

## Energy Efficient / Green Buildings and Their Related Issues – A Literature Review

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### **Abstract**

*The construction industry in India, majorly consist of two sectors namely Real estate and Urban development sectors. Annual GDP growth rate of construction industry in India is decreased by 5.2% as compared with 2018. The slowdown of India GDP provides an opportunity for researchers, professional and others to rethink conventional method of designs, techniques and trends in construction industry. The main objective of the paper is to comprehensive the benefits of employing green building standards, challenges, financial benefits, etc., of energy efficient building and their related issues. A green building generates less waste and provides a healthy living environment for the occupants. It is government duty to create more awareness regarding the energy efficient building and also encourage the stakeholders by means of providing subsidies. The green building / energy efficient building application in India have been exciting and challenging as well. It will ultimately serve to improve not only the energy performance of buildings but will also assist energy conservation and natural resources by increased recovery and recycling of building materials, techniques and technology.*

**Keywords:** Energy Efficient/Green Buildings, Benefits, Financial Status, Assessment Methods

### **1. Introduction**

The construction industry in India, majorly consist of two sectors namely Real estate and Urban development sectors. The real estate sector contains Residence, Office, Hotels etc., and urban development sector covers Water Supply, Transport, Sanitation etc., Construction market is expected to emerge as third largest globally by 2025. But, annual GDP growth rate of construction industry in India is decreased by 5.2% as compared with 2018. The slowdown of India GDP provides an opportunity for researchers, professional and others to rethink conventional method of designs, techniques and trends in construction industry. And also, construction sector in India emits about 22% of the total emission of Co<sub>2</sub>. Out of 22% emission, 80% are resulting mainly from the products/ Industrial process of four intensive building materials such as Steel, Cement, Bricks and Lime. According to German Watch's CCPI (Climate Change Performance Index) India ranked as 14<sup>th</sup> in 2018 and 11<sup>th</sup> in 2019. It should be noted as more vulnerable and must to improve the performance of renewable energy to reduce GHG (Green House Gas) emission by 2030.

Energy efficient building or Green building is the best practice of constructing or modifying structures to be environmentally responsible, sustainable and resource efficient trough out their life cycle. Green building accounts for improving healthy environment, productivity and

reducing the environmental degradation, pollution etc., by 2030. It shows more significance towards the sustainable development of energy efficient techniques and green technologies. The main objective of the paper is to comprehensive the benefits of employing green building standards, challenges, financial benefits, etc., of energy efficient building and their related issues. A green building generates less waste and provides a healthy living environment for the occupants. It is government duty to create more awareness regarding the energy efficient building and also encourage the stakeholders by means of providing subsidies.



**Figure 1. General stakeholder groups in residential construction**

Utterback (1994) and Rogers (1995) investigated the housing markets which are historically localized and local housing industry sometimes prohibits the need of innovation mainly in the technology process. Similarly, stakeholders participation decreases earlier in the potential to spread the risk of innovation and to maximize the pool for investments. So the researchers investigated the development, adoption, technological innovations in the residential construction industry. This literature identifies general determinants of innovation and diffusion such as organizational structure, organizational culture and decision process, market context, industry characteristics, communication channels and social networks, and technical and economic attributes of the innovation.

## **2. Sustainable Development**

Human activity growth has elevated the sustainability development in modern times. Sustainability in real estate sector gives more importance towards the energy conservation and also includes the resource usage, environmental impacts etc., (Roy and Gupta, 2008). For promoting the healthier living for people, adverse effects of the construction and its operation on the environment should be maintained by introducing eco-friendly or green housing homes (Times of India, 2014). Green building practices were introduced in the early 19<sup>th</sup> century

(Cassidy, 2003). Buildings are one of the heaviest consumer of natural resources and emission of green house gases (Yi-Kai, et. al., 2010).

Global warming and climatic changes were caused by anthropogenic green house gas emission, which should be avoided and take immediate action for future generation (Taleb and Sharples, 2011). Building may also generate harmful atmospheric emission (Alnaser et. al., 2008). Indian construction industry having fast growth rate of 10% per year over last 10 years (Indian Green Building Council, 2013). India's economic growing demand is being met by infrastructural development such as city transport, road networks, water board, sanitation etc., Due to urban infrastructure enlargement which requires green and sustainable techniques for building infrastructure (Ramesh and Khan, 2013). Indian Green Building Confederation of Indian Industry (CII), initiates green building concept in India by means of offering advisory services to the industry on environmental aspects and practices (Times of India, 2015).

### **3. Benefits of Energy Efficient Buildings**

Growing awareness of environmental aspects and demand on green building worldwide shows that, the status quo as it exists in the construction industry simply cannot go on. The industry must, and is, changing. In the United States, buildings are responsible for 72% of electricity consumption, 39% of energy use, 35% of carbon dioxide emissions, 40% of raw material usage, 30% waste output and 14% potable water consumption. (USGBC, 2009)

The benefits of adopting green building concept from the literature are discussed as follows:

1. Environmental Benefits
  - a. Enhance and protect eco-system and biodiversity
  - b. Energy Consumption reduction
  - c. Water Consumption reduction
  - d. Air Pollution reduction
  - e. Increased Material Efficiency
  - f. Handling Household Waste
  - g. Conserve natural resources
2. Economic Benefits
  - a. Short Term Benefits
  - b. Long Term Benefits
  - c. Added Project Value
3. Health Benefits

#### **3.1. Financial Status**

Kumar (2013) targeted moderate and low income group of population in Ernakulam city of central Kerala for this study. It focuses on the green homes under development stage of the buildings. It was observed that, people were unaware & unveiling to make heavy investments in

constructing green buildings. The study suggests that housing finance institutions, policy makers and other lending agencies, should insist on compliance with green standards.

Yu et. al. (2011) researched on green retrofitting, benefits and cost of existing commercial buildings in Singapore. The findings revealed that, retrofit project represents 3% of the current cost of construction for new commercial buildings. The savings in energy consumption are significant & represent 10 to 20% of operating expenses of commercial properties.

U.S. Green Building Council (2009) conducted a survey on Regional green building which analysed the post occupancy performance of green buildings conducted for 12 consecutive months. It was found that energy performance was better than conventional buildings. The study noted the green house gas emission in green building, less water usage, reduced health issues, sick time, high occupant satisfaction with respect to indoor air quality & lighting.

### **3.2. Financial Benefits**

- Reduction of operating costs
- Reduction in life cycle energy costs
- Enhance asset value and profit
- Increased employee productivity and satisfaction
- Optimization of life cycle performance
- Less absenteeism / High productivity
- Less health related costs such as insurance premiums
- Reduced litigation risks due to improved indoor air quality
- Staying ahead of regulations
- Reduced employee turnover
- Increased economic life of the facility
- Tax abatements at the federal, state and local level
- Federal grants used as enticements to promote green building (McKinsey and Company, 2009)

Additionally, green buildings function more efficiently by design and produce financial benefits of:

- Operating cost reduction of 8-9%
- Building value increase of 7.5%
- Return on investment improvement 6.6%
- Occupancy ratio increase of 3.5%
- Rent ratio increase of 3% (USGBC, 2009a)

### **3.3. Market Benefits**

- Creation of compatible market value
- Occupancy high rates
- Lesser vacancy period
- Satisfy tenants growing demands
- Company recognition
- Least advertising costs

### 3.4. Industry Benefits

- Positive impact on the Construction Industry
- Allow technology to become part of the green building process improving the outcome of projects
- Allow professionals to become more qualified, educated, integrated
- Allow opening other countries and selling green building know-how
- Help other industries to benefit from new opportunities
- More job vacancies
- Increases funding Agencies / Grants

## 4. Negative Impacts

The numbers below are enough to demonstrate that there is indeed a huge negative impact on the environment due to existing buildings. In the United States, buildings are responsible for:

72% of Electricity Consumption

39% of Energy Use

35% of Carbon Dioxide Emissions

40% of Raw Material Usage

30% Waste Output

14% Potable Water Consumption (USGBC, 2009)

## 5. Building Environmental Assessment Methods

Globally, large numbers of rating tools have evolved in a number of regions that are influencing property markets towards more sustainable practices. They are based on local climates and geographical conditions (Winter, 2008; Elias and Lin, 2015). The predominant ones are:

1. BREEAM
2. LEED
3. CASBEE
4. NABERS
5. GRIHA

Morri and Soffietti (2013) found that higher green premium in green building investment is due to factors viz. cost saving, high occupancy rate, cap rate reduction, and green labelling. Usman and Gidado (2015) pointed economic, social, technological and cultural factors as drivers for green building adoption. Some of the drivers to green building construction mentioned by various authors are presented here:

1. Consumer Demand
2. Energy Cost Increase
3. Superior Building Performance
4. Positive Publicity

5. Incentives
6. Codes and Regulations
7. Green Certification Programs
8. Lending Industry
9. Risk Management
10. Green Practice

## **6. Challenges in Implementing Green Buildings Concept**

The major barrier or challenges to implement green building concept were discussed by Choi (2009); Issa, Rankin and Christian (2010); Zhang, Platten and Shen (2011). The slow recovery of long term cost saving hinders the progression of green building development as identified by Issa et.al. (2010).

1. Higher perceived First Cost
2. Lack of Knowledge
3. Lack of Widely used Standards
4. Scarcity of Products and Expertise
5. Lack of Implementation of Energy Conservation Building Code (ECBC)
6. Lack of Seriousness and Leadership
7. Awareness for Global Marketing Needs
8. Addressing with Economics Perspective
9. Risk and Uncertainty
10. Lack of Experienced Workforce
11. Lack of Effective Enforcement of Policies
12. Lack of Financial Incentives
13. Process of certification

## **7. Recommendations**

The review of literature revealed that much efforts has been made to research area of “Benefits of Green Buildings”, “Green Building rating Systems”, “Barriers and Challenges in adopting Green Building concept” in India as well as outside India. The main objective of this review paper is to analyse the latest literature related to many aspects of housing and residential construction.

1. Educational institutions can carry out more researches to identify the issues and solutions in adopting Green building design and construction.
2. LEED and GRIHA should step forward and in collaboration with the educational institutions for creating awareness.
3. Government should make efforts in formulation strategies and policies which mandate builders to adopt features of green building in the construction projects and give incentives as a motivator for the builders and buyers for choosing

4. Case studies can be conducted to assess the performance of Green Building constructed in a city.
5. A study can be undertaken to find out the financial and environmental benefits of Green buildings.

## 8. Conclusion

The green building / energy efficient building application in India have been exciting and challenging as well. It will ultimately serve to improve not only the energy performance of buildings but will also assist energy conservation and natural resources by increased recovery and recycling of building materials, techniques and technology.

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