency should be exceptionally high and energy usage from on-site should be zero or very low]. The Sustainable Building Institute Europe has defined 10 huge obstacles impeding the principles zero energy structures becoming realistic as well as relevant According to cost-optimality concept of the directive, primary energy usage of  $>0 \text{ kWh}/(\text{m}^2 \cdot \text{y})$  [47] is proposed almost as the total cost of zero energy building. Even under such conditions, no standard definition of the zero-energy building in EU countries has been specifically configured.

**step 1** :Finding best semi conductors.: The best semiconductors for solar panels are chosen based on efficiency, cost, abundance, and stability. Silicon (Si) – The Classic : Crystalline silicon (monocrystalline & polycrystalline) Efficiency: ~15–23% (lab up to ~27%)Pros :Abundant Non-toxic Stable and long-lasting

**step 2** : **Adding heat Resisittance material:** thermoplastic polymer sheet that encapsulates solar cells or PV. In layman's terms, these sheets are made of specialized co-polymers to prevent dirt, water, and humidity from reaching the solar cell.

**Step 3:** An increase in semiconductors in solar panels enhances their efficiency, power output, and durability by allowing better light absorption, reduced energy loss, and improved performance in varying conditions.

#### Step 4 : ENERGY CALCULATION FOR NORMAL VS ADVANCE SOLAR

Appliance	Power Consumption	Normal Solar Panel (18-20% efficiency)	Advanced Solar Panel (22-25%+ efficiency)	Benefits of Advanced Solar
Refrigerator	100–200W (24/7)	⚠ May struggle on cloudy days	✅ Reliable year-round	Stable power, less reliance on grid
Washing Machine	500–1200W (intermittent)	⚠ May need grid/battery support	✅ Handles loads better	Efficient high-load handling
LED Lights	5–15W each	✅ Fully supported	✅ Fully supported	Longer light runtime on cloudy days
Ceiling Fan	60–75W	✅ Runs well during sunlight hours	✅ Consistent performance	Runs longer with stored power
Television	80–200W	✅ Usable, but drains power at night	✅ Stable use even in evenings	Better battery recharge rate
Laptop	50–100W	✅ Easily supported	✅ Easily supported	Charges faster via solar
Microwave Oven	800–1500W	❌ High strain on inverter/battery	⚠ Limited use possible	Short bursts more feasible
Air Conditioner	1000–3000W	❌ Not practical without heavy-duty system	⚠ More feasible with good planning	Allows cooling off-grid
Water Pump (1 HP)	750W	⚠ Midday use only	✅ Full daytime operation	Improved water access
Electric Kettle	1500W+	❌ Very limited use	⚠ Possible with timing/storage	Can be used occasionally
Router/WiFi	10–30W	✅ Fully supported	✅ Fully supported	Internet uptime even in outages

#### IV. CONCLUSION

Choosing **advanced solar panels** over **normal solar panels** is a smart long-term investment for homes, especially if you rely on solar power to run essential appliances. While normal panels can support basic needs, **advanced solar**

panels provide more efficiency, reliability, and flexibility — making them ideal for both on-grid and off-grid setups

**REFERENCES**

1. U.S. Department of Energy (DOE): The DOE offers resources on Zero Energy Buildings, including guidelines and case studies. The DOE Zero Energy Ready Home program is a key initiative in promoting the adoption of ZEBs in the residential sector.
2. Reference: DOE Zero Energy Ready Home
3. International Living Future Institute (ILFI): The ILFI's Living Building Challenge is one of the most rigorous certification programs, often aiming for net-positive energy (producing more energy than consumed) and pushing beyond ZEB standards.
4. Reference: Living Building Challenge
5. European Union's Energy Performance of Buildings Directive (EPBD): In the EU, regulations on Nearly Zero Energy Buildings (NZEB) have been established, requiring all new buildings to meet very high energy performance standards, with significant portions of energy needs being covered by renewable sources.
6. Reference: EPBD Directive
7. Zero Energy Project: This is a valuable resource for builders, homeowners, and industry professionals interested in learning more about zero energy construction, with case studies, best practices, and financial tools.



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