SUSTAINABLE BUILDING SOLUTIONS. A POTENTIAL FOR MAINTAINING AND INCREASING THE PRICE OF REAL ESTATE

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Abstract: *The purpose of this paper is to explain the necessity of sustainable solutions in the real estate sector and their potential benefits for investors. By sustainable construction it is implied that the built structure takes into consideration all three pillars of sustainability: people, environment and profit [5]. Moreover, in the context of climate change and resource scarcity, sustainability is gaining more importance across all economic activities, even in construction industry and real estate. Real estate sector is facing an important challenge, as a large amount of GHG emissions (i.e. almost 40 % of global CO2) [3] is attributed to buildings and their operation. Therefore, it is essential to integrate the ecological and social aspects along with the economic efficiency. To account for all these aspects, buildings should be examined through the entire life cycle. Starting from the design and planning phase, designers and investors should consider energy-saving solutions, durable and safe materials, design for flexibility, etc. to ensure profitability in the long run. These are only few examples of sustainable solutions against the loss of value of real estate.*

Keywords: *sustainable construction, green building, climate change, SDG, energy efficiency in buildings, operational and embodied emissions.*

Rezumat: *Scopul acestei lucrări este de a explica necesitatea unor soluții durabile în sectorul imobiliar și potențialele beneficii ale acestora pentru investitori. Prin construcția durabilă se presupune că structura construită ia în considerare toți cei trei piloni ai sustenabilității: oameni, mediu și profit [5]. Mai mult, în contextul schimbărilor climatice și al deficitului de resurse, sustenabilitatea câștigă o importanță mai mare în toate activitățile economice, chiar și în industria construcțiilor și imobiliare. Sectorul imobiliar se confruntă cu o provocare importantă, deoarece o mare cantitate de emisii de GES (adică aproape 40 % din CO2 global) [3] este atribuită clădirilor și funcționării acestora. Prin urmare, este esențială să se integreze aspectele ecologice și sociale împreună cu eficiența economică. Pentru a ține seama de toate aceste aspecte, clădirile ar trebui examinate pe parcursul întregului ciclu de viață. Începând din faza de proiectare și planificare, designerii și investitorii ar trebui să ia în considerare soluții de economisire a energiei, materiale durabile și sigure, proiectare pentru flexibilitate etc. pentru a asigura profitabilitatea pe termen lung. Acestea sunt doar câteva exemple de soluții durabile împotriva pierderii de valoare a imobilelor.*

Cuvinte cheie: *construcții durabile, clădiri verzi, schimbări climatice, SDG, eficiență energetică în clădiri, emisii operaționale și încorporate.*

Why sustainable buildings?

Global warming, climate change, ozone layer depletion, etc., are all subjects of today's concerns. Greenhouse gas emissions related to anthropogenic activities is the main driver behind the temperature and weather shifts. As these emissions are continuously rising, the Earth becomes warmer. For example, nowadays temperature is by 1.1 °C higher compared to the reference temperature in the late

1800s [11]. Global warming is expected to approach 2.7 °C by 2100 if the current emission rates do not decrease. Some parts of the globe already experience the consequences of the temperature rise. Intense droughts, floods, water scarcity, catastrophic wildfires, rising sea level, severe storms and reduction of biodiversity are just a few examples. Several global frameworks were adopted to keep warming below 1.5 °C. In accordance with the Paris Agreement [2], multiple countries committed to reaching net-zero emissions by 2050 and half reduction of emissions by 2040 to avoid the escalation of climate impacts. According to the IPCC-Report of 2021 "Net Zero Carbon is the condition in which anthropogenic carbon dioxide (CO2) emissions are balanced by anthropogenic CO2 removals over a specified period."

The world currently produces 40 Gt of CO2 per year. According to the International Energy Agency [3], almost 40% of the global energy- and process-related CO_2 emissions belong to building stock, which makes construction industry one of the largest contributors. The latest IPCC report claims that it is difficult to prevent global warming without urgent and substantial emission reductions in all industries and areas [4]. Furthermore, buildings have the most current potential for decarbonization, as seen by the McKinsey Abatement Cost Curve in Fig. 1 [8], which postulates that the most profitable and impactful decarbonization strategies are in the building sector.

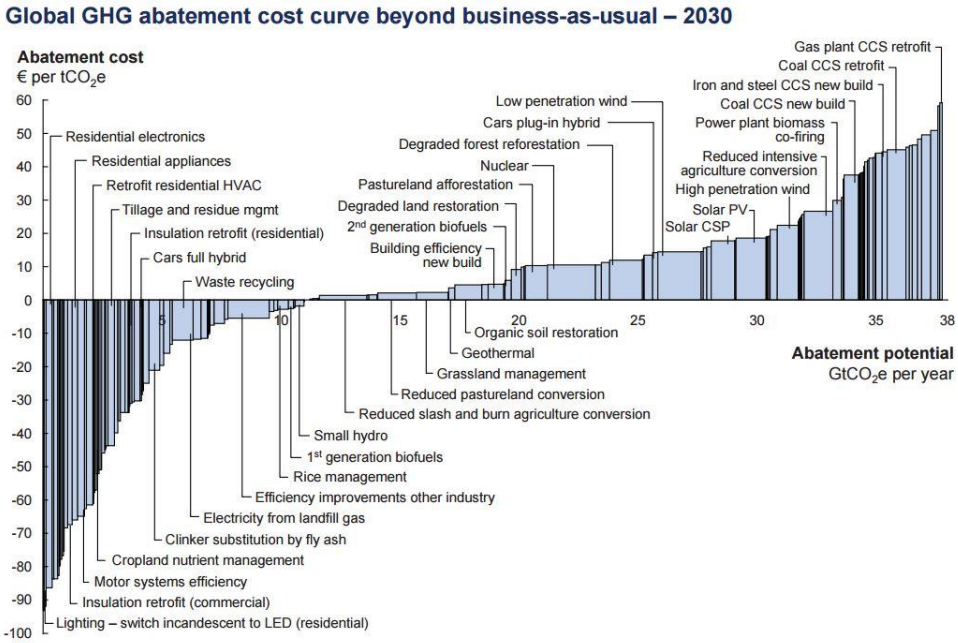

Figure 1. *McKinsey's Global GHG Abatement Cost Curve [8]*

To abide the international agreements, governments launched specific policies and regulations to reduce carbon emissions along the whole life cycle of the buildings. The overall goal is to reduce both operational and embodied carbon of buildings. Net-zero operational emissions could be achieved with reduction of energy demand and renewable energy sources. However, it often requires additional layers of insulation and an airtight envelope, which creates a trade-off between embodied and operational carbon, making it more difficult to achieve net zero embodied emissions. According to Martin Röck et. al. [7], stricter energy performance regulations cause the embodied emissions from building materials and technical systems to contribute more and more to the overall GHG-emissions when looking at the whole life cycle of buildings, rising from approx. 20% to approx. 50% as can be seen in Fig. 2. One must consider carbon emissions derived from manufacturing, transport, installation, use and end-of-life of building materials. Contrary to business-as-usual methods of construction, zero

embodied carbon strategies focus on passive design concepts, re-use of building components, low carbon and bio-based materials, local supply chains.

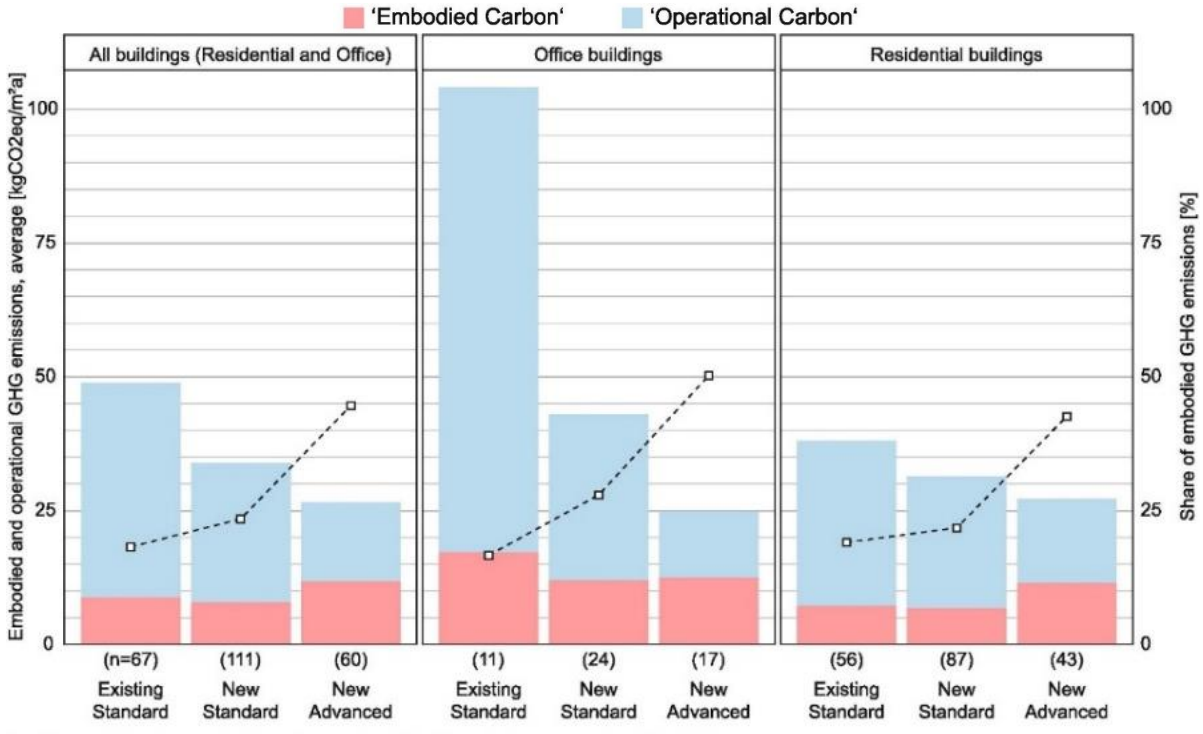

Figure 2. *Global trends in embodied and operational life cycle GHG emissions, Martin Röck et. al[7].*

Construction industry needs to become more sustainable to address the issues described. It is imperative that building owners take a holistic approach in building design, to consider not only the amount of energy but also the life cycle emissions. The only way to reduce the impact of climate change is to decarbonize. This requires fast paced adoption of innovative and sustainable solutions. Furthermore, it is important to increase awareness about climate issues among all stakeholders involved in the decision-making process construction industry. It includes real estate developers, architects, engineers, material suppliers, but also occupants (i.e. building owners and inhabitants have direct influence on energy consumption and, thus, operational emissions).

Implications for Real Estate

Climate change plays an important role in the real estate market. The risks associated with climate transition have direct and indirect effect on the property valuation. The new building codes enforce more sustainable solutions, which creates challenges as well as opportunities for the market [1]. They shape the market by changing the demand both for tenants and investors. Ultimately, the sustainable solutions directed towards global warming mitigation have benefits for multiple parties involved.

Real estate businesses can reduce emissions through several measures, while still obtaining financial advantages and increase in value. For example, a simple measure is switching to an energy-efficient lighting system. Another cost-effective solution is airtight and well insulted envelope. These measures help to minimize the energy demand and, hence, the emissions associated with operation of the property. Furthermore, substantial energy demand reduction could be achieved through passive design strategies. The overall goal is to reduce the need for multiple active systems. Building systems' life span is on average twice shorter than the life time of the structure. Therefore, they require several replacements and, in consequence, account for a large part of the embodied emission during the life

cycle of buildings. Passive design considers local climate, with the aim of ensuring thermal comfort and maximize the use of available environmental resources. For instance, passive cooling can be applied if design considers wind direction and allows cross-ventilation during nighttime, thus reducing the cooling demand and the need of air conditioning systems. Moreover, high performance windows and appropriate shading prevents overheating in summer. Building orientation also play an important role in bio-climatic design. For example, in winter, South oriented rooms, and partially East/West oriented, can benefit from solar gains as a passive heating strategy. This strategy works well in combination with high thermal mass, which allows intermittent heating due to its heat storage potential.

Net-zero emission buildings imply electrification of heating and cooling. Moving to an electrical source will reduce building emissions due to the possibility to generate energy on-site and transition of the electricity grid away from fossil fuels and towards renewable and low carbon generation. All systems must be designed to be as efficient as possible Newer technologies use low-carbon heating and cooling, such as solar collectors, heat pumps, waste heat streams from industry and energy-efficient air conditioning. These systems use the available resources in the immediate environment and need only a small input of electricity to provide the required comfort. Not the least important is the smart control of the buildings. It offers the possibility to optimize the energy use to the fullest and reach greater energy efficiency.

The above-mentioned solutions refer mostly operational carbon reduction which also prove to be financially advantageous solutions. Despite the lack of direct economic incentives, the choice of building materials can also provide benefits for the real estate valuation. Besides the advantages for environment, bio-based and low carbon materials tend to have increased appeal for occupants and increases the value and reputation of the real estate. A conscious choice of materials will not only reduce the amount of greenhouse gas emissions but also has the potential to postpone future renovations. Investment in high performance materials pays off due to their durability and quality.

It is worth mentioning that additionally to positive financial returns associated with energy savings, the stated sustainable solutions contribute to superior indoor comfort and tenant satisfaction. As people spend 80 % of the time indoor, buildings also influence the health of inhabitants. In commercial buildings, comfort affects productivity of employees and therefore has direct influence on monetary return of the business. Buildings that could provide the required indoor comfort, usually have higher value on the market.

As buildings are usually designed for an average life time of 50 years, real estate becomes a long-term investment. Construction are also designed and built for specific purposes, i.e. residential, commercial, industrial, office, public, etc. Over time buildings can lose their initial use, as the recent pandemics has shown. Inability to adapt the built structure for other purpose causes the value of the construction to go down and increases the negative impact on environment. Design for flexibility can allow to adapt buildings according to user needs and, thus, maintain or even boost its value. A step further to cut down material-related emissions would be integration of the construction industry and circular economy. In this way, more value could be extracted from materials. Instead of simply demolishing buildings and turning it into waste, one could rather carefully disassemble and recycle or reuse the components for other purposes. Moreover, the maximum value may be recovered using the design-for-disassembly framework. Up to 90% of the materials from a building designed to be disassembled can be reused, making buildings a source of materials [6]. This concept prevents loss of value of the construction at the end of life and avoids further depletion of resources and use of energy for material manufacturing.

Conclusion:

To sum up, real estate plays an important role in decarbonizing the planet. To reduce the hazards of climate change, real estate industry must become more conscious of the issue and embrace rapidly more sustainable building alternatives. Sustainable construction, according to Miyatake, is founded on the following principles: reduction of resource consumption and maximization of resource reuse, focus on quality, utilization of renewable and recyclable resources and protection of natural environment [9]. These creates the overall objective of high performance, durable buildings, but does not make direct connection with economic aspects. Therefore, in the sector, there is a widespread misconception that there is a higher capital cost associated with sustainable practices, which does not pay off properly [12]. To identify economic potential of sustainable practices, stakeholders must consider financial rewards through life cycle costing. There is a potential for improvement and adoption of sustainable solutions in all phases, from planning to facility management. Starting from the planning phase, it offers wider selection of technology and flexibility in the design choice. Despite the high initial expenditure, property owners can earn a return on investment by implementing cost-cutting measures, such low energy (exergy) heating and cooling systems, efficient use of resources, efficient lighting, high performance envelope. Alternatively, considerable effect is achieved during the operation. Building control and automation systems may save anywhere from 6% to 17% on energy costs [10]. These highly efficient technologies not only ensure financial return but also allow a significant reduction of CO_2 emissions. The aforementioned solutions provide evidence of sustainable construction's economic performance. As a result, it should encourage stakeholders to embrace sustainable construction approaches, which balance economic profit with environmental and social concerns.

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