GREEN BUILDINGS AND THEIR BENEFITS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

CARAIMAN ADRIAN-COSMIN
Ph.D. STUDENT, POLITEHNICA UNIVERSITY OF TIMISOARA, TIMISOARA, ROMANIA,
e-mail: adrian_caraiman@yahoo.com

DAN SORIN
Ph.D., POLITEHNICA UNIVERSITY OF TIMISOARA, FACULTY OF CIVIL ENGINEERING, CIVIL ENGINEERING AND SERVICES DEPARTMENT, TIMISOARA, ROMANIA,

PESCARI SIMON
Ph.D., POLITEHNICA UNIVERSITY OF TIMISOARA, FACULTY OF CIVIL ENGINEERING, CIVIL ENGINEERING AND SERVICES DEPARTMENT, TIMISOARA, ROMANIA,
Corresponding Author's Email: e-mail: adrian_caraiman@yahoo.com

Abstract

In this article we set out to present the benefits of green buildings in the context of sustainable development after studying the specialized literature. In the context of sustainable development, there is a lot of evidence around the world that green buildings bring multiple benefits; they provide some of the most effective means to achieve a number of global goals, such as tackling climate change, creating sustainable and prosperous communities, and stimulating economic growth. In recent decades, there has been a growing concern about environmental issues as well as the consumption of energy and resources in the construction sector. Green buildings or sustainable development are a response to growing environmental concerns.

The green building is the practice of building or rehabilitating structures to be energy and resource efficient throughout the life cycle of a building, from site planning to construction, operation, maintenance, rehabilitation and demolition/decommissioning. Green buildings use natural resources efficiently, in the sense that the quantity is reduced and thus their waste is reduced, which leads to the reduction of both utility bills and environmental impact. However, the idea that these benefits range from being fairly predictable (energy, waste and water savings) to relatively unsafe (productivity/health benefits) must still be accepted. So energy and water savings can be predicted with reasonable accuracy, measured and monitored over time; while, productivity and health-related benefits are much less accurately understood and much harder to predict with precision.

Keywords: *sustainable development, life cycle cost, low cost, sustainable buildings, life cycle assessment*

JEL Classification : *A10, A12, D24, L70, L74*

1.Green buildings in the context of sustainable development

Green buildings, although essential for climate change mitigation, present themselves with a huge investment deficit (Debrah et al., 2022)[4]. In the opinion of the authors, green finance, for green buildings, is a viable option for reducing the investment gap in green buildings. But, nevertheless, despite the benefits that green finance in green buildings (GF-in-GBs) can bring, however, limited attention has been paid to this area of research over time.

Considering that climate change is a global challenge, as the above-mentioned authors said, it is the buildings that are fuelling this challenge by summing up 35% and 38% of global energy consumption and carbon emissions, respectively; this undoubtedly underscores the need to build green buildings. Thus, in the opinion of the authors, green buildings are buildings that, in their design, construction or operation, reduce or eliminate negative impacts and can create, at the same time, positive effects on the climate and our natural environment, and in the end green buildings retain precious natural resources and improve the quality of life of all of us.

Due to the benefits brought, in terms of sustainability, as a result, green buildings have attracted increased attention globally, which has obviously led to a significant number of studies (Darko&Chan, 2016)[2]. But, we are somewhat of the same opinion as Debrah et al., (2022)[4], quoting the authors Sokolowski et al., (2019)[8], that yet green buildings will represent only a fraction of the total investment in the construction of buildings by the year 2030. Moreover, in 2019, for example, global investments in green buildings accounted for only $148 billion out of total investment of $5.6 trillion in buildings (Debrah et al., 2022)[4]. As a result, as the authors mention (Debrah et al., 2022)[4], in order to close this investment gap in green buildings, it is necessary to mobilise innovative financing, such as, for example, green finance, in order to accelerate the development of green buildings in this way. Thus, governments around the world are striving or should strive to promote the development of green finance in green buildings (GF-in-GBs), as claimed by the authors Debrah et al., (2022)[4], quoting Tan, (2019).

Sustainable/ecologic/green finance refers to financial instruments that support the transition to a climate-resilient economy, thus enabling various initiatives such as environmental protection through greenhouse gas emissions (GHG), reducing energy consumption, and developing climate1-resilient infrastructure. As mentioned above, the development of green financing in green buildings (GF-in-GBs) provides a great opportunity to fill the investment gap in green buildings. It could also help to find solution to certain barriers related to the costs of green buildings, as claimed by the authors Debrah et al., (2022)[4], quoting the authors Yudelson (2009) and Darko&Chan (2017)[3]. But nevertheless, in relation to sustainable finance, as the authors Debrah et al., (2022)[4] also mention, it still lacks a systematic review of existing knowledge because previous revisions have focused either on green buildings or on sustainable finance in isolation, separately.

In recent decades, there has been a growing concern about environmental issues as well as the consumption of energy and resources in the construction sector. Green buildings or sustainable development are a response to growing environmental concerns (Khoshbakht et al., 2017)[6]. At the same time, the author agrees with the definition of Yudelson (2010); the latter defining the green building as "a high-performance property that takes into account and reduces the impact on the environment and on human health." However, in the green architecture, however, more obstacles and barriers seem to be encountered. Thus, with regard to the above, Gou et al., (2013)[5] mentioned some of the most important topics in the green/ecological building market, namely availability as well as some cost barriers, such as higher design and execution costs, additional search costs for green alternatives and certification processes, a period longer than 20 years of return on investment as well as a difficulty in defining quantifiable requirements during the procurement process. As a result, as the authors note, the additional costs and risks associated with green/ecological design technology may thus initially discourage investors from engaging in certain environmental attributes. Finally, Khoshbakht et al., (2017)[6], quoting Hwang & Tan (2012), argue that ambiguity of the real costs and benefits is actually a major impediment to the development of green buildings.

In the field of construction, cost-benefit analysis is a quantitative method of economic analysis that assesses the profitability and return on investment for alternative design options (Khoshbakht et al., 2017)[6]. In the authors' opinion, similar to traditional financial strategies and performance evaluations/measurements, cost-benefit studies in the case of green buildings, for example, examine the correlations between green strategies and environmental performance in order to discover the relationships between costs and benefits in order to make the best decisions. Thus, in studies on green buildings, the connections between green strategies and building performance are examined to verify the existence and close connection between certain variables, such as natural ventilation strategies and thermal comfort performance. However, cost-benefit studies aim to identify the connections between the costs of green buildings as a result of environmental strategies and benefits for achieving certain environmental performances. In other words, the additional costs of green buildings are assessed against the additional financial benefits.

In other news, quoting Greef et al., (2004), the authors Khoshbakht et al., (2017)[6] mention the fact that in a building, the quality of working environments and comfort have a great influence on the productivity and well-being of the occupants in it; so that higher employee productivity in an entity, for example, means, or should, in fact, mean greater financial benefits for that entity, as the authors said quoting Fisk (2000). But, nevertheless, we are also of the opinion that it should also be taken into account that the monitoring and management of the quality of the indoor environment, using different sensor devices and certain control strategies, actually requires the purchase of certain specific equipment, which implicitly leads to higher management costs for that building. Finally, as the authors said, it can be said that in a cost-benefit analysis, the additional costs are assessed in relation to the financial gains resulting from the increase in the productivity of the employees of that entity.

In general, the costs of green buildings can be divided into two categories: pre-construction costs and post-construction costs. Pre-construction costs include low costs and high costs. Low costs are costs related to design, commissioning and documentation fees (Khoshbakht et al., 2017)[6]. Higher or consistent costs are the costs related to construction, construction materials and execution services, respectively. Post-construction costs are the operating costs of buildings, including costs relating to energy consumption, water use, maintenance and management of buildings. On the other hand, the benefits include different savings and financial gains, both during the construction and post-construction phases, such as the higher value of buildings in the real estate market, higher rental income, fewer vacancies, different marketing opportunities resulting from social benefits, lower taxes on carbon emissions, greater energy savings, fewer sick leave and higher productivity for the occupants of those buildings, respectively.

As the authors said, we are also of the opinion that it is important to identify the connection between the interests of the parties involved and the cost-benefit assessments. In this respect Bordass (2010)[1], with regard to the different interests of the parties involved in terms of the cost variables throughout the whole life cycle (WLC) of green buildings, mentioned that for developers, those who bear the costs of purchasing land, designing and constructing a building, only the market value of the building at the time of completion of the project is important. In addition, it should also be noted that, as concerning to set the green buildings, it is also important for developers, because it increases the opportunities for marketing, for the sale of the building. Institutional investors, on the other hand, are interested in all cost variables except operating costs. However, Bordass (2010)[1] also argues that many institutional investors aim to achieve energy savings, for example, in order to be able to bear leases for as long as possible and to keep tenants who are good payers also for as long as possible. For building owners, all costs related to the building are important, including the market value at the time of purchase of the building as well as its value in the future. Tenants, in turn, are only interested in operating costs and benefits such as energy savings, maintenance and management costs, productivity, health, as well as social benefits such as socializing relationships. As the author also argues, an important point is that energy savings, health and productivity gains are not very important for retail investors, but in general, it could be said that the accumulation of various cost-benefit variables is imperative for a complete package of economic assessments and that they should be communicated to the various stakeholders in the construction industry, in general, and environmentally friendly ones in particular.

2.The objectives of green buildings and their benefits

The main objective of green buildings is to be an attractive, comfortable and accessible shelter that does not harm the earth when it is built, used or disposed of. This overall goal is determined/amplified by four other goals (Reddy, 2016)[7]:

1. Reducing the impact on land, field, from the construction of buildings and their materials;
2. Reducing the impact that occurs during the occupancy of the building;

3. Reducing the impact of the structure at the end of its period;

4. Creating a more desirable human experience that corresponds to people's desires.

So, as the author said, green buildings are not a mere development trend; but they are an approach to building adapted to the requirements of time, the relevance and importance of which will probably continue to grow. The benefits of green buildings are multiple and can be classified on three fronts: environmental, economic and social.

Environmental benefits such as: reducing emissions, conserving water, managing rainwater, moderating temperature and reducing waste.

Economic benefits such as: energy and water savings, increased property value, reduced infrastructure tension, improved employee participation, increased employee productivity, improved sales, local talent development. Social benefits, such as: improving the health of occupants, improving the school environment; in general, a healthier lifestyle.

As Reddy (2016)[7] said, it is generally recognized that buildings consume a large amount of water, wood, solid fuel, energy and other natural resources that are widely used in the economy. In this regard, green buildings offer promising potential to help address towards mitigation some challenges facing humanity at a global level, such as:

- the high cost of electricity;
- worsening electricity grid constraints, with major problems with energy quality and availability;
- lack of water and waste disposal;
- raising concerns about the cost of global warming;
- increased incidence of allergies and asthma, especially in children;
- the health and productivity of employees, of people in general;
- the effect of the physical school environment on children's abilities to learn;
- increasing the costs of maintenance and operation of the facilities offered by the state over time etc..

So, in view of the above, we are also of the same opinion as the author in the sense that a building is green in the truest sense of the word only when all the processes related to that building, throughout its life cycle, such as site planning, design, service design, construction and operation, are ecological, environmentally friendly and economical.

Green building is the practice of building or rehabilitating structures to be energy and resource efficient throughout the life cycle of a building, from site planning to construction, operation, maintenance, rehabilitation and demolition/decommissioning.Green buildings use natural resources efficiently, in the sense that the quantity is reduced and thus their waste is reduced, which leads to the reduction of both utility bills and environmental impact. However, the idea that these benefits range from being fairly predictable (energy, waste and water savings) to relatively unsafe (productivity/health benefits) must still be accepted. So energy and water savings can be predicted with reasonable accuracy, measured and monitored over time; while, productivity and health-related benefits are much less accurately understood and much harder to predict accurately.

The main financial and economic benefits of constructing green buildings are as follows (Reddy, 2016)[7]:

1. reducing energy consumption;
2. reducing the use of natural resources;
3. lower primary costs;
4. lower costs with losses;
5. annual saving of water costs;
6. reducing greenhouse gas emissions and air pollution;
7. improving employee participation and productivity;
8. lower costs of maintenance and repair of facilities;

9. other benefits for building owners;
10. indirect benefits for society.

1. The reduction of energy consumption leads to a significant reduction in a substantially recognized cost of building operations and which can be reduced by energy efficiency as well as by other related measures that are part of the design of green buildings. Energy savings for green buildings come firstly from low purchases of electricity and, secondly, from reduced demand for main energy point. On average, as Reddy (2016)[7] said, green buildings are about 28% more efficient than conventional buildings and generate about 2% of their energy needed through photovoltaic systems.
2. Reducing the use of natural resources. Green buildings also use fewer materials, through the effective design and elimination of unnecessary finishing materials.
3. Reducing primary costs. Sustainable design team, including owners; design team; landscape designers; operating and maintenance personnel; health, safety and safety experts; the entrepreneur; cost consultants; the representatives of the occupants, all of them must work together from the very beginning and look for solutions for the realization of an integrated project/design. Thus, together the team must develop innovative solutions that meet energy, environmental and social objectives, but at the same time keeping costs within the budget.
4. Lower costs with losses. For example, many green buildings include an elevated plenum area flooring system that creates an air enclosure under the floor used for modular air distribution partitions - HVAC and where modular workstations, modular supply cabling as well as data systems that can considerably reduce costs can also be located.
5. Annual saving on water costs. Green buildings encourage the use of innovative water-saving strategies; so that design teams can follow an integrated process to carry out the assessment of existing water resources, opportunities to reduce water demand as well as alternative water sources.
6. Reducing greenhouse gas emissions and air pollution. Reducing greenhouse gas emissions and air pollution is a set of environmental benefits resulting from the greening of buildings and which can be estimated quite easily. Emissions can be reduced by diminishing energy consumption through energy-efficient design, renewable energy use and the HVAC system efficiently.
7. Improving employee participation and productivity. Sustainable design improves performance at logical thinking tasks; improves performance at the organizational levels well as productivity self-assessment;
8. Lower costs with the maintenance and repair of installations. Sustainable design aims to increase durability and ease of operation and maintenance, as follows:

- durable, long-term use can lead to lower maintenance and repair costs;

-paints with a low percentage of volatile organic compounds provide durability on the elements on which they are applied;

- the use of sustainable spatial planning techniques can lead to a reduction in costs;

-management of rainwater with natural methods etc..

9. Other benefits for building owners such as:

- increasing confidence in the recruitment process of future employees as well as stability from own employees;
- ower costs in handling complaints;
- reducing risk, liability and insurance rates;
- increasing the life of the building;
- increasing the resale value of the building etc..

10. Indirect benefits for society that relate, among other things, and not only, to the increase in the conservation value of the environment and the reduction of pollution in terms of municipal/local infrastructure requirements as well as local and regional economic growth etc..

In conclusion, in view of the above, we are also of the same opinion as Reddy (2016)[7] and as a result we can say that the realization of green, sustainable buildings is the practice of building or renovating the structures of buildings in order to be energy and resource efficient throughout their life cycle, from design, construction, operation, maintenance, renovation and decommissioning/demolition. At the same time, the financial benefits of green buildings include reducing energy costs, eliminating waste, reducing water consumption, reducing environmental costs and emissions, reducing operating and maintenance costs and, last but not least, achieving significant savings generated by increased productivity and health of occupants.

Given that definitions of green buildings vary IFC - International Finance Corporation argues that green buildings reduce or eliminate the negative impact on the environment and climate. These may be linked to carbon and energy targets, such as net-zero emissions or compliance with 1.5°C, as well as considerations of human health and well-being. While green buildings differ in local contexts and have different ecological characteristics, in the view of IFC it is important to have a set of agreed and comparable values that measure the most important material characteristics of what makes a building green.

In this respect, the clear and accepted definition of what constitutes these material characteristics, accompanied by values relevant to the measurement and verification of the performance of a green building, accounting for local variations, are important for the knowledge and development of the market. So definitions and values are essential for the following players in the market:

- industry decision-makers who need to set minimum compliance requirements, as well as provide incentives for private sector innovation to raise the standard;
- developers who have to build green buildings and at the same time get recognition from buyers for their superior quality;
- financial regulators that need to develop market rules for green assets;
- funders and developers to access capital markets for their portfolios of green buildings.

In these circumstances, we are also of the opinion that standardised values and clear reporting requirements are essential to harden investments at the required scale in the context of sustainable development on the construction market. They will help investors assess green buildings for their financial viability, sustainability credentials as well as alignment with portfolio strategies.

So standards provide the necessary definitions, while certifications such as BCA Green Mark, BREEAM, LEED and others can provide an asset rating to help investors define, measure and verify their investments in green buildings. This, according to IFC - International Finance Corporation, facilitates the issuance of green bonds and other forms of green finance, which can increase capital flows to the green building sector.

After several years of investing in green buildings, IFC – International Finance Corporation admits that green buildings should be:

- certified as organic according to one of the internationally recognised certification standards or an approved national standard;
- at least 20% more energy efficient than a basic building without an energy efficient project;
- able to quantitatively report impact values such as energy and water savings as well as reduction of greenhouse gas emissions.

As a follow-up to the above, the IFC report points out that in situations where IFC provide credit lines to its client banks as well as to other financial intermediaries for the provision of loans for green building projects, certification of eligible projects and energy efficiency at least 20% higher than the reference value are required. On the other hand, in situations where IFC uses the

revenues from green bonds to finance green buildings, it is mentioned that the following information is required to be reported: the type of green certification scheme applied; the green space/area; reductions in the value of energy, water consumption and energy incorporated in materials compared to a benchmark; reductions in carbon emissions etc.; and for residential projects, such as housing for people on low incomes, the additional information also includes the number of households or people served. In addition, as stated, this is best practice for ecological/green bond issuers to report to bondholders on quantifiable performance in terms of sustainable development.

In other news, in terms of providing funding for green buildings, the emphasis on operational energy efficiency and the reduction of greenhouse gas emissions are requirements that most funders consider to be sufficient and the most important characteristics to provide funding for green buildings. But, given that the energy consumption can be measured and verified; we are of the same opinion, namely that, focusing only on these aspects, the other benefits of green buildings are not taken into account, such as, for example, the efficiency of water use, water consumption and the reduction of carbon emissions embedded in building materials.

3.Conclusions

Construction of green, sustainable buildings is the practice of constructing or renovating building structures to be energy and resource efficient throughout their life cycle, from design, construction, operation, maintenance, renovation and decommissioning/demolition. At the same time, the financial benefits of green buildings include reducing energy costs, eliminating waste, reducing water consumption, reducing environmental costs and emissions, reducing operating and maintenance costs and, last but not least, achieving significant savings generated by increased productivity and health of occupants.

Sometimes, the inclusion of sustainable features and/or improvements may cause projects to exceed initial budgets; but always a more integrated design approach that intelligently combines passive design, thermally efficient building envelope and space efficient planning to reduce energy demand, as a first step, combined with other highly efficient systems, offers a viable alternative to systems installed on a building that does not have the same degree of energy performance.

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