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Procedia Environmental Sciences 20 (2014) 106 – 115

Procedia Environmental Sciences

4th International Conference on Sustainable Future for Human Security, SustaiN 2013

Green Assessment Criteria for Public Hospital Building Development in Malaysia

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Abstract

As Malaysia moves towards a sustainable lifestyles and development, the need to prepare for the change is imperative. Sustainability has become an important initiative discussed and undertaken not only by private buildings but also by public buildings dealing with residential, office, commercial as well as hospital. Building is known as human habitat. The way people design, construct and operate the building has a profound impact on people health and the environment. Compared to other building types, healthcare buildings have an especially large impact on the environment for the 24/7 use. Thus, the development of green hospital is important as it requires strict cleaning procedures and frequent air changes, which increase the already-high energy costs of the 24/7 operations and sophisticated medical equipment that make hospitals among the greatest energy consumers of any institution. The primary aim for this paper is to investigate green assessment criteria for public hospital building development in Malaysia. It compiles the essential criteria of existing green rating systems for healthcare buildings worldwide and presents the difference between each criteria compared to Malaysian green rating system. Existing tools and guidelines are reviewed, analysed and grouped according to the main criteria. The assessment criteria from each rating systems are divided into similar category covers all aspect of building design, construction and operation. Results from the analysis show the important assessment criteria of green public hospital building correspond to Malaysia. The research intended to produce initial guideline as a starting point for Malaysian public hospital in the most consistent and systematic way in practicing green.

Selection and peer-review under responsibility of the SustaiN conference committee and supported by Kyoto University; (RISH), (OPIR), (GCOE-ARS) and (GSS) as co-hosts

Keywords: rating systems, green building, green assessment criteria, green hospital building, hospital development

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doi:10.1016/j.proenv.2014.03.015

1. Introduction

Green building has now become one of the most widespread areas of focus in the scholarly studies, governmental agencies, civil society as well as building industries. Many countries have set up their own green rating systems according to their appropriateness for the benefits of populace and this progress is seen as a world's target in greening the earth. The rating system provides an effective framework for assessing building environmental performance and integrating sustainable development into building and construction processes; as it can be used as a design tool by determining performance measures to guide the sustainable design and decision-making process [1,2]. To ensure continued growth in the adoption of green building practices, many parties are playing role vigorously in implementing green elements to the building.

With the publication "Our Common Future" (World commission on environment and development, 1987), sustainability became the focus of a major worldwide discussion. Taking a cue from "Our Common Future", there has been the tendency to broaden the concept of sustainability. For example, in the run up to the Johannesburg World Summit on sustainable development, the UN secretary general wrote, "Sustainable development rests on three pillars: economic growth, social progress and protection of the environment and natural resources" [3]. However, the environmental view by defining sustainability as the use of a broader set of criteria used in evaluating different development options, while including the intrinsic value of the nature [4]. The developing countries especially in urban areas which effected with economic and extreme poverty problems have more environmental problems such as improper infrastructures, sanitation and housing which lead to contamination of water bodies and soils [5]. At the same time the construction industry also extremely intense, posing numerous pressures on the environment. These various views of sustainability in the sense of the environmental impact are based on the initial idea that the scale of the human economy should not exceed the capacity of the environment [6]. Therefore, each industry might be characterized by a different approach to sustainability and this is a fact that is especially true for the complex healthcare industry.

2. Hospital sustainability

Healthcare services are water and energy intensive, consume a great deal of hazardous and non-hazardous materials and are responsible for producing polluting emissions [7]. Built environment accounts for 40% of all CO2 emission in the Netherlands, thus, sustainable building has become an important issue. Hospitals alone count for 4% of the built environment, hence there is a lot to gain [8]. Therefore it is necessary that hospitals feel the urgency to undertake actions to reduce their CO2 emissions.

In England, the National Health Service (NHS) is the largest employer and biggest spender in England; it reaches everywhere and touches everybody [9,10]. Its buildings contribute to environmental damage through consumption of natural resources. But the NHS can also make a substantial contribution to social and economic regeneration and reduce its own ecological footprint through lower carbon emissions, effective waste management, and reduced water consumption. As combating climate change is so important, the Sustainable Development Commission's target for a carbon neutral public sector is crucial (UK Sustainable Development Commission). It means that healthcare buildings should aim to make no contribution to climate change. Through effective design of buildings and land management to support local biodiversity, the NHS can directly improve the physical and mental wellbeing of patients, staff, visitors and the local community.

Since hospitals provide patient care for people within a community, they can be characterized by an inherent link to social responsibility and the people-related dimensions of sustainability [11]. Taking care of patients has always been the hospital industry's core business, which fits very well into the social dimensions of the various definitions of sustainability. In sharp contrast to this, hospitals among the biggest polluters and contributors to climate change in the world. In the United States, for instance, hospitals are the second most energy-intensive commercial-sector buildings, using double amount of energy per square foot as regular office buildings. In Brazil, hospitals even account for 10.6 percent of the country's total annual energy consumption [12]. Moreover, medical waste incinerators are ranked among the top four sources for dioxin and anthropogenic mercury emissions in the US, substances that can easily spread through air, land and water [13]. Given that these toxic emissions are prone to

cause respiratory diseases and other illnesses within the population, hospitals are in that sense actually undermining the health of the communities that they are trying to serve. In fact, it is estimated that the hospital industry's conventional energy use in the United States alone causes about $ 600 million per year in increased health care costs due to increases in asthma, other respiratory illnesses and hospital emergency department visits [12]. This shows that hospital sustainability also stress on the three pillars of sustainability (social, environment and economic).

In Malaysia context, based on an end-use energy breakdown for hospital in 2008, it was found that lighting uses a major fraction of total energy consumption (i.e. about 36%) followed by medical equipment (i.e. about 34%). The study found that the hospital consumed approximately 19,311 MWh of energy for that year. The energy intensity of the hospital is found to be 234 kWh/m^2 [14].

In late 1980s and during the 1990s, the World Health Organization (WHO) concept of health, became significant for identifying the concept of a 'healthy building' in terms of building performances (i.e., indoor air quality, thermal comfort, lighting quality and acoustics). A healthy building is free of hazardous material (e.g. lead and asbestos) and capable of fostering health and comfort of the occupants during its entire life cycle, supporting social needs and enhancing productivity. The said criteria have been highlighted in the green building concept.

The healthcare sector is a sector that is constantly changing, with trends rapidly following one another [8]. However, sustainability is not really a part of these trends in the hospital sector yet. Hospitals have traditionally lagged behind other industries in "green" building initiatives that employ environmentally friendly materials and construction methods. Many hospitals have even less interest in green building certification than companies in other industries [15]. In the last few years, sustainability has started to attract increased attention of many hospitals [16]. The new trend to design and build hospitals using sustainable technology, renewable resources and systems designed to reduce energy consumption and carbon emissions is making it possible to achieve higher building performance. Therefore hospital could response in terms of reducing energy consumption, improving indoor air quality and a supportive healing environment.

Concern about the environment and the future of earth has become the focal point of global intention, in recent years, more and more projects have been getting closer and closer to the sustainable goal. A growing number of hospitals are becoming more interested in a sustainable approach. Without change, today's buildings are not likely to be sustainable in the long term. It is therefore critically important that all stakeholders (i.e.: government, industry and etc.) to develop new strategies that improve quality of environment, social and economic.

General public and various organizations have started to regard sustainability in healthcare as a major issue to be tackled. This can be verified by looking at a large number of international discussions and agreements. The World Summit on Sustainable Development in Johannesburg in 2002 identified health as one of the five big priorities for the future. In summary, hospital buildings should be sustainable, healthy, and technologically aware, meeting the needs of the occupants and building, and should be flexible and adaptable to deal with change. This leads to achieving a building that has the best combination of environmental, social and economic values.

3. Hospital building development in Malaysia

In the ninth Malaysia Plan (9MP – 2006-2010), a development allocation of RM10.176 billion was approved for Ministry of Health (MoH) to finance the development of 1,644 projects includes hospitals (new and upgrading), facilities and others [17]. However, MoH allocation was reduced to RM10.016 billion in the midterm review. Prompt to the reduction of development fund, MoH has reduced its total number of development projects to 1073. The allocation was further reviewed in 2009 wih the introduction of the second economic stimulation package (PRE2) on 10th March 2009 (MoH received RM565.962 million) and an additional allocation of RM134.274 million for variation of price (VOP) to support the cost increase in construction materials and petrol. Overall, the revised MoH allocation for the 9MP period is RM10.716 billion [17].

The total health expenditure trend shows an increase in national spending from RM 8.045 million in 1997 to RM33,691 million in 2009 indicating a four-fold rise over thirteen years (Fig. 1. (a). In 2009, MoH spent RM14.713million equal to 80% of public sector spending (Fig. 1. (b) [18].

a b

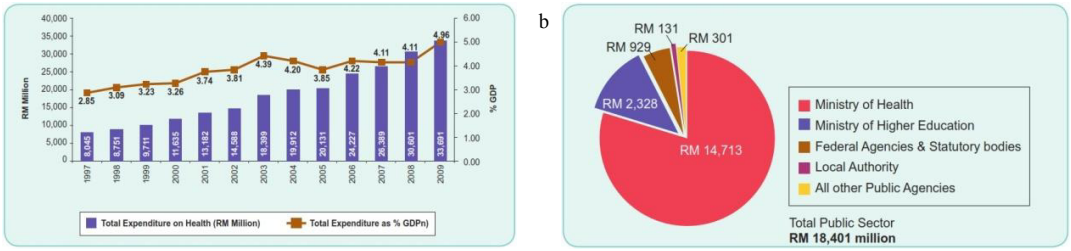

Fig. 1. (a) Trend for total health expenditure, 1997 – 2009 (RM million & percent GDP); (b) Public sector health spending, 2009 (RM million)

During the 9MP period, the thrust of the 9MP (for health sector) is towards achieving better health through consolidation of services. The primary goals are to prevent and reduce disease burden and to enhance healthcare delivery system. Meanwhile the supporting goals are to optimize resources, enhance research and development, manage crisis and disasters effectively and strengthen health management information system [17].

The 10MP formulation was based on the 5 National Mission Thrusts: 1. to move the economy up the value chain, 2. to raise the capacity for knowledge and innovation and nurture 'first class mentality', 3. to address persistent socio-economic inequalities constructively and productively, 4. to improve standard and sustainability of quality of life, 5. To strengthen the institutional and implementation capacity. The health sector directly involves with Thrust 4. Thus, three key result areas (KRA) were identified as main focus in the formulation of 10MP which is to be implemented during 2011-2015 period: 1. health sector transformation towards a more efficient and effective health system in ensuring universal access to healthcare, 2. Health awareness and healthy lifestyle 3. Empowerment of individual and community to be responsible for their health. The health sector transformation highlights several physical development projects will be carried out to build new facilities such as hospitals and health clinics and upgrading of existing dilapidated facilities [18].

The rolling plan concept was introduced in 10MP and is currently used in planning and implementation of health projects / programs. It is implemented every two years with annual review of projects/programs. This will allow more flexibility to maneuver the economy as compared to a five-year plan, and allows commitment to be made based on the government spending [18].

A development allocation of RM 3.927billion was approved to carry out 407 health projects for the first rolling plan (2011-2012) in the 10MP. In 2011, a total of RM 1.984billion was allocated which is 49.86% of the first rolling plan allocation. Expenditure performance of development projects as of December 31st, 2011 was RM1.958 billion which is 98.65% of the 2011's allocation [18].

In order to become sustainable in the long term, Malaysian hospital building need to address significant challenges, including growing complexity, inefficient management, low building performance as well as, in some cases, building failure.

In addition, physical healthcare facilities presents a different problem in every country for the way it is organized is a response to geography, climate, historical development, economic situation and social, cultural and political condition, legislation and regulations. Compared to non-medical organizations, the hospital industry in general has proven to be rather slow in the adoption of new trends and innovations in areas like technology or management practices [19, 20]. With the new focus on strategic planning, Malaysian hospitals industry must also started to pick up on sustainability.

4. Green Rating system for Hospital

4.1. International rating system for hospital building

The rating system provides an effective framework for assessing building environmental performance and integrating sustainable development into building and construction processes; as it can be used as a design tool by setting sustainable design priorities and goals, developing appropriate sustainable design strategies; and determining performance measures to guide the sustainable design and decision making processes [1,2].

There is hundreds of building assessment schemes worldwide focusing on different areas of sustainable development and are designed for different types of projects. By March 2010, there were 382 registered building software tools for evaluating energy efficiency, renewable energy, and buildings' sustainability [21]. However, only few systems are widely acknowledged and really set a recognizable standard for hospital building assessment. The following three (3) systems are chosen to be reviewed in this paper as they are influential and technically advanced rating tools available for healthcare-specific building: 1. BREEAM, 2. LEED and 3. GREEN STAR. The differences between the three of them are shown in Table 1.

BREEAM (Building Research Establishment's Environmental Assessment Method) is the leading and the most widely used environmental assessment method for buildings. It was developed in the UK in 1990 and is the building environmental assessment method with the longest track record [21]. According to BREEAM website, BREEAM can be used to assess the environmental performance of any type of building, new and existing, anywhere in the world. However, BREEAM for healthcare buildings was commissioned by the Department of Health and Welsh Health Estates, replacing NEAT (NHS Environmental Assessment Tool) as the preferred environmental assessment method and certification scheme for healthcare buildings in the UK [22].

All health authorities in the UK (i.e. Department of Health) require, as part of the Outline of Business Case approval, that all new builds achieve an Excellent rating and all refurbishments achieve a Very Good rating under BREEAM Healthcare (Department of Health UK) [22].

LEED (The Leadership in Energy and Environmental Design) green building rating system, developed by the U.S. Green Building Council (USGBC) in 1998, provides a suite of standards for environmentally sustainable construction. Since its inception in 1998, LEED has grown to encompass more than 14,000 projects in the US and 30 countries covering 99 billion m² of development area [23].

As an internationally recognized mark of excellence, LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. Currently, with 10.1 billion square feet of building space participating in the suite of rating systems and 1.5 million feet certifying per day around the world, LEED is transforming the way built environments are designed, constructed, and operated [24].

The needs of healthcare facilities are very unique. Healthcare buildings often have strict regulatory requirements, 24/7 operations, and specific programmatic demands are not covered in LEED for New Construction. Thus, the LEED for Healthcare rating system acknowledges these differences by both modifying existing credits and creating new, healthcare-specific credits. The goal is to help promote healthful, durable, affordable, and environmentally sound practices in the projects [25].

The GREEN STAR rating system has built on existing systems and tools in overseas market, including the British BREEAM system and the North American LEED system, by establishing individual environmental measurement criteria relevant to the Australian marketplace and environmental context [26].

GREEN STAR is a voluntary environmental rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia. The system considers a broad range of sustainable issues while also considering occupant health and productivity, and cost savings [27]. The Green Building Council of Australia (GBCA) released the Green Star - Healthcare v1 tool on 15 June 2009 to support sustainable planning, design and construction of high-performance healthcare facilities.

Table 1. Healthcare-specific rating systems.

Country/Title	Type	Versions/Year	Elements and points	Ratings and level of certification
UK BREEAM (new builds, extensions & major refurbishments)	Environmental Assessment	Healthcare 2008 2008	Management (12), Health and Wellbeing (15), Energy (19), Transport (8), Water (6), Materials (12.5), Waste (7.5), Land Use & Ecology (10), Pollution (10), Innovation (10). Total points = 110	Unclassified <30 Pass ≥30 Good ≥45 V Good ≥55 Excellent ≥70 Outstanding ≥85
US LEED (new construction and major renovations)	Environmental Assessment	Healthcare v2009 2009	Sustainable Sites (18), Water Efficiency (9), Energy and Atmosphere (39), Materials and Resources (16), Indoor Environmental Quality (18), Innovation In Design (6), Regional Priority Credits (4). Total points = 110	Certified 40-49 Silver 50-59 Gold 60-79 Platinum 80 and above
AUSTRALIA Green Star (building at the design phase as well as post construction phase 'As-Built')	Environmental Assessment	Healthcare v1 2009	Management (17), Indoor Environment Quality (32), Energy (29), Transport (12), Water (14), Materials (35), Land use &Ecology (8), Emissions (20), Innovation (5). Total points = 172	Best Practice (4 star) 45-59 Australian Excellence (5 star) 60-74 World Leadership (6 star) 75-100

4.2. Green rating system for hospital in Malaysia

Malaysian scholars and policy makers have recognized the importance of assessment of sustainable development, have taken some initiatives, and have adapted some tools and frameworks[28]. Frameworks and tools are mediums, which enable different institutions and organization, assess the level of sustainable development. Some examples of those assessment approaches are as follows: 1. Malaysia Quality of Life Index (MQLI), 2. Malaysia Urban Quality of Life (MUQL), 3. Compendium of Environment Statistics Malaysian Urban Indicator Network (MURNINet), 4. Malaysia Sustainable Development Approaches at State Level and 5. Green Building Index (GBI) [29].

Green Building Index (GBI) is Malaysia's first comprehensive green rating system for buildings and towns, created to promote sustainability in the built-environment and raise awareness of environmental issues amongst developers, architects, engineers, planners, designers, contractors as well as the public. GBI is developed specifically for the Malaysian-tropical climate, environmental and developmental context, cultural and social needs. The GBI is based upon the existing rating tools such as the Singapore Green Mark and the Australian Green Star system, amongst others which have been extensively modified for the Malaysian application [30]. There are 10 versions of GBI rating systems; 1. residential new construction (RNC), 2. non-residential new construction (NRNC), 3. non-residential existing building (NREB), 4. NRNC Data Centre, 5. NREB Data Centre, 6. industrial new construction (INC), 7. industrial existing building (IEB), 8. NRNC retail, 9. NREB retail and 10. township.

For hospital building, there are two (2) different types of assessment depending on the types of construction project. Non-residential new construction (NRNC) for the new construction of hospital project and non-residential existing building (NREB) for renovation, modification, extension and refurbishment projects. Table 2 shows the difference between the two systems.

Currently, there are no public hospital buildings recognized under the GBI system and there are only two (2) numbers of private hospital buildings have been assessed by using GBI. They have been assessed by using GBI NRNC rating system and scored as 'certified' category, namely; 1. Amanjaya specialist center green hospital (2012) and 2. Columbia Hospital, Petaling Jaya (2013) [31]. Looking into this scenario, the re-identification of the green criteria and rating system for hospital building is imperative to study.

Table 2. Rating system for healthcare building in Malaysia.

Country/Title	Type	Versions/Year	Elements and points	Ratings and level of certification
MALAYSIA GBI (Non-Residential Commercial Building – NRNC)	Environmental Assessment	NRNC V1.0 2009	Energy Efficiency (35), Indoor Environmental Quality (21), Sustainable Site Planning and Management (16), Materials & Resources (11), Water Efficiency (10), Innovation (7). Total = 100 points	Certified 50 -65 Silver 66-75 Gold 76-85 Platinum 86+
MALAYSIA GBI (Non-Residential Existing Building – NREB)	Environmental Assessment	NREB V1.1 2011	Energy Efficiency (38), Indoor Environmental Quality (21), Sustainable Site Planning and Management (10), Materials & Resources (9), Water Efficiency (12), Innovation (10). Total = 100 points	Certified 50 -65 Silver 66-75 Gold 76-85 Platinum 86+

5. Methodology

The authors have developed a research topic focusing on green hospital building development. This paper is part of the original research project that is currently conducting in the field area. The comparison on different rating systems is essential for the study to have further direction of the research. This paper approach was qualitative in nature, using holistic account to fulfill the research aims and objectives. This involves reporting multiple perspectives, identifying many factors involved in a situation and generally sketching the larger picture that emerges. During the process of research, the investigator may collect and analyze public documents (e.g. newspaper, minute of meetings, official reports and etc.) or private documents [32]. The different types of green rating systems are used which the greenest building rating systems valuable for the purpose of research are selected. It provides comprehensive criteria for the regions; provide a whole specific type of building evaluation rather than an evaluation of the general building. Identification of green criteria for hospital building is imperative to study to look on the pattern of sensitivity of each rating systems for hospital building.

The research is interested to know whether the green elements for hospital building in Malaysia are different from those conducted in other country. Currently, there are no specific rating systems for hospital building in Malaysia that can be used to assess the environmental of the building. And since there are few specific green rating systems in the world for hospital building, the interest can be completed only by an exploratory study at the beginning stage, reviewing the existing rating systems. The purpose is to succinctly review recent progress in the area. According to Sekaran, exploratory study is undertaken when not much is known about the situation at hand, or no information is available on how similar problems or research issues have been solved in the past. In such cases, extensive preliminary works needs to be done to understand what is occurring, assess the magnitude of the problem, and/or gain familiarity with the phenomenon in the situation. It often relies on secondary research (such as a review of the literature) and/or qualitative approaches to data gathering [33]. Comparison analysis is adopted in presenting

the emerging trends for different rating system. Then, the data is presented in the form of cross matrix analysis to highlight the weightage of each criterion (see Table 3). The descriptive analysis is conducted together with the cross matrix analysis to reveal rich information on green assessment criteria in a coherent manner.

6. Results to date

Building rating systems are becoming more popular tools to confirm green credentials. Most rating systems are applicable across a range of building types and can be applied to both new building projects and existing buildings. Different rating systems apply differently in different climates and geographical conditions. Other systems take into account factors that are not relevant in all environments. For example North American LEED is designed for climates with cool winters and rates buildings with energy efficient heating systems which is not relevant in most Asian markets. The same thing goes to the different versions of rating systems. If the version is technically developed for residential types of building, it is not relevant on commercial building. In Malaysia, currently, there is no specific rating system for hospital building.

With only two hospitals certified under the GBI rating systems, it revealed that hospital buildings in Malaysia have lagged behind other industries in 'green building' initiatives. On the other hand, paucity has been given to the importance of ensuring the sustainability of hospital building in Malaysia. As things stand, little research has been done in the field of sustainability for hospitals, since sustainability is not on the priority list of the hospital boards. Therefore, it is pertinent to explore the green assessment criteria when it comes to sustainability for the hospital building.

Table 3. Points distribution for each green rating criteria.

Green criteria / elements	GBI NRNC	GBI NREB	BREEAM	BREEAM	LEED	LEED	G STAR	G STAR
	100%	100%	110	100%	110	100%	172	100%
Energy efficiency	35	38	19	17.27	39	35.45	29	16.86
Indoor environmental quality	21	21	15	13.64	18	16.36	32	18.60
Sustainable site planning & management	16	10	12	10.91	18	16.36	17	9.88
Materials & resources	11	9	12.5	11.36	16	14.55	35	20.35
Water efficiency	10	12	6	5.45	9	8.18	14	8.14
Innovation	7	10	10	9.09	6	5.45	5	2.91
Transport			8	7.27			12	6.98
Land use and ecology			10	9.09			8	4.65
Pollution			10	9.09			20	11.63
Waste			7.5	6.82				
Regional priority credits					4	3.64		

Table 3 is developed to identify the distribution points for each rating systems used in this study. It shows that the different assessment criteria have different pattern represent the rating system. Percentage is used in determining the similar unit in transforming the data into chart (Fig. 2.).

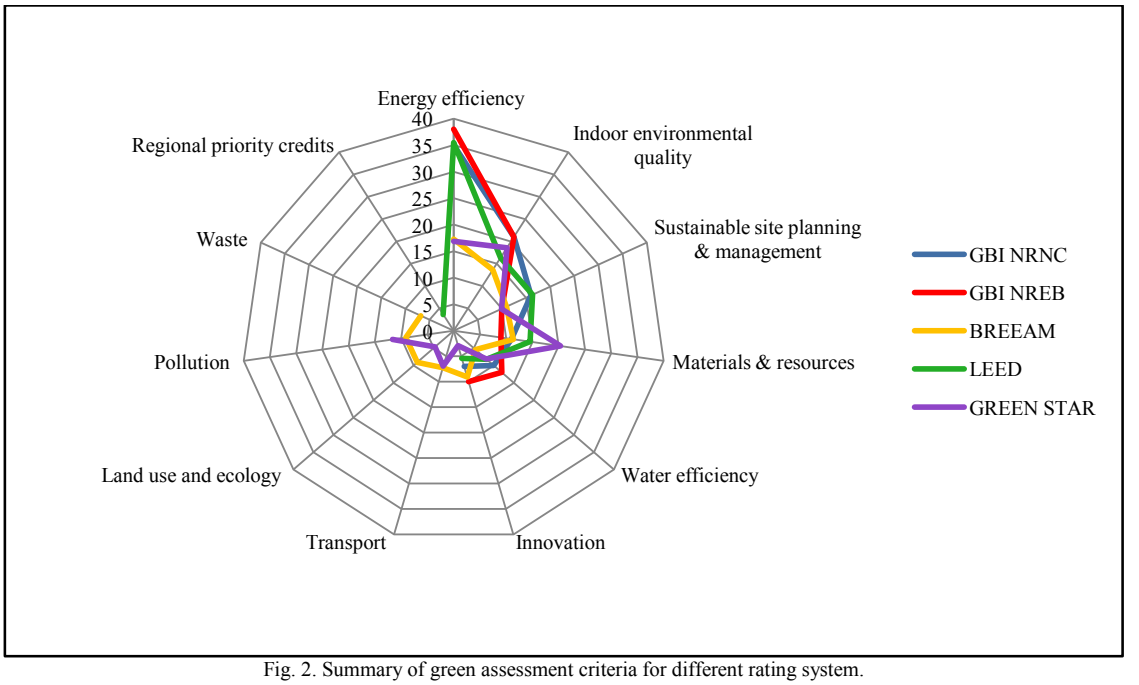

Fig. 2. Summary of green assessment criteria for different rating system.

Fig. 2. show the sensitivity criteria for each rating systems. Apparently, GBI NRNC, GBI NREB and LEED show the energy efficiency is the most important criteria in each rating systems. The similar criterion is stated parallel for BREEAM and GREEN STAR but they are not as high as the other three rating systems (GBIs and LEED) due to consideration of another criterion in their rating systems. However, energy efficiency is still the main priority for BREEAM rating system. GREEN STAR sees the material and resources as the most important criteria in its rating system. The result shows that energy criteria are the most intensity of concern of green hospital building development. GBI and LEED stops at innovation criteria, but it does not mean that another criteria is not in the list of the assessment. The detail assessment criteria only can be seen when the detail distribution of each criterion is constructed accurately. The same criteria happen to transport, land use and ecology, pollution, waste and regional priority credits. Australia allocates materials criteria as the highest points in Green Star rating system followed by Indoor Environmental Quality. The system allows for fit out products (which includes flooring and loose furniture) to be standardized and approved by the Green Building Council of Australia (GBCA) for the environmental merit. It entitles the products when used in practice, 100% of available Green Star points, making a high green standard of building easily achievable. The standard has been developed Green Star points and opportunities will be more accessible throughout the fit out stage. All these criteria need more justification as this study only conducted on broad identification of green assessment criteria.

7. Conclusion

Green building rating systems take a systematic approach to evaluating implementation of green building measures. It is a practice that many hopes will continue, and become standard and understood by owners, architects, building managers, and occupiers. It provides consumers, building professionals and government regulators with a means to evaluate the environmental impact of a particular structure. The growing interest in green building concepts and practices has encouraged a number of organizations to develop green building standards, codes and rating systems. However, it is a must for the developer of the rating systems to ensure the system is practical and useful to the said building. Future study need to be considered on the applicability of each criterion presented in this study specifically focusing on tropical country (i.e. Malaysia).

Acknowledgements

The authors would like to acknowledge the Ministry of Higher Education of Malaysia and Universiti Teknologi Mara (UiTM) for the financial support. Thanks are also to Universiti Teknologi Malaysia (UTM) for allowing the authors submitting this paper. Thanks to everyone who has involved directly or indirectly for assisting and supporting this paper.

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