The perception and challenges of construction stakeholder towards emissions reduction in Malaysia

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Abstract. The increase of global carbon emissions has become an important global issue worldwide including, Malaysia. The construction industry is a large contributor to global emissions despite its efforts of becoming more aligned with sustainability practices. Malaysia has announced a commitment to reduce greenhouse gases (GHG) emissions by delineating the number of measures and targets. However, this commitment has not been greeted with much optimism by all the key players which are believed to be related to the lack of incentives and regulatory procedures to guide into sustainable building construction. In response to this need, this study aims to examine the perception and awareness of construction stakeholder towards emission reduction in construction. Specifically, the research aims to achieve the following objectives; 1) to examine the perception and awareness of construction stakeholder towards emissions reduction in construction, and 2) to identify the challenges that have been faced by construction stakeholder in implementing emissions reduction strategies. In order to achieve the objectives, the questionnaires and interviews have been conducted to 37 construction companies in Selangor. A statistical analysis by using descriptive analysis of relative index and SPSS program is carried out to analyze the data. The findings demonstrate that the majority of the company appear not to monitor emissions in construction site and most of them have a little information about the emissions reduction policy program. The implication of this research lies in providing insight on the strategies and challenges that have been faced by construction stakeholder towards emissions reduction which will help the policy maker in developing an efficient policy, guidelines and regulatory framework of construction emissions reduction schemes.

1. Introduction
The increase of global carbon emissions has become an important global issue worldwide including Malaysia. According to [1], Malaysia has produced 5.97 tonnes CO2 per capita with 1.20 per GDP measures which consider as a relatively high among other Southeast Asia nations. In 1980, Malaysia’s GHG emission was initially lower than the world average at only 2.0 metric tons per capita, before it has steadily increased to surpass the world average in 1995 with 5.8 metric tons per capita and reached 7.7 metric tons per capita in 2010, which making the emissions growth rate within the period approximately at 250\% [2]. In 2009, Malaysia has announced a voluntary commitment to reduce 40\% of its greenhouse gases (GHG) emissions by 2020 (from 1990 levels) [3].

In Malaysia, the construction industry itself is categorized under one of the largest contributors of GHG emissions besides energy, transport and manufacturing sectors [4]. Presently, there is no
consistent framework in Malaysia for assessing GHG emissions from construction operations, which limits the development of an emissions baseline for the construction sector and therefore hindering the development of comprehensive environmental performance policies. This is reflected in the existing Malaysian Green Building Index (GBI) rating tool, which disregards any calculation for GHG emissions from buildings [5]. A number of measures and targets have been initiated by Malaysia governments and policymakers to allow an efficient decrease in emissions, which include institutional, policy, guidelines and regulatory frameworks, however, this commitment has not been greeted with much optimism by all the key players which are believed to be related to behavioral issues and awareness towards the real effect of emissions reduction in construction [6]. [7] study on the construction stakeholder’s attitudes towards emissions. The results show that the quantity of emissions influences attitudes and behaviour of people which they will show concern when the quantity of emissions is large.

This paper presents the construction stakeholders perceptions and awareness on the importance of emission reduction in construction. In this study, a total of 37 construction companies have responded to this survey to give feedback on their perception and awareness on emissions reduction strategies in construction and the challenges that have been faced by them in implementing emissions reduction strategies. A statistical analysis by using descriptive analysis of relative index and SPSS program is carried out to analyze the data.

This paper has been divided into five sections. First, the background of study and the methodology approach employed in this study are presented, followed by a results and analysis. The next section discusses the challenges and strategies of construction stakeholder towards emissions reduction in Malaysia. The final section presents the conclusions.

2. Literature Review

The construction industry is considered to be one of the major contributors to these GHG emissions. According to [8], the construction sector generates a total amount of 131 million metric tonnes of CO2-e in 2002, making it the third highest sector that releases GHG emissions. Construction operations commonly utilize a large range of heavy-duty diesel equipment that generates a considerable amount of greenhouses gas (GHG) emissions including nitrogen oxides (NOX), carbon monoxide (CO), carbon dioxide (CO2), hydrocarbon (HC) and particulate matter (PM). According to [9], the emissions released by construction equipment constitute half of the total impact from construction processes, thus further suggesting that better control of emissions from construction operations is necessary. However, most attention in reducing emissions has been emphasized on the design and operation phase instead of the construction phase.

In response to the negative environmental impact of construction projects, there has been, to varying extents, an enlargement of studies by means of the management framework, stakeholder’s concept awareness, government policy processes and conceptual model in developing emissions mitigation strategies as a mean to reduce the CO2 emissions in the construction industry. Malaysia’s government is taking the leading role to persuade the industry’s player to engage in sustainability development by introducing several national policies namely, National Green Technology Policy (NGTP) and National Policy on Climate Change [10].

In Malaysia, a considerable amount of research has focused in reducing emission from the design and operation phase [11-14], whilst little attention has been given on addressing the construction phase. Several initiatives related to building operation also have been developed by government and semi-governmental organizations, namely, Low Carbon Cities Framework and Assessment System (LCCF), Green Building Index (GBI), Malaysian Carbon Reduction and Sustainability Tool (My CREST) to champion the development of building emissions guidelines. Several attempts have also been made in highlighting emissions in Malaysia particularly in building construction including assessment on emissions in housing construction [15]; energy and emissions in building construction [4,14,16],
emissions legislation and policy [5]. Nevertheless, although prior research on perception and awareness in construction evidently emphasized on environmental practices in Malaysia, past efforts have only focused on the importance of sustainable construction [17-20]. In order to address this gap in the body of knowledge, this study aim to examine the perception and awareness of construction stakeholder towards emission reduction in construction and identify the challenges that have been faced by construction stakeholder in implementing emissions reduction strategies.

3. Methodology

A. Target Respondent
This survey focused on construction stakeholders located in the area of Selangor. This area is selected because many construction companies which have projects throughout Malaysia are based there. The construction companies are approached through postal and online questionnaire survey. A total of 150 construction companies including contractors, consultant, project manager, construction manager, quantity surveyor, client and supplier were approached and 37 questionnaires were returned for analysis. The list of the companies was obtained from Construction Industry Development Board (CIDB). The data was analyzed qualitatively and quantitatively using descriptive analysis of relative important index (RII) and SPSS program.

B. Questionnaire Design
The questionnaire has been designed based on three (3) sections. Section A of the survey requires the respondents to provide their background based on their qualification, working position and working experience in the construction field. Section B focuses on the respondents’ agreement on their level of awareness about emissions reduction strategies in Malaysia while Section C is to seek their opinion on the challenges and difficulties in reducing emissions in construction.

Results Analysis and Discussions

C. Reliability Test
The reliability test using Cronbach’s alpha coefficient was conducted to measure the internal consistency of the variables of the survey. Emphasizing testing the reliability would enhance the quality of evaluations and also indirectly increase the chance of other evaluators to adopt this study. The Cronbach’s alpha for this study is 0.879 (greater than 0.7) which indicates that the instrument used to measure the variable is reliable [21].

4. Results and Analysis

A. Demographic Profile

1) Working Position
Figure 1 shows the percentage frequency distribution on respondents’ designation in construction industry.
Results indicate that the highest percentage of respondents participated in this survey are working at the consultant company as engineers or architects with the percentage 34.4%. About 20% of them are clients, followed by both of project managers and contractor with 11.4% respectively, engineers (9%), quantity surveyor (6%) and suppliers (3%).

2) Working Experience
Figure 2 demonstrates the construction stakeholder’s number of year of working experience in construction industry.

It is shown that 43% from the respondents have working experience between 8 to 10 years, while 34% of them have working experience between 5 to 8 years, 14% of them have less than 5 years of working experience and the rest have more than 10 years of working experience in construction industry.

3) Contracting Activities That Company Involved
Figure 3 shows the number of contracting activities that the company have been involved in construction projects.
Results indicate the types of contracting activities of construction stakeholder under building construction (43%), civil engineering and structure (37%), infrastructure work (20%) and the rest is property development (6%).

B. Level of awareness about emissions reduction strategies in Malaysia

1) Perceptions and awareness on the importance of emissions reduction in construction

Figure 4 indicates that more than 91% of the construction stakeholders are aware on the importance to reduce emissions in construction operations. With a number of measures and targets have been initiated by governments and semi-governmental organizations policymakers to allow an efficient decrease in emissions including institutional, policy, guidelines and regulatory frameworks helps to improve the awareness of construction stakeholders on construction emissions reduction strategies.

Figure 4. Perception and awareness on the importance of emissions reduction

2) Perception on the Level of Current Initiatives towards Implementing Emissions Mitigation in Construction Industry.

Figure 5 shows the perception of construction stakeholders on the level of Malaysia current initiatives in implementing emissions mitigation in construction industry.
Figure 5. Perception on the Level of Current Initiatives towards Implementing Emissions Mitigation in Construction Industry

43% of them agree that Malaysia’s efforts in mitigating emissions are still in average level and 35% of them think that the level of implementations are low.

C. Challenges and Difficulties in Implementing Emissions Reduction at The Construction Site

Table 1. Challenges and difficulties in implementing emissions reduction at the construction site

| Challenges and Difficulties in Implementing Emissions Reduction at the Construction Site | RII   | Rank |
|--------------------------------------------------------------------------------------|-------|------|
| Most of the company appears not to monitor emissions in construction site.          | 0.4286| 1    |
| Majorities of construction company do have a little information about standard and policy program. | 0.4171| 2    |
| Lack of trained skilled workers in managing emissions                                | 0.4057| 3    |
| The cost for the alternative materials is too expensive.                            | 0.4000| 4    |
| Lack of new material in order to reduce emissions.                                  | 0.3943| 5    |
| Lack of information on the availability of innovative low carbon material to reduce emissions. | 0.3886| 6    |
| The cost for low carbon materials is very expensive.                                | 0.3829| 7    |
| Lack of financial resources to implement low emissions reduction in construction.   | 0.3657| 8    |

The findings demonstrate that majority of the construction stakeholders agreed that most of the company appear not to monitor emissions in construction site. Most construction stakeholders also agreed that they have a little information about the emissions reduction standard and policy program. Lack of trained skilled workers and the high cost and availability to use the alternative materials are also among the challenges that have been faced by them to reduce emissions at construction site.
D. Overall Findings
As a summary, the findings show that there are positive attitudes towards the awareness of industry emissions reduction. Majority of construction stakeholder shows the positive perception on the importance to reduce emissions however most of the company appears not to monitor emissions in construction site. Parts of the construction industry particularly the policy makers and government demonstrate a strong commitment to emissions reduction by introducing several initiatives including policy, guidelines and regulatory frameworks, however majorities of construction company said that they do have a little information about standard and policy program available. This result is consistent with the studies conducted by [22] where they agreed that the lack of awareness, training and education are among the major barriers in implementing sustainable construction. Presently, there is no consistent framework in Malaysia for assessing emissions from construction operations, which believe to limit the development of an emissions baseline for the construction sector and therefore hindering the development of comprehensive emissions performance policies. It is crucial for construction stakeholder in the construction industry to promote existing guidelines to reduce the emissions [23]. Regulations and standards are one of the methods to mitigate emissions at construction site [6]. However, [24] believe that there are still a lot of efforts required on construction industry in order to develop relevant and appropriate regulations on emissions reduction.

5. Conclusions
This study focuses on the perception and challenges of construction stakeholder towards emissions reduction in construction and to identify the challenges that have been faced by construction stakeholder in implementing emissions reduction strategies. The questionnaires and interviews have been conducted to 37 construction companies in Selangor. The finding shows that the construction stakeholders are aware on the importance of reducing emissions in construction operations. However most of the company appears not to monitor emissions in construction site and majority of them agreed that they do have a little information about standard and policy program available. There is a critical need to strengthen on existing efforts and a broad range of tailored information and tools is crucial in ensuring the comprehensiveness of information and policy regarding emissions mitigations.

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References
[1] IEA. (2011). CO2 Emissions From Fuel Combustion. Paris: International Energy Agency.
[2] World Bank. (2015). CO2 Emissions (metric tons per capita). World Bank Group http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries/1WCN-IN-ID-SG MY?display=graph
[3] Department of Environment. (2010). COP 15: The Copenhagen accord. In C. M. Chun (Ed.), Quarterly DOE update on environment, development and sustainability. Putrajaya: Department of Environment (DOE), Ministry of Natural Resources and Environment.
[4] Begum, R. A., & Pereira, J. J. (2010). GHG emissions and energy efficiency potential in the building sector of Malaysia. Australian Journal of Basic and Applied Sciences, 4(10), 5012-5017.
[5] Zaid, S. M., Myeda, N. E., Mahyuddin, N., & Sulaiman, R. (2015). Malaysia’s rising GHG emissions and carbon ‘lock-in’risk: A review of Malaysian building sector legislation and policy. Journal of Surveying, Construction and Property, 6(1), 1-13.
[6] Wong, P. S., Ng, S. T. and Shahidi, M. (2013), Towards understanding the contractor’s response to carbon reduction policies in the construction projects, International Journal of Project Management, Vol. 31, No. 7, pp. 1042-1056.
[7] Carmichael, D. G., Mustaffa, N. K., & Shen, X. (2018). A utility measure of attitudes to lower-emissions production in construction. Journal of cleaner production, 202, 23-32.
[8] EPA (2008). *Quantifying Greenhouse Gas Emissions from Key Industrial Sectors in the United States*, EPA Sector Strategies Program, US Environmental Protection Agency, USA, viewed 25 Nov 2017, https://archive.epa.gov/sectors/web/pdf/greenhouse-report.pdf

[9] Guggemos, A. A. and Horvath, A. (2006), *Decision-support tool for assessing the environmental effects of constructing commercial buildings*, Journal of Architectural Engineering, Vol. 12, No.4 pp 187-195.

[10] Suhaida, M. S., Tan, K. L., & Leong, Y. P. (2013). *Green buildings in Malaysia towards greener environment: challenges for policy makers*. In IOP Conference Series: Earth and Environmental Science (Vol. 16, No. 1, p. 012121). IOP Publishing. Technology, 53, 807-814.

[11] Chua, S. C., & Oh, T. H. (2010). *Review on Malaysia's national energy developments: Key policies, agencies, programmes and international involvements*. Renewable and Sustainable Energy Reviews, 14(9), 2916-2925.

[12] Samari, M., Ghodrati, N., Esmaeilifar, R., Olfat, P., & Shafiei, M. W. M. (2013). *The investigation of the barriers in developing green building in Malaysia*. Modern Applied Science, 7(2), 1.

[13] Omar, W. M. S. W., Doh, J. H., Panuwatwanich, K., & Miller, D. (2014). *Assessment of the embodied carbon in precast concrete wall panels using a hybrid life cycle assessment approach in Malaysia*. Sustainable Cities and Society, 10, 101-111.

[14] Wen, T. J., Siong, H. C., & Noor, Z. Z. (2015). *Assessment of embodied energy and global warming potential of building construction using life cycle analysis approach: Case studies of residential buildings in Iskandar Malaysia*. Energy and Buildings, 93, 295-302.

[15] Fujita, Y., Matsumoto, H., & Siong, H. C. (2009). *Assessment of CO2 emissions and resource sustainability for housing construction in Malaysia*. International Journal of Low-Carbon Technologies, 4(1), 16-26.

[16] Hassan, J. S., Zin, R. M., Majid, M. A., Balubaid, S., & Hainin, M. R. (2014). *Building energy consumption in Malaysia: An overview*. Jurnal Teknologi, 70(7).

[17] Abidin, N. Z. (2009). *Sustainable construction in Malaysia—Developers’ awareness*. World Academy of Science, Engineering and Technology, 53, 807-814.

[18] Idris, N. H., & Ismail, Z. (2011). *Framework policy for sustainable construction in Malaysia*. In Business, Engineering and Industrial Applications (ISBEIA), 2011 IEEE Symposium on (pp. 441-446). IEEE.

[19] Hamid, Z. A., & Anuar Mohamad Kamar, K. (2012). *Aspects of off-site manufacturing application towards sustainable construction in Malaysia*. Construction Innovation, 12(1), 4-10. 12

[20] Kamar, K. A. M., & Hamid, Z. A. (2012). *Sustainable construction and green building: the case of Malaysia*. Sustainability Today, 167, 15.

[21] Nunnally J.C. and BernsteinI.H., *Psychometric Theory*, Third. New York: McGraw-Hill, New York, 1994.

[22] Shafii, F., Arman Ali, Z., & Othman, M. Z. (2006). *Achieving sustainable construction in the developing countries of Southeast Asia*.

[23] Zaid, S. M., Myeda, N. E., Mahyuddin, N., & Sulaiman, R. (2014). *Lack of energy efficiency legislation in the malaysian building sector contributes to Malaysia’s growing GHG emissions*. In E3S Web of Conferences (Vol. 3, p. 01029). EDP Sciences.

[24] Lu, Y., Cui, P. and Li, D. (2016), *Carbon emissions and policies in China's building and construction industry: evidence from 1994 to 2012*, Building and Environment, Vol. 95, pp. 94-103.