

## Review Article

# A Unified Sustainability Assessment Metrics for the Countries of the Gulf Cooperation Council - A Critical Study

Mohamed M. Shawky Abou Leila <sup>a,b</sup>

Naif Sultan Alaboud <sup>a</sup>

<sup>a</sup> *Department of Islamic Architecture, College of Engineering and Islamic Architecture, Um Al-Qura University, KSA*

<sup>b</sup> *Architecture Engineering Department, Faculty of Engineering, Mansoura University, Egypt.*

*mmabouliela@uqu.edu.sa*

*n\_alaboud@hotmail.com*

(Received 18/10/2022; accepted for publication 18/12/2022.)

**Abstract:** Many governmental authorities and international organizations have embraced ecologically friendly building standards and achieved sustainable design as the concept of sustainable architecture and its numerous economic, environmental, and social development aims has grown. Despite the Gulf Cooperation Council countries' continuous and joint cooperation, and despite their agreement in climatic and environmental conditions and resources, and their heavy reliance on oil products, and countries' aspirations for unity, there is a large gap represented in the multiplicity of sustainability assessment systems in those countries. According to the Gulf Cooperation Council's charter. Based on this, the research aims to study sustainability assessment systems in a number of countries that have begun to work on sustainability assessment systems. An analytical comparative study of sustainability assessment systems in Kingdom of Saudi Arabia, the United Arab Emirates, and the system for the Emirate of Dubai within the United Arab Emirates, known as Al Sa'fat, and the State of Qatar, represented by the QSAS system. The different systems can be unified, their assessment individually demonstrated strengths and weaknesses for each. Gulf Cooperation Council countries have sustainability assessment systems that needs further updates and inclusion of different architectural design elements.

**Keywords:** Sustainability Assessment Metrics, Nations of Gulf Cooperation Council, MOSTADAM, ESTIDAMA, QAQS, AL SA'FAT. Rating System.

## 1. Introduction

On May 25, 1981, in Abu Dhabi, the leaders of the United Arab Emirates, the State of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, the State of Qatar, and the State of Kuwait reached a cooperative formula aimed at achieving coordination, integration, and interdependence between their countries in all fields. The rationale for achieving unity was stated clearly in the statute's preamble, which emphasized the particular links between the six nations, related traits, similar systems founded on the Islamic faith, and trust in a single destiny and unity of purpose (S. G. o. t. G. C. Council, 2022).

The GCC countries are distinguished by the depth of ties that, as a whole, represent factors of rapprochement and unification, which is reinforced by the flat geographical area across the coastal desert environment that embraces the inhabitants of this region, facilitates communication and communication between them and creates cohesion and homogeneity in identity and values. It was also agreed upon the council's objectives, which are to achieve coordination, integration, and interdependence among member states in all fields in order to achieve unity, strengthen ties between their peoples, and establish similar systems in various economic, financial, commercial, customs, and transportation fields, as well as educational,

**Table (1). Basic information about the Arab Gulf Cooperation Countries**

Country name	Capital	Citizens	Population	Area (km <sup>2</sup> )
Kingdom Saudi Arabia	Riyadh	33,000,000	20,768,627	2,149,690
Sultanate of Oman	Muscat	4,592,115	2,521,289	309,500
United Arab Emirates	Abu Dhabi	9,397,000	1,588,820	83,600
Kuwait	Kuwait	4,348,395	1,385,766	17,820
Qatar	Doha	2,675,522	560,173	11,581
Bahrain	Manama	1,378,000	664,707	765
Total		44,829,043	27,489,382	2,673,123

cultural, social, health, and media affairs.

Tourism, legislative, and administrative issues encourage scientific and technological advancement in the domains of industry, mining, agriculture, water, and animal resources by creating scientific research institutions, launching collaborative projects, and promoting private sector collaboration (S. G. o. t. G. C. Council, 2022).

The Cooperation Council for the Arab States of the Gulf, also known as the Gulf Cooperation Council or the Cooperation Council for the Arab States of the Gulf as shown in figure no (1), is an Arab regional political, economic, military, and security organization made up of six Arab countries that overlook the Arabian Gulf and cover the majority of the Arabian Peninsula. Table No. 1 explains the following (wikipedia, 2022).

In regard to the Arab world, the Gulf Cooperation Council nations are positioned to the east. The Gulf Cooperation Council nations are located between longitudes 35 and 60 east of the Greenwich line and latitudes 16 and 32 north of the equator. The Cancer Tropic runs across many Gulf

Cooperation Council nations.

The research raises an important research question about the extent of the possibility of creating a unified system for assessing sustainability in the countries of the Gulf Cooperation Council, based on the unity of the common destiny, environmental and geographical compatibility, and the great sharing of the natural resources of the countries of the region, as stated in the preamble to the statute, which stressed the special relations that link the six countries. Common features, similar systems, as well as the procedures that countries take in order to achieve this.

The research aims to study sustainability assessment systems in a number of countries that have begun to work on sustainability assessment systems, namely the Kingdom of Saudi Arabia represented by a sustainable system and the United Arab Emirates represented by the sustainability system and the system of the Emirate of Dubai, based on those common concepts on which the Gulf Cooperation Council countries were founded. Within the UAE, known as Al Sa’fat, and the State



**Figure (1). The Gulf Cooperation Council states (S. G. o. t. G. C. Council, 2022a)**

of Qatar, represented in the QSAS system. Each of them was compared and analyzed in order to approach and answer the study question, as well as the extent to which a joint sustainability assessment system or a unified Gulf system might be developed to evaluate the sustainability systems in the Gulf Cooperation Council nations.

## 2.Sustainability and Green Architecture

### 2.1 Green Buildings Definitions:

Green buildings may be defined in two ways. The former describes green buildings as structures created using environmentally friendly procedures that employ resources efficiently during the building's whole existence (Agency). It is the result of the Environmental Protection Agency's work in the United States (EPA). Nonetheless, that idea extends beyond traditional building issues such as cost, durability, and comfort. There are two primary definitions of green buildings. The former describes green buildings as structures created using environmentally friendly procedures that effectively employ resources during the building's full existence (Agency). It is the result of the Environmental Protection Agency's efforts (EPA). Nonetheless, that concept extends beyond traditional building factors such as cost, durability, and comfort (Abou Liela, 2017).

### 2.2 Green Architecture in the Gulf Cooperation Council Region

A group of architectural experts said at the "INDEX" show in the United Arab Emirates that the Gulf Cooperation Council countries may save 3.5 billion dollars by using energy-efficient "green buildings," emphasizing that in light of the acquisition of energy and facilities management. According to a recent analysis by the Middle East Association for Management, energy-efficient buildings in the GCC may save up to \$3.5 billion when combined with up to 90% of building expenses, including \$2 billion in the UAE alone. Facilities. Although the use of glass surfaces is used in many of the projects, architects and building owners in the Arab Gulf region are increasingly required to work by following international best practices in energy efficiency, in line with national sustainability programs adopted in several countries such as the UAE, Saudi Arabia, and Qatar. Appropriate shade and seclusion are essential for achieving comfort within structures, achieving the needed savings in energy expenditures, and providing good visual designs (Lusail, May 18, 2016; Ramadan, May 18, 2016).

The Gulf Cooperation Council countries have qualitative opportunities to benefit from the boom in projects they are witnessing and through the various visions launched by the countries to lay the foundations of a green industry that



Figure (2). A Map Showing Different Rating Systems around the World(Abou Liela, 2017)

meets environmental standards, especially since this sector represents an appealing investment opportunity in light of the growing global demand for green buildings, i.e. those that meet environmental standards through design. The Gulf Cooperation Council countries have qualitative opportunities to benefit from the boom in projects they are witnessing and through the various visions launched by the countries to lay the foundations of a green industry that meets environmental standards, especially since this sector represents an appealing investment opportunity in light of the growing global demand for green buildings, i.e., those that meet environmental standards through construction. Because of the constant building and construction activity and the creation of large-scale infrastructure projects, as well as these countries' efforts to specialize in a new economic sector, the Arab Gulf area is regarded one of the world's major construction marketplaces. The green construction industry is the most strategic sector for Gulf nations to invest in long term, as it contributes to accomplishing its development goals by providing contemporary and sophisticated infrastructure that keeps pace with the global wave of green technology (Mahroum, Saturday 14 April 2018) (Mahroum, Wednesday 18 April 2018).

### 2.3 Environmental Sustainability Assessment Systems

With the expansion of the concept of sustainable architecture and its numerous economic, environmental, and social development aims, many governmental bodies and international organizations have sought to adopt environmentally friendly construction standards in order to accomplish sustainable design. These systems promote the design, construction, and administration of environmentally friendly facilities, as well as the advancement of environmentally responsible building practices. They also play a role in motivating investors to improve their performance by utilizing an objective and authorized instrument that represents the quality of their buildings' environmental performance, giving them a competitive edge in the real estate market. The usage of these systems began voluntary, but some towns have begun to insist that certain degrees be met in order for new projects to be permitted (Zhang, 2019).

These systems rely on providing an assessment

in order to compare the performance of buildings. These systems are classified into four areas based on their field of interest: urban planning tools, urban design tools, tools for assessing the sustainability of the building, and assessment tools at various stages of the structure's existence (Lazar, 2020). Since 1990, various environmental evaluation methods for buildings have emerged and been launched across the world, the most prominent of which are Environmental sustainability assessment systems are defined as the methodology, standards, and foundations that aim to achieve an assessment tool for buildings within the framework of the most important environmental effects of the building, such as energy, water, waste, transportation, the internal environment, and individual health, in order to ensure access to a more energy-efficient building, reduce negative environmental effects, and achieve comfort and well-being. The evaluation is carried out in the presence of a minimum required to achieve these requirements and standards in accordance with the applicable and available practices, and to grant certificates based on an evaluation approach based on environmental principles that guarantee the building's environmental application, confirm the building's commitment to it, and determine its classification (Wen, 2020). The environmental evaluation contributes to the establishment of the foundations and standards that define the interaction of the building with its surroundings, as well as to the creation of a spirit of competitiveness and interest in fulfilling the environmental dimension in buildings. It should be noted that in the environmental assessment curricula for buildings, the relationship of the building with the environment appeared in the form of separate environmental issues when assessed, with the exception of the CASBEE system, in which the assessment result is based on the environmental efficiency index as a final indicator of the assessment, which depends on two main factors: achieving quality and reducing the environmental load (Lee, 2013). Some issues have emerged in most systems, such as: energy, water, building materials, transportation, and the quality of the internal environment, with different weights depending on different interest in evaluation issues, it is possible for the building to obtain a high rating in some evaluation methods, it may not be the same in other evaluation methods, and there are some issues that are unique to the systems and not to others, and the evaluation references that. The building evaluation systems aim to achieve the best

building performance, encourage the establishment of sustainable buildings, reduce the negative impacts of buildings on the environment, ensure the best environmental practice, support investment by stimulating demand for sustainable buildings within the framework of immunizing the environmental impact of age processes in terms of construction, operation, and maintenance, and achieving comfort and health. The evaluation method also escalates the work of a specific grading to classify the building in terms of its preference in dealing with the environment, creating a system for comparing buildings with each other to create a spirit of competition in their environmental performance and their own in line with their climate, heritage, and cultural value, and the tools for measuring sustainability have varied throughout the world. Some are on a worldwide scale and are used by more than one nation, while others are more local as shown in figure no (2):

LEED (Leadership in Energy and Environmental Design), for example, is one of the most well-known in the world, and it is adopted by the United States of America as well as 135 other nations, including Canada, India, and many Arab Gulf countries. In Britain, the United Kingdom, and other Arab Gulf nations utilize the BREEAM system (Building Research Establishment Environmental Assessment Method), whilst Australia, New Zealand, and South Africa use the STAR GREEN system.

HQE (High Quality Environmental Standard), LEED CANADA (Leadership in Energy and Environmental Design), LEED CANADA (Leadership in Energy and Environmental Design), LEED CANADA (Leadership in Energy and Environmental Design), LEED CAN (Leadership in Energy and Environmental Design), Green Pyramid Rating System (GPRS), Green Star Rating System (Estidama), Green Building Index (GBI).

## 2.4 Environmental Sustainability Assessment Systems in the Gulf Cooperation Council Countries:

### 2.4.1 Mostadam: Building Evaluation Systems in KSA

The Saudi system of sustainable assessment, which was inaugurated in October 2019, is the system of sustainable evaluation (Housing, 2019). It is one of the most essential goal aspects of the Kingdom of Saudi Arabia 2030 vision as shown in figure (3) (Energy, Water, and Health)(vision2030). It aims to provide a unique service that permits the accurate assessment of the building’s sustainability. This is accomplished by adhering to stringent environmental regulations that increase the building’s efficiency and improve the quality of life within it. It also reduces the damage caused by building materials and environmental pollutants. Among the system’s most significant benefits are: (1) the best possible efficiency of water and energy



Figure (3). Relationship between Vision 2030 and Mostadam for Residential Buildings O+E (Housing, 2019a)



consumption, (2) the improvement of domestic life quality, (3) a high standard of house-waste recycling management, (4) the reinforcement of the sustainability culture as well as its application within society, (5) the best operational management of buildings and minimizing maintenance costs, and (6) combating environmental pollution both inside and outside the building. (Housing, 2019b) Formalized paraphrase Furthermore, the sustainability evaluation method is based on nine major categories used to assess the level of building compatibility, which are further subcategorized into two major subsections. They cover the levels of sustainability of location, energy, water, health and wellbeing, education, creativity, and operation), as well as transportation, rapport, area, district, culture, materials, and wastes. Nonetheless, it is a contemporary system in need of refinement. (Banani, 2016).

#### 2.4.2 ESTIDAMA SYSTEM IN ABU DHABI, UAE

The grading system, designed particularly for the Emirate of Abu Dhabi’s hot heat and dry environment, provides a set of standards and requirements for analyzing a project’s prospective performance in regard to the four Estidama pillars as shown in figure (4): environmental, economic, cultural, and social. Version 1.0 of the Pearl Rating



Figure (4). The Four Pillars of Estidama(A. D. p. Council, December 2016)

System applies to all types of buildings, sites, and associated facilities. It contains a variety of standards for assessing structures (public, office, retail, apartment complexes, schools, mixed use), villas (single family homes), and communities (neighborhoods). There is also the Pearl Rating System for Urban Communities (PCR, Building Rating System). The Pearl Rating System (PBRs) and the Pearl Rating System for Villas are two types of rating systems (PVRs) (Abu Dhabi urban planning council, April 2010; Abu Dhabi urban planning council, Nov. 25, 2018; Docplayer, 2010; Elgendy, April 17th, 2010; fidic, 2022; transport., 15 DECEMBER 2021; Yumpu, 2016)

#### 2.4.3 QAQS assessment IN QATAR

The GSAS development process began in 2007 with an in-depth and careful study of existing building evaluation systems, tools, and guidelines, which exceeded 140 systems from around the world as a first stage, which was later reduced to the study of 40 total or comprehensive building evaluation systems as shown in figure (5) (SYSTEM, 2010). This was followed by a thorough examination of the best practices of six of the most prominent systems on a worldwide scale. The Global Sustainability Assessment System (GSAS) is the Middle East and North Africa’s first system of its type, evaluating green construction and infrastructure projects using objective performance criteria(M. Salim Ferwati, 2019). The fundamental goal of the “GSAS” system is to establish a sustainable construction environment while taking into consideration the region’s unique demands. The process of designing the “GSAS” system was based on integrated systematic research that included an evaluation of the best practices employed in mature systems in the field of sustainable building at the global and regional levels(Nuri Cihat Onat, 2019). The GSAS system was created from the ground up using a bottom-up approach to enable for a seamless integration process between local requirements and sustainable development goals. GSAS offers three types of certification programs to the construction industry: GSAS “Design and Build,” which aims to assess the sustainability of newly constructed or completely renovated buildings, as well as urban plans and infrastructure, and the “GSAS” system certification for construction management, which is used to assess the negative environmental impact of the contractor’s construction operations on the

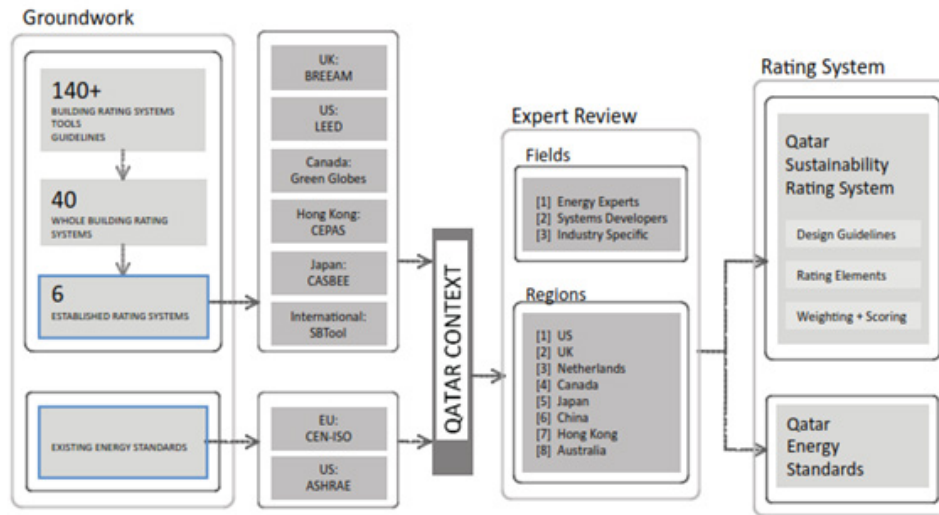


Figure (5). Development process (SYSTEM, 2010)

project land (Prakash C. Phondani, 2016). The assessment method entails assessing all activities that occur on the project site in accordance with the eight GSAS axes, which are urban communication, location, energy, water, external environment, materials, economic and sociological aspects, and lastly management and operation, and the GSAS system certificate for operation, which is used to evaluate new or existing buildings for the purpose of verifying the efficiency of their performance in terms of their ability to save on energy and water consumption, as well as the quality of their internal environment, in addition to matters related to the treatment of waste generated during operation, and the certificate is certified by the GSAS Trust after the project conforms to the requirements of the targeted GSAS certificate ((GORD); Waked, October 30, 2021).

#### 2.4.4 AL SA'FAT System Evaluation Dubai UAE

In 2010, His Highness Sheikh Mohammed bin Rashid Al Maktoum established a set of standards and specifications for green buildings in Dubai, and in 2016, His Highness Sheikh Mohammed bin Rashid Al Maktoum chose the moniker "Al Sa'fat" as a method for certifying green buildings in Dubai. The Dubai Municipality began updating the list of green construction criteria and specifications and elevated them to a categorization system. Green buildings are classified into multiple categories based on how well the standards in each category

are met (Fatima Alhamlawi, 2021). The Al Sa'fat System - Dubai Green Building System has been adopted as an alternative to the list of requirements and standards for green buildings as of October 19, 2020. The methodology divides green buildings into three groups depending on the fulfillment of each category's standards (Awadh, 2018). The Silver Sa'fa standards are the obligatory minimum for all types of new structures in the Emirate of Dubai, and a series of extra requirements must be met in order to obtain the Golden or Platinum Palme. The silver Safa system is required for all structures in the emirate, whereas the bronze Safa system is required for private villas and industrial buildings, and it is optional in the golden Safa system, as it is in the platinum system (Ahmed, 2019; Municipality, 2021, October 2020; Newspaper, July 13, 2016; Sebaei, August 27, 2020).

### 3. Materials and Methods





This study provides an overview of the policies, various planning methods, and assessment methods available to estimate energy efficiency and sustainability in buildings as a spatial determinant in the GCC countries, allowing the use of different tools to investigate the building energy performance of existing buildings and new building designs, as well as critical evaluation of the results presented by systems of various classification. The focus of this research is on the study of sustainability assessment systems in Gulf Cooperation Council countries that

have experience with the aforementioned systems, where these systems will be reviewed and analyzed, and the strengths and weaknesses of each will be determined and then compared through nine points and then reached. An endeavor to create a unified Gulf system for assessing sustainability by comparing them as a result of their participation in a set of common climatic and environmental conditions in the Arab region, as well as their historical partnership. Based on a comparison, the following criteria are used (Mattoni, 2018; Shan, 2018):

- The fundamentals (Starting work - developer - geographical scope - obligatory bezel - Benefits of the System- Objectives of the System)

- The primary assessment categories
- Building types included in the system
- Validity of Classification Time
- Grades of classification, characteristics, development, and resident buildings
- Rewards and incentives for classification
- Fees and expenses associated with the evaluation procedure
- Stages and a system for evaluation
- Form of evaluation

#### 4. Results and discussion

	Mostadam(building, 2020)	ESTIDAMA(Government, 2022)	QAQS((GORD); SYSTEM, 2010)	AL SA'FAT(Municipality, 2021)	
<b>The fundamentals</b>	 <p>البناء المستدام Sustainable Building</p>	 <p>استدامة estidama</p>	 <p>QAQS SYSTEM 2010</p>	 <p>السفوفات السفوفات السفوفات</p>	
	<b>Starting work</b>	October 2019	began in 2008 The mandatory implementation began in 2010.	The GSAS development process began in 2007.	Work began in 2020.
	<b>Developer</b>	The Kingdom of Saudi Arabia 2030 Vision (energy, water, and human health) 2030 Sustainable Construction Program	The Abu Dhabi Urban Planning Council, as a significant component of the Abu Dhabi Plan 2030, Al Ain Plan 2030, and Al Dhafra 2030 Plans, strives to create Abu Dhabi and the whole Abu Dhabi Emirate in accordance with innovative green standards (Government, 2022).		Municipality of Dubai
	<b>Geographical scope</b>	Local, inside the kingdom	Abu Dhabi, Al Ain, Al Dhafra, The United Arab Emirates	Local, inside Qatar	Municipality of Dubai
	<b>obligatory bezel</b>	not legally binding	All contemporary structures must have at least one pearl, while government buildings, schools, and mosques must have two pearls.		The list of standards and specifications for green buildings in Dubai was published in 2010, and it was initially necessary only for new government buildings, but it was subsequently amended to include all new structures.



	<b>Benefits of the System</b>	<p>Improving energy and water usage efficiency.</p> <ul style="list-style-type: none"> <li>• An increase in the level of internal living quality.</li> <li>• Improving home garbage recycling management.</li> <li>• Strengthening the sustainable culture and its implementation in society.</li> <li>• Enhance building operation management while lowering maintenance expenditures.</li> <li>• Reducing pollutants both inside and outside the building.</li> </ul>	<ul style="list-style-type: none"> <li>• Reducing natural resource consumption and waste</li> <li>• Reducing negative environmental effects</li> <li>• Improving quality of life</li> <li>• Rationalizing energy and water consumption</li> <li>• Enhancing the prestige and marketing value of buildings</li> <li>• Optimizing supply chains for sustainable and recycled materials and products</li> </ul>	<ul style="list-style-type: none"> <li>• Intuitive integration of sustainable methods and regional needs</li> <li>• Combines the best features of the world's most established sustainability rating systems</li> <li>• A measurable and results-oriented approach rather than a feature-oriented approach</li> <li>• Individual components are adaptable to any project of any size without jeopardizing the system's integrity</li> <li>• Allows full control over the rating system's development, customization, deployment, future modifications, or expansion based on any set of specified requirements</li> </ul>	<ul style="list-style-type: none"> <li>• The Safat system improves building occupant safety while also ensuring a more sustainable environment for future generations. It also promotes innovation in order to accomplish integration of green systems and technologies in building design, which enhances performance, rationalizes energy use, boosts the efficiency of electrical and mechanical systems, and so decreases carbon emissions.</li> </ul>
	<b>Objectives of the System</b>	<p>Providing a service that permits assessing the sustainability of a building by adhering to environmental criteria that increase the building's efficiency, enhance the quality of life within the structure, and limit the harm caused by construction waste and environmental materials.</p>	<p>Creating more sustainable global communities, cities, and institutions, as well as balancing the Estidama Program's four pillars:</p> <ol style="list-style-type: none"> <li>2. Environmental</li> <li>3. Economic</li> <li>4. Cultural</li> <li>5. Society</li> </ol> <p>It promotes the decrease of:</p> <ul style="list-style-type: none"> <li>• Reducing water use</li> <li>• Reduce energy use</li> <li>• Reduce the use of waste</li> <li>• Reducing the use of materials</li> </ul>	<p>It aims to create a sustainable construction environment while taking into account the unique demands of the location.</p>	<p>Saving electricity by 20%, cutting water use by 15%, reducing trash by 50%, and lowering carbon dioxide emissions by 20%.</p>

<b>The primary assessment categories</b>		<p>To analyze a building's sustainability, a sustainable evaluation approach is based on nine major categories as shown in figure (6):</p> <ol style="list-style-type: none"> <li>1. Location Sustainability (9%)</li> <li>2. Transportation and connectivity (optional) (7%)</li> <li>3. Region and culture (optional) (7%)</li> <li>4. Energy (27%)</li> <li>5. water (27%)</li> <li>6. health and comfort (14%)</li> <li>7. Materials and waste (optional) (4%)</li> <li>8. Education and innovation (4%)</li> <li>9. Operating (4%)</li> </ol>		<p>Estidama conducts an environmental impact assessment as a result of building site selection, design, construction, and maintenance. Points are divided into seven areas of environmental effect, each addressing an action that improves or has the potential to improve a building's environmental performance. For acts that indicate that the building satisfied the evaluation requirements, points are assigned to each credit.</p>		<ul style="list-style-type: none"> <li>• management and operation</li> <li>• cultural and economic value</li> <li>• Water</li> <li>• Energy</li> <li>• Location</li> <li>• urban connectivity</li> <li>• Materials</li> <li>• indoor environment (optional)</li> </ul>		<ul style="list-style-type: none"> <li>• Energy Efficiency</li> <li>• Design and building environment</li> <li>• Resource efficiency and waste management</li> <li>• Vitality of buildings and human comfort</li> <li>• Efficient water use</li> </ul> <p>There are two ways to comply with the regulation's different requirements:</p> <ul style="list-style-type: none"> <li>• the technique of achieving standards, which is the major way used, and the method of gaining performance, which is the other method.</li> <li>• The technique of meeting standards in which buildings meet all of the energy criteria specified in the legislation.</li> </ul> <p>The way of attaining performance, in which a specific calculating approach is employed for structures that do not correspond to the efficiency of the given water supply. It is a way of comparing the yearly consumption of the building to the annual consumption of a reference building that fits all of the criteria specified in the rule, such that the reference building is a comparable building in the figure. The proposed building's size and pattern of usage are judged compliant if its yearly consumption is less than or equal to the consumption of the reference building.</p>	
		Building assessment categories	Weight	PBRS	Weight	Building assessment categories	Weight	Building assessment categories	Weight
		location Sustainability	(9%)	Integrated Development Process (IDP)	(13)	managem ent and operation	(13%)	Energy Efficiency	It is determined by the way of adhering to the numerou
		Transportation and connectivity (optional)	(7%)	Natural Systems (NS)	(12)	cultural and economic value	(4%)	Design and building environment	

	Region and culture (optional)	(7%)	Livable Building (LV)	(36)	Water	(22%)	Resource efficiency and waste management	standards in the regulation, which is either the method of attaining standards or the method of attaining performance.
	Energy	(27%)	Water (PW).	(43)	Energy	(17%)	Vitality of buildings and human comfort	
	water	(24%)	Multiple Energy Sources (RE).	(44)	Location	(28%)	Efficient water use	
	health and comfort	(14%)	Building Materials (SM).	(28)	urban connectivity	(8%)	Innovation (the innovation component is not calculated from the total weights)	
	Materials and waste (optional)	(4%)	Innovative Practices (IP) (optional)	(3)	Materials	(8%)		
	Education and innovation	(4%)			indoor environment (optional)	(19%)		
	Operating	(4%)						
	<b>TOTAL</b>	<b>100%</b>		<b>176 points</b>		<b>100%</b>		

<b>Building types included in the system</b>	<ul style="list-style-type: none"> <li>Residential units in the design and construction phase</li> <li>Existing housing units</li> <li>Complexes and neighborhoods in the design and construction phase</li> <li>Existing complexes and neighborhoods</li> <li>Commercial buildings in the design and construction phase</li> <li>prefab commercial buildings</li> </ul>	<p><b>Villa PVRs's Pearl Rating System includes</b> as shown in figure (8) <b>(transport., 15 DECEMBER 2021c)</b></p> <ul style="list-style-type: none"> <li>Small Buildings</li> <li>Housing units</li> <li>Independent Building</li> <li>Three story building</li> </ul> <p><b>Rating level</b></p> <ul style="list-style-type: none"> <li>PVRs for private or development villas is a single pearl.</li> <li>PVRs for Government Subsidized Villas is one of two pearls.</li> </ul> <p><b>Pearl Rating System (PBRs) for Buildings includes(transport., 15 DECEMBER 2021a)</b></p> <ul style="list-style-type: none"> <li>Buildings such as factories, hospitals, labs, and hotels</li> <li>Offices, colleges, and universities</li> <li>Shops, restaurants, cafes and banks</li> <li>Residential multi-unit</li> <li>School, mosques and clubs</li> <li>Mixed-use buildings</li> <li>one or more structures having a total size of less than 75,000 square meters</li> </ul> <p><b>Rating level</b></p> <ul style="list-style-type: none"> <li>Buildings by Pearl and Wahda - PBRs for all building types</li> <li>Two pearls for buildings: PBRs for government buildings and PBRs for commercial structures.</li> </ul> <p><b>The Pearl Rating System (PCRS) for the urban community includes(transport., 15 DECEMBER 2021b)</b></p> <ul style="list-style-type: none"> <li>Road and sidewalk network</li> <li>Every amenity in the community</li> <li>parks and public services</li> <li>Communities of more than 75,000 square meters in size</li> </ul> <p><b>Rating level</b></p> <ul style="list-style-type: none"> <li>PBRs for all forms of complexes - a single pearl for complexes</li> <li>PBRs for Government Communities - Two Pearls for Communities</li> </ul>	<p>There are numerous sections to the GSAS system:</p> <ul style="list-style-type: none"> <li>Commercial buildings.</li> <li>Administrative buildings.</li> <li>Educational buildings.</li> <li>Mosques</li> <li>Residential buildings</li> <li>Railways</li> <li>Health buildings</li> <li>Sports buildings</li> <li>Gardens</li> </ul>	<p>Public Buildings as shown in figure (11):</p> <ul style="list-style-type: none"> <li>It includes the following types of buildings:</li> <li>Banks and Post offices</li> <li>Cinemas, Theaters</li> <li>Malls (commercial shopping centers) and shopping outlets – shopping malls and Retail Outlets</li> <li>Governmental Buildings.</li> <li>Mosques and Worship Houses</li> <li>Culture and Education - Education Facilities</li> <li>Exhibitions and Festival Centers</li> <li>Health centers and sports clubs and - Healthcare Facilities, Sports Complex Center</li> <li>Museums, Historical and Heritage Buildings</li> <li>Sports and Recreational Centers - Sports and Entertainments Centers</li> <li>Petrol Stations</li> </ul>
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<p><b>Validity of Classification Time</b></p>	<p>The newly developed sustainable system is based on granting the building a sustainable appraisal certificate in accordance with a clear system, as the building owner, upon registration of the building wishing to obtain a sustainable appraisal certificate through the sustainable construction platform, the building is registered, and the engineering offices approved by the platform are presented to the owner for appropriate selection from the engineering offices. This, in turn, appoints a specialized engineer in the so-called MOSTDAM AP to supervise the plans and follow up on the demand in the sustainable building platform, whether for new or existing buildings, from the design and construction stage, and once the building obtains the certificate, it is considered an unexpired evaluation certificate.</p>	<p><b>Certificate validity period</b></p> <ul style="list-style-type: none"> <li>• Certificate of construction for two years</li> <li>• The rating certificate is valid for the whole life of the structure.</li> </ul> <p><b>Evaluation of design</b> The design approval is granted following completion of the design or master planning and represents acknowledgement of the sustainable standards followed throughout the design phase. It is valid until the commencement of construction work, after which the construction assessment processes are commenced.</p> <p><b>Evaluation of construction</b> Given upon completion and verification that the project's construction activities met the design objectives and included the measures specified in the design evaluation stage. The pearl evaluation for the construction stage is valid for two years, after which the project moves on to the operational evaluation stage.</p> <p><b>operational assessment</b> This stage is unique to the pearl rating system, in which the pearl assessment of the operational stage is carried out to check the project's operational performance in order to guarantee that the design has accomplished the intended objectives that will be used in the future.</p>	<ul style="list-style-type: none"> <li>• All projects wishing to receive "GSAS" accreditation for design and construction must designate a "GSAS" service provider who meets the following criteria.             <ul style="list-style-type: none"> <li>- GSAS design and construction service provider license</li> <li>- A green design and construction expert who has been accredited by the "GSAS" system.</li> <li>- For energy evaluation, a "GSAS" certificate is required.</li> </ul> </li> </ul> <p><b>Stage of authentication:</b></p> <ul style="list-style-type: none"> <li>• The GSAS design and construction system accreditation examines the long-term viability of newly constructed or completely renovated buildings, as well as urban architecture and infrastructure.</li> <li>• There are two steps to the design and construction certification process:             <ul style="list-style-type: none"> <li>- At the completion of the design stage, obtain a temporary design and construction certificate in the form of a letter of conformity (LOC).</li> <li>- Phase Two: During the building phase, the CDA Design Conformity Check is performed.</li> </ul> </li> </ul> <p>If the first and second stages are completed successfully, the project will be eligible</p>	<p>The Sa'fat certificate has a three-year validity period, and all buildings that have obtained the Sa'fat certificate are re-evaluated for the purpose of renewal after the expiry of this period, based on an official request submitted by the building owner or his legal representative via the Sa'fat site.</p>
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			<p>for the final "GSAS" certificate for design and construction, as well as the design and build shield.</p> <ul style="list-style-type: none"> <li>• The categorization time is good for one year, and you must pay the certificate charges to renew.</li> <li>• The categorization has a general validity period, and if the client desires to renew, a price is paid for the certificate.</li> </ul>	
<p><b>Grades of classification, characteristics, development, and resident buildings</b></p>	<p>The assessment method is sustainable since it is based on five categorization levels, which indicate the number of points required to be eligible for one of the five levels of certifications. The project score is the total of the criterion points earned. There are five levels, beginning with green, which indicates the lowest score of 20 degrees or more, and progressing to diamond, which may be attained from 80 degrees up to 100 degrees, the highest score as shown in table (1).</p>	<p>Rating scores are separated into five categories, as is the Estidama rating system's area of work:</p> <ul style="list-style-type: none"> <li>• Residences (residential for one family)</li> <li>• Structures (public, office, retail, and residential buildings, schools, mixed uses)</li> <li>• Urban enclaves (neighborhoods)</li> </ul>	<p>the rating degrees are separated into six stars as shown in figure (9):</p>	<p>"Bronze, Silver, Golden, and Platinum" are the four categories of the Sa'fa. All owners, investors, and developers must apply the Palme Bronze criteria, and they will be urged to apply additional criteria and put them into effect in order to attain further advanced system classes, noting that these requirements are mentioned below. Carbon reduction, energy savings, healthy indoor environment needs, smart applications, innovation requirements, and an improvement in building lifespan are all achieved in the many areas listed.</p>



<p><b>Rewards and incentives for classification</b></p>	<p>One of the benefits of the sustainable assessment system is that the building can receive an accreditation certificate after achieving the required standards from each of the six main axes, in which there are a number of requirements, some of which are basic and some of which are optional to achieve a higher classification degree, and there are three optional axes for those wishing to further improve the performance of the building, according to a report.</p> <p>There are no financial incentives from the system, but there are several indirect benefits in the system in terms of lowering the cost of electricity and water bills, and one of the internal benefits of the system is a sustainable evaluation that the building can obtain a minimum score of 20 to obtain the accreditation certificate after meeting the required standards from each of the six axes. The main, which has a number of requirements, some of which are basic and some of which are optional to achieve a higher classification degree, and there are three optional axes for those wishing to further improve the performance of the building and according to an approved sustainable methodology and obtain the system's highest certificate.</p>	<p><b>Financial inducements</b></p> <ul style="list-style-type: none"> <li>• Because the system is mandatory for all modern buildings, there are no financial incentives provided by the state, but the effect of this system benefits the user by lowering the cost of energy by using renewable energy and the cost of water bills by using reused water, achieving and efficiency of the building, raising the market value of the building, selling units at higher prices than their counterparts, and raising the efficiency of the building. The overall aesthetic value of the structure, both inside and externally, by enhancing the proportions of visible areas, natural lighting proportions, and psychological comfort.</li> </ul> <p><b>Incentives in general</b></p> <p>When the four sustainability goals are accomplished, there are several benefits for everyone, the most important of which are:</p> <ul style="list-style-type: none"> <li>• Increased returns on Pearl Rating and development investments</li> <li>• Lower your operating and maintenance costs.</li> <li>• Improving life quality and increasing productivity</li> <li>• Increase rental returns by improving tenant retention.</li> <li>• lowering the demand for and use of resources such as electricity and water</li> <li>• Protecting and strengthening the vulnerable environment, as well as restoring its vigor</li> <li>• To safeguard human health, we must reduce pollution of the land, air, and water.</li> <li>• Reduced greenhouse gas emissions are being used to combat climate change.</li> <li>• Reviving Abu Dhabi's heritage of attaining maximum results with less resources</li> <li>• Maintaining Abu Dhabi's distinct identity and cultural heritage</li> </ul>	<p>GSAS The Global Sustainability Assessment Method is an integrated system for assessing sustainability, whether at the level of buildings of all types or infrastructure and urban planning. It also comprises all stages of real estate project development, beginning with design and finishing with operation. It is also distinguishable from the other international systems by the existence of evidence for the evaluation of unique types of facilities established by "GSAS," such as the evaluation system for open air-conditioned stadiums, railway stations, and mosques. The GSAS system has the following components:</p> <ul style="list-style-type: none"> <li>- Design Principles</li> <li>- Benchmarking tools for high performance</li> <li>- A governance system that is automated and based on objective criteria that are in compliance with the most recent international technological specifications.</li> </ul> <p>The potential to save 40% of electrical energy usage, 30% of fresh water consumption, and 50-70 percent of total public garbage through recycling. Building base points are granted in seven categories, and additional points are awarded in the form of percentages. Points are used to clear basic objects.</p>	<p>The "Al Sa'fat" document is a list of green building evaluations in Dubai. It includes the Golden Palm, Silver Palm, Bronze Palm, and Platinum Palm, which are awards given by Dubai Municipality to Green Buildings after they have been evaluated to ensure that they preserve natural resources and the environment and ensure a healthy environment in accordance with the highest international standards. And, due to Dubai's competitive leadership and the creation of investment opportunities and new markets that benefit the national economy, it is expected that the Green Building Evaluation Regulation "Al Sa'fat" will contribute to saving 34% of energy and reducing carbon dioxide emissions to about seven million tons within five years, which is equivalent to planting 36 million trees in the city.</p>
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		<ul style="list-style-type: none"> <li>• Creating cohesive and connected communities with services</li> <li>• Promoting long-term viability at all levels</li> <li>• Raising awareness and fostering long-term growth, livelihood, and quality of life</li> </ul>		
<b>Fees and expenses associated with the evaluation procedure</b>	<p>The property owner selects one of the engineering firms approved by the service to design the house using an electronic platform. Following the agreement, the fees of 2,800 Saudi riyals are paid through his account on the electronic platform. The engineering office will next upload the files to the computerized platform for examination and approval by an assessor as shown in figure (7).</p>	<p>Because the system is mandatory for all contemporary facilities, whether villas, manifolds, or new metropolitan complexes, there are no material costs given by the owner. There are, however, expenses and fees for the alternative and the emirate to extract licenses that are unrelated to the evaluation system.</p>	<p>The fees and expenditures associated with the review process and getting a GSAS D&amp;B certificate vary depending on the project, as stated in the table as shown in figure (10).</p>	<p>Dubai Municipality has developed a green construction website that includes information on the "Safat" system, a particular area on electronic training, and a list of green and sustainable materials vendors in the emirate. It also created the smart application (Green Buildings), which provides a detailed explanation of the laws in the list of conditions and specifications for green buildings in a simple and enjoyable language, as well as a service for calculating the economic cost of selecting sustainable applications during the building's operation.</p>






<p><b>Stages and a system for evaluation</b></p>	<p>The assessment process is carried out in three steps in a sustainable system:</p> <ul style="list-style-type: none"> <li>• Stage of design (after selecting the approved engineering office on the platform and through a certified sustainable engineer).</li> <li>• Phase 2 - Construction</li> <li>• Phase of operation (optional after at least one year of operating the building, equivalent to 75 percent ).</li> </ul>	<p><b>The application's submission</b></p> <ul style="list-style-type: none"> <li>• The project is registered with the relevant municipality and on the Estidama website.</li> <li>• Preliminary drawings and detailed drawings are used to evaluate the design in two stages.</li> <li>• Construction evaluation is divided into two stages: pre-construction and post-construction.</li> <li>• A step that will be used in the future is operational evaluation.</li> </ul> <p><b>Stages of accreditation, application submission, and exemptions</b></p> <p><b>Submission of the application</b></p> <ul style="list-style-type: none"> <li>• When you register the project on the Estidama website, you will be given a project number.</li> <li>• Appointing a certified specialist to assist with the categorization process and application</li> <li>• A workshop to promote integrated growth and the advancement of all credentials.</li> <li>• Examine and revise the design and implementation processes.</li> </ul> <p><b>Evaluation of design</b></p> <ul style="list-style-type: none"> <li>• As part of the development project design review submission, a certified expert will offer complete information.</li> <li>• Throughout the design process, the Professional will evaluate and update contributions on a regular basis.</li> <li>• Estidama Members may request clarification or more information from a certified professional during the review process.</li> <li>• The design review is completed and the credits earned by the development are granted.</li> </ul>	<p>The procedure of the phases of the assessment mechanism begins by registering the project in GSAS GATE via the website. Pay the registration fee on-site and then activate the project on the site. In the first stage, ensure that the project complies with the new requirements, and then verify for design compliance. The project has been submitted for the second round of evaluation and auditing. The third and final stage involves verification, awarding the project the degree it merits, and receiving the certificate. If the project fails to meet the requirements, the applicant has the option to submit an appeal to have the project reviewed, request the appeal, pay the fee of the appeal, and then resubmit the proposal with the resumed criteria. In the event of conformance, the project is examined and authorized.</p>
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		<p><b>Evaluation of construction</b></p> <ul style="list-style-type: none"> <li>• The competent professional assesses and updates the data after reviewing the building job. The construction audits are carried out by the pearl appraiser.</li> <li>• Final submissions are made after construction is done but before the project is delivered.</li> <li>• The pearl appraiser will analyze the application and may seek explanations or more information from the Structural Building Quality Program.</li> <li>• Achieving the establishment evaluation, and it is rewarded based on the development's balances.</li> </ul> <p><b>Employment Assessment</b></p> <ul style="list-style-type: none"> <li>• Applications for an operational pearl rating can be made two years after construction is completed. The procedure for getting an operational rating for pearl grades is described in the separate Operational Rating Handbook (currently under development).</li> </ul>		
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Figure (6). Mostadam for Residential Buildings O+E categories(Housing, 2019a)

Table (3). Mostadam rating levels(Housing, 2019a)

Number of Points Achieved	Rating Level
≥ 20	 Green
≥ 35	 Bronze
≥ 50	 Silver
≥ 65	 Gold
≥ 80	 Diamond

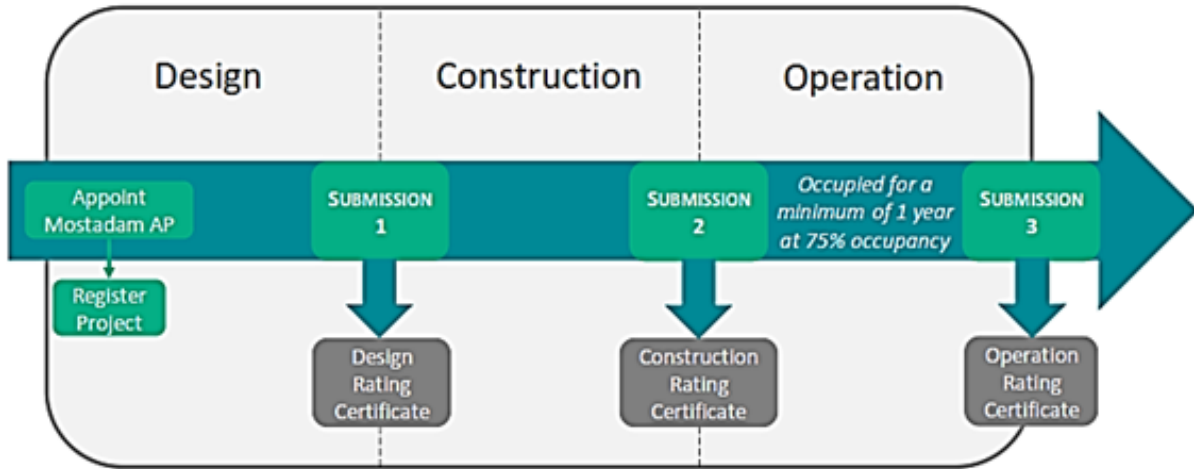


Figure (7). Submission process for Mostadam(Housing, 2019a)

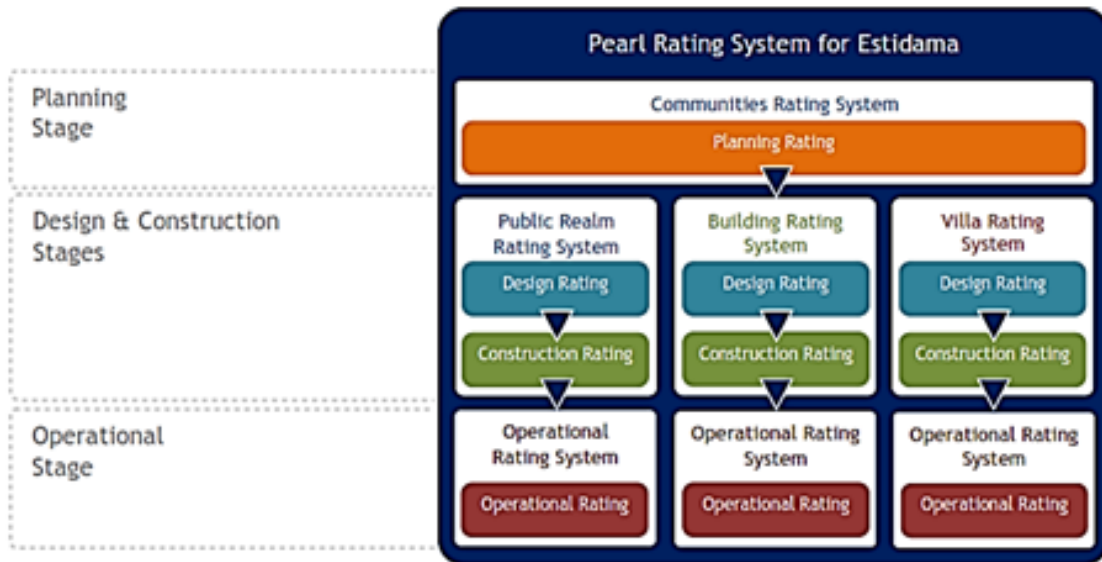


Figure (8). Links between the Pearl Rating Systems(Abu Dhabi urban planning council, Nov. 25, 2018)

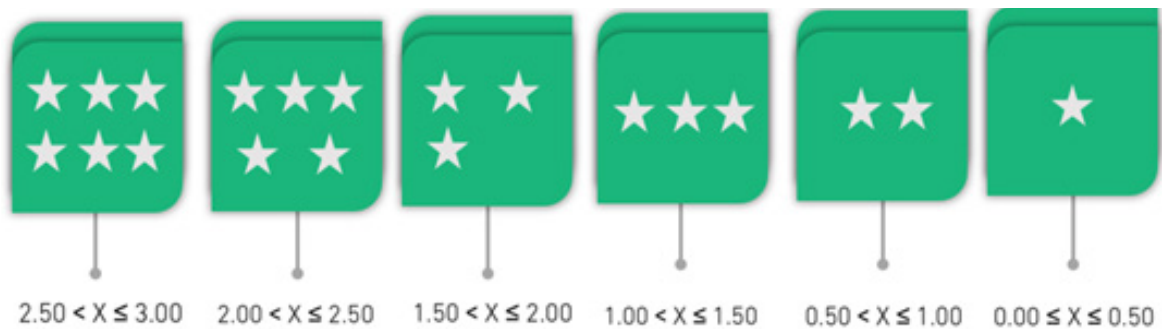


Figure (9). GSAS rating degrees are divided into six stars(SYSTEM, 2010).



**LICENSES FEES**



**I. GSAS Service Providers**

CERTIFICATION	SCHEME	FEES (QR) PER (1) YEAR
GSAS Design & Build	Building Typologies	5,000
	Districts	10,000
	Energy Centers	3,000
	Healthcare	5,000
	Railways	5,000
	Sports	5,000
GSAS Construction Management		10,000
GSAS Operations		5,000

Figure (10). Fees and expenses related to the review process and obtaining a GSAS D&B certificate(SYSTEM, 2010)

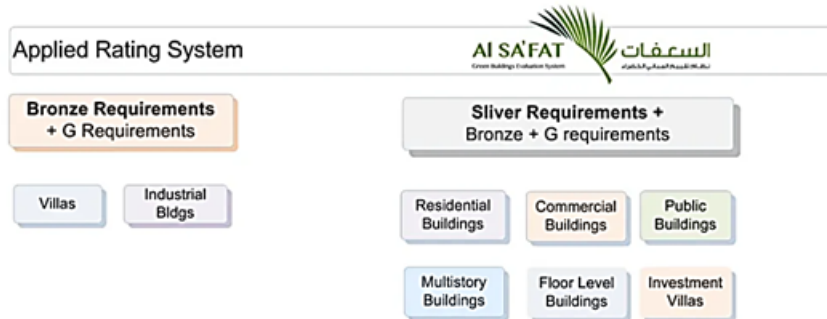


Figure (11). Building types included in the Al Sa'fat system(Municipality, 2021)

**4. Conclusions**

Based on the evaluation of each system and the comparison criteria established by the research, the following key findings about assessment systems in Gulf Cooperation Council nations were reached:

- The systems in general are new, with their usage beginning in the second decade of the millennium; some are optional, while others are mandatory.
- Even though their ratios differed from system to system, the water and energy components appeared to be the most relevant main assessment categories in the systems overall.
- Some systems dealt with different types of

buildings and created their own assessment system for each category or type of building, rather than a general system that is comprehensive for all buildings, and so the evaluation categories changed in the systems based on the type of buildings.

- Depending on the kind of system, the validity of construction certificates ranged from open for life to renewed specified time.
- The systems agreed that there are degrees of classification with varied distributions depending on the system and the term.
- In general, the incentives procedures offered to buildings with assessment certificates were insufficient in all systems and must be

improved.

- Fees for assessments vary depending on the system, with some being free and others being charged depending on the system and the kind of structure or its location.
- The evaluation phases and mechanisms differ depending on the system. There are systems in which the assessment process begins with the design stage and progresses through the operating stage, which may be voluntary, such as the Saudi sustainable system, and some systems continue to the post-operational stage.
- The assessment forms range from one system to the next based on the evaluation categories and the points system for each category.
- It is possible to create a unified system that brings together the Gulf Cooperation Council countries if we rely on the common points and common elements in the evaluation categories, which revealed that the water and energy components are among the most important elements on which the evaluations are made, and there are some other complementary elements that can be agreed upon on the extent of their importance and relative weight, such as sites. Transportation, intervention, management, and operation are all aspects of the business.

### **5.The foundations of the Pan-Gulf Assessment System:**

Could be summarized in the following points:

#### **6.1 Concerning utilized water conservation:**

Because of the scarcity of water in the Arab Gulf region, PW is seen as one of the most critical evaluation factors, and so plays a significant role in assessment categories such as the Estidama system. There is a total of (43). As a result, because it is one of the most essential requirements in the Arabian Gulf region, the water performance clauses in indoor and outdoor locations must be fully covered in the lowest categories for receiving the certificate.

#### **6.2 Regarding the materials used:**

One of the most important aspects of systems is the use of local and available materials in the surrounding environment, as well as their preservation without expiration and benefiting

from them in the future for future generations, with the addition of an item on whether or not to recycle the building components as an additional degree in the evaluation because it has a significant impact on the sustainability of materials after the building's demolition or expiration. Its life span increases with an increase in the percentage of the item (materials) for the importance of materials in achieving sustainability, and safety aspects of fire systems, sound insulation, ease of cleaning the building, and others as essential elements in the building's sustainability should not be overlooked.

### **6.3 In terms of energy and transportation systems:**

For a system to be suitable for the Arabian Gulf region, with its hot desert climate, and therefore (many energy sources). RE) is one of the most important criteria that have been focused on by various systems, such as the Estidama assessment system and other evaluation systems, in which the global trend today is to reduce reliance on fossil fuels and rely on alternative energy systems to conserve the country's resources, which affects construction operations and internal transportation, for example, and thus importance should be given to transportation standards in obtaining the lowest certificate due to the nature of the atmosphere and the large distances in countries such as Saudi Arabia that require a large public transportation system.

### **In terms of stimuli:**

There is a need for more tangible rewards, in the form of money or incentives for projects that have been evaluated for creativity and innovation, which encourages more endeavors to achieve creativity and sustainability.

## **6.Recommendations**

The study validated the theoretical hypothesis of a unified assessment system for sustainability in Gulf Cooperation Council countries, which is combined by backgrounds, rules, environmental systems, climate, and one geographical area, even if its urban scope differed and varied according to the specific nature of each region. Possible, and the study resulted in the following recommendations:

- In general, evaluation systems should be updated on a regular basis, and new versions should be issued based on local studies and new

studies, making the regulations mandatory for all modern buildings, eliminating the costs of obtaining certification, merging the system with municipalities, and giving government-supported buildings a higher evaluation than individuals. Throughout all three stages of the electronic evaluation mechanism's operation, including design, construction, and operation to enable transactions and achieve accreditation, as well as an electronic program that automatically conducts calculations for each item in the assessment. As a result, we push for making the final report easier to present in other assessment systems, while also working to educate the community about the importance of sustainability assessment systems and stressing their environmental advantages.

- Studying the various architectural design elements and allocating special elements to each of the areas in order to achieve the negative design in the building so that the design has an evaluation through directing the building and using architectural elements that achieve sustainability such as solar breakers and others in addition to the architectural character of each area so that if the architectural character of each area is achieved Additional degrees are offered to the structure, which also aids in preventing visual pollution and incorrect interpretations of the façade outside the style of the region, taking into account the cold portions and the difference in assessment degrees rates from the hot area.
- Working on the creation of a sustainable organization that connects all sustainability systems with Gulf states in order to debate the most important issues, offer seminars and lectures, and share system-wide methodological ideas.
- Evaluation of new degrees for the innovation criterion, which is critical in the development and improvement of the system.

#### Conflict of interest:

No potential conflict of interest was reported by the author(s).

#### Compliance with ethical standards:

Not applicable.

#### Legal Public/Private Permissions

In this research, there are no necessary permissions (Not applicable.)

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## نظام موحد لتقييم قياس الاستدامة في دول مجلس التعاون الخليجي - دراسة نقدية

محمد محمد شوقي أبو ليله<sup>١,٢</sup> نايف سلطان العبود<sup>١</sup>

<sup>١</sup> قسم العمارة الإسلامية - كلية الهندسة والعمارة الإسلامية - جامعة أم القرى - المملكة العربية السعودية

<sup>٢</sup> قسم الهندسة المعمارية - كلية الهندسة - جامعة المنصورة - جمهورية مصر العربية

[mmabouliela@uqu.edu.sa](mailto:mmabouliela@uqu.edu.sa)

[mmshlila@mans.edu.eg](mailto:mmshlila@mans.edu.eg)

قدم للنشر في ٢٢ / ٣ / ١٤٤٤ هـ؛ وقبل للنشر في ٢٤ / ٥ / ١٤٤٤ هـ.

ملخص البحث. مع نمو مفهوم العمارة المستدامة لتحقيق أهداف التنمية الاقتصادية والبيئية والاجتماعية تبنت العديد من الهيئات الحكومية والمنظمات الدولية معايير بناء صديقة للبيئة لتحقيق تصميم مستدام، وعلى الرغم من التعاون المستمر بين دول مجلس التعاون الخليجي، ورغم وجود شبه توافق بين الظروف المناخية والبيئية بينها واعتمادها الكبير على المنتجات النفطية، ومع تطلعات هذه الدول لعمليات الوحدة الشاملة في كافة المجالات حسب ميثاق مجلس التعاون الخليجي، إلا أن هناك فجوة كبيرة يطرحها البحث تتمثل في تعدد نظم تقييم الاستدامة المستخدمة في تلك الدول، ويهدف البحث إلى دراسة أنظمة تقييم الاستدامة في دول مجلس التعاون الخليجي والتي بدأت العمل على تنفيذ مثل هذه الأنظمة، وذلك من خلال دراسة تحليلية مقارنة لأنظمة الاستدامة في كل من المملكة العربية السعودية - نظام مستدام، دولة الإمارات العربية المتحدة - نظام استدامة، ونظام إمارة دبي - الإمارات العربية المتحدة - نظام السعفات، ودولة قطر - نظام جي ساس وذلك من خلال تحليل هذه الأنظمة وتقييم نقاط القوة والضعف لكل منها في الوصول لنظام موحد لتحقيق التعاون المشترك بين دول مجلس التعاون الخليجي في مجال نظم الاستدامة وتقييمها، حيث خرج البحث ببعض التوصيات أهمها أن نظم تقييم الاستدامة في دول مجلس التعاون الخليجي في حاجه الي التحديث المستمر كما تحتاج الي إضافة عناصر أخرى الي عمليات التقييم.

الكلمات المفتاحية: مقاييس تقييم الاستدامة، دول مجلس التعاون الخليجي، مستدام، استدامة، جي ساس، السعفات، نظم التقييم.