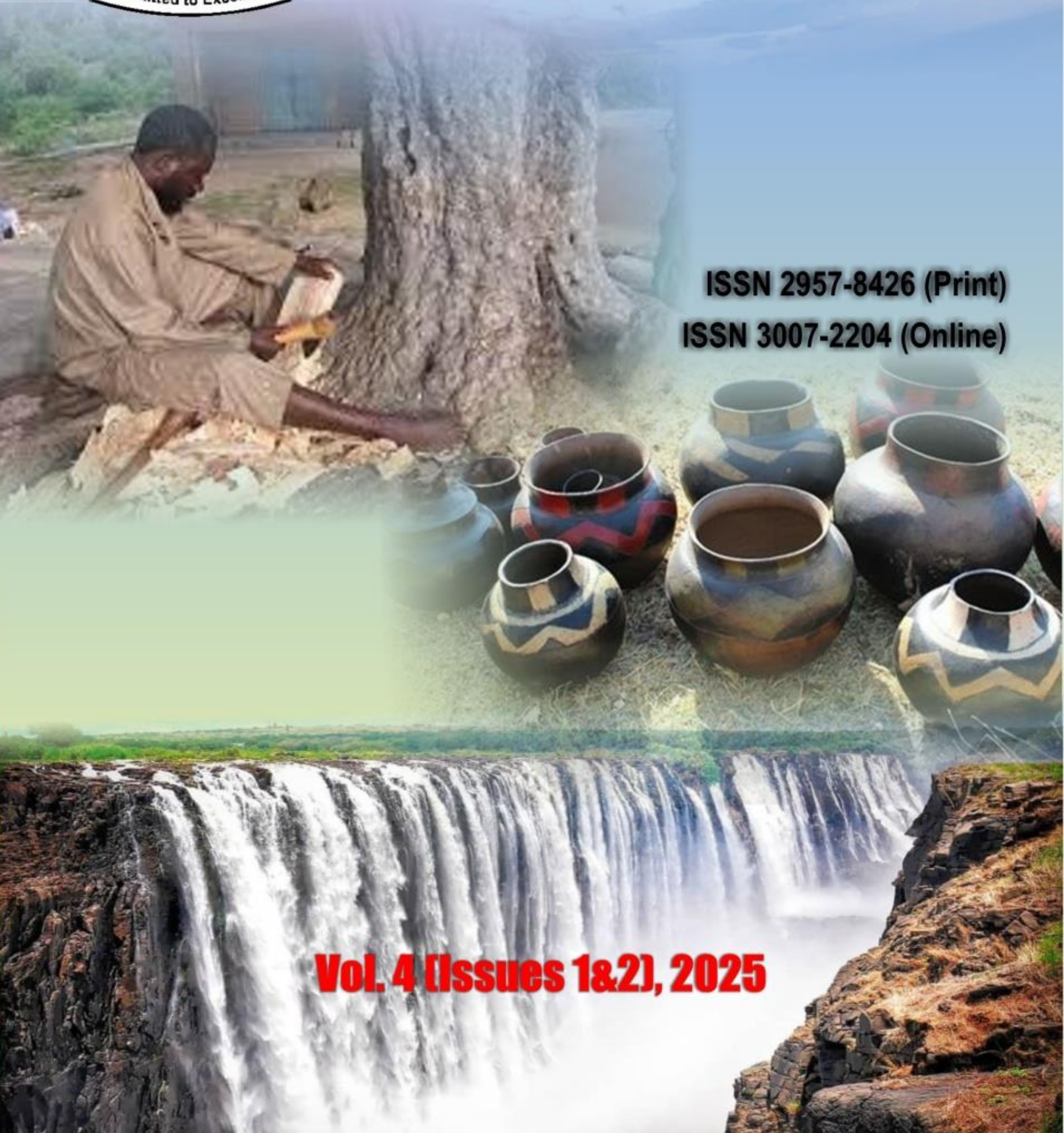
ZEGU
ZIMBABWE
EZEKIEL GUTI
UNIVERSITY
Committed to Excellence

KUVEZA NEKUUMBA

THE ZIMBABWE EZEKIEL GUTI UNIVERSITY
JOURNAL OF DESIGN, INNOVATIVE THINKING AND PRACTICE

ISSN 2957-8426 (Print)
ISSN 3007-2204 (Online)



Vol. 4 (Issues 1&2), 2025

©ZEGU Press 2025

Published by the Zimbabwe Ezekiel Guti University Press
Stand No. 1901 Barrassie Rd,
Off Shamva Road
Box 350
Bindura, Zimbabwe

All rights reserved

"**DISCLAIMER**: The views and opinions expressed in this journal are those of the authors and do not necessarily reflect the official position of funding partners"

Typeset by Divine Graphics
Printed by Divine Graphics

EDITOR-IN-CHIEF & MANAGING EDITOR
Innocent Chirisa, Zimbabwe Ezekiel Guti University.

EDITORIAL ADVISORY BOARD

Dr Tawanda Mushiri, University of Zimbabwe, Zimbabwe
Professor Trynos Gumbo, University of Johannesburg, South Africa
Dr Peter Kwaira, University of Zimbabwe, Zimbabwe
Professor Chakwizira, North West University, South Africa
Dr Average Chigwenya, National University of Science and Technology, Zimbabwe
Dr Edgar Muhoyi, University of Zimbabwe, Zimbabwe
Mr Brilliant Mavhima, University of Zimbabwe, Zimbabwe
Dr Emily Motsi, Freelance Researcher, Zimbabwe
Dr Samuel Gumbe, University of Zimbabwe, Zimbabwe

SUBSCRIPTION AND RATES
Zimbabwe Ezekiel Guti University Press Office
Stand No. 1901 Barrassie Rd,
Off Shamva Road
Box 350
Bindura, Zimbabwe
Telephone: ++263 8 677 006 136 | +263 779 279 912
E-mail: zegupress@admin.uz.ac.zw
http://www.zegu.ac.zw/press

About the Journal

JOURNAL PURPOSE

The purpose of the *Kuveza neKuumba - Zimbabwe Ezekiel Guti University Journal of Design, Innovative Thinking and Practice is* to provide a forum for design and innovative solutions to daily challenges in communities.

CONTRIBUTION AND READERSHIP

Planners, engineers, social scientists, business experts, scholars and practitioners from various fields.

JOURNAL SPECIFICATIONS

Kuveza neKuumba - Zimbabwe Ezekiel Guti University Journal of Design, Innovative Thinking and Practice

ISSN 2957-8426 (Print)
ISSN 3007-2204 (Online)

SCOPE AND FOCUS

The journal is a forum for the discussion of ideas, scholarly opinions and case studies of multidisciplinary perspectives of design and innovative thinking. The journal is produced bi-annually.

Guidelines for Authors for the Kuveza Nekuumba Journal

Articles must be original contributions, not previously published and should not be under consideration for publishing elsewhere.

Manuscript Submission: Articles submitted to the *Kuveza neKuumba - Zimbabwe Ezekiel Guti University Journal of Design, Innovative Thinking and Practice are* reviewed using the double-blind peer review system. The author's name(s) must not be included in the main text or running heads and footers.

A total number of words: 5000-7000 words and set in 12-point font size width with 1.5 line spacing.
Language: British/UK English
Title: must capture the gist and scope of the article
Names of authors: beginning with the first name and ending with the surname
Affiliation of authors: must be footnoted, showing the department and institution or organisation.
Abstract: must be 200 words
Keywords: must be five or six containing words that are not in the title
Body: Where the authors are more than three, use *et al.,*
Italicise *et al., ibid.,* words that are not English, not names of people or organisations, etc. When you use several authors confirming the same point, state the point and bracket them in one bracket and ascending order of dates and alphabetically separated by semi-colon e.g. (Falkenmark, 1989, 1990; Reddy, 2002; Dagdeviren and Robertson, 2011; Jacobsen *et al.,* 2012).

Referencing Style: Please follow the Harvard referencing style in that:
— In-text, citations should state the author, date and sometimes the page numbers.
— the reference list entered alphabetically, must include all the works cited in the article.

In the reference list, use the following guidelines, religiously:

Source from a Journal

Anim, D.O and Ofori-Asenso, R. (2020). Water Scarcity and COVID-19 in Sub-Saharan Africa. *The Journal of Infection, 81*(2), 108-09.

Banana, E, Chitekwe-Biti, B and Walnycki, A (2015). Co-Producing Inclusive City-Wide Sanitation Strategies: Lessons from Chinhoyi, Zimbabwe. *Environment and Urbanisation*, *27*(1), 35-54.

Neal, M.J. (2020). COVID-19 and Water Resources Management: Reframing Our Priorities as a Water Sector. *Water International*, *45*(5), 435-440.

Source from an Online Link

Armitage, N, Fisher-Jeffes L, Carden K, Winter K *et al.,* (2014). Water Research Commission: Water-sensitive Urban Design (WSUD) for South Africa: Framework and Guidelines. Available online: https://www.greencape .co.za/assets/ Water-Sector-Desk-Content/WRC-Water-sen sitive-urban-design-WSUD-for-South-Africa-framework-and-guidelines-2014.pdf. Accessed on 23 July 2020.

Source from a Published Book

Max-Neef, M. (1991). *Human Scale Development: Concepts, Applications and Further Reflections,* London: Apex Press.

Source from a Government Department (Reports or Plans)

National Water Commission (2004). Intergovernmental Agreement on a National Water Initiative. Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory. Available online:https://www.pc.gov.au/inquiries/completed/ water -reform/national-water-initiative-agreement-2004.pdf. Accessed on 27 June 2020.

The source being an online Newspaper article

The Herald (2020). Harare City Could Have Used Lockdown to Clean Mbare Market. *The Herald*, 14 April 2020. Available online: https://www.herald.co.zw/harare-city-could-have-used-lockdown-to-clean-mbare-market/. Accessed on 24 June 2020.

Energy Efficiency in Existing Buildings that were Constructed before the Green Building Agenda was Mooted

WILLOUGHBY ZIMUNYA[1] AND AARON MHLANGA[2]

Abstract

The article is based on a study that investigated the challenges and strategies in retrofitting older buildings in Mutare City, Zimbabwe, to improve their energy efficiency and sustainability. The existing buildings significantly account for global energy consumption and carbon emissions, thereby contributing to rapid climate change and its associated problems. This necessitates urgent action to enhance energy efficiency in existing buildings in many cities, particularly those built before the Green Building Agenda through green retrofitting. Several developed countries have made strides in retrofitting existing buildings in urban areas to achieve the goals of green retrofit designs. Despite these successes in developed countries, the implementation of retrofitting has remained slow in developing countries due to several barriers, with significant implications for addressing climate challenge issues. This article examines the challenges to implementing energy-efficient technologies in these structures and explores strategies which have improved energy efficiency in similar situations. The qualitative research approach was employed to guide the study using the case study research design. Participants were selected through non-probability sampling techniques. The data were collected through the interview and observation methods. It was analysed through

[1] Department of Demography Settlement and Development, University of Zimbabwe, Harare, Zimbabwe, https://orcid.org/0000-0002-4789-9338, wzimunya70@gmail.com

[2] Department of Architecture and Real Estate, University of Zimbabwe, Harare, Zimbabwe,https://orcid.org/0009-0005-4585-5840, mhlangaaaron2020@gmail.com.

thematic analysis and presented textually through narrative description. Findings reveal that the barriers to improving energy efficiency in old buildings in Mutare are socioeconomic, technical and regulatory factors. It is also revealed that a multiplicity of strategies can be used to address challenges impeding green retrofitting of old buildings in Mutare. Conclusively, it emerged that addressing these barriers is a necessity and requires a multifaceted approach. The recommendation involves adopting a multifaceted approach to tackle the challenges affecting green retrofitting to optimise the energy performance of the existing building stock.

Keywords: old building, energy inefficiency, climate change, sustainability green retrofitting, carbon footprint.

INTRODUCTION

Existing buildings constructed before the adoption of the Green Building Agenda account for high global energy consumption of nearly 36% (Bello and Olufemi, 2024). Unlike green and newer buildings, which have energy-saving systems, many older buildings were constructed without energy efficiency aspects, leading to high energy demands for cooling, heating and lighting (Azhgaliyeva and Rahut, 2022). The energy demands are exacerbated by rapid urban growth and the high prevalence of older structures which are not green building compliant and characterised by poor insulation and inefficient heating, ventilation and air conditioning (HVAC) systems. This high energy consumption in existing buildings is a problematic issue in many ways. Economically, it strains resources and also increases operational costs for owners and occupants. In addition, environmentally it contributes significantly to global carbon emissions which are about 39%, including 28% from operational energy use (Iwuanyanwu *et al.*, 2024). The reliance on fossil fuels for energy further exacerbates greenhouse gas emissions (GHG) (Santos, 2022) These increasing emissions are also leading to major climatic changes with huge socio-economic and environmental impacts (Clarke *et al.*, 2022). For instance, Aryal *et al.* (2021) allude that rapid climate changes emanating from high carbon emissions are causing droughts, destruction of assets, loss of lives and suffering of people across the globe.

In the context of climate change and its negative impacts, reducing the carbon footprint of existing buildings is becoming crucial. It is more urgent, particularly in urban areas of developing countries like Zimbabwe, which are grappling with the dual challenge of managing huge stocks of older buildings while striving to meet modern energy performance standards. The experiences in countries like Canada, the United States of America, the United Kingdom, Australia, Korea and Japan, demonstrate that implementing green building practices (Dwaikat and Ali, 2018) through sustainable retrofitting of older buildings can play a key role in combatting climate. The Green Building Agenda aims to mitigate climate change impacts by promoting sustainable construction and maintenance practices that integrate saving energy in buildings to promote sustainability (Liu *et al.*, 2022) Mostafavi *et al.* (2021) and Kwakye *et al.* (2024) have noted that retrofitting can significantly lower emissions to support global climate action efforts by enhancing energy efficiency and integrating renewable energy sources in older buildings. The retrofitting process involves the updating and modification of existing buildings to improve their energy efficiency, sustainability and overall performance (Sharma *et al.*, 2022). This includes upgrading HVAC systems, enhancing insulation, integrating renewable energy sources and employing smart building technologies (Dadzie *et al.*, 2022). Its ultimate aim is to reduce energy consumption and carbon emissions, improve thermal comfort and extend the lifespan of the building.

Despite all the benefits of having energy-efficient buildings to achieve environmental sustainability, reduce costs, increase property values and improve liveability, the acceptance and adoption of green building practices through the green retrofitting of existing buildings, is still low in developing countries (Oguntona *et al.*, 2019; Ejidike and Mewomo, 2022; Amoah and Smith, 2024). The failure to improve the energy efficiency of existing older buildings in the context of high energy demand and increasing carbon emissions, has environmental, economic and social implications for society. Therefore, it is against this background that this article aims to investigate the specific barriers affecting the green retrofitting of older structures in developing countries to improve their energy performance using the case study of Zimbabwe. By examining socio-economic, technical and regulatory factors that hinder the adoption of energy-efficient technologies, this study aims to provide insights into effective strategies that have proven successful in similar contexts. Ultimately, the findings will underscore the necessity for a multifaceted approach grounded in innovation and green building principles to optimise the energy performance of existing buildings in Mutare City. By identifying and assessing the barriers, the study aims to enlighten and encourage the built environment professionals and building owners on the need to undertake green retrofitting measures for the existing building. The following sections will delve deeper into the specific challenges and strategies for sustainable retrofitting of older buildings, providing a comprehensive overview of the relevant issues.

CONCEPTUAL FRAMEWORK

Presented here is the conceptual framework that addresses the integration of green building principles into the retrofitting of old structures within urban areas, with a specific focus on combating climate change. The need for this framework arises from the significant contribution of existing buildings to global energy consumption and GHG emissions, which are critical factors in climate change. The central issues for discussion in the framework are the context of the research problem and the challenges and strategies for retrofitting old buildings to enhance energy efficiency and sustainability within the context of the Mutare urban area. It also highlights the goals of green retrofitting and the implications of not retrofitting buildings constructed before the adoption of the green building concept.

Older buildings account for a substantial portion of energy use and carbon emissions globally. The high energy consumption and carbon emissions contribute to climate change which causes environmental, social and economic problems and impacts particularly urban areas. Green retrofitting these structures is essential for achieving sustainability goals and reducing environmental impact. Green retrofitting involves upgrading existing buildings to improve their energy efficiency and reduce socioeconomic and environmental impacts (Tawfik, 2023; Amoah and Smith, 2024). There are several case successful studies of retrofitting programmes for old buildings across the globe. The experiences of countries, like China, Canada, the United States of America, the United Kingdom, Australia, Korea and Japan, demonstrate that implementing green building practices (Dwaikat and Ali, 2018; Lin *et al.*, 2023) through green retrofitting of older buildings can play a key role in achieving green retrofit design goals. The goals of green retrofitting include improving energy efficiency reducing carbon emissions to combat climate change and ensuring that existing buildings meet contemporary environmental standards (Tawfik, 2023). For example, a recent study by Amoah and Smith (2024), indicates that green buildings produce 33% fewer carbon emissions, use up to 45% less energy and have higher occupant satisfaction than non-green buildings. This study demonstrates the benefits of green retrofitting older structures.

While green retrofitting existing buildings has several benefits, including combating climate change, there are several challenges in implementing it, particularly in developing countries (Tawfik, 2023). One of the factors are structural features of older buildings that may not accommodate modern energy-efficient technologies (Oseghale, Abiola-Falemu and Oseghale, 2015). Apart from that limited technical capacity and knowledge about sustainable building practices, is undermining the green retrofitting of the existing structures (Amoah and Smith, 2024). Besides that, economic barriers in the form of high initial costs also affect the retrofitting of existing buildings (Bassey and Ibegbulam, 2023). Moreover, another factor affecting the retrofitting of existing buildings are regulatory barriers in the form of outdated policies, legislation and standards (Nguyen *et al.,* 2017; Juliardi *et al.*, 2019).

It is important to note that retrofitting existing buildings to enhance energy efficiency to achieve sustainability is both feasible and beneficial, despite various challenges. The key strategies include providing financial support to building owners in the form of subsidies or low-interest loans to encourage building owners to invest in retrofitting projects (Amoah and Smith, 2024). These incentives help alleviate the high initial costs associated with retrofitting (Sharma, 2022; Leung, 2024). Besides that, investing in innovations (Tawfik, 2023) and sustainable technologies such as renewable energy sources, assists in overcoming technical barriers in green retrofitting (Lin *et al.*, 2023; Setty and Sriram, 2024). Additionally, it enhances communication to stakeholders about the benefits of green retrofitting existing buildings (Smith, 2018), as many building owners are hesitant to invest in such projects because they are uninformed about their enduring advantages. Finally, it is noteworthy that streamlining regulatory instruments and procedures is another important strategy to address barriers to implementing green retrofitting in existing buildings (Iwuanyanwu *et al.*, 2024; Liu *et al.*, 2023). These strategies collectively contribute to more sustainable and efficient existing buildings.

This conceptual framework has explored the intersection of existing buildings, climate change and green retrofitting. It has shown the need for green retrofitting of older structures, highlighting the economic, social and environmental benefits. It has also examined the challenges faced in retrofitting existing buildings, including technical, financial, regulatory and logistical hurdles. It has also highlighted promising solutions to these challenges in the form of innovations in energy-efficient technologies, renewable energy integration, smart building technologies, renovation of the building envelope, upgrading of the building system and sustainable materials, capacity building and policy reforms. Overall, the framework has demonstrated that retrofitting existing buildings through a multifaceted approach for sustainability is essential for addressing the significant economic, social and environmental benefits of the current building stock constructed before the adoption of the green building concept.

LITERATURE REVIEW

The article focuses on investigating the challenges and possible strategies for retrofitting existing buildings in urban areas in Zimbabwe, with a particular focus on Mutare City. Therefore, this section reviews literature on the intersection of existing buildings, climate change and green retrofitting to draw insights into similar situations to situate the study. It examines the problems of existing buildings and the need for green retrofitting of these older structures. It explores the barriers to retrofitting existing buildings in urban areas and the strategies that can be implemented to retrofit the buildings.

The energy efficiency of existing buildings constructed before the adoption of the green building concept, must be improved to mitigate climate change and its impacts. Climate change is a major global issue and its mitigation is considered to be the shared responsibility of all countries in the world in line with Sustainable Development Goal Number 13 (SDG13) of the United Nations (Lin *et al.*, 2023). These existing buildings are major energy consumers and contributors to GHG emissions (Bello and Olufemi, 2024). Around 75% of existing buildings are inefficient in energy use (European Commission, 2020). Unlike green and newer buildings, which have energy-saving systems, many older buildings were constructed without energy efficiency aspects, leading to high energy demands for cooling, heating and lighting (Azhgaliyeva and Rahut, 2022). The energy demands are exacerbated by rapid urban growth and the high prevalence of older structures which are not green building compliant and characterised by poor insulation and inefficient HVAC systems.

To demonstrate the energy inefficiency of existing buildings, it is estimated that approximately 40% of the global energy stock is consumed by existing unsustainable buildings (World Green Building Council; 2020). Further, Liu *et al.* (2023) observes that in China, the highest energy consumer in the world which accounts for about 26.5% of the world's primary energy consumption, 90% of the existing buildings are not energy efficient. Their poor energy performance, coupled with the harsh climate and rapid urbanisation, has exerted huge pressure on energy resources and environmental implications.

In light of the rising trends in global energy consumption and carbon emissions and their associated consequences, various initiatives are being implemented to improve the energy performance of existing buildings. One of the solutions has been the green retrofitting of existing buildings. This refers to the change in the existing building to increase its energy efficiency, reduce negative impacts and operating costs and maintain occupant comfort (Amoah and Smith, 2024). Green retrofitting involves incorporating green design principles into existing buildings retrospectively. There are several reasons to integrate these principles in the existing building stocks, including enhancing energy efficiency, achieving climate change's medium- and long-term objectives and shifting towards a sustainable, low-carbon economy by 2050 (Nationwide Construction, 2016; European Commission, 2020). As argued by recent research, green retrofitting has improved energy efficiency, improved building performance, increased tenant happiness and increased economic return while lowering GHG emissions (Lin *et al.*, 2023; Amoah and Smith, 2024).

There are several examples of case studies and success stories of implementing green retrofitting. For instance, Singapore is testimony to implementing the green building concept. She has many green buildings that increased from 20 in 2005 to about 2 100 by 2015 (Hwang *et al.*, 2017). The Government of Singapore has contributed immensely by financing programmes to ensure the integration of green building principles (*ibid.*). There are about 32 government financing programmes for sustainable construction in Singapore (Tan and Kwek, 2015). These include the Building Retrofit Energy Efficiency Financing and Green Mark Incentive Scheme for Existing Buildings which provides credit facilities to building owners to undertake energy efficiency retrofits (Hwang *et al.*, 2017). In addition, experiences of countries like Canada, the United States of America, the United Kingdom, Australia, Korea and Japan, also amply demonstrate the sustainability benefits of implementing green building practices (Dwaikat and Ali, 2018)

While some countries are implementing green retrofitting to address the problem of high energy consumption and carbon emissions to achieve environmental sustainability, others, particularly developing countries, are still lagging (Oguntona *et al.*, 2019; Ejidike and Mewomo, 2022 Amoah and Smith, 2024). Several barriers hinder the effective implementation of retrofitting initiatives. These challenges include insufficient regulatory frameworks, lack of financial resources and limited public awareness about the benefits of green buildings. These challenges vary by region but often include economic, regulatory, social and technical factors as explained below.

Barriers to Retrofitting Buildings for energy efficiency and sustainability Economic Barriers

Bose *et al.* (2012) established an approach termed “financial gradients”, to question financial flows in sustainable construction projects. This scheme can support identifying and securing a single, long-term even inflow of finance to sustain the process of sustainable construction projects. Bassey and Ibegbulam (2023) point out that there are high initial costs associated with retrofitting existing buildings. The upfront costs associated with retrofitting can be prohibitively high, discouraging investment from property owners and developers. In South Africa, for instance, high investment costs and low consumer appeal have been identified as significant barriers.

In addition, inadequate funding is another economic barrier that limits initiatives on building energy efficiency. Ekechukwu and Simpa (2024) articulate that lenders are hesitant to fund retrofitting projects due to uncertainty in financial returns. Many regions face a lack of financial resources to support retrofitting projects. In Zimbabwe, inadequate finance for energy investments has been highlighted as a major obstacle. Furthermore, income levels also paralysed the initiatives. Economic disparities often mean that many individuals and organisations cannot afford the costs associated with retrofitting, leading to low uptake of energy-efficient technologies.

Regulatory Barriers

The legislative and institutional are identified as the hurdles to green building (Nguyen *et al.*, 2017). Outdated building regulations restrict the retrofitting of projects. Many African countries have building codes which do not adequately address modern energy efficiency standards. For example, the absence of definitive legal requirements in South Africa's National Building Regulations has been a barrier to implementing energy efficiency measures. The lack of government support remains a stumbling block to effectively practise building retrofitting. The regulatory and planning gaps have limited the public sector from being at the forefront of improving energy efficiency in buildings (Juliardi *et al.*, 2019). There is often insufficient governmental policy support or incentives to encourage retrofitting initiatives. In Zimbabwe, outdated policies have not kept pace with the need for energy efficiency improvements.

Social Barriers

Socially, retrofitting old buildings is plagued by occupant resistance. Property occupants may resist changes due to concerns about disruptions during the retrofitting process or scepticism about the benefits of energy efficiency upgrades. However, Juliardi *et al.,* 2019) note lack of awareness and occupants' resistance as the major impediments to sustainably retrofitting existing buildings. A general lack of awareness about the benefits of energy efficiency can impede efforts to promote retrofitting. Many stakeholders may not fully understand how retrofitting can lead to long-term savings and environmental benefits.

Technical Barriers

Lack of training of sustainable practices in the construction industry is leading to shortfall of skilled labour (Oseghale, Abiola-Falemu and Oseghale, 2015). There is often a shortage of skilled professionals who are knowledgeable about modern retrofitting techniques and technologies. This gap in expertise can lead to poorly executed projects which fail to deliver the expected results. In addition, the availability of building materials also determines the uptake of green buildings. In some regions, the unavailability or high cost of materials necessary for retrofitting can delay or prevent projects from being completed successfully.

Addressing barriers affecting the effective implementation of retrofitting initiatives is feasible. It requires a multifaceted approach, involving the implementation of several innovative strategies. One of the strategies is continuous investment and innovation in retrofitting technologies and practices (Ekechukwu and Simpa, 2024). The other strategy is providing public financial support by implementing government financial incentives and subsidies such as tax credits, grants or low-interest loans, to encourage building owners to invest in retrofitting projects. These incentives help alleviate the high initial costs associated with retrofitting (Amoah and Smith, 2024). This can be achieved through public-private partnerships involving collaborations between government entities and private firms to facilitate funding and resource sharing, thereby making retrofitting projects more financially viable (Iwuanyanwu *et al.*, 2024). The other strategy is to conduct enhanced public awareness campaigns by educating stakeholders This involves disseminating comprehensive information about the long-term benefits of retrofitting such as reduced energy costs, increased property value and improved occupant comfort and quality of life (Amoah and Smith, 2024). These awareness campaigns can help persuade building owners to undertake retrofitting initiatives. For instance, it is argued that the sharing of successful retrofitting examples in the form of case studies and success stories during educational campaigns can illustrate the benefits of retrofitting and motivate other property owners to follow suit.

Another key strategy lies in enhancing communication with stakeholders about the benefits of green retrofitting existing buildings. Many building owners are hesitant to invest in such projects because they are uninformed about their enduring advantages. Thus, Smith (2018) alludes that educating stakeholders about reduced energy costs, increased property values and improved occupant comfort resulting from retrofitting existing buildings, can help bridge this gap. He also suggests that encouraging industry organisations to advocate for sustainable building practices can lead to broader acceptance and implementation of retrofitting strategies across different sectors. Furthermore, Iwuanyanwu *et al.* (2024) argue that sharing case studies and success stories from previous retrofitting projects can serve as powerful examples, illustrate the benefits of retrofitting and motivate other property owners to follow suit. However, the success of this strategy has implications for the development of a clear communication strategy to guide the implementation of the awareness-raising and advocacy activities on green retrofitting of existing buildings.

On the technical front, investing in innovations is vital to overcoming compatibility issues between new systems and existing structures. Studies by Peiris *et al.* (2023) and Iwuanyanwu *et al.* (2024) show that integrating smart technologies, such as energy-efficient HVAC systems, smart lighting solutions and renewable energy sources like solar panels, can significantly enhance the energy efficiency and sustainability of retrofitted older buildings. Additionally, Peiris *et al.* (2023) indicate the adoption of adaptive engineering solutions also plays a crucial role by addressing structural limitations and ensuring that new systems seamlessly integrate with older designs. However, the success of this strategy is dependent on the availability of competent technical capacity among other issues which has implications on the development of local expertise in energy-efficient technologies.

It is noteworthy that streamlining regulatory tools and procedures is one of the important strategies to address barriers to implementing green retrofitting in existing buildings. This is because outdated building codes often fail to align with modern sustainability practices, creating obstacles for retrofitting efforts. Therefore, updating these codes to reflect current technologies and standards is essential (Iwuanyanwu *et al.*, 2024). Additionally, Amoah and Smith (2024) argue that simplifying permitting processes is another way to streamline retrofitting initiatives. Essentially, by reducing bureaucratic red tape, property owners can implement their retrofitting projects more efficiently.

This review has examined the implications of existing buildings focusing on their energy consumption and carbon emissions and the resultant sustainability impacts and other outcomes. The review show that existing buildings that are not green are a major contributor to high energy consumption and carbon emissions, leading to major climate change. This highlights the need to improve their energy efficiency to reduce carbon. While retrofitting existing buildings offers solutions to reduce their sustainability impacts, it is faced with numerous challenges. These include financial constraints, regulatory hurdles and technical difficulties. However, it emerged that to effectively implement retrofitting initiatives, various strategies can be employed to address these challenges. By overcoming these challenges, many nations can significantly improve their existing building stock's energy efficiency and contribute to broader sustainability goals.

STUDY DESIGN AND METHODOLOGY

This section describes the methodology used by the study to gather and collect data aimed at answering the research in question. The research employed the qualitative approach and the case study research design to gain deep insights into contemporary phenomena in real-world settings (Patnaik and Pandey, 2019). The target population of the study where participants were selected, included experts in the built environment drawn from government departments and agencies, council officials and the private sector in the City of Mutare. The participants included engineers, architects, urban planners, quantity surveyors and realtors. These were selected through purposive and snowball sampling techniques. Data were collected using semi-structured interviews and observations. The interviews with the selected participants were conducted in person and virtually, where the participants were not available for physical interactions. Each interview took about 40 to 50 minutes. The benefit of using an interview method in the study was that while it allowed the interviewers to prepare questions ahead of time, it still left room for the follow-up questions during the interview. It also allowed for a more relaxed environment where the interviewee felt safe to express their own opinion regarding the topic. The interview method was chosen because it allowed interviewees to elaborate on specific questions or statements, thereby providing reliable qualitative data. The data collection through observations involved assessing the conditions of selected existing structures to check whether they possessed characteristics of green buildings or not. This process was guided by a checklist and assisted in understanding the nature of the problems affecting the existing non-green buildings.

The thematic analysis method was used to analyse the findings by identifying patterns in the data and developing a framework and themes from the responses to questions. Following this, interpretation of the data was done to derive meanings to enhance a comprehensive understanding of the informant's viewpoints and observations that were made. To ensure the validity and reliability of the research, guidelines proposed by Noble and Smith (2015) were followed. Thus, the research accurately recorded the data and ensured that the interpretation of data was consistent; sought out similarities and differences across all data to ensure that all perspectives were covered. The findings of the study were presented textually through narrative description.

The methodology proved very effective for the study as it enabled it to collect data on the importance and challenges of retrofitting older buildings in Mutare City and, furthermore, allowed the collection of data retrofitting strategies that can be adopted to promote energy efficiency and reduce carbon emissions in existing buildings. Overall, this methodology assisted in illuminating a deeper understanding of issues around existing buildings in Mutare City and how they can be addressed.

FINDINGS

This section presents the results of the study carried out in Mutare City. It outlines the barriers and opportunities to implementing energy-efficient technologies and strategies that can be used to improve energy efficiency in similar situations.

Participants indicated financial constraints as the primary barrier limiting property owners' ability to invest in retrofitting. Mutare City is enduring high costs of building materials which escalates the construction cost. The majority prefer immediate financial benefits over long-term benefits. Furthermore, some property owners lack access to affordable financial options such as loans or grants and many do not possess title deeds for the properties. The available building societies are demanding high interest rates of 17% to obtain the money market. The results show that houses in in Sakubva (Old Township), including Chinyausunzi and Chisamba suburbs are in a deplorable state. Economic disparities are deemed to cause low uptake of energy-efficient technologies in existing buildings. Most city residents are involved in the informal sector, therefore flagging extreme poverty. Participants indicated that their livelihoods system, given their proximity to Beira, Mozambique, is centred on vending of fruits and used clothes. This henceforth reduces per capita income which is essential for retrofitting the old buildings they occupy.

Interviews revealed that there is a lack of understanding and awareness regarding the benefits of energy efficiency, which stagnates green building initiatives. More than 55% of the participants expressively showed unfamiliarity with innovative technologies that promote building retrofitting. During power cuts, residents use cell phone torches, candles, LP gases, firewood and charcoal for cooking and lighting. One of the respondents said: “All houses are connected to electricity, but the major challenge is unreliability, with power returning at odd hours we cannot use it” They added that utilising renewable energy sources for cooking and refrigeration is a permanent solution, as it reduces our energy bills.’

In addition, technical barriers were noted as the major barriers. The findings indicate older builders are dilapidated, which is most difficult to apply modern energy-efficient technologies. Some of the buildings exceeded their lifespan. One of the participants articulated that there are limited skills in how to repair these buildings to promote liveability. Many contractors and builders in construction lack energy-efficient practices, leading to over-reliance on traditional methods which do not prioritise energy efficiency. This significantly affects the effectiveness of achieving retrofitting outcomes.

It also emerged that there existed a clear lack of effective and updated regulatory frameworks. There is no clear policy which promotes green building of old buildings to effectively promote energy efficiency. To this end, key informants indicated that property owners do not have compliance regulations which foster the upgrading of old buildings to pursue energy efficiency. Critically, key informants alluded that a lack of incentives, including subsidies from the government, creates a binary that limits property owners to engage in retrofitting initiatives.

The key informants talked highly about the importance of retrofitting buildings, that it improves energy efficiency and environmental performance in buildings. The findings indicate that retrofitting old buildings enhances good ventilation, non-toxic materials and the building's resilience to extreme weather events. This initiative reduces the demolitions of buildings with negative impacts on the environment. Green building is crucial for urban ecosystem protection; need for new structures, that would require further clearing of land, is reduced.

Socially, the findings indicate that green buildings increase user satisfaction. The most common benefit is health and safety for occupants in retrofitted buildings. One key informant argues how it encourages humans to spend much of their time in indoors. This incident significantly improved human mental health and work efficiency. The findings also indicated retrofitting old buildings increases property value which potentiates building demand for letting and buying. They indicated that retrofitting lowers operation costs and hence promotes energy savings by reducing utility bills. This initiative contributed significantly to economic development through job creation and attraction of potential investors. Ultimately, this also leverages more sustainability and resilience.

The key strategy pointed out during interviews was community engagement and awareness programmes on green building. The exposure improves energy efficiency in retrofitting old buildings. One key informant highlighted that educating property owners, stakeholders and occupants about the benefits of retrofitting their buildings, reduces resistance. One of the respondents said:

> "The government should use seminars, workshops and informational campaigns to make property owners aware of how green buildings benefit them in the long run."

Educating the locals promptly encourages retrofitting innovative developments within the urban areas.

The findings indicate that utilising innovative technologies gives an upper hand, especially in retrofitting old buildings. The use of smart building technologies, energy management systems and renewable energy sources promotes sustainability. One key informant indicated that the installation of solar panels should be prioritised to reduce energy bills. There is need for sustainable innovations such as replacing small windows with bigger windows for lighting and ventilation, leading to energy savings. During renovation and refurbishment, utilising building information modelling promotes building energy performance.

In addition, responses from respondents highlighted that there is need for financial incentives and support mechanisms. There was an emphasis from all key informants that government and private partners should promote tax incentives for property owners who undertake energy-efficient retrofitting projects and offer grant programmes. Private players are known for their efficiency in undertaking projects, therefore, it makes retrofitting more successful. These initiatives partnership should be tailored to promote retrofitting to reduce the burden of upfront costs. Lowering interest rates also encourages individuals to participate in retrofitting programmes.

Furthermore, responses from respondents highlighted the need to upgrade regulatory frameworks to address critical barriers which block innovative initiatives. One key informant indicated that building codes and regulatory frameworks should be capacitated with modern energy efficiency standards that help retrofitting efforts. One respondent said,

> "Some old buildings are saved as historical heritage but my question is, is there no innovative technology that can be used to promote their energy efficiency so that tenants are willing to rent them and pay high rentals? Look my brother, these buildings are let at low rent because they do not have enough light."

It is essential to create a clear streamlining process which guides the obtaining of approvals and permits for retrofitting existing buildings. Informants highlighted the need for capacity building and training programmes for the built environment experts to foster successful retrofitting initiatives. The training of builders, contractors, architects and engineers on retrofitting old buildings is an essential initiative, as it enhances building performance. One key informant added the need to collaborate with academic institutions in training experts on sustainable building practices focusing on the enhancing energy efficiency and sustainability of buildings. It was emphasised that organising these innovative initiatives, directly promotes sustainable construction and reduces gas emissions in the existing buildings.

DISCUSSION

The study established that there are multifaceted barriers surrounding green building of existing buildings which are economic, social, technical and regulatory constraints. The study depicted that economic constraints emerge as the primary barrier that discourages property owners from innovating into energy-efficiency initiatives on existing buildings. This aligns with Bassey and Ibegbulam (2023), who point out that there are high initial costs associated with retrofitting existing buildings. Results from participants indicated that interest rates in building societies are high (17%) which limits the willingness to borrow. This also corresponds to Ekechukwu and Simpa (2024) who articulate that lenders are hesitant to fund retrofitting projects due to uncertainty about returns, hence charging high interest rates to discourage borrowers. The property owners do not have adequate disposable income since the majority of them are involved in the informal sector hence impeding the uptake of energy-efficient technologies. In addition, regulatory barriers hinder retrofitting of existing buildings. There are clear regulatory frameworks that convey how to effectively enhance energy efficiency in existing buildings. This discourages property owners from having the motive to pursue energy efficiency. Juliardi *et al.* (2019) claim that regulatory and planning gaps have limited the public sector from being at the forefront of improving energy efficiency in buildings. These further stifle and paralyse green innovation practices in different nations. Nguyen *et al.* (2017) articulate that legislative and institutional are the hurdles to green building.

Furthermore, lack of awareness and understanding of energy efficiency has also become topical as argued by results. It is indicated in the findings that the majority of the participants are unfamiliar with retrofitting technologies that can be used to promote energy efficiency in existing buildings. This also tallies with the research carried out by Juliardi *et al.* (2019), who observed that occupants are resistant to retrofitting existing buildings due lack of awareness. The long-term benefits enjoyed by energy-efficient buildings are disregarded due to a lack of information. Technical barriers also moot the successful implementation of energy-efficient retrofitting. The study shows that there is a lack of skill in modernising old buildings with energy-efficient techniques. This, therefore, affects building performance on energy consumption. It is necessary thus to target to train all involved in construction to be equipped with skills to effectively retrofit existing buildings.

Despite these challenges, there are considerable opportunities identified in the study which enhance energy efficiency by retrofitting. Economically, it reduces operational costs and increases property value which is critically important for developers and property owners. The findings suggest that good building performance and energy efficiency tend to save or lower utility bills and promote financial viability. Furthermore, socially it enhances occupant health and well-being. Suggestions that were brought were that it helps the indoor air quality and comfort which is necessary as people spend much of their day life under the roof, either at work or home. Environmentally, suggestions were made that, it protects the ecosystem from harm as the demand for new buildings is reduced. This, therefore, underscores the importance of retrofitting in urban environments.

Strategies were established from the study, which include community engagement and awareness programmes on green retrofitting. In addition, upgrading of regulatory frameworks and capacity building were underscored in the study. The need for training programmes, financial incentives and support mechanisms were also suggested in the study. Technically, the use of smart building technologies, energy management systems and renewable energy sources also suggested that it promotes sustainability. This also aligns with Tawfik *et al.* (2023) who highlight three technical strategies that can be used to promote green buildings, including renovation of the building envelope, upgrading the building system and installation of a renewable energy system.

CONCLUSION AND RECOMMENDATIONS

The article aims to investigate the barriers hampering the green retrofitting of existing buildings for energy efficiency in Zimbabwe. Based on the findings of the data gathered from participants and observations in Mutare City in Zimbabwe, the major barriers to green retrofitting for enhancing energy efficiency were identified. From the study, it is concluded that if efficiency is to be achieved through building retrofitting projects, then these barriers need to be addressed. The study also examined the possible strategies to address the impediments to green retrofitting. From the study, it is concluded that a multiplicity of strategies, including community engagement and awareness programmes, capacity building, provision of financial incentives and support, streamlining regulatory processes and supporting innovation and the adoption of smart technologies, can be used to support green retrofitting of old buildings. The recommendation is that the green retrofitting of existing buildings for energy efficiency needs to be adopted by local and central governments with other stakeholders as a pathway to achieving the sustainability objectives of the United Nations Sustainable Development Goals. It is also recommended that a multifaceted approach involving all stakeholders in the built environment be adopted to address the challenges to the implementation of green retrofitting of existing buildings. This approach should be anchored on stakeholder engagement, innovation and capacity-building with the government providing support through coordination, fiscal incentives, legislation and policies.

REFERENCES

Amoah, C. and Smith, J. (2024), Barriers to the Green Retrofitting of Existing Residential Buildings, *Journal of Facilities Management*, *22*(2), 194-209. https://doi.org /10.1108/JFM-12-2021-0155

An, Y. S. and Kwek, L. J. (2015). Environmental Sustainability and Sustainable Development. In: Tan, Y.S. (Ed.). *50 Years of Environment: Singapore's Journey Towards Environmental Sustainability*, 247-263. London: World Scientific Publishing Co. Pvt Ltd.

Aryal, J.P., Rahut, D.B., Marenya, P. (2021). Climate Risks, Adaptation and Vulnerability in Sub-Saharan Africa and South Asia. In: Alam, G.M.M. *et al.* (eds.). *Climate Vulnerability and Resilience in the Global South. Climate Change Management.* Cham: Springer, https://doi.org/10.1007/978-3-030-77259-8_1

Azhgaliyeva, D. and D. B. Rahut. (2022). Promoting Green Buildings: Barriers, Solutions and Policies. ADBI Working Paper 1331. Tokyo: Asian Development Bank Institute. Available: https://doi.org/10.56506/CVYC4388

Bassey, K. E. and Ibegbulam, C. (2023). Machine Learning for Green Hydrogen Production. *Computer Science and IT Research Journal, 4*(3), 368-385.

Bello, O.A. and Olufemi, K. (2024). Artificial Intelligence in Fraud Prevention: Exploring Techniques and Applications Challenges and Opportunities. *Computer Science and IT Research Journal*, *5*(6), 1505-1520.

Bose, A. *et al.* (2012). A Case Study for Sustainable Development Action Using Financial Gradients. *Energy Policy, 47*, 79-86.

Clarke, D. *et al.* (2022). Extreme Weather Impacts of Climate Change: An Attribution Perspective. *Environmental Research: Climate*, *1*(1), 1-25. https://doi.org/10.1088/2752-5295/Ac6e7d

Dadzie, J., Pratt, I. and Frimpong-Asante, J. (2022, November). A Review of Sustainable Technologies for Energy Efficient Upgrade of Existing Buildings and Systems. *IOP Conference Series: Earth and Environmental Science 1101*(2), 022028). Bristol: IOP Publishing.

Ekechukwu, D. E. and Simpa, P. (2024). A Comprehensive Review of Innovative Approaches in Renewable Energy Storage. International J*ournal of Applied Research in Social Sciences, 6*(6), 1133-1157.

Ejidike, C.C. and Mewomo, M. C. (2022). Barriers Facing Retrofitting of Existing Building in Developing Countries: A Review of Literature. Conference Proceedings. The 16th Built Environment Conference – Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster and Development, Lanseria, South Africa. September 26-27.

European Commission (2020), "In Focus: Energy Efficiency in Buildings", Available online: https://ec. europa.eu/info/news/focus-energy-efficiency-buildings-2020-Feb-17_En

Iwuanyanwu, O. *et al.* (2024). Retrofitting Existing Buildings for Sustainability: Challenges and Innovations. *Journal of Engineering Science and Technology, 5*(8), 2616-2631. https://doi.org/10.51594/estj.v5i8.1515

Juliardi, R. D. *et al.* (2019). The Problems in Renovation and Retrofitting Works to Achieve Green Building Performance: A Review. in *International Graduate Conference of Built Environment and Surveying 1 (1)*, 295-303).

Kwakye, J.M., Ekechukwu, D.E.and and Ogundipe, O.B. (2024). Systematic Review of the Economic Impacts of Bioenergy on Agricultural Markets. *International Journal of Advanced Economics*, *6*(7), 306-318/

Leung, B.C.M (2024). Carbon-Neutral Existing Buildings Strategies. *Journal of Modern Green Energy*, 3: 3, Pp:1-23 DOI: 10.53964/ Jmge.2024003

Li, Y. *et al.* (2017). A Review of Studies on Green Building Assessment Methods by Comparative Analysis. *Energy and Buildings 146*, 152-159.

Lin, Y. *et al.* (2023). Green Renovation and Retrofitting of Old Buildings: A Case Study of a Concrete Brick Apartment in Chengdu. *Sustainability 2023 (15),* 1-19. https://doi.org/ 10.3390/su151612409

Liu, C., Sharples, S. and Mohammadpourkarbasi, H. (2023). A Review of Building Energy Retrofit Measures, Passive Design Strategies and Building Regulation for the Low Carbon Development of Existing Dwellings In the Hot Summer-Cold Winter Region of China. *Energies*, *16*(10), 1-25. https://doi.org/10.3390/ en16104115

Liu, T. *et al.* (2022). Sustainability Considerations of Green Buildings: A Detailed Overview on Current Advancements and Future Considerations. *Sustainability, 14,* 14393. https://doi.org/10.3390/ su142114393

Mostafavi, F., Tahsildoost, M., and Zomorodian, Z. (2021). Energy Efficiency and Carbon Emission in High-rise Buildings: A Review (2005-2020). *Building and Environment*, *206*, 108329.

Nationwide Construction (2016), Eco-Friendly Construction: 8 Advantages of Green Building, Available online: https://nationwideconstruction.com/eco-friendly-construction-8-advantages-of-green-building/

Oguntona, O. A. *et al.* (2019). Barriers to Retrofitting Buildings for Energy Efficiency in South Africa. IOP Conference Series: *Materials Science and Engineering, 640*(1). https://doi.org/10.1088/1757-899x/640/1/012015

Patnaik, S. and Pandey, S.C. (2019). Case Study Research In: Subudhi, R.N. and Mishra, S. (eds.) *Methodological Issues in Management Research: Advances, Challenges and the Way Ahead*, Bingley: Emerald Publishing Limited, 163-179.

Peiris, S. *et al.* (2023). Smart Retrofitting for Existing Buildings: State of the Art and Future Research Directions. *Journal of Building Engineering, 76*(2023), 1-23. https://doi.org/10.1016/j.jobe.2023.107354

Santos, F. D., Ferreira, P. L. and Pedersen, J. S. T. (2022). The Climate Change Challenge: A Review of the Barriers and Solutions to Deliver a Paris Solution. *Climate*, *10*(5), 75. https://doi.org/10.3390/cli10050075

Setty, S. and Sriram, Y. (2024). *Incorporating* energy efficiency and sustainable energy practices in the renovation and retrofitting of a 50-year-old independent house. https://doi.org/10.62576/izte2884

Sharma, S. *et al.* (2022). Retrofitting Existing Buildings to Improve Energy Performance. *Sustainability, 14*(666), 1-14. https://doi.org/10.3390/su14020666

Smith, P. (2018). Sustainable Retrofitting — Global Strategies and Implementation Issues *Modern Environmental Science and Engineering, 4*(3), 244-253, https://doi.org/10.15341/mese(2333-2581)/03.04.2018/007

Tawfik, T., Khodeir, L. M. and Fathy, F. (2023). Identifying Retrofit Technology to Improve Building Energy Performance: A Review. *Engineering Research Journal, 178*, 174-200.

Wang, B.-G., Shan, M. and Phuah, S. L. (2017). Safety in Green Building Construction Projects in Singapore: Performance, Critical Issues and Improvement Solutions. *International Advanced Research Journal in Science, Engineering and Technology, 7*(3), 87-93.

World Green Building Council (2020), Green Building and the Sustainable Development Goals, Available online: www.worldgbc.org/green-building-sustainable-development goals