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Popular article**Carbon Footprint and Green Building****Krishang R. Deshmukh¹ and Dr Surabhi Singh¹****Corresponding author: deshmukhkrishang@gmail.com**Received: 10/04/2025**Published: 07/05/2025***INTRODUCTION**

Carbon footprint is a measure of the amount of greenhouse gases (GHGs) that are emitted as a result of human activities. These emissions can be direct or indirect, and include gases like carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).

Carbon footprints can be calculated for individuals, organizations, events, or products. For example, a person's carbon footprint can include the energy they use in their home, the emissions from their car, and the waste they generate. An organization's carbon footprint can include emissions from their direct use of fuels, employee travel, and emissions from their supply chain. Human activities such as food, transportation, coal and burning of fossil fuel are the primary cause of the increased carbon dioxide concentrations in the atmosphere.

A green building is a structure that is designed and constructed to be environmentally responsible and resource-efficient throughout its life cycle. Green buildings are also known as sustainable or high performance buildings. Some characteristics of green buildings include:

- Energy efficiency
- waste reduction
- water conservation
- renewable energy use
- improved air quality
- less air pollution

One of the most effective ways to promote green building is to use evidence and examples that demonstrate its benefits and feasibility. Data can be used and statistics to show the quantifiable impacts of green building on energy consumption, water use, waste reduction, carbon footprint, and health outcomes. From the aggravation that climate gets to the exhaustion of the resources that nature has, the catcher of a high carbon footprint is too far-reaching. It is extremely threatening to biodiversity; it disturbs ecosystems and ruins the fine-tuning of the planet's climate.

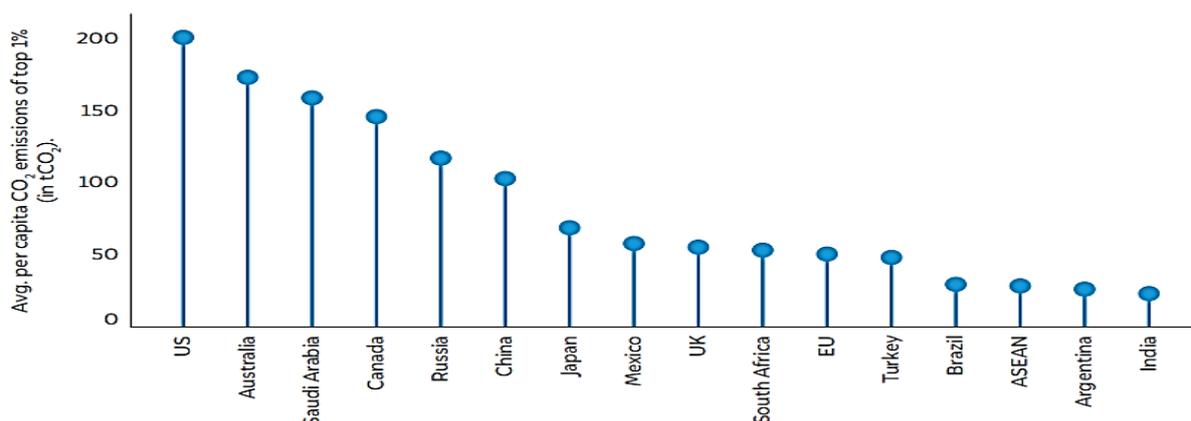
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Carbon Footprint

- The term Carbon Footprint is defined as a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product.
- While the term itself is rooted in the language of Ecological Footprinting (Wackernagel 1996), the common baseline is that the carbon footprint stands for a certain amount of gaseous emissions that are relevant to climate change and associated with human production or consumption activities.
- Origin of carbon footprint can be traced back to as a subset of “ecological footprint” proposed by Wackernagel and Rees (1996).
- Ecological footprint refers to the biologically productive land and sea area required to sustain a given human population expressed as global hectares.

Importance of carbon footprint

- Carbon footprint, being a quantitative expression of GHG emissions from an activity helps in emission management and evaluation of mitigation measures (Carbon Trust 2007b).
- Having quantified the emissions, the important sources of emissions can be identified and areas of emission reductions and increasing efficiencies can be prioritized.
- This provides the opportunity for environmental efficiencies and cost reductions. Reporting of carbon footprint to the third party or disclosure to the public is needed in response to legislative requirements, or carbon trading or as a part of corporate social responsibility, or for improving the brand’s image (Carbon Trust 2007b; L.E.K. Consulting LLP 2007).



It is clear that high income countries leave the biggest footprint while it is substantially low for developing countries. Carbon footprints are now used as an important indicator of event management (London 2012 Sustainability Plan 2007).

Calculation of carbon footprint

- Alexandra Shimo-Barry, author of "The Environment Equation," has come up with a formula that explains how to calculate carbon footprint
 - Simply follow the below steps, and calculate.
1. Multiply individual monthly electric bill by 105
 2. Multiply individual monthly oil bill by 113
 3. Multiply individual total yearly mileage on individual car by .79
 4. Multiply individual monthly gas bill by 105
 5. Multiply the number of flights individual've taken in the past year (4 hours or less) by 1,100
 6. Multiply the number of flights individual've taken in the past year (4 hours or more) by 4,400
 7. Add 184 if individual do NOT recycle newspaper
 8. Add 166 if individual do NOT recycle aluminum and tin
 9. Add 1-8 together for individual total carbon footprint
- Keep in mind that an "ideal" carbon footprint (or a "low" footprint) is anywhere from 6,000 to 15,999 pounds per year. 16,000-22,000 is considered average. Under 6,000 is considered very low. Over 22,000 is not good so individual should take some of these "**living green**" practices into consideration.

Things that contribute to the carbon foot print

- **Food:** Livestock, especially beef, is a major contributor to greenhouse gas emissions.
- **Transportation:** The transportation sector has seen the largest increase in greenhouse gas emissions since 1990. Over 90% of transportation fuel is petroleum based.
- **Household energy:** Residential buildings are the largest contributor to energy sector emissions, accounting for 12.5% of all emissions globally.
- **Consumption:** The consumption of goods like clothing, electronics, and plastics contributes to greenhouse gas emissions.
- **Transportation**
- **Construction**
- **Industry**
- **Waste**
- **Climate change**

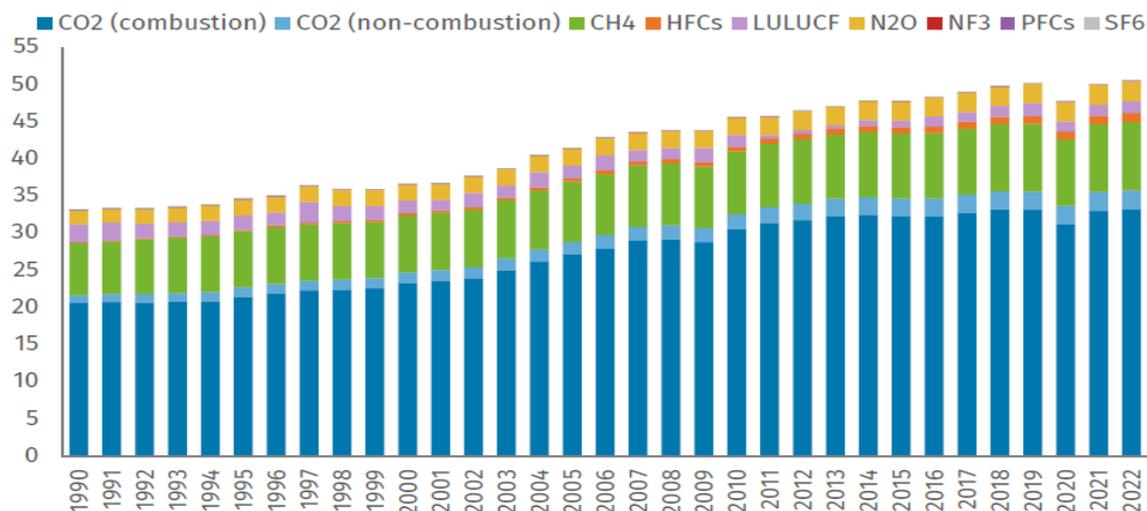
Ways to reduce carbon footprint

- **Reduce energy use:** Use energy-efficient appliances, reduce heating and cooling, and save electricity.

- **Reduce water use:** Conserve water and avoid wasting it.
- **Reduce food waste:** Avoid wasting food, and eat leftovers.
- **Reduce plastic use:** Cut down on single-use plastics and choose products with less packaging.
- **Recycle:** Recycle materials and donate items to op shops instead of sending them to landfill.

Global GHG emissions for 1990-2020 and preliminary estimates for 2022

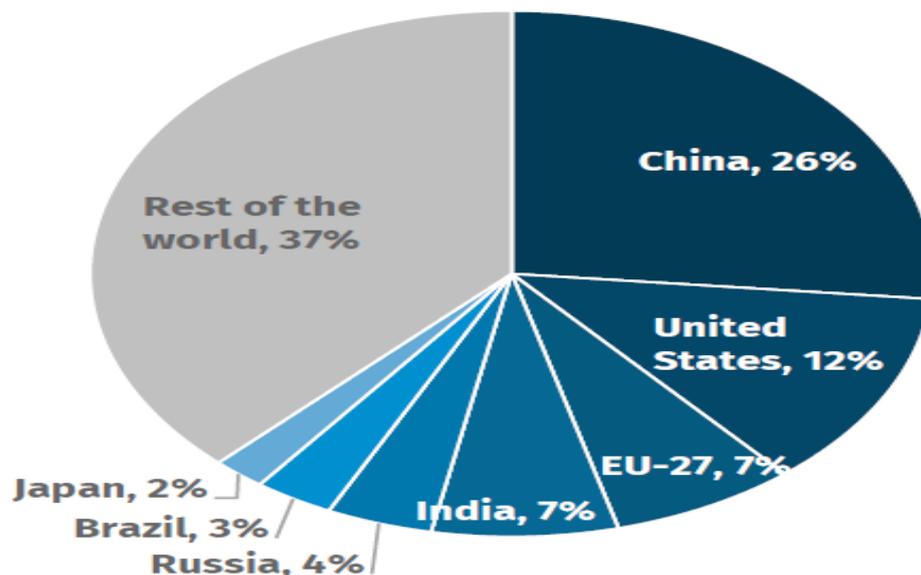
Billion metric tons of CO₂e



Source: Rhodium Group

- Carbon dioxide CO₂
- Methane (CH₄)
- Hydrofluorocarbons (HFCs)
- Land Use, Land-Use Change and Forestry (LULUCF)
- Nitrous oxide (N₂O)
- Nitrogen trifluoride (NF₃)
- Perfluorochemicals (PFCs)
- Sulfur hexafluoride SF₆

2022 net GHG emissions from the world's largest emitters
 Percent share of global total

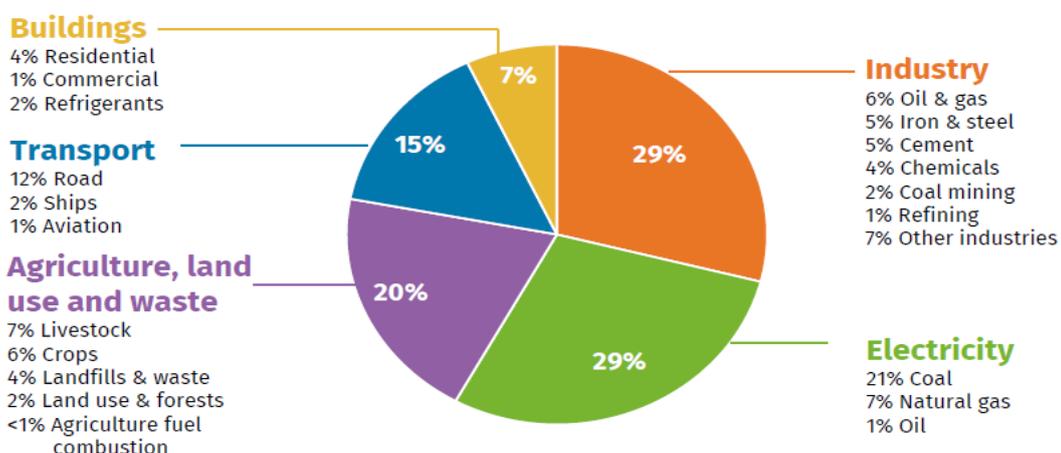


Source: Rhodium Group

- Seven economies were responsible for close to two-thirds of global emissions in 2022 (Figure 3).
- Relative emissions shares among the world’s major economies remained the same as previous years.
- China was the highest-emitting economy, contributing 26% of global emissions, followed by the US at 12%, and the EU and India each at 7%.

Global emissions by sector

Percent share of 2021 net GHG emissions



Source: Rhodium Group

- In 2021, the most recent year with detailed sectoral data, industry and the electric power sector were neck-and-neck in their contribution to global GHG emissions, together constituting nearly 60% of the global total (Figure 6). The industry and the electric power sector each accounted for 29% of total GHG emissions, with the vast majority coming from coal combustion. Land use, agriculture, and waste collectively contributed 20% (though this excludes the impact of forest fires), while transportation and buildings contributed 15% and 7%, respectively.

Renewable energy source carbon free energy

- Experts say that it is critical to reduce carbon emissions from fossil fuels while investing in carbon sequestration technologies both in terrestrial and marine ecosystems in order to achieve carbon neutrality and to ensure sustainable human development.
- The renewable energy approach to emission reduction and industrial development is scientifically sound and is based on years of research and data analysis . The optimal use of these resources is the basis for sustainable development: they reduce our impact on the environment, produce a minimum amount of secondary waste, and meet the current and future socio-economic needs of society .
- In contrast to conditional energy sources, renewable ones are replenished naturally and will not run out. These include hydropower, solar and wind energy, bioenergy, geothermal energy, and ocean energy, as well as nuclear and hydrogen fuel.

Hydropower Energy

- `Hydropower is one of the most common forms of renewable energy, in which the energy of flowing or falling water is used to produce electricity. This method of energy generation has a long history, so the technologies are technologically mature and are actively used worldwide .
- The benefits of hydropower are significant. Firstly, it is a clean and environmentally friendly source of energy. Hydropower is expected to play an important role in the deep decarbonization of the energy sector. It should be noted that the capacity of hydropower has not changed much over the past 10 years
- The idea that hydropower is a completely carbon-free alternative to hydrocarbon energy, on a par with solar and wind, is controversial .
- Secondly, hydropower is highly efficient. Hydraulic structures, such as hydroelectric power stations and small hydropower, are capable of converting the kinetic energy of a water flow into electrical energy with high efficiency. hydropower is one of the most efficient ways to produce electricity of all renewable resources .

Solar Energy

- Solar energy, as a versatile resource, can be harnessed and converted into various usable forms.
- One common method is the conversion of solar energy into heat or electricity. Solar thermal systems use sunlight to generate heat, which can be used for heating water or spaces.

- On the other hand, photovoltaic (PV) systems convert solar energy directly into electricity using photovoltaic cells. Furthermore, solar energy can also be transformed into solar fuels. One prominent example is the process of photosynthesis, where plants and certain microorganisms convert solar energy into chemical energy .

Wind Energy

- Wind occurs due to horizontal gradients of atmospheric pressure, which, in turn, are the result of the uneven heating of the Earth's surface by the sun. Wind is a common atmospheric phenomenon and is present everywhere on our planet. However, different wind speeds and numbers of windy days are observed in different regions. Grasslands, deserts, coasts, and islands are rich in wind resources .
- The use of wind energy is another way to mitigate the effects of climate change. It is based on converting the kinetic energy of moving air into electrical energy using wind generators, which rotate under the wind's influence. Wind energy has a number of advantages that make it an attractive alternative for the energy sector
- The current worldwide installed capacity of wind energy has reached ~900 GW, creating significant interest from public and private investment companies in the further development of this sector .

Bio energy

The biomass of living organisms, usually plants, is a renewable source of energy. Its application is based on its ability to be used as a solid, liquid, or gaseous fuel for a wide range of applications, including biofuel for transport, power generation, house heating, and cooking.

- Biomass makes up 70% of all renewable energy sources, and its use provides ~14% of the annual global energy consumed .
- Today, bioenergy resources are usually divided into two categories. The first, traditional bioenergy is the main source of energy for more than a third of the world's population. Historically, it has been associated with the combustion of plant materials, wood, and agricultural and livestock waste. Traditional bioenergy poses a major challenge to sustainable development because it is deeply rooted in the daily lives of poor people in developing countries and provides them with vital energy services such as cooking and heating.
- The second category is modern bioenergy. It represents the development of technologies for using the biomass of living organisms to produce fuel products with a high added value.
- Various technological processes are used to convert biomass into energy, including thermochemical, chemical, and biochemical conversion methods. Through deep technological processing, biofuel and biogas are produced. Bioethanol and biodiesel are the most common types of biofuels used currently in private, public, and commercial transport.

Geothermal Energy

Geothermal energy is a renewable energy source based on the use of heat stored inside the Earth. Geothermal energy is obtained from hot underground reservoirs or geothermal wells that contain heated water or steam.

- This type of energy does not contain carbon, so its use produces virtually no anthropogenic emissions of greenhouse gases or other pollutants, which helps in reducing our negative impact on both the climate and the environment. This is consistent with combating climate change and achieving sustainable development goals through global energy transition.
- Compared to other renewable, carbon-free sources of energy such as solar and wind energy, geothermal energy has a number of advantages. It is characterized by high efficiency and high stability: it does not depend on the season or weather conditions .

Ocean Energy

- The use of ocean energy is one of the most promising areas for development in terms of renewable energy technologies .
- Oceans cover more than 70% of the Earth's surface and have enormous potential for energy production. There are generally five different forms of energy provided by the ocean: tidal energy, wave energy, ocean current energy, thermal energy, and osmotic energy .
- Tidal energy is one of the most common ways to harness ocean energy, extracting it from the tidal movements resulting from the gravitational interaction of seawater with the Moon or Sun. Tide energy includes the potential energy associated with water levels and the kinetic energy of the tidal current. Tidal energy installations are built at the border between the sea and land, so the use of tidal energy makes it possible to generate electricity both during high and low tides.
- The potential of tidal energy is estimated at approximately 1200 TW per year, which is a relatively low share of all ocean energy, since there are only a limited number of places where tidal energy may be collected .

Zero or green energy building

- Green building (also known as green construction, sustainable building, or eco-friendly building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance .
- Green buildings help reduce negative impacts on the natural environment by using less water, energy, and other natural resources; employing renewable energy sources and eco-friendly materials; and reducing emissions and other waste.
- There is no lack of studies investigating the costs and benefits associated with green building developments. The main purpose of these studies is to justify the value of going green which will assist decision making process

- In essence, these studies focus on pros and cons of green building developments compared to conventional buildings.
- A common approach adopted in existing studies is to compare the characteristics of green buildings to those of conventional buildings such as energy efficiency, water efficiency, indoor environmental quality, thermal comfort, health and productivity.

Importance of green building

Environmental

- It is well recognized that there are a number of benefits associated with green buildings. From environmental perspective, green buildings help to improve the urban biodiversity and protect the eco-system by means of sustainable land use .
- Reduction of construction and demolition waste is a critical component of sustainable building design .
- Indeed, the recycling rate has to be above 90% in order to mitigate the obvious environmental impacts of construction and demolition waste which means reused and recycled materials in new buildings.
- Compared with conventional buildings, green buildings generally provide higher performance reflected from energy efficiency, water efficiency and carbon emission reduction.
- Jo et al. stated that a large amount of CO₂ emission could be reduced (derived from energy efficiency) if LEED rating tools were adopted in all new construction works in Seoul. Their study showed that commercial buildings will benefit most from LEED certification in terms of CO₂ reduction, followed by residential buildings and public buildings.

Economic

- Turner and Frankel found that the LEED certified building can achieve more than 28% of energy savings compared to the national average level . Among these buildings, library appears benefit most from LEED certification in terms of energy efficiency.
- The cost savings are also associated with the improved building performance, particularly from the life cycle perspective. As a result, the operation cost is optimized. According to Economist, green building can save 30% of energy consumption than conventional buildings . The research report released by Davis Langdon showed that extra upfront cost is required for green office building than conventional office buildings . To achieve the GBCA Green 5 Star and 6 Star ratings, an extra construction cost of 4% and 10% are needed respectively. However, the cost of not going green is high as well, considering the carbon trade cost and rocket high energy price. The cost savings during the operation and maintenance stages will help to offset the upfront cost required for green building features.

Human aspects

- Some scholars argued there are other benefits associated with green building that are not directly cost related. These studies placed focus on human aspects and benefits from green

buildings. This is due to the fact that human beings stay in buildings for a considerable amount of time.

Thermal comfort

The satisfaction of building users is closely related to thermal comfort which is a complex dynamics of temperature and humidity. This has attracted extensive attention from researchers to simulating and measuring the thermal comfort level in green building compared to conventional buildings. As a result, the range of room temperature required could be proposed. Psychological, physiological, cultural and behavioral factors may play a role as well which attributes to adaptive thermal comfort

Methods to increase green building

- Life cycle assessment (LCA): The life cycle assessment (LCA) approach is one of most popular method to analyze the technical aspects of green buildings. In essence, LCA considers a building as a system, while quantifying the material flow and energy consumption flow across various stages of the life cycle.
- The advantage of LCA is to go beyond the traditional study of focusing on a single stage by extending the investigation to other stages as well, e.g. manufacturing and transportation of materials; energy consumption, water consumption and GHG emissions during the operation stage.
- Since 1990, LCA has achieved wide implementation in building assessments. This is reflected in a recent discussion paper from the GBCA which emphasize utilizing LCA to assess the environmental impacts of building materials in green building assessment.
- Referring to ISO 14040 and ISO 14044, LCA consists of four phases, i.e. goal and scope definition, inventory analysis, impact assessment, and results interpretation. LCA has been utilized to analyze the water consumption, energy consumption, carbon emission and cost of buildings.
- The LCA can be applied to either the entire building or individual components or materials to evaluate their impacts on environment hence improve building design Mahlia *et al.* conducted life cycle costing assessment on lighting retrofitting in a university in Malaysia as the lighting accounted for 42% of total electricity consumption of buildings.

Managerial

- There are multiple managerial aspects of green buildings, i.e. project level, company level and market level. At project level, specific project management skill sets are required for managing green buildings. According to Robichaud and Anantatmula, these differences include: involvement of specialist consultant on green buildings, adopting green building assessment methods such as LEED, providing green building related continuous education and training opportunities to employees, and engagement of external stakeholders

Behavioral/cultural

- The behavioral and cultural factors are also crucial for green building developments. Therefore, it is critical to raise the level of awareness of all stakeholders (e.g. clients, designers,

contractors, and end users) on concepts of sustainable development and green buildings. According to Hoffman and Henn, there are a large number of social and psychological related barriers to the implementation of green buildings such as over discounting the future, egocentrism, positive illusions and presumed associations. Indeed, they stated that "... [For the adoption of green building practices and LEED certification], obstacles faced by the green building movement are no longer primarily technological and economic. Instead, they are social and psychological."

- Based on a survey of occupants of GBCA certified office buildings, Kato et al. suggested that the benefits of green star certification are more psychological oriented (e.g. feeling good in such work environment) than physical (e.g. improved health and productivity) . McCunn and Gifford's study, however suggested that there is no statistically significant relationship between sustainable features of office and the attitudes and behaviors of employees toward environment. This is supported by Rashid et al.'s study which further pointed out that green building does not necessary improve the organization image directly . Rather, organization image is improved by green building indirectly due to higher level of satisfaction of occupants
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Introduction to the case study

- Shenzhen Vanke project is located in Banxuegang area, Buji town, Longgang district of Meilin, accessed by the Shenzhen Vanke Real Estate Co., Ltd. in 2003 through a public auction market, with a total area of 44.04 million square meters, 45.27 million square meters of construction area as well as more than 4,000 households. This project belongs to the residential project and has complete ancillary facilities which include commercial matching and nine-year public schools of 30,000 square meters.
- The four-phase of this project is located in the northeast of Shenzhen Vanke project, designed in June 2005 and completed in January 2009. It covers 96,201 square meters and 125,986.21 square meters of construction area.
- This project includes high-rise residential, low-rise residential, commercial, residential facilities and kindergarten. The number of high rise residential accounts for 81.2% of the total number; the green site rate takes up 38.1%; the high-rise residential utilized the shear wall structure while the low-rise residential used frame structure.

- In April 2006, the four-phase of Shenzhen Vanke Project had passed the review of the Country's top ten key energy conservation projects judged by the National Development and Reform Commission and was the only Green Building Integrated Demonstration Projects.
- In June 2006, the four-phase of Shenzhen Vanke Project had become the first batch of circular economy demonstration projects and the first green building demonstration projects. It has obtained a three-star grade for the design stage in March 2009 and three-star grade for the operational stage in February 2011.
- Project Description Its Phase 1 Science and Innovation Park, operational since October 2022, focuses on enhancing energy efficiency and relying on high-renewable energy sources (aiming for 100% green electricity during operation). This approach significantly trims the operational carbon footprint.

Key results of operational evaluation

- Land Saving and utilization
- Energy saving and utilization
- Water saving and utilization
- Material saving and utilization

Land Saving and utilization

- This project took the original topography, climate in the south, ecological planning and technical difficulties into account. The project is reasonable to develop the use of underground space, high-rise residential underground space for parking and equipment, low rise residential underground space for storage.
- Besides, it ultimately ensured the continued operation, reflecting the true value of the whole life-cycle of green building.

Energy saving and utilization

As Shenzhen belongs to such an area with hot summer and cold winter, therefore, based on its own climate characteristics, this project optimized the community planning and apartment design by introducing the concept of natural ventilation. For example, the opening of the window should be accounted for more than 10% of the floor area, which was higher than the design standard of 8%. Although it increased the construction cost, it was beneficial to the indoor natural ventilation.

The project uses the solar hot water system, in which the high-rise residential use a direct-insert solar vacuum tube hot water system. The lower house uses the solar panel hot water system. The upper and lower floors total 227 households use solar thermal system, accounting for the total number of 836 households 27%.

Water saving and utilization

- The four-phase of Shenzhen Vanke Project utilized 100% water-savings appliances which can effectively conserve water. It is the first project in the south with the wide use of reclaimed water. High-quality miscellaneous drainage, sewage is the sources of reclaimed water that can

be used in irrigation, road spraying, landscape watering and others. This system of scale waits for the developers to build water stations, and needs for recognition from society and customers, and asks for effective technology solution of high performance and easy maintenance which to some extent will hinder the promotion of water system. If the city voluntarily intervenes to provide the reclaimed water, then there will be a better solution with municipal reclaimed water usage.

Material saving and utilization

The four-phase of Shenzhen Vanke Project involved simple elements of residential building design. Decorative construction costs accounted for only 0.27% of the project cost which was far less than the requirements of 2%, and the buildings used 100% the ready mixed concrete. Solid waste produced in the project included cardboard, metals, concrete blocks, asphalt, beverage cans, plastic, glass, gypsum board, wood products, and others. Recycled waste took up 41.41% of the total amount of the wastes. Using recycled material is a very environmental and friendly way that not only saves money but also reduces carbon emissions, fully reflecting the necessity of material saving for green buildings.

Measures and suggestions for promoting green building

- With the development of globalization, green building evaluation systems in other countries are used for evaluating the architecture of China, of which BREEAM and LEED are the most commonly adopted. Whether the other evaluation systems are in line with Chinese national conditions and development remains to be further explored and studied. However, most of the interviewees' suggested similar measures to promote green buildings within the operational stages. Further, these measures can be used to overcome the barriers.

Central macro-control and local specific implementation

- Government is the policy maker, who develops the framework of green buildings, including laws, regulations, and incentive mechanism. Technically, the government is also the supporter of research and development.
- Green buildings cannot be separated from the application of new technologies. Therefore, the government has the responsibility to promote the development of technologies.
- Due to different climate conditions, specific standards for different regions are lacking. Evaluation systems should contain quantitative standards with high qualities, research and application on quantitative, qualitative index must be enhanced.

Coordination of various departments

- The construction and evaluation of green buildings is not a department's or agency's responsibility. It needs to take energy, land, water resources, material, indoor environment and other factors into account, which requires the coordination of the Development and Reform Commission, the Planning Department, Construction Department, Financial Department, Transportation Department and other departments as well as strengthened supervision and implementation of green buildings.

- All departments should study how investments in green buildings contribute to local economy. They should also launch a communication campaign to inform developers that green building offers a higher net operating income.

Implementing compulsory measures

- Most green building evaluation systems around the world are voluntary basis for the implementation, which requires a high degree of consciousness of the enterprise. However, it is necessary to take compulsory measures for some large construction projects from the long term interests.
- The government should play an important role in promoting green building implementation. According to the interviews, in China, there is a requirement to obtain a green building design evaluation label, before obtaining the construction permit. This strategy has a significant impact on developing green designs. However, this approach can further be extended to cover the operational phase as well.

Training professionals of green buildings

- Lack of knowledge of technologies has become an obstacle in green building development. The existing evaluation system does not qualify green buildings from the personal perspective. Therefore, it is necessary to train relevant personnel as well as conduct qualification examination.
- The government should continue to support research and development on energy saving technologies for promoting technical communication. Moreover, improving the level of property management is equally important.
- Currently, the personnel of property management do not understand the true meaning of green buildings, which greatly affects the operational stage of green buildings. Therefore, it is necessary to pay additional attention for strengthening the cultural quality and professional level of property management personnel, and thus improving their awareness of green buildings.

Green buildings have many benefits, including:

- **Environmental impact:** Green buildings reduce their negative impact on the environment by using less energy, water, and natural resources. They also reduce emissions and waste.
- **Energy efficiency:** Green buildings use energy-efficient design features like advanced insulation, efficient HVAC systems, and renewable energy sources. This can lead to significant cost savings for building owners and occupants.
- **Water efficiency:** Green buildings use water resources wisely to ensure a reliable supply of clean water.
- **Waste reduction:** Green buildings focus on reducing waste by reusing construction materials and using compost bins.

- **Indoor air quality:** Green buildings have better indoor air quality, which can have a positive impact on human health.
- **Work environment**
- Green-certified office buildings can offer a superior work environment by integrating high quality environmental features, such as access to sunlight.
- **Corporate image**
- Green buildings can help companies benefit from a green corporate image and leave a positive impression on customers, employees, business partners and shareholders.
- **Cost advantages**
- Green buildings tend to have lower operating costs, which can attract savvy buyers.

Literature review

- Pandey *et al.* (2011) Carbon footprint has emerged as a strong mode of GHG expression. While earlier studies focused only on CO₂ emissions as the guidelines and suggested inclusion of all the important GHGs in calculation, carbon footprint started becoming synonymous to a comprehensive GHG account, over the life cycle stages of any product or activity. No definition, however, has yet been accepted coherently as is clear from the fact that there are different selection of gases and tiers among studies.
- Lobuset *al.* (2023) There is an urgent need to change existing production systems in order to reduce greenhouse gas emissions and to sequester them. In this review, we consider up-to-date scientific approaches and innovative technologies, which may help in developing roadmaps to reduce the emissions of climate-active gases, control rising temperatures, decarbonize economies, and promote the sustainable development of society in general.
- Zuo *et al.* (2013) It is found that the existing studies played predominately focus on the environmental aspect of green building .Other dimensions of sustainability of green building, especially the social sustainability is largely overlooked. Future research opportunities were identified such as effects of climatic conditions on the effectiveness of green building assessment tools, validation of real performance of green buildings, unique demands of specific population ,and future proofing.
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CONCLUSION

Based on the case study results, this paper also analyzed the barriers of operating green buildings and provided suggestions for further measures and developments. The promotion of effective operating green buildings as per design requirements must combine the participation of various stakeholders with the concept of sustainable development, life-cycle consideration, and other related concepts. Considering the status of green buildings and basic national conditions, stakeholders should find a suitable road for the development of green buildings while paying full attention to the operational stages of green buildings.

From the aggravation that climate gets to the exhaustion of the resources that nature has, the catcher of a high carbon footprint is too far-reaching. It is extremely threatening to biodiversity; it disturbs ecosystems and ruins the fine-tuning of the planet's climate.

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- Carbon footprinting must be harnessed as a strong tool to promote GHG emission reductions among businesses, events, and civil society and should be included as indicator of sustainable development

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