ACHIEVING LOW CARBON BUILT ENVIRONMENT IN ISKANDAR MALAYSIA USING EXPANDED LIFE CYCLE ASSESSMENT WITH INDUCED IMPACT: OVERVIEW OF EXISTING ASSESSMENT SYSTEM DEVELOPED FOR ISKANDAR MALAYSIA

Dora Yeap Chu Im and Ho Chin Siong

Faculty of Built Environment, Universiti Teknologi Malaysia

dorayeap@gmail.com, ho@utm.my

ABSTRACT This paper presents the comparative review of the existing assessment systems on different scale of analysis namely, building scale and urban scale within the context of Iskandar Malaysia by means of the review of the literature. The findings of the paper show that there are numerous green assessment systems developed for Iskandar Malaysia, yet varying in nature, assessment characteristics and methods, focusing at the different spatial level or scale that caused complications and confusion when comes to utilization of different systems in the same region. An integrated and holistic scale of assessment system has thus become the most sought after system in this region. Besides identifying the background and issues of problems that current green assessment systems are facing, this paper further confirms the future research motivation, which is to fill in the research gap on the integrated and holistic scale of assessment system in order to achieve low carbon built environment in Iskandar Malaysia using the new expanded life cycle assessment methodology to capture the missing "induced impact" – environmental impact resulting from the interaction between building and urban.

1. INTRODUCTION

Subsequent to the aspiration to reduce 40% carbon emission intensity by 2025, greater efforts have been made by Malaysia ministers, agencies, industry, professional bodies, universities and research institutions in developing frameworks, assessments and rating tools focusing at the different spatial level or scale. There is no singular formula or standardized regional assessment system on building scale, urban scale, and city scale that can be adopted for Iskandar Malaysia (IM). Each of these systems varies in nature, assessment characteristics and methods. These differences have caused complications and confusion in comparing the green performances of buildings that utilizing different system. Moreover, should the same building be evaluated by more than one assessment system, the divergences of different systems in terms of baseline and benchmarking yardstick has no doubt affected the perception or even resulted in misleading conclusions. (Ng, et.al, 2012)

Most of the existing assessment systems in IM are largely criteria based that are developed solely to aid design of buildings and then to accord them 'green' status based on the prescribed criteria without taking into account the significant environmental impact, in particular at post design and construction stage. Therefore, the performance based rating systems that can quantify the actual impact of buildings upon the environment in terms of their carbon emission levels in city at any stage of buildings' lifecycle is urgently needed in this region.

Today the needs for reliable data on the actual energy consumption and carbon emission of newly constructed or retrofitted buildings are the pressing needs more than ever in the construction industry. But then again data means nothing without data analytic. However, there exists a gap within the scale specific analysis. The analysis either focuses on the individual building or the larger urban context, while is useful for creating boundaries for the complexity of the built environment, creates several problems. Analysis at building scale treats building as stand-alone from its surroundings, whereas analysis at urban scale studies urban as a whole. The significant impact resulting from the interaction between building and urban - the "induced impacts" is missing. (John, et. Al, 2015) Hence, an integrated and holistic scale of assessment system is lacking.

2. OVERVIEW OF ISKANDAR MALAYSIA

Mooted in 2005 and launched in 2006, Iskandar

Malaysia is now administered by Iskandar Regional Development Authority (IRDA), a regional development authority since 2007. IM is one of the five regional economic growth corridors in the country and is the single largest economic zone ever to be developed in Southeast Asia. Thanks to its geographic location and advantages, IM is more viable compared with other economic growth corridors in Malaysia.

Within the resource rich state Johor in Peninsular Malaysia adjacent to Singapore, IM lies at the heart of Southeast Asia and the southernmost point of continental Asia. It is strategically situated at the crossroads of the east-west trade routes, midway between the rapidly growing economies of China and India, easily accessible via air, land, rail and sea transportation from within Asia and the world. (IRDA, 2011) Due to its strategic location and sheer proximity to Singapore, IM is often dubbed the 'Shenzhen of Malaysia', comparable to the model of the Pearl River Delta Economic Zone. (Carl, 2013)

Encompassing a vast acreage of land, IM measures an area of 547,669 acres or 2,216.3 square kilometres in total that is 3 times the size of Singapore and twice that of Hong Kong. It covers the entire district of Johor Bahru, Kulaijaya and several sub-districts of Pontian. The covered area falls under the jurisdiction of 5 local government authorities, namely Johor Bahru City Council (MBJB), Johor Bahru Tengah Municipal Council (MPJBT), Pasir Gudang Municipal Council (MPPG), Kulaijaya Municipal Council (MPKu) and Pontian District Council (MDP). The population of this region is projected to reach over 3 million by 2025 more than double from 1.35million in 2005 and the GDP per capita is also expected to rise to RM141.4 billion in 2025 from RM35.7 billion in 2005. (LCARC, 2013)

3. COMPARISON OF GREEN ASSESSMENT SYSTEM

The comparative reviews of all green assessment systems covering both building and urban scale found in Malaysia, namely Green Building Index (GBI) building and township tools, Public Works Department Green Rating Scheme or Skim Penilaian Penarafan Hijau Jabatan Kerja Raya (PH JKR), Construction Industry Standard (CIS) 20:2012 Green Performance Assessment System in Construction (Green PASS), Malaysian

Table 1 Characteristics of Malaysian Green Rating Tools (Building Scale) (modified after Zuhairi, et.al, 2014)

Criteria	GBI building	PH JKR	Green PASS	MYCREST	Green RE building
Date of establishment	2009	2012	2012	2014	2013
Developed by	PAM and ACEM	JKR	CIDB	CIDB and JKR	REDHA
Certification process	Voluntary	Voluntary	Voluntary	Voluntary	Voluntary
Nature of assessment	Criteria based	Criteria based	Performance based	Criteria & performance based	Mainly criteria based
Phase of assessment	Design & Construction	Design & Construction	Construction & Operation	Design, Construction & operation	Design, Construction & operation
Mode of assessment	Criteria checklist	Criteria checklist	Based on carbon emission	Criteria checklist and carbon calculator	Criteria checklist and carbon calculator only for CED
Rating system	Score (by points) 1) Platinum 2) Gold 3) Silver 4) Certified	Star rating (by points in percentage) 1) 5 stars 2) 4 stars 3) 3 stars 4) 2 stars	Diamond rating (by carbon reduction in percentage) 1) 6 diamonds 2) 5 diamonds 3) 4 diamonds 4) 3 diamonds 5) 2 diamonds 6) 1 diamond	Star rating (by points in percentage) 1) 5 stars 2) 4 stars 3) 3 stars 4) 2 stars 5) 1 star	Score (by credits) 1) GreenRE platinum 2) GreenRE Gold 3) GreenRE silver 4) GreenRE Bronze
Themes of coverage	1) EE 2) IEQ 3) SM 4) MR 5) WE 6) IN	1) EE 2) IEQ 3) SM 4) MR 5) WE 6) IN	Building Construction 1) Site 2) Building materials 3) Energy 4) Water 5) Waste Building operation 1) IEQ 2) Energy 3) water	1) PD 2) IS 3) EP 4) OH 5) EC 6) WE 7) SC 8) DP 9) IN 10) WM 11) FM	Energy related requirement 1) EE Other green requirements 2) WE 3) EP 4) IEQ 5) IGF 6) CED

Table 2 Characteristics of Malaysian Green Rating Tools (Urban Scale)

Criteria	GBI Township	LCCF	Green RE Township
Date of establishment	2011	2011	2014
Developed by	Green Building Index Sdn Bhd	KeTTHA	REDHA
Certification process	Voluntary	Voluntary	Voluntary
Nature of assessment	Criteria based	Performance based	Criteria based
Phase of assessment	Design & Construction	Construction & Operation	Design & Construction
Mode of assessment	Criteria checklist	Based on carbon emission	Criteria checklist
Rating system	Score (by points) 1) Platinum 2) Gold 3) Silver 4) Certified	Diamond rating (by carbon reduction in percentage) 1) 6 diamonds 2) 5 diamonds 3) 4 diamonds 4) 3 diamonds 5) 2 diamonds 6) 1 diamond	Score (by credits) 1) GreenRE platinum 2) GreenRE Gold 3) GreenRE silver 4) GreenRE Bronze
Themes of coverage	1) Climate energy & water 2) Ecology & environment 3) Community planning & design 4) Transport & connectivity 5) Building & resources 6) Business & innovation	1) Urban environment 2) Urban transport 3) Urban infrastructure 4) buildings	Energy related requirement 1) EE Other green requirements 2) WM 3) Material & waste management 4) Environmental Planning 5) Green Bldg & Green Transport 6) Community & Innovation

Carbon Reduction and Environmental Sustainability Tool (MyCREST), Green Real Estate (Green RE) building and township tools, and the Low Carbon Cities Framework and Assessment System (LCCF), across a number of criteria are summarized in table 1 and table 2 with regard to their development, application and measurement system. Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is excluded since it is not a Malaysian developed green rating tool. Low Carbon Society (LCS) Blueprint for Iskandar Malaysia 2025 also is not included because strictly speaking, it is a blueprint and is not an assessment system itself.

The nature and mode of green assessment systems in particular, the tables show that most of the tools are criteria based using criteria checklist and only a few are performance based on measurement of carbon emission, which are Green PASS for building scale and LCCF for urban scale. However, both Green PASS and LCCF are constrained to its scale of analysis and unable to match an integrated and holistic scale of assessment system that is most wanted in Malaysia.

Furthermore, the above tables also show that most of the tools focus on design phase as criteria checklist based method is implemented in this phase, while only a few tools focus on post design stages which are construction and operational phases. As such, an ideal green assessment system is to cover the overall life cycle, starting from design to operational phases. Green RE building tool and MYCREST claim to cover all the phases of implementation. Nonetheless, Green RE township tool does not claim so and MYCREST stops short of developing urban tools.

CONCLUSION

In reviewing the existing assessment system developed for IM, it points to the fact that there is no singular standardized regional assessment system for IM and the existing systems are divided between building and urban scale and city scale with the “induced impact” missing out. In examining the academic literature, the study on expanded life cycle assessment with “induced impacts” by means of a real case study to comprehensively quantify all the environmental impacts and to illustrate the importance of “induced impacts” being a very new and under-researched subject. Yet, it is critical for the effectiveness, credibility, and long-term viability of existing city policies to be based on integrated and holistic assessment of environmental performance of the built environment to achieve environmental goals of IM. It is this research gap that the

future study aims to fill in.

In view of this, a new methodology to evaluate the missing "induced impact" is crucial. Unquestionably, life-cycle assessment (LCA) is a proven method for the environmental evaluation. Nonetheless, the validation of new assessment system – expanded life-cycle assessment that captures the missing environmental impact is needed to be proven scientifically in an actual case study locally. (John, et.al, 2013) Comprehensively quantification of all environmental impacts including "induced impacts" is required for better implementation and formation of evidence based city policies to achieve environmental goals of IM.

Before the construction industry could make a profound shift to the new low carbon paradigm, independent and cross-disciplinary academic researchers are indispensable for the researches essential to revolutionizing the industry. This effort cannot be left to the industry funded researches, let alone the industry itself, as its highly competitive and adversarial nature inhibits the progress of the researches in an unbiased and objective manner that is free from conflicts of interest.

REFERENCES

Carl Berrisford (2013, June 10*). Iskandar follows the Shenzhen Script*. Retrieved June 7, 2015, from http://www.scmp.com/business/money/markets-investing/article/1257278/iskandar-follows-shenzhen-script

Iskandar Regional Development Authority (IRDA), (2011). *Invest Logistics Iskandar Malaysia – Asia's Most Central and Expandable Logistics Hub*, Johor Bahru. Retrieved June 7, 2015, from http://www.iskandarmalaysia.com.my/pdf/investment/IM-Invest-Logistic.pdf

John E. A, Gebhard W., Werner L. (2015). Energy Analysis of the Built Environment – A Review and Outlook. Renewable and Sustainable Energy Reviews 44 (2015) 149–158

John E. Anderson, Gebhard W., Werner L. (2013). *Expanding the Use of Life-Cycle Assessment to Capture Induced Impacts in the Built Environment*. The 6th International Conference on Life Cycle Management. 2013 Gothenburg

Low Carbon Asia Research Centre (LCARC) (2013) *Low Carbon Society Blueprint for Iskandar Malaysia 2025*, Low Carbon Asia Research Centre, Johor Bahru

Ng S.T., Chen Y., Wong J. M. W. (2012) *Variability of building environmental assessment tools on evaluating carbon emissions*, Environmental Impact Assessment Review, 38, 131-141

Zuhairi Abd. Hamid, Maria Zura Mohd Zain, Foo Chee Hung, Mohd Syarizal Mohd Noor, Ahmad Farhan Roslan, Nurulhuda Mat Kilau and Mukhtar Che Ali (2014) *Towards a National Green Building Rating System for Malaysia Malaysian Construction* Research Journal; Vol. 14/No. 1. 2014 Malaysia

Ho Chin Siong is a Professor at the Faculty of Built Environment, Universiti Teknologi Malaysia; Senate Member; and Director of the university's office of International Affairs. His current interests include urban planning, low carbon city and housing development.

Dora Yeap Chu Im received a Master degree from National University of Singapore. She is currently pursuing PHD under the supervision of Professor Ho Chin Siong. Her current research area is low carbon built environment and life cycle assessment.