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THE IMPORTANCE OF GREEN REAL ESTATE PLANNING AND DEVELOPMENT

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Abstract. Green real estate (GRE) planning and development have become critical to achieving environmental sustainability and urban resilience. This paper explores the importance of incorporating eco-friendly techniques into real estate developments, with a focus on lowering carbon footprints, increasing energy efficiency, and encouraging sustainable land use. Regulatory rules, market demand, and technical breakthroughs are all key drivers of green development. The study emphasises the advantages of green buildings (GB), including better health outcomes, lower costs, and higher property values. By evaluating case studies and current research, this study emphasises the importance of stakeholders implementing sustainable practices to reduce environmental consequences and promote long-term economic growth. The findings call for a coordinated approach between governments, developers, and communities to ensure the success of green real estate programs.

Keywords: *Green real estate, sustainability, real estate development, eco-friendly techniques.*

INTRODUCTION

Structures that are designed, constructed, and maintained ecologically consciously to reduce their environmental effect are referred to as a green real estate. The idea of sustainable development, which aims to balance social responsibility, environmental preservation, and economic progress, is strongly related to this. While the fundamentals of GRE have been around for a while, the urgency of reducing greenhouse gas (GHG) emissions and growing awareness of global warming have made them extremely popular in recent years. Green development originated in the ecological movements of the 1970s, and its first official application in real estate emerged in 1987 with the release of "Our Common Future", a study by the World Commission on Environment and Development. This historic paper criticised the conventional macroeconomic development model for ignoring environmental effects and offered 16 environmental management principles to promote green growth. At first, the real estate sector adopted green practices inconsistently, sometimes putting financial concerns ahead of environmental ones. But when environmental concerns and laws gained traction, the industry began to place greater emphasis on green development.

Currently, GRE stands for a forward-thinking method of developing real estate, working to link the previously disjointed parties in the value chain and build ecosystems for wise, healthy, and sustainable projects. GRE is used in various settings, including commercial buildings, industrial facilities, and residential residences. Single-family houses, apartments, and planned unit projects are all included in the residential sector. Real estate utilised for business, such as hotels, offices, and retail centres, is referred to as the commercial sector. Industrial real estate includes buildings frequently held by utility corporations, such as factories and power plants.

1. GREEN REAL ESTATE DEVELOPMENT

The real estate and construction sectors have an outcome for socially sustainable development of the economy and environment (Azizi et al., 2015). For example, the real estate and construction sectors in China contribute favourably to national economic growth while simultaneously consuming a substantial quantity of social resources (Zhao et al., 2015). The tremendous production of emissions of GHG during building development exacerbates global warming. The key element of GRE is green buildings (GBs), and they are essential for obtaining sustainability in urban development, which is why they are growing more popular across the world. They aim to reduce the environmental effect of buildings throughout their life cycles, enhance occupants' living conditions and quality and boost investor and community returns. They have become an unavoidable option for long-term urban growth. After being proposed in 1960, they have grown in popularity across the world, particularly in more industrialised nations.

GBs primarily focus on technical innovations and architectural design and construction, While GRE development encompasses a broader range of topics, such as sustainable residential area site design, programme planning, material selection and technical design, building, operation and maintenance, and destruction. Figure 1 depicts the components of a GB. Integration of green technologies such as solar power systems, energy-saving appliances such as smart-grid refrigerators, smart dishwashers and smart washing machines, energy-saving lighting, smart power strips, programmable thermostats and the use of recycled building materials are required to maximise the benefits that can be realised from GB.

The environmental and social value of group buildings at the regional level not only considers its environmental impact from a low carbon and environmental protection perspective, it also considers residents' demand for a high-quality living environment from a user experience perspective (Zhang, 2015). The present goals of environmental preservation, energy conservation, and emission reduction must be met via Green Real Estate (GRE) development while maintaining a high quality of life. Additionally, it must maximise operating efficiency, upgrade public service facilities, and employ recyclable building materials to offer social value, all of which come with extra expenditures (Eichholtz et al., 2010). The increased costs have made it more difficult to promote GRE widely.

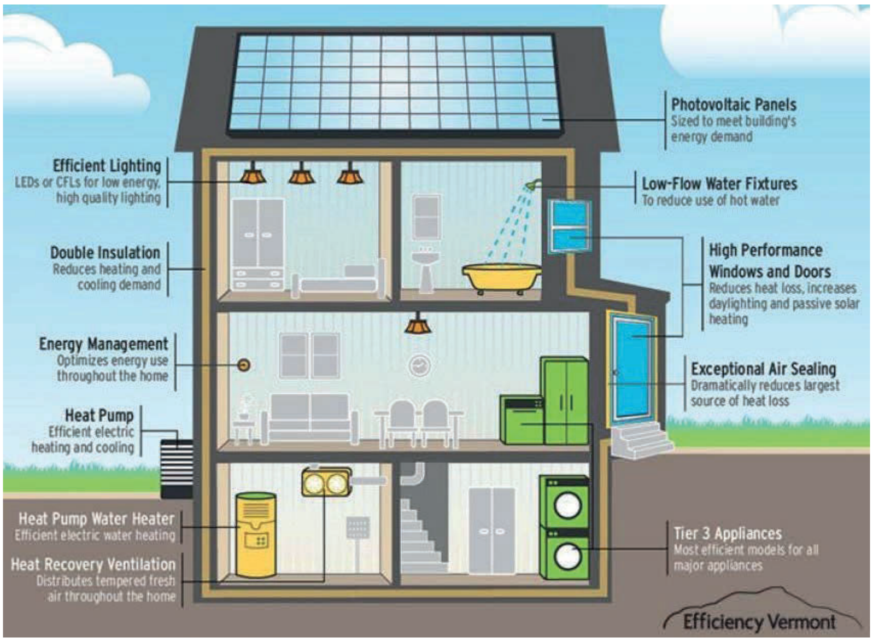

Fig. 1. Components of a green building (CAD Pro, 2020).

The primary drivers of GRE development have been government subsidies and regulatory incentives, which incentivise its positive externalities. According to a recent study, users may be able to shoulder part of these additional expenditures, especially if they lead to improved living circumstances. This would lessen the financial strain on governments and encourage the long-term expansion of the GRE. Research on residents' willingness to pay (WTP) for GB indicates that WTP is mostly driven by personal preferences as opposed to moral responsibility. WTP and contentment with individual homes have received much of the emphasis in research, with wider residential districts receiving less attention, particularly in China and comparable circumstances. Comfort, operation, maintenance, design, and accessibility to public resources are among the aspects of satisfaction that have been researched (Huang, 2015).

1.1. GRE and Environmental Benefits

The construction sector exerts a significant impact on the environment, recognized as pivotal in counteracting the repercussions of global warming on humanity. Enhancing energy efficiency and bolstering environmental sustainability within buildings constitute the fundamental essence of the shift toward eco-friendly construction. Sustainable building, as a positive performance construction, has a minimum influence on the environment, which may also lessen lifetime environmental consequences (Zuo & Zhao, 2014). The primary goal of sustainable building is to reduce environmental interference and construction waste. The handling of construction and demolition waste is critical in the development of sustainable building design. The main elements of sustainable building are show in Fig. 2.

Fig. 2. Main elements of sustainable building (Fokaides et al., 2020).

The value of the recovery rate in building wastes should be greater than 90 %, which may significantly minimise the impact of waste formation. Furthermore, the large amount of trash generated by construction might pollute the air and water. Thus, the selection of construction materials plays a significant part in sustainable development and may assist in generating healthier and safer environments. Timber is an environmentally friendly building material that reduces energy usage and carbon dioxide (CO_2) emissions.

The life cycle of a structure relates to the use of energy and greenhouse gas emissions. The construction industry is a "resource-intensive industry," consuming a massive amount of energy and natural resources each year, including more than 40 % of all energy, 40 % of raw materials, 16 % of all water, and 25 % of all timber consumed globally. It has also been established that the building industry contributes more than 40 % of global GHG emissions (Zuo & Zhao, 2014).

Over traditional buildings, it often brings superior performance embodied in energy conservation, water conservation, and CO_2 emissions reduction. GB is a unique presentation of energy and resource efficiency. Along with raising awareness about climate change, architects should consider the energy performance of building designs. Sustainable buildings may save 40 % more energy than typical structures, increasing energy efficiency and lowering CO_2 emissions, implying that the design should account for energy conservation and emissions reduction. Furthermore, low-carbon components in GB have been shown to lower building life-cycle emissions by up to 30 % (Qiao & Liu, 2020).

As therefore, GRE may be employed to achieve the long-term development of low-carbon construction. It is often intended to attain high environmental performance, which may be measured using GB methods such as LEED certification. Commercial buildings would gain the most from LEED certification, followed by residential and public structures.

As well, the use of energy in buildings in metropolitan settings may be quantified by using a spatial regression model to investigate the relationship between building greening rate and surface temperature. Furthermore, green construction may help to improve urban biodiversity and safeguard ecosystems through sustainable land use.

Table 1. Environmental Impact and Contribution of Built (World Economic Forum Industry, 2016)

Environmental impact	Share of buildings in total output/use
Raw material consumption	30 %
Solid waste generation	25–40 %
Potable water consumption	12 %
Water effluents	20 %

The environmental impact and contribution of built form are shown in Table 1. Future environmental effects of the real estate industry will rise due to global socioeconomic pressures. Most projections indicate that by 2030, there will be close to 8 billion people on Earth, with over 60 % of that total living in urban areas. The building and real estate industries will both see rapid expansion because of this.

1.2. Health Benefits of GRE Building

It is becoming more and more obvious how much poor indoor environmental quality (IEQ) in business buildings costs in terms of both productivity and health. Estimates of these expenses go as high as hundreds of billions of dollars yearly. People spend ninety percent of their time indoors, where pollution concentrations are usually higher than outside, sometimes by a factor of ten or even a hundred, which is not unexpected. The connection between building design and operation and worker productivity and comfort is intricate. Thousands of research papers, publications, and articles on the topic show much lower rates of sickness symptoms, lower absenteeism, and higher reported productivity compared to workers in a group that did not have these characteristics.

The pertinent characteristics listed below are typical of GBs and support better work environments:

- 25–30 % more energy efficient on average.
- Significantly reduced source emissions because of better siting (avoid parking garages adjacent to outlets, for example, and prevent recirculation) and improved building material source controls (avoid requiring excessive attention to storage, for example). When using the following, certified and silver-level GBs obtained 55 % of the potential LEED credits, and gold-level LEED buildings obtained 88 % of the possible credits.
- Less hazardous materials, paints, carpets, composite wood, adhesives and sealants with low emissions, and indoor chemical and pollutant source management.

- Notably improved lighting quality, encompassing increased daylighting (at least 75 % of the 21 LEED GBs analysed had daylighting), improved daylight harvesting and shading utilisation, increased occupant control over light levels, and reduced glare.
- Better ventilation and generally increased thermal comfort, particularly in buildings that use underfloor air for space conditioning.
- Better performance of HVAC, ventilation, and air conditioning systems is ensured by commissioning, measurement, verification, and monitoring.

Evaluating the precise financial effect of more eco-friendly, more pleasant, and healthier buildings is challenging. Sick days, decreased productivity, unemployment insurance, and medical expenditures are only a few of the "hidden" costs associated with poor indoor environmental and air quality. Other costs include higher absenteeism and an increase in respiratory conditions, allergies, and asthma. However, higher productivity has been favourably and strongly connected with four characteristics of GB design: enhanced temperature control, increased daylighting, increased ventilation control, and increased lighting control. Tenant control over temperature, lighting, and ventilation increases advantages that may be quantified, ranging from 0.5 % to 34 %.

On average, measured workforce productivity improvements are 7.1 % with lighting control, 1.8 % with ventilation control, and 1.2 % with thermal management. Increased daylighting has also been demonstrated to result in notable, quantifiable gains. There are additional measurable benefits to GB in terms of drawing and keeping a dedicated staff. The standard of advantages offered to employees, such as the physical, technical, and environmental aspects of the workplace, may have a significant role in attracting and keeping top talent. The purpose of GBs is to create happier and healthier work environments. Multidisciplinary teams may live longer and experience less stress when they operate in environments that are better suited for knowledge workers (Kats et al., 2011).

All LEED-rated buildings have some combination of features that save health care expenses and illness-causing pollutants, enhance lighting quality and daylighting, and provide tenants more comfort and control. Buildings certified as LEED Green regularly use a variety of material, design, and operating strategies that directly enhance worker productivity and wellness. Since Gold and Platinum-level LEED buildings apply IEQ-related metrics more thoroughly than Certified or Silver-level GBs, they should be seen as offering greater productivity and health advantages. Considering the research and statistics, the Report suggests giving Certified and Silver-level buildings a 1 % productivity and health boost and Gold and Platinum-level structures a 1.5 % benefit.

The analyses of ventilation, temperature control, light management, and daylighting for various building measures show that these percentages fall towards the lower end of the productivity increase range. Given that labour costs – both direct and indirect – are significantly higher than those associated with building or energy, productivity and health benefits have a comparatively big impact. Because of this, even modest improvements in productivity and health result in significant financial gains. The advantages would be significantly greater if the facility were to operate for a longer period, like 30 or 40 years. It is noteworthy that:

- Education accounts for 25 % of the Massachusetts population. Only 43 % of high-volume chemicals have been reviewed for probable human toxicity, and only 7 % have been investigated for potential impacts on children's development.
- Asthma is the primary reason for hospital admission and absence from school for children from metropolitan areas (Landrigan, 2002).

2. PLANNING AND MAINTENANCE OF GRE

A few proposals and focused initiatives are made to move GRE forward in the future, considering its current situation. Evolving the technology framework for GRE development must happen faster to fulfil future market demands. The study and development of important technologies should be bolstered by developers. To boost the degree of commercialization and market penetration of new technologies, the government should provide more funding for technical research and communication. In the meanwhile, new technologies must be made commercially viable by means of a strong platform that will serve as both a showcase and an advocate. In the process of developing GREs, property developers play a pivotal role in determining whether to utilise green technology, goods, and projects.

The process of developing GRE benefits from increased stakeholder awareness. Most developers work with the intention of making money. Developing green construction practices is a strategic approach aimed at achieving not just financial gains but also improving an enterprise's social standing and future reputation. However, obtaining the honour in the future without jeopardising the collection of present payments is necessary, especially for small-scale construction firms. Quality construction building components are necessary for enhancing building performance and achieving sustainable building. For instance, in the winter, thermal energy may be conserved by increasing the air impermeability of the windows; sound insulation is required to lessen internal noise. Therefore, windows that perform better are required, which will raise the original cost.

Customers take strong cost performance more seriously than sustainability in these circumstances. Small businesses can only implement basic building development measures, and only major businesses have the financial resources to think about GRE development. Consequently, actions to raise the sustainability consciousness of small-business stakeholders are required; it is their duty to spread the word about green construction, make it more popular, and help develop a mature GRE industry. As a result, the market will draw in and encourage more businesses to create GREs.

Promoting the social, economic, and environmental advantages of GREs may be done by the government through local, state, and federal initiatives. Government awareness campaigns might also be used to persuade builders and renters to embrace GRE due to the structures' rising value, reduced operating expenses, and improved reputation in the neighbourhood. Finance, taxation, and economic incentive programmes must be strengthened. A significant internal incentive to support the development of green construction may be created by these incentive plans for relevant departments. To promote sustainable growth, a unique type of financing is known as “green finance”. Initiatives seeking to promote green construction practices are eligible to apply for funding, which will reduce their financial burden. As a result, if the project in which money is invested is a GRE, the government may return certain benefits like tax breaks to the developers and customers. For certain nations and areas, related regulations and policies must first be improved. The cornerstone of green construction advocacy is legislation. Energy efficiency requirements are one example of a set of regulations pertaining to green construction that have been in place for a long time but have not had the desired impact.

Projects failing to fulfil required requirements ought to be penalised. For offering specific assistance, green construction standards must meet regional requirements. Additionally, local economic growth, weather patterns, regional resources, and construction level should all be sufficiently considered while creating and enhancing GRE standards. Furthermore, there should be strong quantitative criteria in the assessment method. More emphasis should be placed on the study and use of both quantitative and qualitative indicators. The real GRE creation goal can only be achieved in this manner. In addition, the GRE lifecycle evaluation needs to be completed before moving on to the design and construction phase.

2.1. Water Conservation Index

The actual amount of water used in a building divided by the average water consumption across all buildings is known as the “water conservation index”. Another term for the indicator is the “water saving rate”. Water use assessments by buildings consider the amount of water used and the amount of water saved via rainwater collection, recycling, and the reuse of grey water. It is necessary to assess the amount of water each structure uses since water is becoming a scarce resource. It is thus necessary to determine each building’s water-saving rate (WR) using the water conservation index to determine whether the structure qualifies as a GRE and whether renovations are necessary to incorporate water-efficient design elements. According to the necessary water consumption quantity, the water conservation index is also helpful when planning a new building.

Buildings with WR values less than 0.8 fall under the category of GRE. The real water saving rate (WR) is only applied to residential structures. To determine the water-saving rate in buildings other than residential ones, the rate of adoption of water-saving equipment, or AR, is employed. A building cannot be designated as a GRE unless it is not a residential building and has an AR value of less than 0.8. This method states that projects must save more than 20 % of their water to be considered GREs. In addition to promoting GRE design and construction for future construction projects, its goal goes beyond water saving in already-existing structures (Cheng, 2003).

2.2. Water Efficient Technology

The reduction of both water consumption and water waste is referred to as water efficiency. The depletion of freshwater resources occurs when there is wastage or excessive use of water, which pulls more water from the supplies. To preserve freshwater resources, which are already scarce, water-efficient methods have been created for both potable and non-potable water. Many water-efficient fixtures and fittings in buildings come from this category. Greywater recycling and reuse, as well as rainwater collection, are also included. Half of the water consumed in households is utilised for baths and toilet flushes, as shown in Figure 3.

For this reason, water-saving fixtures and fittings can be utilised instead of opulent but water-wasting ones. Using low-flow shower heads and low-flush toilets instead of bathtubs and standard flushes, which consume more water, are two examples of this.

Fig. 3. Water efficiency in GB (HRV, 2018).

Additional fittings and fixtures include bidets, composting toilet systems, dry urinals, water closets with two sections, auto-sensor water taps, etc. However, rainwater collection and greywater recycling and reuse account for most water savings.

2.3. Ways to Reduce the Use of Energy

Exploring implies that several approaches exist to curtail building energy use, and significant endeavours have been made to include sustainable materials and renewable energy sources to optimise energy usage in buildings. The section below covers how energy usage in buildings may be reduced. Lighting uses 4 % of the energy in houses but may account for up to 30 % of the energy consumed in business buildings. Smart meters and light control are suggested as best practices to reduce the energy used in buildings. When no one is inside the building, a network of sensors that make up these devices may switch off the lights. A smart metre scan can assist find the answer to increase energy efficiency by tracking where and how energy is consumed in the building. Energy-efficient appliances, more natural lighting, and enhanced light-emitting diodes (LEDs) can all help cut down on electricity usage (Scott, 2009).

Modifications to building shapes, orientation, and materials, as well as integrated building design, can also help reduce energy use. LED lighting is ten times more energy-efficient than eight conventional lightbulbs and provides superior brightness and contrast. If used, the need for power will be cut by 75 %. According to an IEA report, lighting is responsible for 1.9 Gt of CO_2 emissions yearly and 9 % of global power consumption. Compared to conventional lighting methods, LED lights and sophisticated control provide greater efficiency. Nevertheless, their cost is more than that of traditional lamps. Government funding is needed to help the LED sector transition from traditional lighting to LEDs. China installed 210 000 LED streetlights in 21 cities, making it the first nation to launch a significant LED programme.

2.4. Green Technology

Green technology aims to cut GHG emissions and minimise global warming. The creation of cutting-edge technologies that preserve natural resources is the primary objective. Humans, animals, and the global health community will be spared more harm from it. Because we produce so much rubbish, our planet is beginning to suffocate. One major way to help reduce GHG emissions is to deploy green technology effectively. Several industrialised and developing nations are utilising this technology to protect their citizens from the detrimental impacts of climate change. Although pollution has always been a concern, the concept of green technology is new.

One rapidly expanding sector is green technology. Since environmental preservation is so important, green technology goes beyond a fad. Green technology is vital because pollution affects the lives of nine million people every year. Reduced environmental risk and resource conservation need green technologies.

In this way, non-renewable energy sources are preserved by using clean, renewable energy sources. Delaying global warming is aided by green tech. The rise in global surface temperature over the last century has been 0.4–0.8 %. By 2100, the IPCC predicts a 1.4-to-5.8-degree Celsius increase in global temperature. The GHG effects are intensified by this temperature increase. Some of the negative effects include ozonation loss, ocean acidification, pollution, and changes in plant development. Green technology, by using increasing carbon consumption and predicted energy generation, has the potential to prevent global warming.

Reducing emissions of GHGs like carbon dioxide and nitrogen oxides is also crucial for the fight against global warming. Green technology includes strategies like metallic foams, battery storage, and green construction, in addition to renewable energy sources. Technology is already widely used worldwide and is growing rapidly. On the other hand, green technology combines technology with recyclable parts. Such an endeavour contributes to the creation of a clean, life-sustaining ecosystem.

Sustainable construction features are introduced by green technology. Property value is raised in the building industry by this environmentally friendly innovation. GBs are more costly at first, but they eventually pay for themselves. Geothermal installations, for example, cost more money but consume half as much energy as conventional systems. 70 % of CO_2 is saved with geothermal pumps. Both money and the environment are saved by doing this.

The long-term viability of green technology is finally demonstrated. This clean technology is essential and crucial, as the devastating image of pollution and climate change makes clear. Green technology also facilitates the creation of sustainable structures, supplies biodegradable products, encourages recycling, and provides alternative energy sources. This has a major impact on fossil fuel conservation, emissions reduction, and global warming mitigation.

2.5. GRE and Sustainable Development in the Real Estate Industry

Table 2. Sustainable Development in the Real Estate Industry

Sustainability dimension	Sustainability issues	Principle objectives
Economic sustainability	Maintenance of high and stable levels of local economic growth and employment; improved project delivery, increased profitability and productivity.	Improved output, consistent profit development; contentment among staff, suppliers, and clients; reduced defect rates.
Environmental sustainability	Regarding sustainability and environmental preservation, a lot of false information is out there. It has been falsely said that sustainability and GB are interchangeable at times.	Minimising and eradicating trash; preventing pollution-related occurrences and environmental law violations; cutting down on hazardous emissions; protecting sites and depots from noise and dust disruptions; creating new habitats and improving the ecology; managing building projects with caution in order to safeguard fragile ecosystems. Consider using green transportation for your location and business operations.
Social sustainability	Social advancement that acknowledges everyone's needs. Courtesy toward employees collaborating with nearby communities and drivers. Collaboration in action.	Maintain employee morale, provide fair terms, and ensure a safe work environment. Offer effective training and equal opportunities and involve employees in decisions. Reduce local disruptions, support job growth, and enhance community services.

As a strategic element of sustainable development, GRE development must thus be precisely defined. Since the idea of sustainable development shot to the top of the international political agenda, it has become clear that sustainable ways of developing the urban environment in general, and the real estate subsector in particular, are essential to all aspects of sustainability (Table 2). Real estate investors have too long prioritised generating a profit over all other key objectives. However, increasing awareness of the limited availability of natural resources, the tendency towards climate change, and escalating social inequality have made it evident that the sector needs a thorough and well-defined sustainability programme.

CONCLUSIONS

Green real estate (GRE) offers a potent solution to the problems of urban sustainability and climate change, marking a revolutionary step forward in the way we approach real estate development. Using sustainable practices and eco-friendly methods, GRE not only improves energy efficiency and lowers carbon footprints but also fosters better living conditions and economic resilience. The many advantages of GRE, such as reduced operating expenses, elevated property prices, and enhanced tenant well-being, emphasize its pivotal role in establishing a sustainable future.

With continued legislative backing and technology developments driving the implementation of GRE, the real estate sector is well-positioned to make substantial progress towards long-term economic prosperity and environmental stewardship. Governments, developers, and communities must work together to remove obstacles and welcome creative ideas if the GRE is to be successful. GRE is poised to become a pillar of urban development as its importance becomes more widely acknowledged. It will build thriving, resilient communities that strike a balance between environmental preservation and economic advancement. Adopting GRE practices now guarantees future generations a prosperous and sustainable future where people and the world may coexist and thrive.

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