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The effect of carbon dioxide emissions on the building energy efficiency

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ABSTRACT

During this anthropocentric period, sustainable energy supply and climate changing could be a main source of problem for human being. Scientists believe that the ratio of climate changing and global warming is linked to the increase in greenhouse gas increment due to fossil fuels, particularly CO_2. According to studies, the building sector is a main source of carbon dioxide (CO_2) emissions into the atmosphere. Building construction, operation, and the use of unclean energy sources have led in a significant quantity of CO_2 being emitted into the environment. As research progresses toward zero-energy buildings and usage of sustainable clean energy, it is critical to reduce a building's total energy consumption and environmental effect throughout its existence. Total energy is made up of operational and embodied energy, the latter of which is linked to embodied CO_2 (ECO_2) emissions that relates to the greenhouse effect. CO_2 is calculated by multiplying the mass of the materials by the CO_2 coefficients (kg CO_2/kg). The findings give useful baseline metrics for each material's contribution in case of mass and ECO_2. It was determined that this method could save a significant amount of energy, CO_2, and power. The major benefits were identified to include greater building performance, a rapid and sustainable design processing, increased energy efficiency and the supply of superior design choices.

1. Introduction

Global warming has been caused by rising average air temperatures led in a few alterations to the climate systems such as the scarcity of raw resources and environmental pollution [1–6]. These fast transitions occur as humans keeps on emitting heat-trapping greenhouse gases (GHG) into the atmosphere [7,109,113]. CO_2 is the most significant anthropogenic greenhouse gas due to its ability to remain in the atmosphere for centuries [8]. Both natural and man-made CO_2 emissions are conceivable. One of these factors is the advancement of urbanization. Along with population increase and the extension of the built environment laterally and vertically, modernization is a dynamic process that converts rural areas into urban areas. Many countries have trying to have cleaner production and a prime example of this is the reduction of cement during the manufacture of concrete [9–13]. The built environment is one of the most essential parts of a country's economy and social progress since it refers to the manufactured surroundings that provide facilities and infrastructure for human activities. Thus, urbanization has a considerable impact on the construction CO_2 emissions and its reduction [14–18]. The building sector, in general, includes everything from construction through operation, and it is further subdivided into residential and non-residential structures [114,116-118]. These comprise of the procedures of adding buildings to regions of land beside the building's servicing, operation, and maintenance. The building sector is seeing a resurgence in expansion, which has a tremendous direct and indirect effect on the environment taken as one of the most

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waste-producing and waste-producing sectors of the economy [19,110-112,115]. This sector's environmental effect might be divided into three classes as public impacts, natural resource impacts, and ecosystem impacts [20]. This industry also uses high energy while producing great pollutants, such as carbon monoxide, nitrogen oxide, sulfur dioxide, particulate matter, and GHG emissions [21]. Fig. 1 shows contribution of building to energy ratio by 30%.

The amount of CO_2 in the atmosphere has grown because of this sector's energy use, leading in massive CO_2 emissions [22,23]. For every tens of buildings, approximately 900 kg of carbon dioxide gas is released into the atmosphere [24]; the cement industry alone is responsible for nearly seven percent of the global carbon dioxide emissions [25–28]. The energy needed for the production and delivery of building materials, as well as construction waste management, processing of resources, and the needs of construction equipment are all sources of CO_2 emissions in this sector [29]. The construction industry utilizes a huge quantity of nonrenewable energy and emits a large amount of CO_2 [30]. Buildings account for around 39% of worldwide CO_2 emissions each year [31]. The building industry is reported to account for more than a third of CO_2 emissions and overall energy consumption in both industrialized and developing countries [32]. Therefore, CO_2 emission decrement strategies are important [33]. Planning for energy saving and execution of methods to minimize potential emission mitigation need to be emphasized to enhance CO_2 emission mitigation [34]. The aim of this study is to provide a view of concerns, confinements, and mitigation techniques in the construction industry to reduce and control CO_2 emissions. Fig. 2 shows the deep path result of 80% less energy demand for buildings in globe.

Construction, engineering, architecture, and business could be a major source of pollution, while producing high ratio of carbon emissions and waste. The construction industry (CI) is accountable for roughly 40% of the pollution in potable water while creating 50% of landfill trash. It pollutes the air by ~ 23% [35], consumes 40% of the world's energy, and emits a significant quantity of greenhouse gases. To reduce carbon emissions and waste, prefabrication methods are used. Green and zero-energy buildings are also being built to offset the detrimental effects of CI on climate change [36–41]. The importance of greenhouse gas emissions and the implementation of green practice and unsustainable was the only emphasis of a recent studies [42]. People in poor nations such as Pakistan are ready to invest in and benefiting from zero-energy buildings [43]. Building Information Modeling (BIM) is useful in both sustainability research and management, as well as in the stages of building operations, maintenance, and destruction [44–46]. According to certain research, the Green BIM aims are "to meet defined sustainability targets through 3D modeling, working and creating with coordinating building data across the project life cycle to enhance the quality, efficiency, and performance of the building" [44–47]. The advantages for green building and even regular building construction include the advantages of cooperation between project stakeholder and client [45]. Also, the cost of projects is lowered. Regarding the use of BIM for construction projects, sustainable buildings has been recently a key trend in CI. BIM and green buildings have a strong relation, according to project stakeholders [8].

BIM systems are popular for addressing classification as well as regression issues in recent years [48–52]. This is because the results are more dependable than those acquired using traditional procedures [53–57]. BIM systems have displayed promise in handling real-world issues, particularly non-linear ones [58–63]. Through the implementation and testing of emerging computer models that can approximate the mechanical characteristics of concrete mixtures, material science has seen substantial growth [64–68]. Companies in the AEC sector use BIM for regular projects and the Green BIM concept for sustainable projects since the 2010s. BIM-based integrated design methodologies make it easier to create green buildings [47]. BIM such as energy simulations, software for air analyses, reuse and recycle analyses of construction waste are studied for application in the construction, management and design of green buildings [44,69–73]. These models could be employed to calculate the compressive strength of concrete containing waste or by-products [74–77]. BIM models can be utilized to test and verify current empirical models that are employed in global standards in the case of big and varied databases [78–82]. Furthermore, the Leadership in Energy and Environmental Design (LEED) program that certifies green sustainable buildings has some suggestions for green building construction, such as optimizing green facades, building mass, having green vegetated roofs that reuse greywater and control temperatures, and installing lighting sensors for optimizing energy usage [83]. As a consequence, this study addresses some of these issues by modifying the aforementioned factors and analyzing their impacts on energy efficiency, leading in the potential achievement of the relevant Sustainable Development Goals (SDGs). To date, much research has been performed, for example, to connect the accomplishment of SDGs through building material developing and consumption [84]. The authors of a new research for Chinese

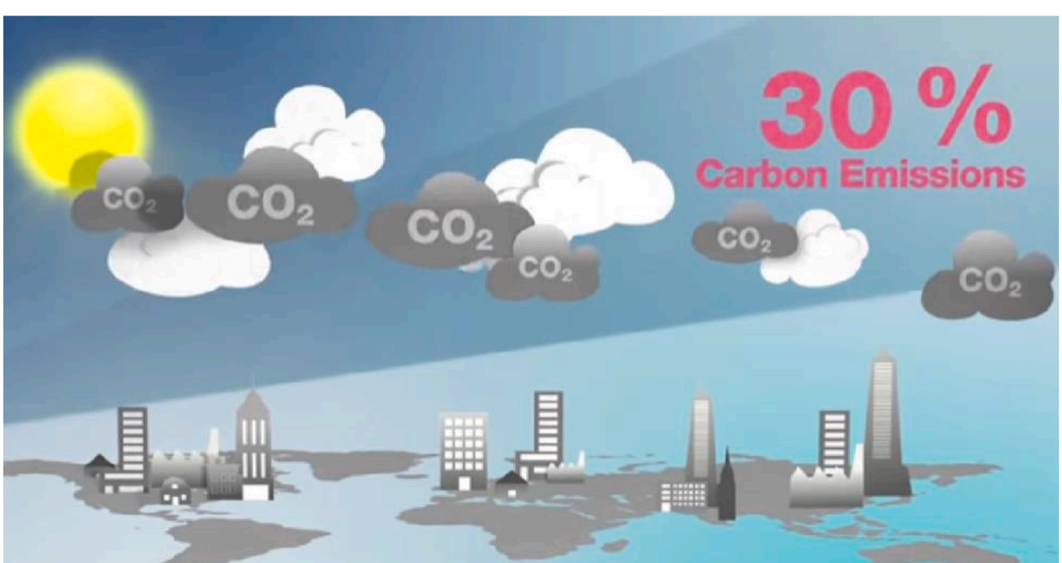

Fig. 1. Contribution of building to energy ratio by 30%.

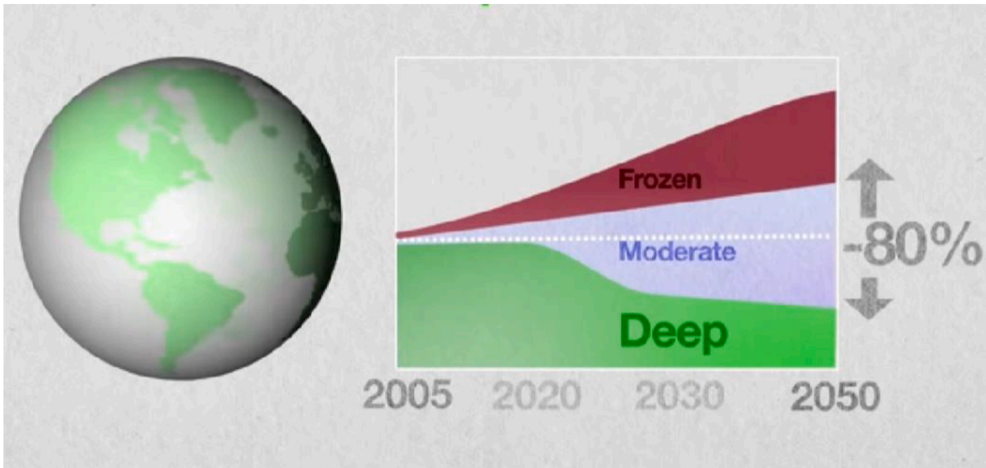

Fig. 2. The deep path result of 80% less energy demand for buildings in globe.

CI explored the challenges to the implementation of sustainable practices and the achievement of SDGs. The particular aims of this research are the finding and ranking of BIM elements that have a beneficial effect on green buildings, as well as the confirmation of those advantages by an integrated energy analysis of a case-study 3D BIM model using Green Building Studio (GBS). Social development, environmental protection and Economic development are defined as three interdependent factors of sustainable development by World Summit Outcome (2005). It displays academics' efforts in various locations of the globe towards the highlighted SDGs' direct and indirect successes. Despite the fact that the concepts of "environmental sustainability" and "sustainable development" are properly known to the AEC industry for long term, the industry has been regarded in the beginning of managing and controlling carbon emissions [44]. After being slammed by devastating global warming challenges, unanticipated climatic shifts, environmental degradation, a scarcity of energy supplies, and rising energy costs, the AEC sector is under constant pressure to reduce energy use in order for avoiding carbon emissions and tackling the concerns. As a result, humanity and the AEC sector have moved their attention to the construction and developing of low carbon green buildings and environmental sustainable communities [84] Green design is best served by an integrated design processing; which BIM is well recognized for aiding. Taking this into consideration, ongoing efforts are being undertaken to investigate the potential of BIM in easing the creation of green buildings. BIM has provided several new approaches to manage, predict, and monitor the environmental impacts of building via its virtual visualization and prototyping tools. Due to its integration and coordination attributes with multiple methodologies such as Mechanical, Plumbing, Electrical, and architecture, BIM can enclose and incorporate a large amount of information in a single model, assisting in the effective analysis of environmental performances and improving sustainability measures [44]. BIM is possibly the finest way for merging analog-energy buildings, airflow assessments, and building sunlight ecosystems. BIM allows us to reduce energy consumption and waste while enhancing construction quality [85]. With cutting-edge software such as GBS that collects data from its nearest weather station and use cloud computing technologies for a variety of building studies, it calculates the annual energy consumptions, carbon footprint of a building, and produce and consume renewable energy [44].

1.1. *Energy efficiency opportunities*

The impact of energy saving potential in industry, buildings, electric grid and transportation are calculated beside determining the goals that are both ambitious and technically feasible, as well as cost-effective. As a starting point, by use of Annual Energy Outlook (AEO, 2019), the energy efficiency solutions might cut US GHG emissions in half by 2050. They would reduce primary energy consumption by 49%. Carbon dioxide (CO2) emissions would be cut by 57% as a result of the efficiency gains (2.5 billion metric tons). Since there was a transition from fossil fuel use to electricity for both automobiles and buildings, the emissions decline is higher than the energy falls. When additional GHGs like methane are included, in overall GHG emissions in 2050 are reduced by 49%. The following are the top sector-specific saving opportunities: Vehicles that are both efficient and electric in 2050, a move to electric cars and trucks (80% of light-duty vehicles and 45% of heavy-duty vehicles) combined with sustained fuel economy advances under revised regulations may reduce vehicle carbon dioxide emissions by ~ 50%. Smart manufacturing and strategic energy management could reduce industrial energy usages and emissions by 15% while industrial processes, new technologies, and feedstock (including electrification strategies) could save extra 14%.

1.2. *Transportation system efficiency*

Less driving in vehicles and light trucks, increased freight efficiency, and more effective airplanes and aviation may reduce emissions by 30%, 25%, and 53%, respectively. Energy efficiency enhancements may reduce energy use and emissions by roughly 18% for houses and 23% for commercial buildings, while smart control systems might reduce energy use and emissions by 18% for commercial buildings and 11% for homes. Electrification of remaining loads reduces emissions by an extra 13%. New zero-energy buildings and residences efficient design of commercial and residences including electrification and use of renewable power to meet typical yearly needs could reduce emissions by up to 80%. Updated efficiency requirements and expansion of the ENERGY STAR® program may reduce total residential emissions by 13%. Table 1 represents Ranking of BIM factors.

1.3. *Construction related carbon emission*

In 2004, direct emissions from the building sector were about 3 GT CO_2, 0.4 GT CO_2-eq CH_4, 0.1 GT CO_2-eqN_2O and 1.5 GT CO_2-eqhalocarbon. Because mitigation in this sector involves several actions targeted at reducing power use, it's helpful to compare mitigation potential to CO_2 emissions comprising of those caused by electricity usage. Energy-related CO_2 emissions comprising of those from electricity usage, 8.6 GT/yr, accounting for about a quarter of world total CO_2 emissions [87]. Construction industry is a big user of all types of energy and a major contributor to emission. India's construction sector accounts for around 22% of the country's total yearly CO_2 emissions. The products/industrial processing of energy demanding building materials,

Table 1
Ranking of BIM factors. AI: Average Index [86].

Rank No.	Factor	AI
1.	Quick and Sustainable Design Process	4.4828
2.	Improved Energy Efficiency	4.4483
3.	Enhanced Building Performance	4.3448
4.	Provision of Better Design Alternatives	4.3103
5.	n-Dimensional Visualization	4.2759
6.	Improved Facility Management	4.2414
7.	Green Innovation and Supply Chain Collaboration	4.1724
8.	Better Project Definition	4.1379
9.	Construction Waste Reduction	4.1034
10.	LCA of Energy, Water, and Fuel Usage	3.9655
11.	Calculations of Water Availability and Usage	3.8621
12.	Quantification of Rainwater Harvesting Systems	3.7586
13.	Carbon Saving during Building Operation	3.6552
14.	Estimation of Grey Water Reuse Potentials	3.6207
15.	Viable Options for Low Carbon Footprint	3.3448
16.	Estimation of Potential Green Energy Production	3.3437
17.	Efficient Procurement of Materials	3.3432

such as lime, bricks, cement, steel, and aluminum account for 80% of the emissions from the construction industry [88]. Furthermore, as the world's population grows, the need for these materials raises as well, notably in housing that stands for about 60% of the resources used by the construction industry each year [89]. Construction material production is mostly reliant on traditional energy sources. Coal is still the most common fuel used to generate energy. Nonetheless, high-capacity nuclear power and renewable energy sources partially replace coal in power generation, resulting in CO_2 emissions reductions of 10% and 4%, respectively. Saradhi et al. found that cumulative CO_2 emissions for 2005 to 2035 in various cases are much lower 33% in the low-growth scenario. Likewise, as compared to the business-as-usual scenario, the strong renewable scenario reduced CO_2 emissions by 4%. Enhancing building energy efficiency, replacing high CO_2, CO_2 emission fuels with low CO_2 emission per MJ fuels, replacing fossil fuels with renewable technology, and accelerating the use of high-performance heat pump method are all basic measures for reducing building-related emissions [90]. A systematic method is required to reduce carbon emissions from the energy industry across the world. To accomplish quick improvement, a mix of market mechanisms and regulation would be more successful [91]. Improved energy efficiency of a building is the best alternative among numerous solutions to be developed for fulfilling energy demand and minimizing CO_2 emissions [92]. Improving energy efficiency in existing buildings is clearly one of the best sustainable and viable ways to decrease carbon and energy costs [93].

2. Carbon emissions

Climate change has far-reaching consequences; some of them are currently unclear. Increased atmospheric greenhouse gases are the primary driver of climate change. The burning of fossil fuels is one of the primary contributors of greenhouse gases. The most harmful greenhouse gas is CO_2 [94]. "They were astonished to discover from the record inscribed in ice cores that the Earth had often suffered rapid and severe fluctuations in temperature. Since then, they've compiled a thorough account of the last 800,000 years. Temperature, CO_2 levels, and sea levels have unusually close correlations: they all increase and fall together, practically in lockstep. Carbon dioxide is estimated in parts per million (ppm), which indicates how many CO_2 molecules are presented per million dry air molecules [95]. Carbon dioxide levels in the past varied from 180 ppm to 300 ppm, according to measurements derived from ancient air bubbles frozen in ice. CO_2 levels were 280 parts per million before the industrial revolution. It peaked at 315 ppm in 1950 then reached 385 ppm in 2012, greatly above previous highs [95]. Fig. 3 show energy consumption of 20 and 60% for heating and cooling, respectively in 2021 in globe. Table 2 shows CO_2 emission in different products.

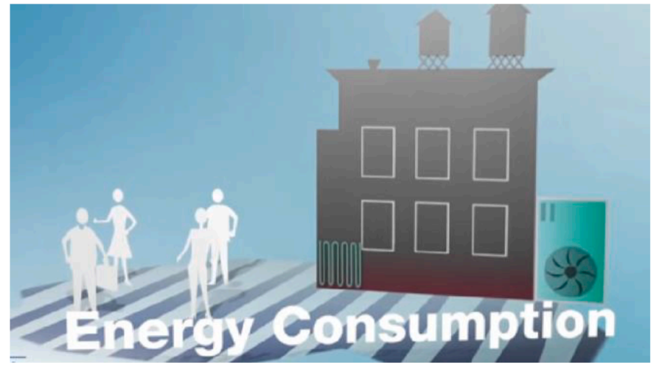

Fig. 3. Energy consumption of 20 and 60% for heating and cooling, respectively in 2021 in globe.

Table 2
CO_2 emission in different products.

Sub-sector	Mt CO^2
Wood and wood products	1.8
Paints, varnishes, printing ink etc	0.1
Rubber products	0.6
Plastic products	3
Glass and glass products	1.1
Structural clay products, Cement, lime and	9.6

Beside fossil fuels, deforestation is a key source of carbon emissions, accounting for up to 15% of total emissions. Forest destruction both releases stored carbon from soils and plants and lowers the number of trees available to absorb CO_2. If humanity is to avoid the devastating effects of climate change, significant decreases in carbon emissions are required. To limit the ratio of climate changing, experts predict that greenhouse gas emissions must be eliminated by 2050. Reducing carbon emissions isn't as difficult as it may appear. A carbon footprint study examines the carbon emissions produced by various human activity. The content, origin, sinks, and removal ratio of greenhouse gases are all measured in a carbon footprint study. These measures are combined to establish the net emission rates of various activities and processes associated with an event, product, or service [96]. Since it is an assessment of total greenhouse gas emissions, carbon footprint analysis is also known as "greenhouse gas inventory." Since carbon is the most prevalent gas emitted by human activity, the other greenhouse gases are changed to carbon equivalents. According to Franchetti and Apul's Carbon Footprint Analysis, "in order to have one unit for presenting results, emissions from other gases are normalized to the mass of CO_2, and the carbon footprint results are presented as mass of CO_2 equivalent (CO_2e)" [96]. Carbon footprints are often calculated by data collection and measurement, as well as a tour of the facility, if one is available. Following the collection of the essential information, suggestions are developed to boost efficiency and minimize energy usage, hence lowering costs and emissions. The use of energy is not the only source of greenhouse gases in the atmosphere. When doing a carbon footprint study, additional sources, such as land-use, industrial operations, forestry, agriculture, land-use change, and waste are frequently significant [96] Fig. 4 show appropriate design of cites to less pollution and quieter.

3. Considerations for whole building performance

One of the most important tactics for reducing a building's energy consumption is to examine the 'whole building performance than just combining low-energy solutions. The climate, design, and envelope are the most crucial factors to consider. The link between these factors is

Fig. 4. Appropriate design of cites to less pollution and quieter.

critical to creating an energy-efficient building with minimal carbon emissions.

3.1. Climate

Before designing a building for most energy properness in a specified area, the climate of the area need to be analyzed. Following the climate data of the Natural Resources Conservation Service Water and Climate Center, these data includes relative humidity, heating and cooling degree-days, wind speed, temperature, and sunshine [97].

3.2. Thermal comfort

Many factors influence whether or not a person feels at ease in their surroundings. Too cold, too hot, wet, or dry, activity levels, and thermal obstacles like clothes vary by location. The psychometric diagram is a simple approach to comprehend the interrelationships of the environment's thermal statues. The chart takes into account specified humidity, air temperature, and relative humidity to establish the best effective thermal comfort measures [97].

3.3. Lighting

Since lighting is the 2nd greatest user of power in buildings, it is critical to consider daylighting options. Artificial lighting, although lowering direct electric demand, could contribute to the cooling load in the summer [97]. The electric load could be reduced significantly by designing the building to proper day lighting distribution. One purpose of day lighting is to diffuse sunshine so that routine activities may continue indoors without overheating workstations [97]. The direction of the windows, like shading, must be taken into consideration. East and west facing windows only receive half of the day's sunshine, and receive more sun in the summer than in the winter. As a result, north and south windows are better for letting in light. Since vertical windows only reach a certain distance, the shape of the structure affects how much floor space may profit from windows [97]. The most usable light comes from horizontal windows that are spaced out. To lessen the quantity of glare, it's also beneficial to have windows on many walls. It is recommended to place windows on opposite walls so that light is distributed evenly [97].

3.4. Analysis of structure of changes in CO_2 emissions

From 2005 to 2009, CO_2 emissions related with energy use grew in general as seen in Fig. 5. Between 2005 and 2006, CO_2 emissions increased at a very rapid rate. Since average earnings climbed faster than energy properness and the deployment of energy-efficient structural measurements, the rate of CO_2 emissions grew. In 2007 the increment was 5.85 times of that in 2006. Though the general energy usage was raised, the incremental margin was led from energy efficiency after 2007. So, the structural alterations were raised in energy due to occurrence of the relevant energy-saving work. The rising margin caused by average incomes could be mitigated, resulting in lower CO_2 emissions in 2008 that were 1.19 times higher than in 2007. Fig. 6 depicts the shifting emissions and the impact of several factors, using 2007 as the base year. The rise in CO_2 emission and energy usages was mostly due to rising average income. Meanwhile, increased energy effectiveness was a key factor in lower energy usage and CO_2 emissions that can somewhat counterbalance the impact of changes in average income. Furthermore, the reduction in CO_2 emissions was unaffected by a change in energy structure. Fig. 7 depicts the link between the rise of CO_2 emissions and the contraction of GDP, as measured by energy efficiency. The offset ΔC_I was weak in pre measurement of energy-saving in 2007. After this transformation, the adverse proportion of change obviously accelerated, and ΔC_R was still raised. Nevertheless, the situation has been improved as a result of the present high cost of energy usage. The improvement of energy usage efficiency may greatly limit the pace of CO_2 emission increase, according to this investigation on energy-saving renovation and carbon emission falling in public buildings. There is a significant difference between industrialized nations in terms of current energy consumption efficiency, so there is still a lot to improve. In the field of energy saving and improving energy efficiency, several strategies such as the utilization of waste pressure and heat, green lighting, building energy conservation etc. might be enhanced to produce a stable energy-saving level.

4. Carbon dioxide emissions from building energy consumption

The building industry generates up to one-third of greenhouse gas emissions due to energy usage, mostly by using fossil fuels throughout their operating period in both developing and developed nations. These

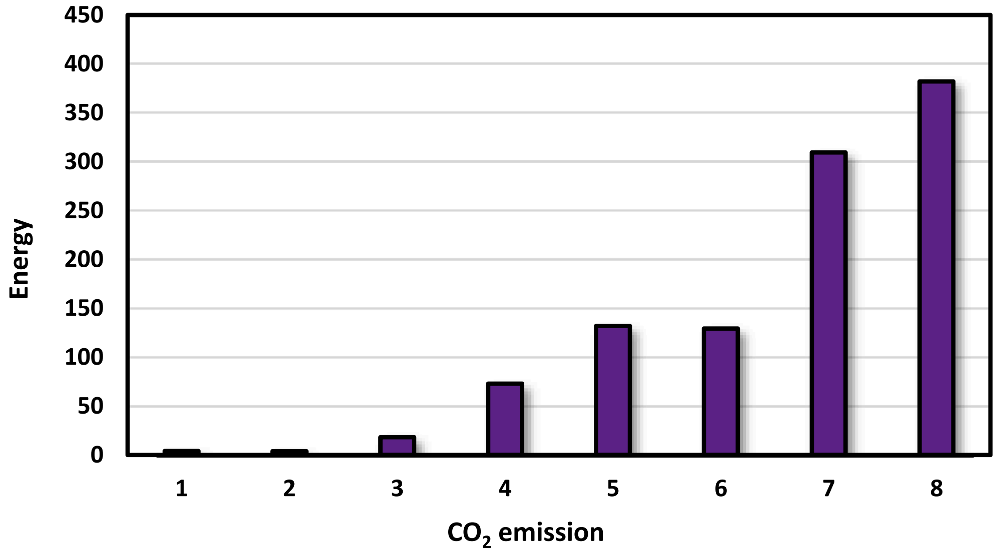

Fig. 5. The incremental ratio of emissions of CO_2 related with energy consumption (2005 to 2009).

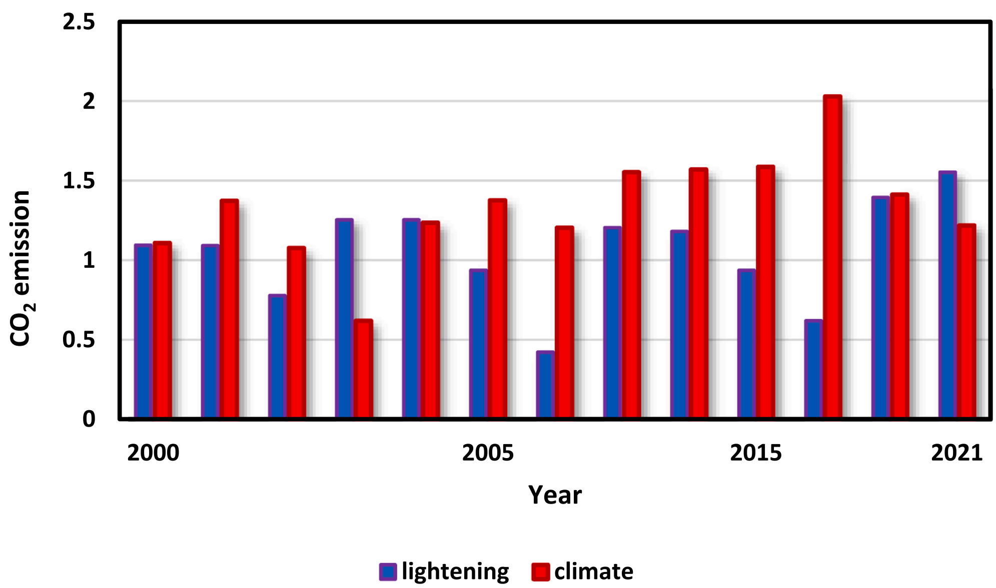

Fig. 6. The changing emissions and the effect of lightening and climate from 2000 to 2021.

emissions are expected to be accelerate than other economic sectors during the next 25 years [98,99]. CO_2 emissions from energy utilization are classified into two types: emissions from the electricity used to cool, heat, and power buildings and direct emissions from on-site burning of fuels for cooking and heating. The relationship between these two forms of CO_2 emissions and building service demand might vary greatly from year to year based on the factors that influence them [100]. Some methodologies are utilized to analyze the relationship between energy usage and CO_2 emissions, resulting in energy conservation and CO_2 emission reduction [101]. In terms of a process combination and input–output assessments, system accounting for overall energy usage and CO_2 emissions generated by buildings is shown [102]. Furthermore, CO_2 emissions and energy usage may be measured using a life cycle measurement that considers all stages of building construction and operation [102]. Additional enhancements in environmental and energy management may be developed based on the techniques using a concrete procedure that covers diverse materials, personnel input, equipment, and operating costs. Unlike fossil fuels, most of these renewable energy methods produce less or no CO_2 emissions [103,104]. Moreover, a variety of well-established and widely utilized methods, such as low-carbon appliances, high-efficiency HVAC systems, energy efficient technologies, and smart design may highly decrease energy usage and CO_2 emissions [105–107]. Despite their capacity to cut CO_2 emissions, the contribution of these techniques is highly based on economic rivalry between the society and these technologies and varies significantly by nation and location [108]. As a result, the function of these techniques in lowering CO_2 emissions and mitigating climate alter in buildings need to be further investigated, taking into consideration the overall economic analyses, cost, end-use efficiency measures, and socio-cultural advantages and limitations.

4.1. The role of energy efficiency and insulation in global climate change

Energy efficiency is described as cost-effective methods of reducing energy usage by existing and upgraded technology as well as smart energy management practices. Energy efficiency is based on the basic principle that if people use low energy, there would be low greenhouse gas emissions due to fossil fuel combustion. As a result, both developing

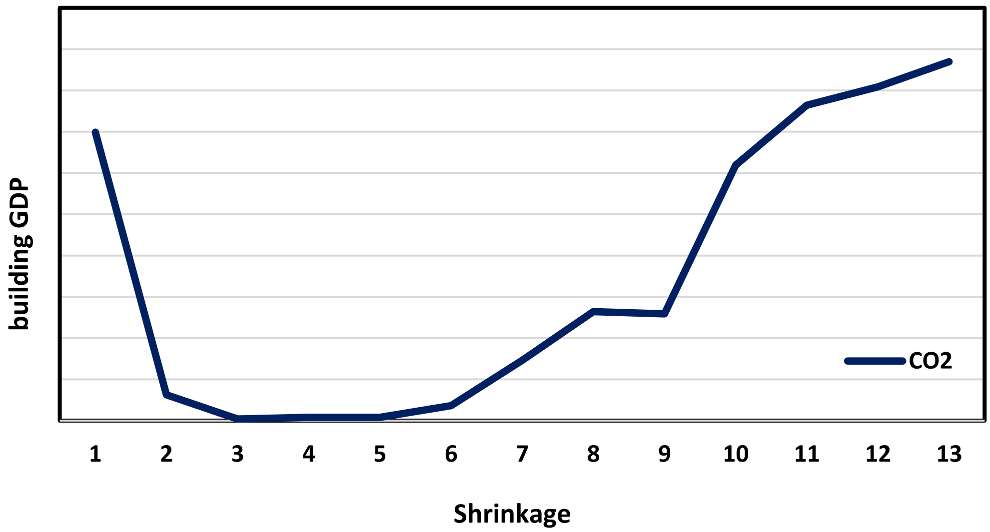

Fig. 7. The relationship between the increase of CO_2 emissions set toward building GDP and its shrinkage.

and developed countries will have access to more fossil fuels that may be utilized for various reasons. As a result, energy efficiency technology and practices could help to mitigate the threat of global warming. Insulation is one of the simplest and most effective energy-saving measures available today. Personnel protection, sound management, thermal performance, fire protection, condensation control, and personal comfort are just a few of the many advantages of insulation. Insulation products that are made from a range of materials such as foam, mineral wool, fiber glass, and other materials are primarily intended to limit heat transmission through building structures in residential, commercial, and industrial applications. Insulation products enable consumers to save more energy and emit fewer pollutants per year than its manufacturing. As a consequence, the environmental balance and total energy for thermal insulation is quite beneficial. Fig. 8 shows role of energy efficiency in reducing the threat of global climate change.

5. Conclusion

Nowadays, construction industry uses a substantial ratio of energy and emits almost an equivalent amount of CO_2 emissions. This proportion is expected to rise in the future year due to significant changes in lifestyle and technology. It was also said that economic improvement, building size, tenant behavior, climatic, service needs, urban density, spatial organization, building operation, building life, and geographic location all have an impact on energy consumption in buildings. Thus, in order to solve this challenge and reduce the impact of climate change, new tactics and techniques that take these aspects into consideration, as well as the deployment of renewable energy technology need to be explored in the future for reducing energy uses in buildings. As the initial stage in every building energy-saving project, diagnosing and analyzing building energy usage and CO_2 emissions is critical to improve building energy management. CO_2 emissions are controlled by the carbon content of energy, which is determined by the energy supply system. The adverse rate of change of substantially accelerated after the building's alteration. Nonetheless, despite high energy consumption costs, the existing situation has been developed. According to the results of the research above, while changes in energy structure contribute less to CO_2 emissions, the pace of rise in CO_2 emissions could be slowed to some amount if the consumption of new energy sources such as gas and wind energy sources is increased.

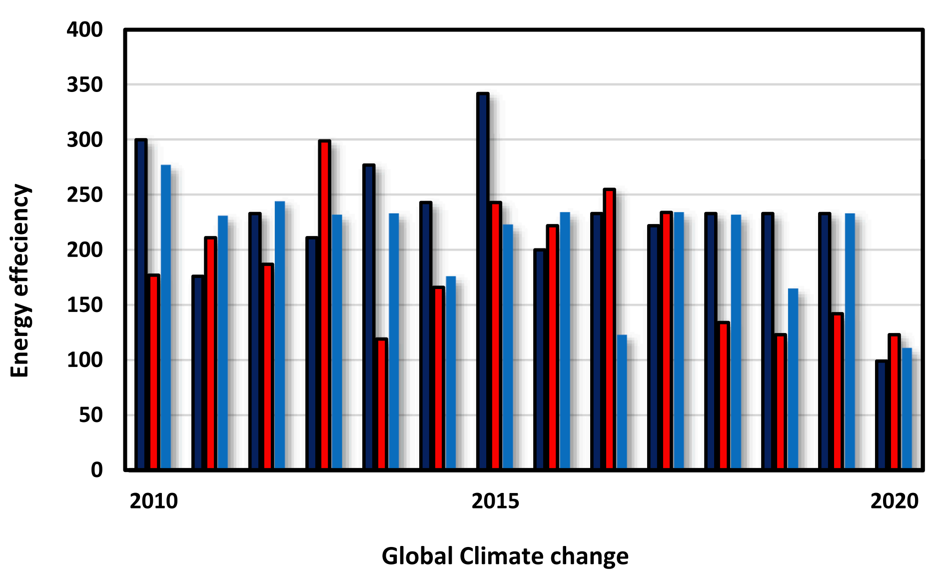

Fig. 8. Role of energy efficiency in reducing the threat of global climate change.

CRediT authorship contribution statement

Ji Min: Methodology, Validation, Writing – original draft. **Gongxing Yan:** Supervision, Project administration. **Azher M. Abed:** Data curation. **Samia Elattar:** Writing – review & editing. **Mohamed Amine Khadimallah:** Conceptualization, Software. **Amin Jan:** Writing – review & editing. **H. Elhosiny Ali:** Conceptualization, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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