

## Sustainability plan to evaluation structures and the construction market in Egypt

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**ABSTRACT :** The negative consequences that buildings and structures may have on the environment include water pollution, energy consumption, waste generation during the construction period, and carbon dioxide gas emissions. The first step towards sustainability in Egypt is to start having no environmental effect. In Egypt, 16 buildings have earned the LEED (Leadership in Energy and Environmental Design) certificate, while 54 projects are awaiting a score. Therefore, the purpose of this study is to determine what proportion of different structures investigations from the construction market need to be "Going Green" and how we can help to raise the number of investigations. Reducing a building's detrimental environmental consequences is known as "Green". Numerous factors determine this process's performance, and the only way to guarantee it is to have a means of evaluating them. Rating systems are one of the various instruments available for environmental evaluation. On the market, there are several rating systems accessible. For instance, water is given little weight in LEED and is mostly focused on energy consumption. Since the GPSS Green Pyramid Scoring System in Egypt did not fully address the five dimensions of sustainability—environmental, social, economic, technical performance, and stability—a survey will be distributed in order to begin the process of creating a new scoring system that satisfies these requirements. Thus, an investigation aimed at spreading the idea of "sustainability" in Egypt.

**KEYWORDS** sustainability, leed, energy consumption, environmental design, carbon footprint.

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### I. INTRODUCTION

Since they employ materials that must be taken from the natural world and transported great distances, which take up valuable road space, buildings have a significant negative environmental effect (Mezher, 2006).

Later on in the building process, employees are working in very loud and filthy surroundings having an impact on nearby residents. Water and energy use by building occupants results in waste water, solid waste, carbon, and radon. Deconstruction trash is produced when a structure is demolished at the end of its useful life. According to the CIA, some of Egypt's current environmental problems include: "sandstorms and urbanization displacing agricultural land the sole permanent water supply; the Nile and natural resources are being overstretched by the fast population increase. Residential use makes up over 40% of Egypt's energy consumption, which is more than the industry's 35% total use (Egyptian Electricity Holding Company, 2009).

### II. THE SIGNIFICANCE OF BECOMING "GREEN"

In comparison to business power loads, home electricity loads increased significantly in 2008/2009 due to two sources. These are the global financial crises, which had an impact on industrial demand because of the usage of gasoline-powered automobiles in the transportation and distribution phase.

Table 1: Main Activity and Environmental impacts

Activity	Environmental impacts
Mining/Drilling/Extracting	<ul style="list-style-type: none"> <li>• Deforestation</li> <li>• Destruction of plant and animal habitat</li> <li>• Existing settlements</li> <li>• Land erosion</li> <li>• Water pollution</li> </ul>
Manufacturing/Assembly	<ul style="list-style-type: none"> <li>• Energy consumption (impacts of producing energy)</li> <li>• Waste generation</li> </ul>
Transportation/Distribution	<ul style="list-style-type: none"> <li>• Energy consumption</li> <li>• CO2 emission</li> <li>• Resource use (packaging)</li> </ul>
Building	<ul style="list-style-type: none"> <li>• CO2 emission</li> <li>• Pollution and radiation from the materials and technologies (exposed to chemical and climatic activities)</li> <li>• Pressure and damage</li> </ul>
Maintenance/Life cycle	<ul style="list-style-type: none"> <li>• Energy consumption</li> <li>• CO2 emission</li> <li>• Resource use and replacement</li> <li>• Wear and tear</li> </ul>
Recycle/waste	<ul style="list-style-type: none"> <li>• Landfill decomposition</li> <li>• Groundwater contamination</li> <li>• Methane gas production</li> </ul>

The objectives and advantages of green structures are examined from the perspectives of the environment, economy, and society, along with any potential drawbacks that may affect any of these groups.

### III. LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN)

The term "sustainability" was reintroduced in 1992 during a UN conference on environmental development held in Rio de Janeiro. Numerous building types, such as offices, labs, hostels, and schools, can use the LEED-EB standard. Structure performance and environmental effect are the system's main concerns. It includes both currently constructed buildings and those that were previously LEED-NC certified. According to Army (2004), the LEED-EB certification also aids in lowering building operating expenses, resolving operational issues.

Designers must do comprehensive sustainability studies. Compared to previous approaches, Building Information Modeling (BIM) offers the potential to undertake these assessments more correctly and efficiently since it allows multidisciplinary information. Software for BIM-based sustainability evaluations can be used directly or indirectly to create documentation supporting LEED credits. By employing this strategy, the LEED certification process might be streamlined and significantly reduced in time and cost compared to using standard methods. (Ahmed, Ahmed, Olsen, Carlton, 2010). It has been observed that a construction project must have a basic degree of commissioning in order to receive any LEED grade. A project team can be guided through the re-commissioning management handbook by a LEED-accredited expert (Ellis, 2003). The system is capable of performing real-time measurement of electrical data that can be effectively transferred to a remote monitoring center via the internet.

### IV. TERMINOLOGIES "GREEN VERSUS SUSTAINABLE"

Green structure must first be defined and set apart from other frequently used terms before rating systems for green structure can be discussed. Terms like "green structure" and "sustainability" are frequently used to describe ecologically favorable structures and/or methods. However, it is uncommon to distinguish these concepts clearly. Thus, three "green" and "sustainability" ideas are presented and explored in the part that follows. Subsequently, a definitive deduction is made from them to obtain a comprehensive perspective and comprehension of the meaning of those phrases, enabling the determination of how to arrive at them in further study.

• THEORY #1:

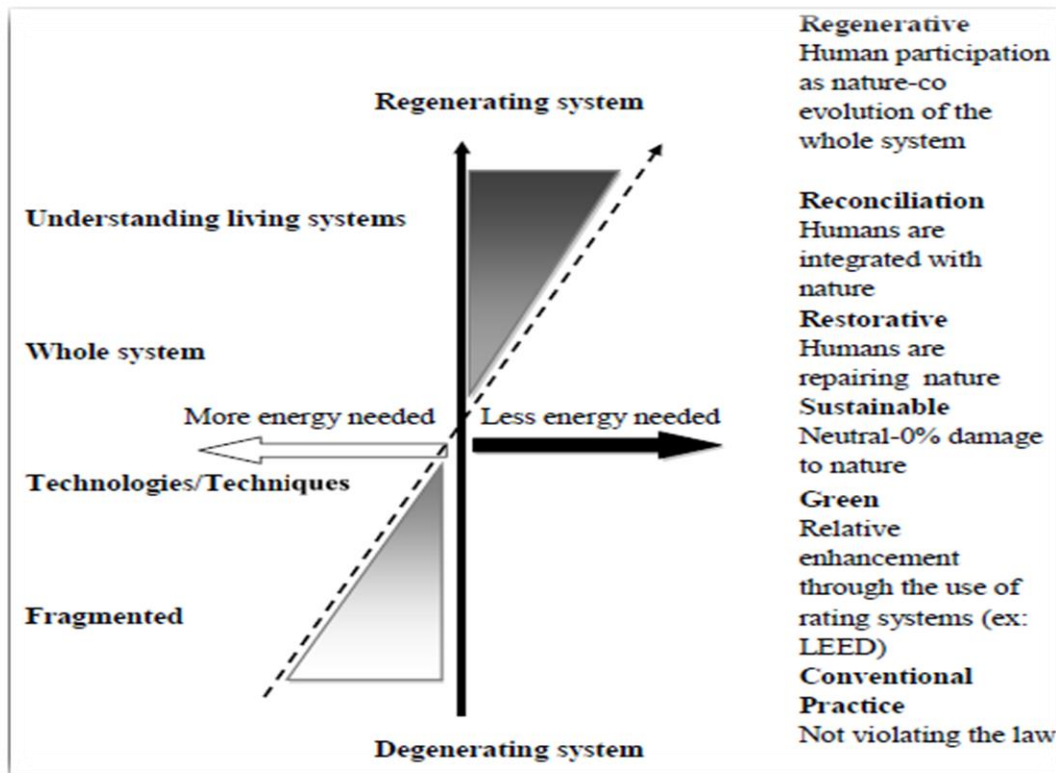


Fig1: (yudelson, 2009) the difference between commonly used terminologies is shown on an energy use and effect on environment basis.

The differences between frequently used terminologies are displayed in Figure 1 (Yudelson, 2009) based on energy usage and environmental impact.

The trajectory of environmentally conscious design is seen in Figure 1 and indicates a favorable upward spiral from traditional design to completely restorative and regenerative design, via green design. Going green is a step toward sustainability, it might be said.

In comparison to a conventional construction, a green structure consumes much less energy and water, has fewer site impacts, and often has better indoor air quality. It also takes into consideration the life-cycle effects of selecting different kinds of décor, construction materials, and furniture. Improved site development techniques, decisions made during design and construction, and the overall results of using, maintaining, removing, and perhaps reusing building materials and systems. (Marvin, 2009). Conversely, sustainability is described as “live in a way that enables future generations to have a similar quality of life as ours.” Using resources sensibly and producing durable commodities are essential components of living in harmony with the environment (Yudelson, 2010).

• Theory #2:

According to a different perspective, the connection between sustainability and green is as seen in figure 2 below (Attmann, 2010). Figure 2 uses the term sustainability to refer to environmentally stable, technologically, materially, and ecologically sound building design.

Primarily from an economic perspective, and conversely, green is seen as an ethereal notion encompassing ecology, performance, and sustainability. In this instance, ecology is concerned with how the building interacts with and balances with nature. This idea states that a structure can be stable and sustainable yet not green because of its poor environmental effect or low performance. The same holds true for excellent performance devoid of stability, ecology, etc.

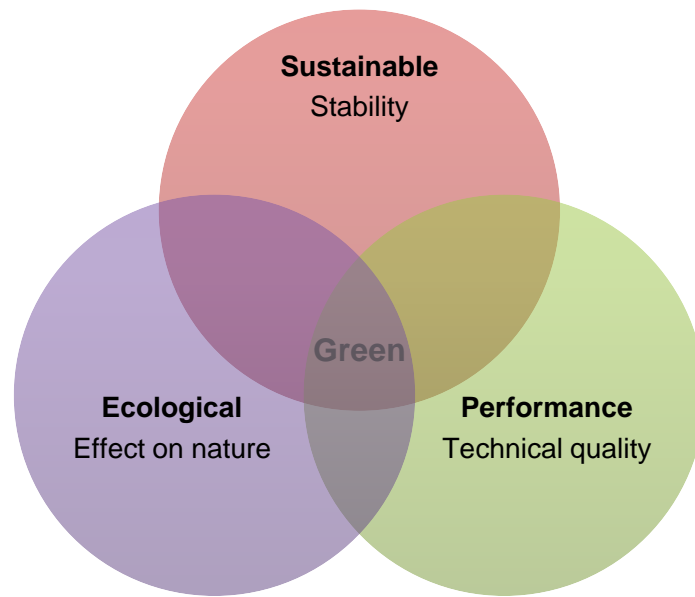


Fig. 2. Relationship between green, sustainability, ecology, and performance (Attmann, 2010)

**V. RESEARCH OBJECTIVE**

The main aim of this paper is to evaluate the construction projects which reach the requirement of LEED Certificate and to highlight the week point in this score. There are sixteen construction projects in Egypt get the LEED certificate until now. These projects were constructing in Cairo and Alexandria and Upper Egypt, see figure 3.

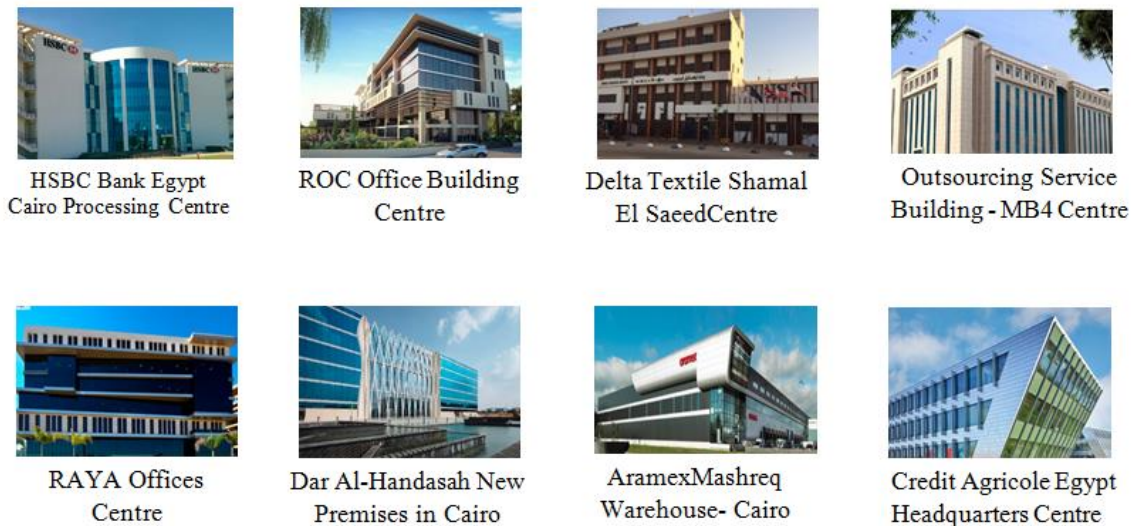


Fig. 3. Some of construction projects in Egypt get the LEED certificate.

**VI. METHODOLOGY**

Figure 4 showing the steps of thinking and research methodology which is collect the entire construction projects in Egypt and evaluate the result of the scoring point system (100), Analysis the result of the scoring rate of these projects and summarize the result and also highlight the weakness of this scoring system.

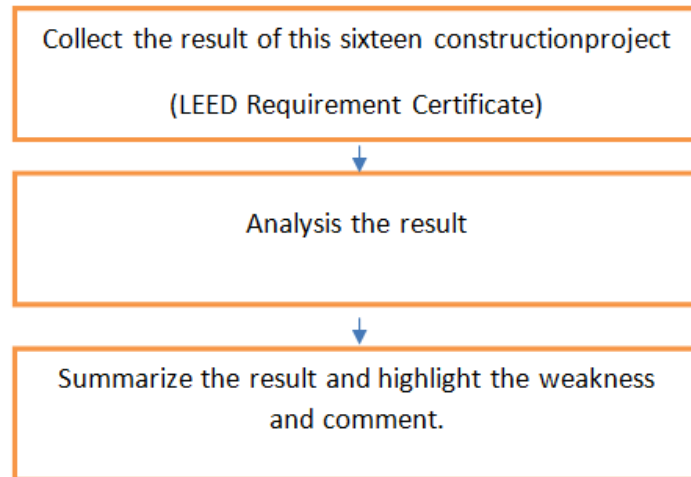


Fig.4. Research Methodology

Table 4: Projects certified LEED in Egypt and total score achieved.

#	Project Name	Project Certification Level	scoring
	LEED NC 2.2		
1	HSBC Bank Egypt Cairo Processing Centre	Gold	44
	LEED NC 2009		
2	Credit Agricole Egypt Headquarters	Platinum	81
3	AramexMashreq Warehouse- Cairo	Silver	51
4	Dar Al-Handasah New Premises in Cairo	Gold	62
5	RAYA Offices	Gold	60
6	Info Fort Warehouse Project	Silver	53
7	Galleria 40	Gold	64
8	Mobinil New Call Center- Pyramids Height	Gold	61
9	Outsourcing Service Building - MB4	Silver	50
10	LOREAL PYRAMIDS	Silver	54
11	Aramex Burg El-Arab	Silver	50
12	MARS EGYPT SITE DEVELOPMENT	Gold	64
13	New Connection	Silver	54
14	Bureau 175	Gold	61
15	Delta Textile Shamal El Saeed	Certified	40
16	ROC Office Building	Silver	58

Table 4 refers to the sixteen construction projects certified LEED in Egypt, all this project construct from 2000 until now and the type of LEED requirement which based on it qualified (LEED NC 2.2 OR LEED NC 2009). The Score are also show. The separated score of Energy and atmosphere, Materials and resource, indoor Environmental Quality, sustainability sites, water efficiency, innovation and design in table five.

**VII.SUSTAINABILITY PROJECT IN EGYPT.**

Egypt's first LEED-certified structure is the HSBC Global Service Center. The HSBC Bank Egypt Global Service Centre is the first building in Egypt to be awarded the prestigious LEED (Leadership in Energy and Environmental Design)-Gold accreditation. The 21,000 square meters, four-story structure has two subterranean parking levels and three regular floors on the ground floor.



Numerous environmentally friendly elements included into the HSBC Global Service Center. The building's energy-efficient design allows for cost savings of 9% on electricity consumption, 39% on chilled water usage, and 47% on domestic water consumption. The building's achievement of the renowned green grade may also be attributed to the fact that about 84% of the construction trash was redirected from landfills. The building is situated in the master-planned community of Smart Village Cairo in Giza, Egypt.

The new CréditAgricole Egypt (CAE) head office complex was designed to house employees various Central Cairo locations. The property occupies 20,385 square meters of land and is situated in New Cairo's Fifth Settlement. It consists of a 5,100 m<sup>2</sup> state-of-the-art two-wing building with services and landscaped spaces that can accommodate up to 1,500 workers. The building structure is made up of three conventional levels, ground floor, garden level, and two basements.

The facility was created to fulfill the requirements needed to obtain a LEED Platinum certification. Complete LEED paperwork, including lighting simulation and feasibility studies, was created during the project. The bank's head office complex has already gained 80+ points out of 100 in the several areas related to green building design, including water efficiency, energy and atmosphere, materials, resources, and interior environmental quality, earning it a LEED Platinum designation.

The creation of an energy simulation model to assess the building's design and orientation in relation to its overall energy efficiency was another aspect of ECG's LEED coordination. Meanwhile, ECG employed the Revit BIM software throughout the design process to meet the requirements of this specific project in terms of precise modeling and collaboration amongst various disciplines, beginning from the initial conceptual design to the latter phases of the design. Prestigious LEED Green Building Certification Awarded to Aramex-Mashreq The sustainable logistics facility in Cairo, Egypt owned by Aramex-Mashreq has been given a coveted LEED Silver Certification. The new 350,000 square foot AramexMashreq warehouse in Cairo, Egypt has just granted the esteemed LEED Silver accreditation. Prestigious LEED Green Building Certification Awarded to Aramex-Mashreq. The sustainable logistics facility in Cairo, Egypt owned by Aramex-Mashreq has been given a coveted LEED Silver Certification. The newly constructed 350,000 square foot AramexMashreq warehouse in Cairo, Egypt, 26 percent. The location has achieved savings in carbon emissions equal to 83 passenger vehicles' worth of emissions over the course of a year because to reduced interior lighting power density, increased building insulation, and specialized automated building management technologies. The warehouse offers two priority parking places for low-emission, fuel-efficient, or hybrid automobiles in addition to five private shuttles to encourage staff members to take public transportation. In order to manage waste during construction, specific spaces were built on the site for the gathering and storing of recyclable items. In addition, 41.6% of the building's materials were produced and sourced locally, reducing emissions from transportation. Moreover, smoking is not only forbidden within the building to further encourage and preserve a clean and healthy environment, but moreover all windows and entrances within 25 feet.

At now, Aramex is striving to obtain the LEED accreditation for five other buildings located in Amman, Cairo, Dubai, and Muscat.

The relocation of DAR AL-HANDASAH CAIRO (Shair and Partners) to their new LEED Gold-certified headquarters in Smart Village, Cairo, is now complete. The 41,800-square-meter Perkins+Will-designed facility accommodate 2000 employees with workspace and amenities.

The new offices are very eco-friendly and visually appealing. Apart from the LEED-Gold accreditation, an executive level that meets zero-carbon criteria is also planned. The triangular structural form helps it to withstand Cairo's intense heat. The structure is consists of six-story water wall, which uses evapotranspiration to cool the inside, are two further distinctive architectural features.

Due to its outstanding efforts, Dar Al-Handasah Cairo has recently made headlines in Egyptian and Middle Eastern media. The company was successful in its application for the Suez Canal project, which intends to create a massive global industrial and logistical complex in the Suez Canal region. It did this by defeating a group of fourteen firms in competition.

Raya Offices exudes a strong professional presence that is ideal for conveying a positive corporate image. Offices come fully equipped with top-notch finishes, the newest technology, and a sleek, modern design that exudes sophistication. Along with kitchen and lounge amenities, there are executive meeting and conference rooms accessible. The committee staff provides a multitude of support services, such as administrative support, mail processing, and phone answering. Leases with variable terms may be tailored to your specific business needs, giving your organization the freedom to grow trouble-free. This corporate center, which is part of the fast growing economic district of New Cairo, provides great connection with Cairo. With a restaurant, snack bar, and fitness center on the property, you'll have access to a variety of practical services without ever leaving. Additionally, there is several banking, financial, and insurance establishments close by, making it an ideal place to network. The major road is conveniently located and offers great access to Cairo by vehicle or Micro bus service. It takes about 25 minutes to go straight to Cairo International Airport.

"The best place to experience luxury and energy in West Cairo is Galleria40. An excellent location with a comfortable, contemporary vibe. The lavish blend of local and worldwide retail brands, excellent dining, lively nightlife, business amenities, family entertainment, and exquisite dining is the solution to all needs. GALLERIA40, which is only 20 minutes from downtown Cairo and is situated in a prime position on the 26th July Corridor in Sheikh Zayed, brings business, retail, and luxury to life in the West of Cairo. Cairo is a favorite vacation destination.

Orange New Call Center- Pyramids Height Being a Gold LEED certified facility, the Orange Call Center exemplifies our dedication to environmentally friendly building materials and techniques. The project included a number of elements that were all intended to support the best possible working conditions and increased productivity, such as modern communication technologies, well-functioning office spaces, and worker amenities. Nextep Construction's skillfully combined cutting-edge technology, contemporary design features, and environmentally friendly solutions to create an ideal working environment for Orange's call center operations, from the painstaking planning phases to the faultless implementation.

Construction MB4 is a 4,200-square-meter contact center that has four standard levels, a ground floor, and a basement. It's in Cairo's Maadi neighborhood. The structure incorporates a number of energy-saving features, including effective lighting and a high-performance, reflective roofing system. LEED certified is MB4.

LORAL PYRAMIDS Built in accordance with LEED guidelines, the Cairo facility is the first factory in any industry in Egypt to receive certification. These include a US quality standard that describes excellence in the design and construction process of buildings with respect to important sustainability factors including atmosphere management, water and energy efficiency, resource usage, and environmental quality. The plant strives to reduce CO2 emissions, water consumption, garbage creation, and waste generation in order to fulfill L'Oréal's "Sharing Beauty with All" obligations.

EGYPT SITE DEVELOPMENT FOR MARS Mars Egypt planned to extend its current facility in Industrial Zone 3, 6th of October City, across an 82,000 m2 plot of land. The new addition with its steel construction was combined with the current plant.

Table 5: the sixteen projects and separated score of every scoring item

#	Project Name	Energy and atmosphere	Materials and resource	indoor Environmental Quality	sustainability sites	water efficiency	innovation and design
LEED NC 2.2							
1	HSBC Bank Egypt Cairo Processing Centre	9	6	11	10	3	5
LEED NC 2009							
		35	14	15	26	10	6
2	Credit Agricole Egypt Headquarters	28	7	13	19	8	6
3	Aramex Mashreq Warehouse- Cairo	16	4	5	17	5	4
4	Dar Al-Handasah New Premises in Cairo	12	7	12	14	13	4
5	RAYA Offices	18	2	4	22	10	4
6	Info Fort Warehouse Project	17	3	8	11	9	5
7	Galleria 40	19	4	7	20	11	3
8	Mobinil New Call Center- Pyramids Height	18	7	8	12	12	4
9	Outsourcing Service Building - MB4	8	3	9	22	6	2
10	LOREAL PYRAMIDS	2	6	11	17	13	5
11	Aramex Burg El-Arab	15	5	6	9	9	6
12	MARS EGYPT SITE DEVELOPMENT	20	3	8	20	10	3
13	New Connection	13	4	6	22	5	4
14	Bureau 175	12	4	6	22	13	4
15	Delta Textile Shamal El Saeed	2	2	6	13	13	4
16	ROC Office Building	12	4	6	21	11	4

Table 6: the relative score of each scoring item

	Energy and atmosphere	Materials and resource	indoor Environmental Quality	sustainability sites	water efficiency	innovation and design
sum	212	65	115	261	148	62
total sum	560	224	240	416	160	96
relative score	0.378571429	0.290178571	0.479166667	0.627403846	0.925	0.645833333

### VIII. ANALYSIS OF RESULT

The relative score of this sixteen construction project of Energy and atmosphere is equal  $212/560=0.38$ , materials and resource  $65/224=0.3$ , indoor environmental Quality= $115/240=0.48$ , sustainability sites  $261/416=0.63$ , water efficiency  $148/160=0.93$ , innovation and design  $62/96=0.65$ .the weakness score in the total certificate is Material and resource, Energy and atmosphere, indoor Environmental Quality cannot achieve 50%.

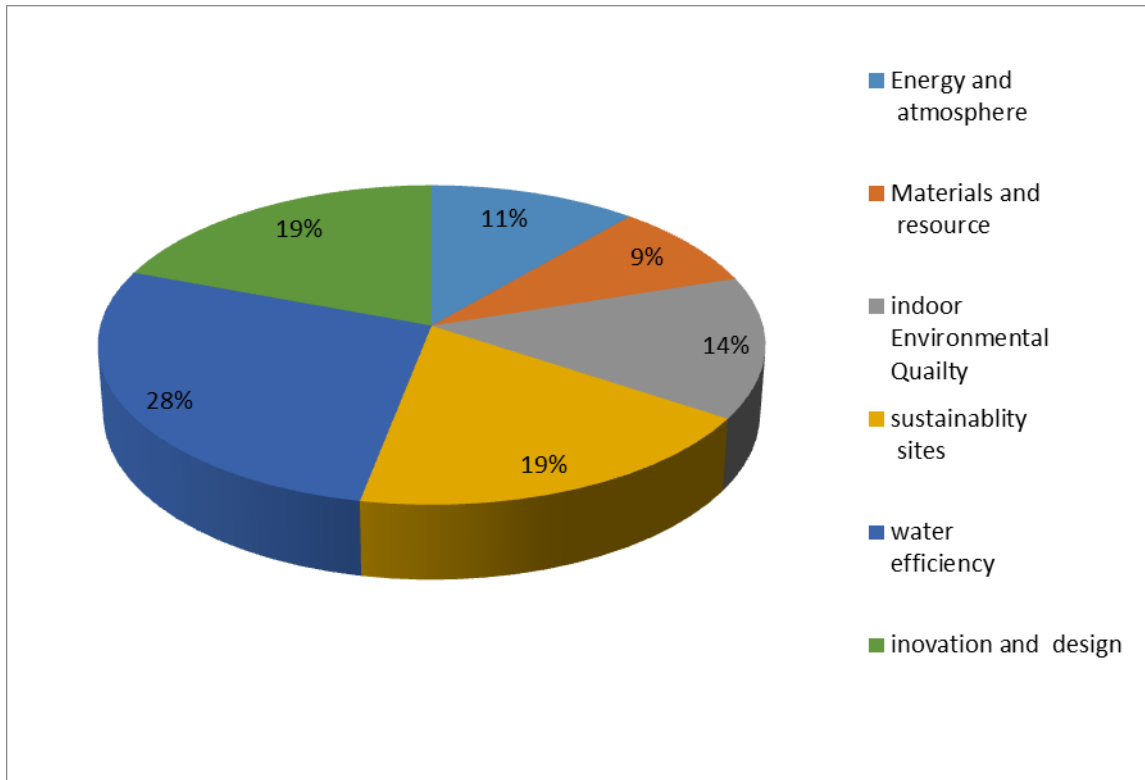


Fig.5. Scoring Leeds items percentage

Fig.5 represent the scoring LEED percentage, the water efficiency got 28% and it's the maximum percentage score, sustainability site and innovation and design criteria got 19%, indoor environmental quality got 14% , energy and atmosphere got 11 % and the last and low scoring percentage weight was material and resource usage got 9% .So, Material and resource is the weakest score in LEED Certificate projects in Egypt we need to use recycle material and less carbon print. "The homes feature excellent lighting, minimal glass, and controlled ventilation with heat recovery, ultra-tight construction, excellent insulation, and off-the-shelf appliances. Most importantly, anyone can construct them. These homes instruct builders in establishing performance metrics that correspond with current building science knowledge and materials (Lstiburek, 2008). A new program to promote sustainable housing has been established in Canada and Egypt.(Mayo &Sinha, 1997).

### IX. CONCLUSION

This paper summarizes the situation of Green structure projects in Egypt. And highlight this projects which are sixteen projects achieved the LEED requirement and certificate, but, also highlight the weakest separate score in Egypt which is material and resource that can't achieved 50% of the score.

In order to meet LEED requirements, new projects must plan to use more materials and resources. These can be achieved by adding new materials that have a lower carbon footprint, making the building ultra-tight, and controlling ventilation with heat recovery, avoiding the use of a lot of glass, providing good lighting, and using only off-the-shelf items.

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