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Assessment of energy credits for the enhancement of the Egyptian Green Pyramid Rating System

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HIGHLIGHTS

- The Egyptian rating system is underway but not on track.
- The main objective is the enhancement of the Egyptian rating system.
- We propose a methodology for assessment of the energy credits.
- The results show the optional energy credits with their optimal weights.
- The results show the mandatory energy credits that should be considered.

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ABSTRACT

Energy is one of the most important categories in the Green Building Rating Systems all over the world. Green Building is a building that meets the energy requirements of the present with low energy consumption and investment costs without infringing on the rights of forthcoming generations to find their own needs. Despite having more than a qualified rating system, it is clear that each system has different priorities and needs on the other. Accordingly, this paper proposes a methodology using the Analytic Hierarchy Process (AHP) for assessment of the energy credits through studying and comparing four of the common global rating systems, the British Building Research Establishment Environmental Assessment Method (BREEAM), the American Leadership in Energy and Environmental Design (LEED), the Australian Green Stars (GS), and the PEARL assessment system of the United Arab Emirates, in order to contribute to the enhancement of the Egyptian Green Pyramid Rating System (GPRS). The results show the mandatory and optional energy credits that should be considered with their proposed weights according to the present and future needs of green Egypt. The results are compared to data gathered through desk studies and results extracted from recent questionnaires.

1. Introduction

Greenhouse gas emissions, an important topic within the green building domains, have been an area of discussion for years. Nowadays, global organizations are disbursing much attention on the impacts of the various emissions such as carbon dioxide (CO_2), carbon monoxide (CO) and other unsafe gases affect the surrounding and participate in climate change (Rozlan et al., 2011). Accordingly, several developments for maintaining a green and sustainable planet with the integration of three main goals, social, environmental and economic goals, have been practiced (Aly et al., 2012) and much attention has been focused on green building sectors. On the other hand, researchers are directed to the use of new alternatives to replace the fossil fuel by renewable energy sources, especially with the declining availability of fossil fuel resources and the considerable increase of global fuel price (Shahriar and Erkan, 2009; Wafik and Hanafy, 2015).

The success in this green trend depends on many criteria, and the only way to insure its success is to have an approach to evaluate them (Choongwan et al., 2014; Elgendy, 2010). Consequently, green building rating systems have been rapidly instituted and introduced in the civilized countries like Canada and United Kingdom. In 1990, the British Building Research Establishment Environmental Assessment Method (BREEAM) was introduced (The Building Research Establishment Environmental Assessment

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Method (BREEAM), 2015). It is one of the earliest introduced rating systems, and one of the world's most important environmental assessment methods and rating systems for buildings inside and outside United Kingdom. BREEAM uses the following weighting ranges to certify a building's rate, pass (25–39%), good (40–54%), very good (55–69%), and excellent (70% and above). It is obvious the simple measurability of the BREEAM system (The Building Research Establishment Environmental Assessment Method (BREEAM), 2015; U.K. Green Building Council, 2007). In 1998, the American Leadership in Energy and Environmental Design (LEED) is introduced (LEED, 2015; U.S. Green Building Council, 2012). Quickly, it became one of the most popular green building rating systems throughout the world (Yudelson, 2008). This is because LEED is mainly concerned with the main problem of energy use and gives lower importance to water whilst BREEAM does the opposite (Younan, 2011). Based on the number of credits achieved, a project is certified with one of the four levels: certified (40–49 points), silver (50–59 points), gold (60–79 points), and platinum (80 points and above) (LEED, 2015). In 2003, the Australian Green Stars (GS) is presented. It uses a simple certification level of stars as a measure of sustainability of buildings, 4 Stars for low, 5 Stars for moderate, and 6 Stars for highly sustainable buildings (GBCA, 2002; Green Star, 2003). It is considered one of the easiest environmental green building rating systems that help in reducing the energy consumption and water uses. Despite it is a new rating system, it changes the way of thinking of the Australian construction markets. It is not strange that some countries, for example South Africa, depend on it because of its usability and applicability (Ammar, 2012).

In the Middle East region, specifically in the United Arab Emirates (UAE), there are two rating systems to assess green buildings, to be precise: UAE–LEED of Dubai and ESTIDAMA–PEARL Rating System of Abu-Dhabi (Pearl Rating System for Estidama, 2010). The ESTIDAMA–PEARL Rating System was established and introduced in 2010. It intends to focus on the sustainability of a given structure from design through construction to final operation (Estidama, 2010). Even the word ESTIDAMA in its name means sustainability in Arabic (Ammar, 2012). It depends on points addition to give a final rating in a range from 1 PEARL to 5 PEARL (best). It mainly depends on LEED with additional focus on their local water problems. Even though it is simpler to use and easier to be implemented than the LEED system; it focuses on finding quick solutions to minimize energy consumption rate rather than concentrating on maximizing the use of renewable energy sources. This is mainly because the economy of the oil-based nature of this region (Ammar, 2012; Elgendy, 2010; EmiratesGBC, 2006; Estidama, 2010; PEARL Rating System for Estidama (2010)). Going eastern in the Middle East; the first edition of Egypt's Green Pyramid Rating System (GPRS) was introduced on April 2011 for public review (Egypt-GBC, 2009; GPRS, 2011). Successive questionnaires with the aid of researchers, businessmen and expert opinions in the field demonstrates that the Egyptian Green Building Council has to develop and update the Egyptian GPRS that suites its environment and construction market through studying more global systems. Accordingly, this paper proposes a methodology using the Analytic Hierarchy Process (AHP) for assessment of the energy credits through studying and comparing four of the common global rating systems, thus developing and enhancing the Energy Category of the Egyptian GPRS. The results show all the energy credits that should be considered with their proposed weights according to the present and the future needs of greener Egypt. The results are compared to data collected through desk studies and the results of questionnaires taken from existing publications (Aly et al., 2012; Younan, 2011).

The well-known Analytic Hierarchy Process (AHP) is used as a decision-making tool for finding the optimal weights of the different energy credits because of its simplicity and well proven gains over years in engineering aspects. AHP depends on using a set of judgment matrices based on the relationships between the various credits and many other factors (Farghal et al., 2002; Loken et al., 2006; Saaty, 1980).

2. Methods

2.1. Energy credits in the considered global rating systems

A comparison is carried out between the well established energy credits in the considered global rating systems. Based on (Green Star, 2003; LEED, 2015; PEARL Rating System for Estidama (2010); U.K. Green (2007) the following credits are included in the comparison.

2.1.1. Credit 1: Minimum energy performance

According to BREEAM, this credit aims to recognize and encourage buildings designed to minimize the energy demand, consumption and CO_2 emissions. Beside, LEED and GS were more specific in asking for establishing the minimum level of energy efficiency for the proposed building in order to achieve the same goal. On the other side, PEARL has a different vision in the creation of a decision support tool to assist the project team in making decisions about the alternatives of the building design to achieve the same target. This credit is mandatory for all of these rating systems.

2.1.2. Credit 2: Fundamental refrigerant management

According to LEED and PEARL, this credit aims to reduce ozone depletion. They classified it as a mandatory credit. It can be achieved by minimizing the use of chlorofluorocarbon-based refrigerants. On the other hand, it is optional in BREEAM system with a weight of 7.1%. In the GS system, it is not included, in contradiction with the location of Australia that is close to the ozone hole over the Antarctic. It should be noted that the highest rates of skin cancer are recorded in Australia because of this fact (Ozone Hole, 2015).

2.1.3. Credit 3: Peak energy demand reduction

This credit aims to minimize peak energy demand at peak usage time. In both USA and UK, despite the obvious focus on the demand-side management that aims to reduce peak demand on energy supply infrastructure or move the time of energy use to off-peak times, especially after the energy crisis in 1973 (Aleh and Jessica, 2014), both BREEAM and LEED do not recognize this credit. On the other hand, the GS system considers this credit with a weight of 6.9%, whilst its highest weight is given as 9.1% in the PEARL rating system. It should be mentioned that this credit may have a special importance in the Egyptian system due to the considerable difference between the produced and utilized electric power that can reach 700 MW in a typical day which led to a partial blackout on September 2014 that affect around 20 million people.

2.1.4. Credit 4: Global warming impacts of refrigerants and fire suppression systems

This credit aims to improve selection of electrical and mechanical equipments according to their impact on the environment. It has a weight of 9.1% in PEARL and 5.7% in LEED. However, it is not included in the remaining systems under study.

2.1.5. Credit 5: Energy monitoring

It aims to broaden the use of metering facilities that allow the energy performance of the building to be recorded in order to be