A Structured Review on the Improvement of GBI-RNC

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Abstract. This paper presents the reviews of studies with regards to the development of Green Building Index- Residential New Construction (GBI-RNC). GBI-RNC is considered since the development of Residential Construction is expected to increase every year since Malaysia is considered as a developing country. The Carbon Emission of Residential Construction is evident thus one of the ways to control and commit to Carbon Emission reduction is by promoting Sustainable Development. Even though GBI-RNC has been introduced to the industry since 2009, participation increased just slightly by the year and to reach a rating more than 'Certified' are low. Furthermore, a national green rating system is proposed by JKR, to assist with all residential government projects. Therefore, this paper shall present the suggested modifications that should be made to GBI-RNC to improve its elements and gain more influence to maintain as the most used green rating system for residential construction.

1 Introduction

Among Malaysia's efforts in supporting climate change can be seen in the Ninth Malaysian Plan which prospects is to ensure a sustainable urban planning development [1]. Hence, Persatuan Arkitek Malaysia (PAM) and Association of Consulting Engineers Malaysia (ACEM) created Green Building Index (GBI) rating tool as a guide for developers for a more sustainable building construction [2]. In line with the Ninth Malaysian Plan, any construction that receives a GBI certificate after the end of its assessment shall be given an incentive by the government [3]. Support was clearly shown for sustainable development as the number of GBI rated building increased year by year since its formation on 2009. However, the increment in higher rating for Residential New Construction (RNC) is not promising. Since Malaysia is known as a developing country, new residential construction is expected. Thus, some studies have shown that the GBI-RNC rating tool is not suitable to be used as a residential assessment.

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2 Steps towards a building rating system

2.1 Carbon emission of residential construction

Previous studies have identified that Residential Construction is one of the major contribution of Carbon Dioxide (CO₂) in which United Nations Environment Program (UNEP) has quoted that “the building sector contributes up to 40% of greenhouse gas (GHG) emissions, mostly from energy use during the life time of buildings” [3]. Xiadong et al. [4], from China stated that the operation stage of residential construction contributes to approximately 32% of global final energy consumption and 30% being of energy related to CO₂ emission. A study in United Kingdom, states the statistics of the CO₂ emission of residential sector increased at about 3% around the year 2012-2013 by studying the electrical energy supplied by the power station to the end user [5].

Wood [6] stated a report made by U.S Energy Information Administration in 2004, presented that residential building does contribute to 21% out of the total emission made by buildings of 48%. In Malaysia, GBI has summarized that RNC covers 51.55% of gross floor area of GBI Certified Projects where CO₂ reduction of RNC is stated to be 25.47% as of 15th June 2018 [7]. This however only states for projects that applied and registered for GBI certificates and not the total projects awarded by Construction Industry Development Board (CIDB). Nevertheless, statistics by CIDB confirms that residential construction proves to be the second most in awarded projects in Malaysia as of Q1 2017 [8]. This clearly states that a mitigation method for a green solution is much needed in the construction industry, especially for residential buildings either globally or locally.

2.2 Sustainable development towards green building

The Ninth Malaysian Plan was the turning point towards Malaysia's commitment on climate change. During the United Nations Climate Change Conference in 2009, Malaysia's has agreed to reduce 40% of its CO₂ emission by the year 2020 as compared to its carbon emission in 2005 [9]. The devotion to deliver its commitment continued in the 10th Malaysian Plan for 2011-2015, the government allocated a fund of RM1.5 billion to promote green technology and announcing several incentives to encourage the construction of green buildings [10]. Ever since 2009, the Ministry of Energy, Green Technology and Water (MEGTW of KeTTHA), has announced that incentives such as tax exemption and stamp duty exemption are given to any building that receives a GBI Certificate [11].

Considering Malaysia is a developing country, more construction especially in residential construction is expected. As stated by Chetan et al. and Levine et al., the construction industry is a major consumer of natural resources. Thus, sustainable construction strategy should include all parameters to reduce energy and atmospheric carbon emission [12, 13]. Thus, the best approach stated by United Nations Framework Convention Centre is sustainable construction through green building [14]. Green building can be associated also as sustainable building. This is because since green building is defined as; "One whose construction and lifetime operation assure the healthiest possible environment while representing the most efficient disruptive use of land, water, energy and resources [15, 16]. Therefore, implementing sustainable development through green building would be a desirable mitigation method for the construction industry to compliment the issues of climate change.

2.3 GBI as a building rating system

Since 2008, PAM and ACEM decided to develop a building rating system starting by making a comparative study of green building assessments such as BREEAM (United Kingdom), LEED (United States), GREENMARK (Singapore) and GREENSTAR (Australia), which was then further discussed to adhere with Malaysia’s construction industry. The outcome of the study leads to the formation of GBI [2]. Projects registered with GBI are awarded based on 6 key criteria stated in Table 1 and will be rated and classified based on points awarded in Table 2 [17].

Table 1. 6 Key criteria of GBI Malaysia rating [7]

Part	Criteria
1	Energy Efficiency (EE)
2	Indoor Environmental Quality (IEQ)
3	Sustainable Site Planning & Management (SM)
4	Material & Resources (MR)
5	Water Efficiency (WE)
6	Innovation (IN)

Table 2. GBI classification [7]

POINTS	GBI RATING
86+ points	Platinum
76 to 85 points	Gold
66 to 75 points	Silver
50 to 65 points	Certified

As of 2016, GBI has provided 14 different rating tools for different types of construction category where each rating tool exhibits different point distribution [17]. One of the rating tools provided is GBI-RNC rating which will be further discussed in this paper. This shows that GBI is committed to reduce the CO₂ of each types of building that are available in the Malaysian market.

3 GBI-RNC rating tools

3.1 Development of GBI-RNC rating tools

GBI-RNC was one of the earliest rating tools created by GBI in 2009 [2]. Throughout its implementation, it has been revised three times until the latest version; GBI-RNC Tool V3.0 was finalized on July 2013 [18].

The changes are made to cater for different building types which include linked houses, apartments, condominiums, townhouses, semi-detached and bungalows [17], redistributed and rebalanced points as per Table 3.

Table 3. GBI-RNC Point Distribution Development [19-21]

GBI-RNC			
Criteria	V1.0 (2009)	V2.0 (2011)	V3.0 (2013)
EE	23	23	23
EQ	11	12	12
SM	39	37	33
MR	9	10	12
WE	12	12	12
IN	6	6	8

The latest version, GBI-RNC V3.0 was revised to cater more to Passive Design and to adhere to building typologies of landed, low-rise and high-rise [21]. Most GBI certified projects received with provisional certification after Design Assessment (DA), which is provided after the design is finalized, while some received final certification after Completion & Verification Assessment (CVA) which is done within 12 months after completion or 50% occupied [22, 23]. Throughout the summary of the awarded projects since 2013, it can be seen that the increment of applied and registered buildings increases slightly. Nevertheless, it does not seem to compliment the results of awarded projects. The summary of awarded GBI-RNC projects can be seen in Fig. 1 and Fig. 2.

Fig. 1. Summary of GBI-RNC projects [7].

Fig. 2. GBI-RNC Certified Projects by Rating [7].

4 BARRIERS encountered by GBI-RNC

4.1 Development of new rating tools

Observation from Fig. 1 and Fig. 2 shows that the low percentage difference may be due to the incoming of new building rating system in Malaysia. These new rating assessment tools followed closely with GBI’s development [23, 24] as can be seen in Table 4.

Table 4. Malaysia’s Building Assessment [20-21]

Assessment tool	Year of establishment	Developed by
GBI	2009	PAM and ACEM
GASSIC	2011	CIDB
GreenPass	2012	CIDB
PH JKR	2012	JKR
PWD Green Rating	2012	Public Works Department
GreenRE	2013	REHDA

This may due to Ismail et al. case studies on 2010 and 2012 [26, 27], stating GBI-RNC does not represent the actual Green Building (GB) of the studied houses, even though GBI has proclaimed in its website that GBI-RNC evaluates a variety of residential buildings sustainable aspects [17]. Since new rating tools are implemented almost each year, developers may also have a hard time to choose which rating tools are reliable or may even choose rating tools that are much more agreeable with their construction practices.

4.2 Weightage distribution

In 2008, Ding [28] concluded that the inflexibility, complexity and lack of consideration on the weightage system are the major obstacles of a building rating system. This was followed by studies from Hamid et al. and Bahaudin et.al [25, 29], which clearly stated that GBI-RNC weightage of point distribution only emphasize on developed areas as it only focuses more on EE, WE and IV. However, Ismail et al. [22] study indicates that SM should be more flexible to cover for more rural areas and MR only welfares towards builders that adopt schemes by CIDB such as Industrialized Building System (IBS) and Quality Assessment System in Construction (QLASSIC). Other observation was WE should be weighted realistically depending on the cost and space of inhibitions [26], while another study states it should be emphasis more or less equivalent within the tool [25]. Recently, in the Malaysian-University Green Building Collaboration Conference (MU-IGBC) on 2015, IEQ was presented having lesser importance or completely ignored as compared to Non-Residential Assessment [30, 31, 33]. This shows that the weightage points for the current GBI-RNC tool has to be looked through again on its weightage distribution. The weightage points should also cater to buildings in rural areas as well as emphasizing criterions that are relevant with its significance in a residential building.

4.3 Application of OTTV

It was also proposed in MU-IGBC that the element Overall Thermal Transfer Value (OTTV) should be deconstructed and replaced with Fanger's Thermal Comfort Calculation Tool and ASHRAE 90-1975 [32]. OTTV is regulated under EE2, which carries 12 points [18] in GBI-RNC. OTTV was taken from MS 1525:2007; Code of Practice for Non-Residential Buildings to comply with passive design elements [33, 34]. It was discovered that the Thermal resistance, U-value and solar absorptivity, α coefficients are the main influence in OTTV and if initially the building envelope design is to be implemented and set at 45 Wm^{-2} , around 80% of buildings in Malaysia might meet the requirement standard of OTTV [34], which is fixed to not exceed 50 Wm^{-2} [34, 36]. On another hand, it was found that in MS1525:2007, the U-values of walls didn't take into consideration of all components that constitute a wall, especially infill panels and support structure [26]. Since different materials have different U-values, this may affect the total calculation of OTTV [26]. Even though MS1525:2007 was revised to MS 1525:2014, no modifications were made on OTTV and its coefficient values, but the major modifications made are mostly on improvement of passive design strategies regarding daylight and façade design [37]. The application of OTTV has been a popular debate since its implementation in GBI-RNC, especially to outfit non-residential buildings. The suggestions to implement thermal comfort calculation may be more suitable or else the U-values in the OTTV calculation should be scrutinized in detail to every material used on a wall.

5 Suggested improvements for GBI-RNC

5.1 Global residential tool trend

According to Chandratilake et al. [38], in 2008, after comparing most rating systems for buildings, in a national context; site selection, energy efficiency and water efficiency are ranked in need of improvement over 6 six other domains by professional groups consists of architects, engineers and quantity surveyors. This was supported by Hamid et al.'s study in 2014 [25], that global trends emphasize more on measuring the performance of carbon and

water efficiency. GBI should consider on following the global tool trends that are relevant with Malaysia’s construction practices since other rating tools are open to any new proposals and research that accommodate their local practices that may reduce CO₂.

5.2 Implementation of construction life cycle in assessment

A comparison was also made by Grace [28], in 2008 on 20 environmental rating tools and concluded that a more effective way to achieve better sustainability in a project is by incorporating environmental issues before a design is conceptualized, especially during the feasibility stage of a project. In 2012, a study made by Lützkendorf [39] recommended the top-down approach which was then supported by [29]. They show that a green project life cycle which includes green planning should be considered in design and especially the control of the construction stage. Similarly, it was supported that the overall construction work cycle, especially from design to operational phase, should be incorporated in the rating system [25, 29]. The consideration to include an overall green assessment throughout a building emphasizes more to sustainable practices instead of just implementing assessment after a building is constructed. This is because results after a construction is made can be modified slightly especially if no enforcement on inspection of data requested for GBI-RNC tool.

5.3 Employment of new criteria

Some studies have suggested that new criteria should be implemented and to consider with issues with GBI-RNC. However, implementing new criterion may affect the overall weightage points. Thus, careful consideration must be analysed thoroughly. Listed are the new criteria that were suggested by previous studies;

- a) Pollution Control on Wastages and Maintenance [25, 26, 29]
- b) Implementation of Value engineering [28, 29]
- c) Project management [28, 29]
- d) Certification Process [25, 40]
- e) Material efficiency [39, 30]

5.4 Improvement of current criteria

Most improved suggestions are done by Rashid et al. [30] since they have made comparisons of case studies of Centre for Environment, Technology and Development Malaysia (CETDEM)’s Demonstration, Cool and Energy Efficient House (DCEEH), Smart and Cool Home (SCH) and CoolTek House, with GBI-RNC.

Table 5. Incompatible indicators vs. suitable indicators within GBI-RNC [22].

Indicators	Need Changes	Inapplicable	Points Available
EE1	√		3
EE3	√		10
EQ1		√	2
SM2		√	12
SM3		√	8
SM4	√		4
MR2	√		2
MR4	√		1
MR5	√		1

MR6	√		1
WE1	√		4
WE2	√		2
WE3	√		2
In total = 13 incompatible indicators in GBI-RNC		Total points	52

As seen from Table 5, GBI-RNC clearly fails to capture a real-life situation in these case studies [26]. However, it is suggested that further research in any locations in Malaysia should be done or otherwise it is recommended that GBI-RNC follow Malaysia’s local housing industries intentions and interests [26]. Therefore, GBI should reanalyse the latest GBI-RNC as the total incompatible indicators are nearly a half of total points, which is 100 points. This may have been the major reason most registered GBI-RNC buildings have difficulties in achieving more than a ‘Certified’ rating.

6 Conclusion

From this study, suggested improvements for GBI-RNC can be considered since the residential construction in Malaysia is expected to increase, year after year. This is based on CIDB awarded projects and National Property Information Centre (NAPIC)’s summary of existing stock. Furthermore, a national green rating system that is aiming to be implemented in government projects are currently at work by Malaysian Public Work Department (JKR). Completing these suggestions in the GBI-RNC should be another step for future studies, especially if followed with case studies on actual new types of residential construction aimed by GBI-RNC.

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