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Potentials and Challenges of Implementing a Green Building Rating System (GBRS) in Bahrain: A Focus on Affordable Housing in the Real Estate Sector

Thesis submitted in partial fulfillment of the requirements for the degree of Ph.D. in Environment and Sustainable Development

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Defense Committee's Approval Page

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Abstract

Amid rapid population growth and urbanization, concerned ministries and city planners in Bahrain have been prompted to develop strategies to address the demand for affordable housing. There is a need to develop a formula that accommodates rapid population growth and the best sustainable environmental practices within the constraints of limited resources, allowing stakeholders to meet future housing needs in a sustainable manner.

In December 2021, Bahrain developed a national Green Building Code based on Green Building (GB) criteria for all construction projects, which has since been incorporated into the building code regulations, Benayat. Beneyat V1.3, the latest version of the building code, illustrates how the code has evolved over time to incorporate the latest sustainable practices.

This study aims to examine the potentials and challenges of the Green Building Rating System (GBRS), particularly in relation to affordable housing projects in Bahrain. The study also investigates the relationship between strategy and implementation in order to identify and address any gaps as well as the barriers that prevent widespread adoption and utilization of the GBRS in the context of affordable housing in Bahrain.

Initially, the study was designed to use a mixed method approach, but owing to a low response rate and some limitations identified during the pilot phase, qualitative methods were determined to be more appropriate. Qualitative methods have increasingly been employed in similar studies, as indicated in the literature. They provide insight into perceptions, motivations, and perspectives that underpin the actions of key stakeholders. This insight is a crucial aspect as field specialists and developers determine the motivations and influences of public and private development.

This study has revealed that stakeholders are largely aware of GRBS. Nonetheless, there is still a lack of widespread adoption of any GBRS throughout the country. Furthermore, despite the positive comments and appreciation expressed towards GBRS, and the interest expressed in its potential benefit to the affordable housing industry, there is still a lack of clarity on the extent and level of readiness to implement GBRS principles and requirements among stakeholders.

The findings of the study revealed that GB development faces major challenges and has low levels of stakeholder engagement due to uncertainties regarding costs, requirements, implementation regulations, lack of expertise and knowledge in the field, and the inability to guarantee a return on investment. The findings are presented and contrasted against stakeholder perspectives on affordable housing criteria collected during in-depth interviews.

The study also makes recommendations to expedite the use of GBRS in affordable housing. This includes the unification of GB definitions and objectives among stakeholders, the promotion of awareness through publications, education, and training, and the development of a clear, measurable, and time-bound implementation plan.

The recommendations made in this research call for a more integrated, participatory, and adaptive approach to address Bahrain's affordable housing demand. Furthermore, this study calls for it to be done in a manner that contributes toward the achievement of Bahrain’s visions and sustainable goals.

Keywords: GBRS, Gulf Cooperation Council, Leadership in Energy and Environmental Design, Bahrain, Green Buildings, sustainable buildings.

Dedication page

In the Name of Allah, the Most Beneficent, the Most Merciful.

First and foremost, I would like to praise Allah the Almighty, the Most Gracious, and the Most Merciful for the countless blessings bestowed upon me. and May Allah's blessings be upon His final Prophet, the messenger of Allah, Mohammed (peace be upon him) - my revered master and role model, through his profound teachings, he illuminated the purpose of life and guided us towards the path of righteousness.

I also express my heartfelt gratitude to my father and mother, who have been my pillars of support throughout my journey. Their unwavering love, encouragement, and sacrifices have made this accomplishment possible. I am forever indebted to them for their guidance, support, and prayers.

I would also like to extend my gratitude to my beloved wife and my siblings, who have been my constant companions and sources of inspiration. Their love, and support have been my anchors in times of difficulty. I am blessed to have them in my life.

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May Allah bless all those who have played a role in my success, and may Allah guide us all on the path of righteousness.

Acknowledgment page

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As I reflect on my research and the incredible people and organizations that have contributed to it, I am filled with a deep sense of gratitude and optimism for the future of Bahrain. My aspiration is to continue to work towards a more beautiful and sustainable Bahrain, one that honors its rich cultural heritage and embraces innovation and progress. I am proud to have had the opportunity to study and conduct research in this dynamic and thriving environment, and I look forward to contributing to its ongoing growth and development.

May Allah bless all those who have played a role in my success, and may He guide us all on the path towards a more beautiful and sustainable future for Bahrain.

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Table of Abbreviations

Word/Abbreviations	Full Title
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BEE	Building Environmental Efficiency
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
EWA	Electricity and Water Authority Bahrain
GB(s)	Green Building(s)
GBC	Green Building Code
GBI	Green Building Initiative
GBM	Green Building Manual
GBRS	Green Building Rating System
GSAS	Global Sustainability Assessment System
GCC	Gulf Cooperation Council
GEA	Global Energy Assessment

IES	Illuminating Engineering Society
IoT	Internet of Things
ISO	International Standards Organization
KPI	Key Performance Indicator
LEED	Leadership in Energy and Environmental Design
MEPS	Minimum Energy Performance Standard
MOH	Ministry of Housing
NAHB	National Home Builders Association
NEEAP	National Energy Efficiency Action Plan
NREAP	National Renewable Energy Action Plan
PCA	Principal Component Analysis
PQP	Pearl Qualified Professional
QSAS	Qatar Sustainability Assessment System
ROI	Return on Investment
SEA	Sustainable Energy Authority Bahrain
SEU	Sustainable Energy Unit
SIDS	Small Island Developing State
SSCW	Standard Specifications for Construction Works
UN	United Nations

US	United States
UNDP	United Nations Development Program
USGBC	US Green Building Council

Chapter 1: Introduction

This section provides some background on Green Building (GB) and the principles of Green Building Rating Systems (GBRS), including introductions on the importance of such systems. Moreover, the chapter reviews existing initiatives to promote sustainable real estate and examines sustainable real estate sector practices. This introductory chapter provides a theoretical overview of the study's subject matter by analyzing the research question, objectives, and hypothesis. It also outlines the context, significance, setting, and terminologies of the study and explores the potential value to property development and real estate businesses of utilizing GBRS.

This chapter outlines:

1. The background and context of the study by describing the industry in Bahrain and its relationship with GB.
2. The statement of the problem and the absence of a GBRS in Bahrain with particular focus on affordable housing.
3. The purpose, significance and setting of the study.

1.1 Background

The Arabian Peninsula possesses limited natural resources, yet major cities within the region have developed from small enclaves into fast-growing economic centers (Galbraith, Consultants, & Pe, 2008). Regional development and construction along the peninsula have experienced unprecedented growth. The impact has been felt in many ways, including the development of land and property investment, as well as growth in the real estate market. For such promising development, protection protocols must be followed to prevent environmental damage.

There is reason to address global energy demand, which is growing at rates faster than production levels. Increasing energy efficiency and promoting sustainable practices among developers and construction operators who invest in sustainable building methods will reduce climate change threats, improve human health, preserve the environment, and meet governmental regulations (Schneider Electric & O'Mara, 2012).

GBs are in demand among forward-thinking owners, operators, and residents. The GB movement shows economic and environmental value in the real estate market for building owners and tenants. The concept of GB is central to sustainability. GB aims to improve the quality of life through various green strategies and design standards while protecting community environments. GB practices also reduce natural resource consumption during building construction (Bahadori, Hasheminezhad, & Karimi, 2017a).

Bahrain is achieving its commitments in the UN Sustainable Development Goals agreement. The country has given special attention to the seventh goal, which stipulates citizens have access to clean, secure,

sustainable, and affordable energy. The 2022 Government Action Plan is included in Bahrain's national goals while promoting GB applications and improving efficiency standards (Alumran, 2013). Under the development program, citizens are protected by the principles of prosperity, efficiency, fairness, and innovation (Innovation, 2018).

In this study, the purpose is to assess the entities contributing to the development and application of GBRS in Bahrain. It also explores the literature, efforts, and influences on deploying such a rating system. Furthermore, it appraises Bahrain's nationally developed GBRS initiatives for their effectiveness in highlighting and suggesting corrective actions to address the future needs of the real estate sector.

GB research in the region has evolved over time. In assessing its trajectory and evaluating its status, this research employs a qualitative-method approach to study homeowners, field experts, and decision-makers' perspectives on GB. This study is also a research project aimed at understanding the challenges associated with the implementation of Bahrain’s GBRS and the real estate sector.

The challenges of implementing a GBRS for Bahrain's sustainability goals have yet to be investigated. This knowledge gap can be addressed, as shown by other countries. International literature has discussed a variety of rating tools and explored their benefits and applicability. Researchers investigate various assessment tools and examine how to choose the proper one for their respective countries. However, few studies have explored the employment of GBRS in the Bahraini real estate sector, and in the affordable housing sector in particular. Thus, it is hypothesized that there is no GBRS or another tool that can be accessed across the affordable housing market.

International concerns over climate change, global warming, and pollution levels have inspired governments worldwide to develop green policies to address these issues. As environmental concerns have increased, initiatives have been taken by governments to combat environmental degradation (Warner, Hamza, Oliver-Smith, Renaud, & Julca, 2010). Real estate development is a key topic to consider when discussing global warming as buildings and construction create pollution and waste (Sharma, 2018).

Research has been conducted and measures have been implemented to decrease pollution levels and increase our energy efficiency since the 1960s energy crisis (Yinqi Zhang et al., 2019). As the problems are closely linked to the construction industry, the concept of GB has emerged worldwide. The emergence of GB has resulted in the implementation of GBRSs, which have helped construction companies improve their standards. GBs address multiple issues, and their definition has evolved in tandem with construction industry development (Sharma, 2018).

A GBRS is a wide-ranging evaluation framework and structure developed by construction officials, government agencies, and private consulting firms to assess a building's sustainability and greenness (Nguyen, Toroghi, & Jacobs, 2016). With the rapid advancement of GB principles since 2000, a variety of GBRSs has emerged (D. T. Doan et al., 2017). A building must meet specific performance requirements before it receives certification. Such guidelines assist project teams in exceeding requirements (Mattoni et al., 2018). GBs seek to increase production levels in electricity, water, and materials used for buildings and reduce the negative environmental impacts of their operations on environmental and human health.

The GBRS evaluates the eco-friendliness and sustainability of a building. It evaluates the building based on green materials and procedures that were incorporated while identifying sustainable principles and procedures used during construction (Shan & Hwang, 2018a). As GB development progresses, GBRS has become an imperative tool for building owners. It helps in areas like baseline (i.e., establishing an initial point of comparison from which future performance is calibrated), benchmarking (evaluating competitors), decision-making (determining solutions), and documentation (Providing evidence that green practices are being followed) (Eisenstein et al., 2017a).

GB design trends are being applied to projects, including corporate facilities, sports stadiums, hospitals, and community neighborhoods. GB is a dynamic process that involves equitable, transparent, and science-based applications where resources and goods are evaluated according to a project's environment (Gluch, 2006). GB measures and tools are available to engineers, policymakers, and decision-makers. They help to incorporate lifecycle costs and determine evaluation data for comprehensive construction blueprints and designs (Figure 1: IGBC Construction Life Cycle**Error! Reference source not found.**). They also help to define environmental and economic tradeoffs, provide reasonable product comparisons, and focus on guidelines established by a consensus-based organization such as the American Society for Testing and Materials (ASTM), the American National Standards Institute (ANSI), and the International Organization for Standardization (ISO).

Global GBRSs have been developed in recent decades (Mattoni et al., 2018). These region-specific GBRSs have been developed to cater to the particular needs and requirements of the target country and its construction

industry (Shan & Hwang, 2018a). GBRSs have participated in the promotion of GBs due to the positive results and positive outcomes they have provided.

1.1.1 Building Standards

The definition of a standard is a set of guidelines and criteria established for determining a product's quality. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), as well as the American National Standards Institute (ANSI) and the American Society of Testing Materials (ASTM), are among the organizations that set building industry standards through consensus, for example (Stephanie Vierra, Aia, & C, 2012). The ISO contributes to the development and governance of standards and certifications by defining and developing international standards that have become law or the basis for new industry norms (Giama & Papadopoulos, 2015). The ISO defines standards as regulations recognized by consensus or permitted by an acknowledged body that outlines rules, guidelines, or characteristics for building practices or results. By defining standards, they can either be prescriptive (detailing methods for achieving the goal) or performance-based (stating expectations for results) (Standards Australia, 2016). The development of consensus-based standards follows a formal, voluntary process, exemplified by openness and due process. They are backed by high-level government support and can have a worldwide influence. There are proprietary or regulatory standards developed outside of the consensus methods of organizations such as ANSI and ISO, where standards are used to motivate improvement (Wilson, 2010).

There are green product standards available that have not been developed through formal ANSI and ISO consensus channels (Stephanie Vierra et al., 2012). These standards may have greater or fewer restrictions than consensus

standards and are transparent and open to public scrutiny. Standards such as these are trusted because they are associated with an organization committed to protecting the environment, where ANSI/ASHRAE/IES standard 189.1, for example, describes only the minimum requirements for the selection and design of sites for high-performance GBs, as well as for the construction and operation of GBs, yet excludes low-rise residential units within the building code (Stephanie Vierra, 2018). Topics covered include on-site, water, energy effectiveness, indoor environment quality, and material selection.

1.1.2 Green Codes

Sustainable and energy-efficient building standards are largely focused on building design and construction and new GB codes continue to be developed and adopted. Code formats can be categorized into three groups: prescriptive, performance, and outcome-based (Ivanova et al., 2016).

The prescriptive approach to code compliance is expedient, comprehensive, and conservative. Materials and equipment adhere to stringent standards, and performance-based codes, which are measured through performance tables, emphasize achieving results rather than meeting individual component requirements (Miljana Horvat & Paul Fazio, 2005). An outcome-based code establishes a target energy consumption level and measures and reports building performance to ensure energy consumption remains within the target range.

Unlike GBRSs, adherence to codes is mandatory, and the impact of GB codes on the environment can be substantial if they are adopted broadly (Stephanie Vierra, 2018). State or local green codes must be identified to govern the scope and direction of any new project, whether it is a renovation or an entirely new construction.

In collaboration with ASTM International and the American Institute of Architects (AIA), the International Code Council (ICC) published the International Green Construction Code (IGCC). These requirements aim to negate the harmful impact that buildings can have on the environment (Stephanie Vierra, 2018). Manufacturing companies, design professionals, and contractors can benefit from the IGCC, which was designed to be administered by code officials. The IGCC was adopted by government entities as a tool to expand the market segment of GB beyond segment regulations dominated by voluntary certification systems.

The following organizations have implemented green code requirements:

- IGCC is a building and construction code for new construction and major reconstructions and renovations in jurisdictions and municipalities. IGCC is an inclusive code that contains standards for energy conservation, water efficiency, and commissioning as well as energy efficiency standards, as well as enforcement procedures and guidelines for renovating buildings (IGCC, 2021).

  Furthermore, the IGCC has the potential to help the environment at a scale that would be impractical with voluntary GB programs and GBRSs (Ivanova et al., 2016).
- The National GB Standard (NGBS) ICC 700 was developed in the US by a committee of developers, producers, and industry representatives and was adopted by the ANSI as an international standard on January 29, 2009 (NAHB Research Center, 2012).
- The California GB Standards Code (CAL Green) as the first GB code in the United States, is included in the California Building Standards Code. CAL Green promotes healthy living and working environments

that are environmentally friendly, cost-effective, and environmentally responsible (Blunk, 2019). CAL Green aims to improve public health, protection, and general welfare by improving building design and construction to comply with building concepts that minimize negative environmental impacts or create positive environmental impacts (Blunk, 2019). In addition, CAL Green promotes environmental construction practices in the areas below:

- Conceptualization and design of the project
- Efficient use of energy
- Conservation and efficiency of water
- Conservation of materials and resource efficiency
- The quality of the environment

1.1.3 Green Product Certifications

Certification refers to the confirmation that a product meets the standards defined in an accreditation scheme (Standards Australia, 2016). The ISO is defined as a certification for "any activity to determine directly or indirectly if applicable requirements are met" (Stephanie Vierra et al., 2012). Green product certification outlines and confirms that a product complies with a specific standard and whether it offers environmental benefits.

There are several product-certification programs and labels that offer certification grounded on life-cycle factors, making their programs multi-attributable (Taylor, 2011). Parameters incorporate energy consumption, recycled content, air and water emissions during manufacturing, disposal, consumption, and another approach focuses on a single attribute, like water, chemicals, or energy usage that impacts Indoor Environmental Quality (IEQ).

The most credible and reputable green product certifications are those awarded by an independent third party. Such parties are not affiliated with a manufacturer, contractor, designer, or specifier (Florez, 2020). Labels and certification programs from third parties are useful in evaluating green products as they confirm that products meet certain standards and are independent of the industry. Additionally, LEED, Green Globes, and the National Green Building Standard are recognized as other GBRSs by-product certifications.

The real estate market is evolving. Consumer demand for greener products is rising, which has triggered demand for green product certifications. Problems such as greenwashing and using fraudulent green claims to sell products or services to bolster a company's image have become commonplace among ambitious companies in the green marketplace. The requirements of green certification should be closely examined to properly understand the information they provide.

According to ISO methods, labels are categorized by their applicability to various products (Table (1)). The ISO-defined labels and their meanings are outlined below. Most products available in the US carry Type I and Type II certifications. However, Type III labels have become mandatory in France. They are also found in Europe and used by manufacturers who target international customers (Stephanie Vierra et al., 2012).

1.1.4 GB Rating and Certification Systems

Design and project delivery are integrated to create resource-efficient and sustainable structures at every stage of a project's lifecycle. This includes

construction, renovation, maintenance, site selection, operation, and demolition. The integration of these programs can be a single-aspect mode, addressing water or energy, while others address emissions, toxicity, and environmental performance (D. T. Doan et al., 2016).

A product's sustainability or performance level can be determined by standards and certifications. Nevertheless, each of these requirements should be integrated into the project throughout to ensure sustainability. GBRSs look beyond a product while considering the entire project. GBRSs are guides used to rate performance or give rewards to those who meet established requirements. It is not uncommon for rating systems and certification systems to overlap (D. T. Doan et al., 2016).

These certification systems differ in their philosophy, approach, and methods, but they share a common objective. Awarding or certifying is designed to minimize the undesirable impacts of the built environments on its immediate surroundings and human health. Any project can be rated green, regardless of its scale. A single building can be rated green, as can an entire neighborhood. In addition to GBRSs for new construction projects, which apply to verdicts made during the design and planning procedure and actions taken during construction, there are also GBRSs for existing current buildings, which emphasize operation and conservation (Retzlaff, 2008).

GBRSs were designed to help outline, implement, and measure green policies, and to measure their results and the impact they ultimately have. When selecting a standard, rating system, or certification, consideration is given to which organization is assessing the standards and whether it is a first, second, or third-party assessment (Florez, 2020).

First-party assessments are delivered by an organization associated with the unit making a claim or by another entity that benefits from it. A party with a potential interest in the outcome, like an exchange organization, executes a second-party assessment. Third-party assessments are managed by parties independent of the project and outcome (Florez, 2020).

In the US, the RSMeans database is among the most popular cost database for construction (M. Hu & Skibniewski, 2021). RSMeans considers the following factors when evaluating a GBRS:

- Scientifically based – Assessments results and verdicts should be repeatable by others who follow the same procedure.
- Transparency - There should be a transparent process for awarding certifications and for the development of standards.
- Independence - The certification bodies should not have conflicts of interest.
- Progressive standards - Standards should be helpful to industry practices, rather than rewards for conducting business as usual.

1.1.5 The Five Elements of a GBRS

One of the first steps in creating a truly sustainable building is to gain an understanding of the site, including all of its complexities and interconnections. A holistic design approach balances the introduction of new systems with existing, naturally occurring, ecological functions performed on-site. As a result, these ecological functions store water, purify the air, react to the sun, and provide habitats.

GBRSs and the green construction code focus on five areas to decrease the building's environmental effects. A summary of the five principles of GB

design is as follows: Sustainable Site Design, the conservation of Water and Quality, Energy and the Environment, the quality of the Indoor Environment, and Materials and Resource Maintenance. (Ragheb, El-Shimy, & Ragheb, 2016).

1.1.5.1 Location, Site, and GBRSs

A building's location has a direct effect on its performance as regards green standards. The local climate, solar access, shading, and the form and orientation of a building have direct impacts on its energy usage, ventilation, and lighting needs (Sanaieian, Tenpierik, Linden, Mehdizadeh Seraj, & Mofidi Shemrani, 2014).

Protecting Greenfields and the restoration of Brownfields are the most important factors within the sustainable sites category. In most rating systems, the development of Brownfields is encouraged as a means of improving the site. Brownfields are contaminated sites that would enhance the natural environment through their environmental cleanup (Dorsey, 2003).

A building project should coexist with nature, which means construction should not occur in undeveloped areas like forests, parks, or those protected from development where rainwater might affect local ecosystems (Agency, Brownfields, & Revitalization, 2020).

1.1.5.2 Water and GBRS

Freshwater makes up 2.5 percent of the world's water supply, with even smaller percentages accessible for human consumption (Warner et al., 2010). With the earth's population growth and water supplies diminishing, water access has become a priority. As such, every GBRS looks at how to reduce water usage in a building's construction and surrounding area.

The building, construction, and land development industries require a great deal of water for their operations (Al-Qawasmi, Asif, el Fattah, & Babsail, 2019). GB standards include alternative water-saving methodologies, such as rainwater harvesting, which is aimed at reusing and recycling water for buildings and landscaping, as saving energy and potable water are seen as equal priorities.

1.1.5.3 Energy and GBRS

Through more efficient energy usage and the on-site generation of energy, a building can achieve a net-zero, or even a net-positive energy consumption score. A major focus of most GBRSs is the energy efficiency and general resources consumption of a building (Jadhav, 2016). Eliminating a building's contribution to climate change has been the focus of GBRSs. Construction projects with net-zero or net-positive energy emissions result in no carbon dioxide being released as a result of the operation. Building efficiency is a first-generation priority following sustainable design with GB standard objectives (Adnan & Jalala, 2016).

1.1.5.4 Materials and GBRS

As the global population increases, the need for goods and services will follow as the need for energy, water, steel, concrete, copper, aluminum, plastic, and other materials will increase as these materials' finite resources. (Meadows, Meadows, & Randers, 2006). The category and quantity of construction materials used can impact the environment (Akdag & Beldek, 2017).

During construction, remodeling, maintenance, and building operations, natural materials are extracted, processed, and discarded. Approximately three

billion tons of raw materials are consumed by building and construction worldwide each year, or 40 percent of international consumption (Ana-cristina Tudora, 2011).

1.1.5.5 Air Quality and GBRS

It is estimated that humans spend 90 percent of their time indoors. Harmful indoor air environments are detrimental to human health as they contribute to illness and reduce human capacity to function (Schneider Electric & O'Mara, 2012). Indoor air quality (IAQ) also impacts human health, efficiency, and well-being. Sick building syndrome is well documented in relation to harmful indoor air environments and human illness.

In most GBRSs, the goal is to optimize indoor air quality and create pollution-free environments. GBs are viewed as having better indoor air quality (Mishra et al., 2019).

1.1.6 GB Design, Construction, and Operating Cost

A GB is no more expensive than other projects, especially if budget controls, program management, and environmental strategies are considered during its early development (Gibbs & Neill, 2012). While there can be a cost premium associated with GBs compared to conventional projects, they are not as costly as perceived.

One barrier to implementing an environmentally sustainable development policy in GB construction is the costs perceived upfront. Designing green or standard buildings with a correlation between initial costs and environmental certification remains problematic (Hall, Hopkins, & Hopkins, 2014). However, GB projects can achieve certification at a lower cost than less ambitious projects.

Worldwide, building codes have become firmer, supply chains for green technologies as well as green materials have matured, and developers are becoming more skilled at constructing GBs. Overall, this has reduced design and construction budgets for GBs.

GBs have higher upfront costs, but their long-term expenses decrease. This is true for buildings with high-performance façades and energy-efficient building systems (Sukeri et al., 2016). GBs also create savings through reduced energy consumption, the use of water, and long-term operational and maintenance expenses (Sukeri et al., 2016). GBs are also cost-effective in the long term, with energy savings resulting from their design and construction outweighing premiums associated with construction.

In addition to reducing operating costs, GBs provide indirect benefits on renovation and reconfiguration costs. High-performance buildings should be supported by legitimate commissioning, management, leadership, and communication to meet performance expectations.

1.1.7 Affordable Housing in Bahrain

In its quarterly report, the Bahrain Economic Development Board (EDB), Khairy (2017) stated that 225,000 housing units needed to be built in Bahrain by 2030. Bahraini housing demand was also anticipated to grow from 145,181 units in 2010 to 263,536 units in 2020, according to the report, and 346,718 in 2030, signifying pressure on the Ministry of Housing (MOH) (Al-Saffar, 2014). The country's housing authority provides low-income citizens with housing services to help ensure stability and achieve a higher standard of living in the Kingdom. It also improves citizens' lives by providing a safe and sustainable living environment. In addition, it facilitates housing for Bahraini

families and provides quality and affordable home services (Ministry of Housing | Bahrain, 2021).

The Mazaya Program was introduced by Bahrain's MOH in conjunction with the private sector to provide housing for citizens on waiting lists. The program allows the government to offer financial support to citizens who want to purchase property through an affiliated bank. This system allows homebuyers to pay the difference between the installment amount specified by the bank and the monthly payment up to a maximum of 25 percent of their annual income (Ministry of Housing | Mazaya Program, 2021).

1.1.8 Bahrain Building Standards

According to the 2011 census, Bahrain's resident population was 1,234,571. In 2014, the population reached 1.3 million. Initial projections indicated that the population would reach 1.592 million in 2020, but it surpassed expectations and hit 1.7 million. Predictions for 2030 have projected the figure to reach 2.12 million, representing an increase of 621,000 since 1999. This represents an average growth rate of 7.4 percent (Population and Demographics – Ministry of Information Affairs | Bahrain, 2021).

Demand for housing units among low and middle-income families is on the rise. An estimated 3,000 marriages are reported annually, with half of those unions requiring new homes, amounting to 1,500 annually (Kingdom of Bahrain - eGovernment Portal, 2021).

Bahrain's urban growth has occurred because of its increasing population and urban development. Bahrain's high-density urban areas are due to resident concentration in metropolitan areas like Manama, Riffa, and Muharraq (Yusuf

& Elghonaimoy, 2020). Furthermore, residential construction has contributed to energy consumption and environmental degradation.

Changing the typology and configuration of Bahrain's building forms created the requirement for cooling and humidity mechanism implementation measures, adversely affecting the residents' comfort. In this way, extroverted built forms impacted microclimate conditions and decreased comfort levels (Al-Hashimi & Khalid, 2021). The size and complexity of Bahrain's residential buildings have created diverse challenges. However, with conventional residential typologies, the modular building consists of a series of enclosed extroverted blocks. Today, structures are integrated with extroverted courtyards, and openings are allocated to external walls.

Despite Bahrain's uniform standards on opening ratios, roof spans, external obstructions, insulation, and glazing types, this system is not without its disadvantages. For example, they have not been defined by green regulations or studies identifying and assessing statistics for comfortable living conditions and efficient performance (Al-Saffar, 2014).

Environmental factors should be considered when developing regulations. Residential buildings are not suited to provide comfort in harsh climates. Incorporating a GBRS increases their integration among real estate development systems. They are derived from traditional designs and reduce integration from passive systems.

The literature indicates that the Kingdom of Bahrain is developing a GBRS collaboratively between the Ministry of Works (MOW) and the Sustainable Energy Authority (SEA). The MOW is committed to fulfilling its mission and vision by being a leading professional organization that

contributes to the development of the Kingdom and provides quality services by utilizing innovative sustainable practices, technologies, and best practices.

On 18th November 2009, the Bahrain MOW launched the Standard Specifications for Construction Works (SSCW) and these specifications have been updated regularly by the MOW since. By providing developers with a valuable reference that supports them in completing construction projects to the required standards, the newly updated SSCW is designed to create consistency in the construction industry. This guide provides design professionals with an understanding of accepted construction practices for MOW projects. As a standard reference and best practice guide for the design and construction of civil engineering projects in Bahrain, it serves as a standard reference and best practice guide.

Applying these standards will assist the construction industry in harmonizing professional practices, curtailing informal development, and ensuring that all building developments and infrastructure, as well as other services and projects, are well-planned, well-maintained, safe, and cost-effective throughout the country.

In order to make these specifications as accurately as possible, it is recommended that they be interpreted in connection with and alongside the standards that are currently being used in the Gulf region. The SSCW was developed based on the best available international standards and specifications. In order to reflect the latest technological innovations within the construction sector, the SSCW is periodically updated and new editions will be published. The main goal of the project is to review, unify, and update the specifications as necessary. A secondary objective of this project is to explore the options for a more fitting format that will transform the

specifications developed for use on all projects as a unified national standard specification.

An initiative jointly undertaken by the Ministry of Electricity and Water Authority (EWA) and the United Nations Development Program (UNDP) was established in November 2014 to establish Bahrain's SEA. The SEA is responsible for developing a coherent and sustainable energy policy, It is also important for the country to promote the use of renewable energy sources and energy efficiency measures. Furthermore, the SEA is responsible for bridging legal, institutional, and capacity gaps in order to ensure that Bahrain's energy sector is equipped for future challenges.

By working closely with stakeholders and partners in Bahrain, the SEA promotes energy-efficient practices, transfers and disseminates renewable energy technologies, and provides guidance and drafts regulations and policies related to the field. The SEA finalized the National Energy Efficiency Energy Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP) in October 2016, which outlined targets for the countries and policies to achieve these goals.

As part of the SEA, companies that specialize in energy-efficient building methods are being sought by the organization. SEA is seeking firms with experience and expertise in reviewing and designing green building codes as well as green building certification programs.

By combining both SEA and MOW's efforts and developments, the collaboration achieves a unifying objective of comprehensively developing Bahrain's green building codes. This collaboration is intended to become part

of the Benayat building permit requirements, which will be included shortly in the Benayat Code Building Permit Mandatory Requirements.

Among many other sustainable objectives, the Bahrain Green Building Code is being developed to enhance the efficient use of energy in existing buildings. It establishes clear guidelines for mutually new construction and retrofitting projects in Bahrain to ensure the lowest level of energy efficiency is achieved. Energy-consuming systems like HVAC (air-cooling system), lighting, engines, and pumps, as well as the building envelope and construction techniques, are important concerns especially within the constraints of the budget for the development of affordable, inexpensive housing while maintaining the highest levels of quality and living standards.

1.2 Statement of the Problem

As GCC countries have experienced rapid growth in their construction and real estate sectors, housing demand is expected to increase. Considering more than half of the population of each GCC nation consists of young adults (Mehtap, 2014), the rate at which new families will be established will increase, triggering an increase in the volume of housing demand, as shown in Figure 2. Among expanding markets, energy consumption increases will impact the environment (Al-Hathloul & Mughal, 2004).

Construction, occupancy, refurbishing, repurposing, building, and real estate construction can, directly and indirectly, impact the environment. The construction of buildings consumes a great deal of energy, water, and raw materials. They emit waste materials and are potentially hazardous to the environment.

In response to acute housing shortages and rapid urbanization, government officials and city planners are examining economic, environmental, and sustainable activities. Their review efforts include an analysis of how policies could influence market behavior. This scenario makes it imperative to develop an integrated and flexible formula to approach joint collaboration among GCC members (governmental or otherwise) to address rapid urbanization, population growth, and rising demand for affordable housing in metropolitan areas.

Nevertheless, cities face the challenge of incorporating sustainable, resilient urbanism into their work. The purpose is to ensure that what they do today will provide a sustainable development solution going forward (Dormon, 2008). Bahrain suffers from the international problems of pollution and lack of energy, especially given the limited resources of water and other materials (Abdellatif, 2014). Despite this, many building projects in Bahrain are developed without consideration for sustainability among all stakeholders (Alnaser, Flanagan, & Alnaser, 2009).

Electricity also plays a major role in Bahrain's economy, given Bahraini households' reliance on the internet and other technologies. In Bahrain, more than 90 percent of people spend their time indoors (Alnaser et al., 2009). Meanwhile, Bahrain struggles with reducing CO2 emissions, making meeting obligations agreed upon under the Doha Amendment to the Kyoto Protocol problematic. This collective measure called for countries to reduce emissions by 18 percent by 2020 (Tudor, 2016).

Bahrain's relative statistics show that 60 to 70 percent of total energy consumption occurs in building and construction, which are responsible for

55 percent of carbon dioxide emissions (Ajmi, A. N., El Montasser, G., & Nguyen, 2014).

Demand exists for Bahrain to create an environmental development action plan to address the rising burden of new infrastructure trends and their effect on the environment as part of creating a comprehensive construction strategy. This plan should offer new regulations and protocols for building design, adhere to internationally recognized GB standards, provide affordable housing, and enhance construction sustainability.

It is necessary to create a sophisticated connection between the environmental, economic, social, and political conditions of a society or country to meet requirements without compromising the future ability to meet its needs. GBRS remains under-utilized, and its benefits are unrealized. In general, it can offer solutions to environmental, energy, and resource-related problems. GBRS can also provide practical solutions for energy needs.

Bahrain has shown its dedication to environmental security. The country's MOW has passed multiple legislative measures aimed at environmental concerns. However, gaps remain among GBRS theories, literature, and implementation. This gap should be addressed to promote GBRS.

Research has yet to be conducted to distinguish the challenges related to the implementation of a GBRS in Bahrain. The implementation of such a system could help Bahrain to meet its obligations regarding Sustainable Development Goals. The knowledge gap presented here can be filled. The literature on GBRS describes the benefits of rating tools and their applicability in Bahrain. This research largely focuses on assessment tools and on choosing

the right tool for local use. However, few studies explore the employment of GBRS in the real estate sector, and fewer again focus on affordable housing. Thus, the hypothesis being considered is that there is no single rating system or tool being utilized for the affordable housing market.

1.3 Purpose of the Study

A primary objective of this research is to recognize challenges that need to be addressed faced in implementing a GBRS in Bahrain. The focus includes the country's affordable housing sector, where it is anticipated to identify the gaps between the strategies and attempts towards implementing a building rating system and the implementation of such system. It further assesses stakeholder knowledge of GBs, collects perspectives, and recommends future directions for GBs to help meet the future housing demand with a sustainable approach.

With Bahrain's significant population growth, the market for real estate in Bahrain has grown. The country's comfort and ownership laws have made Bahrain's properties more appealing to both locals and investors, as has its straightforward ownership process, variety of options, and affordable prices.

A major driving force behind Bahrain's housing program is the government's vision to expand housing services through the development of integrated and self-sufficient towns. In particular, the majority of initiatives involve strengthening partnerships with the private sector to deliver housing services, through initiatives launched by the Ministry since 2012. The future of housing services in Bahrain depends increasingly on these partnerships since they can lead to a more sustainable system of delivery.

Bahrain announced it would provide 40,000 housing units in towns and towns throughout the Kingdom by 2030. The government of Bahrain will construct 70 percent of the units, and the private sector will construct the outstanding 30 percent (Housing, 2019a). Therefore, this research focuses on this 30 percent. Based on the trends, these percentages are expected to increase.

Cooperating with the private sector in real estate development strengthens the public-private partnership. it reflects positively on the availability of housing services and the volume of beneficiaries, along with meeting the following objectives:

- Enhancing design, planning, and implementation innovation through development and creative approaches.
- Contributing to finding solutions overlapping non-exploited land and non-calcified sites.
- Increasing private sector participation in infrastructure construction.

By involving the private sector in the housing program, their expertise and capabilities would be utilized as well as promoting economic activity in the Kingdom by investing in the banking and the real estate sectors.

Bahrain has been named among the most prosperous countries in the region in terms of rising to the challenges presented by a growing population. Residential housing is particularly susceptible to this problem. However, energy production, land, and resources will need to increase to meet growing demand and require costly investments in the early stages (Al-Saffar, 2014).

Although neighboring countries (namely UAE and Qatar) have been developing their strategies for green-building adaptation over the last decade,

the Kingdom of Bahrain has concentrated on enhancing the country's internal affairs, like education and standard of living. In the last 40 years, Bahrain has experienced stable developmental growth in health, education, and earnings (UNDP, 2016). However, Bahrain has discovered its infrastructure and buildings need improvement.

The rapid spread of "modern" development on top of primitive infrastructure and modern interventions in the new towns has unavoidably degraded the infrastructure within the residential neighborhood, so some are pushing forward the process of development, and economic activities, In order to attract investment from both domestic and foreign sources, appropriate infrastructure must be provided.

Two important elements contribute to Bahrain's modern housing layout and advanced infrastructure services: the automobile and air conditioning units. As a result of the immoderate uses of these elements, the built layout has been negatively impacted and their significant requirements have governed the design and planning approaches in housing. Due to the scarcity of land, land use efficiency is vitally significant. Reducing the number of spaces for automobile movement, especially in internal clusters, will allow for more use of built and developed areas.

In addition, using public land as efficiently and effectively as possible by combining as many applicable uses and facilities as possible shall be maintained as feasible in the future for a healthy and appropriate environment.

This development prompted decision-makers to meet these requirements while also considering sustainable methods and techniques for regulating construction and building. This includes the need to utilize guidelines,

certifications, evaluation, and developing building rating systems aimed at mitigating the impact of the construction process and the lifecycle of buildings on the environment.

In order to face the successive developments and challenges of the real estate sector, it is vital to analyze the condition of the sector through the eyes of the stakeholders and key decision-makers to establish a clear understanding and present a roadmap for solutions and helpful recommendations. Therefore, this research includes the following:

- an examination of the integration and performance levels of green initiatives in Bahrain;
- an investigation of the views and perspectives of the real estate sector stakeholders about GBRS(s);
- an examination of the real estate sector's preparedness for the implementation of a GBRS in Bahrain;
- An analysis of the barriers and challenges associated with the implementation of GBRS in Bahrain;
- a proposal for changes/guidelines to form future implementation plans.

The aim is to define the challenges and obstacles associated with bridging the gaps between existing strategies and efforts. The development and deployment of a rating system that corresponds to local needs, where the leading GBRS systems may be incorporated into an integrated local rating framework and contribute to its design and implementation, is also reviewed in this study.

There are several reasons to pursue a GB certification for a project, such as having the green status of the project officially verified. Designed for

building owners, designers, and construction teams involved in the creation of sustainable buildings, it serves as an educational and marketing tool. Developing and promoting highly sustainable construction practices can be influenced by GB certification, which functions as an incentive. Furthermore, a GBRS helps the consumer understand the market and how the product compares with its competitors by providing a point of reference. Additionally, GBRSs provide information on how green products should be included in construction specifications, as well as what types of green products should be included.

A project's certification system depends on that project alone; none of these systems are universal. Projects may require one system but be prohibited by another due to their dynamic nature. The selection is determined by the nature of each project. Each project should be considered independently, taking into account the budget, scope, and goals of the project. Identifying the most applicable GBRS and certification level can be done simply by comparing issues like cost, usability, and building performance.

It is important to note that GB is the fundamental platform for sustainable development. The concept of GB has gradually developed with the increase in public awareness of environmental protection, which, in turn, includes a wide range of aspects. Considering that GB is rapidly becoming a trend in the real estate and the construction industry, it presents an opportunity to reduce global warming while achieving energy efficiency.

A major anticipated result of the successful implementation of a GBRS is the impact it will have on sustainability and long-term development goals of SDGs. This benefit includes environmental, economic, social, and health and safety aspects.

GBRSs can change and evolve to reflect ever-changing standards in order to achieve ever-higher sustainability levels. Hence, this study examines the latest versions in order to understand the requirements that must be met in order to achieve optimal results.

1.4 Significance of the Study

Research on the affordable housing sector is minimal. In this study, the significance lies in the analysis of Bahrain's GBRS status for the booming demand-driven sector of housing, and the sector of affordable housing in particular. Therefore, it should contribute to the research on identifying knowledge gaps. It also addresses the obstacles preventing the comprehensive implementation of a GBRS in the expanding affordable housing market. Studies and research on sustainable design contribute to numerous economic and environmental benefits, often with standards, ratings, and certifications.

Research and studies on GB analyze contextual problems, selected approaches, and the available solutions where it is significant to define those within the context of educational research. Environment studies are about learning techniques, addressing challenges, and developing sustainable strategies to protect the environment. Developing a sense of living and physical well-being environments as well as strategies for resolving challenging environmental issues will contribute to environmental protection. Studies and research on environmental science also emphasize the importance of adopting a sustainable development strategy to raise awareness about pressing environmental issues.

Energy savings of 30 to 97 percent can be achieved through LEED-certified buildings by reducing energy consumption, carbon emissions, water

consumption, and waste. In addition to reducing operating costs, GBs command a higher price in the market by up to 7.5 percent. The return on investment (ROI) of sustainable buildings has increased by 6.6 percent, occupancy has increased by 3.5 percent, and rental rates have increased by 3 percent as well (Stephanie Vierra et al., 2012).

Additionally, green office buildings are thought to improve productivity and occupant health by increasing the quality of indoor air, increasing natural daylight, and using healthier materials and products.

A comparison of 12 US General Services Administration (GSA) GBs against industry standards was conducted in the following areas: water, maintenance, energy, operations, waste, recycling, transportation, and the satisfaction of occupants. These 12 sustainable buildings were found to be more energy-efficient, environmentally friendly, and had lower energy bills than common commercial buildings (Stephanie Vierra, 2018). The benefits were dependent on climate, geography, timing, Synergies in the credit sector, and local building standards among others.

Furthermore, this study discusses the research performed on real-world GBRS in the region and the effects that it had in similar circumstances within Bahrain Additionally, this study also provides a complete overview of prevailing regional building standards, contributing to GBRS knowledge. Though there have been recent studies on GBRSs, this one is unique as it examines regionally adopted GBRSs that are comparable to Bahrain's circumstances, and as such, it provides a broader context and is a more useful comparison tool than other contemporary studies.

Bridging the performance gaps and incorporating GBRS optimizes the potential for urban growth, Sustainability can be viewed in four main categories: the economic pillar, the financial pillar, the social pillar, and the political pillar. The perception of sustainable development and the concept of sustainable urban growth in particular remain open to various interpretations that encompass at least three major dimensions: economic, environmental, and sociodemographic.

1.5 The Study Setting

Numerous stakeholders play a role in the real estate industry, but four are of particular importance: the end-users or occupants, real estate agents, Regulatory agencies and related industries, as well as the government (Ullah, Sepasgozar, & Hussain Ali, 2019). Table (3) defines and lists the basic needs of these stakeholders, as recognized in the relevant literature.

The development locations of affordable housing in Bahrain are focused in new and major towns and involve unit development to address expanding demand for housing. Therefore, this research focused on four key locations showing the major housing developments to provide a comprehensive overview.

There are five governorates where most of Bahrain's population resides and these are: Manama, Muharraq, Northern, Central, and Southern governorates (Population and Demographics – Ministry of Information Affairs | Bahrain, 2021). The locations were selected based on population density in the country’s major cities to ensure the selected projects were in areas of high population density and housing demand. The selection for these projects was based on their inclusion on the list of approved registered

developers by the MOH, which ensured that they met the definition of affordable housing.

Selected candidates for this study are individuals who are interested in low-rise, standalone affordable housing located throughout Bahrain and who meet the following criteria (Ministry of Housing | Regulations and rules - Bahrain, 2021).

1. It is necessary for the applicant to be a Bahraini citizen.
2. In order to be eligible for this program, the applicant must be the family head.
3. An applicant must be no younger than 21 years old and no older than 35 years old at the time of application, and the financing must have been disbursed.
4. The applicant's monthly income must be between BD 600 and BD 1200.
5. Neither the applicant nor any of his family members have previously availed of any housing service from the government or any other organization.
6. Neither the applicant nor any of his family members can be the owner of a property in the three years preceding the application.

The following four projects have been selected from the list of the approved developers by the MOH to ensure that they comply with the description of affordable housing in communities that share common service areas, which have been classified and defined under the MOH approved regulations (Ministry of Housing | Bahrain, 2021).

1. Budaiya Area - Al Faridha Project. Located in the Al Markh area, the Al Faridha project consists of 18 two-story villas, each offering three bedrooms. Each villa has an average land area of 160 SQM and a built-up area of 200 SQM (al Faridha Project| Alsaraya-Bahrain, 2022).
2. Saar Area – Reem 3 Project. Located in Maqabah, the Reem 3 project consists of 26 two-story villas, each offering three bedrooms. Each villa has an average land area of 200 SQM and a built-up area of 220 SQM (al REEM 3 Project| Alsaraya-Bahrain, 2022).
3. Hamla Area - Janayin Al Hamala Project. A residential community located in Hamala, Janayin Al Hamala features more than 1,400 affordable homes on either side of the subdivision, all of which are surrounded by parkland, and 99 residential buildings parallel to the main road, providing a full density of residents for a variety of household types (Janayin Al Hamala Project – Kingdom Properties, 2021). The project consists of 190 two-story villas, each offering three bedrooms with an average land area of 180 SQM and a built-up area of 200 SQM.
4. Dyar Al Muharreq area - Deerat Al Oyoun Project. The project, which will be built on a 1.5 million square meter site in the south of Diyar Al Muharraq, will include 3,043 residential units. The project will consist of partly social housing units and partly affordable units for Mazaya at the cost of BD 276 million to the government in accordance with an agreement between the MOH and Diyar Al Muharraq (Deerat Al Oyoun, 2021).

    The project's name Al Oyoun is derived from the fact that Bahrain was renowned in ancient times for its abundance of fresh water in areas near the project site. The word Deerat is the singular form of Diyar,

which embraces this project. Three thousand two-story villas, each offering three bedrooms. The villas have an average land area of 1,700 sq. ft. and a built-up area of 2,100 sq. ft.

Chapter 2: Literature Review

The purpose of this chapter is to provide theoretical and international perspectives on the development of GBRS, as well as theory and theoretical models related to the GB principles.

There are three parts to the chapter:

1. The first part of the chapter examines previous studies on definitions and standards associated with GBs and sustainability.
2. The second part discusses international and regional adaptations of GBRSs.
3. The third section reviews a summary of previous studies and provides a conclusion.

This chapter summarizes the literature on GB and GBRS, describing past and present developments and studies on GB standards and principles of building rating systems. It highlights critical gaps within existing research that should be resolved and knowledge that requires investigation to ensure continuity, contribute to previous research, and overcome deficiencies. This chapter also observes the obstacles and challenges related to implementing a GBRS in Bahrain and provides a critical review of the literature addressing the relationship between the strategy and implementation of GBRS in Bahrain, and the suitability of the GBRS developed at the national level in Bahrain.

Finally, the chapter reviews the relevant literature on the potential and possible challenges of implementing a GBRS in Bahrain, while identifying essential research projects and guidance for further GBRS development.

2.1 Sustainability and the Built Environment

The term "built environment" describes manufactured structures and settings, which provide shelter, transport, and other human necessities (Frank & Engelke, 2001). In Bahrain, new structures are built annually. While Bahrain's sophisticated built environment contributes to the health of the population and their wellbeing, it also poses health risks.

Human health has always been affected indirectly or directly by the built environment. In this case, the effects may occur immediately or passively (e.g., the quality of the indoor environment) or by encouraging behavior that can positively affect health by involving active participation from individuals (e.g., the design of the building may encourage walking). It is through the lenses of history, politics, economics, and culture that we define what health and disease are, as well as how they are classified (Zardini, Mirko, & Giovanna Borasi, 2012).

Health and illness are affected by broader cultural and social factors as well as by medical knowledge. The treatment and cure of disease were the main goals of medicine throughout the majority of the nineteenth and twentieth centuries. Most of the medical research was devoted to pathology. There is no doubt that the concept of health-related quality of life has been widely accepted as a tool to deal with the new situation that has emerged as societies have experienced a significant epidemiological transition over the past few decades (Omran, 1971) characterized by the decline of infectious diseases and the rise of chronic diseases. It is more than just the absence of illness that defines health in the modern world; rather, it is a state of wellness on all levels, including physical, mental, and emotional well-being (Steemers, 2015; Tsekleves & Cooper, 2017).

Based on the close interconnection among the built environment, climate change, and public health, architects and urban designers aim to improve general well-being of psychological and physical health taking into consideration the modern approach to health and what is considered a problem. A built environment strategy contributes to the mitigation of climate change through the construction of transportation infrastructure, building construction, and land-use planning. Multiple benefits can be achieved by combining built environment strategies with other wellbeing practices and approaches. To reduce GHG emissions and mitigate the effects of climate change, it is necessary to lead and collaborate across various professions in the built environment, climate change, and public health fields.

Tremendous stress is placed on environmental systems by drawing on Bahrain's natural resources. Buildings and real estate constructions have a direct and indirect effect on the environment. Buildings require raw materials and consume energy. They produce waste materials and emit damaging atmospheric pollutants during their construction, occupancy, refurbishing, repurposing, and demolition. Many countries in the GCC have witnessed rapid growth in the building and real estate sectors over the previous decade, leading to an increase in per capita domestic energy consumption (Al-Hathloul & Mughal, 2004).

In Bahrain, the construction and development industry consumes almost 45 percent of the country’s energy supply. Over 90% of residents in some regions of the country spend most of their time indoors due to the extremely hot weather conditions (Sustainable Energy Authority – Bahrain, 2021). Approximately 3 billion tons of raw materials are consumed annually by

construction and development activities around the world (Jagannathan, 2014).

The environmental effect of the building industry is significant as it consumes 40 percent of the natural resources generated in the developed world, 70 percent of the electricity, 12 percent of the drinking water, and an output of 45-65 percent of landfill waste (Castro-Lacouture, Sefair, Flórez, & Medaglia, 2009). As these figures suggest, reducing the environmental effect of buildings is a concern that has yet to be addressed.

2.2 The Real Estate Industry and GBs

A GB is a building that can decrease the harmful effects of construction and building activates on the environment and human health, thus providing healthier lifestyles (Oyewole, M. O., Ojutalayo, A. A., & Araloyin, 2019). In the US, 718 executives, including designers, construction professionals, real estate specialists, business owner-occupants, contractors, engineers and corporate occupants participated in a survey on sustainable building practices. They emphasized how the reasons for integrating green structures into a design project are energy conservation, reduced costs associated with operating and maintaining the building, as well as its value (Yaron, Ll, Ll, & Noel, 2013).

Bertrand, (2010) examined the advantages of GB design for real estate developers and discovered that it is within the power of developers to reduce associated risks and costs of obtaining GB accreditation. Research was carried out in China (Ying Zhang, Kang, & Jin, 2018) to investigate ten common barriers encountered during real estate growth and facility management with a questionnaire survey. They discovered the high cost of green equipment and

lack of motivation among consumers were two of the biggest obstacles facing development of GBs.

The key obstacles in creating GBs are a shortage of demand for sustainable buildings by clients, insufficient knowledge and education in sustainable architecture and construction, and a " The lack of provision for long-term savings in service fee systems, as well as the higher costs associated with sustainable building practices " (Williams & Dair, 2007).

The real estate sector's return on investment (ROI) from GBs and sustainable building practices are gaining attention for economic reasons. ROI is a measure of the economic benefits obtained from a program relative to its costs. It is calculated to demonstrate an investment's profitability (Brousselle, Benmarhnia, & Benhadj, 2016).

In a recent study, Schneider Electric & O'Mara (2012) concluded that GBs' ROI is higher in new construction and existing building projects. Other estimates have suggested the global GB market will reach $980 billion by 2023 (King & Perry, 2017). There is much potential for ROI in the GB sector, including lower energy consumption, reduced greenhouse gas emissions, increased occupancy rates, and lower operating expenses. These statistics indicate a return on investing in GBs:

- Smart buildings boasting integrated systems can reduce energy costs by 30–50 percent in present buildings that are not currently energy efficient (King & Perry, 2017).
- Power-over-Ethernet (PoE) technology is capable of reducing the power loss associated with AC-to-DC conversions by 15 percent

compared to inefficient systems (Krarti, Ali, Alaidroos, & Houchati, 2017).

- GBs release 36 percent less CO2 emissions In comparison with averages across the country (Buildings, 2019).
- LEED-certiffied projects command an average of 3.7 percent higher rent, have a four percent higher occupancy rate, and have a 5.6 percent greater tenant renewal rate than their counterparts without certification (Brousselle et al., 2016).
- The operating costs of new GBs are 14 percent lower than the average (Petrullo, Jones, Morton, & Lorenz, 2018).
- There is a seven percent increase in asset value for GBs over traditional buildings (Petrullo et al., 2018).

As energy prices increase so too does payback, making energy efficiency improvements profitable investments. These factors are consistent, emphasizing the need for immediate and ongoing change and transformation in the built environment. Urbanization at an unprecedented rate and scale, population growth, economic growth, ageing infrastructure and building materials, market demands, shareholder and public pressure, and regulatory conditions drive demand for a new style of high-performance GBs. As demand grows and as new approaches to addressing demand emerge, it is critical for developers and residents to understand the choices available to them.

By showing the importance of moving from conventional buildings to GBs in their paper, (A. Ahmed, Almanea, & A Alsuliman, 2021) try to demonstrate the importance of adopting GB practices. In particular, by providing information necessary to understand what GBs are and why they

are better than conventional structures. In their definition of GBs, they define them as buildings that do not harm the environment or use excessive quantities of resources. In order to determine how green a building is, they used LEED as the most common measure. To illustrate the applicability of GBs in Bahrain, they conducted a case study on an existing building. The LEED crediting system was used to compare conventional buildings and green buildings. According to this case study, conventional buildings consume a greater amount of resources, and GBs are considered a better choice from an environmental, energy, and cost standpoint. Based on the findings of the case study, it has been concluded that GBs are more cost-effective, create less waste, and consume much less energy when viewed in the Bahraini context, bearing in mind its infrastructure and geographical circumstances.

2.3 Ratings of GBs

Internationally, sustainable development is recognized as a priority for policymakers when developing policies at all levels of government (Singh, Murty, Gupta, & Dikshit, 2012). A World Economic Forum report has identified the construction sector as one that requires attention as it accounts for 40 percent of worldwide energy consumption, 40 percent of carbon dioxide emissions, and 20 percent of water consumption (Umar et al., 2015) (WEF, 2018).

It is well established that buildings are one of the main contributors to climate change, and this puts pressure on the construction industry to look beyond cost and time as traditional priorities. In response to these circumstances, various rating systems and tools have been created to evaluate the sustainability of construction activities. Even though this move is welcomed without hesitation, there has been confusion among stakeholders.

It is crucial to measure the effectiveness of rating tools as they relate to buildings and infrastructure (Yung & Siew, 2014).

These tools demonstrate obvious challenges that need to be addressed before implementing advances in sustainable real estate. Notable deficiencies include an overemphasis on environmental issues with little attention given to social or governance issues, assessment methods that overlook assessor variability, inefficient definitions of permit scale differentiation between projects, and a lack of scientific benchmarks (Yung & Siew, 2014).

Standards are a set of parameters and criteria that serve as guidelines for measuring and judging the performance of a product. ANSI, ASTM, or ASHRAE are among the organizations that create common principles related to building practices (Becchio, Corgnati, Fabrizio, Monetti, & Seguro, 2014).

The ISO provides regulation and governance for standards and certifications by defining and developing international standards that commonly become law or are incorporated into industry norms. Vierra et al (2012) defines an ISO standard as "a written document, developed by consensus, approved by a recognized body, that specifies a common and repeated use as rules, guidelines, or parameters of an activity, product, or procedure." A standard can either apply detailed prescriptive methods to achieve a set of requirements or have performance-based expectations on how to achieve them.

There are proprietary and regulatory green product standards available, which have not been developed in accordance with formal consensus processes like ANSI and ISO. Some standards might be stringent compared to other consensus standards, and will include greater transparency and public

feedback. However, many standards are trustworthy as they are associated with groups that possess legitimate environmental credentials (Wilson, 2010).

Codes that are performance-based are designed to achieve specific results rather than to meet specified requirements for each individual element of a building. Result-based codes establish a target for energy, water, and consumption. An example of green codes is the IGCC, which provides a comprehensive set of standards and requirements to minimize the harmful environmental impact of buildings.

Outcome-based codes set the consumption target for water, resources, and energy use levels and provide for the measurement and reporting of energy use to ensure that the completed building operates at the established level. Building evaluation systems allow developers to determine if buildings and projects meet sustainability goals. While at first, building assessment systems appear similar, they have significant variations and can yield different outcomes when used to implement GB programs. There are differences in how issues are weighed, prioritized, and in how communication is emphasized.

While building rating systems offer new tools to help communities make sustainable choices, the details of each system should be considered before selecting which one to implement. It would be desirable to have building rating systems that are adaptable to local environments, so that building assessment systems could be used to their fullest extent (Retzlaff, 2008).

Many GBRSs, like LEED, contribute to improvements in the approach of owners, designers, and contractors for building design, construction, and operation. A common method for GBRSs is to determine enforcement with each green standard through a point rating system. A GBRS has yet to allign

its ranking with the buildings' level of greenness. The certification level does not reflect the corresponding reduction of carbon emissions and environmental impact.

One issue is the framework for the correlation of GB principles with corresponding carbon emissions. First, reviewing the criteria for direct and indirect carbon emission measurement, following, identifying the critical point when modeling carbon emissions and, finally, identifying the variables that should be considered when modeling carbon emissions for buildings (K.Y. G. Kwok1, C. Statz1, Wai K. Oswald Chong1, 2012).

According to Pyke, McMahon, Larsen, Rajkovich, & Rohloff (2012), buildings are designed to last for decades, and as such, are long term capital investments. A crucial challenge for the construction industry is the potential for climate change to affect these assets over the long term. In their study, they weighed up the opportunities for assessing climate sensitivity and the adaptive opportunities associated with GB practices. Their work has culminated in the development of two complementary indicators, the Climate Sensitivity Index (CSI) and the Climate Adaptation Opportunity Index (CAOI). They were used to evaluate various strategies ('credits') within LEED, the New Construction Rating System. There are also two additional scores for each index – the CSI reflects potential sensitivity to variable conditions (i.e., The risks associated with performance outcomes), Adaptive opportunities are identified by the CAOI (i.e., probable adaptation strategies). The indices analyzed the prevalence of sensitive and adaptive activities among a global collection of 2440 LEED-certified projects.

Adaptive incentives in the LEED-NC classification system are more prevalent. The CSI and CAOI indices demonstrate how knowledge can be

extracted by analyzing LEED credit performance trends. Despite the weak economy, the demand for development that achieves green rating criteria remains high.

US cities are adopting green development regulations or policies with different environmental objectives, often with a focus on addressing global climate change. Meanwhile, in both state and federal jurisdictions, environmental advocacy groups and storm water regulators are concentrating on low-impact design (LID) methods to reduce long-term impacts on water for new developments and redevelopment projects. Also, replenishing groundwater resources and ensuring that rainwater is captured and reused are included in design strategies (Watson, 2004). Opportunities were explored to leverage momentum associated with the GB initiative for the implementation of LID principles in redevelopments and new developments (Laura Prickett, AICP, Senior Planner, EOA, Inc.1 and Jill Bicknell, P.E., Managing Engineer, EOA, 2010).

The authors investigated to what degree LID designs could earn GB credits under new construction (LEED-NC) and community development (LEED-ND) rating systems. Among the findings were an examination of LEED's green building requirements and alternative rating systems based on LID techniques which could gain green growth credits. A lack in credit availability is defined for different LID strategies, as well as opportunities to further incorporate the LID approach and GB initiatives.

LEED is credited as an innovative tool which drives demand for GBs and green communities. LEED is also credited with affecting significant change to how the industry approaches design, construction, and the operation phase of a GB. LEED's identification of ASHRAE standards 90.1, 62, and 55, as

well as standards arranged by the California Air Resources Board and the National Association of Sheet Metal and Air Conditioning Contractors, display its objective of benchmarking beside industry-accepted standards.

In response to demands from stakeholders and communities, the ICC established the IGCC. Widespread adoption of the IGCC and its 189.1 compliance path is expected to advance the construction sector with achievements and outcomes that are adaptable to economic, environmental, and health considerations (Bayraktar & Owens, 2010).

The construction industry's demand for metrics to justify sustainable construction designs can be addressed by developing tools for assessing the performance of buildings in their economic and environmental life cycles. Economic performance is measured using standard costing methods for the life cycle (Bayraktar & Owens, 2010).

Environmental performance is measured with life cycle assessment (LCA) methods that evaluate a building's carbon footprint in terms of its environmental impact. In addition, 11 other sustainability metrics are included, like fossil fuel depletion, air pollution, water use, habitat changes, indoor air quality, and human health impacts. Ratios of carbon efficiency and other eco-efficiency metrics are established in order to determine relative value, or to make a business case by using science-based measurements for GBs.

The measurement concentrates on heating, ventilation, air conditioning, and energy efficiency technologies. Tatari & Kucukvar (2011) claimed the environment developed effects the economy, culture, and climate. In addition

to growing environmental awareness of a building, their environmental assessment has gained prominence in the construction industry.

Researchers Pandey, Hindoliya, & Mod (2013) developed an artificial neural network model of their empirical observations to determine whether GBs with LEED certification are more expensive. Their results indicated that the green roof test cells regularly performed Comparatively better than those with the standard cement RCC rooftop, and their findings led to the following conclusions:

- It has been found that a green roof reduces heat transfer throughout the roof, thereby reducing the energy requirement for the building air conditioning, and that the most optimal type of roof garden is a shrub garden (exposed roofs as a baseline example). When a roof garden is planted with shrubs (with soil and shrubs that are 3 cm thick) it is possible to reduce the peak cooling load of a building by 73.8% by planting shrubs on the roof.
- Covering the roof with dry clay soil could reduce the amount of heat gain from the roof (a typical flat roof with 900mm of soil as the base case would lessen the amount of heat gain from the roof), which results in a reduction of 67.8% from the roof). As opposed to a roof covered in wet clay soil (Based on 900 mm thick soil with 40% moisture content, a typical flat roof is considered) it is possible to achieve a reduction of 22.6% in the heat gain from the roof with the soil layer thickness showing the least variation of all the parameters presented.
- Green roofs were proven to be particularly effective in reducing the temperatures and the daytime temperature variations that arise

during the summer on conventional roofs, As a result of the wide variation in temperatures.

- In testing with green roofs, it was consistently demonstrated that the test cells with green roofs outperformed those with conventional cement roofs. A green roof, while not able to achieve thermal comfort, can reduce the need for air conditioning and air pollution from the atmosphere because it will reduce the need to use air conditioning.

The researchers have built that decision model that can direct owners in calculating cost percentages based on the LEED credits they have requested. Demonstrating that sustainable sites and LEED groups like Energy & Atmosphere have been found to have considerable sensitivity in cost premium estimations.

GBs indorse public health and security, and a few US cities like Boston and San Francisco have required buildings to be LEED Silver Certified because of these benefits. Such mandates are expected to boost GB growth.

2.3.1 GB Materials

The choice of building fabrics and materials is critical in achieving GB goals. Selection is done both in the initial design phase, when typical and strategic decisions are made regarding the building, and in the working phase, when materials are selected from the market.

Kubba (2010) defines GB materials as a range of products and materials available in the marketplace and used over a range of building construction, furnishing, and energy generation activities. Few requirements are necessary for materials to be included on these lists. Materials can be included if they

are made of recyclable materials and contain low levels of volatile organic compounds. The more criteria a product meets, the more environmentally friendly it is. The lack of a consensus on the definition of GB materials has caused materials to be marketed as green without providing evidence to support or refute their claims (Kubba, 2010).

Choosing the right building materials plays an important role in achieving the objective of the GB. Choices are made before construction begins (through the acquisition and selection of a general design and strategic plan), as well as the material selection phase (at the stage of selecting materials available on the market). Sustainability is also considered in the pre-use phase of a building, such as the potential environmental impacts of chosen building materials (i.e. It includes the extraction of raw materials, the manufacturing process, and the delivery to the construction site of the finished product).

GB materials offer benefits for owners and residents that include reduced maintenance costs, increased productivity, improved health, creative space usage by applying design flexibility and improved energy efficiency. GB materials and products facilitate the conservation of limited non-renewable resources. This helps to offset the environmental impact of extraction, transport, processing, manufacturing, installation, reuse, recycling, and disposal of building materials.

2.3.2 Waste and GBs

Waste is defined as discarded materials and goods, leftover materials, or items created during construction or maintained. The most severe environmental and health issues in cities within developing countries are related to inadequate solid waste management. Gas released through the decomposition of waste is an environmental concern, hence the need to focus

on the household and community solid waste generated. When combined with other waste, food waste contains high levels of sodium salt and moisture, making recycling difficult.

The proportion of food and garden disposal in municipal waste streams is increasing, and a proper strategy for managing food and garden waste needs to be developed to ensure its environmentally friendly and sustainable disposal. The need for effective solid waste management worldwide has been magnified by increasing urbanization and population growth. As a means of minimizing the potential risk to the health of humans and the environment, economically feasible solutions are sought for the treatment of solid waste, especially in low and middle-income urban areas (Rahman, 2019).

GBs, also known as sustainable buildings, are environmentally friendly and resource-efficient over a building's lifespan, which can be broken down into the following stages: design, construction, service, repair, restoration, and demolition. As part of environmental and sustainability concerns, energy, water, and materials are used efficiently so waste is avoided, environmentally sound and friendly construction design is performed, and the construction process is carried out in a way that is environmentally friendly.

Environmental issues and the growth of the construction industry with the aid of Green Supply Chain Management (GSCM) give rise to issues surrounding construction waste management. This requires close cooperation during every project stage with design teams, architects, engineers, and clients. GSCM reduces energy use and waste, thus preventing problems that may affect human health and the environment.

2.3.3 Energy and GBs

GB can lead to reduced energy consumption, more efficient use of land resources and water, less soil construction, air and water pollution. This meets the demands of the times and improves people's quality of life. In the future of the construction industry and today's market, GB will become a central cultural concept, inspiring people to buy based on harmony with nature (Lv, 2012).

Environmental concerns have become the biggest obstacles in the lives of people as a result of economic globalization and technological advancement. Living environments and standards have become worse, so developers and policy makers have started to focus on events independent to the economy to aid people take notice of environmental issues and put forth the idea of GB.

GB is a new architectural concept and the modern construction industry continues to develop in this direction. The concept of GB in the construction sector enjoys prominent significance. Not only can it reduce resource waste and improve asset use, but also it reduces human activities surrounding the destruction of nature while improving people's quality of life and promoting harmony between humans and nature. The use of environmentally friendly energy-saving technologies in GBs should be applied to a building’s design, construction, and utilization process, enabling green energy-saving technologies to maximize their construction efficiency.

2.3.4 Water and GBs

The construction industry relies heavily on water as one of the most important natural resources and it is used significantly in the process. As such,

water and energy efficiency are given high priority in GBRSs. Worldwide, the building and construction sectors account for 40 percent of total energy consumption, 40 percent of waste, 30 percent of greenhouse gas emissions caused by energy use, and 12 percent of water consumption, while only employing ten percent of the labour force (Resource efficiency | UNEP - UN Environment Programme, 2021).

The built environment is significantly affecting many local and global challenges, like demographic shifts, climate change, water availability, land use, and other constraints. Rapid population growth in Asia and Africa by 2030 is expected to add 2 billion urban residents, resulting in demand for sustainable buildings and green construction (Resource efficiency | UNEP - UN Environment Programme, 2021). Environmentally friendly buildings are being adopted by governments around the world, as a key policy to combat climate change and water shortages (Shen, Yan, Fan, Wu, & Zhang, 2017).

The World GB Council information indicates that GB can assist in achieving the UN Sustainable Development Goals and also has the potential to “address the water scarcity and availability problems” (World GB Council, 2021). A country's construction industry contributes to its socioeconomic well-being; unfortunately, this industry consumes natural resources and energy. There is no doubt that active participation within this industry can be conducive to sustainable development.

2.3.5 GBs and Human Health

GBs strive to minimize their impact on the environment through the reduction of water and energy use and the minimization of disturbances to the

environment. Moreover, GBs contribute to human health through the construction of healthy indoor environments (Allen & Health, 2015).

The benefits of reducing energy and water consumption are well established, but the potential health benefits of GBs have only recently been studied. GBs conserve energy and water by reducing resources. The environmental impact of the construction process is also reduced by selecting a building site that minimizes the impact on its surrounding environment. However, the methods used to design GBs for improving human health are less well known and scientifically examined.

The preliminary scientific indication shows that GBs offer better indoor environmental quality than non-GBs, resulting in direct health benefits for the building's occupants. There are limitations to much of the research to date because many of the health measures used are indirect, lagging, and subjective.

It has been acknowledged that occupants of GBs are happier with indoor air quality, work environment, building hygiene, and building maintenance. GB practices ensure indoor environmental quality is superior to that of traditional buildings. Occupants are exposed to fewer allergens, pollutants and other environmental contaminants, like formaldehyde used in building materials. GB residents reported lower absenteeism and fewer lost work hours due to asthma and allergies in one study (Salina, de Almeida, & Bittencourt, 2020).

In addition to reducing sick building syndrome symptoms, better indoor environmental quality leads to healthier lives on both a physical and mental level for building occupants (Srinivasan, O'Fallon, & Dearry, 2003). There is

also an association between working in a GB and a higher level of productivity, lower employee turnover, and a reduction in the number of open positions. The benefits of green hospitals extend to both patients and medical professionals. One study found that the standard of care improved, the number of bloodstream infections decreased, and patient deaths were also lower. However, acoustics have consistently performed poorly in GBs, as studies found that those surveyed expressed dissatisfaction with noise levels (Allen & Health, 2015).

2.3.6 Economic Benefit of GBRSs

The economic advantages for builders, real estate developers and homeowners are becoming more evident as the application of GBRS becomes more prevalent. The most well-known financial benefit of the GBRS application is the reduction in operating expenses, such as power and energy consumption for heating, cooling, lighting, and ventilation as well as multiple maintenance operations during the building lifecycle. While GBRS's initial application may raise the capital expenses needed for buildings, the different gains arising from reduced working expenses will compensate for the capital expenses.

Building expenses are decreased when buildings are designed with an efficient framework and structure that is based on fewer properties that need regular maintenance. Furthermore, the increase in property value is another advantage, where a building's company value could increase when the benefits of implementing a GBRS are transferred to clients.

2.3.7 Social Benefits of GBRSs

The social advantages of sustainable construction and the application of GBRS enhances quality of life, safety, and comfort. The application of a GBRS leads to enhanced employee efficiency and superior, healthier working environments. These advantages can be achieved in different settings, including houses, communities, and society. Several features implemented in GBRS can also improve and develop the quality of life of building residents. Increased natural heating and ventilation not only relieves stress from electric and mechanical devices, but also provides healthier living and working conditions. Enhanced outdoor access, stimulating environments, and innovative designs can provide healthier and productive working and living spaces and comfort.

When people are inside a building, they will also try to make themselves more comfortable. In tropical steamy climates, the majority of the energy is utilized to cool the area, and in semitropic climates, the majority of the energy is used to heat the area by using air conditioning cooling systems. As a result of its use, these systems provide a number of benefits, such as allowing cooler air to be introduced into the room and removing hot air from it, especially in tropical climates. As a consequence, whether consciously or unconsciously, it reveals the readiness of occupants and individuals to sacrifice the environment outside the building in exchange for the thermal comfort that is provided within the building as a result of this tendency.

Despite this, it is still possible to improve comfort with natural air and lighting without compromising the environment or harming it as much as possible in the process. A building is designed and constructed with the use of natural air and lighting in mind until a point at which these conditions

cannot be met, in which case mechanical or electrical equipment is forced to be employed in order to meet the expected conditions.

There is an important point to understand that human comfort is more than just physical comfort; it is also influenced by the intermediate conditions of clothing worn, as well as physiological conditions such as the gender of the individual and the age (Hegger, 2012). Thermal conditions, such as The flow of air, the temperature, and the humidity, as well as visual conditions, such as contrast, glare and color, as well as acoustic/audial conditions such as frequency, power level (noise), and olfactory conditions (smell), such as odor, carbon dioxide, dust, as well as other conditions like air pressure, can be considered physical conditions.

There is an opinion held by Hegger and Zeimer regarding comfort, which is in line with the opinion presented by Bougdah and Sharples (2009). The argument presented by these individuals is that comfort is a state of mind that is caused by a number of factors such as physical conditions, the ability of humans to control those conditions, and other physiological conditions that play a role in the comfort of a individual.

The temperature of an environment can also be affected by human activity in that area, as humans can absorb and generate heat. The effect of human activity on the temperature of a particular environment depends on the level of human activity, as well as the size and sex of the person (Bougdah and Sharples 2009).

When it comes to visual conditions, Bauer (2007) argues that lighting the interior of a room is influenced by three factors: Dimensions of the room, the physical presence of the barrier, as well as the kind of lighting on the buildings

facades, all of which can affect the quality of light in the room. In order for a room to be of good visual quality, the brightness inside the building must be the same as the brightness outside, so that the space is bright enough for people to carry out their daily routines without feeling uncomfortable. Other indicators of good visual quality are whether the sunlight is evenly distributed in the room, if the lighting in the room changes with the outside brightness (Hence, it is possible to recognize the rhythm of light outside a building from within it) and if there is no glare.

Furthermore, in order to support the occupants' activities, the air health conditions in the room are crucial. There are numerous aspects to the issue of contaminants in space (Bougdah & Sharples, 2009). First of all, pollutants enter into a room through a number of different means, including cleaning materials and equipment, office equipment (Printers, photocopiers) In addition to finishing materials (paints). This adverse effect can be counteracted by choosing equipment and materials with certain specifications and also ensuring that proper ventilation is in place to remove pollutants.

2.3.8 Environmental Benefits of GBRSs

The environmental benefits of GBRS include natural resource conservation, waste management, improving air and water quality, and ecosystem protection. Real-estate development and the construction industry are associated with global warming. As one of Bahrain's largest sources of greenhouse gas emissions, the energy sector continues to contribute 77 percent of Bahrain's total greenhouse gas emissions (UNDP in Bahrain, 2020).

Bahrain’s emissions are amongst the highest in the world when examined on a per capita basis, and continue to grow, despite the overall small emissions from the country as a whole (Jagannathan, 2014). Bahrain's per capita carbon dioxide emissions in 2013 were twice that of high-income countries and nearly five times as high as those around the world (Sustainable Energy Authority – Bahrain, 2021). Several factors contribute to Bahrain's high per capita emissions, including Bahrain's small land area, high population density, extreme weather conditions, limited water resources, and dependence on desalination plants that consume a great deal of energy. Developing energy efficient policies, utilizing renewable energy and generally improving our energy efficiency overall could result in a reduction of greenhouse gas emissions in Bahrain.

A total of 24,705 GWh was consumed by the Kingdom in 2014. Approximately 66 percent of total electricity consumption was supplied by grid electricity supplied by EWA. Approximately 34 percent of Bahrain's electricity is generated and consumed by its industrial sector.

46 percent of total grid consumption in Bahrain is attributable to the residential housing sector (Figure 3). The commercial segment is the second-largest user accounting for 36.4 percent, followed by the industrial sector at 17.3 percent (Electricity and Water Authority (EWA), 2021).

Implementing GBRS’s environmental advantages are not restricted to decreasing fossil-fuel usage and emissions of GHGs. Components of green construction cover water control, waste generation, recycling of products, preservation of resources, and biodiversity. Technical alternatives can be far-reaching to these issues and can solve them simultaneously. An example of green technology addressing environmental issues are green towers that

provide alternative ventilation solutions, absorb air emissions and coal storage. They offer insulating characteristics, decrease outdoor noise, provide habitats for small animals, and add to reducing the impact of urban thermal islands.

Sustainability requirements are often interconnected, but the challenge remains for designers to combine these requirements in an innovative fashion. An approach must be adopted when designing new builds that takes into account the impact of each design choice on the natural resources of each environment, local, regional or global. As part of the sustainability requirements for building designs and construction, these requirements are applicable at all stages of the building life cycle, from the design of the building to the use of the building over its lifetime and even to the management of building waste after demolition.

The implementation and regulation of a GBRS is intended to decrease global environmental and human health impacts through reduction of waste, environmental degradation. Energy, water, and other assets are used to protect occupant health and enhance consumption effectiveness. The use of a GBRS holds the construction industry accountable for the choices they make and ensures that sustainable building practices are at the core of each project. These practices must aspire to balance sustainable performance with economic and social performance to ensure GB remains an attractive option.

Taking this into consideration, it becomes clear how sustainable development and construction are linked together; The construction industry has a high economic significance and a substantial impact on the environment and society. With an increasing awareness of environmental protection, the importance of this issue has been recognized by construction professionals all

over the world where GB practices are often cited as a progressive way to ensure the economic advancement of the industry while minimizing its environmental impact.

As part of the construction industry's commitment to sustainability, there are three principles that help reduce these negative environmental impacts. These are the use of resources efficiently, efficient cost management, as well as designing for human adaptations. As a result of these three principles, a framework is established for the integration of sustainability principles into the conceptual phase of construction projects (Akadiri, Chinyio, & Olomolaiye, 2012). As a result of this framework, there is a significant potential for accelerating the knowledge of and application of sustainability in the building and construction industries. It highlights the need for building projects to be considered holistically, integrated, and comprehensively when considering sustainability principles, strategies, and methods.

Akadiri et al.'s (2012) argues that Building Performance Assessment framework is not an assessment system in itself but rather a framework that is expected to be used as a complementary tool to other established GBRSs, like LEED. The goal is to improve not only the quality of the methods used to assess the environmental performance of buildings, but also to ensure that there is a level of uniformity across different methods. Building sustainability involves identifying and addressing factors that affect the environmental performance of buildings during design, construction, operation, refurbishment and deconstruction, Furthermore, the framework will serve as a starting point for the development of an operational decision support tool for building and construction sustainability implementation.

2.3.9 GBs and Building Envelopes

GBs require the development of the right building envelope. Having an insulated envelope ensures that its occupants have a productive and healthy environment without wasting energy. Envelopes in GBs differ from conventional buildings as they function differently and aim to achieve broader goals (Gibberd, 2014).

Researchers are exploring innovations like self-shading envelopes since a well-designed building envelope can lower the temperature inside, reducing the amount of air being conditioned, thereby lowering the amount of energy used (Gibberd, 2015).

There are components and factors, such as wall, barriers, fenestration, roofs, foundations, Thermal system insulation, thermal mass in addition, there are external shading devices that are part of the building envelope. It has been shown by researchers around the world that improvements to the building envelope have a significant impact on the consumption of energy.

The envelope is also made up of external elements such as walls, roofs, windows, doors, and floors that form the exterior of a building. Building envelopes are fundamental to the structure of the building that allows it to provide shelter, protection, solar and thermal control, moisture control, control of indoor air quality, control of daylight exposure, protection from the elements, cost-effectiveness, and aesthetic appeal.

Building envelopes are required to fulfill functions and sometimes-competing functions, requiring a comprehensive and integrated approach that encompasses all phases of their life cycles. Sustainable practices contribute to increased environmental commitment and conservation. A balance is

maintained between costs, environmental, social, and human benefits, achieving the desired facility function and mission.

2.3.9.1 Building Envelope, Foundation and Flooring

The foundation is perhaps the most challenging envelope component of a building from energy transport and hydrothermal perspectives. The foundation provides the basis of energy and materials upon which the sustainability of the structure depends.

From a material perspective, the foundation must provide a lasting interface between the surrounding ground and the building's interior in the presence of bulk water, soil, biotic activity, and plague infestation, while at the same time being the structural basis of the building. From an energy perspective, the foundation should isolate the interior from the surrounding soil and ambient atmosphere and provide an interior surface temperature that produces comfortable conditions while reducing both active and residual thermal loads.

Accordingly, the foundation systems for residential buildings form the basis for sustainable GB design. The complexity of their hydrothermal transport phenomenology and the structural requirements they impose make sustainable foundation design challenging (Code & Conserva-, 1995).

2.3.9.2 GBs and Building Envelope Walls

In terms of architectural aesthetics, walls are an integral part of the building envelope, and their function should be to provide thermal and acoustic comfort to the occupants inside the building without impairing its structural integrity. Thermal resistance of a wall (R-value), which is an insulation performance metric, is a measurement of how well a two-

dimensional thermal barrier (an insulation layer, a window, a wall, or ceiling) resists the transmission of heat and is employed to determine whether or not the thermal insulation is more effective than other forms of insulation (Raouf & Al-Ghamdi, 2020). The R-value is vital because it impacts the amount of energy consumed by the building, this is especially important for high-rise buildings where there is a high ratio between the area of the walls and the area of the total envelope.

Surface condensation occurs on walls with thermal insulation if the relative humidity of ambient air is greater than 80 percent, given the external wall coefficients of convective and radiative heat transfer are low (Yao, 2013). The problem is more severe in high humidity regions.

2.3.9.3 GBs and Building Envelope Roofs

Roofs are one of the most vulnerable parts of the building envelope for both solar radiation and environmental effects, thus affecting indoor comfort conditions. Roofs can contribute to heat gain or loss, especially large-scale roof structures like sports complexes, auditoriums, and exhibition halls.

Some passive cooling techniques could be implemented in tropical climates due to changes in roofing architecture. These include compact cellular roof layouts with minimal solar exposure, dome and vaulted roofs, natural or mechanically ventilated roofs, micro ventilated roofs, high roofs, and double roofs. Other methods, like whitewashed outer surfaces of the roof to reduce solar absorption, vegetation-covered roofs providing humidity and shade, and using high thermal capacity materials, such as concrete, to minimize the demand for peak load are also becoming popular. Roof shading also offers an alternative to raising the effect of solar radiation on rooftops.

2.3.9.4 GBs and Building Envelope Fenestration

The fenestration of a building refers to the openings within the envelope, such as windows and doors. In addition to providing thermal comfort, an effective fenestration system ensures adequate lighting levels in buildings. In addition, they are also distinguished from an architectural viewpoint in that they complement the design of a building in an aesthetic way. Significant advances in glazing technologies have been made in recent years. There are many technologies used to achieve these goals, including solar control glasses, thermally insulating glass units, low emissivity coatings (also known as Low-E coatings), evacuated glazing, aerogels, gas cavity fillings, enhanced frame design, and spacer configurations.

The literature review has shown that although Bahrain's MOW and the Urban Planning and Development Authority has suggested GB criteria for buildings and public construction projects, the Small Island Developing State (SIDS) has not developed an operational regulated rating system, nor has it adopted an international sustainable rating system.

2.4 Regional Adaptations of GBRSs

As a result of water shortage, harsh climate conditions, ecological dilapidation, and fossil fuel extraction conditions and requirements, there are significant environmental and socioeconomic challenges in the Middle East (Ismaeel, 2020).

As a result of its hot climate, and due to the prevalence of glass exteriors in commercial and residential buildings, as well as a heavy reliance on air

conditioning, buildings in the Middle East consume more energy than their counterparts elsewhere in the world (Nahiduzzaman et al., 2018).

Economic expansion, in turn, has led to a population explosion in the region. In 2010, the GCC population grew from 28 million to 43.2 million; by 2025, it is expected to reach almost 60 million (Almulla, 2014).

As GCC construction work expands, both energy demand and environmental conditions are challenged. This impacted domestic energy supply and desalination water needs, with an expectation that by 2025 electrical consumption could reach 1094 TWh (Abdul Mujeebu & Alshamrani, 2016).

It is estimated that the MENA countries are responsible for 5.2 percent of the world's Greenhouse gas emissions (Abdul Mujeebu & Alshamrani, 2016). MENA countries have comparable development objectives and challenges, as well as international obligations to reduce energy consumption and emission releases. A wide range of eco-friendly architecture, traditional building methods, and sustainable construction techniques have been used by the Middle East's building industry over the past few decades.

In addition, GCC companies have integrated into globalized economic networks and complex international supply chains. As part of their interaction with foreign markets and businesses, they are gaining a greater awareness of the sustainability agenda (Hodgson & Hanson, 2014).

Furthermore, states in the region are endorsing efficiency methods to accomplish energy security, playing a role in boosting the local GB industry. Sustainable construction enables healthier working conditions and improved

productivity, which explains why the real estate industry is opting for a more sustainable approach to address its rapid development.

To guide rapid development, building environmental assessment methodologies have been developed since the 1990s and have become quite successful in the subsequent years (Helgeson & Lippiatt, 2009). During the same period, the standardization of issues pertaining to environmental building has also increased. For instance, the ISO and the European Committee for Standardization (CEN) have been effective in providing descriptions for the standardized principles for the environmental assessment of buildings (Alyami & Rezgui, 2012a).

There have been a variety of assessment systems developed in various countries throughout the world. In many rating systems, there are prescriptive ratings that call for answers. There are also fewer prescriptive rating systems and assessment tools in building rating systems used to assess buildings and their surroundings vary according to circumstances. In some cases, the tool focuses on a single issue, like energy usage or carbon dioxide production, whereas in others, a wide range of problems can be dealt with under one umbrella tool.

Building certification has become prevalent, and systems like LEED and other GBRSs are being used to enable comparison of building performance and other trading values (Gobbi, Puglisi and Procedia, 2016).

2.4.1 Implementation of International GBRSs in the Region

Sustainability and GBs are no longer marginal concepts. They are becoming the norm for sustainable construction and modernization. In the MENA region, GBRSs are gaining momentum and their development and

application have become a regional trend. Many countries have developed similar systems to keep pace to the global green movement.

Building certification has become important to stakeholders and has received significant attention, and systems that achieve LEED and BREEAM certification and other locally developed GBRSs have become a foregone conclusion and essential to the sustainability of the region. The implementation of international rating systems has spread throughout the GCC region and has been welcomed by its members. Around 1,170 buildings have achieved LEED certification where LEED-registered buildings have more than doubled over the past decade, from almost 620 in 2010 to a projected 2,500 by 2020 (Shaawat & Jamil, 2014).

Of the environmental evaluation methods and comprehensive green rating systems for buildings, BREEAM, LEED, SBTool, and the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) are the most common and prevalent worldwide (H. H. Ali & al Nsairat, 2009).

2.4.1.1 LEED Rating System

The LEED GBRS is the most used worldwide for GBs (Obata, Agostinho, Almeida, & Giannetti, 2019). Compatible with all types of buildings, LEED provides a framework for designing healthy, efficient, and cost-effective GBs. Globally recognized for its leading role in sustainability, LEED certification is a symbol of achievement in this field.

The LEED credential was established by the USGBC in 2000 (Bayraktar & Owens, 2010). The LEED Building certification program offers certifications for all phases of construction, including new construction,

interior design, operations and maintenance, and the structural system. To achieve its primary goal, LEED seeks to transform building markets into ones that are focused on sustainable design, construction, and operation practices.

LEED helps buildings become more eco-friendly by improving their performance in multiple “green” areas. Many prerequisites must be met for a building project to qualify, including following certain energy efficiency engineering standards. Other green measures can earn additional points as well. Among the prerequisites and optional measures are energy efficiency, management of water resources, efficient use of resources and materials, and a healthy indoor environment, where a project's certification status will be determined by how many points it accumulates for these optional measures (Chance, 2012).

A number of states have implemented incentive programs to encourage owners and developers of private buildings to attain LEED certification. LEED accreditation assists the identification of innovative leaders in green design through incentive-based programs (Biofilter, 2013). The purpose of granting such mentions serves as a marketing tool as well as increasing consumer awareness of green design. A variety of incentives are available, including An incentive program can include grants, tax credits, and expedited permitting processes as well as reduced building and construction permit fees and duration. A tax incentive exists in Connecticut for building owners and developers who develop or acquire commercial properties that meet or exceed the LEED gold standard. The GBs tax credit program is administered by the Department of Energy and Environmental Protection and the Office of Policy and Management.

LEED Categories

The configuration of the LEED Rating System is segmented into sectors, credits, and points. In order to achieve LEED certification, the following seven sections must be met: Site Sustainability, Energy Efficiency and Water Efficiency, Atmosphere and Water, Material and Resource Management, Quality of Indoor Environment, Technological Designs and Innovations, and Regional Priorities (Figure 4). Certification is achieved by obtaining credits in these areas. The USGBC certifies a LEED-compliant building when it attains 40 points (Choi, Bhatla, Stoppel, & Shane, 2015).

Following is the point distribution among the seven categories:

- The criteria for Sustainable Sites: 26
- Efficiencies in the use of water: 14
- The atmosphere and energy: 35
- The resources and materials used: 10
- The quality of the indoor environment: 15
- The use of innovative design techniques: 6
- Priorities for the region: 4
- The total number of points possible: 110

LEED Certification Levels

For an integrative process to be successful, all categories must be considered. Obtaining LEED certification requires achieving at least 40 points in accordance with the applicable rating system.

The certification points system comprises of 100 base points plus ten along with ten additional points (totaling 110 points) (Figure 5) and provides certification levels based on the following criteria:

- Certified status: is awarded to those with 40 to 49 points
- Silver status: is awarded to those with 50–59 points
- Gold status: is awarded to those with 60–79 points
- Platinum status: is awarded to those with 80 points or higher

With this framework definition of sustainable design, earlier energy-efficient design concepts have been incorporated into building aspects, systems, and site development questions. There are usually one or more prerequisites for most sections. In the absence of these prerequisites, the balance of the category points will not be included.

LEED Adaptations

In the MENA regions, Arab countries face similar challenges in promoting GB practices and have similar development goals. The LEED rating system has been introduced in this area as a third-party GBRS recognized internationally.

With the launch of the international LEED version in the ten years, LEED has spread throughout the MENA region, starting with the UAE, and has since been adopted throughout the region in many other countries (Figure 6). The system has served as a reference for other rating systems developed locally, which are based on the same assessment criteria, but differ in the way they allocate weight to respective factors.

LEED is the region's most common system used with the highest number of registered projects (Ferwati, Al Saeed, Shafaghat, & Keyvanfar, 2019). Figure 7 shows LEED adaptation across the GCC.

There has been considerable evidence that LEED diffusion can be attributed to a wide range of factors, including political, economic, legislative, social, and environmental (Gou, Lau, Building, & 2013, 2013). Ismael has stated that economic factors play a major role in the LEED demand for the Middle East and North Africa region due to the high capital costs required for LEED certification.

LEED has been embraced by the GCC because of increased energy consumption and emissions, hence its widespread adoption in countries with high GDPs and GDP per capita. Table (6) shows the status of the LEED certification building in Bahrain.

To be successful with the LEED system, challenges must be overcome: implementation challenges (expertise and knowledge) and those related to local contexts (where and why), as well as the practitioners' capacities (who) as average LEED adoption rates vary according to local conditions (Ismaeel, 2020). LEED comparison adoption rates between Arab countries and the global average is shown in Figure 8.

2.4.1.2 BREEAM Rating System

BREEAM was developed in 1990 by the Building Research Establishment (BRE) in the United Kingdom (UK) (Shamseldin et al., 2020). The BREEAM rating system was intended as a voluntary rating system for GBs to assess the environmental performance of buildings. There are different

ways of implementing BREEAM worldwide. It has been adapted to suit the regions in which it will be used and reflect differences in standard practices or cultures (T. Saunders, 2009). A certified BREEAM assessment results in a number of outputs, one of which is the rating assigned to the building. Based on the certified ratings, it is possible to determine how well the project and its stakeholders performed as compared to the standards set by the project.

BREEAM categories measure sustainability. As a result, they are categorized according to their most important characteristics, which include low impact designs and the reduction of carbon emissions; design durability and resilience; adaptation to climate change; and ecological value and the preservation of biodiversity (Diaz-sarachaga & Jato-espino, 2019).

In addition to providing reassurance to customers and users, the rating facilitates comparison of projects and enables to compare the quality and value of information and services provided by the asset. International projects submitting for BREEAM evaluations should use BREEAM Bespoke International (Sabie, Pitts, & Nicholls, 2014). In this way, the client can also assign a local expert to investigate the local codes and benchmarks in the certain country or region.

By collecting this information, the Building Research Establishment (BRE) formulates final assessments criteria that the assessor uses to determine the suitability of this building for assessment.

BREEAM Categories

Its rating system involves a variety of assessment criteria to assess a building's sustainability, making it a widely used and internationally recognized certification scheme (Figure 9). BREEAM focuses its assessment

on holistic environmental factors, it includes the management of energy and water, internal well-being, pollution, materials, waste, transportation, recycling, and ecology, as well as the use of materials, waste, and recycling.

The BREEAM In-Use assessments are based on key environmental categories which provide a comprehensive picture of how a building structure overall performs from the standpoint of its environmental impact (Quality and Performance in the NHS, 2012).

BREEAM Certification Level

Sustainability is measured by various categories in BREEAM. These categories cover a wide range of topics, such as low impact designs that reduce carbon emissions, durability, resilience, climate change adaptation, ecological value, and the protection of biodiversity, as well as low impact designs that minimize impact on the environment (Figure 10).

The categories are subdivided into a collection of evaluation issues, each with its specific goals, targets, and standards. The BREEAM classifications are Energy, Health and Wellbeing, Innovation, Land Use, Materials, Management, Pollution, Transport, Water ,and waste management (Quality and Performance in the NHS, 2012.).

When a target or benchmark is reached, the BREEAM assessor will award credits to the development or asset based on their achievement. Following the calculation of credits earned, a category score is calculated according to that category's weighting. Following the assessment of the development, the final performance rating is calculated by adding the weighted categories' scores together to determine the final performance rating (Figure 11).

As part of the BREEAM rating system, buildings are rated on multiple factors, which are based on a series of stars from the BREEAM certificate. An expert determines if the building is acceptable (used scheme only), passable, very good, excellent, or outstanding (T. Saunders, 2009).

From design and construction to operation and renovation, assessment and certification are possible throughout the built environment life cycle. Third-party certification under BREEAM involves an inspection by neutral experts as part of the certification process. The BREEAM assessment is the assessment of buildings and projects to ensure they meet the quality and performance standards by a qualified and licensed assessor. As part of the certification process, certification bodies are at the core of the process and are organizations that have been granted government approval to certify products, systems, and services by national accreditation bodies.

BREEAM Adaptations

Due to the Gulf's regional conditions, BREEAM incorporated regional factors and attributed weight standards to make them more relevant to the region's environment. The BRE Group has launched a customized version of its energy rating system BREEAM, which is designed for the Gulf region. Thought there was a difference between BREEAM and BREEAM-G, as BREEAM-G incorporated regional factors that were specific to the Gulf region. The weights of the assessment were different from those of the BREEAM assessment (Jamil, Ferwat, Alsaeed, & Komeily, 2014).

The rating system covers water conservation and energy issues in its new form. In the new BREEAM program, designers and developers have the opportunity to assess the environmental, social, and economic impacts of their

building designs by using standard BREEAM credit categories. BREEAM Gulf was developed in collaboration with organizations headquartered in Qatar, Abu Dhabi, and Dubai for the purpose of providing guidance to the construction industry in order to achieve higher levels of sustainability and recognizing local contexts (BREEAM -BRE, 2021).

The BRE developed the BREEAM Gulf program in collaboration with local governments. BREEAM customized its renowned sustainability rating methodology by considering the local climate, available resources, and the opportunities and constraints of the region. Most Gulf projects are mixed-use projects, making BREEAM Gulf (unlike BREEAM in the UK) consider the various uses of a building, including retail, residential, and commercial spaces under a single scheme.

The BREEAM Gulf rating system was designed to pay closer attention to the Gulf challenges and circumstances that consider water conservation and energy issues in its new form. This program lets the local GCC designers and developers evaluate the environmental, social, and economic impacts of their building designs via the standard BREEAM credit groups with relevance to their unique circumstances.

BREEAM Gulf consists of two stages: The Design Stage and the Post Construction Review (Kalmner, 2012). The design stage evaluates building designs, resulting in an interim design certificate. A BREEAM Gulf certificate is awarded following the completion of the mandatory Final Post Construction Review.

After the assessment of each building within a single property, a score is awarded. The assessment yields a percentage score based on how

sustainability and eco-friendliness are integrated into the construction and specifications. The score is translated into a star point system, like the quality star system used by the hotel industry. Star ratings range from one to five, with five stars representing the best environmental performance (Burg & Hupp, 2016).

A BREEAM Gulf assessment program was launched in 2008 and is designed to assess the environmental impact of buildings in the Gulf region in terms of their environmental performance (UAE, Oman, Qatar, Bahrain, Saudi Arabia, and Kuwait). as a result of a lack of support from the construction sector and building owners. It has been found that stakeholders in the sector did not show sufficient interest in applying the BREEAM-G procedures and standards (Shaawat & Jamil, 2014).

A comparison has been made between the BREEAM gulf version and the gulf region characteristics and it has been found that there is a big difference between the weightages provided which is apparent through the sustainability of the site, the water, and the durability and reliability of the materials. A major factor is the geographical location of the application area. It is due to the differences in the availability of resources, climate, the materials available for constrictions, and a number of other traditional aspects that weights vary from region to region (Lisa Zimmermann, 2015).

A rating system designed for a particular region can only be applied to the region in which the system was created. It may not be applied to other regions for which the system was not designed. Assuming the factors for a rating are the same in every region, if it is applied to a building in another region, the rating may not be accurate. This is due to the fact that factors assumed for a rating may vary from one region to another. There can be a

considerable variation between regions when it comes to the factors that are assumed for the purpose of a rating. Based on this, it can be concluded that each rating system has been developed based on a variety of factors, including resources, materials, and regional trends, which are unique to that region. Consequently, one rating system developed for one region cannot be applied to any other region as it can produce inaccurate results if it is applied to another region.

2.4.1.3 The CASBEE Rating System

In 2001, the CASBEE was developed in Japan with support from the Ministry for Land, Transportation, and Infrastructure (MLIT). It offered a sustainable approach for the governmental, academic, and industrial sectors (Fowler & Rauch, 2006). So far, CASBEE tools have been developed and made available for multiple building types.

The CASBEE for Real Estate Certification process involves third-party certification. An assessment is conducted based on the CASBEE real estate standards to determine the results, where an application for certification should be accompanied by a report from an accredited real estate CASBEE professional. The certificate validates a building's environmental performance for prospective home buyers and sellers (Hayashi & Hiyama, 2021).

CASBEE Categories

There are four main components of CASBEE: The efficiency and conservation of energy, resources, and natural resources, the local environment as well as the indoor environment. These factors have 80 sub-points, which are divided into two categories: Q (Quality) and L (Loadings) (Miljana Horvat & Paul Fazio, 2005).

CASBEE is composed of four primary assessment tools: An early pre-design version of the (CASBEE-PD), ACASBEE for the construction of a new building (CASBEE-NC), A CASBEE conducted for existing structures (CASBEE-EB), In addition to the CASBEE for Renovation (CASBEE RN). These tools are referred to as the CASBEE Family and their extended versions for specific purposes (Bernardi et al., 2017). The methods are used to assess single buildings and aimed at providing building assessment tools tailored to building assessments. For example, among these are workplaces, schools, retail stores, cafeterias, restaurants dormitories, hotels, and apartment buildings.

CASBEE Certification Level

As an assessment on whether green building practices are sustainable, CASBEE utilizes a BEE (Building Environmental Efficiency) assessment (Huimin, Mao Xiaoping, & Qiming, 2009). The Building Environmental Efficiency Equation is calculated by weighting coefficients as indicated in the equation below (Built Environment Efficiency (BEE), 2021).

$$\text{BEE} = \frac{Building\ environmental\ quality}{Building\ environmental\ loadings}$$

CASBEE's approach to completing the final assessment results makes it unique when compared to other assessment tools. As an alternative to using additive metrics, this standard introduces BEE as a distinct concept with weighting coefficients for assessing the sustainability of buildings from an environmental perspective (Taylor, 2011).

An evaluation is conducted by surveying stakeholders such as designers, building owners, and real estate agents. It reviews the collected data using analytical hierarchy processes (Endo, Murakami, & Ikaga, 2007). CASBEE

also evaluates building energy, resource and recycling efficiency, and other environmental-impact reductions. It also factors in comfort and landscaping when evaluating a building's environmental performance.

There are five possible grades for the CASBEE assessment: superior (S), very good (A); good (B+); slightly poor (B-), and poor (C). Furthermore, there are tools included in CASBEE, referred to as the CASBEE family. They can be adapted to project scales, residential and non-residential construction, as well as urban and district development spanning town and city development (Shin, Shin, & Tea, 2013).

CASBEE Adaptation Levels

The uniqueness of CASBEE methodologies relies on assessing aspects simultaneously and calculating scores based on their relationship (Alyami & Rezgui, 2012b). Similarly, Gu, Wennersten and Assefa (2006) and Sev (2011) consider CASBEE as the most advanced assessment system covering issues that arise during the building construction stage.

The purpose of CASBEE is to be able to serve a variety of markets and applications. In terms of implementing CASBEE, the governments have been the most active in making it available for practical purposes.

2.4.1.4 SBTool Rating System

The SBTool is a system for rating the sustainability of buildings based on a number of criteria that have been developed by the International Initiative (the IISBE organization) for a Sustainable Built Environment. As a result of this assessment, users should be able to reflect on the priorities, technologies, building traditions, and the cultural values of each region and country involved in this assessment in order to identify the different priorities,

technologies, and building traditions in each region and country. The SBTool is broader in scope and more dynamic, using a toolkit approach that allows users to select issues according to their building type and location.

SBTool Categories

SBTool, previously known as GBTool, is organized into four levels according to weighted aggregation. In the higher levels, there are one goal, seven issues, and 29 categories to follow from the lower levels (Chew & Das, 2008). In contrast to focusing on GBs, the system addresses issues related to sustainable buildings. The tool also accommodates regional and site-specific conditions to enable users to tailor their applications according to local priorities and requirements (Sev, 2011).

SBTool Certification Level

According to this assessment system, there are four phases of evaluation: (1) Pre-design; (2) Design; (3) Construction; (4) Operations. The SBTool has an adjustable scope to include parameters ranging from 120 to six according to a building's size and requirements (International Initiative for a Sustainable Built Environment, 2021).

SBTool Adaptation Levels

The SBTool was designed to include local criteria in the host language, making it more appealing to fit within national systems where comprehensive versions of SBTool work have influenced national systems. This can be seen in Italy, the Czech Republic, Spain, and Portugal (Larsson & Larsson, 2015).

2.4.2 Rating Systems Developed in GCC Countries

The Gulf Region consists of six countries: Bahrain, Saudi Arabia (KSA) Kuwait, Oman, Qatar, and the United Arab Emirates (UAE). The region is known for its growth fueled by cheap energy and a lack of regulations protecting building environments (Almulla, 2014). Over the past decade, the region's reputation has stemmed from building heights constructed in Riyadh, Manama, and the Emirate of Dubai.

More than any other city worldwide, Dubai has 18 buildings that reach beyond 300m. Among the most impressive is the 828m Burj Khalifa, completed in 2010, which is the world's tallest building (M. M. Ali & Al-kodmany, 2012). GCC faces challenges in terms of the environment and climate change, as well as air pollution. GCC has the highest per capita CO2 emissions in the world (Herzog, 2009).

Compared to other countries, GCC has the highest per capita consumption of fossil fuels (Almulla, 2014). Furthermore, according to the World Resources Institute, GCC countries have among the lowest levels of freshwater availability among all countries worldwide. The GCC relies on desalination, which is environmentally damaging (Dawoud, 2005). In terms of waste production per capita, GCC ranks in the top ten countries worldwide (Herzog, 2009).

Therefore, Middle Eastern and Gulf countries have placed a high priority on GB design over the past few years. It is estimated that there will be 2500 LEED-registered buildings throughout the region by 2020, up from 623 in 2010 (Shaawat & Jamil, 2014).

Dubai is ranked third among the cities with the highest number of LEED-certified buildings in the world, which is indicative of the fact that the UAE is among the top ten countries holding LEED certifications in the world. UAE, Saudi Arabia, and Egypt are among the countries with the highest number of projects that have been LEED certified (F. A. Ahmed, 2019).

Among the most renowned and distinguished GBs include the Masdar Science and Technology Institute (Masdar City), the Building of the Climate Change Initiative (Dubai), the National Convention Center of Qatar (Doha), the King Abdullah University for Science and Technology (Jeddah), as well as the World Trade Center (Bahrain).

The Siemens headquarters building in Masdar City stands out as the first office buildings in the Middle East to achieve LEED Platinum certification with a world-class design and execution (Griffiths & Sovacool, 2020). Downtown Doha's Msheireb community has been recognized internationally as the first sustainable community with over 100 buildings that have been designed to achieve LEED gold and platinum certification (Asif, 2016).

Qatar and the UAE building codes and standards incorporate social, economic, and environmental factors into modern architecture. GSAS (Global Sustainability Assessment System) from Qatar is regarded as the world's most comprehensive GBRS, whereas Abu Dhabi's Pearl Rating System (Estidama) and Dubai's GB guidelines have created a unique vocation for themselves in the global GB market as a result of their respective GB regulations (Krarti et al., 2017).

2.4.2.1 KSA GB Rating Initiatives and Status

A key commitment of the Saudi Arabian government has been to implement sustainable development goals as part of its unique principles, putting them at the top of its priority list. In its entirety, the Kingdom's 2030 vision is aligned with the Sustainable Development Goals (SDGs) (Balabel & Alwetaishi, 2021).

Saudi Arabia has incorporated this vision, along with the multiple implementation programs, into the national planning process to advance the development of the Saudi nation in a sustainable manner. Considering the growth of the Saudi economy, the country has increased urbanization activities in its metropolitan regions, which numbered 284 in 2014, which has contributed to surging city development (Balabel & Alwetaishi, 2021). This progress has also created challenges for modern urban environments.

To achieve sustainable urbanization in the Kingdom of Bahrain, the Future Saudi Cities (FSC) program was introduced (Saudi Arabia Ministry of Housing, 2019). It was developed in response to the urban challenges created by the Kingdom’s rapid growth and as a method of supporting a balanced development strategy. The program has been recognized as a successful initiative, complying with the Kingdom's 2030 vision in terms of both goals and outputs.

The program also aims at achieving sustainable urbanization, which is in line with the Kingdom's sustainability standards. An important goal of a sustainable city is to become an eco-friendly city, to have a good infrastructure, and to offer residents a high quality of life.

Performing an evaluation of the state of Saudi cities, performing a challenge analysis, and finally, implementing pioneering strategic plans and projects with the help of the academic community will allow this to become a reality in the future. Sustainability is related to environmental impact, as is the case with sustainable cities. There are factors that can contribute to these issues, including water, air pollution, energy, and waste.

For Saudi sustainable cities to become more functional and healthier, it is important to optimize all aspects of economic, financial, social, and environmental sustainability. In order to ensure the implementation of sustainable design and construction in the construction industry, the government has implemented sustainability-related measures, and they are also aware of the importance of sustainability rating systems (Aboneama, 2018).

The Saudi GB Forum has joined USGBC's LEED International Roundtable, demonstrating the Saudi government's understanding of the consequences of negative behaviour towards the environment and the future of the country (Aboneama, 2018). The result has been the establishment of Saudi Arabia's GBRS, which is called Mostadama. Mostadama is tailored to the needs of the country and aims to promote sustainable construction standards in conjunction with Saudi's MOH and their sustainable clean tech consultancy, Alpin. The rating system was developed specifically for the Saudi market (Arabia, Al-alawi, & Cavallari, 2020).

In shaping its vision, the MOH utilized sustainable pillars outlined in Vision 2030, a plan to reduce Saudi reliance on oil, diversify its economy, and develop public service sectors including health, education, infrastructure, recreation, and tourism. Since 2019, as a result of the new rating system, there

should be an improvement in the sustainability of the construction industry as well as a positive impact on the economy and society. The standard applies to residential and commercial buildings and communities based on the needs and characteristics of the region, climate, and environment.

Rating systems consist of two components: Design and Construction, as well as Operation and Existing Facilities. The Mostadam initiative was designed for Saudi Arabia based on its regional conditions, climate, and environmental characteristics. By adopting the new GBRS, Saudi Arabia's construction industry can become environmentally friendly, and the construction industry can produce high-quality projects.

In addition to being designed to support Saudi Arabia's economy and create jobs, the rating system is also expected to have a positive impact on the country's social life. Mostadam is also designed in such a way that it complies with local laws. There is a strong emphasis on local design as well as local culture. As a result of the initiatives of such a standard, it is expected that sustainable buildings will be able to save significant amounts of energy.

Additionally, there are also many social and economic benefits associated with this type of development, including the improvement of ventilation, the improvement of working conditions, a higher rate of productivity, as well as an increase in rents, sale prices, and occupancy.

2.4.2.2 Kuwait GB Rating Initiatives and Status

Researchers and experts in Kuwait's construction field are concerned with the environmental impacts caused by construction activities. Building construction in Kuwait is expanding, and the environmental impact of its building and construction practices is well-known. Creating additional

strategies for improving building performance regarding the environment is an area Kuwait is lacking in. The government of Kuwait spends a substantial amount of budget on supporting the construction sector in Kuwait, one of the prominent countries in the Middle East.

Although the concept of green and sustainable construction and production is becoming more popular because of its impact on the environment and national economy, it will require additional strategies to implement sustainable construction practices in the future.

In the state, only one official GB has been certified. The USGBC certified Kuwait's first LEED Gold rating under the core and shell rating system (Alsanad, Gale, & Edwards, 2011). The project was cancelled due to the global financial crisis. In comparison with other countries in the GCC region, Kuwait has the lowest engagement and adaptation of GB standards projects (Alsanad, 2015).

Even though there are indications of government action at the national level, there is no legislation for the implementation of sustainability and green construction (Alsanad et al., 2011). However, there are efforts by professionals in Kuwait’s construction industry, both in the private and public sectors, to develop practice guidelines.

A major initiative is the Kuwait GB Council KGBC, which was created in parallel with the National Committee of Building Codes of Kuwait (NCOBC) to provide leadership and advice aimed at accelerating Kuwait's transition to an environmentally sustainable future (Al.Sayegh, 2015).

KGBC is a non-profit organization with a focus on education, research, and community building. It was founded in 2009 in partnership with a number

of organizations within Kuwait (Z. F. Ali, 2016). Among the members of this organization are universities, local authorities, suppliers, architects, engineers, energy companies, and other top private companies of all sizes. They are also affiliated with the World GB Council and network members.

KGBC provides training and knowledge to promote sustainable development in the property sector, to provide its members with information and resources, like scientific and technological findings, reports on best GB practices, and projects certified to achieve green design.

KGBC integrates sustainable building principles and technologies into the construction sector to become the leading non-profit organization for addressing sustainability issues in Kuwait, encouraging GB, and guiding the development of sustainable initiatives.

KGBC also works towards finding educational resources to support GB processes and principles. They organize educational programs, networking conferences, and providing training courses for those interested in GB's goals, processes, and principles.

KGBC works to promote the exchange of opinion, information, and experiences on sustainable building between its members and everyone in the construction industry. They also spread environmentally friendly building practices throughout the industry and community, and serve as a focal point for information regarding environmentally sustainable building among consumers and builders. In addition, they advocate for the adoption of policies and a customized national certification program - a quality label for building owners proving that the sustainability criteria have been followed. Such policies are necessary for the purpose of establishing a certifying body to offer

building guidance, provide services to new and existing buildings, and to grant certifications (Sedaghat, Alkhatib, Amir, Oloomi, & Sabri, 2020).

To promote green and sustainable construction and to take part in this trend, Kuwait's building and construction industry must take positive action. As well as understanding the concepts involved in green and sustainable construction, it must also take responsibility for the resources consumed and their impact on the environment.

Implementation of the concept requires extensive support from the public and private sectors, reinforced by effective policies and legislations to ensure complete implementation in future projects. It is the government's obligation to promote sustainable construction and to ensure that the country’s construction industry is less impactful on the environment. To improve and advance the knowledge and level of awareness and understanding of sustainable applications, guidelines should be issued, workshops should be organized, and incentives should be provided to promote green construction.

2.4.2.3 Qatar GB Rating Initiatives and Status

Qatar has achieved progress in the GB sector, with many cutting-edge sustainable construction projects appearing in recent years. Among the countries outside the United States, the country has the fifth most number of buildings that are LEED certified and registered. This provides the country with insight and experience to share on the system's local relevance and application (Adnan & Jalala, 2016).

Of the buildings in the Middle East that have achieved LEED certification, almost 65 percent are located within the UAE. When taking all GBRS-rated buildings into account, Qatar comes in first place with 173 GBs.

Saudi Arabia comes in second with 145, Lebanon is third with 25, and Egypt is fourth with 22 (Rybkowski et al., 2017).

Organizing large-scale international events in Doha, including the FIFA World Cup 2022, has helped the city emerge as a global powerhouse providing a solid foundation for substantial construction and comprehensive investment projects (Furlan & Sipe, 2017).

The rapid development of Qatar has resulted in the development of comprehensive master plans which address a broad range of sustainable development demands, including physical as well as non-physical pillars (e.g., environment and economy) (M. S. Ferwati, al Saeed, Shafaghat, & Keyvanfar, 2019).

Throughout Qatari planning and urban development, promoting sustainable urban development has been an integral component of the government's commitment to creating sustainable urban environments. The government of Qatar aims to develop in a sustainable manner at both the macro and micro scales while maintaining environmental sustainability.

Qatar Development Framework 2032 and Qatar National Vision 2030 have been developed to accommodate sustainable urbanization and to develop the best practice methods for building green and developing green cities in Qatar (Al-thani, 2019).

In response to Qatar's realization of the importance of sustainability, the country began promoting the adoption of GBRSs like LEED and BREEAM. A comprehensive sustainability framework has been developed by Qatar through the Qatar National Vision (QNV) and Qatar Development Strategies (Mohammad & Atif, 2017), where a local GBRS was suggested by the Qatar

Diar Investment Company in 2004 under the name Qatar Sustainability Assessment System (QSAS).

Global Sustainability Assessment System

As a result of a collaboration between the Gulf Organization for Research and Development, the University of Pennsylvania's TC Chan Centre, and the Georgia Institute of Technology's School of Architecture, GSAS was created in 2010 (GSAS, 2021). The QSAS is also becoming one of the most common GBRSs in the Gulf (Awadh, 2017a).

GSAS is a global building code assessment based on an analysis of best practices in 40 designs from around the world (Alhorr, Chaarman, & Sustaanably, 2019).

As part of the GSAS, it seeks to build environmentally sustainable and socially and culturally responsive communities, assisting with the region's specific social and cultural needs, as well as the environment that surrounds them (Guimarães, Barbosa, & Bragança, 2016).

GSAS is a standard that is priced, like BREEAMS and LEED (GSAS, 2021). One GSAS component are the environmental design programs at Qatar University, and King Fahd University. Both swiftly incorporated GSAS into their curriculums (Attia & Ap, 2014). Additionally, Qatar Construction specifications were required to integrate GSAS requirements (L Balbo, 2012).

GSAS Category

GSAS has been recognized as the first sustainable building rating system in the Middle East and North Africa, based on performance-based criteria

(Fadli, 2014). It is the only rating system certified by the Qatar Construction specifications (Z. Hu et al., 2018).

For a multidimensional approach to sustainability, aspects at the macro and micro levels are addressed by the GSAS framework in eight categories:: Urban Connectivity, Site, Energy, Water, Materials, Indoor/Outdoor Environment, Cultural & Economic Value, and Management & Operations (Awadh, 2017a).

Every GSAS Category has a direct impact on the environment and/or human well-being as well as indicators to measure the effects aspects. A subset of these categories is then divided into specific criteria defining the specific issues. As such, all categories, measurements, and criteria are based on the performance of the organization, to the extent that it can be quantified.

Best practices related to the implementation of measures under each criterion are provided as guidelines in GSAS Guidelines manuals. According to GSAS, the Analytic Hierarchy Process (AHP) is used to quantify the relative importance of GSAS Categories; GSAS uses the concept of relative impact as a method of weighting each criterion within a given category (Awadh, 2017b; Shan & Hwang, 2018b).

GSAS Certification Level

An important aspect of QSAS is evaluating the impact new buildings will have on the environment and the urban fabric. QSAS recommended an enhancement to the standard that reflects a practical standard relevant to building design which encompasses all aspects of building design that may effect natural and built environments.

The system now encompasses commercial buildings, residential construction (single or group), education, mosques, and industrial buildings (like warehouses and factories). The QSAS considers the specific needs of each building class and formulates a mutual rating ground for building types.

The GSAS rating system measures and evaluates projects according to eight factors directly related to mitigation of environmental stress as shown in Figure 12. According to the Analytic Hierarchy Process (AHP), each category carries a specific weight (al Horr, Y., Arif, M., Kaushik, A., Elsarrag, E., & Mazroei, 2017).

In order to measure and define the categories, they are further broken down into specific criteria that measure and define the categories. After each criterion has been scored according to its compliance level, the score is recorded. In general, The lowest star rating recognized by investment authorities is two stars.

Rating levels are simulated by star certification levels. The impact of certain criteria on the environment and other factors can cause criteria to earn zero points, indicating that a given indicator is measured according to its environmental impact to the built environment, which was one of the sustainability challenges observed by GSAS experts. There are many challenges associated with the built environment, including air pollution, land use contamination, fossil fuels depletion, water exhaustion, water contamination, materials exhaustion, human discomfort, sickness and climate change. As a guide, these are used to determine a framework for ensuring robustness in mitigating adverse environmental impacts (M. S. Ferwati et al., 2019).

With QSAS, certification levels are rated according to a points system, which is equivalent to a star rating in which each star represents a different level of certification from non-certified to level six; according to QSAS, a score is calculated on the scale of -1 to 3 (-1, 0, 1, 2, 3) as shown in Figure 13 and Figure 14.

GSAS Adaptation Level

Over 128 buildings have been certified through QSAS since its establishment (M. S. Ferwati et al., 2019). Kuwait adopted GSAS in 2013, but no date has been set for its implementation (Burroughs, 2017). Saudi Arabia also adopted the GSAS, but very limited information is available regarding its implementation of the standard there.

As a result, QSAS applications are now being embedded in a variety of fields like design, environmental design, and construction.

2.4.2.4 Oman GB Rating Initiatives and Status

In Oman, Al-Jebouri, Shaaban, Raman, & bin O. K. Rahmat (2017) indicated a need for a construction industry rating system that takes into account Omani conditions, politics, culture, and social characteristics, since they don't exist at the moment.

The concept of sustainable building is still at its infancy in Oman, and the country does not have any sustainable rating system, but the country does provide some references regarding sustainable building in the building regulations (Al-Jebouri et al., 2017). There are few examples of GBs in the country that follow certain international standards (Powmya & Abidin, 2014).

A prototype model for sustainability was developed by the Research Council in Oman (2012). In order to achieve the objectives of the Oman

National Spatial Strategy (ONSS), one of the main objectives is to identify indicators for the sustainable development of both urban and rural areas in an integrated manner (Shaaban, 2017).

There is an urgent need for Oman to implement an action plan that promotes green design, improves environmental management, and increases consumer awareness of green issues through the adoption of a comprehensive environmental rating system for buildings.

A framework has been proposed by the government of Oman for an environmental rating system for buildings, and the scheme is designed to evaluate the environmental impact of the strategy, construction, design and operation of a high-performance GB. It is intended that this system will be officially titled the Oman Building Environmental Certification (OMBEC).

It is intended to use the system as a pilot rating system for present-day homes, which will then be expanded in the future to apply to other types of buildings as well. Three levels of rating are proposed: categories, indicators, and parameters (Alnasiri, 2016).

There were three factors used in the process of generating the levels: a review of the specific clauses contained within Agenda 21 , an analysis of the rating systems used in different parts of the world, and consideration of the local context in Oman. These types of levels fit within the framework set by Agenda 21, including its deadline and a range of priorities, the sustainable built environment in Oman (Powmya & Abidin, 2014).

During the 1992 Rio de Janeiro Conference on Environment and Development, Agenda 21 was established. Several revisions were made to this document and endorsed by the United Nations Department of Economic and

Social Affairs in 1992 and by the United Nations Earth Summit in 2012. Agenda 21 sets principles and actionable programs which describe ways for governments to develop and implement national sustainable development strategies (United Nations Development, 1992).

According to the platform for implementing Agenda 21 of the United Nations Conference on Environment and Development, a variety of international rating systems are tested and verified in order to understand their common concerns as well as their particular priorities. Test and verify whether international and regional rating systems are available for sustainable buildings. The development of Oman's local rating system was based on the principles of Agenda 21 (Powmya & Abidin, 2014).

There are 40 chapters that make up Agenda 21, and each chapter falls into one of the following categories:

1. Dimensions of social and economic development
2. The conservation and management of natural resources for the purpose of development
3. Enhancing the role of major groups in the development process
4. Implementation Methods and Means

In each chapter, there is a description of several programs, including goals and objectives, the basis for action, objectives, accomplishments, and means of implementation (United Nations Development, 1992).

Additionally, there are a number of additional categories that are included in the general requirements, such as design, process innovation, and education. Sustainable development and the built environment are considered

to be the key elements of the proposed indicators, which represent the second level of the assessment.

In order to calculate the rating scores of the proposed system, parameters will be used to measure the importance of each indicator and category. Throughout this process, specialized teams representing stakeholders on a national scale will be required, including representatives from the Supreme Council of Planning, related ministries, local municipalities, and nongovernmental organizations.

There is a need to conduct research and testing of the proposed structure at a national level and to use consensus-based processes based on the analytical hierarchy to obtain feedback from stakeholders, while also conducting surveys of stakeholders at local levels. The objective of this process is to translate subjective human judgment into a quantitative one, in order to develop a weighting system as a result of which both local needs are reflected and government policy and environmental aspects are prioritized.

A typical construction pattern in Oman includes unsustainable community patterns, a low occupant density, a high water and energy consumption, and a high amount of air conditioning (Abidin & Powmya, 2013).

There are a number of proposed indicators under each category, which have been chosen based on their relevance to Agenda 21. A consideration was made for how extensively each indicator was used in international systems and its relevance to Oman when selecting and compiling the indicators within each category. The second group of indicators lacked international applications, but local constraints affected their relevance.

The process of selecting and compiling the indicators included the compilation of indicators for:

- Efficient use of water
- Efficiency in energy use
- Techniques and materials used in construction
- The sustainability of sites
- Indoor Environmental Quality
- The Management of Wastes and Pollution
- Priorities for local development and the Integrated Development Process.

The inclusion of an indicator in each category was determined by the extent to which it was integrated into international systems and its relevance to Oman. The remaining indicators had no international application but their relevance was determined by local conditions (Al-Jebouri et al. 2017). Consequently, Table (7) illustrates the proposed OMBEC's final category and indicator list.

Therefore, Oman must develop assessments tools to promote environmental improvement in the country, as well as encourage the national government to implement its plans to develop sustainable building methods.

2.4.2.5 Bahrain GB Rating Initiatives and Status

Each year, Bahrain completes an accumulative number of new construction projects (There are numerous shopping malls, residential and commercial properties, and other significant landmarks in the area). Many large-scale construction projects have created new islands like Amwaj, Diyar AlMuharraq, Durrat al Bahrain, and more (M. S. Ferwati et al., 2019). The

construction companies use non-sustainable materials and prioritize cost over environmental friendliness in the design and construction of buildings, thus contributing to the energy crisis as well as damaging the environment by causing more CO2 emissions.

Alnaser, Flanagan, and Alnaser (2008) reported that many buildings built in Bahrain and the wider region did not take sustainability into consideration. The development of a sustainable built environment in Bahrain is therefore vital to prevent any negative environmental impacts, such as energy consumption, carbon emissions, water consumption, and other negative environmental impact factors.

To promote sustainability in Bahrain, the government has taken the initiative to launch over 40 environmentally friendly building projects (Alareeni & Alqahtani, 2020). Bahrain has also recognized that economic development and environmental management are complementary elements of suitability to the vast industrial and commercial growth occurring in the country, which can be compromized without adequate environmental protection. This goal had led to the enactment of Decree-law No.21 of 1996, which established under the MOH Municipalities, and the Environment, there is an Environmental Affairs Agency (Gov, 2016).

The creation and enforcement of environmental laws in Bahrain began in 1983. The government initially formed the Environmental Protection Committee (EPC), but this committee was later changed into the Environmental Affairs Office (EA) (Bahrain, 2018). Two major non-departmental directorates were established by the major legislative decree No. 21 of 1996: The Directorate for the Assessment of Environmental Conditions and the Directorate for the Control of Environmental Conditions. These

directorates were established to work towards creating a more sustainable future. As the authorities grew, In its current form, it is called the Supreme Council for the Environment (SCE), which is responsible for protecting and observing the country's natural resources.

As part of its commitment to environmental protection, the government of Bahrain has undertaken several environmental legislative measures to resolve pollution problems and environmental degradation. As it relates to protecting the environment and achieving sustainable development, Bahrain has signed and ratified many regional and international agreements, conventions, and protocols. In addition, Bahrain is a signatory to all of the regional and international agreements related to the environment (Table (8)), protocols, and conventions.

In the areas of air, water, waste, chemicals, fisheries, and occupational health, environmental legislation has been passed, implemented, and enforced. In accordance with the legislation, any company or facility seeking to establish operations in the country must obtain a 'No Objection' permit from the SCE in order to meet the requirements of raw materials, products, by-products, waste generation (including solid, liquid, and hazardous materials), chemicals, and resource usage (including gas, electricity, and water).

There is also a requirement for assurance that their projects or activities will not adversely affect occupational and public health as well as fragile national environmental resources. Environmental professionals and inspectors inspect industrial establishments regularly for compliance with various environmental standards.

In the case of noncompliance, warnings are given, and a repeat offense will result in the revocation of the license for commercial registration. Specifically, the SCE frames guidelines for pollution control, industrial safety, environmental waste management, and environmental resource conservation (Innovation, 2018).

Bahrain's GB Manual (Benayat)

In 2018, Bahrain has launched its first energy conservation code which focuses on the use of energy by government entities. As of 2020, Bahrain will have a mandatory building code with mandatory requirements for all buildings in the kingdom, the Unified Guidebook of Building Permit Regulations.

Bahrain circulated its Unified Guidebook of Building Permit Regulations in 2019 through its building permit portal, Benayat (Rodriguez-Ubinas et al., 2020). As a point of interest, the regulations did not focus on sustainability or energy efficiency. In particular, it is responsible for implementing the latest international construction standards and best practices in the Kingdom. However, as later comparisons made in this study show, Bahrain's guidelines are similar to the energy efficiency-oriented codes set by other GCC countries, and the Bahrain Sustainable Energy Authority (SEA) is working on the GB Code, and Labelling Program is under development (Innovation, 2018).

The guidebook aims to collate building permit regulations in Bahrain in a unified document in accordance with international standards and practices. To address the prerequisites and requirements of concerned political entities, the first edition of the Unified Guidebook of Building Permit Regulations was published.

For the Kingdom of Bahrain, Benayat's Building Permit System is the official system for issuing permits for all building projects, regardless of whether they are residential, industrial or commercial. Building permits can be applied for through the system by engineering offices licensed to operate in Bahrain, and inquiries regarding the status of their applications can be made via the system, as well as gain consultation from concerned government agencies regarding building permits, and pay related building permit fees. With the assistance of an interactive map that provides key information for land parcels, combined with the centralization of all relevant regulations and regulations under one system, Benayat allows applicants to acquire all the necessary information to prepare drawings and documents required for a building permit application.

Benayat Scope

Benayat aims to enhance the performance of buildings in Bahrain by reducing their energy consumption, water consumption, and material consumption, reducing greenhouse gas emissions, enhancing public health and safety, and transforming the building planning, design, construction and operations to create a city that provides its residents with the essentials of success and comfort. Benayat is also meant to support the Kingdom of Bahrain's Strategic Plan, help to create a more sustainable urban environment, and expand the capability of its infrastructure to support the Kingdom's future needs.

Those involved in construction who want to abide by the rules and regulations of this manual, including developers, owners, operators and designers, are expected to benefit from this manual. Despite the manual's guidance and instructions, it is not intended to offer detailed design

information or to serve as a substitute for the expertise of building designers and contractors. Nor is it intended to provide the detailed design information or substitute for the experience and expertise of building designers and contractors.

All buildings within the Kingdom of Bahrain, including free zones, are subject to the provisions of the Benayat guidelines, which can be classified as follows:

1. In the definition of a villa, there are three types: investment villas, private villas, and Arabian style residences, which are traditional houses constructed in an urban style on the basis of traditional architectural designs.
2. A variety of residential buildings, including apartments, hostels, and working accommodations.
3. Various types of commercial establishments such as hotels, motels, and furnished apartments, laboratories, offices, restores, and restaurants and food outlets.
4. Buildings that serve the public include banks, cinemas/theaters, libraries, educational facilities, government buildings, and healthcare buildings. Historical buildings, museums, service stations, post offices, retail outlets, malls, and mosques and other places of worships are also considered to serve the public.
5. Manufacturing facilities including factories, warehouses, and workshop buildings.
6. Suitable alternative materials, design, and methods of construction and equipment.

The provisions of this manual actively encourage innovation and it is not intended to prevent the use of any alternative material, appliance, installation, device, arrangement, design, or method of construction that is not specifically prescribed by the regulations. However, approval of the alternatives will be required by the relevant authority.

Energy and Water Compliance in Benayat

Benayat describes the sustainable features that can be found both inside and outside buildings, on the site as well as in their environments and gives instructions on how each solution can be used for the most beneficial outcomes. A number of provisions in the manual contain instances in which these provisions are legally enforceable or otherwise feasible, depending on the circumstances in which they are included. After the publication of the practice guide, a more detailed description of the classification program for buildings should be made available (Benayat -Bahrain, 2021).

Streamlining the process of achieving compliance with the Building Energy Efficiency Standards is possible through two paths. According to the standard method of achieving compliance with international standards, the elemental method refers to the standard, and by comparison, the performance method refers to the alternative.

Two types of compliance are available for energy performance in buildings. The regular method is known as the Elemental Method, while the alternative method is called the Performance Method. In the case of the Elemental method, the structure must fulfill with all the regulations stipulated in the Benyat manual, and a calculator will be made available to the designer. In contrast, the Performance Method allows the building to use a calculation

method that does not have to meet all of the requirements of the articles listed in the manual.

The Performance Method is typically used in smaller buildings where airflows are not complex or non-linear, such as a whole-building transmission heat loss calculation or overall heat loss calculation that compares the annual energy consumption of the proposed building to a reference building and meets all the elements listed. The reference building must be the same size, shape, and operation pattern as the proposed building.

In order to determine the water efficiency of a building, the Elemental Method and the Performance Method options also apply (Building Permit Regulations 2021). The Elemental Method requires that the building must comply with each of the regulations outlined in the Benayat Manual, whereas the Performance Method does not require a building to meet the elemental requirements to be deemed as water efficient, as a calculation tool may be used. A calculation tool is used in the Performance Method to compare the annual water consumption of the proposed building with the annual water consumption of a reference building that meets all the requirements. This reference building must also be roughly similar to the proposed building in shape, size, and operational pattern. It is important to note that in order to demonstrate compliance with these requirements, the annual water consumption of the proposed building must be equal to or less than the annual water consumption of the reference building.

Benayat Energy Compliance Method

Taking into consideration each of the stages outlined in Figure 15, and all elements listed, a building would have to comply with each of the rules in

order to be able to use the elemental method. For this purpose, if the designer decides to use this method, they can use an online calculation tool to make this determination.

GB Code in Benayat Manual

Benayat's Building Permit Portal is the official issuance system for building permits in the Kingdom of Bahrain, whether they be for residential, industrial, commercial or investment projects. Benyat is a system that enables Engineering Offices licensed in Bahrain to apply for permits, inquire about the status of their applications, obtain consultation from government entities regarding building permits, and pay building permit fees, among other building related services. Benayat offers applicants the ability to obtain all the necessary information and drawings required to complete building permit applications through an interactive map that provides key information for land parcels and by centralising all the regulations and requirements under one system (Benayat Portal, 2022).

A chapter in the Unified Guidebook of Building Permit Regulations features the Green Building Manual (GBM) under Law 212, 2019, which was published in the Gazette of Bahrain as the GBM (Information & eGovernment Authority -Benayat 2021).

A key aim of the manual is to improve the performance of buildings in Bahrain by reducing their consumption of energy, water, and materials, coupled with reduced GHG emissions. It also aims to improve public health, safety, and general welfare, as well as to design, construct, and operate them in a way that facilitates success and comfort. Additionally, the manual aims to support Bahrain's Strategic Planning, create a sustainable urban

environment, and extend the Kingdom of Bahrain's infrastructure to meet future demands. While this manual is not intended to provide detailed design information, or to replace the expertise of building designers and contractors, it is intended as a guide for developers, owners, operators, designers, and all involved in construction who wish to adhere to the rules and regulations it contains.

In Benayat, Bahrain's government redefines its role as one of service provider to one of regulator by streamlining the building permit process and streamlining the institution of building permits. By re-engineering, automating, and making current systems transparent, a redefinition process applies through the application of a transformational policy provides maximum benefits to organizations.

In a study Abdulkarim and Aljawder (2021) attempted to determine the level of satisfaction related stakeholders had with the operational effectiveness of the transformational policy and the Benayat system's technological application of the project, by gathering opinions of engineers working within the public sector, private consulting firms, real estate developers, and investors in Bahrain.

It has been found that knowledge of a transformational policy does not necessarily correlate with the operational efficiency of the same policy or any of its expected benefits (Abdulkarim and Aljawder 2021). In spite of this, there was a direct relationship between the technologies used in implementing the transformational policy and the expected outcome and operational efficiency of the building permit process. There was a significant correlation between the benefits that the transformational policy was expected to bring and the operational effectiveness. Additionally, the operational effectiveness

and the satisfaction of stakeholders were highly correlated with each other. According to the study, it was recommended that the Beneyat system be promoted more widely to riase stakeholder awareness, In addition, they need to be trained on how to utilize it effectively.

2.4.2.6 UAE GB Rating Initiatives and Status

A quiet revolution has been underway beneath this glitzy exterior over the past five years, led by the UAE, which has seen a difference in attitude and demands pertaining to the sustainable built environment. The innovative Masdar City development in Abu Dhabi was the first to demonstrate this approach, as it demonstrated the construction of a highly sustainable city. Comprehensive use of renewable energy sources and GB principles were integral to the success of this project (Meir et al., 2012). There are 3.1 million square feet of LEED-certified buildings in the UAE, making it the fourth-largest stock outside the US. In addition, among all countries in the world, In the UAE, LEED-certified construction professionals make up the fourth largest percentage of the construction workforce (NezamiFar, 2020).

Although energy costs are still relatively low, Dubai and Abu Dhabi have led by example by enacting regulations and specifications that adopt the best international GB standards, adapting where necessary to meet their extreme local conditions. The UAE's GB Code (GBC) also demonstrated stability and emphasized the UAE's status as a leader of GB in the Middle East. As a result, the UAE became one of the first MENA countries to adopt LEED certification.

A notable contribution to the LEED certification for Homes has been made by the Bayti project, with 118 buildings participating in 2016 and 15 buildings participating in 2017, resulting in the achievements of 118 buildings

in LEED certification for Homes. Consequently, the UAE's LEED projects have become much more noticeable among peers in the region as a result of this.

Nearly half of the LEED projects are classified as 'certified', which is the lowest certification level, while a third of the projects have achieved the Gold level of certification. A majority of these projects are certified through LEED V2008 for Homes, followed by LEED NC. Dubai is the largest city with LEED-member organizations, followed by Abu Dhabi with 61 and 6 organizations, respectively. Additionally, there are 1628 LEED specialists in the UAE, of whom half are are green associates and another quarter are LEED AP BD+Cs (Alobaidi, Rahim, Mohammed, & Baqutayan, 2015).

Throughout the UAE, various sustainable rating systems and GB regulations are enforced in order to reduce environmental impacts and improve socio-cultural and economic performance of buildings. These rating systems and regulatory requirements for construction and demolition waste management have the aim of facilitating waste reduction during construction and preventing the depletion of material resources (Umar et al., 2015).

Examples of GBRS in the UAE:

- The Al Sa’fat GBRS in Dubai – According to the system, all new buildings must obtain a permit prior to their construction. The Al Sa’fat rating system aims to reduce waste by 50 percent, reduce carbon emissions by 20 percent, reduce electricity consumption by 20 percent and reduce water consumption by 15 percent (Arabia et al., 2020b).

- The Trakhees Environmental, Health, and Safety Department's rating system for Dubai – Trakhees is an authority with jurisdiction in Dubai. This system aims to reward projects that divert 50–75 percent of all construction and demolition waste materials from landfills (Jagannathan, 2014).

- The Estidama rating system in Abu Dhabi – This system is intended to divert a minimum of 30 percent of construction and demolition waste through recycling/salvaging. The aim is to encourage the reuse of existing building stock and to reduce waste and associated environmental impacts (Umar et al., 2015b).

Estidama is one of the first environmental assessment methods developed in the Arabian Gulf countries. It means 'Sustainability' in Arabic, and it was developed in 2008 by the Abu Dhabi Urban Planning Council (AUPC) in the UAE (Banani, Vahdati, & Elmualim, 2013).

The Estidama assessment method has a rating tool called the Pearl Rating System (PRS) that helps to deliver sustainable development efficiently. The main aim of using PRS is to address the sustainability in a building throughout its entire lifecycle: design, construction, and operation (Ramani & García De Soto, 2021). Additionally, as a suite of rating systems specific to the design and construction of communities, buildings, and villas, PRS was created to guide and rate the sustainability performance of a given development as a way of guiding, measuring, and learning the sustainability performance of that given development. In addition, any assessed building can be awarded at least one Pearl point, which contains credit elements for the different criteria.

The Pearl Rating System of Estidama

Developed by Estidama, 'Pearl Rating System for Buildings' is a practical guide that aims to encourage designers, construction companies, and building owners to build and operate homes, buildings, and communities in a more sustainable manner. A key component of Plan Abu Dhabi 2030, Plan Al Ain 2030, and Plan Al Dhafra 2030 is the Pearl Rating System for Buildings, which is intended to follow innovative green standards when constructing the Emirates. The PRS is designed specifically for the hot weather and dry nature of Abu Dhabi and provides direction and requirements that permit projects to be rated on their prospective performance in terms of the three pillars of Estidama: cultural, social and economic.

A series of protocols described in the Pearl Rating System in its Version 1.0 apply to each type of buildings, their location surrounding, and associated amenities. These protocols can be used to evaluate buildings (offices, retail, residential, schools, and general multi-use property and buildings), villas (single-family residential), and communities (neighborhoods). In the Pearl rating system, three types of rating systems are available: the Pearl Community Rating System (PCRS), the Pearl Building Rating System (PBRS), and the Pearl Villa Rating System (PVRS).

As part of the rating process, up to five Pearls may be awarded in recognition of sustainability. New buildings and villas must be rated at least 1 Pearl, and government-owned properties must be rated as a minimum 2 Pearls. Each rating system is uniquely developed for neighborhoods, villas, and buildings. Abu Dhabi uses this system in order to evaluate the sustainability of its construction practices.

The Pearl Rating System Categories

The PRS is a points-based system that utilizes credits in the same manner as LEED and BREEAM. It is divided into seven categories and includes both mandatory and optional additional credits. There are no fees charged by Estidama to a municipality or the DPM (Estidama's certification authority) for managing the PRS for the project owner.

In every section of the PRS, there are both optional and mandatory credits. While the mandatory credits must be complied with, the optional credits award credit points for each credit that is achieved. A project must meet all mandatory credits in order to acquire a 1 Pearl rating, but to score any higher the project must comply with optional credits along with the mandatory ones.

The PRS involves seven sections, as presented in Table (9), each with a certain sum of credits available (Awadh, 2017; Shan & Hwang, 2018).

1. Integrated Development Process (IDP): Facilitating the integration between the quality management and environmental systems throughout the life of a built environment.
2. Natural Systems (NS): Protecting and supporting the local habitat and natural environments.
3. Livable Buildings (LB): Enhancing the quality of both outdoor and indoor areas.
4. Precious Water (PW): Minimizing water consumption, aiding efficient water distribution and alternate sources.

5. Resourceful Energy (RE): Minimizing energy use through renewable sources, sustainable design measures, energy-efficiency, and control of demand.
6. Stewarding Materials (SM): Considering the full life cycle of the built environment in question when selecting building materials.
7. Innovating Practice (IP): Boosting innovation initiatives in building design and construction.

In each of the categories, points are awarded based on the completion of mandatory and optional credits. All 20 obligatory credits must be completed in order to receive a Pearl rating. As the Pearl rating level rises, there will be a requirement to fulfill all obligatory credits, along with a minimum number of voluntary credits. Having earned these credits points, the development and design teams are able to achieve a rating as high as 5 Pearl. Figure 16 outlines the Estidama certification levels and credit points system.

The Pearl Rating Process

Pearl grading is designed to recognize that ownership and responsibility are transferred from one team to another as a project progresses from a design team to a construction team to a facility management team. As a result, three stages of grading have been developed: Design, Construction, and Operational. With the Pearl Rating System, a specific project can be effectively and educationally assessed in terms of its sustainability. The general steps required to be undertaken by developers and their consultants in the process are summarized as follows:

Planning stage

1. Record the development with Estidama for the applicable Pearl Rating System. Individually project will be provided with a exclusive identification number.
2. Appoint a Pearl Qualified Professional (PQP) to accelerate the rating development and co-ordinate the submission.
3. Assist with the facilitation of workshops in accordance with the Estidama Integrated Development Process PQP (compliant with IDP-R1).

Design stage

4. Ensure that credit submissions are reviewed and updated regularly throughout the design process.
5. Upon completion of construction certification, to submit the final design credit submissions to Estidama.
6. As part of the evaluation process, the submission will be evaluated by a Pearl Assessor who may ask the PQP for clarifications or additional information if necessary.
7. The Pearl Evaluator will award a Pearl Design Rating based on the credits achieved by the development.

Construction stage

8. Review and apprise credit submissions on a consistent basis throughout the construction process.
9. Issue the final construction credit submissions to Estidama after construction is complete.
10. The submission will be appraised by a Pearl Assessor, who may demand clarifications or additional information from the PQP.

Estidama reserves the right to undertake on-site verification if deemed essential.

11. Based on the credits achieved by the development, the Pearl Assessor will award the Pearl Construction Rating.

Building Life Cycle Phases in the Pearl Rating System

As soon as a building reaches an occupancy level of 80% two years following completion of construction, a Pearl Operational Rating application may be submitted. The Pearl Operational Rating System (currently under development) details how to achieve a Pearl Operational Rating.

During the design development of a project, the Pearl Design Ratings recognize measures that meet the requirements and meet the intent of the credit. The certification is valid until the project is completed, and all collateral, branding, and other communications materials must identify the project as Pearl Design Rated.

As part of the Design Rating, the Construction Rating ensures that the commitments made have been met. It is required that all marketing materials, collateral, and branding be designed so that the project can be clearly identified as Pearl Construction Rated.

Operational Ratings are calculated based on the features and performance of a building's operational systems in order to ensure that they are run sustainably and efficiently. A building can achieve its Operational Rating only after two years after completion of construction and after 80% occupancy has been achieved.

The Pearl Rating System as a Mandatory Scheme

Contrary to LEED and BREEAM, both of which are voluntary guidelines for GBRSs, the Pearl Rating System is a mandatory requirement of the Abu Dhabi Emirate's building code. It is mandatory for all new villa, building, and community projects to comply with Pearl Rating Systems requirements after September 2010 in order to obtain a permit for the construction of the building, as well as a Completion Certificate. It is a requirement that every building project that is constructed for permanent use with a gross air-conditioned floor area of at least 50 square meters comply with the Pearl Building Rating System..

In order to receive approval from DPM, new projects must receive a minimum Pearl rating of 1. Moreover, all government and public funded buildings (including mosques, public schools, government hospitals, etc.) are required to achieve a minimum rating of 2 Pearls. It is mandatory for all new individual single-owned buildings or villas built after May 2011, to comply with the requirements of the temporary 1 Pearl Buildings and Villas Programme, a simplified version of the Pearl Rating System. This does not apply to the government, developers, conglomerates, and owners of business groups. According to its own regulations, Masdar City, a sustainable community planned and constructed on the outskirts of Abu Dhabi, requires that all buildings in its area achieve a Pearl rating (equivalent to a LEED Gold rating).

The requirement for an air-conditioned building to pursue the Pearl Building Rating System has been changed from 50 square meters to 2,000 square meters as of February 2017.

Through the successful Estidama certification of several new schools, the Abu Dhabi Education Council (ADEC) has demonstrated its commitment to sustainability. A total of ten primary and secondary schools in Abu Dhabi and Al Ain have achieved the Pearl Design rating of 3 Pearls as part of Phase III of the ADEC Future Schools Program..

Market Penetration

It is clearly evident that the Pearl Rating System has played a significant role in the design and construction of new developments within Abu Dhabi over the past few years, and it has penetrated deeply into the Emirates construction market as well. It is estimated that there are more than 5,000 Pearl Construction Rated Villas and almost 19000 Pearl Design Rated Villas, as well as over 260 Pearl Construction Rated Buildings and more than 2,200 Pearl Design Rated Buildings, with more than 2,000 Pearl Quality Points. While in comparison, the number of LEED certified projects is 39 (all levels) projects and (106 Registered) as well as over 1,900 LEED professionals (EGBC, 2020).

2.4.3 Comparison of International and Local Rating Systems in the Region

The environmental considerations of a particular rating system can determine whether its direct use should be considered in the region over any other rating system. Examples of such factors include:

- The climatic conditions
- The geographical attributes
- Potential for developing renewable energy sources
- Consumption of natural resources (water, fossil fuels, etc.)

- Materials and techniques employed for construction
- Stocks of buildings
- Government policy and regulations
- Appreciation of historical significance
- Population growth
- Public awareness

Environmental building issues have also become more standardized. BREEAM was the first effort (Doan et al., 2017b) and other methodologies followed, including the SBTool, LEED, and the CASBEE. Table (10) examines the differences and similarities among these methods.

While research into the regional application of GBRS exists, there is very little comprehensive discussion that tests the applicability of existing internationally acclaimed GBRS to countries or regions where the tools are not enforced such as the GCC and in Bahrain.

There is a considerable body of literature that exists today about sustainability rating tools that surveys and compares a number of selected tools. Other studies examine the application of rating tools that are used for specific purposes, the use of sustainability rating tools for infrastructure projects or the suitability of climactic conditions. The selection of international rating tools globally, especially in countries that have not developed their own rating tool, seems to be driven by the eco-political scene and does not appear to have any empirical basis.

Considering the lack of in-depth comparison including potentials and challenges, the purpose of this study is to bridge this gap by exploring these

missing areas and developing interview questions that are tailored to the areas that merit further investigation.

2.5 Summaries of Earlier Studies

Among the main functions of a GBRS is the evaluation of the environmental performance of buildings. This evaluation process assesses the degree to which an assessed building is sustainable based on the ranking of a list of criteria against environmental performance.

It is almost universal that all environmental assessment methods are tailored to the territory they are applied to. Environmental assessment methods in GCC countries were developed with a different focus than those in other regions and are not applicable to every environment (Hopkins, Cole, & Mason, 1998). The literature shows that countries of the GCC are actively adopting international GB standards. However, there has been a shift in the GCC away from the adoption of existing, international GBRSs due to the emergence of regionally developed GBRSs, like GSAS and Pearl.

Bodies who set environmental standards internationally (like ASTM) host workshops in the Gulf region, and the fact that many of these collaborations are becoming international has led to an increase of international GB initiatives. Despite the initiatives however, an assessment of the region's GB standards indicates that there is little chance that the region will develop a region-specific, uniform set of standards, or GBRS. This is due to the impending standard's competition with the UAE's Pearl Standard and Qatar's GSAS.

The GCC’s approach to environmental practices has progressed in recent years. This change is due to the GCC’s increased engagement, awareness, and

investment in GB and green technologies. Despite the GCC's lack of a cohesive GBRS, the standards adopted by individual GCC states are appropriate for the region. Through the development of GSAS and Pearl, national and international standards for GB are aligned with the region's specific needs.

Although little research has been conducted on the alignment of regionally developed GBRSs and the holistic implementation of a GBRS in Bahrain, a general theme was observed in which the literature was focused mainly on one aspect at a time despite the wide spectrum of criteria in GBRSs, which range from energy or water consumption and reservations, CO2 emissions and methods to mitigate emissions, or renewable and alternative energy sources.

In Bahrain, there has been a relatively limited amount of research conducted regarding the comprehensive implementation and deployment of a GBRS when analyzed as an integrative approach to exploring GBRS implications, strategies, implementations, and challenges. It is evident in the literature that the majority of studies into GBRS place a large emphasis on a single aspect at a time, which ignores the fact that a GRBS is designed to encompass many different aspects of sustainability and the environment simultaneously, whether it be energy consumption, water consumption and reservations, CO2 emissions and methods of mitigating those emissions, or renewable and alternative energy sources. This literature overview aims to highlight this trend in recent works focusing on a particular aspect of GBRS.

According to Al-Saffar (2014), increasing the thermal performance of walls could reduce energy consumption and CO2 emissions better than upgrading other components of the building envelope. In addition, the results

of that study provide insight into one of the smallest housing prototypes in Bahrain. It would reduce national energy consumption and CO2 emissions if applied to the larger scale of housing urban development and housing units, thereby reducing the nation's energy footprint.

A study by Radhi, Sharples, Taleb, & Fahmy (2017) It was concluded that Bahrain's hot climate, which has a long cooling season, makes cool roofing the most cost-effective approach. The development of new urban areas in Bahrain has led to a reduction in UHI intensity and cooling loads on buildings, which in turn has resulted in a reduction in the amount of electricity consumed by power plants and the amount of greenhouse gases emitted.

As reported by Alareeni & Alqahtani, (2020), Bahrain’s support of sustainable building constructions has been sub-par. Most building construction designs do not include renewable energy sources. In addition, in the construction of buildings, renewable energy sources such as wind and solar are rarely utilized. A consensus has not been established on reducing the energy in materials, the construction process, and energy used by buildings during their lifecycle.

Given Bahrain's situation, lessons from regional and international GBRSs have proven that applying GB regulations can reduce energy consumption and CO2 emissions. Furthermore, it should contribute to the goals and achievements of the Bahraini National Vision 2030, which is based on three guiding principles: sustainability, fairness, and competition.

Literature and scientific evidence have shown the potential and positive effects of GB methods for environmental preservation and sustainability. Studies on their local applications on residential urban development in

Bahrain discovered the application of GB methods in upgrading the walls' thermal performance would achieve the highest reduction in energy consumption and CO2 emissions. Despite programs and regulations with the rapid upcoming developments, a lack of GB methods, sustainable building practices, and utilization exists in Bahrain.

These studies focused on a single-aspect of GBRS are important, since they often offer a more substantial look at a specific sector with detailed structural information and technical explanation, yet, a comprehensive analysis is still necessary to connect all of the sectors and to look at the holistic system of interconnected nodes and connections within the sector which could facilitate the understanding of the overall trend. A comprehensive approach would also offer more effective observation and analysis of current themes, the ability to identify and plan for potential obstacles, and help to facilitate the future development of a comprehensive GBRS in Bahrain.

As such, this thesis takes a comprehensive approach to the development of Bahrain's GBRS. The study considers the current efforts to establish a GBRS in Bahrain, focusing on a holistic perspective, while also providing an analysis of the current and potential prospects, status and challenges regarding the implementation of a GBRS in Bahrain.

The literature review (Chapter 2) revealed that certain areas had yet to be explored and these gaps were identified. There is a lack of literature describing the challenges associated with the implementation of GBRS in Bahrain and there exists no concise roadmap for the gradual deployment and implementation of a GBRS in Bahrain.

Given these results, this research hypothesizes that there are major challenges which prevent the application of GBRS in Bahrain. The purpose

of this study is to investigate these challenges and create a link between the strategies concluded by the literature and the practice of GBRS in Bahrain. Furthermore, the literature revealed that qualitative methods were highly effective for helping to gain an understanding of the underlying reasons and motivations, to provide insights into how a problem is structured, to provide a basis for hypothesis generation to uncover common predominancies in opinion and thought in the setting of a problem. (Cupido, Baetz, Pujari, & Chidiac, 2010). This encouraged the adoption of a qualitative methodology for this research.

2.6 Literature Conclusion

In Richardson and Lynes' (2007) study, semi-structured analysis, in-depth interviews, documentation, and a process analysis of constructing a GBRS were conducted. It was determined that a lack of internal leadership among stakeholders who had the power to make decisions, working without quantifiable sustainability targets, and a lack of communication between facility management and professional designers were contributing factors towards the relatively slow adaption.

Williams and Dair (2007) found that stakeholder awareness and their desire to implement GB had no effect on the development of a GBRS and should not be considered as barriers or motivators. Rather, they argue that the high costs associated with GB implementation and poor conditions at the site, like the use of unreliable, insufficient, untested products or systems are the main barriers to GBRS development. According to Darko and Chan (2017),

education and awareness are the main obstacles facing the construction sector on the implementation of GB.

Winston, Daly and Kit (2010) described GB challenges as a combination of financial, organizational, social, and educational obstacles. Winston determined that a set of barriers in achieving GB includes the following aspects: a lack of an existing vision for GB, unstable building policies and non-compliance with existing regulations, a lack of knowledge and expertise in GB technology, misunderstanding of higher density housing, poor quality designs, negative reception to social mix, failure to realize the demand for social renewal, and limited resources.

Azizi, Fassman and Wilkinson (2011), who were interested in GB risks in Bahrain and the Gulf region, found that financial risk, regulatory risk, the standard of care/legal risk, inexperienced consultants and contractors, the availability of green materials and GB performance were risks hindering GBRS development, but their study did not address awareness levels.

Häkkinen and Belloni (2011) outlined the primary obstacles to implementation of GBRS were steering mechanisms, economics, a lack of understanding by the customers, and processes (procurement, tendering, timing, cooperation, and networking), and underpinning knowledge (knowledge and common language, the availability of methods, and tools of innovation). They also discovered that GB struggled with organizational and procedural challenges required by the adoption of a new process. Their study revealed that new technologies were resisted due to method changes, risks, and unforeseen costs.

According to Saleh (2016), the main barriers to the successful completion of green projects in Jordan were the lack of green expertise, higher costs, time issues, and a lack of government support. Waterbury (2018) defined the barriers preventing GB's success as the following: building regulations and a lack of client awareness, a lack of business case understanding, demand from clients, proven alternative technologies, single measurement, and planning policy. Lu, Wang and Zhang (2020) noted that financial and regulatory barriers were responsible for hindering GB development in many projects (Hatamleh, Hiyassat, Sweis, & Sweis, 2018).

The world's population is ever increasing and there is no doubt that the increase in population will result in a higher demand for water, energy, and other natural resources as a consequence. In order to achieve a sustainable system, the GB can be understood as a system that uses natural resources as efficiently as possible throughout its life cycle. A GBRS is an evaluation tool that measures the performance of a building at every stage of its life cycle based on environmental aspects related to the building. There has been a significant increase within the past two decades in the number of Global GBRSs that have been developed by governments in various countries around the world for the purpose of rating and certifying GBs (Awadh, 2017c). Several of these templates are designed for different types of projects and a few of them are designed for different phases of a project. A vital role that they play in popularizing and implementing GB is educating the public about its benefits. The majority of these systems are made for specific countries or regions and are designed to suit the climatic conditions and exposure conditions of the specific area in which they are used. Therefore certain

systems might seem less effective when they are considered in terms of other countries.

Making improvements to the “environmental, economic, and social conditions” of the current generations, as well as future generations, is a key component of sustainability. This is achieved by “Providing people with a healthy environment and enhancing their quality of life " (Ortiz, Castells, & Sonnemann, 2009). As Chethana et al., (2016) mention, it is only if a construction is economically, environmentally, and socially sustainable that it can be considered sustainable. It is possible to achieve sustainable development in the building sector through the adoption of GB practices. In order to improve the efficiency of buildings, they maximize the use and recycling of resources and thus reduce the negative impacts of the construction industry on the environment through the use of maximum resources. In addition to being environmentally friendly, it also helps to eliminate and reduce the negative impact that construction practices and material usage have on the environment (Peng et al., 2018).

It was in the late 1990s that the first GBRS was developed, which was followed by the development of many more in the 2000s (Jo et al., 2018). It has been found that many versions of GBRSs have been developed in order to make assessments of the sustainability of different types of buildings at different stages or phases of the construction process. There are many reasons why GBRS can be very important when it comes to the development of GBs because they assist building owners and engineers in complying with aspects (Eisensteinet al., 2017). Rating systems such as LEED, BREEAM, and CASBEE have become more popular and widely accepted in recent years (Jo et al., 2018).

A GB rating tool is defined as a guide or standard used to evaluate the performance of GBs throughout their life cycle (Vivian etal., 2017). There are a number of parameters which are required to be considered as part of the rating tool in order to determine whether the building is a GB (Vivian et al., 2017). Throughout the world, there are many assessment tools and GB rating systems that are widely used as a means of assessing GBs (Gowri, 2004). Buildings that are certified by GBRSs are expected to consume lesser energy, utilize resources in the best manner, provide better living environment, and contribute to overall reputation of property (D. Doan, Ghaffarianhoseini, Environment, & 2017, 2017).

BREEAM was among the first developed GBRSs, and it has since become one of the most widely used tools among them. LEED is another tool that has been widely adopted, being accepted by more than 160 countries around the world since it was developed in 1998. According to the GB Council (2015), there were 71 members of the GB Council and approximately 600 GBRSs (Vierra, 2016).

There are different types of GBRSs that have been developed for different types of buildings, such as residential buildings, educational buildings, office buildings, and industrial buildings. In some systems, the building is evaluated during the design stage, whereas in others it is evaluated during the functional phase.

In some instances, GBRS are formed solely for the purpose of evaluating buildings in a particular country or region. The attributes and criteria for the rating tool are going to be the most appropriate for that particular region if it is country specific, and may not be the same for other regions if it is regionally specific.

The first sustainability rating system developed in the world was BREEAM, which was developed by the UK in 1990. It was then in 1994 that the US GB Council released the LEED certification standard (Zhanget al., 2017). LEED has been estimated to be the most widely used rating system for green buildings in the world. It operates through the USGBC and takes a triple bottom line approach to its work. There are seven major categories in it that include not only energy, but also people, planet, and profit. It categorizes buildings into four categories: certified, silver, gold, and platinum (Ding et al., 2018).

In conclusion, the common consensus is that GB is a kind of development that seeks to improve the sustainability and efficiency of buildings and minimize the negative effects of construction on human health. According to most sources, GB is a form of development that seeks to increase the sustainability and efficiency of buildings, as well as minimize the negative effects of construction on human health. The environment is always at the core of GB, regardless of the evolving definition of the term. As a concept based on ever-improving sustainable practices, sustainability can be viewed as a continuously developing concept. It has been reported that many studies have attempted to identify the drivers of GB and the obstacles preventing its adoption, while other studies have sought to raise awareness by exploring the benefits associated with GB.

The concept of sustainability is central to GB. Sustainability is the aim to manage limited resources in order to meet the needs of the present generation without compromising future generations. Bahrain’s Vision 2030 adopts comprehensive development standards in all aspects of Bahraini society. To achieve such standards, numerous initiatives and programs have

been launched to meet the needs of the present without compromising the needs of the future. GBCs play a significant role in meeting sustainable development goals by reducing energy consumption, increasing energy efficiency, and reducing greenhouse gas emissions.

As part of its development strategy, the Kingdom intends to develop its own GBCs. Consequently, the "Benayat - Green Code" evaluation service was recently launched to assist existing and new buildings in achieving sustainable building standards that are in accordance with Bahraini cultural trends and principles.

The comprehensive investigation presented in this study reveals the current state of GB practices in Bahrain and illustrates the opportunities and challenges associated with sustainable residential building in Bahrain. In addition, the potential of such categories in Bahrain is demonstrated. Some practical strategies and future policies are suggested for bridging the gap between GBs and sustainable vision, as well as the implementation of GBRS.

Considering the findings of the literature review and the observations regarding current trends, the discussion took shape by concentrating on the aspects requiring further investigation and identifying new areas for further exploration. Interview questions were developed and targeted based on this in order to identify the proper stakeholder and engage key decision makers, and to determine what interview questions are needed to address the areas that require further investigation. The questions aim to contribute significantly to a comprehensive understanding of the challenges associated with the implementation of a GBRS in Bahrain, as well as to bridge the gap between the strategies, sustainable development plans and the development of Bahrain Vision 2030.

Chapter 3: Methods and Procedures

The purpose of this chapter is to illustrate the methodologies used to explore the implementation of a GBRS in Bahrain. In addition, this chapter presents the rationale and justification for the use of the tools and the methodology employed. The section describes the research phases, unique strategies, selected methods, ethical considerations, sample size, compilation of data, and analysis.

The chapter is divided into three main sections:

1. An in-depth description of the methodology, procedures and rationale of the study and how they were developed.
2. An explanation of the research design and the data collection, validation, and analysis methods used.
3. A thorough description of a pilot study, which informed the methodology of the main study.

3.1 Research Setting and Context

Research studies are influenced by the contextual factors that shape their outcomes and have a substantial impact on their significance, and the context has come to be recognized as a key element to its successful outcomes, as well as its significance. To identify the context is to define the objectives of your research, to present the culture, and to make it meaningful (Dikilitaş & Griffiths, 2017).

In order to present the context for the research, identifying the when, where, and who are involved the real estate sector and particularly the affordable housing projects in Bahrain, it is important to realize that the affordable housing market is a pivotal part of the economy and has influenced numerous fields in Bahrain. Accordingly, the sector integrates a broad variety of industries and sectors. This research focuses on stakeholders in the affordable housing industry, taking into account their roles and responsibilities within the housing sector, identifying the developers and end-users of affordable housing, and the entities that regulate these processes.

The purposive sampling technique is used in the selection of participants for this study, in particular Expert Sampling, which involves selecting experts in a specific field to serve as participants in this study based on their level of expertise in that field. Samples of this sort are useful when the research is expected to take a long time to conclude or if observational evidence is currently lacking. Expert sampling is a useful tool when exploring new research areas to determine whether further study would be worthwhile (Wu Suen, Huang, & Lee, 2014). However, this technique has resulted in the adoption of the snowball technique in some cases after the respondents in the study provided suggestions and recommendations during the qualitative semi-

structured interviews. This is true of the SEA team members and MOH members in particular. As a result of many of the recommendations and referrals and following the snowballing technique used during the interview process, interviewees from Benayat, Solar One and Green Innova have been added to the list of participants.

The study was initially to take place at participants' offices or workplaces, during which time the interviewing would take place. However, as the study took place between 2020 and 2022, which coincided with the Covid-19 pandemic, the setting was altered accordingly. Fortunately, the convenience of online meetings with the participants has proved advantageous, as the participants were more flexible with their timing, locations and accessibility.

3.2 Research Methods and Procedures

This chapter presents the steps of the research process. The chapter explains the methodology adopted to identify how strategies and implementations of GB initiatives relate to one another in an attempt to identify best practices, as well as to identify potential corrective actions which could aid the implementation of a GBRS in Bahrain.

Figure 17 shows the process and the summary of the methodology chapter with the primary objective summarized for each stage.

3.3 Methodology Description

In 2020, To measure the level of knowledge of GBRS among professionals and academics, a semi structured questionnaire was developed and sent out. Almutiri (2020) revealed that the those who had awareness of GBRSs typically had no official or formal training in any GBRS system. It

was found in the study that over 80% of participants are aware of GBRS, 10.6% have studied them, and 5.3% have some certification in these systems, but have not received any training.

Considering that the GBM has only been published in 2019, there is limited research available and it can be challenging to determine stakeholder perspectives and demand for GB. Public awareness of GB and green development, in general, is still limited. As such, key components of GB processes in Bahrain cannot be understood without knowing the identities and motivations of the stakeholders involved.

In this study, a qualitative-methodological approach is used to investigate the potential and constraints of GBRS deployment and operation in Bahrain, more specifically in the affordable housing market/sector. Stakeholders are defined as field experts (developers and contractors) and decision makers are defined as government officials.

This research was carried out through a detailed interview process conducted with the stakeholders, industry experts, and the most influential individuals in the industry. The interviews are subsequently followed up by a qualitative interpretation and analysis of the results using the qualitative data analysis software NVivo.

In this context, it is essential to understand Bahrain's views on GBs and the way in which the concept of GB is characterized in the country, as views can vary depending on the field of the stakeholder in question. By doing so, we can attain a deeper understanding of the views of stakeholders and assess whether the discussion regarding GB could be framed in a way that addresses their concerns and better explores the potentials and challenges of implementing a GBRS in Bahrain.

3.4 The Rationale for Using a Qualitative Approach

Although it was initially intended to employ a mixed-methods approach in this study, several participants were uncertain about their answers due to a lack of knowledge regarding the concept of GBRS. Other participants rejected the questions due to their unfamiliarity with the study. As a result of the limitations of the applicants, it was difficult to obtain a comprehensive understanding of the direction and perceptions of the public regarding affordable housing. Hence, the pilot phase had a limited response rate and insufficient access to the relevant demographics within the affordable housing market. These factors led to the choice to pursue a solely qualitative approach.

Qualitative approaches have increasingly been used in similar studies, as reflected in the literature, as they tend to provide keen insight into perceptions, motivations, and perspectives that underpin key stakeholder action. This insight is particularly important since field specialists and developers determine the motivations and influences underlying public and private development.

The most common challenge for researchers is figuring out the best strategy to use when trying to answer the research question (Reinecke, Arnold, Quarterly, 2016). Qualitative methods are characterized by their distinctive interpretation of social sciences, through embracing a perspective of reality that is context sensitive (Reinecke et al., 2016). Mayer (2015) points out that the purpose of conducting a qualitative approach in a study is not to arrive at definitive conclusions or absolute truth, but rather to serve as a starting point for future research in the field.

There has been a rapid expansion of qualitative research in the social sciences in recent years, relying largely upon techniques that seek to understand, predict and explain human behavior, and the way humans perceive their social world (Bailey Lawrence F Bailey, 2014). It is generally accepted that qualitative research consists of the use of methods “that make the world visible” (Mayer, 2015). This includes, at the very least, the use of in-depth interview techniques, the knowledge and skill of researchers to accomplish procedures, the interpretation of results, and the ability to answer questions such as ‘why?’ and ‘how?’ (Bailey Lawrence F Bailey, 2014).

Therefore, it can be argued that the objective of qualitative research is to 'understand and explore accounts of social events occurring in the community', whereby open questions and flexible procedures are chosen. These may even be altered during the investigation (Park & Park, 2016).

The main characteristics of qualitative research include a focus on the dynamic nature of reality, a thorough investigation of different points of view, the distinctions it makes between situations, and how it encourages the researcher to consider these factors in a thoughtful and reflective manner.

Consequently, qualitative research should be conducted with a holistic approach, considering social phenomena as one indivisible unit with which one can identify the "patterns, circumstances, repetitions, manifestations and meanings associated with the research questions" and also contribute to the creation of new theories (Park & Park, 2016).

Among the built environment research community, qualitative research has experienced a rapid increase in application, including in doctoral research as well as mainstream social science research. Originating from the social

sciences, qualitative studies are understandably the preferred method for those conducting research that involves human subjects (Alasuutari 2010). The use of qualitative methods in the built environment and building industry field has been identified as a successful method as evidenced by exemplary success stories. This has led to many doctoral students and researchers in the field becoming more inclined to utilize qualitative methods (Sara Alsaadani, Gabriela Zapata 2011).

In recent years, qualitative research methods have been gaining a lot of attention as effective ways to study complex situations and to produce rich findings, while at the same time acknowledging the researchers' role in shaping the research findings (Sutrisna & Barrett, 2007). It has been demonstrated in previous studies that qualitative methods are useful when it comes to assessing the efforts and contributions toward the implementation and deployment of new strategies. In addition, qualitative methods have been shown as useful tools when evaluating the most practical implementation supporting the objectives, as well as assessing the opinions of the experts and decision makers engaged in questions that are exploratory in nature.

According to (Cooper & Schindler, 2006), the qualitative approach is the most appropriate method when undertaking exploratory research as it allows the identification of emerging themes during the research process and subsequent investigations of these themes.

Moreover, as has been pointed out by (B. Saunders et al., 2018), a qualitative approach can help in understanding the reasons for the conclusions drawn by participants as well as providing a better understanding of their attitudes and opinions. Further, a qualitative approach can enable the discussion to extend into other areas that had not previously been considered,

but which may be critical for understanding the issue at hand. It has also been observed by Simon Carter and Lesley Henderson (2005) that qualitative research, by its very nature, centers on perceptions, opinions, beliefs, and attitudes.

Creswell, Hanson, Plano and Morales (2007) recommend that the qualitative approach be used to address problems that are context-specific, have unknown variables, and that require an exploratory research approach. This is to ensure that the research is reliable and verifiable in view of the concrete nature of the context in which it is conducted and done in a way that is relevant to this environment.

There are several qualitative techniques that can be employed depending on the objectives and complexity of the research. It has been shown that a qualitative approach is among the best approaches that can be used to answer the question of research and to reach an understanding of a particular phenomenon (Vaismoradi, Turunen, & Bondas, 2013). Reinecke et al. (2016) suggest that the qualitative methodology acts as a sort of umbrella both in terms of the type of data collected and the way that it is analyzed.

Based on the exploratory nature of this research, and as demonstrated through the literature, conducting one-on-one interviews was deemed to be the most effective method for gathering information for this research.

3.5 The Ethical Review

Research involving active participants requires an ethical review. The process of ethical review is designed to ensure that research participants can feel confident that possible risks have been assessed, minimized, and were deemed to be ethically acceptable (Smajdor, 2009). The process also

maintains the ethical standards of the research practice, protects research participants and research workers from harm and exploitation, and preserves the privacy rights of the research subject.

Given the qualitative nature of the interview and the phenomenological approach to it, there are some ethical concerns that arise regarding prior consent, recording, and maintaining confidentiality of the interview (Parry, Thomson, & Fowkes, 1999). For this reason, and to protect each participant's identity, the names of all interviewees have been omitted.

This study was reviewed for ethical compliance according to the guidelines of the research ethics committee at the University of Bahrain. By following UOB's ethical review process, it has been ensured that this research will result in benefit and minimize harm, while remaining sensitive to the needs of research. Research participants play a crucial role in the research process, not simply as an instrument for gathering data, so the ethical review makes sure they are protected. In this way, participants are aware of their right to know who has access to their data and what is being done with it.

Ethical reviews also contribute to protecting research by demonstrating that it adheres to the accepted standards of a genuine study with proper procedures and quality results. In designing and conducting this study, the following principles were followed:

- Informed consent for data collection
- The rights of participants to withdraw from the research
- Maintaining confidentiality and anonymity for participants and storing and accessing data in accordance with best practices
- Providing participants with adequate information about the research, its outcomes, and how they will be used

3.6 Research Design

Research in qualitative fields is multimethod, involving an interpretive, naturalistic approach to the topic at hand. In general, researchers using qualitative methods analyze phenomena in their natural surroundings, with the intent of making sense of, or interpreting, the phenomenon in terms of the meanings that the individual attaches to it (Simon Carter & Lesley Henderson, 2005).

A qualitative semi-structured interview is conducted to gather qualitative data in this study to gain a deeper understanding of the project's objectives. The activity of observing and recording qualitative data is defined as the process of bringing in new information by averaging and systematizing what has been observed.

Figure 18 illustrates the sequential procedure utilized in this research. An aim of the qualitative information collection process is to gather as much qualitative information as possible to gain the most accurate understanding of the research question. This often involves a back-and-forth process between data collection and data analysis, in which new insights and experiences can lead to adaptations and expansions of the original plan. As a result of some of these insights, the research question and the overall design of the study may also require revision. After a saturation point is reached, that is, when no new information can be found that is relevant to the matter, the process ends. For reasons of transparency, it is essential that all decision-making processes, as well as the reasoning that guides them, are well documented.

According to (Urquhart, 2012), saturation occurs when the coding process reaches a point at which no new codes appear in the data. There are increasing instances of the same codes, but not any new ones', whereas Case and Given (2016) consider saturation to be the condition where the inclusion of further or additional data does not add any new meaning or any new themes to the research. Several scholars have taken a similar position regarding the emergence of new codes or themes (such as Birks et al., 2015; Olshansky & M de Chesnay, 2014). These definitions reflect a change in emphasis and suggest a second model of saturation. The focus remains on analysis, but the decision to be made seems to be determined by the emergence of new codes or themes, rather than by the degree of development of those already identified. In addition, Urquhart (2012) and Birks et al. (2015) relate saturation primarily to the conclusion of analysis rather than collecting new data. In general, the process of determining when and how saturation level may have occurred will vary depending on the type of study, In addition, assumptions are made as to whether it represents a distinct event or a continuous process.

A key consideration in identifying saturation is whether it is viewed as a process or as an event. In general, saturation is referred to as a 'point' (B. Saunders et al., 2018), indicating that it should be viewed as a discrete event that can be recognized by the analyst. Nevertheless, Corbin & Strauss (1990) argue that saturation is a 'matter of degree', arguing there will always be a potential for 'the new' to emerge. According to them, rather than focusing on reaching saturation, saturation should be determined by the point at which further data collection is ineffective, and where 'new' data doesn't necessarily contribute anything to the overall story. A number of researchers follow this

incremental approach to saturation, such as Mason (2010), who refers to the point at which there are 'diminishing returns' from further data collection.

The achievement, maintenance, and fulfilment of data saturation are crucial as a certain level of data saturation is needed to confirm or acknowledge the general agreement of a given view (Brod, Tesler, & Christensen, 2009). The inability to reach data saturation has a negative impact on the quality of research and hampers the validity of content (Kerr, Nixon, & Wild, 2010). In qualitative research, sampling generally continues until no new information is received or no new insights can be gained. The term theoretical saturation refers to this phenomenon. A theoretical saturation occurs when themes and constructs from one case or interview are supported by evidence from another case or interview (Eisenhardt, 1989).

There has been considerable debate in qualitative research throughout the years regarding the definition of an appropriate sample size and the consideration of a study's conclusion based on the sample size in relation to its research objective. For qualitative research to achieve the objectives, selecting a sample size that is appropriate for qualitative conclusions is a challenge that involves considerable conceptual debate, and there is considerable practical uncertainty involved in choosing a sample size for qualitative research (Vasileiou et al. 2018).

The fundamental question is ‘What is the right number of interviews?’ This depends on the nature and type of the research problem and is itself variable (Gubrium & Holstein, 2001). Subsequently, there is also characteristic researcher subjectivity since it is the researchers’ judgement about whether new material is being obtained that is critical. Nevertheless, for qualitative interviews, the literature suggests that saturation is commonly

reached after approximately 6-12 interviews (Gubrium & Holstein, 2001; Guest, Bunce, & Johnson, 2006).

In the context of this study on GBRS, theoretical saturation was determined to be accomplished at 14 applicants. This experience is consistent with similar studies investigating processes rather than events. In similar studies, the valid range of case sampling was found to be at least ten cases (Eisenhardt, 1989). In his research, Hume (2011) evaluated sustainability and young consumers' consumption by conducting interviews, ultimately reaching sufficient saturation after 22 interviews. In their recent grounded theory study of industrial enterprises for the purpose of evaluating green growth behavior and performance, Li et al (2019) examined 12 cases from China, which was considered sufficient to reach theoretical saturation and to present their results.

Sale, Lohfeld, and Brazil (2002) believe that a small and purposeful sample of articulate respondents is sufficient to obtain adequate information for in qualitative research, claiming that two research projects and six participants were deemed sufficient to provide adequate information on the application of GB principles.

In their case study on GB construction in Gauteng province in South Africa, Masia, Kajimo-Shakantu and Opawole (2020) determined that six participants from the two case studies provided adequate data for describing the application of GB principles in focus, and according to the author, qualitative research should be conducted with more consideration given to the data quality rather than the sample size.

It is inevitable that different perspectives on GBRS will exist, since the participants have different backgrounds; hence the interview questions are open ended, allowing interviewees to elaborate freely. This approach results in high quality and relevant responses. The purpose of qualitative research is not simply to develop an initial understanding and to provide a solid basis for further decision-making, but also to obtain new knowledge concerning complex phenomena through exploration.

The interviews with decision-makers identify leadership issues, compliance with policies, and barriers to implementing a GBRS where the data generated provides broad generalizations, depth and detail needed to efficiently address their implications.

3.7 Research Population, Sample Size, and Data Sources

The rationale for selecting and focusing on the professional population is crucial in understanding the challenges and potentials of the GBRS implementation in Bahrain. This is because the views of professionals directly affect decision making, whereas surveying the public's opinion provides a glimpse into the social and economic perspectives of end users. At this point, interviewing end users would provide limited insight into the geopolitical perspectives of the industry. Participants in this study are listed in Table (24) with their corresponding code names.

In addition to the perspectives of professionals, the public's opinion would have added an additional dimension to the views and have provided a broader holistic picture of Bahrain related to GBRS. This is particularly pertinent when considering current trends that exist and the level of public awareness regarding sustainability. While several attempts were made to

reach the required sample size through several different means, it was found that there were difficulties in obtaining homeowner information and an absence of cooperation from the entities that had access to the information of the potential homebuyers. As such, it is recommended that it is essential for future research to be conducted to take into account changing ecological conditions, landscapes, and judicial districts. Furthermore, additional research involving the public, professionals, and NGOs, with their rapidly increasing engagement rate and awareness of sustainable methods, would be beneficial to take into account the full context of the situation in Bahrain.

An evidence-based approach to determining sample size has become increasingly popular in qualitative research over the past decade, as well as for an evaluation of sample size sufficiency to achieve the research objectives. It has been demonstrated that qualitative research should be transparent and thorough in the evaluation of sample size, as part of the application of data sufficiency, to ensure and maintain high quality research that will promote greater appreciation of qualitative work.

To ensure the integrity of data, study-specific reporting must be clear. In general, the review process should assist in exercising nuanced judgments to determine the sample size that is appropriate. Therefore, it has been taken into consideration that the practice of assessing sample size sufficiency, with reference to the study under consideration, is an important component to this area of research. It would caution against the matching of growing methodological research with a decontextualized application of sample size numerical guidelines, norms, and principles.

It has been recommended, although sample size community norms may provide useful guidelines, to utilize methodological knowledge to evaluate

how saturation and other parameters affecting sample size sufficiency relate to the specifics of the project and research objective. There is no straightforward answer to the question 'How many is enough' according to the majority of qualitative researchers and that sample size is contingent on a number of factors relating to epistemological, methodological, and practical matters (Baker and Edwards 2012).

As well as examining the specifics of the study and how it is conducted, there are several factors that may influence the sample size requirement based on the objectives and goals of the study. Given the growing body of methodological evidence in this area, it is essential to present such evidence-based judgments in a transparent manner. This is one of the most important steps toward eliminating what is considered a routine practice of citing the 'small' size of qualitative samples as the fundamental limitation of research.

There has been a growing body of concepts, tools, and guidelines to aid researchers with the ability to set and justify the validity of their sample sizes, which is an indication that this issue represents an important marker of qualitative research quality.

In qualitative research, sample adequacy against the research objective refers to the adequacy of the sample composition and size in comparison to the target population. This is an important consideration in evaluating the quality and trustworthiness of much qualitative research. It is also important for research that is situated within a post positivist tradition and that retains a degree of commitment to realist ontological premises, in assessing both validity and generalizability of the data (Minh Duc, 2003).

Qualitative research tends to have a small sample size, because these small samples can support the depth of case-oriented analyses that are fundamental to this mode of inquiry. Additionally, qualitative samples tend to be chosen in light of their ability to provide richly textured information relevant to the phenomenon under investigation (Luborsky & Rubinstein, 1995).

In qualitative research, selection of participants is a critical element in the data collection process (Noy, 2008). An important aspect of research is the selection of an appropriate source since people are constantly relied upon for knowledge and information. In terms of sampling theory, the purposive sampling technique is a type of non-probability sampling that is used when one wishes to study a specific cultural domain with experts within it (Tongco, 2007). The method remains robust even when tested against random probability sampling, indicating that it is efficient despite its inherent bias.

In a purposeful sampling technique, also known as judgment sampling, a key informant is identified based on his/her skills, qualities, responsibilities, and influence. This is a non-random technique that does not rely on theories or a set number of informants to accomplish its objectives. The principle, to put it simply, is that the researcher must identify the types of information that are necessary to know and then go on to seek out those who are willing and capable of providing the information (Lewis & Sheppard, 2006). Although the sample being studied is not representative of the population, purposive sampling is the primary method by which researchers pursuing qualitative methods research designs can focus on particular characteristics of a population of interest, thereby enabling them to answer the research questions in the best possible way.

According to Rai and Thapa (2015), “Purposive selection refers to a process of selecting a number of groups of units in such a way that, when the selected groups are combined, they yield the same average or proportion as the totality in respect of those characteristics which are already known statistically.” While it does have some limitations, purposive sampling of units can be an effective method when the sample is small and one characteristic of it is to be studied extensively. Thus, the sample is selected with a particular purpose in mind, so that it includes those of interest while excluding those who don't fit the purpose. As a result, taking advantage of this purposeful method allows the researcher to have a greater scope to obtain and bring forth the best possible information possible from the samples, which is largely dependent on the knowledge, judgment, and intellect of the researcher (Rai & Law, 2015).

In this research, a purposive sample was chosen as it is crucial to be certain that the data collected is relevant and of high quality. The reliability and competence of the informants must be guaranteed as well.

The Purposive Sampling technique, also known as selection by judgment, is the thoughtful selection of an informant based on the abilities that the informant holds (Bernard, 2017). As a non-random approach, it does not require underlying theories or a limited number of informants in order to find the information it requires. In simple terms, the researcher determines what information needs to be gathered and employs techniques such as asking people who, by virtue of their knowledge or experience, are willing to provide it (Bernard, 2017; Lewis & Sheppard, 2006).

One example of purposeful sampling is the key informant technique (Bernard, 2017; Lyon & Hardesty, 2005) which solicits one or a few

individuals to act as guides or representatives of a particular culture. The key informants are observers and reflective members of the community of interest who are knowledgeable about the culture and are willing and able to share any information they may have with any member of the community of interest (Bernard, 2017).

Purposive sampling was used in order to identify participants who would be best suited for participation in this study. Taking into consideration the information available, a group of initial participants has been selected from contacts within the SEA team, based on their level of involvements and influence in the development of the GBRSs in Bahrain. In this study, a form of purposive sampling called Expert Sampling is used to select participants. This involves the selection of experts in a particular field as the subjects, although this has resulted in the implementation of snowball sampling as the respondents in the study provided suggestions and recommendations during in-depth interviews, especially with the SEA team members. The snowball method is employed, whereby additional participants are invited to participate in the subsequent rounds. This non-probabilistic approach provides an exceptional method to understand the social network connections.

In Bahrain, there exists a number of sectors that are part of the real estate market, particularly those that deal with affordable housing. The result of this is a broad range of industries and sectors that form the GB sector within the affordable housing market. There were several steps involved in the selection process, starting with grouping the participants into two broad sectors: public and private. There was the public sector represented by MOH, MOW, EWA and RERA, and the private sector represented by the major listed developers

registered as MOH affordable housing Mazaya developers. Table (15) shows the list of interviewees with positions and the rationale behind their selection.

Twenty-five interviews with selected stakeholders were conducted for this study. Nevertheless, after filtration, five interviews were deemed not to be appropriate for analysis. This was due to several interviewees being unable to share certain information pertinent to the core questions, either due to a lack of authorization or limited access to information. These five interviews were therefore excluded and a total of twenty interviews were deemed appropriate for analysis. As described by Busetto, Wick, and Gumbinger (2020), generally, qualitative studies do not mandate a fixed or predetermined sample size. In fact, a sample size can only be considered as a useful quality indicator when it is related to the purpose of the research, the methodology that was used, and the composition of the sample.

Throughout the course of this investigation, a particular focus was placed on the views of all the stakeholders and decision makers who were involved in the development of affordable housing projects in Bahrain from a variety of fields and disciplines. Table (11) illustrates the description of the sample.

It is important to note that when snowball sampling is used, there will be interrelationships between the respondents who were interviewed, as those participants are the ones who provide the referrals. Accordingly, the quality of the referral process is related to both the quality of the interaction, and to how participants frame the interview encounter in their mind (Noy, 2008).

It has always been a challenge in a qualitative investigation to determine when the sample size is sufficient to conduct a study (Mills, Durepos, & Wiebe, 2009). Compared to the traditional quantitative methodology involving a sufficiently large sample size to generate a representative

population, qualitative research differs in many ways from the conventional quantitative methodologies as it focuses on reaching new knowledge before saturation occurs and does not allow for generalization.

Considering the distinctive nature of qualitative research, the results should not be viewed as representing the entire universe of the phenomenon under consideration. Nevertheless, Mills et al. (2009) argue that the goal of theoretical saturation is to guarantee that the research question was rigorously answered, systematically explored, and as complete as possible. In principle, one cannot be certain when theoretical saturation has been reached by looking at results that emerge from interviews. Over time, the results tend to become more and more similar, which implies that no more information needs to be collected. However, the literature asserts that theoretical saturation is speculative in nature and that it is impossible to ascertain whether or not it has been achieved (Bernard, 2017; Ozanne & Murray, 1995). In this study, the saturation point is identified as the point where answers from respondents become less original, or repetitive, and no new information arises from the answers.

Fugard & Potts (2015) believes that the issue of determining sample size in qualitative research should not pose a problem for qualitative researchers when carrying out qualitative research, emphasizing that qualitative researchers should concentrate on gaining insight into the researched field to obtain the necessary understanding. Furthermore, they suggest that researchers should be more transparent about their evaluations of sample size sufficiency and assessing the results for data adequacy.

The number of interviews required for this study was based on the point of theoretical saturation, as described in section 3.6 of this study. As the

respondents were high-quality, senior officials from relevant organization, saturation was deemed to be achieved after 14 interviews. Bahrain's key stakeholders and decision makers were interviewed regarding the development of affordable housing projects in Bahrain, with the aim of eliciting high-quality, relevant answers. As stated by Mason (2010) and Wetherell, Taylor and Yates (2001) even a small sample is sufficient to confirm the pattern of analysis shared by other members of the context of the field researched and to confirm that the most or all the emerging concepts have been identified as they apply to the context.

To ensure consistency in the responses from participants, the working definition of "affordable housing" was described as follows. Bahrain's MOH has described what constitutes an affordable home as one with a value of less than 120,000 Bahraini dinars ($320,000 USD) (Ministry of Housing | Regulations and Rules -Bahrain, 2021). Additionally, the housing projects were classified under the Residential MOH (RA-MOH) category by the Urban Planning & Development Authority, a residential area that permits one or more housing units to be constructed per plot with a low or medium building density (Urban Planning & Development Authority, 2022). Furthermore, the Urban Planning & Development Authority classified these housing projects under a particular classification, which is a residential area permitted to be occupied by one or more residential units on each plot of land with low or medium building density (Urban Planning & Development Authority, 2022). Ensuring that this definition was understood by interviewees was a key component in ensuring consistent and measured responses.

3.8 In-depth Semi Structured Interviews: Questions and Rationale

Table (12) offers questions addressed at government entities in a semi-formal in-depth interview. The drive of the interview is to understand the underlying motivations, beliefs, attitudes of government directions, and perceptions of GBRS. The respondents chosen for this study (see Table (15)) were chosen due to their status as senior officials in the relevant bodies, who had decision making capacity or were of a sufficient level to influence decisions. All participants chosen to take part in this study were at the level of executive or higher executive in their relevant organization, which is an indicator of their professional status and suitability for candidacy. The rationale behind the questions is described in sections 3.13.7 to 3.13.10.

Hijmans & Kuyper (2007) refer to qualitative interviews as "an exchange with an informal character, a conversation with a goal". The aim of a qualitative interview is to gain an understandings into a person's individual experiences, judgements, and inspirations instead of facts, data, and behaviors of individuals.

The types of interviews vary depending on whether they are structured, such as a questionnaire, open, like a free discussion or autobiographical interview, or semi-structured, such as the one used in this study. The semi-structured interview is characterized by open-ended questions and is done with the help of an interview guide, or topic guide. For this research, GB is defined as the broad area of investigation and is broken down into sub-questions based on the industries and disciplines of the candidates being interviewed. In the interview guide, the pre-defined topics had been taken

from literature reviews, previous research, a preliminary method of data collection, and observations from the field.

Although the focus of this research has remained consistent across all interviews, some questions have been skipped altogether in particular situations, such as when the interviewee is not able or unwilling to answer the questions, or for worries about the extent of the discussion, or the ineligibility of the interviewee.

It is generally not necessary to conduct qualitative interviews in a transcribed format in order to prevent impeding the interactive aspect of the interview process. Qualitative interviews have the benefit of being collaborative and thus allowing for unanticipated topics to materialize and be addressed by the researcher, which is not the case with quantitative written surveys (Jansen, 2007). Having information about what is previously identified or anticipated to be applicable to the research and objective of the study has helped remove a lot of bias similar to that found in transcribed surveys, which can only measure what is previously well-known and what is assumed to be relevant to the research.

Table (13) shows the in-depth interview questions addressed to developers, contractors and consultants to extract detailed information, provide a context for other data collection, provide a complete picture of general stakeholder perceptions, and to present the potential and challenges of GBRS in Bahrain from the perspective of all stakeholders.

Specifically, data was obtained from respondents through in-depth interviews via Google Meets, and transcribed manually on Google Docs.

3.9 Data Collection Methods

In some cases, the most effective method to use in this type of research regarding exploring the perspectives of stakeholders is an in-depth interview, particularly in cases where the goal of the research is to explore the perspectives and identify the meaning of a phenomenon from the point view of the stakeholders involved (Connolly & Prothero, 2003).

Table (14) shows the data collection method along with the rationale for each process.

Through the detailed in-depth interview strategy, the individuals were given an opportunity to describe their perception and understanding of GBRS in their own words. Arnould and Wallendorf (1994), Graue (2015) and Moisander and Valtonen (2006) have all concluded that it is much easier to communicate participants' perceptions through in-depth interviews when compared to how difficult it is for other scientific methods to be able to reproduce human behavior patterns as caused by social interaction.

To conduct the interview more effectively, as much information as possible has been gathered regarding the participant prior to the interview. In addition to the interview context, the implementation of the interview provides the necessary environment in which participants can speak and detail their experiences (von Schwedler & Fernandes, 2018). As stated by Ozanne and Murray (1995) it is preferable to conduct the interview in the participant's private space to increase the level of intimacy and trust during the interview, having established a trust relationship with the interviewees enables the interviewer to contact them later in order to clarify any doubts that have arisen during the transcription of the interviews. Thus, for the purposes of creating

and guaranteeing a comfortable environment during the interviews, all interviews were scheduled in a convenient time for the participants, and are conducted online, allowing participants to contribute from wherever they felt comfortable doing so.

Parry et al. (1999) state that to conduct an effective interview the interviewer should be on an equal footing with the interviewee and so the questions should be posed as the dialogue proceeds. In addition, the authors suggest avoiding asking 'why' questions in order not to give the interviewer an overly intrusive role. In addition, many of the responses to this type of question can be characterized by feelings of prejudice and defensiveness. As a result of these factors, the in-depth interview questions have been built in a way that allows the participant the comfort and freedom to answer and elaborate freely. The objective of these phenomenological interviews as stated by Black and Cherrier (2010) is usually to explore subjectivity, which is based on the assumption that responses do not represent facts, but rather individual experiences. During the interview process, all of the interviews were recorded using the standard Google Meet application on desktop so that the meaning of the words could be preserved, and also serve as a reference during the writing of the interview scripts.

Secondly, the in-depth interview evaluates how the developers with knowledge in GB, listed in

Table (16), are trying to market the concept to consumers and homebuyers.

Interviewees are requested to identify observed barriers and/or challenges or obstacles originating from governmental or commercial sectors

that might possibly impact the implementation of a GBRS in Bahrain's real estate industries. The interviewees are then asked to give their opinions on how the implementation challenges can be addressed.

3.10 Data Validation

During qualitative data analysis, validation of data is one of the most critical steps for a successful study. Since data is an integral part of research, it is imperative to ensure the data is accurate.

Content validation is an essential part of drafting the interview questions since it enables the evaluation of the interested phenomenon by checking how the items match the theoretical construct, which underlies the instrument (Article & Enfermagem, 2017). Data validation determines whether an assessment measures what it claims to measure (Kazi & Khalid, 2012). The survey instruments are systematically organized to ensure that the interview questions are comprehensive and are relevant to the objectives of the study.

This study conducts the following procedures to establish the validity of the data questions:

1. The validation by experts, or the face validity process, is implemented, which describes the appropriateness, sensibility, or relevance of the test and its components as they appear to the person answering the question (Holden, 2010). The validity and compliance of the instrument are checked by experts on the topic, who can analyze the interview questions for accuracy, consistency, and adequacy. The experts then determine whether the questions adequately capture the concept. These experts are academics who teach postgraduate students in the Colleges of Science and Engineering at the University of Bahrain. They are

experienced and knowledgeable in the fields of the built environment and sustainable development.

2. For the pilot test after the draft validation, the interview questions are completed, and a revised version is prepared and sent to a small segment of the population consisting of experts and practitioners from various disciplines. A pilot study is conducted to test the aspects of the techniques intended for investigation. The final interview questions are compiled based on the updates.
3. The responses are then exported into a spreadsheet after the pilot data collection is completed. The research questions were then reorganized and further edited.
4. An analysis of the underlying components of the survey is then completed using Principal Component Analysis (PCA) to validate what the survey aimed to measure. PCA entails converting a set of observations into a set of linearly uncorrelated variables (principal components) through the use of mathematical formulas (Jain & Shandliya, 2013).

3.11 Data Analysis

As Mayer (2015) points out, data analysis is an important step in qualitative research, and its application has a major influence on the results. In the social sciences, reality is not fixed according to Moisander and Valtonen, (2006), meanings are constructed in different contexts, so texts must be interpreted as autonomous data sets. With this interpretive perspective, the objective is to identify cultural specificities that represent ways of acting, speaking, relating and understanding. As part of the data

analysis process, the first step is to conduct verbatim transcriptions of the interviews and to take field notes during the observation (Black & Cherrier, 2010).

As well as observing these aspects of the context in which the interviewees live, their social relationships, or where they work, the researcher must record them in writing and provide empirical data for analysis. Transcribing the interview is recommended to begin as soon as possible after the first interview to integrate into the script aspects that may arise during the interview or even as self-critique to enhance the performance of the investigator.

The first step in the interpretation process, Moisander and Valtonen (2006) suggest, is for the researcher to obtain a pre-understanding of the disciplines that constitute the theoretical reference to provide an interpreting frame or horizon from which texts may be interpreted (pp. 109-101). Using a data analysis program (e.g., NVivo) to facilitate the process of coding and comparing data is also recommended. The analysis began with reading the transcripts to be able to have a holistic understanding and to create a vision (Connolly & Prothero, 2003).

Ultimately, the text should also be analyzed from the perspective of the theoretical framework; and the theoretical framework should be interpreted using the broader perspective of the informants' narratives and meanings, in an interactive manner (Thompson, 1997). For instance, Moisander and Valtonen (2006) suggest that during the analysis phase researchers begin by becoming "de-familiarized" (p. 121) with the data (i.e., moving away from aspects that often come to mind but are taken for granted), allowing these aspects to be seen analytically.

Also, this allows the researcher to take a deeper dive into the phenomenon, changing the perspective of the researcher, and incorporating points of view, as well as similarities and differences. It is recommended to constantly revisit and keep up to date on the literature throughout the process of data analysis, so that a comprehensive and up-to-date overview of the state of the art can be provided.

For the qualitative semi-structured interviews section, the data analysis process involves analyzing the answers, concepts, and development of ideas through a content analysis method which is very dynamic, and practical. This method is commonly used to evaluate patterns within the content by utilizing a data analysis software to recognize general themes and to create a firm conclusion. When faced with a large amount of information, content analysis is a commonly used method to identify meanings, concepts, terms, and words (Mills et al., 2009).

Using this systematic approach to coding and categorization, it is possible to compress a great deal of information in all types of recorded communications, such as transcripts of interviews, discourses, observations, documents, etc. (Mayring, 2015). The aim is to determine how words are used, their frequency, and categories, as well as who says what, to whom, and to what effect, to make inferences about the study subject, the audience, or a particular culture (Mills et al., 2009; Vaismoradi et al., 2013).

Using qualitative content analysis clarifies textual data, reduces it to manageable segments using inductive and deductive codes, and reorganizes data to draw and verify conclusions (Forman, Damschroder, & Content, 2015). After summarizing the observations of literature and primary data, the in-depth interviews are then transcribed into protocols and transcripts.

Analyzing the data through synthesizing the answers to the questions involves re-reading the interview transcripts to identify themes emerging from the respondents' answers.

A subsequent step consists of the coding of the protocols and transcripts by placing one or more short descriptors, marked or tagged, to identify the contents of a particular sentence or paragraph (Fossey, Harvey, McDermott, & Davidson, 2002). The concept of coding is defined by (Jansen, 2007) as "connecting raw data with "theoretical" terms". The concept simply refers to the process of sorting raw data with mathematical terms. It allows for a comprehensive analysis of all segments of data and the possible relationships among them. Codes were then grouped, summarized and categorized through an abstraction and synthesis process.

The outcome of the coding and analysis process is then described and represents the behavioral pattern under examination, which is known as a descriptive theory (Jansen, 2007). The coding process in this study is performed using the qualitative data management software, NVivo. This software provides the necessary tools to facilitate the completion of the analysis.

3.12 Data Verification

Data verification is an integral step in qualitative research because it raises a basic epistemological question for counselling researchers: How do we know what we think we know about our participants? In recent years, member checking has emerged as one of the most important methods of verification in the scholarly literature (Guba & Lincoln, 1989), but it is not without its limitations (Carlson, 2010).

In some cases, it may not be possible to return to participants for a member-checking process (Buchbinder, 2010). However, it is the researcher's responsibility to ensure that each participant's voice is authenticated and accurately represented in results (Hays & Singh, 2011). Through activities such as ensuring methodological coherence, verification strategies ensure the validity and reliability of data during the inquiry itself, sufficient sampling, the development of dynamic relationships between sampling, data collection, and analysis, and the development of theories.

It is all aspects of verification strategies that contribute incrementally and interactively to and build reliability and validity, including methodological coherence, sample relevance, collecting and analysing data simultaneously, thinking theoretically, and developing theory. To ensure rigor, the following steps were followed to ensure that qualitative inquiry is rigorous, beyond challenge, and provides pragmatic scientific evidence that can be incorporated into a growing body of knowledge:

Step 1: Determining the Data Sample

- A section of the data was checked rather than the complete data set for the purpose of determining the amount of data to sample and the acceptable level of error.

Step 2: Performing a Database Verification

- Prior to moving the data, it was ensured that all necessary data existed in the existing database. Comparing the fields of the source and destination data helped to determine the number of records with the specific names and dates.

Step 3: Confirming the Data Format

- It was determined what changes needed to be made to match the target schema based on the source data. Ensuring that data has been used and protected in a proper manner in order for it to be effectively utilized. Identifying and rectifying inaccurate or incomplete counts, duplicate data, incorrect formats, and empty field values.

A summary of the qualitative analysis is prepared, incorporating the results from the analysis. Table (19) shows the summary of the qualitative analysis. The graphical representation of the sequential procedures in Figure 18 shows the steps involved in establishing and compiling the methodology as well as qualitative materials to make a determination and compile findings.

3.13 Pilot Study

To conduct good qualitative research, it is important to go back and forth between the collection of data and the analysis of the results, revising and improving the methodology as necessary. A good example of this is the use of pilot interviews , where different aspects of a questionnaire are tested on a small number of participants, evaluated and revised based on their responses. This is particularly useful for the interview guide, but also for other aspects such as the location of the interview or whether the interview can be audio-recorded. (Hijmans & Kuyper, 2007). Consequently, a pilot study is used in this research to test the methodology to determine whether it is appropriate and effective. The pilot will allow the methodology (including the interview questions and techniques) to be adapted and improved based on the outcome. In many countries around the world, GBRSs are used to certify GBs. There is,

however, there is little evidence that stakeholders in Bahrain understand the theory and practical implementation of GBRS. The purpose of this pilot study is to identify the challenges faced in implementing a GBRS in Bahrain.

The pilot study is carried out before the finalization of the research design for the purpose of identifying the research question, validating the proposed study design, and testing its feasibility, and to examine the feasibility of the proposed approach and methodology that will be used in the main study. To explore the possibilities and challenges of implementing a GBRS in Bahrain, this research adopts a cross-disciplinary approach, with the primary objective of obtaining a deeper understanding of the views of all stakeholders concerned.

3.13.1 Pilot Study Overview

The primary objective of this study is to explore the potential and constraints of the deployment and operation of GBRS in Bahrain, particularly in the real estate and affordable housing sectors. Moreover, it is essential to collect information in the following areas in order to help achieve the purpose of the research:

- The level of engagement and influence of main stakeholders on GBRS regarding the potentials and constraints of GBRS in Bahrain.
- What areas or fields need to be investigated that influence the deployment of GBRS in Bahrain?
- What is the best approach to engage all stakeholders, regardless of discipline, backgrounds, or interests?

The hypothesis is that the public would like to see such programs implemented subject to certain conditions. Through the utilization of a

qualitative method approach, the study aims to identify these conditions to establish the public's perceptions. The data regarding public perceptions is then concluded and directed to decision-makers. The decision makers are then tasked with addressing these constraints or challenges. This will help to create a coherent vision of the main challenges to be addressed for the system to get closer to implementation.

3.13.2 Pilot Study Methodology

During the pilot study, a mixed-method approach was trialed, and questionnaires were utilized in addition to the semi-structured interviews. The questionnaires were used in order to collect data which could be quantitatively analyzed, whereas the semi-structured interviews would provide data which would be subject to a thorough qualitative analysis. The pilot study showed the shortcomings of the quantitative approach which ultimately led to the omission of the quantitative element.

The primary source of information is the respondent via Google Forms, and the participants were asked to log in and fill out the online survey application. Primary data is also obtained through qualitative investigation (semi-structured in-depth interviews) with field experts by applying the snowball sampling technique, allowing for discussion on new ideas. Using the snowballing technique is beneficial in identifying information-rich cases by identifying people who know others who also know where the information exists (J. Creswell, 2012).

This pilot study included three questionnaires, which were developed separately and designed to suit each identified stakeholders' group. The following steps were taken to ensure the quality of the questionnaire:

1. Feedback is requested from the participants to identify ambiguities and challenging questions.
2. The time taken to complete the questionnaire is automatically recorded in order to gauge whether the duration of the questionnaire is appropriate.
3. All questions found to be unnecessary, complicated, or ambiguous are discarded.
4. Results are assessed to determine whether the questions provided produce an adequate range of responses.

3.13.3 Participants and Settings

The public survey participants are all Bahrainis who are interested in low-rise standalone affordable housing located in specific areas across Bahrain. Four projects have been selected from the MOH's list of approved developers. These projects have been selected from the MOH's list to ensure that they comply with the description of affordable housing in gated communities, which share common service areas, and have been classified and defined under the approved regulations of the MOH (Ministry of Housing | Bahrain, 2021). The selected projects are:

1. Budaiya Area - Al Faridha Project located in Al Markh area. Al Faridha project consists of 18 villas, each comprising a ground floor and an additional floor, with each villa offering three bedrooms. The villas have an average land area of 160 SQM and a built-up area of 200 SQM.
2. Saar Area - Reem 3 Project located in Maqabah. The Reem 3 project consists of 26 villas, each comprising a ground floor and an additional floor, with each villa offering three bedrooms. The villas have an average land area of 200 SQM and a built-up area of 220 SQM.

3. Hamla Area - Janayin Al Hamala Project located in Hamala. The project consists of 190 villas, each comprising a ground floor and an additional floor. Each villa offers three bedrooms with an average land area of 180 SQM and a built-up area of 200 SQM.
4. Dyar Al Muharreq - Deerat Al Oyoun: The project consists of 3000 villas, each comprising a ground floor and an additional floor, and each villa offering three bedrooms. With an average land area of 160 SQM and a built-up area of 200 SQM.

The study setting is the participant's home or workplace, as the interviews and questionnaires are completed online. The questionnaires are delivered through Google Forms and the semi-structured interviews are carried out through Google Meet. Both applications are used in their standard form on desktop.

3.13.4 Pilot Study Conducting Stages

Initial contact is made with a representative of each targeted sample project via telephone followed by an introduction email to request permission to distribute the questionnaire and to provide more detailed information about the project, its goals, and the desired outcomes. Those representatives and directors are then provided with a copy of the first draft of the questionnaire to give them the opportunity to provide input, align the questions to their clients' demographics and characteristics of their projects, and to verify the transparency or relevance of the survey as it appears to test participants.

Following the process of reviewing and face validating the questionnaire, representatives and experts from the chosen projects provided the following feedback:

- Provide a brief introduction of GB and sustainability in Bahrain to add context to the survey.
- Substitute technical terms with simple terms where possible.
- Simplify complicated questions by removing complex references and citations from them.
- Minimize the total number of questions by consolidating similar questions where appropriate.
- Replace open-ended questions with multiple choice questions.
- Translate the entire text into Arabic.

Once the face validation and feedback process were completed, the questionnaire was edited, translated, and proofread to be distributed via a convenient sampling approach.

As a result of the distribution of the questionnaire to the sample projects' representatives, it was agreed that the distribution would be carried out by the representatives in order to meet regulatory requirements. Therefore, each representative of the targeted sample projects was asked to send the questionnaire to their client databases via email.

3.13.5 Pilot Survey Questions Rationale

Google Forms is a free service that is easy-to-use, flexible, and suitable for sending out questionnaires and surveys, and receiving results in a timely, structured manner (Douell, 2020). Using the snowball method, the survey is made available online, accessible via Google Forms, because it is simple to use, universally accessible, and allows data to be easily saved directly to a spreadsheet. The survey link is sent to each group as follows:

- Prospective homebuyers: the Google Forms link is sent to the representatives of participating companies to be forwarded to all their contact lists of prospective homebuyers.
- Housing application holders: the Google Forms link is sent to the participating MOH representatives to be forwarded to all their contact lists of Eskan application holders.

In the survey, participants are asked questions about their opinions, areas of support and concern, and familiarity and interest in issues, programs, and policies related to GBs. As part of the survey, participants are asked about their age, education, wages, marital status, and household information. The objective is to gain a deeper understanding of the views and level of engagement and influence of the sampled population on GBRS, while addressing the potentials and constraints of GBRS in Bahrain.

3.13.6 Findings of the Pilot Survey

The questionnaire was scheduled to be sent to the sample project representatives on January 3rd, 2022, so that they could forward the questionnaire to their list of homebuyers. As shown in Table (20), the pilot survey results indicate that after several reminders and follow-ups, only 34 responses had been received in the 40 days following distribution, which represents a low response rate considering the number of potential homebuyers enrolled in the housing program. While several attempts were made to reach the required sample size through several different means, it was found that there were difficulties in obtaining homeowner information and an absence of cooperation from the entities that had access to the information of the potential homebuyers. The number responses received is below the minimum number required. Responses from 30% of the total sample size is

required for the findings to carry any significance. In this case, at least 115 responses were required as the sample size is 383.

Through the distribution of a pilot survey to the convenient sample and validators, it was determined that fewer responses were received because the questions were unclear or difficult to understand. It was recommended by the survey respondents that the questions be narrowed and a brief introduction to the concept be provided along with translation of the full survey to Arabic.

In spite of all these changes and direct communication with the directors in charge and submitting all ethical clearances and affidavits, no significant response was received. This lack of response was due to regulatory restrictions that prevented the distribution of the survey directly to the contact lists and homebuyers' databases in both the affordable housing projects of the estate companies and in the MOH.

3.13.7 Pilot Interview Questions Rationale

Using convenience sampling, a pilot of the semi-structured interview questions is addressed to developers with the aim to understand their perspectives on the challenges and constraints of implementing GBRS in Bahrain. The participants were chosen based on their positions in the official government agencies and the authorities in the institutions where they work. These interviews involved semi-structured questions addressed to the decision makers in order to understand the underlying motivations, beliefs, attitudes and perceptions of general directions. Given the respondent’s positions within their respective organizations, it was thought that their feedback would be a valuable tool improving the questions for the main study.

3.13.8 Findings of the Pilot Interview

The study's in-depth questions have several limitations. Firstly, it is apparent from the results of the interviews that the response was relatively small, due in part to a lack of local experts in GB with extensive experience related to sustainability design.

There were a number of problems with the interview arrangement, including instances where representatives were delegated to take the interview, resulting in suboptimal responses. This was due to the delegated interviewee's lack of knowledge and familiarity with the general idea of the research. This lack of experience and limited authority to disclose information hindered our ability to extract relevant data, so a rescheduled interview was requested.

3.13.9 Revision of the Interview Questions

Based on the pilot study, two additional questions were added to the semi-structured interview in order to better understand the professional's perspectives on the public awareness of GBRS. Although most of the survey questions to homebuyers were general and were aimed at extracting the general knowledge influence and perception of the public about GBRS, the semi-structured interview questions aim to delve deeper into the issue and examine it from the decision makers' perspective. The following two questions were merged with the semi-structured interview.

1. What are the best ways to raise awareness and participation about the positive effects of GBs and sustainable ways of living in the Kingdom of Bahrain?

2. Although many people understand the importance of protecting the environment in theory, few are taking action to make a difference. Can you explain the actions you have taken to increase or contribute to environmental awareness and sustainable living?

3.13.10 Concluding the Qualitative Stage and Completing the Interviews

As opposed to a probability sampling, which is used in quantitative research, the qualitative method is a method in which one chooses a limited number of 'information-rich' cases. Recently, several studies have demonstrated that purposive sampling is a more efficient method than random sampling in qualitative research, thereby supporting the related assertions qualitative researchers continue to make (van Rijnsoever, 2017). In the quantitative research community, a set of statistically based rules for setting sample sizes is fairly straightforward, In qualitative research, however, sample size determination and assessment are complex due to methodological, theoretical, epistemological, and ideological pluralism (Gergen, Josselson, & Freeman, 2015).

This distinction does not permit the use of invariably applied, clear-cut guidelines. Although these challenges have arisen, several conceptual developments have sought to address this issue, and provide guidance and principles and, more recently, an evidence-based approach to sample size determination seeks to ground the discussion empirically (Mason, 2010).

Most qualitative researchers believe there is no straightforward answer to the question of 'how many' is sufficient and that sample size depends on a variety of epistemological, methodological, and practical factors (Baker &

Edwards, 2012). However, Sandelowski (1995) recommends that the sample sizes of qualitative studies be large enough to allow the unraveling of a 'new and rich interpretation' of the phenomenon being studied, but also small enough not to preclude the investigation of this phenomenon in a deeper, case-oriented way. According to (J M Morse, 2000), a smaller number of participants allows more of the collected information to be used in the study. Morse urges researchers to consider parameters, such as the scope of the research, the nature of the topic (such as complexity and accessibility), the quality of data, as well as the study design, when conducting research.

An important factor in qualitative interviewing is the level of structure of questions, since it impacts the richness of data. Empirical research reveals that open questions, which are asked later on in the interview, tend to produce richer data as compared to closed questions (Ogden & Cornwell, 2010). In addition to these recommendations, specific numerical recommendations have also been made, often based on the experience of specialists in qualitative research.

According to Quick and Hall (2015) the experience of most qualitative researchers who conduct an interview-based study with a specific research question is that little new information is generated after interviewing around 20 or so participants belonging to a single analytically relevant participant 'category'. This suggests that studies that employ individual interviews should conduct a modest number of interviews, so that researchers can provide their full attention to the analytical task without becoming overwhelmed by too many interviews.

Field experts have also provided numerical guidelines tailored to various theoretical and methodological traditions as well as specific research

approaches, such as grounded theory and phenomenology. An attempt has been made recently to develop a quantitative tool that can be used to estimate a predetermined sample size based on estimates of the prevalence of themes within the population. In spite of this, it must be noted that this formulaic approach raised criticisms regarding assumptions about the conceptual and ontological status of 'themes', as well as the linearity attributed to sampling, data collection, and data analysis processes (Kathy Charmaz, 2006).

Yvonna S. Lincoln, (1985) proposed that the size of the sample be determined in accordance with the informational redundant criterion which means that sampling may be terminated when no new information is gleaned by sampling more units. The concept of information power was introduced as a pragmatic guiding principle based on the logic of informational comprehensiveness. This suggested that the greater the information power the sample provides, the smaller the sample size needs to be.

Originally, the concept of saturation emerged in grounded theory, a qualitative methodological approach explicitly concerned with empirically derived theory development. It is therefore inextricably linked with theoretical sampling procedures. An iterative process of collecting, analyzing, and developing a theory involves collecting data, analyzing the data, and then developing a theory because of the emerging theory rather than predefined characteristics of a population. Ground theory saturation (often called theoretical saturation) relates to the theoretical categories, rather than data, that are being revealed and occurs when "gathering fresh data no longer reveals new insights into your core theoretical categories nor reveals new properties of your core theoretical categories" (JL Walker & Martin, 2012).

It is important to understand that saturation in grounded theory does not imply the more common focus on data repetition but does move beyond the common focus of sample size as the sole basis for evaluating sampling efficiency. Note that the sample size in grounded theory cannot be determined a priori since it is contingent on the evolving theoretical categories. In addition to its origins in grounded theory, the term saturation has spread to several qualitative fields under the terms "data saturation" and "thematic saturation". In parallel with the expansion of its meaning and being variously equated with "no new data", "no new themes", and "no new codes", saturation has emerged as an indicator of quality in qualitative study (Guest et al., 2006).

It is clear from the results of the most recent studies that studies previously published contended that there are no clear assessments of sample size sufficiency or that these assessments are inadequate since conceptual or methodological progress has contradicted those assessments. Although, for determining sample size and assessing the sufficiency of a sample, the saturation principle is undoubtedly the most widely used principle (Malterud, Siersma, & Guassora, 2016).

Therefore, the interviews and coding concluded when there was a sense of saturation with the information. This was reached at interview number 14 when it was felt that the research question had been rigorously answered, systematically explored, and data received were as comprehensive as possible. It has been found that the information that emerged after 14 interviews became increasingly repetitive, suggesting that the data collection process is complete.

3.13.11 Changes and Updates to the Main Study

As a result of the findings and limitations observed from the survey and interview phases of the pilot study, as well as the weak response rate, which was below the anticipated levels of participation, a change in methodology is required. It was decided that the research would omit the quantitative element and focus purely on the qualitative methodology.

3.13.12 Adopting a Different Methodology

It was observed during the pilot study that quantitative research methodology was not a feasible method when interacting with the public for various reasons. A main reason was the difficulty in encouraging participation from members of the public, thus the focus was placed on the qualitative semi-structured interviews with the professionals, as it was more feasible to obtain insights about the challenges facing the implementation of GBRS in Bahrain from them. Given that social-political conditions in Bahrain are not truly conducive to people pushing for green legislation and interventions, it was deemed more effective to include professionals and government sources, as they have far more influence regarding the implementation of a GBRS in Bahrain.

It was found in this study that homebuyers listed in the MOH's Affordable Housing Scheme as well as decision makers both from the private and public sectors are both major stakeholders in the influence and progression of the GBRS in Bahrain. After failing to receive a significant amount of cooperation from homebuyers, the research has been modified to incorporate the questions of homebuyers and to make minor adjustments to

the questions that are being posed to both decision makers and influencers from the public and private sectors.

To gain feedback from decision makers, there was a need to engage with them regarding the difficulty in gaining a clear understanding of homebuyers' perceptions caused by inadequate disclosures and restricted regulations. Consequently, the study focused on obtaining qualitative information through semi-structured interviews with decision makers as a way of obtaining qualitative feedback.

Chapter 4: Results and Discussion

The aim of this chapter is to present and describe the results of the study as well as to draw conclusions from them. Furthermore, discussing the implications and status of GBRS and defining the trends that surround the development of GBRS in Bahrain.

This chapter includes:

1. A comprehensive review of the results of the study. The results are presented by theme.
2. An informative, in-depth discussion on the results and findings of the study.

4.1 Results

As a result of the literature review in Chapter 2, it was concluded that sustainability and GBRS are becoming increasingly important to Bahrain (Section 2.4.2.5). It was demonstrated that sustainable development in the real estate sector is an acute need in a sector that is experiencing tremendous growth and change. In addition, there is a substantial body of evidence that GPRS will be extensively exploited in the future, and that taking this into consideration at present is imperative. There are existing measures in place from various ministries, as well as the Benayat GBM, that provide sustainability guidelines covering a range of green and sustainable standards for housing projects. The methods used to determine each of these recommendations are typically distinct and unique. As more and more developers, owners, consultants, designers and vendors are participating in the global GB movement, the pace of innovation is increasing rapidly. People and organizations are working together to switch to GBs.

This study seeks to explore the efforts and contributions made to deploy some kind of GBRS among all stakeholders in Bahrain, to recognize the relationship between the strategy and implementation of GBRS, and to highlight and suggest corrective actions and future needs in the real estate sector. The data were collected with the use of semi-structured, in-depth interviews. The data was first transcribed verbatim and then analyzed using NVivo. A rereading and coding of the interviews took place, and once the data coding was complete, the data was searched for similar codes to categorize them. Each theme was then examined following the categorization. Visual representations of the data were created using word clouds and maps.

As a result of the investigation and analysis of the interviews and data generated by the investigation, repeated ideas by multiple interviewees were grouped to represent a theme. Each participant represented a specific field of expertise and source of knowledge due to their private, government or NGO designation. The roles were cross-checked against the latest government guidelines and observed through re-emphasis and unanimity across various stakeholder groups to reflect credibility. Below are some examples of what has been observed. Full details of the results and representative statements can be found in Table (17), Table (18), Table (19) and Table (22) in section 5.2.1 of this thesis. Participants in this study are listed in Table (24) with their corresponding code names.

Theme 1: Functional GBRSs in Bahrain

Participants were asked whether they were aware of the existence of a GBRS in Bahrain. Almost all participants stated that Bahrain does not have a GBRS, although some participants indicated that Bahrain has some encompassing buildings environmental guidelines. Some participants were aware of a GBRS system being in use in other GCC countries, but couldn't say if there was an active GBRS in Bahrain. Others claimed that a GBRS has been developed in Bahrain by the authorities, but has not been implemented in the sector.

GBRSs exist in Bahrain

As stated, some participants were of the opinion that there is a GBRS in operation in Bahrain. As stated in one participant's response:

"I think there are some rating systems, maybe at the GCC levels. There are some initiatives that I am aware of. GBRS also involves the efficiency of the buildings and even the other equipment that goes into the air conditioning of the buildings. It's about the efficiency, the usage of and consumption of power. I am familiar with those."

GBRSs do not exist in Bahrain

Two participants stated that Bahrain has no rating system, as can be seen in the following quotations: "No. Unfortunately we don`t have it yet" and "No, no, I am not sure. I think an initiative has already been released by the Sustainable Energy Authority, in which no information is accessible. The short answer is no, we don't have regulated functions."

However, one participant stated that a rating system has been developed, but is not yet functional. They claimed:

"The role of the SEA was actually to develop the rating scheme for Bahrain, which has been done, and it is now at the stage where it needs to be presented to the authorities for them to review it and to accept it and then it'll follow a process to get implemented."

Another participant made a similar claim, "Now, we do not have a regulated GBRS. At the moment, it is under development and is something we are working on."

Theme 2: Awareness of GBRSs

The study revealed that the majority of respondents are aware of GRBS, but some participants have little knowledge of the concept (Figure 19).

There is a general definition of awareness in which one would describe it as the sum of what people, groups, organizations, communities, and nations know about a particular topic in their own way (Glaser, B. G., & Strauss, A. L., 1964). Hence, this structural concept can be applied to virtually any problem requiring awareness at any level of analysis.

Knowledge has been conventionally defined as beliefs that are true and are justified (Hunt, D. P., 2003). The following definitions of some basic concepts are based on the axioms listed by Spuzic et al (2008). Knowledge is a construct based on the interconnection of various intellectual components, of which the simplest is "information". Information also has a simpler form, which is referred to as 'data', and which is tentatively positioned at the boundary between knowledge strata as the term implies. As a way of identifying and defining knowledge and awareness, based on these general definitions, awareness will be defined as familiarity with the concept, whereas knowledge will be considered to be a deeper understanding of the concept as defined by the general definitions.

There have been few studies in Bahrain that examine the awareness, knowledge, attitude and practice of multiple stakeholders with regard to GB design and assessment. Moreover, different stakeholders may have different perspectives on the design and assessment of GBs. As a result, to understand dynamic interactions and promote coordination among stakeholders, it is essential to investigate their knowledge, attitudes, and practices about GB design and assessment. Work experience and knowledge is the leading source of GB knowledge for the stakeholders excluding for the architects. As cited by multiple stakeholders in Bahrain, architects learn more about GB through training courses, which is slightly higher than work experience or self-

learning via online resources such as articles, webinars or podcasts. This self-learning was perceived as the primary source of GB knowledge among the multiple stakeholders. A few of the participants gained their knowledge about GBs through their education and their involvement in academic research or tertiary education.

While stakeholders in the Bahraini real estate sector demonstrate good knowledge, positive attitudes, and strong motivations towards GB design and assessment, GB practices are still immature. Participating in GB projects was considered by stakeholder groups to be the most important source of GB knowledge, despite the weak practice and modest number of certified GBs in the country. There has been an empirically significant correlation between knowledge and practice that has been found to be positive and significant.

It was autodidacticism or self-learning from online resources that accounted for the second largest share of stakeholders' knowledge of the GB design and assessment. In spite of the fact that most of the participants have not received any formal education or training courses on GBs, they still claimed that they at least have a good understanding of GB requirements. Of all stakeholders, architects claimed to have better knowledge and understating of GB standards and assessment requirements as training courses were their main source of GB knowledge. Contractors and suppliers had the lowest understanding of GB standards and certification requirements. Due to this disparity in knowledge levels, there may be potential knowledge and practice gaps in the application of GB principles between architects and contractors/suppliers. This could be achieved by the introduction of tailored training courses.

Furthermore, a wide range of Bahraini stakeholders demonstrated a positive attitude towards GBs. Stakeholders' motivations for GBs tend to focus on "intangible motivations", such as reducing a building's environmental impact, regardless of the absence of tangible motivations like incentives, financial rewards and an improved quality of life. That shows a strong sense of environmental and social responsibility. However, developers seek GB certifications primarily to attract clients and improve their public profile. One of the major barriers to increasing the uptake of GBs in Bahrain, as reported by the stakeholders, was the lack of enforceability mechanisms and ambiguity of some government regulations.

According to 100 percent of stakeholders in Bahrain's built environment, the government could take the lead in ensuring the sustainable development of the built environment. The findings suggest that the promotion of GB in Bahrain is more dependent on external factors such as real estate development costs and building codes than it is on the attitudes of the stakeholders.

In addition to the lack of technical skills, engineers and consultants believe that clients' demands are another major obstacle to implementing a GBRS in Bahrain, while architects believe lack of technical skills is an important factor.

There was no correlation found between participant experiences in GB design and assessment and his or her attitude and level of awareness towards sustainability, suggesting that even with a positive attitude toward sustainability, it is still difficult to adopt GB concepts and certifications in the real estate sector.

An aim of this research is to explore the knowledge, attitude, and practices of a wide range of stakeholders in relation to GB design and assessment, as well as to identify their motivations for GBs and barriers to the implementation of a GBRS in Bahrain. The results of this study provide a holistic picture of multiple stakeholders' perspectives on GB design and GBRS in Bahrain.

Additionally, the results of the research revealed knowledge gaps and behavioral patterns among various stakeholders that can be improved to enhance collaboration and engagement, as well as to assist policymakers in planning and implementing system interventions. Overall, the results of this study indicate that multiple stakeholders in Bahrain have adequate knowledge and a positive attitude towards GBRS, but an immature level of practice regarding the design and assessment of GBs. GBs in Bahrain are primarily motivated by the desire to reduce environmental impacts and to improve the quality of life for residents. However, the cost associated with the design process, the assessment process, and the lack of a clear governmental mechanism prevent the stakeholders from implementing a GBRS in Bahrain.

Based on the overall theme and directions, it was evident that stakeholders' knowledge of the GB is a significant factor that influences their attitudes. While there is no significant correlation between attitude and practice, suggesting there is an attitude-practice gap. Furthermore, the results suggest that there is a noteworthy difference in GB practices between the stakeholder groups, particularly between engineers and contractors. The study findings have important implications for future practices in the GB industry and for academic research.

Several recommendations are made for promoting GB design and assessment in Bahrain;

1. Ensure GB certifications are mandated and provide financial incentives for them.
2. Implement tailored training programs for each stakeholder group to enhance their GB expertise.
3. Establish effective collaborations between the GB industry and academic research institutions.
4. Develop GB courses in tertiary education. According to the study, further tertiary education is vital in order to achieve the level of specialization based on each specialty field in a higher tertiary education program.

Aware of the concept

One participant who reported that they are aware of the concept stated: “I am familiar with the GBRS. It is basically a system that rates the contribution of the buildings and their effects on the environment and climate change." Another claimed “I am familiar with the concept and we in Green Innova built the GB System for EWA, which took about a year. We helped with the development, so yes, I am familiar with it.”

Little awareness

Some participants stated that they have little awareness regarding the topic. For example, one respondent stated that he was aware of the GBRS concept, but ”Not the detail. But what I understand is that it's about how the energy saving conservation can be achieved by using the right kind of design materials. So very limited knowledge.". Another participant stated “I have a

few minor details. Although I am not an academic like you, I understand that there is a global ranking for buildings and I have visited one of those buildings in Sharjah that was ranked number 15 in the world."

Theme 3: Sustainable Methods Implemented

This theme highlighted the sustainable methods that the participants have utilized regarding green housing. The axial codes of the theme are shown in Figure 20.

Developers are working on affordable housing

The data showed that developers are working on sustainable and affordable housing schemes and that prospective clients have started approaching them. There has been a general interest from prospective clients reported in GBs, but this doesn't necessarily point to a trend or confirm a market direction. Rather, this indicates a certain type of positive interest on the part of prospective clients which correlates with a broader understanding of sustainability and environmental influences. However, this requires further study and deeper investigation, as stakeholders from the developer groups have also reported that some prospective clients consider GBRS in homes to be a luxurious trend rather than a necessity.

As ERGI stated:

"Three years ago, there was little awareness of GBRS, so we went to consultants. We went to building ministries and so on, but now we are known in the market. Now, people are approaching us and we are being proactive because there has been a lot of work coming our way."

Garbage Collection Committee

It was noted that a number of developers expressed concerns and stressed the importance of implementing a garbage collection system that is in accordance with GB principles in affordable housing projects. As waste reduction, separation, and recycling have significant impacts on the community, economy, and environment, it is becoming increasingly important.

MQD1 stated that a Garbage Collection Committee is in place.

> "So, the garbage collection company. They come every two weeks, three or four times, for collection. We tell them "we will send you an SMS, you don't need to come." They say "Yeah, no problem. I'm passing anyway." So, it's a problem However, we're still trying our best. We faced a lot of difficulties with that. It was not an easy journey and we are still facing difficulties with it. We are still investing more in them just to be sure the system works."

GB Code

Participants from the governmental sector indicated that the implementation of the GB Code is also a priority. In the governmental sector, sustainable principles and green building codes continue to be developed and progressed through their buildings. Initiatives and development projects aiming to expand the external implantations of building design and construction standards.

> "We have many buildings, and we have a list of buildings they have already begun bringing up to code. It involves implementing the GB Code

with ratings. They have a schedule of what they have implemented and what they haven't, and they even rate their own buildings, because the Ministry of Works has implemented the GB Code on government buildings before the private sector and other buildings."

"We are working on a GB Code, which is already in progress. For example, we use it to respond to proposed technical drawings and concepts. In most of our design, we take into account the GB Code's criteria based on the type of project. So we take some sustainability measures"

"GB Codes are both mandatory and voluntary. "Hey guys, this is your license, but we have a few more cherries here to pick and then the rating scheme to consider, which will now give you competition in the market" Who is going to build a better building, right? Who is going to nudge the market towards doing things better?"

Healthy lifestyles

A number of stakeholders emphasized the positive impact that GB Green buildings have on human health directly at an individual level by providing an optimal indoor environment, as well as indirectly on a population level by reducing energy use, reducing air pollution.

AAD1 argued that they promote healthy lifestyle and stated, "We are always making better systems for installations. Investing more in healthier lifestyles by adding facilities for things like cycling, jogging and tracks. Two days ago, we introduced electric bikes."

Recycling grey water

Recycling grey water is another initiative reported by the participants. HAEG stated:

> "It is this policy that we follow in terms of water consumption and recycling grey water in some cases. If it's feasible, it could be the use of solar panel inserts for water heaters, since you need a large roof to generate electricity."

Improving the performance of a building

Furthermore, the participants unveiled that they strive to improve the performance of a building.

> "Some of them are mandatory, some of them are not as I know, but it is there and there are some calculations which SEA can tell you about it. They have their own calculations regarding those points, as I told you, and they are designing the buildings according to that."

Solar system

Installing solar systems is another beneficial contribution. As stated by FSOI:

> "All the lighting there is based on a solar system. More than 100 street lights. It is all from a solar system. All our CCTV cameras on the site are solar, which helps us a lot when relocating them, given that we do not need to do the connections. It is just Wi-Fi and solar and that is it. That's the main thing that's coming in my mind."

Another participant HAEG stated that "Solar energy is not generated through solar cells, but rather by using the sun's heat. If you generate

electricity from a solar system, you need a battery backup. Solar cells can power the water heater.". It was asserted by another that "They're installing a solar energy system that is 7.8 kilowatts, which is about 20 families or 24 solar panels. I'd say I have 16.4% coverage, but again, maybe they don't use as much AC."

Thermal insulations

Another respondent argued that they encourage the use of thermal insulations and stated, "We do thermal insulations and insulation finishing systems. Likewise, for all of our working projects, such as the airport, we help them to be LEED certified."

Using GB materials

Another participant stated that the use of GB materials is enhanced by them and MKR argued, "RERA's contribution to GBs and green real estate projects is a necessity that we need. Green methods, renewable energy, and energy conservation have been encouraged for all developers. Especially for real estate. Initiatives have been put in place to protect them. When we license a new development in Bahrain, we ensure there is a sustainable energy component, and if there is not, we encourage them to pursue such initiatives in their projects to save energy, whether it be electricity, or any aspect of saving energy, we urge them to do so."

Theme 4: Benefits of GBs

Despite the fact that there does not seem to be a consensus regarding what the specific advantages of green buildings are, a number of benefits were mentioned during the interviewing process. Many respondents to the question

of the benefits of GB stated that it saves money, supports developers, and reduces waste and heat transfer while others argued that it reduces waste and heat transfer. Below is a more detailed description of the mentioned benefits.

Economically feasible

TSMS stated that GB is economically feasible claimed , “I find it to be more economically viable for me.”

Lower maintenance costs

Another major benefit stated by a HAEG is the decrease in maintenance costs. As quoted:

> “One of the highest benefits of GBs are their lesser maintenance costs and that they feature specially-engineered design elements to lower energy consumption and support reduce energy costs and water bills for each resident. These efficient structures can save corporate and residential owners a bundle. For example, whenever an area of a structure becomes unoccupied, green technology automatically shuts off lights and adjusts HVAC, cooling, heating, and ventilation options. Building owners can realize as much as 30% savings in their energy expenses.”

Reduce heat transfer

Other participants stated that another benefit of GBs is that they reduce heat transfer, ERGI and HAEG argued, “We use only double-glazed aluminum. To reduce heat transfer, we use high-performance tinted glass. This balances things out. We are also trying to use recyclable material.”

RSEA likewise stated, “Even though I'm not aware of any, I've seen buildings that use the sun's rays to bring in light without heat. This will reduce the transmission of heat from outside to inside, and reduce air conditioning use.”

Reduce the waste

And MQD stated that GBs help to reduce waste.

“Additionally, we have added more as inputs for renewable energy so that we have a better guide as well when it comes to the building with better engineering. The waste could be reduced if we improved engineering. According to my own study, 92% of energy consumption goes to waste management. In some parts of the world, innovation is being tapped into to generate energy rather than consume it.”

Save time

FFBF argued that GBs help in saving time and stated, “Let's say I want to build 500 houses. I will do the math. Investing more in these houses will save me time.”

Support developers

It was also claimed that GBs support the developers. As stated by a FFBF, SKS and AAD, “it will help and support the developers if we have our own rating system.”

Waive some fees

Multiple benefits can be derived from GBs. However, a lack of knowledge or uncertainty about the benefits of this technology, coupled with

an unclear cost analysis associated with GBRS, may prevent a faster development of the technology. The government may need to provide incentives in order to encourage the use of green technologies. A number of incentives, such as tax breaks and subsidized loans, have been suggested by stakeholders, indicating that both incentives and a long-term commitment by the government to fund GB maintenance can make a significant difference. 90 per cent stated that it is effective in cutting the cost down:

> "Going for a higher rating will waive some of the fees, while a GB that is ready in a day will have the priority. So it's either initiatives from the government as fees or time, or any other special services that would be feasible."

> "In my opinion, the environment will be better, and you'll have a more affordable building." In general, I believe people are going to benefit from living in a GB over a conventional one over the long term."

Thermal insulation

The thermal insulation makes the building profitable. As stated by ERGI , "There is thermal insulation regulation, so it is fair. They also have the installations for the wall and the ceiling. They also have other criteria. The measures of reducing energy consumption are no longer the only factors making this building profitable now."

Net zero carbon or waste

Moreover, ERGI stated that they strive to adopt a zero carbon, zero waste strategy and said, "We have a clear quality innovation to help buildings reach net zero carbon or net zero energy. These are aspirations we are working on.

There must be some sort of building behind our green. A green policy or greenhouse policy published by the electric stand water authority or by the Sustainable Energy Authority."

Sustainable housing

In addition, another EKW and ERGI stated, "The mission is to develop affordable, sustainable housing through Eskan Bank, by making the world a more sustainable, green place."

Theme 5: Potential Challenges of Implementing a GBRS in Bahrain

Participants were asked about the challenges they might encounter when implementing a GBRS. This study identified the following challenges.

Absence of evaluation standards

MKR noted that the lack of evaluation standards is a barrier to GBRS implementation and related this to another initiative that adopted an international system and argued, "There is the IVS, an international valuation standard. We never had a valuation standard in Bahrain, so we adapted the international best practices. To give it our own touch, we called it BVS, Bahrain Value Standard, to have Bahrain's own theme and look to it."

Application of rating system

Another major barrier faced by the participants is the application of GBRSs, as shown in the following responses from the participants:

"Although we cannot actually design a ratings system yet, there is an implied point that knowledge needs to be ingrained into the project development process from the very beginning... Therefore, we recognize that there is an implication but right now we are working on it based on the information we have."

"It is important to incorporate knowledge from the very beginning, during the development of the project. The item I am currently looking for is the thermal insulation, which is a component of GB design, however that has taken some time to implement due to the implementation process."

Facilitate the implementation of the GBRS by the government or major stakeholders

OKK stated that to "Enable the government or enable the private sector to follow a GBRS" is another big issue. He further added, "There will always be challenges, but those challenges are manageable and I think that there should be more cooperation between the public and private sector."

According to the participants, the government can play a significant role in improving GB practices as well as shifting Bahrain's built environment in the direction of sustainability. There is still no mandatory requirement for GBRS in Bahrain compared to neighboring countries. According to research that has been conducted in Australia, mandating energy efficiency certifications has resulted in an improvement in the efficiency of building structures in terms of energy consumption and carbon emissions Kim, S., & Lim, B. T. H. (2018). Therefore, introducing regulations that mandate a GBRS, for both the public and private sectors, can be considered as one of the best ways to promote sustainability in the real estate industry. Furthermore, it

has been shown that there is a strong need to spread awareness and education about the GBC in the Benayat manual since it has been shown that little knowledge of the specifics of the GBC is present among the stakeholders. Financial incentives are also an effective method to encourage building owners and developers to pursue GB certifications. By taking such actions, poor practices can be improved and the gap between attitude and practice can be bridged, thereby motivating the various stakeholders to align their practices with their positive attitudes toward GBs.

It was evident from the results that there is also a lack of collaboration between academic institutes and the GB industry in Bahrain, as reflected by the results of the study. In order to enhance engagement between academic research and the GB industry in Bahrain, the study recommends the development of effective engagement strategies. It is important for academic institutions to develop links between their research and the needs and practices of the GB industry in order to suggest realistic solutions that will address current obstacles and improve sustainability in the built environment.

Encouraging developers

Encouraging the developers to adopt a GBRS is another major barrier reported by the participants. SGHE said, “Encourage developers to develop further in Bahrain and protect end users at the same time. There are many challenges that we faced when we came into play in 2017. We had ad hoc projects. We had a number of projects without a straightforward agreement between the developer and users.”

Establishing rhythmic system by the government

SKS stated, “Most challenging is establishing this rhythmic system by the government.”

High cost

Almost all of the participants stated the cost is the biggest barrier in implementation and stated, “The challenges, I think number one will be the cost. To review and to submit this will incur an extra cost and the cost will be reflected on the end user as well.” Some other statements show a similar sentiment:

> “The developer's power lies in finance; we need better, stronger consultants. Finance dictates design, after all.”

> “In the construction and development stages, it will cost a lot, but it will pay off in the end. It's hard to maintain, but the Eskan bank is still trying to do so even though it will be more expensive than the standard product.”

> “Look at the biggest challenge right now: it is financial. People look at the upfront cost and it turns them away because if you're installing it on your house, it can vary depending on the size of the house and can cost as much as buying a new car.”

> “Depending on the nature of the design or the type of materials used, the cost may change. This may result in a higher price.”

Lack of awareness

Lack of education and awareness around GBRS is another major barrier. As stated by TSMS, One of “The biggest challenges is an awareness of the owners. If only they understood what is being done here and how would it

affect their social side and their lives. There is only one aspect that people are focusing on at the moment: whether it is financially feasible or not. Most people don't realize how this will contribute to the society as a whole. This is the main challenge."

"I think one of the challenges, of course, will be the awareness and education and we need to do more about awareness and education because there will be some challenge with people resisting change."

Monitoring

NMW stated monitoring the implementation is also an issue and stated, "The regulation must be monitored and the correct implementation must be ensured. But that doesn't mean there can't be minimum requirements. That may result in higher costs. The end goal is to have GBRS in place,"

Rigidity

In addition, people have a traditional nature of not accepting change that can pose a problem. NNJ stated, "The culture and the mindset has to change. The mindset, whether at the regulator level or at the private sector level, has to change."

Skill gap

Another hurdle in the implementation of rating system is skill gap. As ERGI highlighted, "So we have a skills gap here, a huge skills gap in terms of energy efficient buildings professionals."

Subsidizing

NMW stated, “If you want people to go and do something else of their norm or for the greater good, try to subsidize them.”

Technical issues

Moreover, ASEA stated technical issues may become a huge hurdle and argued, “It's mostly technical issues. First, we would like to do a pilot project on it then we would like to study how we can develop those procedures with SEA.”

Transparency

GB's planning, designing, building, and operating processes are complex and frequently unfamiliar to some stakeholders, whose association is crucial to implementing sustainable resolutions.

transparency facilitates complicated, unfamiliar processes by making their standing, goals, and rules transparent to all stakeholders.

Transparency is of vital importance as OKK stated, “We might have some challenges with transparency and the availability of information and the transparency of what system. Some specs may not be very transparent or some buildings may not be disclosed.”

Theme 6: Suggestions Made by Stakeholders

Lastly, the participants gave some recommendations to make the GBRS more effective. These are elaborated on with their representative statements in Table (18).

Best way to involve private sector is by deterring non-compliance

Employing GBRS in the private sector is significant too. TSMS stated that deterring non-compliance is the best way to make them adopt it and argued, “Put the regulation in place, whatever they say. It's mostly public PR, so this has worked to some extent, but if there is a way to push the private sectors toward this, there should be regulation.

Create awareness

The participants also consider raising awareness of GBRS to be important. EKW recommended, “Creating more awareness, increasing the use of green products, and ensuring that more rules and regulations are put in place by all the government entities so that green products are more economical and consume less energy.”

FFBF likewise stated,

> “We need to educate the public and we need to educate ourselves as individuals and as developers. I will give a small example of how people don't think about electricity consumption when they go to an appliance store to buy a fridge. People rarely ask, "What is the electricity consumption of the fridge?" It will take until the government mandates that air conditioners be energy-saving.”

> “The awareness-raising methods such as: workshops, training, conferences and lectures.”

> “In order to protect the environment, I believe we must first help and influence the culture and educate people about the importance of protecting the environment. It is clear that we still have a lot of work to do, and it can

begin even within the education system. This should be integrated into the educational system."

Encouragement

Participants recommended encouraging stakeholders that implementing GBRS may also work effectively in creating awareness regarding the implementation. As a TSMS stated, "So we need to push, we need to nudge, we need to encourage. We need to change the thinking of the market so that they start building correctly."

Other participants likewise argued,

"In other words, if a system is being set up in Bahrain and is clear to be implemented, for people to acquire the level you want to achieve, they will have to be encouraged to do this because they see the benefits it will bring. Dark green development means you are thinking in terms of thermal installation and so on, and that will attract people. In which the darker the green the higher the applications and effect"

"First, they need to ensure that the system is adaptable to the country's standards. Then, they would create an initiative to encourage people to use it and then set a time frame for it so that everyone adopts it, or at least anyone adopting such initiatives should be encouraged and perhaps compensated."

Enforcing the system

Some participants advised to enforce the system. As quoted,

"If it is not regulated, it is not measured and it doesn't work. Having a strict and stringent health and safety measure access is important. All of this really needs to be established so that there is no ambiguity about it."

"Some motivating and encouraging and more enforcing and fines would be most appropriate to expedite the development of our sustainability and the community experience, having the enforcement punishment. Otherwise, people are very ignorant about the changes, which are taking place around them. Unless there is some enforcement. Otherwise, people tend to ignore."

"Regulations and some scenarios. Enforcing it and making it a condition before approval, in addition to regulating it. When a developer seeks permission to build something, compliance will be a requirement."

Having an advisor

SKS stated that having an advisor may be helpful. "A company like this should offer advice on sustainability. Many criteria will be agreed upon, but they will advise how to meet them. Afterwards, they will tell you how to achieve a full grade on this environmental aspect."

Implementation of cost-effective systems

It is also useful to implement cost-effective systems according to two participants. NMW and ERGI stated,

"It's like buying a generator somewhere and then using it at home. Your generator is your electricity. We install our products, and if anything goes wrong, we fix it. However, the energy is already coming from your roof into

your property, and any extra you have is sold back to the EWA grid. Beyond that, we have no involvement. Your electricity belongs to you. We're out of there once the installation is done."

"It's a matter of getting it designed and approved which is internal and then getting it to the market in a way that the market understands it's just a matter of correct introduction. Capacity. Building within the market to understand, and to implement the GB Code and the GBRS."

Offering incentives

According to AAD, offering rewards and incentives is really effective. "If an incentive is offered, or if you buy the accessory saver, you will benefit from it. For other things, like the cars, if yours are electric cars you will have a special lane on the King Causeway.

TSMS likewise stated, "The quickest way is basically to reach into people's pockets. This can be done by providing incentives. For instance, in credits. It is the fastest way to ensure that it takes less time to implement it. There should be more awareness; they need to create more seminars or have more events. Speaking to this government, they need to take the lead with their own project as well, so others will follow."

Presence of building permit Benayat system

RSEA stated presence of building permit may also work well and stated, "It is up to the government, but it would most likely be better if there were a building permit Benayat system in place for dealing with these issues and

verifying and approving the GB Code in accordance with the system, as well as the criteria selected. In addition to this, it is suggested that a subcontractor be employed during the process with the consultant to advise him on how to proceed. This will generate one new profession to be established."

Raising stakeholders' awareness of sustainability

Raising stakeholders' awareness of sustainability is highly significant as SGHE stated, "There needs to be more workshops on how to implement GBRS. What are the mandatory points? What is the rating? How will the GB Code be implemented? How do you gain from implementing the GB Code? Let's say, decreasing the financial expenses of the building itself."

Solving problems one by one

FSO advised to "Just break the problem into smaller issues and tackle them one by one, but you have to have a plan. You have a budget. You have to have a backup. Yeah. Something like that."

Taking civil defense

Another way is to take civil defense directory. As stated by HAEG, "Taking civil defense as an example, it is the most important service because without the regulations, you may lose your building. There are high risks in building without any civil defense regulations, but there is also an awareness of civil defense."

Tax relaxations

According to FFBF, tax relaxation is also effective. As argued, “It is also important and prestigious. Perhaps tax relaxation and other items could encourage it.”

4.2 Findings and Discussion

This section provides an informative discussion of what the analysis revealed and how it was interpreted to provide an informative analysis of the findings.

4.2.1 Drivers Associated with GBRS

There are many drivers associated with GBRS that influence the growing trend of GB. These drivers and risks are significant factors when considering how to close the gaps between strategy and implementation of GBRS in Bahrain. This section discusses and lists the main drivers behind GBRS in Bahrain as outlined by the stakeholders.

The current market trends show that there has been an increase in the number of GB measures being implemented in Bahrain. The pace at which new GBs are being developed has been rapidly increasing, and the implementation of new government policies will promote or mandate energy efficient IEQ, water efficiency materials, and sustainable site management and planning. The government is interested in reducing environmental impact and at the same time fulfilling the needs for development. This is due to the impact of global pressure, which drives the government to put high focus towards sustainability.

Through the analysis of the interviews with stakeholders, it was evident that the government should consider providing incentives to promote sustainable development. Suggestions included tax credit schemes and regulatory mechanisms, as well as supporting the implementation of other economic instruments (e.g., favorable banking and insurance products, low interest rates, and low insurance rates) that support sustainable development in property and construction or offering lower tax rates on sustainable properties to encourage energy efficiency.

There should be a focus on convincing stakeholders that GBs will generate higher profits and tend to be more cost-effective to operate. Developers, owner occupants, and tenants are normally recognized as the three most important parties involved in the implementation of a GB.

Developers who participate in the implementation of GB for commercial and residential buildings are motivated by the profit they can make from selling properties with eco-labeling. Therefore, they seek a good return on their investment, either in the short term or in the long term.

The owner-occupier and the tenant are interested in the low operating cost of the GB as well as expanding their business. Based on studies by McGraw-Hill Construction (2006) and GVA Grimley (2007), occupants are willing to pay for the extra cost associated with GBs through a higher rent under certain circumstances. These studies showed that tenants will pay a premium for a green home if they offer four particular benefits, which have been identified as reduced operating costs, increased productivity, improved image for owners and occupants, and reduced risks of operating the building.

In general, stakeholders consider cost benefit and cost implications when making decisions. As long as they believe they will benefit from their investment, they will act in a socially responsible manner, in line with government aspirations. This can be achieved by presenting the results from multiple studies that have been conducted on the efficacy of GBs, to raise awareness of their positive qualities.

The presentation of the findings from multiple studies on GB effectiveness will raise awareness and encourage adoption. According to research and publications, awareness of the benefits of GB has grown over the past decade. It was suggested throughout, that these drivers, along with many other factors, will contribute significantly to a faster adoption of GBs in Bahrain. Nevertheless, there are also risks associated with the development of GB that need to be mitigated in order to accelerate its growth.

4.2.2 Risks Associated with GBRS

In order to fully understand the importance of a GB, it is essential to explain the types of risks associated with its design, construction management, operation, and maintenance. These risks have received less attention than those associated with conventional buildings. A potential reason for this could be that GB is a relatively new concept and still in the early stages of development. The growth of GB will be accelerated if the associated risks are understood and can be effectively managed and mitigated against.

The lack of consistency correlated with inexperienced crew members, establishing benchmarks for implementation costs, post-implementation performance, and government encouragements are all significant risks that need to be considered when deciding whether to execute a GB project. Such

risks can make GB seem less attractive and could potentially affect the implementation or adoption of a GBRS in Bahrain.

The following categories of risks related to GBs have been identified, and the next section will further explain the types of risks associated with GB design, construction, operation, and maintenance.

4.2.2.1 Financial Risks

In a study by Colliver (2007), a project's financial risk at the design stage was described as a soft cost associated with designing, permitting, and certifying the proposal, as well as delays. Implementing GBs may be difficult due to these expensive soft costs (Cupido et al., 2010). The cost is also cited as a risk to the growth of GB in a report by Marsh (2009). It is in line with the findings of a report by Hanatani (2009), that GBRS is prohibitively expensive. Consequently, the growth of GB may be hindered. The author believes that a reduction in certification fees could have the potential to accelerate the growth of GBRS.

There is also an element of potential financial risk stemming from a lack of knowledge and experience surrounding GB. This lack of knowledge could lead to misperceptions that ultimately cause the stakeholder to opt for conventional construction methods. According to a study by (Richardson & Lynes, 2007), the perception of the high initial capital cost and the considerable time it takes to gain back the initial investment are barriers to the growth of GB. According to another study (Cupido et al., 2010), GBs tend to be perceived as more expensive than conventional construction projects. These perceptions impact people's decision-making process and result in them resorting to conventional construction methods. Contrary to what has been

found in research (Bordass, Cohen, Standeven, & Leaman, 2002), GBs do not necessarily result in higher initial capital costs for construction. In their studies, both Abidin (2009) and Lin, Yang, & Skitmore (2003) identified this perception as the first cost mentality, which means that there is a fear of investing in high costs with an uncertain return on investment.

Accordingly, the financial risks associated with GB can be summed up as follows:

- Since it is commonly believed that "green costs much more," There is a possibility of lending amounts that are disproportionate to needs, resulting in debt that is unnecessary.
- For ROI to become more predictable, it needs a historical perspective to increase investor confidence.
- A team with little experience may be unprepared to implement green technology properly, which could impede its efficacy.
- Life cycle cost is not usually tracked in company budgets, making it difficult to measure long-term performance.
- There may be litigation costs if certification cannot be reached between the architect/engineer and the owner.
- Failure to meet certification requirements could result in loss of tax incentives.
- GB materials may create issues never before encountered, which could lead to litigation.
- Potential loss of financial gain should the building not perform as expected.
- Unexpected conditions associated with retrofitting an existing building.

These risks pertain to GB as a form of construction, but are relevant to the implementation of GBRS in Bahrain. Adoption of a GBRS may be less likely if GB is considered a high-risk investment.

4.2.2.2 Market Risks

Because of the lack of knowledge surrounding GBs, there are major risks in the real estate market. Additionally, the market does not have a consensus on leading green standards, and the lack of knowledge about GBs among financial institutions results in loans based on the status quo. Real estate agents also struggle to explain the benefits of GB and are more interested in easier sales with no learning curve. Moreover, the market misunderstands the energy efficiency of GBs, giving developers a reason to believe they might not achieve the expected results.

The availability of green materials in the market remains a problem during construction, according to a study conducted by Tredrea and Mehrtens (2008). Financiers and real estate firms have been slow to respond to the changes. Green materials are harder to source, which presents a challenge for contractors. Consequently, the consultants are faced with the challenge of auditing the contractor's work. Market related risks such as these hinder the implementation of GBs.

4.2.2.3 Regulatory Risks

A key finding was that Bahraini government subsidies have a huge impact on developments and real estate projects plans, making any change to them or to the tax incentives one of the risks associated with implementing a GBRS in Bahrain. Among the risks identified by Marsh (2009) is the shift in

government priorities, such as maintaining green regulations while eliminating tax incentives. Changes in governmental subsidies and tax incentives have a significant impact on various industries due to their interconnectivity, which creates ambiguity in the minds of regulators and developers regarding the implementation of GBs.

A study by Ashuri (2010) showed that tax and incentive programs are not standardized and may differ from state to state, and over time. The lack of uniformity and instability of tax and regulatory incentives can be viewed as a risk to the growth of GBs. Furthermore, the dates on the expiration of the incentives are uncertain, which would affect stakeholders' decision-making process in implementing GBs, to postpone or cancel the project.

Consequently, subsidies, tax and regulatory incentives have a large impact on the development of GBRS and are prone to change. Over time, these incentives will likely become more complex because of the interdependencies of various field sectors. As legislation changes, new risks will be introduced that are not yet known and, therefore, cannot be mitigated against.

4.2.2.4 Technology Risk

Using innovative and advanced technologies in new constructions and buildings poses its own set of risks (for example, LED lighting, HVAC equipment, solar installations), which can arise from unintended consequences that result from their use, or from fears about the consequences of their use, or from concerns about maintenance regimes that should be followed. As a result, these can be a barrier to implementing sustainable solutions. It should, however, be noted that a reluctance to implement new technologies that could change the demand-side behavior (e.g., wireless measurement of energy consumption at the appliance level) could result in

increased obsolescence and missed opportunities to reduce operational costs. It is important for real estate investors to realize that sustainability entails both risks and rewards. Understanding the full range of sustainability issues that may affect investments is crucial for investors to prepare for and mitigate unwanted outcomes.

4.2.2.5 Inexperienced Industry Risks

In the Bahraini real estate industry, knowledge of GB does not seem to be equally spread among the various project participants.

The risks associated with the industry are likely to diminish with time but are still significant today. A report by Marsh (2009) noted that the lack of consultants and contractors who were experienced with green projects can result in schedule delays. These issues revolve around the pace of change, the dynamic nature of standards, and the availability of information. Another study by Ashuri (2010) revealed that contractors may lack the skills needed to properly implement green technology. This could hinder the technology's effectiveness. Ashuri (2010) stated that unforeseen conditions of retrofitting existing buildings to become green are identified as a common risk during the construction stage.

Due to these reasons, it is imperative to hire experienced consultants and contractors when building GBs. Consultants and contractors take on these risks when they select inexperienced individuals. Choosing consultants and contractors with enough experience and a good track record is crucial when implementing GBs. Therefore, not engaging in GB practices may result in architects, engineers, and construction companies becoming obsolete.

There is a need for more green and sustainable education in Bahrain's real estate industry. Developers and investors do not have enough access to detailed local information to reassure them that GB is a practical option to pursue.

Constant improvement is necessary to keep pace with changes in standards because early incorporation of disciplines is essential for GBs. Education of stakeholders across interconnected involved entities is also essential as part of the process.

4.2.3 Discussion

This section contains an in-depth discussion on the main themes of this study. The discussion focuses in particular on the theme of affordable housing in the context of the research. It goes on to discuss green design generally as well as in the Bahraini context and finally explores the importance of stakeholder engagement in the GB sector.

4.2.3.1 Affordable Housing

GBs and sustainable building principles were described as desirable by 100% of affordable housing developers as a means of contributing to the quality of their end products as well as achieving their overall objectives from the perspective of sustainability and housing demand. However, these developers noted and believed that GBs could be more expensive upfront than traditional construction projects.

This research, however, argues that GBs are more energy-efficient and cost-effective than conventional buildings. In addition, they dispute the perception that GBs are prohibitively expensive to maintain over time. In spite of the fact that green construction is undoubtedly beneficial, the benefits are

most evident after the houses are occupied for many years by their owners. Consequently, the research identified areas requiring further investigation in order to support the argument that affordable green housing provides significant measurable benefits.

In this study, the findings indicate that developers and builders are unaware of the economic benefits associated with GB. The payback period and return on investment are especially important considerations. Affordable housing stakeholders stressed the importance of including areas where occupant financial capability is at the center of the equation. The results indicate that developers are considering several factors related to the occupants who will need to reduce their utility bills, increase their household budget for items such as food, healthcare, and transportation, and allow them to live in a more comfortable environment.

According to the findings of this study, GB programs and technologies have immense potential for affordable housing developments. Therefore, additional analysis is needed in order to provide a more comprehensive understanding of the economic impact. Moreover, it is estimated that affordable housing that has been certified by a GBRS will be less expensive in the long run as demonstrated in the study.

Compared to non-sustainable or conventional construction, GB is more cost effective in terms of development and construction costs, as well as soft construction costs. As a result of GBRSs, low-income communities are more likely to have a higher quality of construction and a higher performance housing stock when compared to conventional housing. Several empirical studies indicate that GBs provide a variety of benefits to affordable housing

stakeholders, which has led to the diffusion of GB policies and incentives across the Gulf region and surrounding countries.

Developers of affordable housing emphasize the following recommendations, which were unanimously agreed upon by interviewee builders and contractors. These recommendations can be applied to operationalize GB principles in affordable housing development policies, programs, and investments so as to expedite all stakeholders' involvement:

1. Maintain accountability throughout the construction process and beyond
2. Promoting environmental stewardship through education
3. Participation in the planning process should be encouraged
4. The focus should be on affordability and total value
5. Develop green building standards and rewards for developers

4.2.3.2 Green Design

As stated by Williams (2007), green design uses environmentally friendly materials to ensure a healthy and non-disruptive working environment before, during and after the production, construction, manufacturing and demolition processes take place. This idea needs to be emphasized because designs that have considered the concept of green sustainable development approach will be useless if the processes, such as making the material (building materials), developing it, utilizing it, and destroying it, do not consider the concept of green sustainability. GBRS encompasses the entire life cycle of a project from conception to demolition.

Furthermore, stakeholders have noted other aspects of relevance, such as establishing strategies to minimize environmental impact, maximizing energy

efficiency, and improving the comfort and health of occupants during the building's life cycle. From the design process to the maintenance process, it can reduce the impact on the environment to the greatest extent possible by making the design process a holistic thinking process.

Changing the design process may be one of the ways we can change a product objective. For example, starting from the beginning and working through the design process with various disciplines, so that the outcome is an optimization of the various options under consideration (McLennan, 2004).

In the current world of buildings, the design process is no longer linear. Traditionally, the design process would begin with the architect, then move to structural experts and then mechanical, electrical, and plumbing experts. Now, it is a highly interactive process between many disciplines from concept through to completion.

Alternatively, a change of perspective can be affected by viewing the environment as a subject rather than an object to ensure that its interests remain paramount, or by making the environment a 'friend' rather than an 'enemy' exploiting its potential and minimizing its threats. By optimizing the use of sunlight as a source of natural light and driving it over the heat, building heating can be reduced or even converted into electrical energy. In the same way, trying to use the wind for natural and passive air circulation and minimizing the amount of dust or heat that it brings, or reducing the pressure so that it remains comfortable.

Several studies have shown (Heerwagen, 2000; Heerwagen & JA Wise, 1998) that GBs play a crucial role in promoting awareness to the key players in sustainable development. According to one study (Yang & J Yang, 2009),

sustainable housing contributes to the level of awareness by providing mutual benefits. The study (Seewald, 2009) recommended that the appropriate authorities should use software to measure the benefits of GBs. This is also a contribution to raising awareness. A recent study by Thomas and Baird (2006) that examined the level of comfort of the occupants has helped to emphasize the benefits of GBs by promoting them as attractive places to live as well as being environmentally friendly.

A building can also be designed to minimize its impact on the environment by choosing the materials based on their availability in nature and the subsequent effect if the material is used up. It is important to restrict the use of materials that are difficult to obtain naturally. Furthermore, materials that may have adverse effects on the health of their inhabitants should not be used (Zainul Abidin, 2009).

Stakeholders in the construction industry consider the construction stage to be an integral part of the life cycle of a building since it directly impacts the investment. The focus is currently on reducing investment costs rather than focusing on environmental concerns. At this point, environmental considerations correlate with a high increase in investment costs (Fan, 2003). The increase in investment costs only ranged from 2% to 6%. This amount in comparison to the benefits gained by the property during the operation period like reduced energy use, reduced environmental impacts and improved comfort for its residents is not significant (Morris and Langdon, 2007).

As a rule, efforts are made to minimize environmental impacts during the construction process through the design of appropriate construction methods that have a lower impact on the existing ecosystems. These methods

may reduce contaminants such as dust and reduce CO2 emissions from the construction site (S. Bry Sarte, 2010).

In addition to planning construction methods, using recycled materials, and other methods that minimize the use of energy and other resources, there can be other efforts that can be made to help reduce activities that use non-renewable resources (Addis, 2001). For example, the Internet of Things (IoT) provides facility managers with access to data they did not have before. Connected sensors can improve sustainability by integrating with automated building systems. IoT sensors can dynamically adjust the ventilation and lighting levels inside a building based on climate, weather, and CO2 readings. The facility manager does not have to manually input data from multiple equipment pieces or stay on top of these adjustments.

Another option is underlayment for synthetic roofs. Typically, roof underlayment is asphalt-based, which breaks down relatively quickly. It is necessary to replace this layer to keep humidity from damaging the building's interior. Underlayment made of synthetic sustainable materials offers a lighter and more durable alternative to traditional underlayment. This material is made of recycled scrap polymer. Green roofs are another way to make use of the tops of commercial properties. It is possible to grow plants, flowers, bushes, and other greenery on roofing materials. In contrast to a bare roof, stormwater is absorbed into the soil and managed more easily, which improves the air quality and lowers heating and cooling costs.

Businesses are increasingly turning to renewable energy to power their properties, but many grid systems lack the storage necessary to provide power during periods of low solar availability. By storing excess energy, a hybrid system can run renewable sources at night, during overcast days, and in other

conditions that may not be optimal. Passive solar construction is another option for leveraging a sustainable solar energy source. Due to its location and design, the facility maximizes solar energy for heating during winter, while limiting its impact during warmer months. A greywater system reduces a facility's freshwater usage since everything, but the toilet streams can be recycled. Irrigation and the supply of water to toilets are the two most common uses for this water. Electrochromic Glass uses electrical currents and ultraviolet light can cause a glass to become opaque when it is exposed to external stimuli, such as an electrical current or UV light. The system eliminates the need for shades and other window treatments, adapting passively to current conditions. The system also blocks the vast majority of UV rays. All of these options can be used in addition to construction methods to help reduce activities that use non-renewable resources, as referenced by Addis (2001).

Among some of the issues considered to be hindering efforts to mitigate the effects on the environment during the construction process are the lack of understanding and knowledge, the lack of firmness in implementing regulations, and the fact that the application of this understanding has yet to be fully implemented (Zainul Abidin 2009). A lot of the time, the process of operational energy usage in buildings escapes the attention of construction industry stakeholders. This could be attributed to the fact that the burden of building operating costs is transferred to building users.

Despite the fact that the operational period (decades) is considerably longer than the age of the building, most of the conditions that arise at this stage are directly due to the two stages preceding it, namely the design and construction phases. The design and construction process has taken the role

of reducing the environmental impact as much as possible, leading to better results in the finished product. Even so, there are still measures that can be taken, especially by residents, to reduce the impact on the environment, namely by reducing the amount of waste produced every day.

In spite of the fact that every space conditioning (heating, ventilation, air conditioning) activity requires energy, there are several strategies that can be used to reduce energy requirements or optimize the energy use (Hegger, 2012), as illustrated in Figure 33: EWA Energy Efficiency Label of Colling Appliances (EWA recommendations). It is through the designer's knowledge of shapes, orientations and envelopes of buildings that he can play a major role in the strategy of minimizing energy requirements.

For buildings and constructions in tropical climates, direct heating is avoided in order to reduce energy consumption. When direct heating does occur, all that is needed for the building to be cooled are processes such as evaporation, convection, and capillary action. It is also possible to utilize the wind to cross ventilate the building through the use of the sun's light. In this case, the sunlight lights up the room as long as possible and all the hot air is vented out of the building using the sun's light.

As opposed to the period during which the building will be used, the construction phase is often considered to be an energy efficient phase due to the fact that the implementation period is comparatively short. In spite of that, there are still ways to make savings during the construction period, such as choosing the most appropriate construction and building method and utilizing energy as necessary.

According to S. Bry Sarte (2010), regarding energy consumption in buildings, there are two ideas that could be implemented. The first way we can reduce the use of energy is by having the designs of the building that take highest advantage of the situations outside of the building for the purpose of room conditioning. The second option, if outside conditions are utilized effectively, is to make sure that the energy is used as efficiently as possible. An example of such usage would be to use energy-efficient equipment or by using additional machinery, a sensor, for example, which can assist in the process of automatically saving energy.

It is then necessary to look at technological opportunities that can help reduce CO2 emissions, as well as look at renewable and sustainable energy source choices and alternatives that are able to replace some or all of the energy we use in our buildings. As a technical matter, energy conservation efforts in the construction industry can begin with a proper site analysis that clarifies the project needs and objectives and correlates them to the site's energy availability (S. Bry Sarte, 2010).

As each site is distinctive, it is the project designer’s and engineer's responsibility to find and select the best energy methods and application in order to construct buildings, which are in coherence with their surroundings, adaptable to environmental conditions, and will also be able to provide added value in terms of more comfort and inspiration for occupants and residents. There is a unique relationship between human relations and the environment. As humans are also a part of the environment, efforts must be made to reduce the impact of humans on the environment as well.

Despite this fact, humans can also place themselves as organisms outside the environment due to our capability to manipulate it to suit our needs. We

continue to manipulate the environment, despite the fact that in certain conditions the desire of humans to alter the environment so that they can be comfortable and healthy may have detrimental effects on the environment. This is often achieved by activities such as taking down trees and leveling the ground, creating gardens or rice fields, and digging wells, and making roads. Unfortunately, the damage that these activities cause to the environment can be grave.

Aiming to identify various efforts made so far by the Government of Bahrain with regard to the policy on GBs, this research aims to determine which regulations are directly or indirectly related to the implementation of a GBRS in Bahrain. When identifying such regulations, this research focused its search on regulations which are based on the principles of GB (energy-efficient, environmentally friendly, and human-friendly throughout the life cycle of the building). It can be argued that a building is less green if the processes of mining, producing and transporting raw materials do not adhere to GB principles. The same can be said of the process of building, the operation and implementation process, as well as the maintenance and demolition processes.

The process of identifying regulations is also conducted at a number of government agencies, such as the respective energy and mining ministries, the industry ministries, the respective trade and commerce ministries, the respective transportation ministries, the respective ministries of public works and infrastructure, as well as at the agency responsible for national planning. The identification process also takes place on a number of stages of legislative action, ranging from acts, regulations issued by the government's leaders,

national regulations, regional regulations, governor regulations, as well as regulations issued by the minsters.

Based on the results of the analysis in this study, it is evident that the current existing regulations do not fully accommodate GB principles. Furthermore, the various regulations do not form a coherent system, such as a GBRS. This means that the optimization of GB performance is directly linked to the existing regulations.

If there is a stakeholder who requires 'green material', they may not find it possible to source the material on the market. Products that are available on the market may have been produced from illegal mining practices, or they may have been processed by methods that are unfriendly to the environment. The materials may have been shipped long distance, resulting in a high embedded energy cost, or they may have been sent via methods that are otherwise unfriendly to the environment.

GB regulatory requirements downstream need to be accommodated by a variety of regulations upstream so that GB products perform well when used in their true contexts. The government makes an effort to put itself in the middle of a number of interests. In the construction industry, the government is looking for ways to ensure that all parties fulfill their obligations while also protecting their rights. On the other hand, there are certain parts of the country where it is standard that the government acts in favor of certain interests in order to aid in the advancement of improved interests in the future, one of which is the alignment of the government and administration to the environment.

As a result of this desire to accommodate a variety of interests within the community, it is often an obstacle that delays the establishment or dilutes the regulations, as they must accommodate those who will not be able to implement the regulations. As an example, those who are in a position to embrace GB may be able to apply the rules based on the requirements even if they are in a position to meet them or exceed them.

It appears that government-related barriers to the adoption of GBRS exist in developing countries, as reported by Chan et al. (2018). In order to strengthen GB policy and regulation, the government should take into account input from related stakeholders, such as academics, associations, building owners, contractors, and practitioners.

In addition, it has been noted that there are problems when it comes to implementing and enforcing regulations. It is usually the case that regulations that have been set will go through a re-socialization process for a period of one year before they are fully implemented. As a result of the socialization process for a year sometimes being deemed inadequate, the implementation of the program in the second year may remain limited. Another obstacle in government is a lack of readiness to enforce such regulations. This could be due to a lack of personnel, poorly written regulations, or incomplete technical guidelines.

Profit margin is the key consideration for developers when designing and constructing a building. A building being ‘green’ is often used as a marketing tool by the property business, with the goal being to increase profits rather than endorsing sustainability in the industry. Therefore, the developer will only adopt the concept of GB if applying the concept will not result in an

increase in the construction costs and/or the building being unable to be sold once constructed.

According to developers, those elements of the green concept that are most easily adopted are those that are aligned with their main interest, which is to make money. It is more likely that the developer will implement this concept if it results in additional profits (compared to the investment). It is not expected, however, that developers will implement this concept if it is assumed that the application of this concept will simply increase investment or operation costs without the possibility of receiving additional financial benefits or receiving benefits not commensurate to the business.

It is unclear whether the developer has the requisite influence to make a decision about the shape of the resulting building (as it pertains to the implementation of GB methods) as the owner or manager of the funds. There is often an unfortunate lack of balance between philosophical or technical considerations that are put forward by consultants when designing buildings, and the practical consideration of financial and trending issues. The main consideration in determining the design of buildings that need to be built has to do with financial interest.

Architects often face the greatest challenge in persuading their clients, in this case the developer, the contractor, or the owner, that the design has been optimized to fulfil the interests of the environment, users and developers. It is quite common for architects to face developers' comments about construction costs when attempting to satisfy these three interests, including the use of GB strategies in order to adopt environmental interests, since architects have a responsibility to consider the interests and needs of all stakeholders involved in the project.

In order to design buildings with better environmental performance, architects and designers need a variety of software that simulates energy and lighting. The successful implementation of a GB has a lot to do with the architect's ability to convince the developer that the strategy chosen was a result of optimizing the design and had been considered in respect of everyone’s various interests, including those of the developer.

4.2.3.3 Stakeholders and GB

However, not all architects concentrate in having a dedicated division to engage in such matters. There are certain architects who will only use the software when they require it, such as for GB certifications. In these conditions, it appears for the time being that the existence of the software for these purposes is mostly used as a way to justify designs that have been made before and not as a means to select various options for building designs.

It is quite common for a contractor to feel comfortable in his position to be able to execute what has been planned by the architect and developer for a variety of reasons. As a general contractor, the responsibility that he or she has is limited to designing and implementing the construction process, which refers to the design that was produced by the designer as efficiently as possible so as to obtain financial benefits. In certain instances, the contractor may have to carry out some sort of re-design process (value engineering). The aim is usually to minimize costs without compromising the quality of the final product in any way.

A contractor will typically suggest changes to certain materials based on ease of purchase or ease of installation, without changing the design principles already established by the designer. There has been an increase in the number of contractors that have implemented the green concept into the building

process as an integral part of the entire construction process over the past decade.

As a construction principle, green construction focuses primarily on reducing energy consumption and the environmental impact of a construction project. It is generally the contractor's responsibility to suggest changes to the building envelope material when it comes to green strategies, even if the changes are more grounded on efficiency and effectiveness of the construction process rather than environmental concerns or user considerations.

There has been a misinterpretation of the principle of GB by the government, and as a result, the GB principles have not been fully executed. There is still work to be done to adjust and standardize the contents of regulations and to coordinate various regulations and requirements' upstream to support regulation of downstream GBs.

It appears that some of the other stakeholders of GBs, namely architects, constructors, designers and developers, do not fully understand the principles of GB. It is apparent that the motivation for implementing GBs is simply to comply with regulations, rather than to achieve optimal GB performance.

Chapter 5: Conclusion

This chapter outlines the accomplished work and main findings of this thesis and outlines the recommendations for further study. The chapter ends with a summary of the lessons learned from this research.

The main sections in this chapter are:

1. An analysis of the accomplished work and main findings of the study.
2. Concluding remarks about the topic of the study.
3. Some recommendations for further research as informed by the findings of this study.
4. Lessons learned from this research and recommendations for further research.

5.1 Research Contribution

The thesis was aimed at addressing a knowledge gap identified by analyzing the literature and conducting an in-depth literature review. It was demonstrated that while there are numerous sustainability assessment efforts, none of them incorporate a holistically integrated approach that combines and connects the efforts for a better outcome. The evidence for this is seen in the gap observed between the perspectives of different sectors regarding GBRS and their tunnel vision of the impact on the environment of mega construction, focusing on only one aspect of sustainability without regard to the interconnected nature of its effects.

This research demonstrates that a GBRS is essential for development in Bahrain to aid decision-makers in enhancing urban sustainability. By providing insight gleaned from regional adaptation observations, the study hopes to bridge the gap and encourage stakeholders to engage in collaboration to develop a sustainability assessment tool, which incorporates weightings for evaluating the contribution real estate development of rapidly moving and highly desirable affordable housing throughout Bahrain.

In this way, the GBRS will provide an opportunity to determine effective ways that can be used to address the impacts of urban development that will result from meeting housing demand, thus ensuring that urban development is sustainable over the long run. In light of these considerations, the thesis presented herein seeks to provide a better understanding of how the use of GBRS can contribute towards creating a sustainable urban environment by providing a better understanding of how it works.

A GBRS enables the monitoring of a project from early on in the design phase, thereby enabling an understanding of performance through the various phases (design to end-use). GBRS aims to provide decision makers with an assessment strategy that can assist in assessing sustainability, which consists of an indicator scoring system supported by narratives and project-specific explanations. GBRS gives a realistic picture of project performance including its strengths, weaknesses, and virtuous cycles.

Considering the series of sustainable initiatives and efforts across various sectors in Bahrain, such as the EWA Guidelines, the MOW's Benayat Green Codes Guidelines, In particular, Bahrain's first National Renewable Energy Action Plan (NREAP), as well as Bahrain's first National Energy Efficiency Action Plan (NEEAP) are examples of the SEA's initiatives, a blue print and a foundation for a local GBRS can be built and used to accelerate the deployment and application of a comprehensive GBRS in collaboration with all of these sectors initiatives.

The NREAP categorizes viable sources of renewable energy in Bahrain, establishes targets, and proposes policies and initiatives for achieving these targets The NEEAP sets the target and proposes specific measures to achieve the target, and to unlock energy efficiency in Bahrain in order to achieve a more realistic long-term performance and achieve the objectives of Bahrain's Vision 2030.

This study indicates that the government and the GB Council need to evaluate the method for promoting the use of GB and encouraging professionals to obtain certification. Even though real estate developers are aware of this concept, a lack of experience and a lack of clear, measurable returns are the main barriers to the steady progress of professionals taking the

GB certification in Bahrain and the adoption of a GBRS. According to the respondents, the government should play a greater role in accelerating the implementation of the GBRS in the country.

By integrating stakeholder engagement with sustainability targets and improving project performance, the project shall contribute to knowledge. In order to benchmark project performance, top management must consider both tactical and strategic impacts of stakeholder engagement in real estate development.

In order to conceptualize this study, a comprehensive literature review is conducted within a relevant theoretical framework. Studies on stakeholder engagement should be conducted primarily in the manufacturing and service sectors. As stated by Glass (2012), the concept of sustainability is being encouraged to be applied in different ways by real estate development companies and developers, although they have not yet engaged with new reporting methods to engage stakeholders.

Another aim of this research is to bridge the existing research gap on stakeholder engagement in the real estate development sector and contribute to real estate management knowledge. In providing a method for engaging stakeholders in GBRS and real estate development sustainability and improving project performance, this thesis can influence the direction of both real estate development stakeholders and regulatory bodies concerned with achieving real estate development sustainability. This study will fill knowledge and project management gaps and develop approaches to identify, evaluate, integrate, and engage stakeholders to achieve sustainability in the real estate sector to identify the stakeholder's engagement relationship with real estate development sustainability related project performance.

5.1.1 Accomplished Work and Main Findings

In this study, the objectives of the research have been met as stated in chapter 1, section 1.2. and 1.3 by:

- Conducting an in-depth review of the literature on GBRS' potential applications in regional urban areas, specifically affordable housing projects and in terms of functional infrastructures and living spaces.
- Providing a comprehensive understanding of current knowledge in regard to tools and indicator systems for sustainability assessment, continuous improvement tools, as well as providing an overview of existing sustainability assessment methodologies locally.
- Developing a pilot study with a questionnaire methodology used to obtain stakeholder perspectives to observe general themes, the situation, and trends regarding GBRS.
- Reassessing and adjusting the study's focus to a qualitative approach after conducting the pilot study, in order to give an understanding of the ‘why’s and ‘how’s of the potentials and challenges of implementing a GBRS in Bahrain.
- Presenting real-world perspectives of the sector’s main influencers in order to answer the question of what is hindering the implementation of a GBRS in Bahrain.

5.1.2 Concluding Remarks

Chapter 3 of this thesis outlines how qualitative methodology is the most appropriate technique for analyzing stakeholder perceptions, particularly where there is no straightforward answer to the question posed. A qualitative approach allows us to articulate the meaning of the results obtained through interviewing experts in the field, whose own opinions are each influenced by their particular backgrounds, perceptions of risks and business objectives.

It should be noted that qualitative in-depth interviews have disadvantages. It can require multiple sessions to collect sufficient data for analysis. Furthermore, the qualitative research process does not provide a statistical analysis of the data. Qualitative research can also provide research data from a variety of perspectives and may be more effective at obtaining authentic information. However, the small sample size of the research can be a challenge. It takes several perspectives to arrive at a conclusion the researcher can be certain of. Moreover, when collecting data, it is sometimes required to follow numerous divergent paths, which requires more time. Sorting through the additional data is also time-consuming. Since every data point has to be evaluated subjectively, its value is always in question. The standardized guidelines and expectations for other research formats allow for a greater speed of evaluating and using the data collected than what is collected through qualitative research.

The findings of Chapter 4 fulfil objective 2 of the thesis by presenting the critical review of the current state-of-the-art. It introduces current trends, potential, challenges, and the direction of GBRS in interrelationship with sustainability efforts from various sectors in Bahrain.

As the world becomes increasingly urbanized, sustainable urban development has become a major concern for modern societies, as well as a focal point in global debates. To lower the high traffic density of central urban areas and improve the efficiency of land use is of great significance. It is vital to carry out housing development projects in a sustainable manner. Furthermore, this research demonstrated that the use of GBRS is an effective method and that it will be the future of urbanization due to land scarcity and environmental concerns.

Chapter 4 also presents a knowledge gap when it comes to sustainability objectives and bridging the gap between strategies and deployment of GBRS, and the lack of a sustainability assessment tool in Bahrain that would assist decision-makers in improving sustainability. Chapter 4 also identifies major challenges observed by the concerned stakeholders.

It has been observed through the literature review, and also through the interviews conducted in this study, that LEED is the most frequently cited and utilized system in the area, primarily because its versatile process considers each indicator against relevant criteria, circumstance and requirements in multiple countries and contexts. There were a number of reasons why LEED was viewed as being appropriate as it does not include bias and provides a list of generic indicators, which can be modified and adjusted based on the needs and goals of each project.

In her comparative analysis of five building sustainability-rating tools, (Al-Khalifa, 2018) reported on the appropriateness of the selected tools for implementation in Bahrain based on relevance, popularity, their alleged internationalism and versatility, as well as their number of projects that have been certified internationally. Al-Khalifa concluded that LEED is most

popular across the region, as well as being the most internationally recognized and versatile. Therefore, this has led to the inescapable reality that we need expert input to construct a set of indicators and narratives that can be specific to LEED Adaptability to affordable housing projects in Bahrain.

Chapter 4 presents findings, which fulfil another objective of the thesis. Expert opinion was found to be an effective means of determining the weighting of general perspectives and challenges. The use of semi-structured interviews proved to be an effective method for gathering expert opinions (see Section 4.1).

5.1.3 Recommendations

A political and regulatory context governs Bahrain's real estate market and affordable housing projects, and investors are accustomed to operating within those boundaries. Due to the fact that real estate investment is a long-term commitment, investors should be aware of how future legislation may affect the value of a building and its return on investment. Climate change, water scarcity, and the lack of renewable energy sources are all driving factors, in part because the built environment is considered to have a number of significant environmental impacts. Due to the findings of this study and the unanimous endorsement of the idea that the government should lead and implement GBRS, the following recommendations are made:

1. The development of GBRS is one of the major alternative methods for meeting housing demands while achieving a sustainable natural environment in the real estate sector.

2. A unified definition of GBRS should be applied across the various sectors so that strategies, components, and methodologies can be distributed across a broader spectrum.
3. A change in lifestyle and an understanding of the concept of "GB" are necessary steps toward advancing the concept.
4. Develop public awareness on the importance of conserving water resources and minimizing waste, and also in the enhancement of guidelines and approaches for their implementation.
5. In order to generate public awareness, the scientific community, non-governmental organizations, as well as policy makers will need to work together.
6. It is imperative to adopt an action plan with clear objectives and milestones as soon as possible. In accordance with the recommendations, this effort shall be shared by multiple ministries, but should emerge from the Benayat Green Code initiative at the Ministry of Works as stakeholders expressed unanimity on this point.

Furthermore, sustainable practices are hindered by high technology and material costs, the absence of insurance policies, high initial costs, a lack of experience of real estate developers, the difficulty of finding green materials, and barriers to system and product innovation, in order of importance. There are several barriers to the growth of the GB market, including the relative youth of the industry, the nature of the real estate development industry, and the lack of management systems available. A great deal of these barriers may be alleviated through education, government support, and research on GB.

It has been reported that the government may need to provide more sufficient financial incentives, tax exemptions, and policy instruments for GB

and sustainable practices. The respondents' comments indicate a desire for the Bahraini government to provide incentives and establish mandatory regulations, policies, and legislation for GB. Furthermore, respondents are also clear that they want the government to enact energy-efficiency regulations and code changes in order to create a market demand for such products. The government may also play a role in funding professional education and GB research programs, as well as in assisting with the certification process for buildings. Furthermore, buildings that use environmentally harmful products, such as fossil fuels, should be subject to a higher tax rate, while GBs should be subject to a lower tax rate.

Governments should publicly announce the long-term cost savings achieved by demonstrative projects in order to promote a competitive environment. In addition, respondents suggested that more cost-benefit studies be conducted on this topic in order to overcome initial costs and perceptions associated with it. More data and information should be provided to support the arguments for sustainable design, including first costs, annual energy costs, health, productivity, and well-being of occupants, as well as impacts on the environment and other social factors.

It would be beneficial for researchers to develop and refine methods of analyzing the true costs associated with GBs over their entire life cycle. The development of sustainable design will be greatly aided by a greater understanding of financial earnings from productivity. GBs are likely to increase in number as stakeholders begin to realize the benefits they offer. A shift in market demand can be achieved by increasing understanding of the benefits and value of GBs among insurers, banks, and tenants. According to the respondents, the public would demand environmentally responsible

buildings if they were aware of potential savings from the perspective of the entire life cycle of a building. As any additional costs for the project are borne by the clients, educational programs and financial incentives should target the general public directly as potential clients.

A major contribution of the research has been the theoretical conceptualization of the achievement of GBRS by analyzing the current barriers in the real estate sector to implementing sustainability and improving performance, as well as presenting relevant theoretical constructs of stakeholders' views. Furthermore, the research focused on the importance of stakeholder engagement in implementing a GBRS in Bahrain. Novelty of the research can be attributed to these features. A great deal of research has been conducted on renewable and alternative energy resources and sustainable real estate development projects, stakeholder engagement, sustainability, and the performance of real estate development projects, but no research has been conducted on the integration of stakeholder engagement, sustainability, and GBRS in the real estate sector in Bahrain.

The purpose of this empirical study is to present stakeholder engagement barriers and to offer steps in relation to implementing a GBRS and improving sustainability-related project performance in agreement with the research hypotheses. There are some steps of the stakeholder engagement process that can be generalized to real estate development sustainability and real estate development project performance. Moreover, this research has introduced a practical solution for stakeholder engagement that could be used to report a clear plan and identify steps to success for the GBRS program studied herein. Further research could be done on assessing the performance of other sustainability programs for the real estate sector.

In conclusion, this research has narrowed the gap in existing knowledge, with the potential to contribute to theoretical development and management practice in the future. These findings will be helpful to real estate development professionals who aim to improve sustainability related project performance. It may help real estate development practitioners to focus on motivating the stakeholders in order to aid the achievement of sustainability-related project performance by considering both the tactical and strategic impacts of stakeholder engagement. A number of significant correlations have been found between stakeholder engagement, GBRS implementation steps, sustainability metrics in real estate, and project performance. The correlations could be useful for practitioners to analyze the relationship between them and their relationship with sustainability targets. As a result, stakeholders can identify the particular areas where they need to focus in order to achieve sustainability target.

Real estate stakeholders are increasingly considering the importance of achieving sustainability in real estate development as a way to improve project performance and to please customers. It has been found that GB project performance can be improved by engaging all stakeholders and managing them in a manner that motivates them for the achievement of project objectives. This is one of the major areas in this thesis which emphasizes the importance of understanding both the relationship and interaction between them.

This research has introduced a new framework on how stakeholder engagement can be used to improve real estate development sustainability. This could improve the real estate development project performance by addressing the different key issues. A future study should examine other

characteristics of the GBRS sustainability outcome, including stakeholder influence on managing project value and managing project risk, creating a bridge between the real estate development supply chain partners to create sustainable procurement processes by improving their relationship. A significant investment in research resources will be required in order to enable much clearer and more robust conclusions to be drawn. Real estate development professionals should be given the impetus to generate knowledge by understanding the approach and helping to overcome existing obstacles in the future. A deeper analysis of case studies is necessary in order to be able to observe the situation in depth. Detailed sustainability related project performance compositions from the real estate development sector must be examined in future research to better understand stakeholder engagement, increase precision of analysis, and enable firmer conclusions to be drawn.

The rapid growth of the population in Bahrain and the continued development of cities has resulted in significant pressure on the MOH. To meet the needs of the current population as well as those of the future, housing development programs, and affordable housing programs in particular, have been expanded. Nevertheless, rapid urbanization and construction development will adversely affect energy demand and consequently the environment, contributing to global warming through increased carbon dioxide emissions.

Bahrain produces an average of 3190 MWh of electricity annually, according to the Ministry of Electricity and Water. According to Al-Saffar (2014), the overall electricity generation is 50% larger than the consumption, which is estimated at 266 MWh. Each standard household consumes

approximately 132 MWh. Considering all the facts mentioned above, as well as the fact that Bahrain is classified as a hot and arid region, it would be prudent to move towards a more sustainable and environmentally friendly development. In the same manner, most of the GCC states are experiencing similar pressures which have led them to establish a sustainable building assessment certification in order to improve the environmental sustainability of their construction industry.

A study conducted by Krarti et al. (2018) analyzes the potential energy savings that can be achieved by optimizing the design and size of photovoltaic panels needed for net-zero energy for existing and new affordable residential projects in Bahrain. According to the analysis, building energy efficiency codes can be developed and enforced more rigorously. It is anticipated that this will result in substantial improvements in the energy efficiency of buildings. This will result in a 62% reduction in Bahrain's energy consumption in the residential sector. In addition, there will be a reduction of 55% in Bahrain's peak electrical demand compared to business as usual. This evaluation indicates that this will reduce electricity consumption by over 320 GWh annually and peak demand by 87 MW. Bahrain will therefore receive economic and environmental benefits from developing and enforcing a more stringent code regarding building energy efficiency as a result of this study.

Limited research has yet been conducted on the non-energy benefits associated with GB, including its effects on human health. There is limited knowledge about how GBs can improve health outcomes for Bahraini residents who live in affordable housing. There are still limitations in terms of data available for comparative purposes for this type of study. To gain a better understanding of the performance and best practices of GBs and non-green

buildings, it is necessary to collect more regional and national datasets regarding the development, construction, and operation of both sustainable and non-green buildings.

As indicated by the MOH (Ministry of Housing, 2022) program projections, Bahrain has several large upcoming developments, most of which are residential in nature. Moreover, as over 48% of Bahrain's electricity is consumed by these buildings, it is certain that this will be reflected in Bahrain's overall power and resources consumption (Krarti et al., 2018). It is imperative that Bahrain's environmental commitments, agreements, goals, and visions are taken into account.

As determined by Bahrain's MOH, affordable housing addresses the needs of a specific segment of the population with a particular income level. It has been demonstrated in a number of regional studies conducted on various principles of GB that GBs can contribute to a healthier and more sustainable living environment, as well as conserving resources and reducing negative environmental impacts. As a result, residents of affordable housing in Bahrain will be able to reduce their bills and expenses while maintaining a high standard of living.

Developing environmentally responsible projects and meeting the needs of low-income families are not mutually exclusive. There is no doubt that the benefits of housing that promotes healthy living, mitigates safety risks, and reduces utility bills are attractive and important to all Bahrainis, regardless of their income level. Also, the principles of GB challenge critical barriers to affordability, and should be taken into account when designing affordable housing as part of the design process.

Although the benefits of GB are more important issues to assist low-income families, the research indicates that Bahrain's primary stakeholders in the GB sector believe that sustainable, high-performance buildings should be accessible to everyone regardless of their financial circumstances.

Combining GB practices with affordable housing involves utilizing traditional efficient techniques such as energy-efficient construction and renewable energy sources to reduce residents' energy burdens and to increase the resilience of the community.

This study emphasizes sustainability through addressing a need and optimizing a solution in a win-win scenario. Affordable housing is needed, and sustainable buildings are excellent methods to achieve Bahrain's visions and objectives.

5.1.4 Lessons Learned from this Research

In this thesis, the research is primarily concerned with the ever-increasing need to develop a GBRS. A fundamental part of this process is evaluating the principles of sustainable construction with respect to its use, which is critical for those involved in urban planning, designing, and construction.

GBRS does not require all sustainability issues to be addressed by the project team immediately following completion of the project. As a result, sustainability targets and actions can and should be prioritized throughout the entire project life cycle. This is a more comprehensive method of addressing sustainability that provides the opportunity to identify virtuous cycles, resulting in numerous advantages and benefits for all stakeholders. To ensure a more sustainable outcome, the GBRS 'process' ensures that relevant

sustainability indicators are included within the tool, and assessments are conducted against these indicators.

In relation to cost, this research shows that incorporating GBRS into a building could increase property values and rental income in comparison to traditional construction methods. GBRS implementation can result in savings by reducing energy consumption, improving energy efficiency, reducing emissions, and reducing maintenance costs. Furthermore, as a result of their green attributes, GBRS-certified buildings are considered to be of greater value. According to USGBC, GB owners report a return on investment for existing buildings of 19.2% and 9.9% for new buildings. In contrast, the research also contributed to a clearer understanding of stakeholder concerns, as well as to the identification of further areas of investigation.

Historically, in depth analyses of the costs associated with GBRS implementation in Bahrain, and even in surrounding regions, are inadequate. This was identified as a gap in the field in the literature review. GRBS implementation in Bahrain has been complicated by cost uncertainty and concerns about market readiness. Furthermore, stakeholders expressed concerns and observations regarding risks and the infeasibility of ROI on GBs, particularly in light of the lack of comprehensive and detailed cost studies available related to the implementation of GBRS. There is also a notable lack of cost benefit analyses, life-cycle cost analyses, and a lack of incentives and subsidies available to those who may pursue the implementation.

In bringing these challenges to light, the research aims to set a precedent for future GBRS studies to be directed towards bridging the gap between strategy and implementation, comprehensively addressing the challenges and paying attention to their nuances.

5.1.5 Recommendations for Further Research

In conclusion, the purpose and objectives of this research, as outlined in Chapter 1 section 1.3, have been addressed through the presentation of the real-world perspectives and list of challenges facing the GBRS implementation. It is important to recognize that these assertions are based on a number of assumptions and simplifications. However, despite these limitations, GBRS has become well-regarded as a useful tool for assessing the sustainability of our environment.

Although the GBRS is currently in an experimental phase, further research is recommended to further develop and improve its convenience to stakeholders and decision-makers. The limitations that have been identified to date will need to be addressed through further research to enhance the ability to address the challenges facing different sectors as outlined below:

- The research presented in this thesis is largely dependent on information compiled from a review of current literature and findings generated from an in-depth analysis of expert knowledge. Further research is therefore recommended in order to provide opportunities for continuing to enhance the knowledge, such as finding historical data and identifying new indicators related to GBRS-relevant areas for determining the impact, and probability of a particular indicator having an impact.
- Research can be extended by applying the widely cited LEED system as a pilot to a number of actual affordable housing projects currently under construction, and by incorporating feedback from new users to modify the indicators and their associated weights. As a result, the tool

could be refined by using more real-world examples and receiving feedback from users with different backgrounds and needs. This would potentially lead to a more comprehensive and user-friendly tool.

- For the purpose of scoring and ranking the indicators, a trade-off between indicators may need to be taken into consideration, which could be incorporated into a pilot GBRS. It is possible to use this tool to enable all kinds of projects to benefit from it, regardless of their sustainability goals, as well as to determine where some indicators are inapplicable. In addition to this, a trade-off between indicators should also allow the division of weightings between indicators, which again needs to be examined in a much more comprehensive manner that involves many more stakeholder groups, as well as a deeper study.
- Furthermore, further research should clarify the actual quotations and costs associated with alternative planning/design projects in the local context of GBRS. An overview of how to implement the design of the project can be provided by a cost estimation of sustainability assessment if there are different scenarios for the project.

In spite of the relatively small number of developers, consultants, and contractors involved in GB projects in Bahrain, it is likely that both groups will be underrepresented in this study. It would be beneficial to conduct further research with a larger sample size that targets these groups to better understand their perspectives, motivations, and barriers to GBs. Furthermore, it is also recommended that cost analysis research be conducted by comparing GB upfront costs as well as operation costs throughout the building lifecycle to promote the long-term benefits associated with GB in the Bahrain market by using case studies of certified GBs.

5.2 Tables and Figures

All tables and figures referenced throughout this thesis are found in the following section.

5.2.1 Tables

Table (1): Green Product Certification Labels (ISO, 2021)

Type	ISO Number	Purpose
Type-I	ISO 14024	Approval seal for multi-attribute requirements
Type-II	ISO 14021	Type II claims that can be verified with single attributes like carbon emissions, energy consumption, and recycled materials. It can be the first party, such as the manufacturer's self-declaration. Nevertheless, because the industry is demanding third-party attestation, many manufacturers are seeking such verification.
Type-III	ISO >14025	Environmental disclosures for products that are detailed and comprehensive. Similar to product environmental declarations (EPD) (Bernardi, Carlucci, Cornaro, & Bohne, 2017).

Table (2): GCC Housing Programs and Initiatives

Country	Responsible Entities	Housing Programs
KSA	Ministry of Municipal Rural Affairs & Housing	The Saudi Housing Initiative and Sakani Program.
Kuwait	Kuwait Housing Authority	Public Authority for Housing Welfare
Qatar	The Housing Department of the Ministry of Administrative Development Labor and Social Affairs (MADLSA).	The Housing Department Initiative.
UAE	Ministry of Energy & Infrastructure through Ministry of Presidential Affairs (MOPA).	The Mohammed Bin Rashid Housing Establishment (MBRHE) and the Sheikh Zayed Housing Program
Bahrain	Ministry of Housing (MOH)	

		Eskan Housing and Mazaya Program

Table (3): Real Estate Stakeholders and their Needs (Ullah et al., 2019)

Stakeholders	Definitions	Basic Needs
End users (Consumers)	This category includes the real estate buyers, renters, and sellers. These are the main beneficiaries of the real estate	Buying/Selling or Renting
Government and Regulators	It involves both the government and other regulatory agencies in order to maintain an equitable and transparent regulatory environment.	Regulations and Protection
Agents and Associations	It includes the agents who have direct contact with the consumer and facilitate the purchase, sale, or rental process. Additionally, it includes the associations that protect the rights of agents as professionals.	Business – Profit
Complementary Industries	Among them are small and medium-sized enterprises that assist key stakeholders in their tasks.	Business – Profit Other

Table (4): Research Terminologies

Term	Description	Justification
Stakeholders	Affordable homebuyers, developers, contractors, government decision-makers, and influencers.	The implementation of GBRS has an impact on many stakeholders in real estate. This term covers all those involved in and/or affected by the implementation of GBRS.
Homebuyers	Individuals who are interested in low-rise, standalone, affordable housing located throughout Bahrain and who meet the relevant criteria (Ministry of Housing | Regulations and Rules -Bahrain, 2021).	The common standard definition in Bahrain.
Developers	Those engaged in developing and selling off-plan real estate units (master developers or sub-developers) (Real Estate Regulatory Authority- Bahrain, 2021).	The common standard definition in Bahrain.

Contractors	Those who construct residential buildings of all types, including single-family homes, multi-family homes, and high-rises. As part of this activity, buildings are constructed, whether they are residential or non-residential. Parts of the construction process may be outsourced or even the entire process may be outsourced (Business Licensing System (SIJILAT)-Bahrain, 2021).	The common standard definition in Bahrain.
Government Entities	Representatives of key government Bahraini organizations that act as change agents to provide guidance, support, and oversight to implement sustainable development programs (Sustainable Energy Authority – Bahrain, 2021).	The common standard definition in Bahrain.
GB	A set of strategies and design standards aimed at improving the quality of life while protecting community environments (Bahadori, Hasheminezhad, & Karimi, 2017b). **"GB":** An approach to building structures and installations that maximizes the efficiency of materials, including energy, water, and materials, and minimizes the	This commonly cited definition is suitable for this study. Bahrain's GBM also defines this term.

	effects on human health and environment during all stages of construction, such as selecting the best locations, designing, constructing, operating, maintaining, demolishing, and removing debris (Benayat -Bahrain, 2021).	
Rating System	Rating systems can be defined as situations where performance is rated, or rewards are presented for those who meet the requirements (D. T. Doan et al., 2016).	It deals with the meaning of the concept associated with this study.
GBRS	A comprehensive evaluation framework developed by construction officials, government agencies, and private consulting firms to assess a building's sustainability and greenness (Nguyen et al., 2016).	This is a commonly cited definition that is appropriate for this study.
MAXQDA	A research methods analysis tool	

Table (5): Global Rating Systems in Chronological Order

	Tool	Year	Status	Country
1	Building Research Establishment Environmental Assessment Method (BREEAM)	1990	Active	UK / International
2	Leadership in Energy and Environmental Design (LEED)	2000	Active	USA / International
3	Indian GB Council Rating Systems (IGBC Rating Systems)	2001	Active	India
4	Comprehensive Assessment System for Built Environment Efficiency (CASBEE)	2001	Active	Japan
5	Green Globe International Standard for Sustainability	2001	Active	International
6	Building Design Criteria for Energy Saving (BDCES)	2001	Active	South Korea
7	System for Energy Certification of Buildings (S.C.E.)	2002	N/A	Portugal

8	The Green Star rating system (Green Star)	2002	Active	Australia
9	B.C.A. Green Mark	2005	Active	Singapore
10	China National Standard GB50189	2005	Active	China
11	Global Sustainability Assessment System (GSAS)	2007	Active	Qatar
12	DGNB - Global Benchmark for Sustainability	2007	Active	Germany
13	Green Star Tools	2007	Active	South Africa
14	Sustainable Buildings Tool (SBTooL)	2009	Active	Lithuania
15	Green Pyramid Rating System (GPRS)	2009	Active	Egypt
16	Green Star N.Z.	2009	Active	New Zealand

17	Building Environmental Assessment Method (HK BEAM Plus)	2009	Active	Hong Kong
18	GREENSL® Rating System for Built Environment (GreenSL)	2010	Active	Sri Lanka
19	GB Index (GBI)	2010	Active	Malaysia
20	Pearl Building Rating System (PBRS)	2010	Active	UAE
21	Miljöbyggnad (M.B.) "Environmental Building— system for sustainable building certification"	2010	Active	Sweden
22	The Jordan GB Guide (JGBG)	2010	Active	Jordan
23	Vietnamese Energy Efficiency Building Code (VEEBC)	2011	N/A	Vietnam
24	STO NOSTROY 2.35.4–2011 "Rating system for evaluating the sustainability of residential and public buildings" GOST R 54964–2012 "Environmental requirements for real estate."	2011	N/A	Russia
25	Vietnamese Energy Efficiency Building Code (VEEBC)	2011	N/A	Vietnam

26	The Danish Building Regulations BR10	2011	Active	Denmark
27	National Energy Efficiency Standard (S.N.I.) for Buildings	2011	Active	Indonesia
28	France Thermal Regulation R.T. 2012	2012	Active	France
29	ARZ BRS GBRS	2012	N/A	Lebanon
30	High-Quality Environmental (H.Q.E.) Standard	2013	N/A	France
31	Al Safat	2014	N/A	UAE
32	O.I.B. (Austrian Institute of Construction Engineering) guidelines	2015	N/A	Austria
33	National Energy Code of Canada for Buildings (NECB)	2015	Active	Canada
34	Chile Residential Building Code Article 4.1.10	2015	N/A	Chile
35	Iranian GB assessment Tool (IGBT)	2016	Proposed	Iran
36	SAAF (SGBF)	2017	N/A	KSA
37	Oman Building Environmental Certification OMBEC	2017	Proposed	Oman

38	Barjeel	2019	N/A	UAE

Table (6): LEED Building Certification Status in Bahrain (The GB Information Gateway, 2022)

	Project Name	**Certification date**	**City**	**Rating system**	**Version**	**Certification level**
1	FEB TOWER, First Energy Bank		Manama	New Construction	v4	
2	Passenger Terminal Building		Muharraq	New Construction	v2009	
3	Multi-Story West Car Park		Muharraq	New Construction	v2009	
4	Car Rental Building C		Muharraq	New Construction	v2009	
5	CUC		Muharraq	New Construction	v2009	
6	King Abdullah Bin Abdul-Aziz Medical City		Al Jazeera	New Construction	v2009	

7	P937 - Bachelor Enlisted Quarters	7-May-18	Manama	New Construction	v2009	Silver
8	Future Generation Reserve Project		Manama	Core and Shell	v2009	
9	Jaeger		Al Hidd	New Construction	v2009	
10	Bahrain International Airport - AMP		Muharraq	New Construction	v2009	
11	P-928 Waterfront Development Phase 2	28-May-13	NAVSUP PACT	New Construction	v2. 2	Silver
12	P-954 Waterfront Development Phase 3		NAVSUP PACT Bahrain	New Construction	v2. 2	

13	P-908 Consolidated Ops Support Fac		NAVSUP PACT Bahrain	New Construction	v2.2	
14	Raffles City Bahrain		Manama	New Construction	v2.2	
15	Amwaj Gateway		Manama	New Construction	v2.2	
16	AES International Consultants Bahrain		Seef	Commercial Interiors	v2.0	
17	P956 - Waterfront Development Phase IV		Manama	New Construction	v2009	
18	P-940 Dining Facility		Manama	New Construction	v2009	
19	P-935 - Transient Quarters III		Manama	New Construction	v2009	
20	Durrat Al Bahrain		Bahrain	Core and Shell	v2009	

	Waterfront Crescent					

Table (7): Final List of Categories and Indicators of Proposed OMBEC (Al-Jebouri et al., 2017)

Category	Indicators
Efficiency in water use	A comprehensive management program which takes into account indoor consumption, efficiency in external use, distribution and metering, recycling and reuse, and innovative alternatives.
Efficient use of energy	There are a number of techniques and methods which can be used to improve the energy efficiency and performance of the building. This includes active design, passive design, efficient cooling, advanced fittings, advanced meters, renewable energy, delivery performance, envelope performance, energy modeling, efficient lighting.
Construction materials and techniques	This includes materials that are nonpolluting or low in volatile organic compounds, materials that are locally available, materials that are recyclable or reused, materials that are durable, and materials that are energy efficient.

Linkage and sustainability of the site	Community sustainability, safe/friendly transportation, outdoor public facilities, ecological enhancement, appropriate site, sensitive land, microclimate comfort, landscape design, land use and density, site design analysis, natural environment, and infrastructure quality.
Indoor environment quality	These indicators include air quality and humidity, thermal comfort, ventilation efficiency, low-emitting finishes, noise reduction, ventilation systems, visual comfort, natural light, and safety.
The management of waste and pollution	Managing organic wastes, reducing waste, managing wastes and disposing of them, collecting and recycling waste, minimizing environmental impacts of construction, controlling air and water pollution, controlling acid rain, control of pollution, and managing light pollution.
Priorities and integration of local development	(Oman National Spatial Strategy) This includes the following: requirements, sustainable design process, economic benefits, historical values, operation efficiency, and maintenance, as well as commissioning plans.
The design and innovation process	Design methods that are unique to the local community, innovative local design quality, unique regional credits, innovative cultural practices, innovative economic practices, measures not currently addressed by the rating system, and exemplary performance indicators.

Educating and raising awareness	Providing information about the design, construction, operation, and maintenance of the buildings to homeowners, tenants, managers, and the general public.

Table (8): List of International Environment Agreements (SCE, 2022)

No.	**The convention's name**	**The accession**	**Depiction**
1	In accordance with Royal Decree 75 of 2016, the Royal Government ratified the Paris Agreement within the framework of the United Nations Framework Convention on Climate Change (UNFCCC).	2016	As part of the agreement, the global response to climate change will be strengthened by ensuring that the average global temperature remains below 2 degrees Celsius above pre-industrial levels and by fostering climate resilience and low greenhouse gas emissions development as well as increasing the ability to adapt to the adverse impacts of climate change.

2	Gulf Cooperation Council (GCC) Law No. 54 of 2014 Approving the Unified Law (Regulation) for the Arab States on the Control of Substances that Deplete the Ozone Layer	2014	It is intended that the agreement will eliminate the consumption of Ozone-depleting materials, establish safe alternatives consistent with the national interests of the GCC countries, and legalize the import, export, and re-export of these materials.
3	The Beijing Amendment to the Montreal Protocol Concerning Substances that Deplete the Ozone Layer was ratified by Decree No. 32 of 2013	2013	A new control measure was required of Bahrain under the amendment to eliminate hydrochlorofluorocarbons (HCFCs).

4	The 1977 Geneva Convention concerning the Protection of Workers from Occupational Hazards Due to Air Pollution, Noise, and Vibration		The purpose of this convention is to protect workers from occupational hazards caused by air pollution, noise, and vibrations in the workplace. A national law or regulation shall specify the measures to be taken to prevent and control occupational hazards in the workplace due to air pollution, noise, or vibration, and to provide protection against these hazards.
5	The Beijing Amendment to the Montreal Protocol Concerning Substances that Deplete the Ozone Layer was adopted in 1999	Decree 32/2013	Specifically, the amendment was intended to control substances that contribute to the depletion of the ozone layer.

6	Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES)	Law 27/2012	This convention's primary aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild.
7	The Rotterdam Convention on Prior Informed Consent for the International Trade of Certain Hazardous Chemicals and Pesticides	Law 14/2012	Rotterdam Convention is a multilateral treaty that promotes the sharing of responsibilities in the importation of hazardous chemicals. By promoting the open exchange of information, the convention encourages exporters of hazardous chemicals to label their products properly, provide instructions on safe handling, and inform purchasers of any known restrictions or bans.

8	In a joint agreement signed by the Kingdom of Bahrain and the International Atomic Energy Agency, safeguards will be applied in relation to the Treaty on Non-Proliferation of Nuclear Weapons	Law 10/2011	As a condition of the agreement, Bahrain will accept safeguards on all source materials and special fissionable materials used in any peaceful nuclear activity conducted on its territory, under its jurisdiction, or under its control.
9	Cartagena Protocol on Bio-safety	Law 2/2011	The purpose of this protocol is to ensure an adequate level of protection in the field of transferring, handling, and utilizing living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, as well as the risk to human health involved.

10	Nuclear Accident Early Notification Convention	Edict 1/2011	The objective of this international agreement is to promote greater international cooperation in the peaceful development and use of nuclear energy by providing adequate information about nuclear accidents as soon as possible.
11	The Nuclear Safety Convention	Law 44/2010	The goal of this agreement is to enhance international cooperation in nuclear energy safety in order to raise the level of nuclear safety worldwide and to maintain that level by strengthening national measures and international cooperation.

12	Nuclear Material Protection Convention and its amendments	Law 11/2010	The agreement provides that all State Parties are entitled to develop nuclear energy for peaceful purposes in order to achieve their legitimate interests derived from the use of nuclear energy for peaceful purposes.
13	Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC)	Law 4/2010	The purpose of this international agreement is to establish cooperation between countries in order to combat oil pollution in the ocean.

14	Establishment of the Arab Regional Centre for World Heritage (ARC-WH) in Bahrain between the Government of the Kingdom of Bahrain and the United Nations Educational, Scientific and Cultural Organization (UNESCO)	2010	In the agreement, Arab States' properties will be balanced and represented more on the World Heritage List, better protection and management will be achieved, regional and international financial support will be mobilized, and awareness about world heritage will be raised.

15	Cooperation on the peaceful use of nuclear energy under the amended Arab Agreement	Law 17/2008	This agreement is an international agreement aiming to contribute to the development of the Arab community and raise the level of economic development through the mastery of science, research, and nuclear technologies. Further, it aims to facilitate scientific and technical research and promotion in the field of nuclear energy in coordination with the relevant institutions and bodies in the Arab States.

16	Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol)	Decree 45/2005	This is an international environmental treaty that was negotiated at the Earth Summit. Essentially, by stabilizing greenhouse gas concentrations in the atmosphere, it seeks to prevent dangerous anthropogenic interference with the climate system.
17	Persistent Organic Pollutants Convention of Stockholm	Law 39/2005	The purpose of this convention is to transform the Rio Declaration on Environment and Development into a method of protecting human health and the environment from persistent organic pollutants.

18	International Convention for the Prevention of Pollution from Ships (MARPOL)	Law 32/2005	As a result of the International Convention on Civil Liability for Oil Pollution Damage (Brussels, 1969), all States Parties are granted the right to monitor marine pollutants, including petroleum products and other harmful materials, through the monitoring of
19	Treaty on the Comprehensive Ban of Nuclear Tests	Law 2/2004	It is a multilateral treaty whereby states agree to ban all nuclear explosions, regardless of their location or purpose, in all environments.

20	The Gulf Cooperation Council Convention on the Conservation of Wildlife and Natural Habitats	15-May-02	The convention to conserve ecosystems and wildlife in a sound and growing state, especially the species threatened with extinction, and in particular when such species extend beyond the international borders of two neighboring countries or more or migrate across the territorial waters or airspaces of these countries, which are under their sovereignty.

21	The Regional Protocol on the Control of Marine Transboundary Movements and the Disposal of Hazardous Wastes and Other Wastes	Decree 26/2001	The report emphasizes the need for effective coordination and cooperation at the regional level to limit the import of hazardous wastes as well as other wastes from countries that do not sign the convention.
22	Protocols on Substances that Deplete the Ozone Layer: Copenhagen (1992) and Montreal (1997) amendments	Decree 41/2000	New regulations were developed for controlled substances that deplete the ozone layer as a result of the amendments.

23	Convention of the United Nations to Combat Desertification in Those Countries Experiencing Serious Drought or Desertification	Decree-Law 9/1997	The Agreement is the first and only international and legally binding agreement aimed at addressing desertification. Sustainable development management is based on the principles of partnership and decentralized participation.
24	Biological Diversity Convention	Decree-Law 18/1996	As part of the convention, biological diversity is to be conserved and its components are to be used sustainably, while fair and equitable benefits derived from genetic resources are to be shared fairly.
25	The International Convention on Civil Liability for Oil Pollution Damages	Decree-Law 13/1995	States Parties to the Convention are responsible for pollution damage occurring on their territories,

			including their territorial sea economic regions.
26	The Montreal Protocol on Substances that Deplete the Ozone Layer (September 16, 1987) and the Convention on the Protection of the Ozone Layer (March 22, 1985) protect the ozone layer.	Decree-Law 10/1995	Its purpose is to protect the ozone layer by phasing out the production of several chemicals that are believed to be responsible for the depletion of the ozone layer. In accordance with the treaty, the production of each group will be gradually stopped and eventually eliminated over a period of time.
27	Climate Change Convention of the United Nations	Decree 7/1994	In accordance with the UNFCCC, the aim is to stabilize greenhouse gas concentrations in the atmosphere at a level that prevents dangerous

			anthropogenic interference with the climate system.
28	Safety and health at work in accordance with the Arab Convention No. 7 of 1977 and Recommendation No. 1 of 1977	Decree 2/1994	A key objective of this convention is to ensure that Arab legislation includes provisions for occupational health and safety in all fields, including the provision for occupational accidents and diseases insurance.
29	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, as amended, was adopted in 1980.	Decree-Law 11/1992 and Law 8/2005	A treaty aimed at reducing hazardous waste movements between nations and specifically preventing hazardous waste from passing from developed nations to less developed countries (LDCs).

30	The Vienna Convention on the Protection of the Ozone Layer	Decree 10/1990	A multilateral environmental convention that was adopted at the Vienna Conference of 1985 and entered into force in 1988. The treaty provides a framework for international efforts to protect the ozone layer. Nevertheless, it does not include legally binding reduction goals for CFCs, the principal agents responsible for the depletion of the ozone layer.

31	Protecting the marine environment against pollution caused by land-based activities and the Protocol regarding Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf	Decree 9/1990	A key aspect of the protocol is the fight against pollution caused by land-based sources, and it establishes coordination between the state parties in this regard.
32	An international convention for the safety of life at sea and its annexes, signed in London on November 1, 1974	Decree-Law 13/1985	This convention is intended to ensure maritime safety and ensure that ships flagged by signatory states comply with minimum safety standards for construction, equipment, and operation.

33	The 1972 International Regulations to Prevent Collisions at Sea, and their Annexes	Decree-Law 13/1985	The purpose of this agreement is to ensure the safety of people and commercial ships at sea. This law applies to commercial ships that sail on international voyages under the flag of their country of registration. A number of rights and responsibilities are granted to countries under this treaty.
34	A convention for preventing the pollution of the sea by oil, signed in London in 1954, and amendments to it	Decree-Law 13/1985	This convention and the amendments to it are intended to prevent pollution of the sea by oil discharged from ships.

35	The Arab Convention No. 1 on the Working Environment of 1981	Decree 7/1983	Its objective is to protect and improve the working environment and surroundings, so that it is more humane and appropriate for employees, and to establish their own standards for the maximum limits of any factors affecting the working environment.

36	United Nations Convention on the Law of the Sea	1982	This is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which was held between 1973 and 1982. Under the Law of the Sea Convention, nations are defined as to their rights and responsibilities in relation to the use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.
37	Kuwait Regional Cooperation Convention on Pollution Prevention in the Marine Environment	Decree-Law 17/1978	This Convention aims to ensure that states will be able to cope with emergency situations which may cause serious pollution by oil and other harmful substances, and to make joint and effective efforts to address them.

38	International Convention for the Protection of Cultural and Natural Heritage	16-Nov-72	According to the Convention, States Parties are responsible for identifying potential sites as well as protecting and preserving these sites. As a condition of signing the Convention, each country pledges not only to conserve the World Heritage sites located on its territory, but also to preserve its national heritage. It is encouraged that States Parties include cultural and natural heritage preservation in their regional planning programs, establish staff and services at their sites, and conduct scientific and technical research on conservation.

39	The Convention on Wetlands of International Importance, especially as habitat for waterfowl (Ramsar Convention)	1971	It is important that States Parties focus on the conservation of wetlands and water birds by establishing natural sanctuaries on wetlands and providing adequate guards to protect them.
40	Convention on the Establishment of an International Compensation Fund for Oil Pollution Damage	1971	It was established by the convention that States Parties to this Convention would maintain a supplementary fund. Having a legal personality, the fund compensates individuals who suffer damage as a result of oil pollution.

41	International Convention on Intervention in Cases of Oil Pollution Casualties on the High Seas	1969	The purpose of the convention is to provide adequate compensation to persons who suffer damage as a result of oil spills or discharges from ships. Furthermore, it aims to unify the international rules and procedures pertaining to civil liability in this area.

Table (9): PRS Credit Sections

Credit Section	Maximum Credit Points
IDP – Development process for integrated development	13
NS – Natural Systems	12
LB - Livable Buildings	37
PW – Precious Water	43
RE – Resourceful Energy	44
SM – Stewarding Materials	28
IP – Innovating Practice	3

Total	177

Table (10): Comparison of Leading International GBRSs in the Region

	LEED	BREEAM	CASBEE	SBTool
Sustainable categories	An assessment of the environmental sustainability of a site, indoor environmental quality, water efficiency, energy and atmosphere, materials and resources, as well as regional priorities should be undertaken.	Transport, materials, water, waste, land use, and conservation, contamination, and novelty are some of the management, health, and wellbeing topics	It is important to take into account the environmental quality of the building, the indoor environment, the quality of the service, the outdoor environment on-site, the environmental load, energy, resources, and materials, as well as the off-site environment.	There are several aspects to consider when choosing a site, planning and developing the project, allocating energy and resources, loading the environment, consuming energy resources, ensuring that the service is high quality, and considering the economic and social aspects, as well as the cultural and perception factors.

Types of buildings rated	Buildings such as residences, schools, retail stores, commercial buildings, multipurpose buildings, and healthcare facilities	Buildings with multiple functions, retail, industrial units, offices, courts, schools, hospitals, prisons, multi-purpose buildings, and buildings with unusual features	A multi-unit residential building, a retail building, a temporary industrial construction site, or a multi-purpose building	Almost any building
Applicability internationally	Flexible within the USA, but relatively rigid internationally	Flexible in the United Kingdom and relatively flexible abroad	A relative lack of flexibility overseas and a high degree of flexibility in Japan	High flexibility around the world
Methodology for determining	A simple approach based on additives (1 for 1)	An additive pre-weighted credit approach	Special	Additive improved weighted scoring approach

the scoring criteria				
Rating categories	1. Certified 40–49 points	1. Unclassified <30	1. BEE = less than 0.5 (poor)	1.0=minimum acceptable performance
	2. Silver 50–59 points	2. Pass ≥30	2. BEE = 0.5–1.0 (fairly poor)	2.1 = unsatisfactory
	3. Gold 60–79 points	3. Good ≥45	3. BEE = 1.0–1.5 (good)	3.2 = normal default
	4. Platinum 80+ points	4. Very good ≥55	4. BEE = 1.5–3.0 (very good)	4.1–4 = intermediate performance levels
		5. Excellent ≥70	5. BEE = 3.0 (excellent)	5.5 = best practice
		6. Outstanding ≥85		

Table (11): Description of the Study Sample

Qualitative	
Sample	Field stakeholders
Unit	Residential Affordable Housing Projects
Size	25 Interviews

Table (12): Questions Addressed to Government Entities

	Qualitative In-Depth Interview (Government Entities)	**Follow up**
1	From your perspective, are there any challenges facing the implementation of GBRS in Bahrain?	If so, please explain.
2	Are you already implementing green (or sustainable) approaches and principles into the design and construction of your buildings?	If not, why?
3	If we were to develop a GBRS, then why would we develop a local rating system?	
4	Why do you think international systems are adopted in Bahrain?	

5	Who would be the appropriate ministry to implement or regulate such a system?	Could you please elaborate on your answer?
6	Which mechanism or system of checks and controls is recommended for introducing this system?	
7	What is the primary responsibility of the regulator?	
8	How would the ministry or entity introduce, conduct, regulate, manage, and supervise this system?	
9	When would be the appropriate time to introduce such a system?	

Table (13): Questions Addressed to Developers and Businesses

	Qualitative Semi-Structured Interview (Developers and Businesses)
1	How would you describe your built environment activities?
2	Are you familiar with the concept of GBRS? Does Bahrain currently have such a such a system in place?

3	From your business's perspective, what are the main challenges facing the implementation of GBRS in Bahrain?
4	During the development of your building, have you implemented any green (or sustainable) design principles and approaches?
5	Do you think it is important to develop a local GBRS?
6	Do you think it is important to develop an international GBRS?
7	Who would be the appropriate ministry to implement or regulate such a system?
8	Which mechanism or system of checks and controls is recommended for introducing this system?
9	What would the primary responsibility of the regulator be?
11	How would the ministry or entity introduce, conduct, regulate, manage, and supervise such a system?
12	When should a GBRS be introduced in Bahrain?
13	Do you intend to implement green (or sustainable) building design principles and approaches in the future?
14	If you have no intention of pursuing a green (or sustainably designed) building development approach, please indicate why.
15	Do you think green or sustainable buildings make are economically justifiable?

16	Do your customers ask for green features in homes?
17	What is your opinion of customers' preference for green homes?
18	When it comes to the development of new products and the production stage, do you incorporate green principles?
19	Are you taking any steps to reduce the cost of heating and cooling in your developments?
20	Can a company that establishes itself as a "green" company have a competitive advantage in the market compared to a company that does not?
21	Compared to companies that do not sell green homes, do you think companies selling green homes will be more likely to survive on the market?
22	What are your main sources of information on GB practices?

Table (14): **Data Collection Methods and Rationale**

Method	Rationale	How the data is collected
Primary in-depth Interview - Qualitative	The perceptions and motives of field experts are critical to understanding how they see the potential and prospects of developing GB initiatives.	Verbally ask participants open-ended questions in individual in-depth interviews

Table (15): Government's Official Entities Participants and their Roles

Entity	Position of the Interviewee in the Entity	Role of the Entity
Ministry of Housing	Higher executive	The MOH is responsible for providing adequate housing for families with limited income in Bahrain(Ministry of Housing | Regulations and Rules - Bahrain, 2021)
Ministry of Housing	Higher executive	
Eskan Bank	Higher executive	*Eskan Bank* supports the MOH in managing the disbursement of funds to housing beneficiaries of citizens. (Eskan Bank Bahrain, 2021)
Eskan Bank	Executive	

Real Estate Regulatory Authority (RERA)	Higher executive	RERA helps real estate professionals to transition to the new regulatory standards in the Kingdom (Real Estate Regulatory Authority- Bahrain, 2021).
Survey & Land Registration Bureau	Higher executive	SLRB is in charge of land, aerial, and hydrographic survey services and the registration of real estate properties in Bahrain. (Survey & Land Registration Bureau - Bahrain, 2021).
Minister of Works, Municipality Affairs and Urban Planning	Higher executive	Providing different services to citizens, residents, and business owners alike. In 2019, the ministry issued a guide to GBs (Ministry of Works, 2021).
The Sustainable Energy Authority	Higher executive	Develop a cohesive and sustainable energy policy

		and promote renewable energy and energy efficiency in Bahrain (Sustainable Energy Authority – Bahrain, 2021).
Supreme Council for Environment	Higher executive	Responsible for developing Bahrain's future strategy for the environment and sustainable development in line with international standards (The Supreme Council for Environment, 2021). The Council also monitors and acts on any violations to the environmental codes in Bahrain, issues those codes and monitors the satisfaction of submitting and approving.

Table (16): Developers & Business Participants and their Roles

Entity	Role	Objective of choice
● Amwaj Islands ● Al Saraya properties ● The Kingdom group of Companies	Executive	Experience in property development and investment
● Diyar Al Muharraq	Executive	Experience in large-scale real estate projects
● Society of Engineers ● Ministry of Works	Executive	Quality and project management experience
● Bin Faqeeh Real Estate Investment Company	Executive	Contracting and real estate experience
● Seef Properties ● NASS Contracting	Executive	Industrial management experience
● Naseej Development	Executive	Project management and development experience

Table (17): Representative Statements – Qualitative Analysis

Themes	Initial Codes	Representative statements of the interviews
A Functional GBRS in Bahrain	A GBRS exists in Bahrain	I think there are some rating systems, maybe at the GCC levels. There are some initiatives that I am aware of. GBRS also involves the efficiency of the building. I am familiar with those.
	GBRS does not exist in Bahrain	Now, we do not have a regulated GBRS. At the moment, it is under development and is something we are working on.
Awareness of GBRSs	Aware of the concept	I am familiar with the GBRS. It is basically a system that rates the contribution of the buildings and their effects on the environment and climate change.
	Little awareness of the concept	I have a few minor details. Although I am not an academic like you, I understand that there is a global ranking for the buildings, and I have visited one of those buildings in Sharjah that was ranked number 15 in the world.

Sustainable Methods Implemented	Developers are working on affordable housing	Three years ago, there was little awareness of GBRS, so we went to consultants. We went to building ministries and so on, but now we are known in the market. Now, people are approaching us, and we are being proactive because there has been a lot of work coming our way.
	Garbage collection committee	The garbage collection company. They come every two weeks, three or four times, for collection. We tell them "We will send you an SMS, you don't need to come."
	GB Code	The GB Code was implemented first, which makes sense. It is the most common type of building on the island. So, it makes sense to start with them. Also, the government has the ability to influence them, because their impact is highest, but the impact of market is also high. So, inside the government, the GB Code was implemented.
	Healthy lifestyles	We are always making better systems for installations. Investing more in

		healthier lifestyles by adding facilities for things like cycling, jogging and tracks. Two days ago, we introduced electric bikes.
	Recycling grey water	It is this policy that we follow in terms of water consumption and recycling greywater in some cases. If it's feasible, it could be the use of solar panel inserts for water heaters, since you need a large roof to generate electricity.
	Improving the performance of a building	Some of them are mandatory, some of them are not. The standards exist and there are some calculations that the SEA can tell you about it. They have their own calculations regarding those points, as I told you, and they are designing the buildings according to that.
	Solar system	Considering the consumption habits of Bahrainis, just from what we've seen, they're installing a solar energy system that is 7.8 kilowatts, which is about 20 families or 24 solar panels.

		I'd say I have 16.4% coverage, but again, maybe they don't use as much AC.
	Thermal insulations	We do thermal insulations and insulations finishing systems. Likewise, for all of our working projects, such as the airport, we help them to be LEED certified.
	Using GB materials	We ensure there is a sustainable energy component and, if there is not, we encourage them to pursue such initiatives in their projects to save energy, whether it be electricity, or any aspect of saving energy, we urge them to do so.

Table (18): Representative Statements – Qualitative Analysis (Part 2)

Themes	Initial Codes	Representative statements of the interviews
Benefits of GBs	Economically feasible	I find it to be more economically viable for me.
	Lower maintenance costs	One of the greatest benefits of GBs are their lower maintenance costs and that they feature specially engineered design elements to lower energy consumption and help reduce energy costs and water bills for each occupant.
	Reduce heat transfer	We use only double-glazed aluminum. To reduce heat transfer, we use high-performance tinted glass. This balances things out. We are also trying to use recyclable material.
	Reduce the waste	We added more inputs of renewable energy too, so we have a better guide for when it comes to the building with better engineering.
	Save time	If I want to build 500 houses, I will do the math. Investing with green

		methods from the start in these houses will save me time in the long run.
	Support developers	It will help and support the developers if we have our own rating system.
	Waive some fees	Going for a higher rating should be rewarded with a waiver of some fees, and governmental approvals for GBs should be prioritized. It is either initiatives from the government as fees or time saving in approvals and faster applications, or any other special services that would be feasible.
	Thermal insulation	There is thermal insulation regulation, so it is a start of in the right direction to reduce thermal needs and energy, including the insulation for the wall and the ceiling.
	Net zero carbon or waste	By implementing quality innovation, buildings can achieve net zero carbon and net zero energy.

	Sustainable housing	The mission of Eskan properties is to develop affordable, sustainable housing through Eskan Bank, by making the world a more sustainable, green place.

Table (19): Representative Statements – Qualitative Analysis (Part 3)

Themes	**Initial Codes**	**Representative statements of the interviews**
Potential challenges of implementing a GBRS in Bahrain	Absence of evaluation standards	We use an international evaluation standard. We never had a valuation standard in Bahrain, so we adapted the international best practices.
	Application of rating system	One of the reasons why you cannot implement a building rating system faster is that knowledge is needed from the start, during the development of the project.
	Enable the government or enable us to follow a GBRS	Enable the government or enable the private sector to follow a GBRS. Of course, there will always be challenges, but those challenges

		are manageable, and I think that there should be more cooperation between the public and private sector.
	Encouraging developers	Encourage developers to develop more in Bahrain and protect end users at the same time. There are many challenges that we faced when we came into play in 2017. we had a number of projects without a straightforward agreement between the developer and users.
	Establishing a system must start with the government	Putting in place this system is the most challenging part due to the government's ambiguity.
	High cost	The challenges: I think number one will be the cost. To review, to submit this, will incur an extra cost and the cost will be reflected on the end user as well.
	Lack of awareness	Challenges are limited to awareness. We have been trying

		since 2009 to use the awareness-raising methods through workshops, training, conferences and lectures.
	Monitoring	Observing and ensuring that the regulations are implemented successfully. While avoiding increasing the cost. At the end of the day, you want a GBRS introduced to ensure sustainability, because if we don't have one, we aren't sustainable.
	Rigidity	The culture and the mindset have to change. The mindset, whether at the regulator level or at the private sector level, has to change.
	Skill gap	There is a massive skills gap in the field of energy efficient buildings and professional skills required of them.
	Subsidizing	If you want people to go and do something else of their norm or for the greater good, try to subsidize them.

	Technical issues	They are mostly technical issues. Firstly, we would like to do a pilot project on it, then we would like to study how we can develop those procedures with SEA.
	Transparency	There might be some problems with transparency when it comes to detailed information from government agencies, as the availability of information and the method of use are fundamental to any advancement or development.

Table (20): Original Required Sample and Pilot Size

Population size (Homeowners)	Margin of error	Confidence level	Required sample size	Estimated response rate	Number of participants invited	Pilot	Pilot Required sample size
58,145 (Ministry of Housing | Bahrain, 2021)	5%	95%	382	10-20% Based on the survey designed and known response averages	Higher than 3830- 1915 (382*100/20)	30%	114.9

Table (21): Data Analysis Method Description

Method	Approach	How the data is analyzed	Tool
Qualitative	Primary semi-structured interview	Qualitative content analysis	Nvivo
Qualitative	Secondary data collection	content analysis for qualitative analysis.	Google Scholar

Table (22): Representative Statements – Qualitative Analysis (Part 4)

Themes	Initial Codes	Representative statements of the interviews
	Best way to involve private sector is Regulation	Penalties, regulations, whatever they say, this is mostly public relations, so this has worked to a certain extent, but regulations should be implemented if there's a way to push the private sector in this direction.
	Create awareness	Creating more awareness, increasing the use of green products, and ensuring that more rules and regulations are put in

Recommendations		place by all the government entities so that green products are more economical and consume less energy.
	Encouragement	So, we need to push, we need to nudge, we need to encourage. We need to change the thinking of the market so that they start building correctly.
	Enforcing the system	Regulations are sometimes necessary, but also enforcing them and making them a condition of approval. In order to build something, developers must comply with compliance requirements.
	Having an advisor	An entity on a decision maker level should offer advice on sustainability. Many criteria will be agreed upon, but they will advise how to meet them. Afterwards, they will tell you how to achieve a full grade on this environmental aspect.

	Implementation of cost-effective systems	First of all, it’s a matter of getting it designed and approved, which is internal, and then getting it to the market in a way that the market understands it's just a matter of correct introduction. Capacity. Building within the market to understand, and to implement the GB Code and the GBRS.
	Offering incentives	If an incentive is offered, or if you buy the accessory saver, you will benefit from it. For other things, like the cars, if yours are electric cars you will have a special lane on the King Causeway.
	Presence of building permit Benayat system	It is up to the government, but it would most likely be better if there were a building permit Benayat system in place for dealing with these issues and verifying and approving the GB Code in accordance with the system, as well as the criteria selected.
	Raising stakeholders'	There needs to be more workshops on how to implement GBRS. What

	awareness of sustainability	are the mandatory points? What is the rating? How will the GB Code be implemented? How do you gain from implementing the GB Code? Let's say, decreasing the financial expenses of the building itself.
	Solving problems one by one	Just break the problem into smaller issues and tackle them one by one, but you have to have a plan. You have a budget. You have to have a backup. Yeah. Something like that.
	Civil defense as a role model in enforcing the regulation	Taking civil defense as an example, it is the most important service because without the regulations, you may lose your building. There are high risks in building without any civil defense regulations, but there is also an awareness of civil defense.
	Tax relaxations	Those are the things that should be encouraged in a way so developers can start looking at those issues rather than just the financial aspects. It is also important and

		prestigious. Perhaps tax relaxation and other items could encourage it.

Table (23): Data Process Summary Description

Process	Description
Research approach	Inductive and deductive
Data collection	Data was collected from participants through semi-structured interviews
Coding participants	Transcribing the text Establishing codes and variables
Processing and representation of the data (visual models, figures, tables).	NVivo is used to qualitatively analyze the data MAXQDA, a research methods analysis tool, is also used
Validating	Face Validating

Table (24): Code name of participants

Code name of participants		
1	AAD	Development Firm
2	MQD	Development Firm
3	ERGI	Green building expert
4	HAEG	Government entity
5	FSO	Solar energy expert
6	MKR	Government entity
7	OKK	Real estate Financing
8	RSEA	Government entity
9	ASEA	Government entity
10	HSEA	Government entity
11	FFBF	Real Estate Development Firm
12	EKW	Government entity
13	SGHE	Contractor consultant firm
14	SKS	Real Estate Development Firm
15	TSMS	Contractor consultant firm
16	NMW	Government entity
17	NNJ	Engineering firm
18	KAE	Engineering firm
19	SASP	Contractor consultant firm
20	ESAP	Architectural Firm
21	RSAP	Engineering firm

5.2.2 Figures

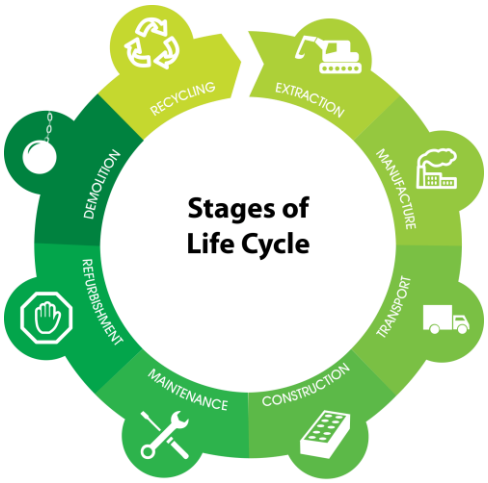


Figure 1: IGBC Construction Life Cycle

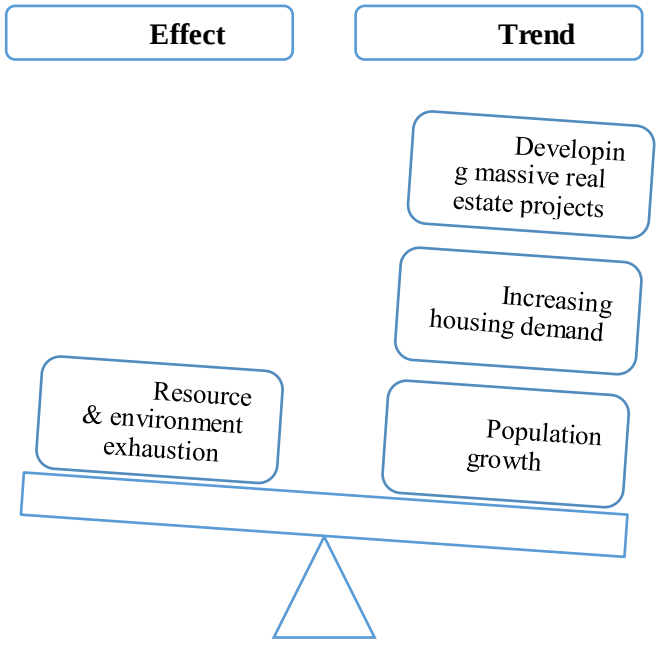


Figure 2: The Burden of Development Trends on the Environment

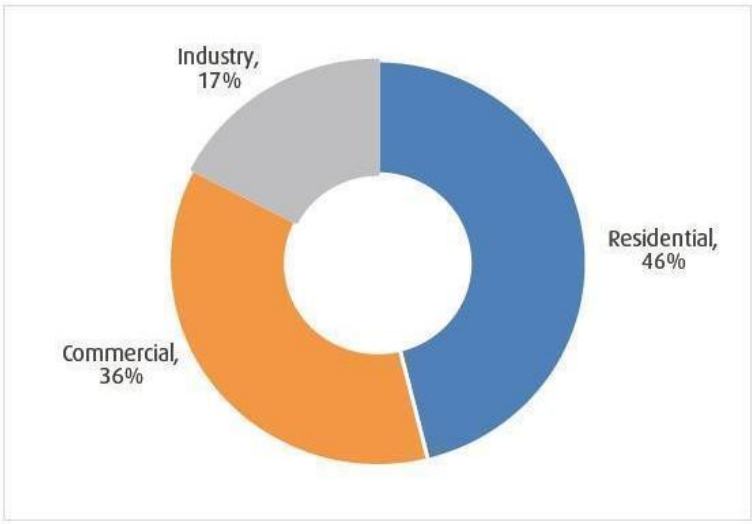


Figure 3: Bahrain Total Grid Electricity Consumption (National Energy Efficiency Action Plan (NEEAP), 2021)

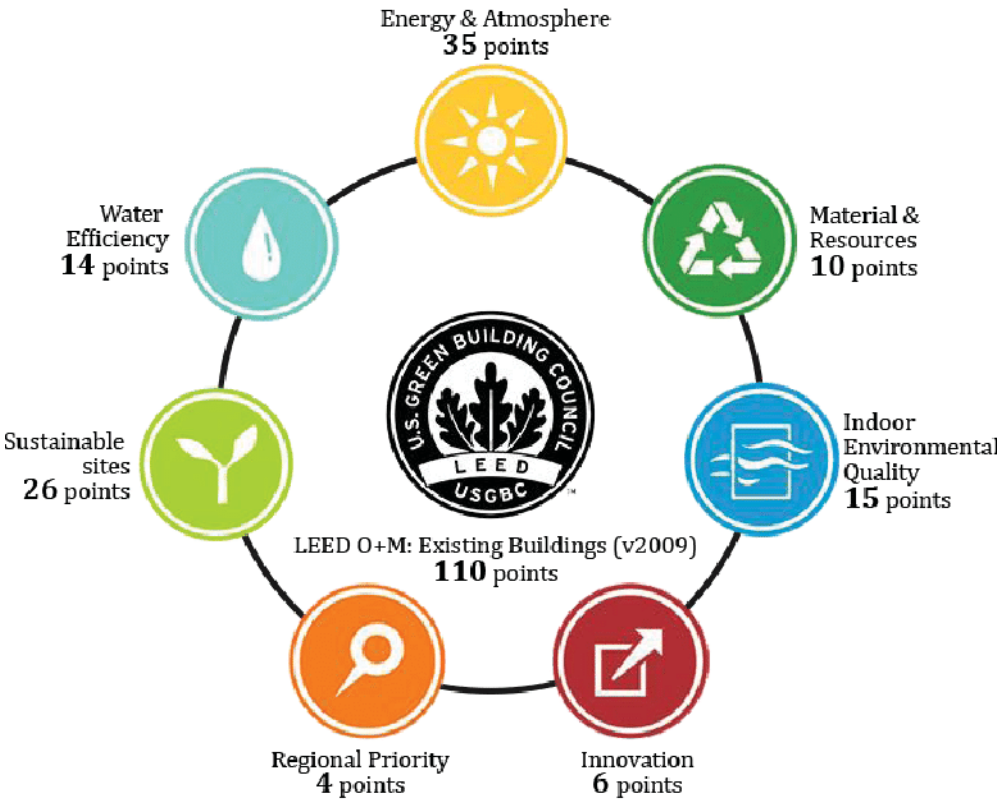
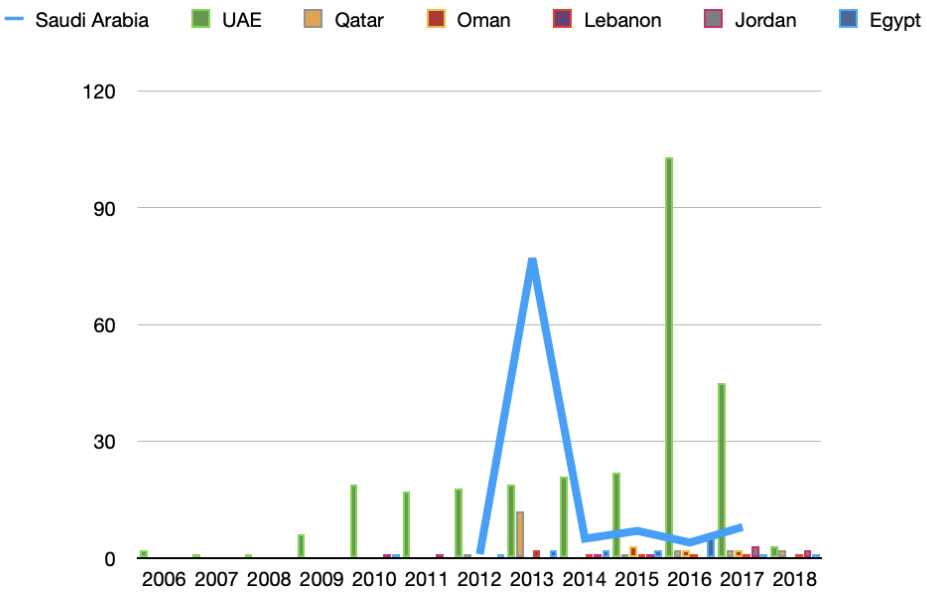


Figure 4: LEED Categories and Assigned Points Based on the Online Checklist (Green Building Council, 2022).



Figure 5: LEED certification levels



		2006	2007	2008	2009	2010	2011	2012
GCC	Saudi Arabia				1			1
	UAE	2	1	1	6	19	17	18
	Qatar							1
	Oman							
	Lebanon							
	Jordan					1	1	
	Egypt					1		1

		2013	2014	2015	2016	2017	2018
GCC	Saudi Arabia	77	5	7	4	8	
	UAE	19	21	22	103	45	3
	Qatar	12		1	2	2	2
	Oman			3	2	2	
	Lebanon	2	1	1	1	1	1
	Jordan		1	1		3	2
	Egypt	2	2	2	5	1	1

Figure 6: MENA Temporal Diffusion Patterns of LEED Projects (Ismaeel, 2019)

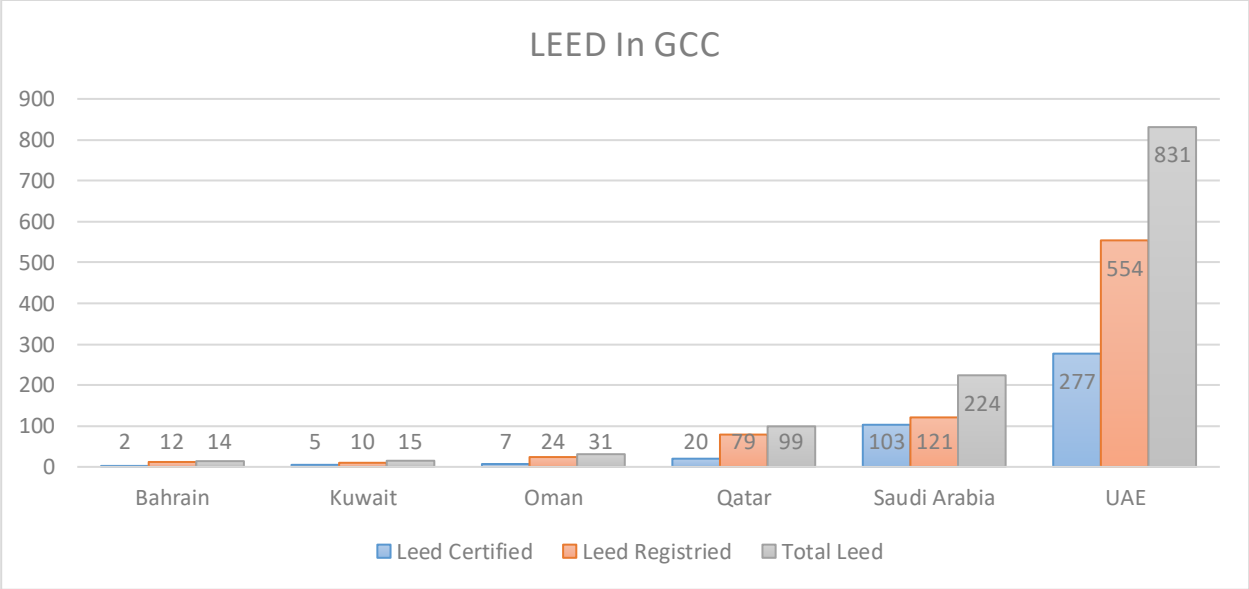
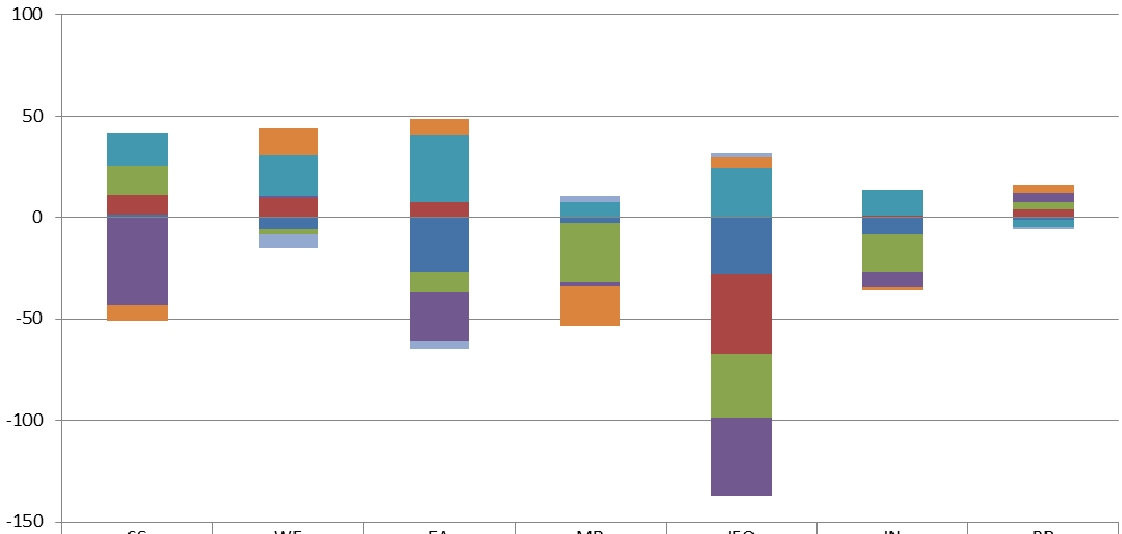


Figure 7: LEED Adaptation Across the GCC



	SS	WE	EA	MR	IEQ	IN	RP
UAE	0	-7	-4	3	2	0	-1
Saudi arabia	-8	13	8	-20	6	-1	4
Qatar	16	20	33	8	24	13	-3
Oman	-43	1	-24	-2	-39	-8	4
Lebanon	14	-3	-9	-29	-32	-19	4
Jordan	10	9	8	0	-39	1	4
Egypt	1	-5	-27	-3	-28	-8	-1

Figure 8: LEED Adoption Rates in Arab Countries Relative to the Total Average (Ismaeel, 2020)



Figure 9: BREEAM Performance-Categories



Figure 10: BREEAM Credit Categories

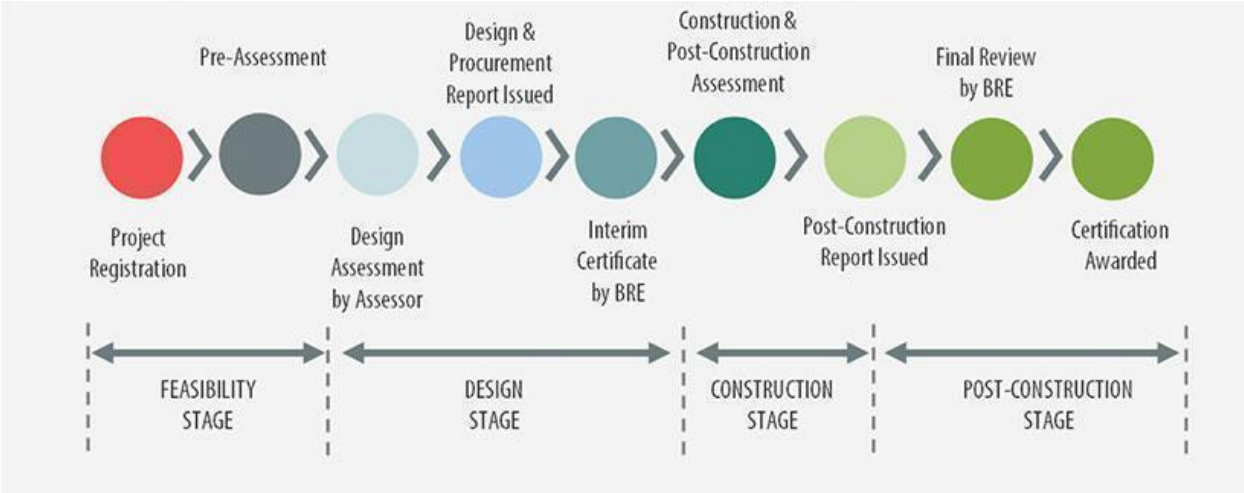


Figure 11: BREEAM Certification Process.

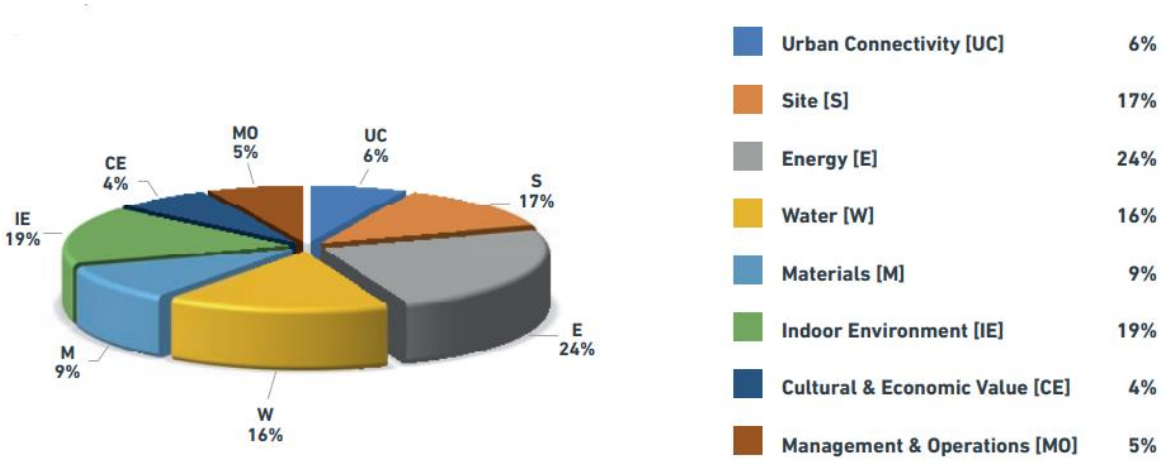
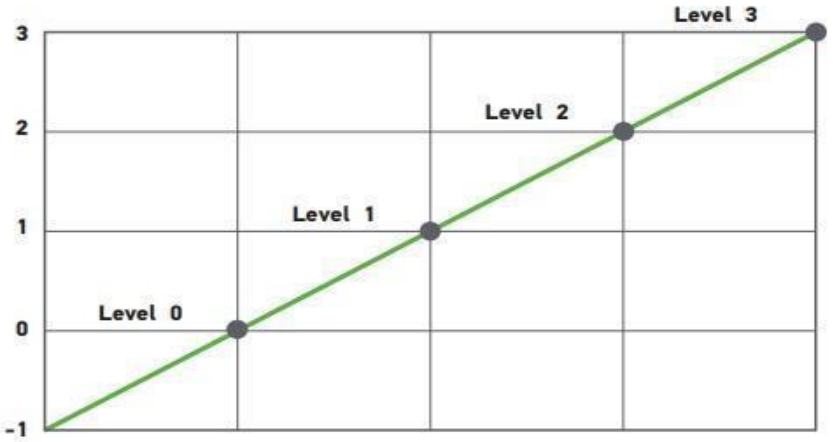


Figure 12: GSAS Categories & Weights (GSAS, 2021)

Cumulative or Aggregated Score (X)	GSAS Star Rating (★)	GSAS Certification
X < 0	Certification Denied	Certification Denied
0.00 ≤ X ≤ 0.50 *	★	Certification Achieved
0.50 < X ≤ 1.00	★★	
1.00 < X≤ 1.50	★★★	
1.50 < X ≤ 2.00	★★★★	
2.00 < X ≤ 2.50	★★★★★	
2.50 < X ≤ 3.00	★★★★★★	

Figure 13: GSAS Overall Rating (GORD, 2015)



Level	Range	Ordinal Scale
Level -1	<0	Does not meet baseline
Level 0	0	Meets baseline
Level 1	1<x≤1	Acceptable
Level 2	1<x≤2	Improved
Level 3	2<x≤3	Optimal

Figure 14: QSAS Criteria Scoring Levels (GORD, 2015)

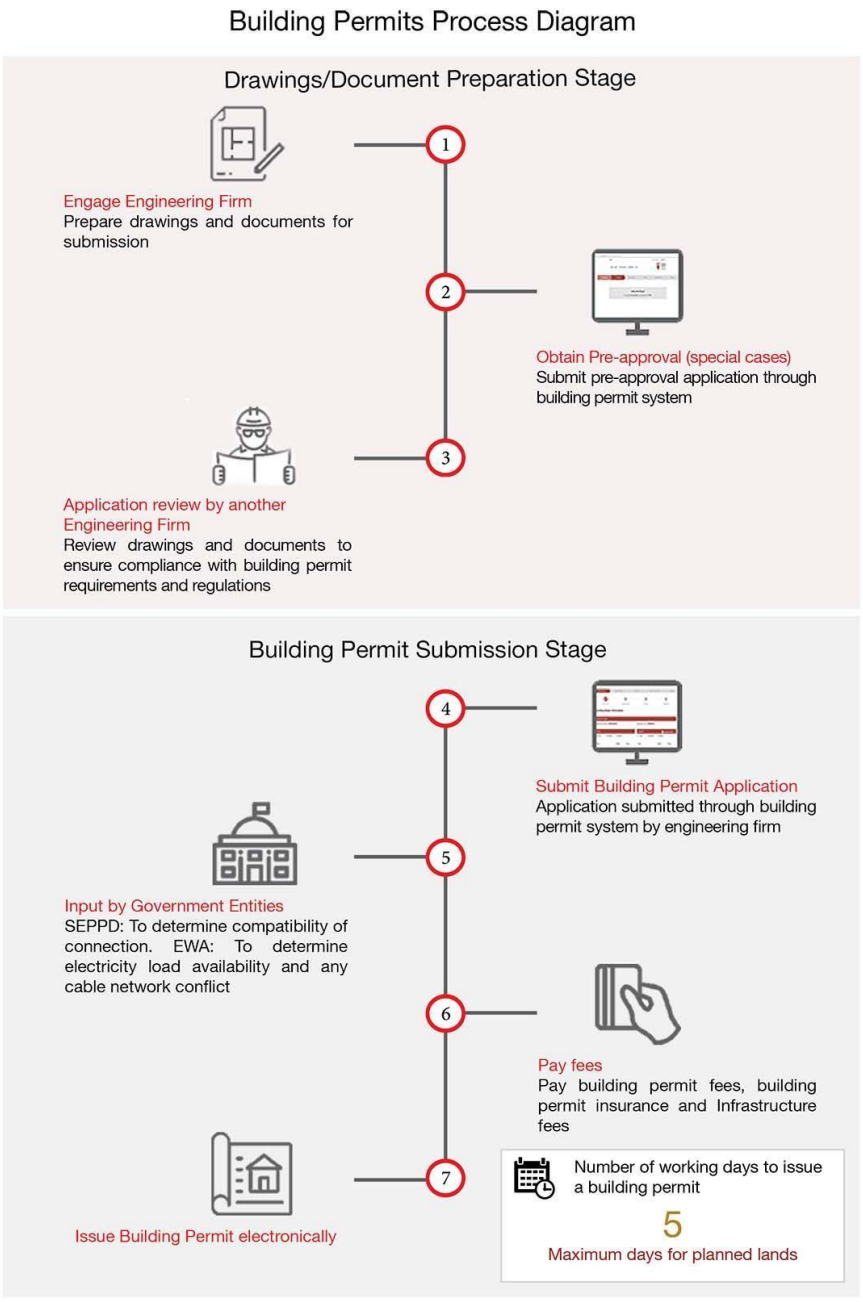


Figure 15: Building Permit Process Diagram (Benayat -Bahrain, 2021)



Figure 16: Estidama Pearl Rating Levels (Emirates GB Council, 2021)

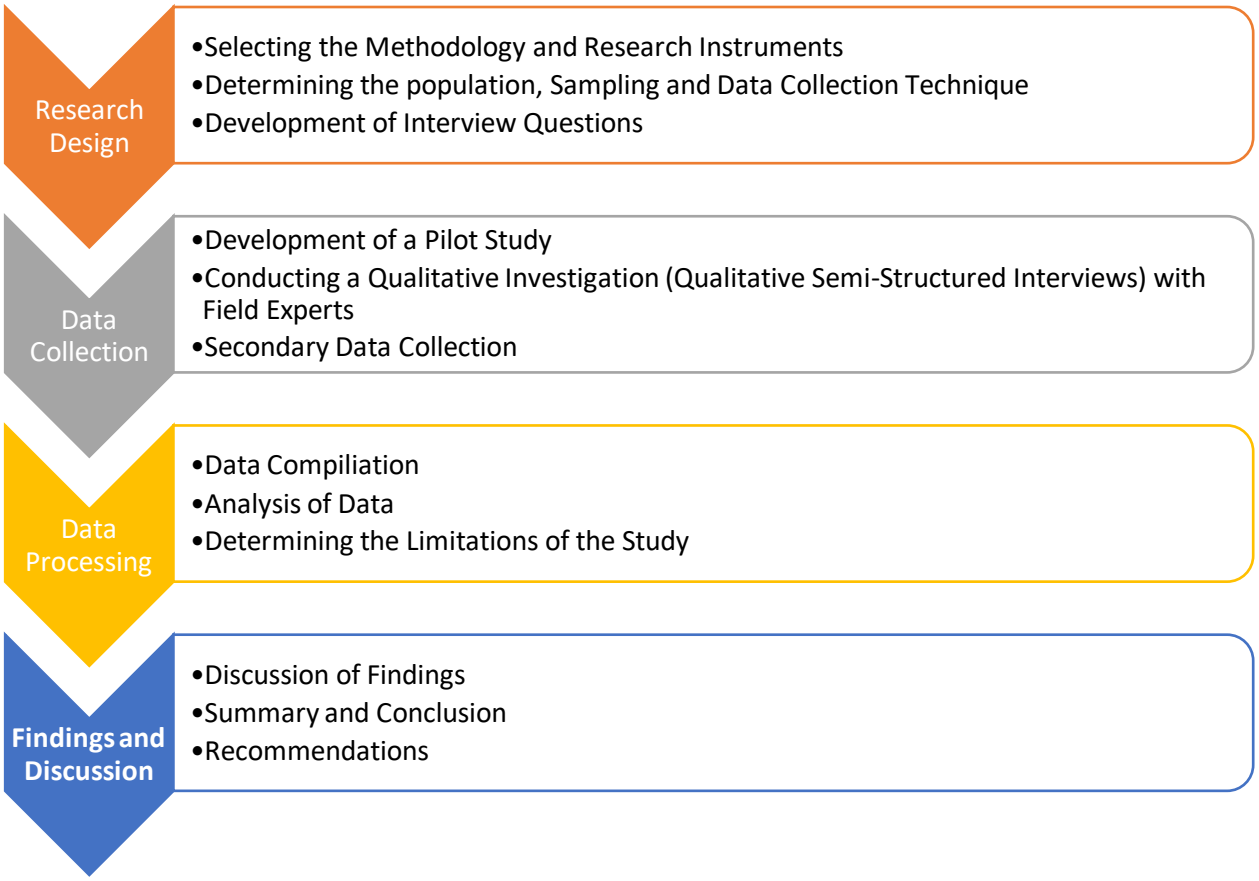


Figure 17: A Summary of the Methodology Chapter

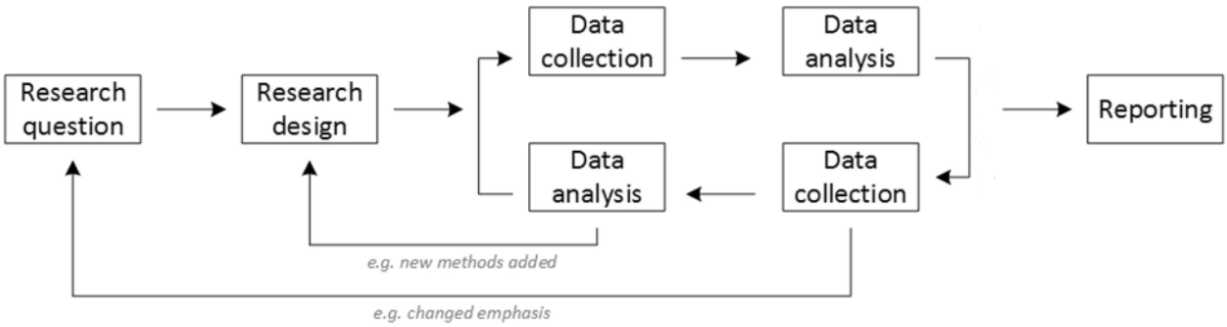


Figure 18: The Research Design Model

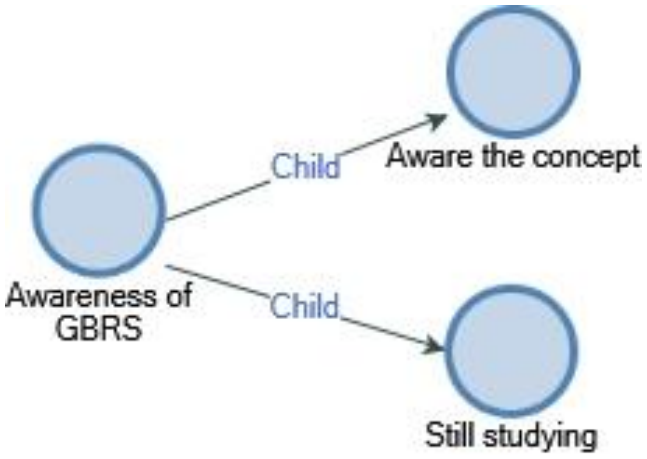


Figure 19: Awareness of GBRS as a Concept

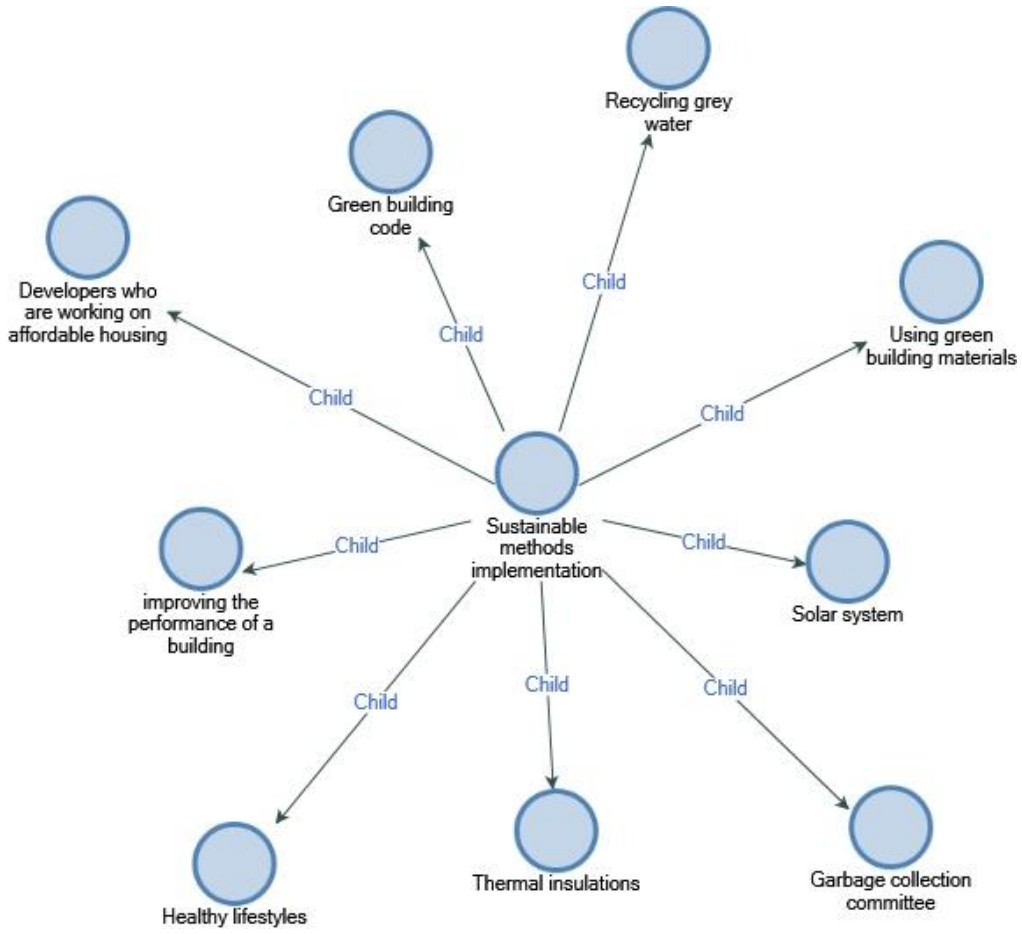


Figure 20: Sustainable Methods Implementation

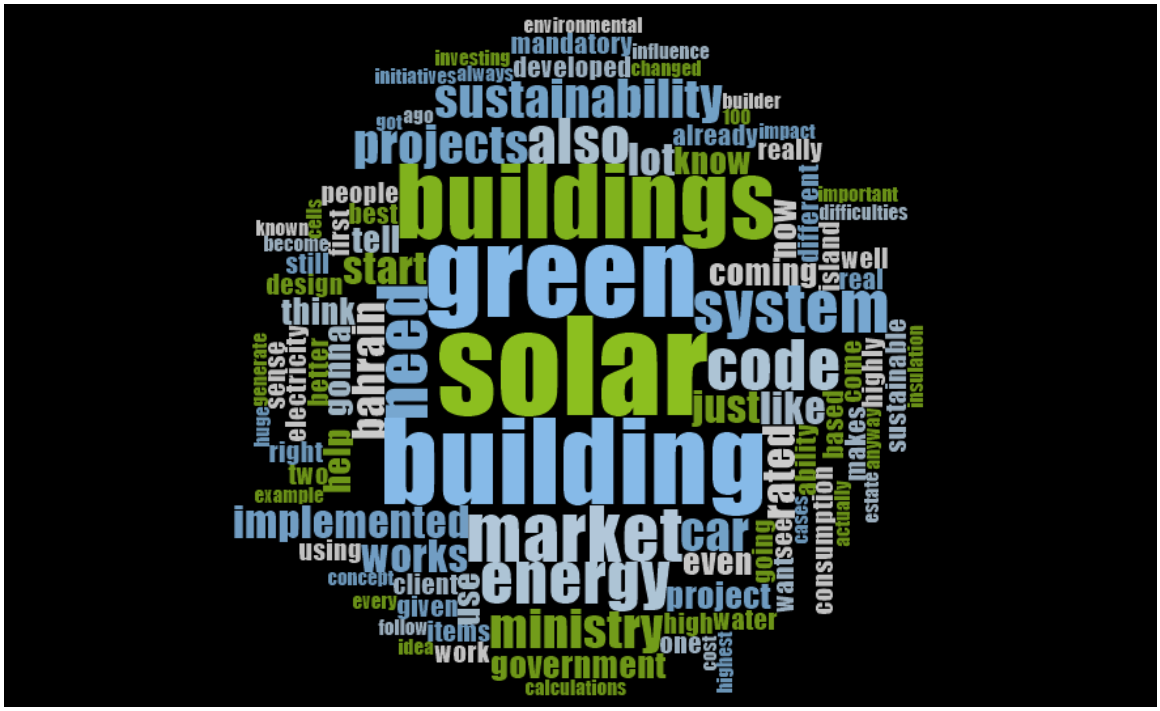


Figure 21: Qualitative Analysis Word Map

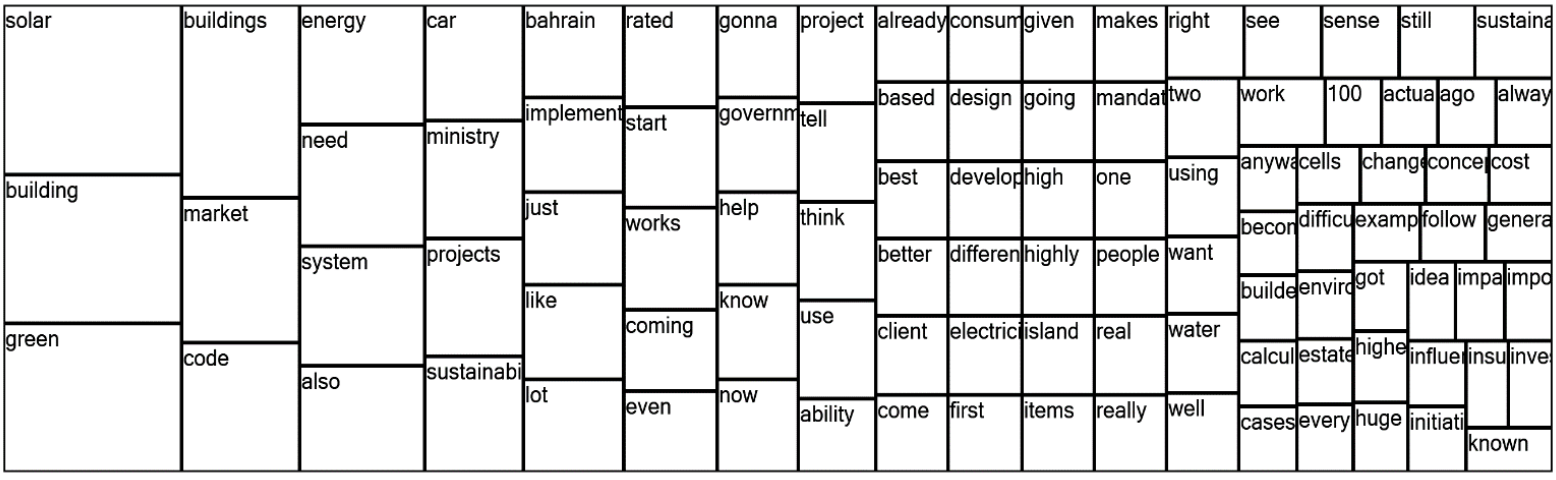


Figure 22: Qualitative Analysis Tile Map

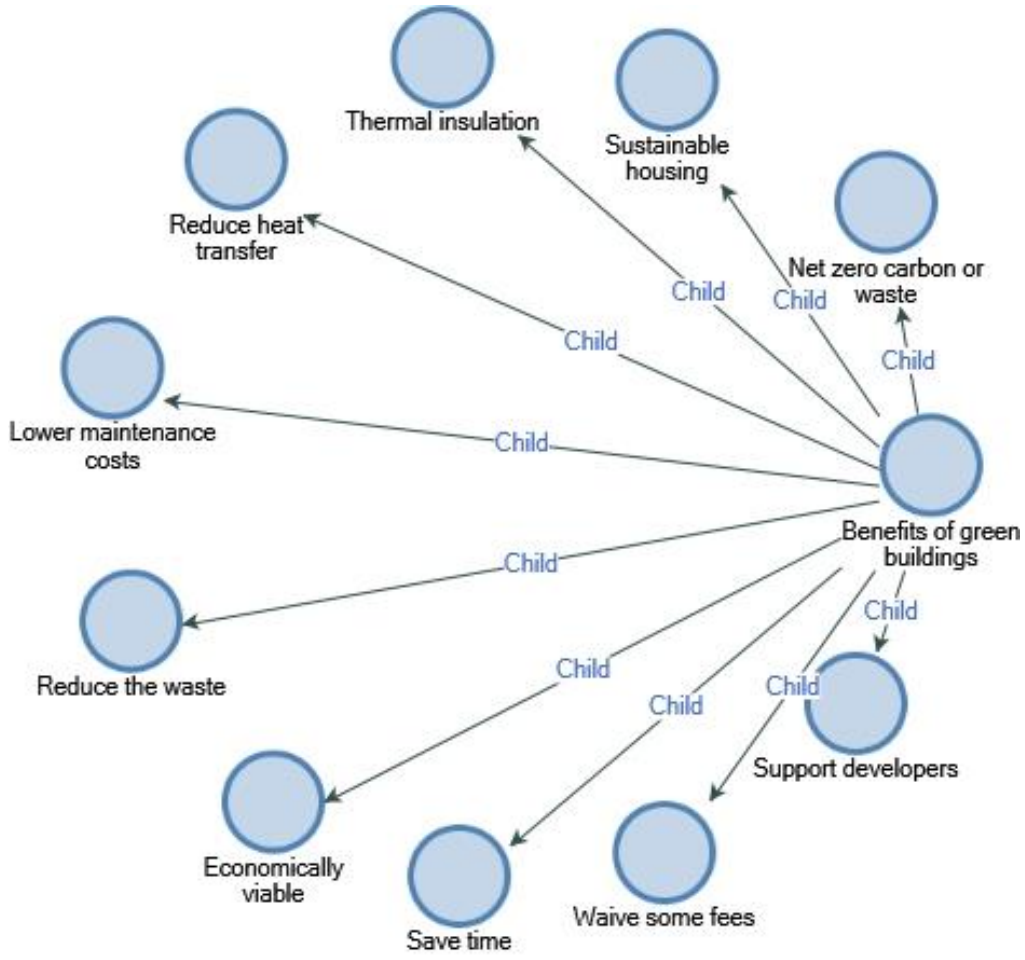


Figure 23: Qualitative Analysis on Benefits of GBs



Figure 24: Word Map on Benefits of GB

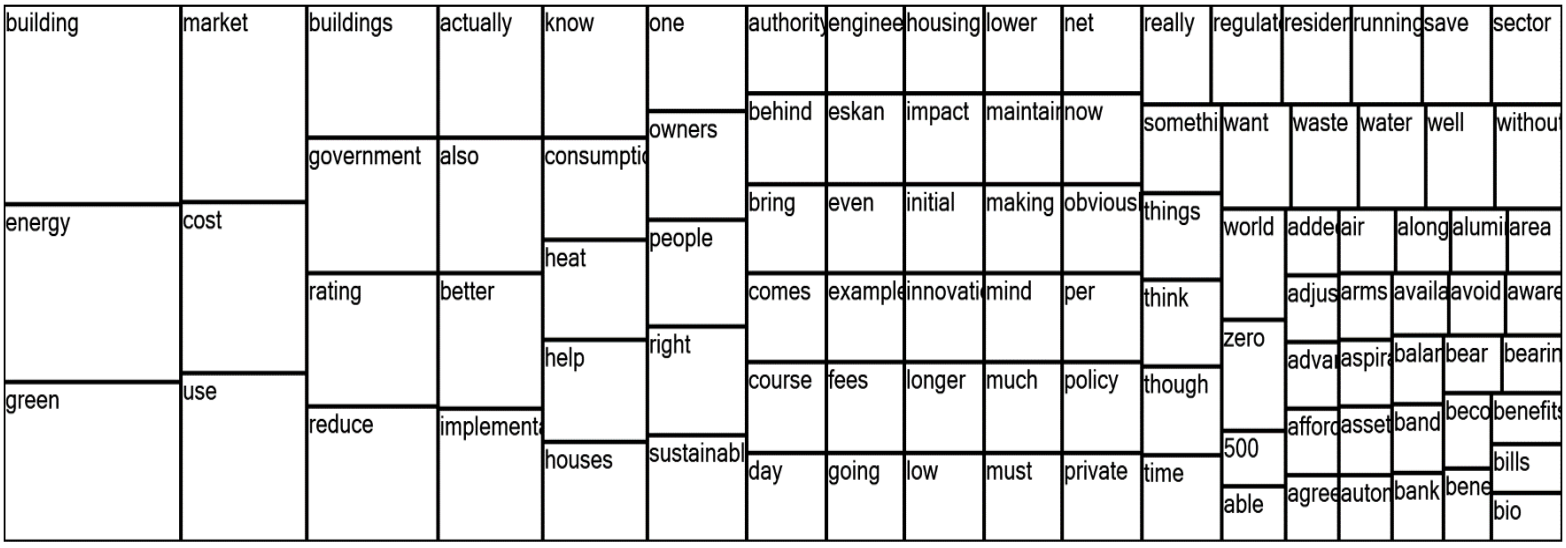


Figure 25: Benefits of GB Tile Map

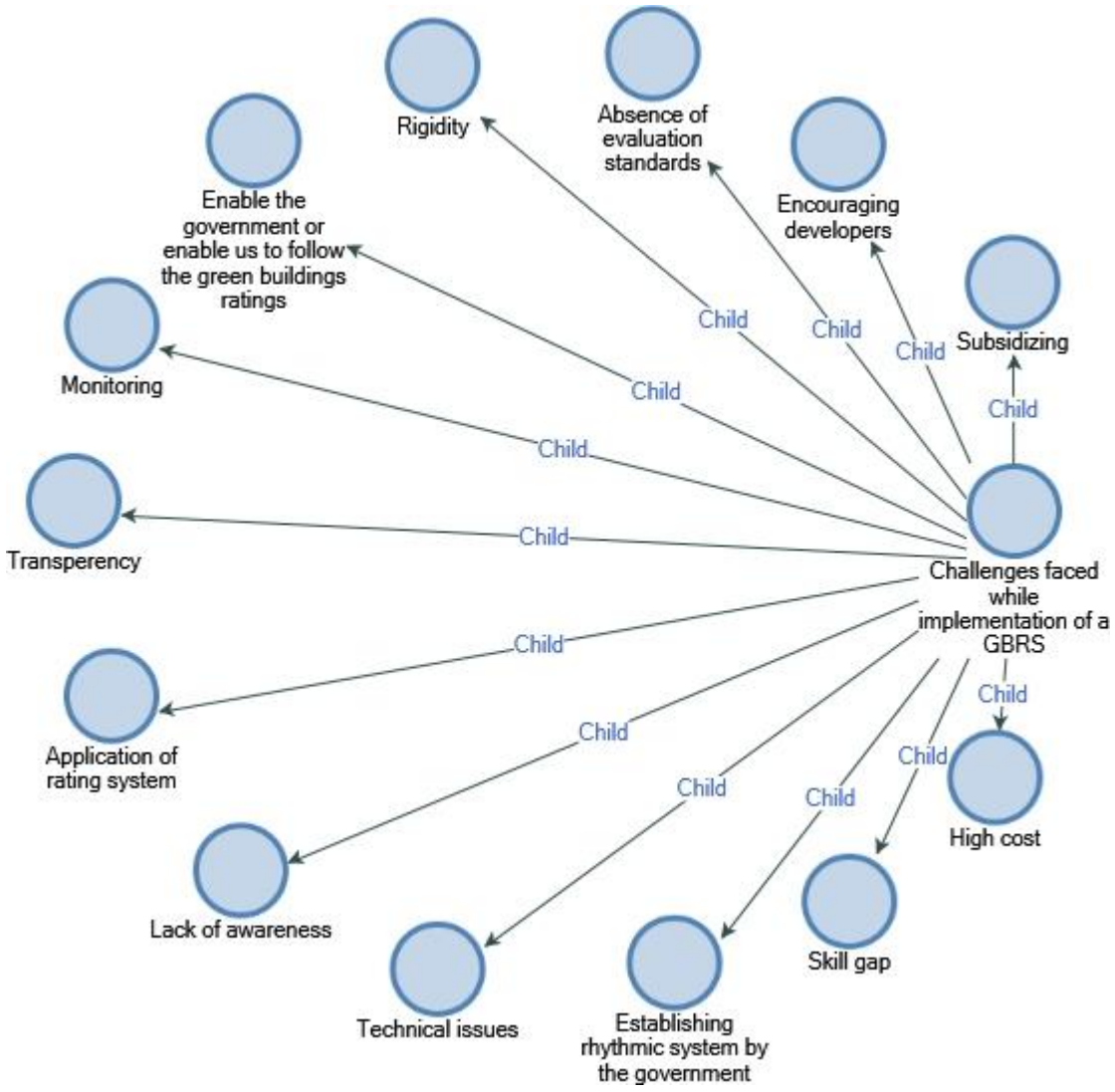


Figure 26: Challenges Faced While Implementing a GBRS



Figure 27: Word Map on Challenges Faced While Implementing a GBRS

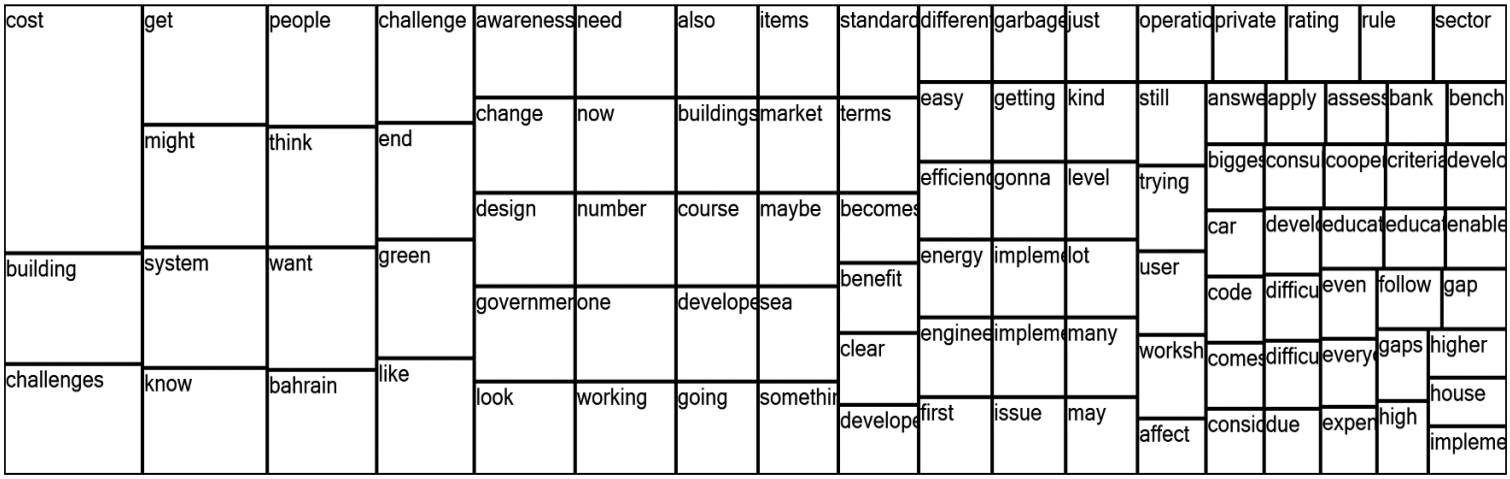


Figure 28: Tile Map on Challenges Faced While Implementing a GBRS

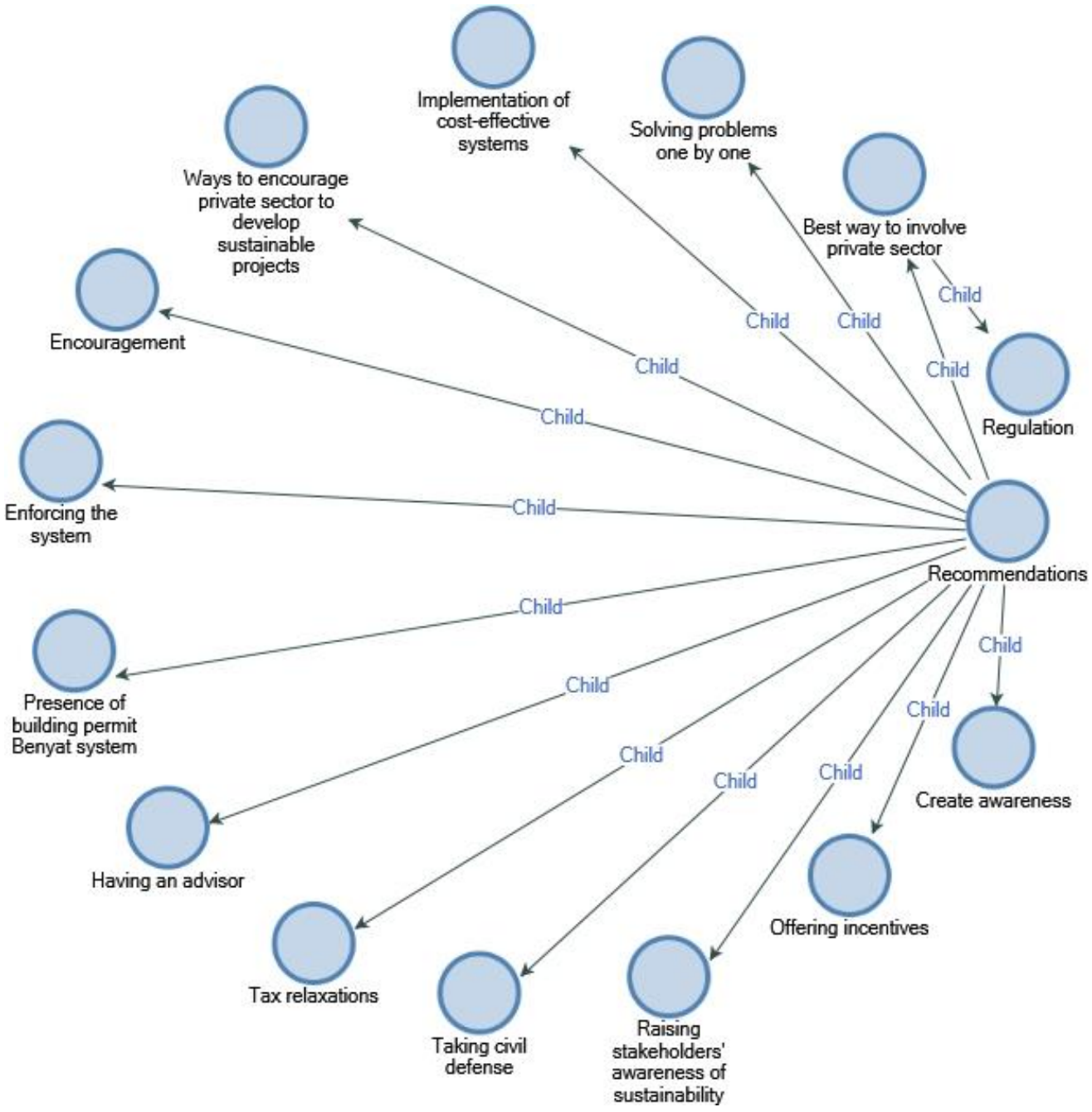


Figure 29: Qualitative Analysis on Recommendations from Participants



Figure 30: Word Map on Recommendations from Participants

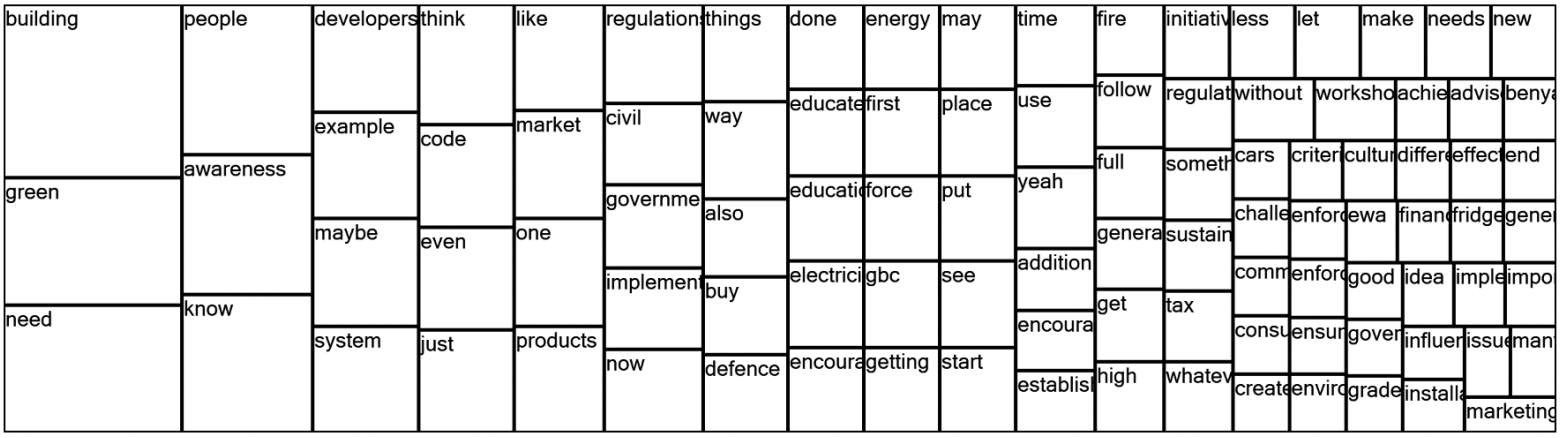


Figure 31: Tile Map on Recommendations from Participants

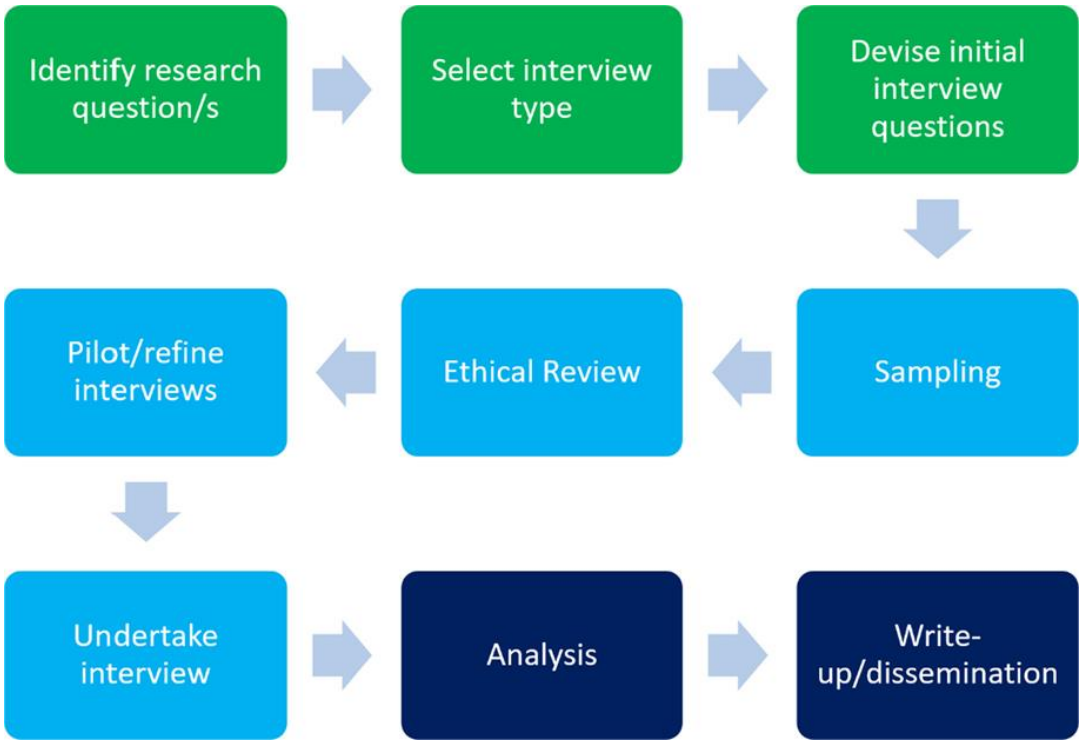


Figure 32*:* Research Processes

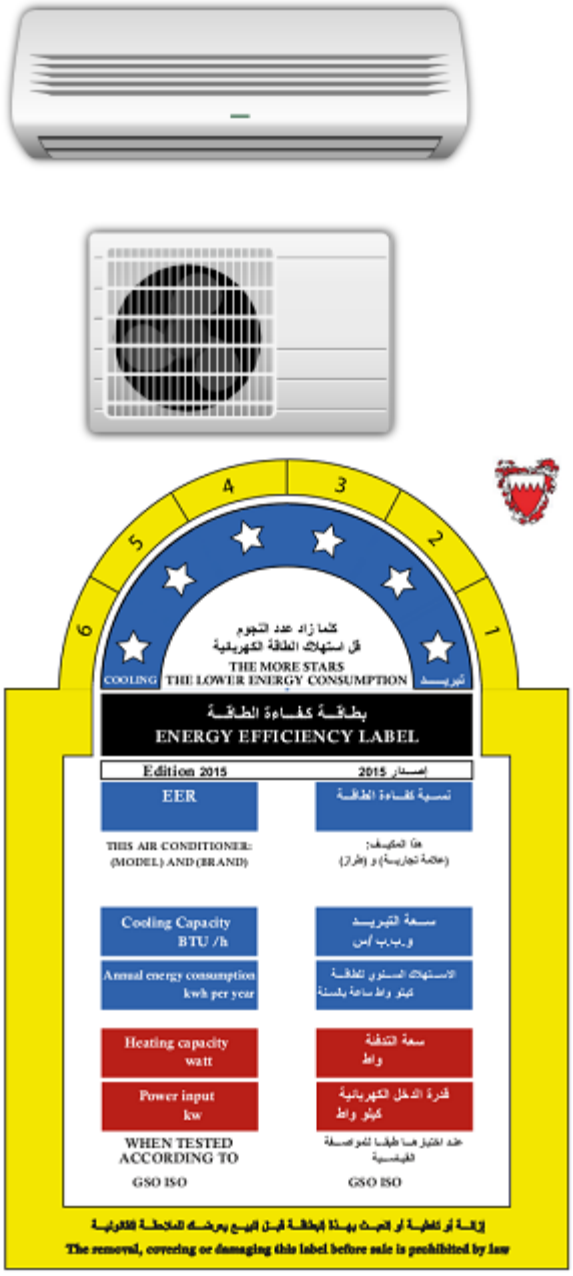


Figure 33: EWA Energy Efficiency Label of Colling Appliances

References

Abdellatif, H. (2014). ERP in higher education: A deeper look on developing countries. *2014 International Conference on Education Technologies and Computers, ICETC 2014*, (December 2014), 73–78. https://doi.org/10.1109/ICETC.2014.6998905

Abdul Mujeebu, M., & Alshamrani, O. S. (2016). Prospects of energy conservation and management in buildings - The Saudi Arabian scenario versus global trends. *Renewable and Sustainable Energy Reviews*, *58*, 1647–1663. https://doi.org/10.1016/j.rser.2015.12.327

Abidin, N. Z., & Powmya, A. (2013). Green Construction in Oman: Progress and Implementation Barriers. *SB 13 Dubai*.

Aboneama, W. A. (2018). *Creating a Unique Sustainable Rating System for Saudi Arabia to Achieve Environmental Assessment and 2030 Vision*. 269–279. https://doi.org/10.14207/ejsd.2018.v7n4p269

Addis, B. dan T. (2001). Sustainable construction procurement: a guide to delivering environmentally responsible projects. Retrieved May 21, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Addis%2C+B+dan+Talbot%2C+R+%282001%29%3A+Sustainable+Construction+Procurement%3A+A+Guide+To+Delivering&btnG=#d=gs_cit&t=1653151000403&u=%2Fscholar%3Fq%3Dinfo%3AbjwZlB4lDjQJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D0%26hl%3Den

Adnan, S., & Jalala, A. B. U. (2016). *Net Zero Energy District NZED: A Strategy Towards Achieving Sustainable Urban Development In Qatar*. (January).

Agency, U. S. E. P., Brownfields, O., & Revitalization, L. (2020). *Environmental Benefits of Brownfields Redevelopment — A Nationwide Assessment*. (May).

Ahmed, A., Almanea, A., & A Alsuliman. (2021). A case study on Green Buildings and its applicability in Bahrain. *Ieeexplore.Ieee.Org*. Retrieved from https://ieeexplore.ieee.org/abstract/document/9668090/

Ahmed, F. A. (2019). *Development of Green Building Rating System for Evaluating Existing Office Buildings in Dubai Based on Al Sa' fat Rating System by Fatima Ahmed Ahmed Diss*. (March).

Ajmi, A. N., El Montasser, G., & Nguyen, D. K. (2014). *Carbon emissions - income relationships with structural breaks: the case of the Middle East and North African countries Ahdi Noomen Ajmi Ghassen El Montasser Carbon emissions - income relationships with structural breaks : the case of the Middle East and*.

Akadiri, P. O., Chinyio, E. A., & Olomolaiye, P. O. (2012). Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. *Buildings*, *2*(2), 126–152. https://doi.org/10.3390/buildings2020126

Akdag, H. C., & Beldek, T. (2017). Waste management in green building operations using GSCM. *International Journal of Supply Chain Management*, *6*(3), 174–180.

Ali, H. H., & al Nsairat, S. F. (2009). Developing a green building assessment tool for developing countries - Case of Jordan. *Building and Environment*, *44*(5), 1053–1064. https://doi.org/10.1016/j.buildenv.2008.07.015

Ali, M. M., & Al-kodmany, K. (2012). *Tall Buildings and Urban Habitat of the 21st Century: A Global Perspective*. 384–423. https://doi.org/10.3390/buildings2040384

Ali, Z. F. (2016). *Environmentally Sustainable Library Buildings: Opportunities and Challenges for Asian Countries*. 1–13.

Allen, J., & Health, P. (2015). *How a green building influences the health of its occupants*. (July), 2–3. Retrieved from https://medicalxpress.com/news/2015-07-green-health-occupants.html

Ana-cristina Tudora. (2011). Assessments Criteria of Building Materials from Ecological Point Of View. *Universitatea Tehnică „Gheorghe Asachi" Din Iaşi Tomul LIV (LVIII)*, (Lviii), 129–138.

Arabia, S., Al-alawi, A. B., & Cavallari, G. (2020). *State of Play for in Gulf Cooperation Council Circular Built Environment*.

Alareeni, B., & Alqahtani, H. (2020). Evaluation of Sustainable Buildings Construction in the Kingdom of Bahrain. *Journal of Sustainable Construction Materials and Technologies*, *5*(2), 450–466. https://doi.org/10.29187/jscmt.2020.49

Arnould, E. J., & Wallendorf, M. (1994). Market-Oriented Ethnography: Interpretation Building and Marketing Strategy Formulation. *Journal of Marketing Research*, *31*(4), 484–504. https://doi.org/10.1177/002224379403100404

Ashuri, B. (2010). An overview of the benefits and risk factors of going green in existing buildings. *Community.Ifma. Org*, *1*(1). Retrieved from https://sci-hub.ren/https://community.ifma.org/cfs-file/__key/telligent-evolution-components-attachments/13-467-00-00-01-05-75-18/2010_5F00_An-Overview-of-the-Benefits-and-Risk-Factors-of-Going-Green-in-Existing-Buildings_5F00_Article.pdf

Asif, M. (2016). Growth and sustainability trends in the buildings sector in the GCC region with particular reference to the KSA and UAE. *Renewable and Sustainable Energy Reviews*, *55*, 1267–1273. https://doi.org/10.1016/j.rser.2015.05.042

Alasuutari, P. (2010). The rise and relevance of qualitative research. *International Journal of Social Research Methodology*, *13*(2), 139–155. https://doi.org/10.1080/13645570902966056

Attia, S., & Ap, L. (2014). The Usability of Green Building Rating Systems in Hot Arid Climates. *The Usability of Green Building Rating Systems in Hot Arid Climates. ASHRAE Energy & Indoor Environment for Hot Climates.*

Awadh, O. (2017a). Author' s Accepted Manuscript Sustainability and Green Building Rating Systems : *Journal of Building Engineering*. https://doi.org/10.1016/j.jobe.2017.03.010

Awadh, O. (2017b). Author' s Accepted Manuscript Sustainability and Green Building Rating Systems : *Journal of Building Engineering*. https://doi.org/10.1016/j.jobe.2017.03.010

Awadh, O. (2017c). Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis. *Journal of Building Engineering*, *11*, 25–29. https://doi.org/10.1016/J.JOBE.2017.03.010

Awadhi, M. H. al. (2011). *Comfort Assessment of a Fully / Semi-enclosed Courtyard: Case Study of Bahrain Low Rise Villa Housing Model By Maryam Hasan Al Awadhi Dissertation submitted in pa*. (June).

al Faridha Project| Alsaraya-Bahrain. (2022). Al Faridha | Alsarayabahrain. Retrieved June 11, 2022, from https://alsarayabahrain.bh/portfolio/al-faridha/

Azizi, M. S., Fassman, E., & Wilkinson, S. (2011). *Risks associated in implementation of green buildings*. *148*, 148–162.

Bahadori, H., Hasheminezhad, A., & Karimi, A. (2017). Development of an integrated model for seismic vulnerability assessment of residential buildings: Application to Mahabad City, Iran. *Journal of Building Engineering*, *12*(April 2021), 118–131. https://doi.org/10.1016/j.jobe.2017.05.014

Bahrain, E. L. in. (2018). *Environmental Legislations in Bahrain*. 2018.

Bailey Lawrence F Bailey, L. F. (2014). The origin and success of qualitative research. *International Journal of Market Research*, *56*(2). https://doi.org/10.2501/IJMR-2014-013

Baker, S. E., & Edwards, R. (2012). *How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research*.

Baker, S. E., & Edwards, R. (n.d.). *How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research*.

Balabel, A., & Alwetaishi, M. (2021). Towards sustainable residential buildings in saudi arabia according to the conceptual framework of "mostadam" rating system and vision 2030. *Sustainability (Switzerland)*, *13*(2), 1–16. https://doi.org/10.3390/su13020793

Banani, R., Vahdati, M., & Elmualim, A. (2013). Demonstrating the importance of criteria and sub-criteria in building assessment methods. *WIT Transactions on Ecology and the Environment*, *173*, 443–454. https://doi.org/10.2495/SDP130371

Bauer, M. & S. M. (2007). Green Building: Guidebook for Sustainable Architecture. Retrieved May 21, 2022, from https://books.google.com.bh/books?hl=en&lr=&id=Xl1nzbozt8QC&oi=fnd&pg=PA24&dq=Bauer,+Michael.+(2007):+Green+Building,+Guide+Book+for+Sustainable+Architecture,+Springer,+Berlin&ots=h_ozZgb41c&sig=8x-TW5d1PXOqjtD4nCBmk6H2okQ&redir_esc=y#v=onepage&q=Bauer%2C%20Michael.%20(2007)%3A%20Green%20Building%2C%20Guide%20Book%20for%20Sustainable%20Architecture%2C%20Springer%2C%20Berlin&f=false

Bayraktar, M. E., & Owens, C. R. (2010). LEED implementation guide for construction practitioners. *Journal of Architectural Engineering*, *16*(3), 85–93. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000013

Becchio, C., Corgnati, S. P., Fabrizio, E., Monetti, V., & Seguro, F. (2014). Application of the LEED PRM to an Italian existing building. *Energy Procedia*, *62*, 141–149. https://doi.org/10.1016/j.egypro.2014.12.375

Benayat -Bahrain. (2021). Benayat Building Permit Portal. Retrieved June 11, 2022, from https://www.benayat.bh/building-permits/public/about

Benayat Portal. (2022). Home | Benayat.bh. Retrieved June 11, 2022, from https://www.benayat.bh/building-permits/index

Bernard, H. (2017a). *Research methods in anthropology: Qualitative and quantitative approaches*. Retrieved from https://books.google.com/books?hl=en&lr=&id=2Fk7DwAAQBAJ&oi=fnd&pg=PP1&dq=Bernard,+H.R.+2002.+Research+Methods+in+Anthropology:+Qualitative+and+quantitative+methods.+3rd+edition.+AltaMira+Press+,Walnut+Creek,+California.&ots=HctxV9kKfo&sig=wSvdpi3TFhtC_mNHOAd9PMO44V4

Bernard, H. (2017b). *Research methods in anthropology: Qualitative and quantitative approaches*. Retrieved from https://books.google.com/books?hl=en&lr=&id=2Fk7DwAAQBAJ&oi=fnd&pg=PP1&dq=Bernard,+H.R.+2002.+Research+Methods+in+Anthropology:+Qualitative+and+quantitative+methods.+3rd+edition.+AltaMira+Press+,Walnut+Creek,+California.&ots=HctxV9kKfo&sig=wSvdpi3TFhtC_mNHOAd9PMO44V4

Bernardi, E., Carlucci, S., Cornaro, C., & Bohne, R. A. (2017). An analysis of the most adopted rating systems for assessing the environmental impact of buildings. *Sustainability (Switzerland)*, *9*(7), 1–27. https://doi.org/10.3390/su9071226

Bertrand, L. (2010). *How Can Developers Harvest the Benefits of Green Building While Reducing the Risks and Cost of Green Building Accreditation* (May), 4 – 6.

Birks, M., Mills, J., & ~s, ~. (2015). *Grounded theory: A practical guide*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=YsGICwAAQBAJ&oi=fnd&pg=PP1&dq=Birks+and+Mills+(2015)+&ots=-O2pkTHiVs&sig=cvg80hCVo58J8CdxA-tJ99Ohu5E

Black, I. R., & Cherrier, H. (2010). Anti-consumption as part of living a sustainable lifestyle: Daily practices, contextual motivations and subjective values. *Journal of Consumer Behaviour*, *9*(6), 437–453. https://doi.org/10.1002/CB.337

Blunk, S. (2019). *2019 CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGreen) TITLE 24, PART 11 By: Scott Blunk*.

Boake (2005). *LEED: A Primer*. 4–7.

Bordass, B., Cohen, R., Standeven, M., & & Leaman. (2002). Bordass, B., Cohen, R., Standeven, M., & Leaman, - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Bordass%2C+B.%2C+Cohen%2C+R.%2C+Standeven%2C+M.%2C+%26+Leaman%2C+A.+%282001%29.+Assessing+building+performance+in+use+3%3A+Energy+performance+of+the+Probe+buildings.+Building+Research+and+Information&btnG=

Bougdah, H., & Sharples, S. (2009). Environment, technology and sustainability. *Environment, Technology and Sustainability*,

9780203878408, 1–303. https://doi.org/10.4324/9780203878408/ENVIRONMENT-TECHNOLOGY-SUSTAINABILITY-HOCINE-BOUGDAH-STEPHEN-SHARPLES

BREEAM -BRE. (2021). BREEAM Projects. Retrieved June 11, 2022, from https://tools.breeam.com/projects/index.jsp

Brod, M., Tesler, L. E., & Christensen, T. L. (2009). Qualitative research and content validity: Developing best practices based on science and experience. *Quality of Life Research*, *18*(9), 1263–1278. https://doi.org/10.1007/S11136-009-9540-9

Brousselle, A., Benmarhnia, T., & Benhadj, L. (2016). What are the benefits and risks of using return on investment to defend public health programs? *Preventive Medicine Reports*, *3*, 135–138. https://doi.org/10.1016/j.pmedr.2015.11.015

Buchbinder, E. (2010). Beyond Checking: Experiences of the Validation Interview. *Http://Dx.Doi.Org/10.1177/1473325010370189*, *10*(1), 106–122. https://doi.org/10.1177/1473325010370189

Buildings, U. S. G. S. A. P. (2019). *performance*.

Built Environment Efficiency (BEE). (2021). Built Environment Efficiency (BEE). Retrieved June 11, 2022, from https://www.ibec.or.jp/CASBEE/english/beeE.htm

Burg, E., & Hupp, E. B. (2016). *Recent Trend in Green Buildings Laws: Potential Preemption of Green Building and Whether Retrofitting Existing Buildings Will Reduce Greenhouse Gases and Save the Economy*

Recent Trend in Green Buildings Laws : Potential Preemption of Green Building and W. 41(3), 489–499.

Burroughs, S. (2017). Development of a Tool for Assessing Commercial Building Resilience. *Procedia Engineering*, *180*, 1034–1043. https://doi.org/10.1016/j.proeng.2017.04.263

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. *Neurological Research and Practice 2020 2:1*, *2*(1), 1–10. https://doi.org/10.1186/S42466-020-00059-Z

Business Licensing System (SIJILAT)- Bahrain. (2021). Business Licensing System (SIJILAT). Retrieved June 11, 2022, from https://www.moic.gov.bh/en/eServices/sijilat-commericial

C Graue. (2015). Qualitative data analysis. *Circleinternational.Co.Uk*. Retrieved from https://sci-hub.ren/https://www.circleinternational.co.uk/wp-content/uploads/2021/01/IJSRM4-9.pdf#page=9

Carlson, J. A. (2010). Avoiding Traps in Member Checking. *The Qualitative Report*, *15*(5), 1102–1113. https://doi.org/10.46743/2160-3715/2010.1332

Case, D., & Given, L. (2016). *Looking for information: A survey of research on information seeking, needs, and behavior*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=IAYvDAAAQBAJ&oi=fnd&pg=PP1&dq=Given+(2016)&ots=Y_TPfyrSz8&sig=CmrwxWI1f_jJMY1gS3-JN6Ky05U

Castro-Lacouture, D., Sefair, J. A., Flórez, L., & Medaglia, A. L. (2009). Optimization model for the selection of materials using a LEED-based green building rating system in Colombia. *Building and Environment*, *44*(6), 1162–1170. https://doi.org/10.1016/j.buildenv.2008.08.009

Chance, S. (2012). *Planning for Environmental Sustainability: Learning from LEED and the USGBC Dublin Institute of Technology View project RoboSlam View project*. Retrieved from https://www.researchgate.net/publication/299251812

Chethana, M., Sorokhaibam, L. G., Bhandari, V. M., Raja, S., & Ranade, V. v. (2016). Green Approach to Dye Wastewater Treatment Using Biocoagulants. *ACS Sustainable Chemistry and Engineering*, *4*(5), 2495–2507. https://doi.org/10.1021/ACSSUSCHEMENG.5B01553

Chew, M. Y. L., & Das, S. (2008). Building grading systems: A review of the state-of-the-art. *Architectural Science Review*, *51*(1), 3–13. https://doi.org/10.3763/ASRE.2008.5102

Choi, J. O., Bhatla, A., Stoppel, C. M., & Shane, J. S. (2015). LEED credit review system and optimization model for pursuing LEED certification. *Sustainability (Switzerland)*, *7*(10), 13351–13377. https://doi.org/10.3390/su71013351

Colliver, R. A. (2007). Colliver, R. A. (2007). Assessing and Allocating... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Colliver%2C+R.+A.+%282007%29.+Assessing+and+Allocating+Risks+Associated+with+Green+Development+Projects+The+Law+of+Building+Green+%281st+ed.%2C+pp.+5-15%29%3A+Stoel+Rives+LLP.+&btnG=

Connolly, J., & Prothero, A. (2003). Sustainable consumption: Consumption, consumers and the commodity discourse. *Consumption Markets and Culture*, *6*(4), 275–291. https://doi.org/10.1080/1025386032000168311

Cooper, & Schindler. (2006). Business research methods. *Business Research Methods.*

Corbin, J., & Strauss, A. (1990). Grounded Theory Research: Procedures, Canons and Evaluative Criteria. *Zeitschrift Für Soziologie*, *19*(6), 418–427. https://doi.org/10.1515/ZFSOZ-1990-0602/PDF

Creswell, J. (2012). Design: Choosing Among Five Approaches. In *Design: Choosing Among Five Approaches* (Vol. 3).

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative Research Designs. *The Counseling Psychologist*, *35*(2), 236–264. https://doi.org/10.1177/0011000006287390

Cupido, A. F., Baetz, B. W., Pujari, A., & Chidiac, S. (2010). Evaluating institutional green building policies: A mixed-methods approach. *Journal of Green Building*, *5*(1), 115–131. https://doi.org/10.3992/jgb.5.1.115

Darko, A., & Chan, A. P. C. (2017). Review of Barriers to Green Building Adoption. *Sustainable Development*, *25*(3), 167–179. https://doi.org/10.1002/sd.1651

Dawoud, M. A. (2005). *The role of desalination in augmentation of water supply in GCC countries*. *186*, 187–198.

Deerat Al Oyoun. (2021). Home - ديرة العيون - Deerat Al Oyoun. Retrieved June 11, 2022, from https://deerat-aloyoun.com/en/

Diaz-sarachaga, J. M., & Jato-espino, D. (2019). Do sustainable community rating systems address resilience? *Cities*, *93*(October 2018), 62–71. https://doi.org/10.1016/j.cities.2019.04.018

Dikilitaş, K., & Griffiths, C. (2017). Research Methods: Options and Issues. *Developing Language Teacher Autonomy through Action Research*, 61–87. https://doi.org/10.1007/978-3-319-50739-2_3

Ding, Z., Fan, Z., Tam, V. W. Y., Bian, Y., Li, S., Illankoon, I. M. C. S., & Moon, S. (2018). Green building evaluation system implementation. *Undefined*, *133*, 32–40. https://doi.org/10.1016/J.BUILDENV.2018.02.012

Doan, D., Ghaffarianhoseini, A., Environment, N. N.-… and, & 2017, undefined. (2017). A critical comparison of green building rating systems. *Elsevier*. Retrieved from https://www.sciencedirect.com/science/article/pii/S0360132317302937

Doan, D. T., Ghaffarianhoseini, A., Naismith, N., Zhang, T., Ghaffarianhoseini, A., & Tookey, J. (2017). A critical comparison of green building rating systems. *Building and Environment*, *123*, 243–260. https://doi.org/10.1016/j.buildenv.2017.07.007

Doan, D. T., Ghaffarianhoseini, A., Zhang, T., Rehman, A. U., Naismith, N., Tookey, J., & Ghaffarianhoseini, A. (2016). Green Building Assessment Schemes: A critical comparison among BREEAM , LEED , and Green Star NZ. *International Conference on Sustainable Built Environment*, (December), 474–478.

Dormon, E. (2008). *The Journal of Agricultural Education An Introduction to Sustainable Development, edited by P . P. Rogers, K . F. Jalal, and J . A. Boyd. Published by The continuing education division of Harvard University, Cambridge , 1844075214), hardback [eu*. (December 2014), 37–41. https://doi.org/10.1080/13892240802416285

Dorsey, J. W. (2003). Brownfields and greenfields: The intersection of sustainable development and environmental stewardship. *Environmental Practice*, *5*(1), 69–76. https://doi.org/10.1017/S1466046603030187

Douell, M. (2020). *Integrating Google Forms as a Means of Formative Assessment Integrating Google Forms as a Means of Formative Assessment in the Elementary Math Classroom in the Elementary Math Classroom*. Retrieved from https://egrove.olemiss.edu/hon_thesis/1467

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532. https://doi.org/10.2307/258557

Eisenstein, W., Fuertes, G., Kaam, S., Seigel, K., Arens, E., & Mozingo, L. (2017a). Climate co-benefits of green building standards: water, waste and transportation. *Building Research and Information*, *45*(8), 828–844. https://doi.org/10.1080/09613218.2016.1204519

Eisenstein, W., Fuertes, G., Kaam, S., Seigel, K., Arens, E., & Mozingo, L. (2017b). Climate co-benefits of green building standards: water, waste and transportation. *Building Research and Information*, *45*(8), 828–844. https://doi.org/10.1080/09613218.2016.1204519

Electricity and Water Authority (EWA). (2021). Welcome to EWA Website. Retrieved June 11, 2022, from https://www.ewa.bh/en

Emirates Green Building Council. (2021). Emirates GBC. Retrieved June 11, 2022, from https://emiratesgbc.org/

Endo, J., Murakami, S., & Ikaga, T. (2007). Application of a Building Environmental Assessment, CASBEE, and its Influence on the Building Market. *Sustainable Building Asia*, (June), 305–310. Retrieved from http://www.irbnet.de/daten/iconda/CIB8054.pdf

Eskan Bank Bahrain. (2021). Contact Us - Eskan Bank Bahrain. Retrieved June 11, 2022, from https://www.eskanbank.com/en/contact-us/

Fadli, F. (2014). New Generation Sustainability Assessment Models (SAMs) Applications for Urban Districts & Neighbourhoods. *New Generation Sustainability Assessment Models (SAMs) Applications for Urban Districts & Neighbourhoods. World SB14*, *7.*, 1–7.

Fan, Y. (2003). *The Costs and Financial Benefits of Green Buildings A Report to California's Sustainable Building Task Force*.

Ferwati, M. S., al Saeed, M., Shafaghat, A., & Keyvanfar, A. (2019). Qatar Sustainability Assessment System (QSAS)-Neighborhood Development (ND) Assessment Model: Coupling green urban planning and green building design. *Journal of Building Engineering*, *22*(December 2018), 171–180. https://doi.org/10.1016/j.jobe.2018.12.006

Ferwati, S., & Alsaeed, M. (n.d.). *Qatar Sustainability Assessment System (QSAS) -Neighborhood Development (ND) Assessment Model : Coupling green*

Florez, L. (2020). Sustainability and Green Building Rating Systems: A Critical Analysis to Advance Sustainable Performance. *Encyclopedia of*

Renewable and Sustainable Materials, (January 2019), 211–220. https://doi.org/10.1016/b978-0-12-803581-8.11411-0

Forman, J., Damschroder, L., & Content, Q. (2015). *Empirical Methods for Bioethics: A Primer Qualitative Content Analysis Article information :*

Fossey, E., Harvey, C., McDermott, F., & Davidson, L. (2002). Understanding and evaluating qualitative research. *Australian and New Zealand Journal of Psychiatry*, *36*(6), 717–732. https://doi.org/10.1046/J.1440-1614.2002.01100.X

Fowler, K. M., & Rauch, E. M. (2006). Sustainable Building Rating Systems Summary. *Contract*, (July 2006), 1–55.

Frank, L. D., & Engelke, P. O. (2001). The built environment and human activity patterns: Exploring the impacts of urban form on public health. *Journal of Planning Literature*, *16*(2), 202–218. https://doi.org/10.1177/08854120122093339

Fugard, A. J., & Potts, H. W. (2015). Supporting thinking on sample sizes for thematic analyses: a quantitative tool. *International Journal of Social Research Methodology*, *18*(6), 669–684. https://doi.org/10.1080/13645579.2015.1005453

Furlan, R., & Sipe, N. (2017). *Light rail transit (LRT) and transit villages in Qatar : A planning strategy to revitalise the built environment of Doha*. (January).

Galbraith, K., Consultants, K. E. O. I., & Pe, K. G. (2008). *Title: Author : Subjects : Structural Sustainability in the Gulf – Fact and Fiction Conference proceeding Unpublished conference paper Magazine article*

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Gergen, K. J., Josselson, R., & Freeman, M. (2015). The promises of qualitative inquiry. *American Psychologist*, *70*(1), 1–9. https://doi.org/10.1037/a0038597

Giama, E., & Papadopoulos, A. M. (2015). *Construction Materials and Green Building Certification Construction Materials and Green Building Certification*. (October). https://doi.org/10.4028/www.scientific.net/KEM.666.89

Gibberd, J. (2014). *Green Building Handbook for South Africa Chapter: Building Envelope and Water Conservation*. (May), 1–6.

Gibberd, J. (2015). Measuring capability for sustainability: The Built Environment Sustainability Tool (BEST). *Building Research and Information*, *43*(1), 49–61. https://doi.org/10.1080/09613218.2014.930257

Gibbs, D., & Neill, K. O. (2012). Green Entrepreneurship: Building a Green Economy? – Evidence from the UK. In *Contemporary Issues in Entrepreneurship Research* (Vol. 2). Emerald Group Publishing Ltd. https://doi.org/10.1108/S2040-7246(2012)0000002008

Glass, J. (2012). The State of Sustainability Reporting in the Construction Sector. https://doi.org/10.1108/20466091211227070

Gluch, P. (2006). Building green perspectives on environmental management in construction. In *Doktorsavhandlingar vid Chalmers Tekniska Hogskola*.

Gobbi, S., Puglisi, V., Procedia, A. C.-E., & 2016, undefined. (2016). A rating system for integrating building performance tools in developing countries. *Energy Procedia*, *96*, 1876–6102. https://doi.org/10.1016/j.egypro.2016.09.156

Goldberg (2006a). Foundations — the Base of Sustainable. *Journal of Green Building*, *1*(3), 46–57.

GORD. (2019). *Crafing a Green Legacy Design & Build Guidelines Manual for Building Typologies.*

Gou, Z., Lau, S., Building, D. P.-J. of G., & 2013, undefined. (2013). Market readiness and policy implications for green buildings: case study from Hong Kong. *Meridian.Allenpress.Com*. Retrieved from https://sci-hub.ren/https://meridian.allenpress.com/jgb/article-abstract/8/2/162/116390

Gov, L. D. 21 B. (2016). *Bahrain Legislative Decree No. (21) for the year 1996 on the Legislative Decree No . (21) for the year 1996 on the 0 environment*. (3), 1–6.

Gowri, K. (2004). Green Building Rating Systems: An Overview. *Undefined*.

Green Building Council. (2022). *LEED rating system | U.S. Green Building Council*. https://www.usgbc.org/leed

Griffiths, S., & Sovacool, B. K. (2020). Rethinking the future low-carbon city: Carbon neutrality, green design, and sustainability tensions in the making of Masdar City. *Energy Research and Social Science*, *62*(April), 101368. https://doi.org/10.1016/j.erss.2019.101368

GSAS. (2021). GSAS Overview – GSAS Trust. Retrieved June 11, 2022, from https://gsas.gord.qa/gsas-overview/

Gu, D., Andreev, K., & Dupre, M. E. (2021). Major Trends in Population Growth Around the World. *China CDC Weekly*, *3*(28), 604. https://doi.org/10.46234/CCDCW2021.160

Gu, Z., Wennersten, R., & Assefa, G. (2006). Analysis of the most widely used Building Environmental Assessment methods. *Environmental Sciences*, *3*(3), 175–192. https://doi.org/10.1080/15693430600903230

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. 294.

Gubrium, J., & Holstein, J. (2001). *Handbook of interview research: Context and method*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=N5leBAAAQBAJ&oi=fnd&pg=PT13&dq=(Gubrium+and+Holstein,+2001).&ots=xbDcxIeR5Y&sig=ig-EiJMODUAciD37emxyCxKG7EQ

Guest, G., Bunce, A., & Johnson, L. (2006). How Many Interviews Are Enough? *Field Methods*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Guimarães, E., Barbosa, J. A., & Bragança. (2016). Erika Guimarães José Amarilio Barbosa Luís Bragança. *Critical Overview of Urban Sustainability Assessment Tools.*

GVA Grimley. (2007). GVA Grimley. (2007) Towards Sustainable Offices.... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=GVA+Gr

imley.+%282007%29+Towards+Sustainable+Offices.+Research+Bulletin%2C+Spring.&btnG=

Häkkinen, T., & Belloni, K. (2011). *Barriers and drivers for sustainable building*. *148*, 148–162.

Hall, S., Hopkins, E. A., & Hopkins, E. A. (2014). *LEED Certification of Campus Buildings: A Cost- Benefit Approach by*.

Hanatani, M. (2009). Hanatani, M. (2009, May 07, 2009). Green is an expensive... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Hanatani%2C+M.+%282009%2C+May+07+2009%29.+Green+is+an+expensive+designation.+Santa+Monica+Daily+Press.+Retrieved+from&btnG=

Al-Hashimi, & Khalid, A. (2021). *A Bioclimatic Study on Housing Patterns in Bahrain*.

Hatamleh, M. T., Hiyassat, M., Sweis, G. J., & Sweis, R. J. (2018). Factors affecting the accuracy of cost estimate: Case of Jordan. *Engineering, Construction and Architectural Management*, *25*(1), 113–131. https://doi.org/10.1108/ECAM-10-2016-0232

Al-Hathloul, S., & Mughal, M. A. (2004). Urban growth management-the Saudi experience. *Habitat International*, *28*(4), 609–623. https://doi.org/10.1016/j.habitatint.2003.10.009

Hayashi, T., & Hiyama, K. (2021). *CASBEE-Wellness Office: An objective measure of the building potential for a healthily built environment*. *4*(1), 233–240. https://doi.org/10.1002/2475-8876.12199

Hays, D. G., & Singh, A. A. (2011). Qualitative Inquiry in Clinical and Educational Settings. *Guilford Publications*, 504.

Heerwagen, J. (2000). Green buildings, organizational success and occupant productivity. *Building Research and Information*, *28*(5–6), 353–367. https://doi.org/10.1080/096132100418500

Heerwagen, & JA Wise. (1998). *Green building benefits: Differences in perceptions and experiences across manufacturing shifts*. Retrieved from https://sci-hub.ren/https://www.osti.gov/biblio/605735

Hegger, M., F. M. , S. T. , & Z. M. (2012). Energy Manual: Sustainable Architecture - Manfred Hegger, Matthias Fuchs, Thomas Stark, Martin Zeumer. Retrieved May 21, 2022, from https://books.google.com.bh/books?hl=en&lr=&id=IWPRAAAAQBAJ&oi=fnd&pg=PA6&dq=Energy+Manual,+Sustainable+Architecture,+Birkhauser,+Basel&ots=vE69WTIaFu&sig=gA6L93twuTp4hWXGRRcHArgP6LY&redir_esc=y#v=onepage&q=Energy%20Manual%2C%20Sustainable%20Architecture%2C%20Birkhauser%2C%20Basel&f=false

Helgeson, J. F., & Lippiatt, B. C. (2009). Multidisciplinary life cycle metrics and tools for green buildings. *Integrated Environmental Assessment and Management*, *5*(3), 390–398. https://doi.org/10.1897/IEAM_2008-069.1

Herzog, T. (2009). *World Greenhouse Gas Emissions in 2005*. 2005–2009.

Hijmans, E., & Kuyper, M. (2007). 4 Het halfopen interview als onderzoeksmethode. *Kwalitatief Onderzoek*, 43–51. https://doi.org/10.1007/978-90-313-6373-5_4

Hodgson, S., & Hanson, D. (2014). Enforcing nationalization in the GCC: Private sector progress, strategy and policy for sustainable nationalization. *Platform.Almanhal.Com*. Retrieved from https://sci-hub.ren/https://platform.almanhal.com/Files/Articles/43991

Holden, R. R. (2010). *Face validity*.

Hopkins, B. L., Cole, B. L., & Mason, T. L. (1998). *A Critique of the Usefulness of Inferential Statistics in Applied Behavior Analysis*. *1*(1), 125–137.

al Horr, Y., Arif, M., Kaushik, A., Elsarrag, E., & Mazroei, A. (2017). International Conference 2017: Shaping Tomorrow's Built Environment. . . *Health and Wellbeing in the Built Environment and Its Relevance in Global Sustainable Assessment System. Welcome to Delegates IRC 2017*, *929*, (September).

Housing laws and policies - Omanuna Portal. (2021). Retrieved June 11, 2022, from https://www.oman.om/wps/portal/index/cr/housing/housinglawsandpolicies/!ut/p/a1/hc_LDoIwEAXQr2HLDEUR3RWND1AqPrEbg6ZWEqAGUPx80bjR-JjdnZybzACHEHgWXWIZlbHKouSeubVlgWEZQ4Ye85cG0iEuAub0id1q1mBTA_wyFP_15yKDNfCfbGY8gYkDRNYeTbp01kTiEt8JWj7BJb4DbzGhSMxV322PLbPXazzBj0Nd4DJRu8fTG5rtTFsCz8VB5CLXz3m9PpblqehoqGFVVbpUSiZC36tUw0-VoypKCF8lnNLwOoqn6dou6A3wibeJ/dl5/d5/L0lKQSEvUUt3SS80RUkhL2Vu/

Housing, M. of. (2019). *Building Sustainable Cities*.

Hu, M., & Skibniewski, M. J. (2021). A Review of Building Construction Cost Research: Current Status, Gaps and Green Buildings. *Green Building & Construction Economics*, *2*(1), 1–17. https://doi.org/10.37256/gbce.212021768

Hu, Z., Yang, Z., Li, Q., Zhang, A., Huang, Y., Sabbagh, M. J., … Toggenberg, V. O. N. (2018). Qatar Sustainability Assessment System (QSAS)-Neighborhood Development (ND) Assessment Model: Coupling green urban planning and green building design. *Sustainability (Switzerland)*, *11*(March), 141–149. https://doi.org/10.3390/su11205545

Huimin, L., Mao Xiaoping, & Qiming, L. (2009). *A Comparison Study of Mainstream Sustainable/Green Building Rating Tools in the World*.

Information & eGovernment Authority - Benayat. (2021). Green Building Manual. Retrieved June 11, 2022, from Green Building Manual law 212, 2019 website: https://www.benayat.bh/building-permits/assets/Green_Building_Code_Eng_01.12.2021_PS_AG_v1.2_Master.pdf

Innovation, E. S. (2018). *The Kingdom of Bahrain Sustainable Energy Policies and Initiatives*. (April).

International Initiative for a Sustainable Built Environment. (2021). SBTool 2012-20 | International Initiative for a Sustainable Built Environment. Retrieved June 11, 2022, from https://iisbe.org/node/140

Ismaeel, W. S. E. (2019). Appraising a decade of LEED in the MENA region. *Journal of Cleaner Production*, *213*(December), 733–744. https://doi.org/10.1016/j.jclepro.2018.12.223

Ismaeel, W. S. E. (2020). LEED in the MENA Regionâ€¦Chances and Challenges of Change. *Green Energy and Technology*, (July), 237–252. https://doi.org/10.1007/978-3-030-24650-1_13

Ivanova, N., Gugleva, V., Dobreva, M., Pehlivanov, I., Stefanov, S., & Andonova, V. (2016). We are IntechOpen, the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %. *Intech*, *i*(tourism), 13.

J M Morse. (2000). *EDITORIAL Determining Sample Size What Factors Should Be Considered?*

Jadhav, N. Y. (2016). *Green and Smart Buildings- Advanced Technology options*. 155–170. https://doi.org/10.1007/978-981-10-1002-6

Jagannathan, P. R. (2014). Achieving low carbon buildings through policy instruments - Sharing the Trakhees-EHS Dubai experience. *Proceedings of the 2014 International Conference and Utility Exhibition on Green Energy for Sustainable Development, ICUE 2014*, (1), 1–10.

Jain, M. P. M., & Shandliya, P. V. K. (2013). *A survey paper on comparative study between Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA)*. *6*(2), 373–375.

Jamil, R., Ferwat, S., Alsaeed, M., & Komeily, A. (2014). *A Guide to Environmental Building Rating System for Construction of New Buildings in Saudi Arabia Related papers CONSTRUCTION OF NEW BUILDINGS IN SAUDI ARABIA*. *1*.

Janayin Al Hamala Project – Kingdom Properties. (2021). Janayin Al Hamala Project – Kingdom Properties. Retrieved June 11, 2022, from https://www.kprbh.com/janayin-al-hamala-project/

Jansen, H. (2007). 3 Systematiek en toepassing van de kwalitatieve survey. *Kwalitatief Onderzoek*, 27–41. https://doi.org/10.1007/978-90-313-6373-5_3

Al-Jebouri, M. F. A., Shaaban, A. K., Raman, S. N., & bin O. K. Rahmat, R. A. A. (2017). Framework of Environmental Rating System for Home Buildings in Oman. *Journal of Architectural Engineering*, *23*(2), 04017003. https://doi.org/10.1061/(asce)ae.1943-5568.0000241

JL Walker, & Martin. (2012). Research column. The Use of Saturation in Qualitative Research. *Search.Ebscohost.Com*. Retrieved from https://sci-hub.ren/http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=08436096&AN=74981872&h=SOkBCWk%2F%2FcdB4gX6KO6h4HT%2B%2BTr%2BMUZZBvR%2Fw7Y%2F3XtuVCayM22pQBnCWagTFbPXKeR%2FhtGcdReS5LfykDKlRw%3D%3D&crl=c

Jo, T. M., Ishak, S. S. M., & Rashid, Z. Z. A. (2018). Overview of the Legal Aspects and Contract Requirements of the BIM Practice in Malaysian Construction Industry. *MATEC Web of Conferences*, *203*, 02011. https://doi.org/10.1051/MATECCONF/201820302011

Kalmner, S. (2012). *The Implementation of BREEAM in a Construction Company Master of Science in Management Supervisor: Alexander Styhre*.

Kathy Charmaz. (2006). *Constructing_Grounded_Theory*.

Kazi, A. M., & Khalid, W. (2012). *Questionnaire designing and validation Introduction and Objectives: Questionnaire Development : Validity : Questionnaire Style and Appearance :*

Kerr, C., Nixon, A., & Wild, D. (2010). Assessing and demonstrating data saturation in qualitative inquiry supporting patientreported outcomes research. *Expert Review of Pharmacoeconomics and Outcomes Research*, *10*(3), 269–281. https://doi.org/10.1586/ERP.10.30

Khairy, H. (2017). Exploring the Implementation of Government Work Program towards Bahrain Economic Vision 2030 with Respect to Strategic and Project Management (A Retrospective Study for the Period 2011-2014). *International Journal of Inspiration & Resilience Economy*, *1*(1), 14–27. https://doi.org/10.5923/j.ijire.20170101.03

Al-Khalifa, F. A. (2018). International Sustainability Rating Tools: A Methodology for Adoption to Local Contexts. *KnE Engineering*, *3*(7), 274. https://doi.org/10.18502/keg.v3i7.3109

King, J., & Perry, C. (2017). *Smart Buildings: Using Smart Technology to Save Energy in Existing Buildings*. (February).

Kingdom of Bahrain - eGovernment Portal. (2021). Kingdom of Bahrain - eGovernment Portal. Retrieved June 11, 2022, from https://www.bahrain.bh/wps/portal/!ut/p/a1/hc_BCoJAEAbgZ-ng1RnXkq2bClqiCBmlewmNbTXMFTXt8duiS1A0txm-f5gBBimwJh8rkQ-VbPL62TPruI7RMgglQZx4FG26j3xn6ZnomwpkCuCPsvFfPuENHIC9GJLINTZzEmAUqSx1tuHOcxEp-QPUnjf4fUcATNSyeP2U2U1hUgGs42fe8U6_dWpcDkPbrzTUcJomX

Ugpaq6f5FXDb5FS9gOknxLaa3rfXBb1GNqzB3gCvhI!/dl5/d5/L2dBISEvZ0FBIS9nQSEh/

Krarti, M., Ali, F., Alaidroos, A., & Houchati, M. (2017). Macro-economic benefit analysis of large-scale building energy efficiency programs in Qatar. *International Journal of Sustainable Built Environment*, *6*(2), 597–609. https://doi.org/10.1016/j.ijsbe.2017.12.006

Kubba, S. (2010). *"Green" and "Sustainability" Defined*. 1–27. https://doi.org/10.1016/B978-1-85617-676-7.00001-4

K.Y. G. Kwok1, C. Statz1, Wai K. Oswald Chong1, A. M. A. (2012). *Carbon Emission Modeling for Green Building: A Comprehensive Study of Methodologies*. *5*(1), 93–94.

L Balbo. (2012). Balbo: Qatar's GSAS Turns Other Rating Systems Green - Google Scholar. Retrieved June 11, 2022, from https://scholar.google.com/scholar?q=related:ywsP-0Uij1wJ:scholar.google.com/&scioq=(Balbo,+2012)+gsas&hl=en&as_sdt=0,5

Larsson, N., & Larsson, N. (2015). *SBTool for 2015*. (July).

Laura Prickett, AICP, Senior Planner, EOA, Inc.1 and Jill Bicknell, P.E., Managing Engineer, EOA, Inc. 2. (2010). Low Impact Development 2010: Redefining Water in the City. *Proceedings of the 2010 International Low Impact Development Conference*, *2013*(Endreny 2004), 4. https://doi.org/10.1061/41099(367)4

Lewis, J. L., & Sheppard, S. R. J. (2006a). Culture and communication: Can landscape visualization improve forest management consultation with

indigenous communities? *Landscape and Urban Planning*, *77*(3), 291–313. https://doi.org/10.1016/J.LANDURBPLAN.2005.04.004

Lewis, J. L., & Sheppard, S. R. J. (2006b). Culture and communication: Can landscape visualization improve forest management consultation with indigenous communities? *Landscape and Urban Planning*, *77*(3), 291–313. https://doi.org/10.1016/J.LANDURBPLAN.2005.04.004

Li, X., Du, J., Research, H. L.-E. S. and P., & 2019, undefined. (2019). Dynamic analysis of international green behavior from the perspective of the mapping knowledge domain. *Springer*, *26*(6), 6087–6098. https://doi.org/10.1007/s11356-018-04090-1

Lin, F., Yang, J., & Skitmore, M. (2003). Design And Maintenance of Office Building Automation: A Decision Support Approach. In Proceedings 5th Asia-Pacific Structural Engineering and Construction. *Academia.Edu*. Retrieved from https://sci-hub.ren/https://www.academia.edu/download/30765075/4478.pdf

Lisa Zimmermann, B. S. (2015). *Green Building Standards in the Gulf*.

Lu, S., Wang, Z., & Zhang, T. (2020). Quantitative analysis and multi-index evaluation of the green building envelope performance in the cold area of China. *Sustainability (Switzerland)*, *12*(1). https://doi.org/10.3390/SU12010437

Luborsky, M. R., & Rubinstein, R. L. (1995). Sampling in Qualitative Research. *Research on Aging*, *17*(1), 89–113. https://doi.org/10.1177/0164027595171005

Lv, G. (2012). On important role of the view of harmony between man and nature in modern art designing--taking environmental design as an example. *Applied Mechanics and Materials*, *209–211*, 23–27. https://doi.org/10.4028/www.scientific.net/AMM.209-211.23

Lyon, L. M., & Hardesty, L. H. (2005). *Traditional healing in the contemporary life of the Antanosy people of Madagascar*. Retrieved from https://scholarspace.manoa.hawaii.edu/handle/10125/182

M Hume. (2011). Compassion without action: Examining the young consumers consumption and attitude to sustainable consumption. *Elsevier*. https://doi.org/10.1002/nvsm.421

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample Size in Qualitative Interview Studies: Guided by Information Power. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Marsh. (2009). Marsh. (2009). Green Building: Assessing the Risks (No. Report No. MA9-10142). New York, USA: Marsh Incorporation. - Google Search. Retrieved June 13, 2022, from https://www.google.com/search?q=Marsh.+%282009%29.+Green+Building%3A+Assessing+the+Risks+%28No.+Report+No.+MA9-10142%29.+New+York%2C+USA%3A+Marsh+Incorporation.&sxsrf=ALiCzsa_BjD3luGsPJEOipf2pleJXry7CA%3A1655125272175&source=hp&ei=GDWnYpnnB7KRxc8PmomowAE&iflsig=AJiK0e8AAAAAYqdDKIoczfUws70CVQs2I85o0tP1r69Q&ved=0ahUKEwiZ052Pvqr4AhWySPEDHZoEChgQ4dUDCAk&uact=5&oq=Marsh.+%282009%29.+Green+Building%3A+Assessing+the+Risks+%28No.+Report+No.+M

A9-10142%29.+New+York%2C+USA%3A+Marsh+Incorporation.&gs_lcp=Cgdnd3Mtd2l6EANQAFgAYOwTaABwAHgAgAEAiAEAkgEAmAEAoAEC&sclient=gws-wiz

Masia, T., Kajimo-Shakantu, K., & Opawole, A. (2020). A case study on the implementation of green building construction in Gauteng province, South Africa. *Management of Environmental Quality: An International Journal*, *31*(3), 602–623. https://doi.org/10.1108/MEQ-04-2019-0085/FULL/HTML

Mason, M. (2010). *Sample Size and Saturation in PhD Studies Using Qualitative Interviews*. Retrieved from http://www.qualitative-research.net/

Mattoni, B., Guattari, C., Evangelisti, L., Bisegna, F., Gori, P., & Asdrubali, F. (2018). Critical review and methodological approach to evaluate the differences among international green building rating tools. *Renewable and Sustainable Energy Reviews*, *82*(April 2017), 950–960. https://doi.org/10.1016/j.rser.2017.09.105

Mayer, I., & & R. (2015). Qualitative research with a focus on qualitative data analysis. *Circleinternational.Co.Uk*. Retrieved from https://www.circleinternational.co.uk/wp-content/uploads/2021/01/IJSRM4-9.pdf#page=57

Mayring, P. (2015). *Qualitative Content Analysis: Theoretical Background and Procedures*. 365–380. https://doi.org/10.1007/978-94-017-9181-6_13

McGraw-Hill Construction. (2006). McGraw Hill Construction. (2006) Green Building Smart... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=McGraw+Hill+Construction.+%282006%29+Green+Building+Smart+Market+Report+2006%2C+McGraw+Hill+Construction.&btnG=

McLennan, J. F. (2004). Chapter One – Defining Sustainable Design. *The Philosophy of Sustainable Design: The Future of Architecture*, 2–8. Retrieved from https://books.google.com/books/about/The_Philosophy_of_Sustainable_Design.html?id=-Qjadh_0IeMC

Meadows, D. H., Meadows, D. L., & Randers, J. (2006). <<I >>nuovi limiti dello sviluppo . *Limits to Growth*, 386, https://www.semanticscholar.org/paper/Limits-to-growth-%3A-the-30-year-update-Meadows-Meadows/891d44ef017cea705a45b1cab1d3959a4ac43a6a

Mehtap, S. (2014). An EU-Arab partnership to foster entrepreneurship education in the Middle East: The ASPIRE program. *International Proceedings of Economics Development and Research*, *81*, 124. https://doi.org/10.7763/IPEDR.2014.V81.20

Meir, I. A., Peeters, A., Pearlmutter, D., Halasah, S., Garb, Y., & Davis, J. M. (2012). An assessment of regional constraints, needs and trends. *Advances in Building Energy Research*, *6*(2), 173–211. https://doi.org/10.1080/17512549.2012.740209

Miljana Horvat & Paul Fazio. (2005). Comparative Review of Existing Certification Programs and Performance Assessment Tools for

Residential Buildings. *Comparative Review of Existing Certification Programs and Performance Assessment Tools for Residential Buildings. Architectural Science Review, 48(1), 69-80.*, (December 2014), 37–41. https://doi.org/10.3763/asre.2005.4810

Mills, A., Durepos, G., & Wiebe, E. (2009). *Encyclopedia of case study research*. Retrieved from https://books.google.com/books?hl=en&lr=&id=XMJ1AwAAQBAJ&oi=fnd&pg=PP1&dq=Mills,+A.,+Eurepos,+G.,+%26+Wiebe,+E.+(2010).+Encyclopedia+of+case+study+research.+Volume+1.+Thousand+Oaks,:+Sage+Publications,+Inc.&ots=n2DnvUcBO1&sig=WOXcxm9eE2xy28PS5g0ygQnNSS8

Minh Duc, N. (2003). *Quality in Qualitative Evaluation: A framework for assessing research evidence*. Retrieved from www.natcen.ac.uk

Ministry of Housing | Bahrain. (2021). Retrieved June 11, 2022, from https://www.housing.gov.bh/

Ministry of Housing | Mazaya Program. (2021). Retrieved June 11, 2022, from https://www.housing.gov.bh/pages/MazayaIntro

Ministry of Housing | regulations and rules -Bahrain. (2021). Ministry of Housing | Regulations and rules -Bahrain. Retrieved June 11, 2022, from https://housing.gov.bh/laws-and-regulation

Ministry of Works, M. A. and U. P.-K. of B. (2021). Ministry of Works, Municipalities Affairs and Urban Planning - Kingdom of Bahrain. Retrieved June 11, 2022, from https://www.mun.gov.bh/portal/indexEn.jsp

Mishra, S., Kannan, S., Manager, C., Statistics, A., Comments, R., & Alert, E. (2019). Get started now. *Indian Journal of Occupational and International Medicine*, *23*(1), 8–13. https://doi.org/10.4103/ijoem.IJOEM

Mohammad, A., & Atif, M. (2017). *Northumbria Research Link*. 435–448.

Mohammed Bin Rashid Housing Est. (2022). Retrieved June 11, 2022, from https://www.mbrhe.gov.ae/en/

Moisander, J., & Valtonen, A. (2006). *Qualitative marketing research: A cultural approach*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=Zz56vpAv3_YC&oi=fnd&pg=PP2&dq=Moisander+and+Valtonen+(2006)&ots=B7T57agPak&sig=-FmUnxy2BwDk7W6EUZpd0b6iZSk

Morris, P., & Langdon, D. (2007). *What Does Green Really Cost?* Retrieved from http://www.cagbc.org/uploads/A%20Business%20Case%20for%20Green%20Bldgs%20in%20Canada.pdf

Almulla, Y. (2014). *Gulf Cooperation Council (GCC) countries 2040 energy scenario for electricity generation and water desalination*. (January 2015). Retrieved from https://www.diva-portal.org/smash/get/diva2:839740/FULLTEXT01.pdf

Almutiri, Y. (2020). Awareness of Building Information Modeling implementation and green buildings in the building industry in the Kingdom of Bahrain. *2020 2nd International Sustainability and Resilience Conference: Technology and Innovation in Building Designs*. https://doi.org/10.1109/IEEECONF51154.2020.9319951

Nahiduzzaman, K., Aldosary, A. S., Abdallah, A. S., Asif, M., Kua, H. W., & Alqadhib, A. M. (2018). *Accepted Manuscript*. 3–5. https://doi.org/10.1016/j.jclepro.2018.03.052.This

Alnaser, N. W., Flanagan, R., & Alnaser, W. E. (2008). Potential of making-Over to sustainable buildings in the Kingdom of Bahrain. *Energy and Buildings*, *40*(7), 1304–1323. https://doi.org/10.1016/j.enbuild.2007.11.010

Alnaser, N. W., Flanagan, R., & Alnaser, W. E. (2009). A "Comprehensive" Model for Accelerating the Building Integrated Photovoltaic (BIPV) / Wind Turbine (BIWT) Construction Projects in the Kingdom of Bahrain. *The Open Construction and Building Technology Journal*, *3*(1), 1–11. https://doi.org/10.2174/1874836800903010001

Alnasiri, N. (2016). Evaluating Social Housing Adequacy in Oman. *International Journal of Planning, Urban and Sustainable Development*, *3*(December), 26–38.

National Energy Efficiency Action Plan (NEEAP). (2021). Key Initiatives – Sustainable Energy Authority. Retrieved June 11, 2022, from https://www.sea.gov.bh/key-initiatives/#neeap

NezamiFar, E. (2020). *Building Occupant Environmental Behaviour (BOEB) model for LEED-certified buildings*. (May). Retrieved from https://www.ros.hw.ac.uk/handle/10399/4194

Nguyen, T. H., Toroghi, Sh. H., & Jacobs, F. (2016). Automated Green Building Rating System for Building Designs. *Journal of Architectural Engineering*, *22*(4), 1–10. https://doi.org/10.1061/(asce)ae.1943-5568.0000168

Nora et al (2018). *Validation by experts: importance in translation and adaptation of instruments*. *38*(3), 1–9.

Noy, C. (2008). Sampling Knowledge: The Hermeneutics of Snowball Sampling in Qualitative Research. *Https://Doi.Org/10.1080/13645570701401305*, *11*(4), 327–344. https://doi.org/10.1080/13645570701401305

al Obaid, H. M. A. (2020). Factors Determining Housing Demand in Saudi Arabia. *International Journal of Economics and Financial Issues*, *10*(5), 150–157. https://doi.org/10.32479/ijefi.10262

Alobaidi, K. A., Rahim, A. B. A., Mohammed, A., & Baqutayan, S. (2015). Sustainability achievement and estidama green building regulations in Abu Dhabi vision 2030. *Mediterranean Journal of Social Sciences*, *6*(4S2), 509–518. https://doi.org/10.5901/mjss.2015.v6n4s2p509

Obata, S. H., Agostinho, F., Almeida, C. M. V. B., & Giannetti, B. F. (2019). LEED certification as booster for sustainable buildings: Insights for a Brazilian context. *Resources, Conservation and Recycling*, *145*(February), 170–178. https://doi.org/10.1016/j.resconrec.2019.02.037

Ogden, J., & Cornwell, D. (2010). The role of topic, interviewee and question in predicting rich interview data in the field of health research. *Sociology of Health & Illness*, *32*(7), 1059–1071. https://doi.org/10.1111/j.1467-9566.2010.01272.x

Olshansky, E., & M de Chesnay. (2014). Generating theory using grounded theory methodology. *Books.Google.Com*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=Ys6sDAAAQB

AJ&oi=fnd&pg=PT41&dq=Olshansky,+E.F.:+Generating+theory+using+grounded+theory+methodology.+In:+de+Chesnay,+M.+(ed.)+Nursing+Research+Using+Grounded+Theory:+Qualitative+Designs+and+Methods+in+Nursing,+pp.+19%E2%80%9328.+Springer,+New+York+(2015)&ots=8z9nnnuD_K&sig=p4RjP8rDjEGQzL0rHANeVBA7PXk

Oman Housing Bank. (2020). Retrieved June 11, 2022, from https://www.ohb.co.om/Default.aspx

Omran, A. R. (1971). The epidemiologic transition. A theory of the epidemiology of population change. *The Milbank Memorial Fund Quarterly*, *49*(4), 509–538. https://doi.org/10.2307/3349375

Ortiz, O., Castells, F., & Sonnemann, G. (2009). Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials*, *23*(1), 28–39. https://doi.org/10.1016/J.CONBUILDMAT.2007.11.012

Oyewole, M. O., Ojutalayo, A. A., & Araloyin, F. M. (2019). *Developers' willingness to invest in green features in Abuja, Nigeria*. https://doi.org/10.1108/SASBE-06-2018-0031

Ozanne, J. L., & Murray, J. B. (1995). Uniting Critical Theory and Public Policy to Create the Reflexively Defiant Consumer. *American Behavioral Scientist*, *38*(4), 516–525. https://doi.org/10.1177/0002764295038004003

Pandey, S., Hindoliya, D. A., & Mod, R. (2013). Experimental investigation on green roofs over buildings. *International Journal of Low-Carbon Technologies*, *8*(1), 37–42. https://doi.org/10.1093/ijlct/ctr044

Park, M., & Park, J. (2016). Qualitative versus quantitative research methods: Discovery or justification? *Papersearch.Net*. Retrieved from https://www.papersearch.net/thesis/article.asp?key=3560136

Parry, O., Thomson, C., & Fowkes, G. (1999). Life course data collection: Qualitative interviewing using the life grid. *Sociological Research Online*, *4*(2). https://doi.org/10.5153/SRO.233

Peng, T., Kellens, K., Tang, R., Chen, C., & Chen, G. (2018). Sustainability of additive manufacturing: An overview on its energy demand and environmental impact. *Additive Manufacturing*, *21*, 694–704. https://doi.org/10.1016/J.ADDMA.2018.04.022

Petrullo, M., Jones, S. A., Morton, B., & Lorenz, A. (2018). *World Green Building Trends 2018*.

Population and Demographics – Ministry of Information Affairs | Bahrain. (2021). Population and Demographics – Ministry of Information Affairs | Kingdom of Bahrain. Retrieved June 11, 2022, from https://www.mia.gov.bh/kingdom-of-bahrain/population-and-demographics/?lang=en

Powmya, A., & Abidin, N. Z. (2014). *The Challenges of Green Construction in Oman*. *5*(1), 33–41.

Public Authority for Housing welfare - Kuwait. (2021). Retrieved June 11, 2022, from https://www.pahw.gov.kw/about_en

Pyke, C. R., McMahon, S., Larsen, L., Rajkovich, N. B., & Rohloff, A. (2012). Development and analysis of Climate Sensitivity and Climate Adaptation

opportunities indices for buildings. *Building and Environment*, *55*, 141–149. https://doi.org/10.1016/j.buildenv.2012.02.020

Alqahtany, A. (2021). Affordable housing in Saudi Arabia's vision 2030: new developments and new challenges. *International Journal of Housing Markets and Analysis*, *14*(1), 243–256. https://doi.org/10.1108/IJHMA-04-2020-0035/FULL/HTML

Qatar National Housing Strategy (QNHS). (2021). Strategic Plans and Projects. Retrieved June 11, 2022, from https://www.mme.gov.qa/QatarMasterplan/English/strategicplans.aspx?panel=housing

Al-Qawasmi, J., Asif, M., el Fattah, A. A., & Babsail, M. O. (2019). Water effciency and management in sustainable building rating systems: Examining variation in criteria usage. *Sustainability (Switzerland)*, *11*(8). https://doi.org/10.3390/su11082416

Quality and performance in the NHS. (n.d.). Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=hmic&AN=DH243066%5Cnhttp://lshtmsfx.hosted.exlibrisgroup.com/lshtm?sid=OVID:hmicdb&id=pmid:&id=doi:&issn=&isbn=&volume=&issue=&spage=&pages=&date=2000&title=&atitle=Quality+and+performan

Quick, J., & Hall, S. (2015). Part two: Qualitative research. *Journal of Perioperative Practice*, *25*(7–8), 129–133. https://doi.org/10.1177/1750458915025007-803

Radhi, H., Sharples, S., Taleb, H., & Fahmy, M. (2017). Will cool roofs improve the thermal performance of our built environment? A study

assessing roof systems in Bahrain. *Energy and Buildings*, *135*, 324–337. https://doi.org/10.1016/j.enbuild.2016.11.048

Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green Architecture: A Concept of Sustainability. *Procedia - Social and Behavioral Sciences*, *216*(January), 778–787. https://doi.org/10.1016/j.sbspro.2015.12.075

Rahman, K. F. (2019).' *Triangulation' Research Method as the Tool of Social Science Research*. (March).

Rai, N., & Law, B. T. (2015). A study on purposive sampling method in research. *Academia.Edu*. Retrieved from https://www.academia.edu/download/48403395/A_Study_on_Purposive_Sampling_Method_in_Research.pdf

Rai, N., & Thapa, B. (2015). A study on purposive sampling method in research. *Academia.Edu*. Retrieved from https://sci-hub.ren/https://www.academia.edu/download/48403395/A_Study_on_Purposive_Sampling_Method_in_Research.pdf

Ramani, A., & García De Soto, B. (2021). Estidama and the pearl rating system: A comprehensive review and alignment with LCA. *Sustainability (Switzerland)*, *13*(9), 1–31. https://doi.org/10.3390/su13095041

Raouf, A. M., & Al-Ghamdi, S. G. (2020). Effect of R-values changes in the baseline codes: Embodied energy and environmental life cycle impacts of building envelopes. *Energy Reports*, *6*(xxxx), 554–560. https://doi.org/10.1016/j.egyr.2019.09.025

Real Estate Regulatory Authority- Bahrain. (2021). Real Estate Regulatory Authority (RERA) | Kingdom of Bahrain. Retrieved June 11, 2022, from https://www.rera.gov.bh/en/

Reeder, L. (2011). International Rating Systems. *Guide to Green Building Rating Systems*, 203–215. https://doi.org/10.1002/9781118259894.ch12

al REEM 3 Project| Alsaraya-Bahrain. (2022). AL REEM 3 Project| Alsaraya-Bahrain. Retrieved June 11, 2022, from https://alsarayabahrain.bh/portfolio/al-reem-3/

Reinecke, J., Arnold, D., Quarterly, G. P.-B. E., & 2016, undefined. (2016). Qualitative methods in business ethics, corporate responsibility, and sustainability research. *Cambridge.Org*, *26*(4), xiii–xxii. https://doi.org/10.1017/beq.2016.67

Resource efficiency | UNEP - UN Environment Programme. (2021). Resource efficiency | UNEP - UN Environment Programme. Retrieved June 11, 2022, from https://www.unep.org/explore-topics/resource-efficiency

Retzlaff, R. C. (2008). Green building assessment systems: A framework and comparison for planners. *Journal of the American Planning Association*, *74*(4), 505–519. https://doi.org/10.1080/01944360802380290

Richardson, G. R. A., & Lynes, J. K. (2007). Institutional motivations and barriers to the construction of green buildings on campus: A case study of the University of Waterloo, Ontario. *International Journal of Sustainability in Higher Education*, *8*(3), 339–354. https://doi.org/10.1108/14676370710817183

Roderick, Y., Mcewan, D., Wheatley, C., & Alonso, C. (2009). Comparison of energy performance assessment between leed, breeam and green star. *IBPSA 2009 - International Building Performance Simulation Association 2009*, 1167–1176.

Rodriguez-Ubinas, E., Alzarouni, S., Alhammadi, N., Alantali, M., Behzad, F., & Sgouridis, S. (2020). Sustainability through energy conservation building codes: Comparative analysis of green building regulations in the Middle east. *WIT Transactions on Ecology and the Environment*, *249*(December), 85–100. https://doi.org/10.2495/SC200081

Rybkowski, Z. K., Shepley, M. M., Bryant, J. A., Skelhorn, C., Amato, A., Rybkowski, Z. K., … Amato, A. (2017). *Facility management in Qatar: current state , perceptions and recommendations*. https://doi.org/10.1108/F-06-2016-0070

S. Bry Sarte. (2010). Sustainable Infrastructure: The Guide to Green Engineering and Design - S. Bry Sarte - Google Books. Retrieved May 21, 2022, from https://books.google.com.bh/books?hl=en&lr=&id=LYiUDwAAQBAJ&oi=fnd&pg=PR13&dq=Sarte,+S+Bry+(2010)+Sustainable+Infrastructure:+The+Guide+to+Green+Engineering+Design,+John+Wiley+%26+Sons+Inc,+Hoboken,+New+Jersey.&ots=g42ZJc3vgP&sig=jHPvWZCScNIxaujk6FMh-QdVRyA&redir_esc=y#v=onepage&q=Sarte%2C%20S%20Bry%20(2010)%20Sustainable%20Infrastructure%3A%20The%20Guide%20to%20Green%20Engineering%20Design%2C%20John%20Wiley%20%26%20Sons%20Inc%2C%20Hoboken%2C%20New%20Jersey.&f=false

Sabie, K. K., Pitts, A., & Nicholls, R. (2014). Sustainability Assessment Methods for the Gulf Region. *30th International PLEA Conference, 16-18 Dec. 2014, CEPT University, Ahmedabad*, *2025*(December), 1–8.

Al-Saffar, M. (2014). *The Sustainability (Environmental and Economical) impact of upgrading Bahrain building regulations for affordable housing units : Case study in Bahrain By : May Al-Saffar*.

Sale, J. E. M., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. *Quality and Quantity*, *36*(1), 43–53. https://doi.org/10.1023/A:1014301607592

Saleh, R., Sweis, R. J., Sweis, G. J., Abdallah, A. B., Omar, B., & Hiyassat, M. (2016). Evaluation of green building awareness in the construction industry: the case of Jordan. *Interdisciplinary Environmental Review*, *17*(3/4), 209. https://doi.org/10.1504/ier.2016.10001091

Salina, F. H., de Almeida, I. A., & Bittencourt, F. R. (2020). *RenovaBio Opportunities and Biofuels Outlook in Brazil*. https://doi.org/10.1007/978-3-030-18488-9_30

Alsanad, S. (2015). Awareness, Drivers, Actions, and Barriers of Sustainable Construction in Kuwait. *Procedia Engineering*, *118*(December), 969–983. https://doi.org/10.1016/j.proeng.2015.08.538

Alsanad, S., Gale, A., & Edwards, R. (2011). Challenges of sustainable construction in Kuwait: Investigating level of awareness of Kuwait stakeholders. *Engineering and Technology*, *59*(0), 2197–2204.

Sanaieian, H., Tenpierik, M., Linden, K. van den, Mehdizadeh Seraj, F., & Mofidi Shemrani, S. M. (2014). Review of the impact of urban block form

on thermal performance, solar access and ventilation. *Renewable and Sustainable Energy Reviews*, *38*, 551–560. https://doi.org/10.1016/j.rser.2014.06.007

Sandelowski, M. (1995). Sample size in qualitative research. *Research in Nursing & Health*, *18*(2), 179–183. https://doi.org/10.1002/nur.4770180211

Saudi Arabia Ministry of Housing. (2019). *Mostadam Rating System for Residential Buildings D + C*. Retrieved from https://www.mostadam.sa/uploads/2019/09/5d91b53e0b866.pdf

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., … Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*, *52*(4), 1893. https://doi.org/10.1007/S11135-017-0574-8

Saunders, T. (2009). *A Discussion Document Comparing International Environmental Assessment Methods for Buildings.*

Al. Sayegh, Eng. A. (2015). *Kuwait Adaptation of Green ` Buildings Standards: Overview & Challenges National Committee of Building Codes in Kuwait*.

Schneider Electric, & O'Mara, M. (2012). *Why invest in high-performance green buildings?* (June), 24.

Sedaghat, A., Alkhatib, F., Amir, S., Oloomi, A., & Sabri, F. (2020). *Experimental study on the performance of solar window films in office buildings in Kuwait*.

Seewald, J. (2009). Seewald, J. (2009). This is the greenest building... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Seewald%2C+J.+%282009%29.+This+is+the+greenest+building+we+have%2C+right%3F+Engineered+Systems%2C+2&btnG=

Sev, A. (2011). A comparative analysis of building environmental assessment tools and suggestions for regional adaptations. *Civil Engineering and Environmental Systems*, *28*(3), 231–245. https://doi.org/10.1080/10286608.2011.588327

Shaaban, A. K. (2017). Ac ce pt e cr t. *Sustainable Cities and Society*. https://doi.org/10.1016/j.scs.2017.02.014

Shaawat, M. E., & Jamil, R. (2014). a Guide to Environmental Building Rating System for Construction of New Buildings in Saudi Arabia. *Emirates Journal for Engineering Research*, *19*(2), 47–56.

Shamseldin, A., Balabel, A., Alwetaishi, M., Abdelhafiz, A., Issa, U., Sharaky, I., … Al-Harthi, M. (2020). Adjustment of the indoor environmental quality assessment field for Taif city-Saudi Arabia. *Sustainability (Switzerland)*, *12*(24), 1–27. https://doi.org/10.3390/su122410275

Shan, M., & Hwang, B. gang. (2018a). Green building rating systems: Global reviews of practices and research efforts. *Sustainable Cities and Society*, *39*, 172–180. https://doi.org/10.1016/j.scs.2018.02.034

Shan, M., & Hwang, B. gang. (2018b). Green building rating systems: Global reviews of practices and research efforts. *Sustainable Cities and Society*, *39*, 172–180. https://doi.org/10.1016/j.scs.2018.02.034

Sharma, M. (2018). Development of a 'Green building sustainability model' for green buildings in India. *Journal of Cleaner Production*, *190*, 538–551. https://doi.org/10.1016/j.jclepro.2018.04.154

Sheikh Zayed Housing Programme. (2022). Retrieved June 11, 2022, from https://www.szhp.gov.ae/Default.aspx?lang=en

Shen, L., Yan, H., Fan, H., Wu, Y., & Zhang, Y. (2017). An integrated system of text mining technique and case-based reasoning (TM-CBR) for supporting green building design. *Building and Environment*, *124*, 388–401. https://doi.org/10.1016/j.buildenv.2017.08.026

Shin, E., Shin, S., & Tea, S. (2013). *A Study on the Developmental Direction of Korean Green Building Assessment by Analyzing Comprehensive Scoring Methods*. *287*, 1189–1193. https://doi.org/10.4028/www.scientific.net/AMM.284-287.1189

Simon Carter, & Lesley Henderson. (2005). Approaches to Qualitative Data Collection | Request PDF. Retrieved April 23, 2022, from https://www.researchgate.net/publication/311777815_Approaches_to_Qualitative_Data_Collection

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2012). An overview of sustainability assessment methodologies. *Ecological Indicators*, *15*(1), 281–299. https://doi.org/10.1016/j.ecolind.2011.01.007

Smajdor. (2009). Applying for ethical approval. *British Medical Journal*, *339*(October), 4013.

Srinivasan, S., O'Fallon, L. R., & Dearry, A. (2003). Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environment and Public Health. *American Journal of Public Health*, *93*(9), 1446–1450. https://doi.org/10.2105/AJPH.93.9.1446

Standards Australia. (2016). Standards and Other Publications. *Standardisation Guide 003*, *1.9*, 1–22.

Steemers, K. (2015). Architecture for well-being and health. Retrieved August 9, 2022, from https://scholar.google.com/scholar_lookup?hl=en&volume=Spring+2015&publication_year=2015&pages=6-27&journal=Daylight+Architecture&issue=23&author=K.+Steemers&title=Architecture+for+well-being+and+health

Sukeri, M., Senior, K., Associate, R. Z., Nafis, D., & Master, A. (2016). *The Motivation Factors in the Provision of Green Criteria in Green Building Development*. *2016*.

Sultanate of Oman | Ministry of Housing and Urban Planning. (2022). Retrieved June 11, 2022, from https://www.housing.gov.om/

Survey & Land Registration Bureau- Bahrain. (2021). SLRB - Home Page. Retrieved June 11, 2022, from https://www.slrb.gov.bh/

Sustainable Energy Authority – Bahrain. (2021). Sustainable Energy Authority – Kingdom of Bahrain. Retrieved June 11, 2022, from https://www.sea.gov.bh/

Sutrisna, M., & Barrett, P. (2007). Applying rich picture diagrams to model case studies of construction projects. *Engineering, Construction and Architectural Management*, *14*(2), 164–179. https://doi.org/10.1108/09699980710731281/FULL/HTML

Tatari, O., & Kucukvar, M. (2011). Cost premium prediction of certified green buildings: A neural network approach. *Building and Environment*, *46*(5), 1081–1086. https://doi.org/10.1016/j.buildenv.2010.11.009

Taylor, P. (2011). *Building Grading Systems: A Review of the State-of-Building Grading Systems : A Review of the State-of-the-Art*. (December 2014), 37–41. https://doi.org/10.3763/asre.2008.5102

Al-thani, S. K. (2019). *Neighborhood sustainability and livability in Qatar National Development Framework 2032*. *6*, 47–56.

The Green Building Information Gateway. (2022). Bahrain: Green Building Information Gateway. Retrieved June 11, 2022, from http://www.gbig.org/places/92/activities

The Saudi Housing Program. (2021). *The Housing Program Delivery Plan (2021-2025)*.

The Supreme Council for Environment, B. (2021). The Supreme Council for Environment, Kingdom of Bahrain. Retrieved June 11, 2022, from https://www.sce.gov.bh/en/

Thomas, L., & G Baird. (2006). Post-occupancy evaluation of passive downdraft evaporative cooling and air-conditioned buildings at the Torrent Research Centre, Ahmedabad, India. *JSTOR*. Retrieved from https://sci-hub.ren/https://www.jstor.org/stable/26148711

Tongco, Ma. D. C. (2007). Purposive Sampling as a Tool for Informant Selection. *Ethnobotany Research and Applications*, *5*(0), 147–158. Retrieved from https://ethnobotanyjournal.org/index.php/era/article/view/126

Tredrea, S., & Mehrtens, V. (2008). Building GREEN STAR rated projects: An Analysis of... - Google Scholar. Retrieved June 13, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Building+GREEN+STAR+rated+projects%3A+An+Analysis+of+Challenges+for+Contractors+and+their+Responses.+Paper+presented+at+the+AIBS+South+Austrailian+Conference-&btnG=

Tsekleves, E., & Cooper, R. (2017). *Design for health*. Retrieved from https://api.taylorfrancis.com/content/books/mono/download?identifierName=doi&identifierValue=10.4324/9781315576619&type=googlepdf

Tudor, C. (2016). Predicting the evolution of CO2 emissions in Bahrain with automated forecasting methods. *Sustainability (Switzerland)*, *8*(9), 1–10. https://doi.org/10.3390/su8090923

Ullah, F., Sepasgozar, S., & Hussain Ali, T. (2019). Real Estate Stakeholders Technology Acceptance Model (RESTAM): User-focused Big9 Disruptive Technologies for Smart Real Estate Management Smart City Management: Applications of Disruptive Technologies View project Six Sigma implementation in construction. *Proceedings of the 2nd International Conference on Sustainable Development in Civil Engineering (ICSDC 2019), Jamshoro, Pakistan*, (December), 5–7. Retrieved from https://www.researchgate.net/publication/337772796

Umar, T., Egbu, C., Ofori, G., Honnurvali, M. S., Shibani, A., Opoku, A., … Goh, K. (2015). *UAE' s Commitment Towards UN Sustainable Development Goals Abstract*

Alumran, M. (2013). *Green and Sustainable Buildings*. (November).

UNDP. (2016). *Human Development Report 2016 Human Development for Everyone*.

UNDP in Bahrain. (2020). Sustainable Energy in National Plans | UNDP in Bahrain. Retrieved June 11, 2022, from https://www.bh.undp.org/content/bahrain/en/home/stories/Sustainable_Energy_in_National_Plans.html

United Nations Development. (1992). *Human Development Report 1992*. https://doi.org/10.18356/1451896A-EN

Urban Planning & Development Authority. (2022). Capital Governorate | Urban Planning & Development Authority. Retrieved June 11, 2022, from https://www.upda.gov.bh/en/category/capital-governorate

Urquhart, C. (2012). *Grounded theory for qualitative research: A practical guide*. Retrieved from https://sci-hub.ren/https://books.google.com/books?hl=en&lr=&id=t6vlDAAAQBAJ&oi=fnd&pg=PP2&dq=Urquhart+(2013)&ots=zPP_eYCfH5&sig=BI_BgIzgKiyz8tfobvNE0Sszv8w

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, *15*(3), 398–405. https://doi.org/10.1111/NHS.12048

van Rijnsoever, F. J. (2017). (I Can't Get No) Saturation: A simulation and guidelines for sample sizes in qualitative research. *PLOS ONE*, *12*(7), e0181689. https://doi.org/10.1371/journal.pone.0181689

Vierra, S. (2016). Green building standards and certification systems. National Institute of Building Sciences, Washington, DC. *Internationalgbc.Org*. Retrieved from https://internationalgbc.org/wp-content/uploads/2021/05/034_green-building-standards-and-certification-system.pdf

Vierra, Stephanie. (2018). Green Building Standards and Certification Systems. *Whole Building Design Guide*, 1–51. Retrieved from https://www.wbdg.org/resources/green-building-standards-and-certification-systems

Vierra, Stephanie, Aia, A., & C, L. A. P. B. D. (2012). Green Building Standards and Certification Systems | Whole Building Design Guide Green Building Standards and Certification Systems Green Building Standards and Certification Systems | Whole Building Design Guide. *Whole Building Design Guide*, *9*, 1–9. Retrieved from https://www.wbdg.org/resources/green-building-standards-and-certification-systems

Vivian, J., Zarrella, A., Emmi, G., & de Carli, M. (2017). An evaluation of the suitability of lumped-capacitance models in calculating energy needs and thermal behaviour of buildings. *Energy and Buildings*, *150*, 447–465. https://doi.org/10.1016/J.ENBUILD.2017.06.021

von Schwedler, M., & Fernandes, E. (2018). Toward Understanding and Using of Qualitative Research Methods in Management studies.

Revistas.Rcaap.Pt. Retrieved from https://sci-hub.ren/https://revistas.rcaap.pt/proelium/article/view/17164/13871#page=8

ALwaer, H., & Clements-Croome, D. J. (2010). Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings. *Building and Environment*, *45*(4), 799–807. https://doi.org/10.1016/j.buildenv.2009.08.019

Warner, K., Hamza, M., Oliver-Smith, A., Renaud, F., & Julca, A. (2010). Climate change, environmental degradation and migration. *Natural Hazards*, *55*(3), 689–715. https://doi.org/10.1007/s11069-009-9419-7

Waterbury, T. (2018). 기사 (Article) 와 안내문 (Information) [. *The Eletronic Library*, *34*(1), 1–5.

Watson, S. (2004). *CAPTURING AND MAINTAINING THE CLIENTS Full Paper FRONT-LOADING THE BUILDING DESIGN PROCESS FOR ENVIRONMENTAL BENEFIT*. 1–15.

WEF. (2018). *The Global Gender Gap Report 2018*.

Wetherell, M., Taylor, S., & Yates, S. (2001). Retrieved April 25, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=wetherell%2C+M.%2C+Taylor%2C+S.%2C+%26+Yates%2C+S.+%282001%29.+%22Discourse+as+data%22+%E2%80%93+A+guide+for+analysis+%28first+Ed.%29.+London%3A+Sage+Publications.&btnG=#d=gs_cit&t=1650868978790&u=%2Fscholar%3Fq%3Dinfo%3Ar08lcpgJE5QJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D7%26hl%3Den

Williams. (2007). Sustainable Design: Ecology, Architecture, and Planning. Retrieved May 21, 2022, from https://books.google.com.bh/books?hl=en&lr=&id=1l3fO6Wqh_gC&oi=fnd&pg=PR9&dq=William,+Daniel+E.+(2007):+Sustainable+Design:+Echology,+Architecture+dan+Planning,+John+Wiley+%26+Sons+Inc,+Hoboken,+New+Jersey&ots=jI7eRzcKcN&sig=sNEF9kry_Vkx2YqJ1REMyccLTKM&redir_esc=y#v=onepage&q&f=false

Williams, K., & Dair, C. (2007). in England? Barriers Experienced Sustainable Developments. *English*, *147*(September 2006), 135–147.

Wilson, A. (2010). Reexamining Priorities in Green Building. *Environmental Building News*, *19*(11), 16.

Winston, N., Daly, G., Kit, R., & Winston, N. (2010). *Regeneration for sustainable communities? barriers to implementing sustainable housing in urban areas*.

World Green Building Council. (2021). Green building & the Sustainable Development Goals | World Green Building Council. Retrieved June 11, 2022, from https://www.worldgbc.org/green-building-sustainable-development-goals

Wu Suen, L. J., Huang, H. M., & Lee, H. H. (2014). [A comparison of convenience sampling and purposive sampling]. *Hu Li Za Zhi The Journal of Nursing*, *61*(3), 105–111. https://doi.org/10.6224/JN.61.3.105

Alyami, S. H., & Rezgui, Y. (2012a). Sustainable building assessment tool development approach. *Sustainable Cities and Society*, *5*(1), 52–62. https://doi.org/10.1016/j.scs.2012.05.004

Alyami, S. H., & Rezgui, Y. (2012b). Sustainable building assessment tool development approach. *Sustainable Cities and Society*, *5*(1), 52–62. https://doi.org/10.1016/j.scs.2012.05.004

Yang, Z., & J Yang. (2009). Sustainable housing implementation through mutual benefits to stakeholders-a decision making approach. *Eprints.Qut.Edu.Au*, *2*, 1012–1018. Retrieved from https://sci-hub.ren/https://eprints.qut.edu.au/31372/

Yao, R. (2013). *Design and Management of Sustainable Built Environments* (R. Yao, Ed.). London: Springer London. https://doi.org/10.1007/978-1-4471-4781-7

Yaron, B. G., Ll, M., Ll, B., & Noel, M. (2013). *Does Building Green Create Value?* (May), 0–3.

Yung, R., & Siew, J. (2014). A Review of Sustainability Reporting Tools (SRTs) for Communities. *Journal of Environmental Management*, *5*(2), 39–52. Retrieved from http://dx.doi.org/10.1016/j.jenvman.2015.09.010

Yusuf, M. B., & Elghonaimoy, I. H. (2020). *Housing Dilemma and Vertical Dimensions*. *8*(5), 1107–1118. https://doi.org/10.13189/cea.2020.080537

Yvonna S. Lincoln, E. G. G. (1985). Naturalistic_Inquiry. *Sage*.

Zainul Abidin, N. (2009a). Sustainable Construction in Malaysia Developers' Awareness. *Proceedings of World Academy of Science, Engineering and Technology*, *41*, 2070–3740. Retrieved from http://eprints.usm.my/15580/1/Sustainable_Construction_In_Malaysia-Developers_Awareness.pdf

Zainul Abidin, N. (2009b). Sustainable Construction in Malaysia Developers' Awareness. *Proceedings of World Academy of Science, Engineering and Technology*, *41*, 2070–3740. Retrieved from http://eprints.usm.my/15580/1/Sustainable_Construction_In_Malaysia-Developers_Awareness.pdf

Zardini, Mirko, & Giovanna Borasi. (2012). Imperfect health: the medicalization of architecture. Retrieved August 9, 2022, from Canadian centre for architecture, 2012. website: https://scholar.google.com/scholar_lookup?hl=en&publication_year=2012&author=G+Borasi&author=M+Zardini&title=Imperfect+health%3A+the+medicalization+of+architecture

Zhang, Ying, Kang, J., & Jin, H. (2018). A review of green building development in China from the perspective of energy saving. *Energies*, *11*(2). https://doi.org/10.3390/en11020334

Zhang, Yinqi, Wang, H., Gao, W., Wang, F., Zhou, N., Kammen, D. M., & Ying, X. (2019). A survey of the status and challenges of green building development in various countries. *Sustainability (Switzerland)*, *11*(19), 1–29. https://doi.org/10.3390/su11195385

Zhang, Yurong, Wang, J., Hu, F., & Wang, Y. (2017). Comparison of evaluation standards for green building in China, Britain, United States. *Renewable and Sustainable Energy Reviews*, *68*, 262–271. https://doi.org/10.1016/J.RSER.2016.09.139

الملخص

وسط التحضر السريع والطلب المتزايد على الإسكان، تعمل الحكومة ومخططو المدن وكافة قطاعات التطوير العقاري في البحرين على تطوير استراتيجيات لمعالجة الطلبات والحاجة الملحة للإسكان وخاصة الإسكان ميسور التكلفة. وبالتالي فإن النهج الذي يركز على التطور المدني المستدام ضروري جدا لمراعاة أفضل السبل والمعايير لتنمية المدن وفي نفس الوقت تلبية الحاجة السكنية والنمو السكاني في السنوات القادمة.

في ديسمبر 2021، طورت البحرين دليل تفصيلي للأبنية الخضراء على أساس معايير الاستدامة للمباني الخضراء لجميع مشاريع البناء، والتي تم دمجها منذ ذلك الحين في لوائح ودليل البناء تحت نظام اصدار رخص البناء (بنايات) وهو النظام المعني بإصدار تراخيص البناء لجميع مشاريع البناء في مملكة البحرين.
ولمواكبة أفضل وأحدث الطرق والأساليب المتبعة التي تراعي معايير الاستدامة ؛ استمر الدليل في التحديث الدائم، حيث يوضح دليل البناء في الإصدار الأخير رقم 1.3، كيف تطور الدليل بمرور الوقت لدمج أحدث وانسب السبل والممارسات المستدامة والتي تتناسب مع طبيعة وتوجهات البحرين المستقبلية .

يهدف هذا البحث الي دراسة الإمكانيات والفرص وأيضا التحديات التي تحول دون تطبيق نظام تصنيف المباني الخضراء، لا سيما فيما يتعلق بمشاريع الإسكان الميسور التكلفة في البحرين. حيث تبحث الدراسة في كافة الجهود التي بذلتها البحرين في المساهمة في نشر سبل تطبيق نظم تصنيف المباني ضمن معايير الاستدامة ، ويناقش البحث أيضا سبل الحث على وضع معايير لتقييم المباني وتطبيق معايير الاستدامة وطرح ما قد ييسر بين الربط ما بين ما تم التخطيط اليه والتطبيق الفعلي لتلك المنهجيات على كافة الاصعدة.

في البداية، تم تصميم الدراسة لاستخدام نهج مختلط، ولكن بسبب معدل الاستجابة المنخفض وبعض القيود التي تم تحديدها اثناء القيام بالدراسة المبدئية خلال المرحلة التجريبية، وعليه ونظرا لتلك التحديات اعتمدت هذه الدراسة في النهاية اسلوب البحث النوعي كمنهجية البحث الرئيسية. حيث

اصبح جليا ان ما يطمح اليه البحث يركز على أراء وتطلعات اصحاب القرار في مجال العقارات وبما ان البحث النوعي يوفر وجهات نظر قوية توفر فهمًا فريدًا للمعلومات المنقولة من خلال اللغة والسلوك التي يتم تحليلها اثناء إجراءات خطوات النهج التي تركز ايضا على العمق الحواري للمشاركين اضافة الى ان النهج النوعي يستخدم لالتقاط المعلومات التعبيرية حول التصورات والدوافع ووجهات النظر التي تكمن وراء القرارات المتخذة وعليه اعتبر هذا النهج ملائم جدا لم يطمح ان يقدمه هذا البحث. ومن الجدير بالذكر انه تم ملاحظة استخدام الأساليب النوعية بشكل متزايد في دراسات مماثلة معنية بدراسة اراء أصحاب القرار، حيث ان النهج النوعي في البحث العلمي يوفر نظرة ثاقبة للتصورات والدوافع ووجهات النظر التي تدعم قرارات أصحاب المصلحة الرئيسيين. هذه الرؤية هي جانب مهم جدا حيث ان رؤي أصحاب القرار المعنيين يتحدد عليه التأثر العام للقطاع المختص وكذلك دوافع المطورون الميدانيون في قطاع العقارات في البحرين والتي تنعكس على توجهات التنمية العامة والخاصة.

كشفت هذه الدراسة أن أصحاب المصلحة على دراية كبيرة بـ نظم تصنيف المباني الخضراء والفوائد المبنية على تطبيق مبادئ الاستدامة ومع ذلك، لا يزال هناك نقص في تبني أي نظام معني على مستوى المطورين على نطاق واسع في جميع أنحاء البلاد. علاوة على ذلك، على الرغم من التعليقات الإيجابية والتقدير الذي تم الإعراب عنه تجاه الفرص التي توفرها تبني نظم التقييم المستدامة، والاهتمام الذي تم التعبير عنه بفوائدها المحتملة على صناعة الإسكان الميسور التكلفة، لا يزال هناك نقص في الوضوح بشأن مدى ومستوى الاستعداد لتنفيذ تلك النظم بين أصحاب المصلحة.

حيث كشفت نتائج الدراسة أن تطوير نظم تقييم المباني الخضراء يواجه تحديات كبيرة ومستويات منخفضة من مشاركة أصحاب المصلحة بسبب التحفظات والمخاوف فيما يتعلق بالتكاليف والمتطلبات ولوائح التنفيذ وكذلك نقص الخبرة والمعرفة في هذا المجال بصافة عامة وعدم ضمان أصحاب القرار من عائد الاستثمار. وعليه يتم عرض النتائج ومقارنتها مع وجهات نظر أصحاب المصلحة حول معايير الإسكان الميسور التي تم جمعها خلال المقابلات المتعمقة.

وأخيرا تقدم الدراسة توصيات لتسريع استخدام نظام تصنيف المباني الخضراء في الإسكان الميسور التكلفة نظرا لما تم سرده من فوائد تطبيق تلك المنهجيات. وتشمل تلك التوصيات توحيد التعريفات على مستوى القطاعات المختصة المختلفة والتركيز على تعريف أهداف تبني نظم تقييم البناء الأخضر بين أصحاب المصلحة والجهات المعنية، وذلك عن طريق العمل على تعزيز الوعي

من خلال توفير المنشورات والارشادات المبسطة والتي توفر نقطة بداية لدعوة المشاركة وكذلك توفير سبل التعليم والتدريب على تلك المنهجيات من قبل جهات مختصة، ووضع خطة تنفيذ واضحة وقابلة للقياس ومحددة زمنياً.

تدعو التوصيات الواردة في هذا البحث إلى نهج أكثر تكاملاً وتشاركية لتلبية الطلب على الإسكان الميسور التكلفة في البحرين. علاوة على ذلك، تدعو هذه الدراسة إلى أن يتم ذلك بشكل يساهم في تحقيق رؤى البحرين وأهدافها المستدامة.

جامعة البحرين

كلية العلوم



برنامج البيئة والتنمية المستدامة

إمكانيات وتحديات تطبيق نظام تصنيف المباني الخضراء (GBRS) في البحرين: التركيز على الاسكان المنخفض التكلفة في قطاع العقارات.

بحث مقدم استكمالا لمتطلبات الحصول على درجة الدكتوراه في البيئة والتنمية المستدامة

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