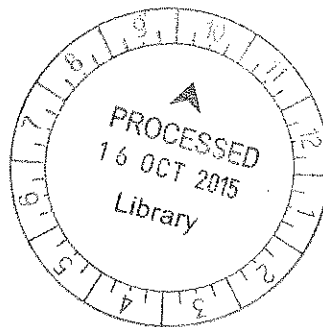


A STUDY OF BARRIERS TO IMPLEMENT ZERO ENERGY BUILDING IN MALAYSIA

FOR REFERENCE ONLY

BY

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TA
KAS
YON
2015

This report is submitted as a partial requirement for the degree
of
Bachelor of Science (Hons) in Quantity Surveying
Faculty of Science, Technology, Engineering and
Mathematics
INTI INTERNATIONAL UNIVERSITY
(April 2015)

ACKNOWLEDGEMENTS

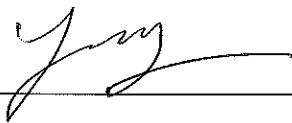
I would like to thank to all people who helped me in this Final Year Project. First of all, I would like to express my gratitude to my supervisor, Dr Sam Man Keong who always helped me and guiding me for this Final Year Report. Without his guidance, this report would not able completed in time and smoothly.

Moreover, I would also like to thank to all the respondents of questionnaire for spending their time to fill or completed the questionnaires. Without their cooperation, valuable information would not be able to obtain and I would not able to complete the data analysis.

Lastly, I would like to thank my family who supported me at all times. They had gave me a lot of useful advice and support to complete this research

DECLARATION BY THE CANDIDATE

I, Yong Wan Lung, I 13002476, confirm that the work in this report is my own work and the appropriate credit has been given where references have been made to the work of other researchers.



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ABSTRACT

The objectives for this study are to investigate the barriers faced in Malaysia to construct Zero Energy Building, to identify the level of awareness of professionals in construction industry against Zero Energy Building and to investigate the solution to optimize the barriers for Zero Energy Building. The quantitative method which was online questionnaire survey had been used. In this research, the population were targeted the Grade 7 Contractors in Selangor where obtain from CIDB website. The questionnaire had been distributed which to fulfill the three objectives. Based on the results, the level of awareness of professionals in construction industry against Zero Energy Building in Malaysia was still in moderate level. For the top three barriers were lack of awareness, lack of enforcement, lack of demand. To optimize the barriers to implement Zero Energy Building, Government had responsible to provide training and education, organize zero energy awareness campaign and promote incentives to stakeholders. It is in order to promote and improve awareness on Zero Energy Building.

ABBREVIATIONS

CIDB	Construction Industry Development Board
GEO	Green Energy Building
GBI	Green Building Index
QS	Quantity Surveyor
ZEO	Zero Energy Building

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CHAPTER 1

INTRODUCTION

1.1 Background

The economy grew in Malaysia increased every year seen Malaysia is one of the most developing countries in ASEAN. Besides, the overall energy demand is also expected to be increased in every year. Due to Malaysia's rapid economic development, the final energy consumption will be grown up each year.

Buildings have a significant impact to the environment and energy use. Buildings such as commercial, residential or office use almost 70 percent of the electricity and approximately 40 percent of the primary energy in Malaysia. Energy consumption in the building or housing will continue increase until buildings can be designed to produce enough energy for the building and reduce the energy demand. (Torcellini,2006)

In Malaysia, the electricity supply and demand increase in every year. Figure 1 show about the installed capacity and maximum demand in West Malaysia from 2006-2010. From the chart, we can see that the maximum demand of West Malaysia increases from 14,245MW in 2009 to 15,072MW in 2010. (Performance and Statistical Information, 2010)

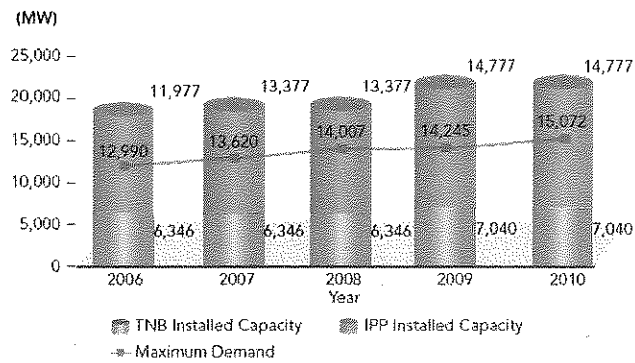


Figure 1.1 The installed capacity and maximum demand in west Malaysia from 2006-2010 (Source: Performance and Statistical Information, 2010)

Zero energy must be introduced or organized in Malaysia in order to reduce energy using. Zero Energy Building can be defined as a building that produces as much energy on-site by renewable energy as it is enough for the building used (Torcellini, 2006). Zero Energy Building is not a single product or technology but it is a combination of closely-integrated evolving technologies. For example the PV system, solar water heating are the most applicable supply side technologies for the Zero Energy Building.

Zero Energy Building plays an important role to reduce energy use and carbon emissions. It brings a lot of benefits to us in terms of economic, environment, and social. But there are many barriers or challenges faced in constructing Zero Energy Building. For example, the challenges faced including lack of information of material or technologies use, lack of information of past project as reference, and also developer skill shortage and knowledge.

The only one Zero Energy Building in Malaysia is Pusat Tenaga Malaysia (PTM). This building only uses 35 to 40 kwh/square meter/ year (85% energy use reduction compared to conventional Malaysian office building) (Poul et al, 2007). This research had been carried

out in order to construct as many as building like Zero Energy Building. Besides, the purpose of this research is also help to find out the barriers to implement Zero Energy Building.

1.2 Aim

The goal of the research is to study about the zero energy and to determine the barriers faced in Malaysia to construct Zero Energy Building.

1.3 Objectives

1. To identify the level of awareness of professional in construction industry against zero energy in Malaysia.
2. To investigate the barriers faced by Zero Energy Building in Malaysia.
3. To investigate the solution to optimize for Zero Energy Building in Malaysia.

1.4 Problem statement

The total energy used per year in Malaysia will be increased due to the increasing of buildings demand as Malaysia is one of the most developing countries among ASEAN countries. Buildings like commercial, residential or office use almost 70 percent of the electricity and approximately 40 percent of the primary energy in Malaysia (Torcellini,2006).

Figure 2 show that, the minimal electricity consumptions are the agricultural and transport sectors if compared to the commercial, residential and industrial. (Performance and Statistical Information, 2010) It can show that the requirement electricity of building structure

increase slowly in each year. Therefore, Zero Energy Building should be introduced in Malaysia to reduce energy demand.

Year	Final electricity consumption (ktoe)										Total
	Agriculture		Commercial		Transport		Industrial		Residential		
	Cons.	% Cons.	Cons.	% Cons.	Cons.	% Cons.	Cons.	% Cons.	Cons.	% Cons.	
2000	0	0%	1,478	28%	4	0%	2,805	53%	975	19%	5,262
2001	0	0%	1,579	28%	3	0%	2,930	52%	1,081	19%	5,593
2002	0	0%	1,698	29%	4	0%	3,059	52%	1,161	20%	5,922
2003	0	0%	1,818	29%	5	0%	3,242	51%	1,248	20%	6,313
2004	0	0%	1,979	30%	5	0%	3,340	50%	1,319	20%	6,643
2005	0	0%	2,172	31%	5	0%	3,371	49%	1,395	20%	6,943
2006	5	0%	2,272	31%	5	0%	3,475	48%	1,514	21%	7,271
2007	16	0%	2,480	32%	4	0%	3,587	47%	1,598	21%	7,685
2008	19	0%	2,598	33%	15	0%	3,687	46%	1,668	21%	7,987
2009	21	0%	2,743	33%	12	0%	3,719	45%	1,792	22%	8,287
2010	24	0%	3,020	34%	18	0%	3,994	44%	1,937	22%	8,993
2011	26	0%	3,172	34%	18	0%	4,045	44%	1,974	21%	9,235
2012	30	0%	3,325	33%	21	0%	4,509	45%	2,126	21%	10,011

Figure 1.2 Final Electricity consumption by various sectors of the economy in Malaysia, 2000-2012 (Source: Performance and Statistical Information, 2010)

The only one Zero Energy Building in Malaysia is Pusat Tenaga Malaysia (Malaysia Energy Centre). This building only uses 35 to 40 kwh/square meter/ year (85% energy use reduction compared to conventional Malaysian office building)(Poul et al, 2007) . Zero energy is bringing benefits in terms of economic and environment but why Malaysia did not construct building or office as Pusat Tenaga Malaysia as more as possible? Therefore, a research is carried out to identify the level of awareness of professional in construction industry against Zero Energy Building and investigate the barriers of implementing Zero Energy Building.

1.5 Key questions

1. What are the levels of understanding on Zero Energy Building by professionals in construction industry?
2. What are the barriers faced by developers in Malaysia to construct Zero Energy Building?
3. Any solution to optimize the barriers for Zero Energy Building?

1.6 Importance of the study

The economy of Malaysia grew every year as Malaysia is one of the most developing countries in ASEAN. Besides, the overall energy demand is also expected to be Malaysia's rapid economic increased in every year. Due to the development, the final energy consumption will be grown up each year.

The only one Zero Energy Building in Malaysia is Pusat Tenaga Malaysia (Malaysia Energy Centre). The construction industry in Malaysia should invest more in Zero Energy Building to reduce energy used and save our environment.

Mostly, stakeholders in Malaysia lack of understanding what is Zero Energy Building rather than the green building (Japheth, 2013). This research is to improve and identify the public and professional in construction industry awareness or knowledge against Zero Energy Building in Malaysia.

Moreover, this study begins with consideration of barriers faced to construct Zero Energy Building in Malaysia. For example, the major barriers faced to build Zero Energy Building in Malaysia are skills shortages and knowledge (lack of research and development,

lack of skill worker)and the construction cost is high which 20% to 30% more than conventional Malaysian building.

Government has plays an important role to optimize the barriers implementing Zero Energy Building in Malaysia. Zero Energy Building may bring a lot of benefits in terms of economic and environment. Lastly, this research will find out the solution to optimize the barriers implementing Zero Energy Building in Malaysia.

1.7 Research methodology

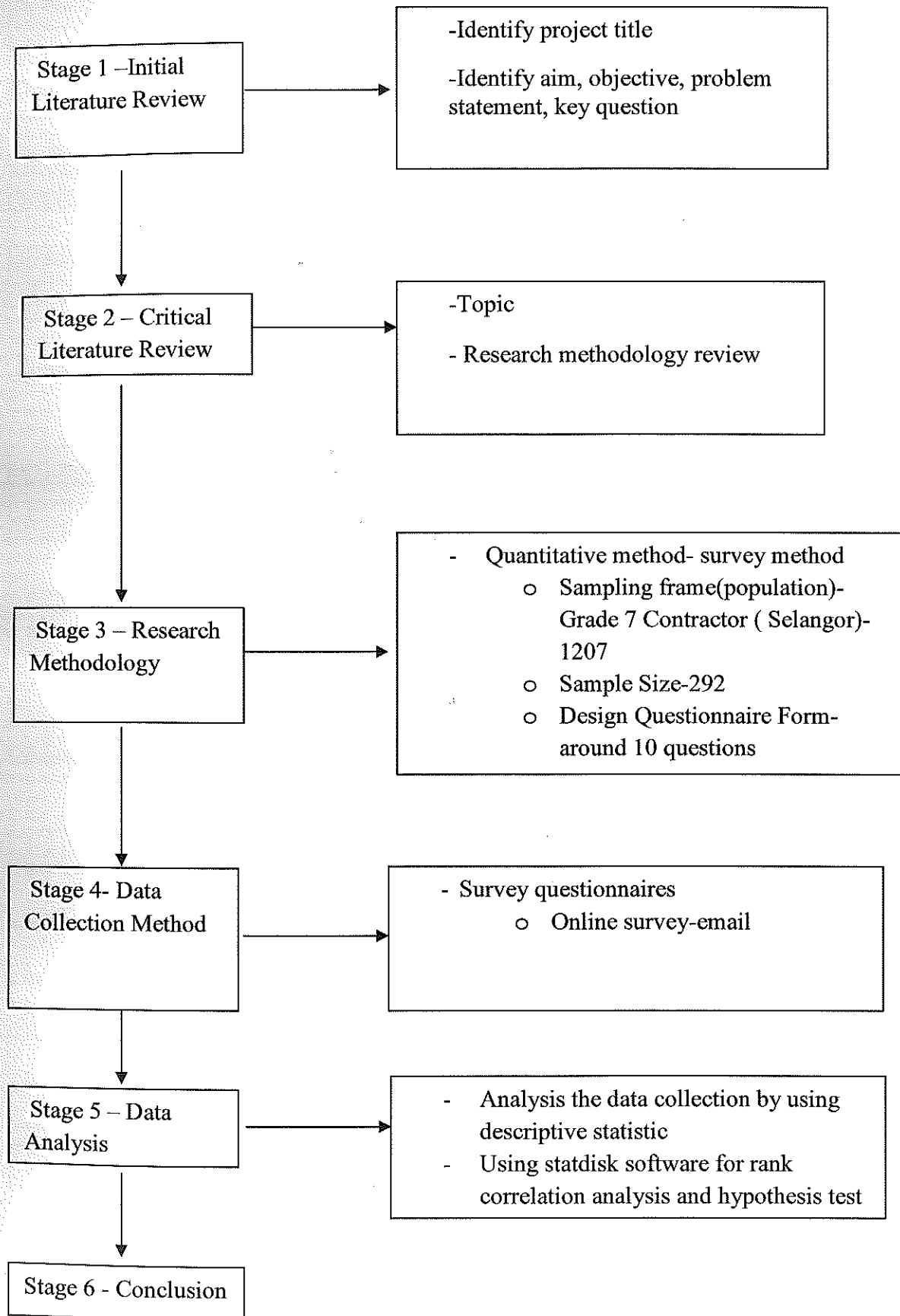


Figure 1.3 Research design

(source: ?)

1.8 Report content

Chapter 1: Introduction

Chapter one is introduction to the research topic. It includes the introduction of zero energy, the aim, objectives, problem statement and the key questions.

Chapter 2: Literature Review

Chapter 2 covers the literature review of research dissertation. It is a comprehensive review of the relevant information about the barriers faced to construct Zero Energy Building, the public awareness on Zero Energy Building, the solution to optimize the barriers. Relevant information is taken from different ways such as journals, website, and articles.

Chapter 3: Research Methodology

Chapter 3 covers the method of collecting data to be adopted which is using qualitative method or quantitative method. Quantitative method which is survey method will be used. The sample frame target is Grade 7 contractor with population of 1207 which obtain from CIDB website. The sample size is 292 which calculated by using sample size calculator with 95% confidence level and 5% margin error. Besides, the simple random sampling will be used.

Chapter 4: Analysis of the result

Chapter 4 covers the data analysis of the questionnaires in order to find out the barriers faced by zero energy in Malaysia, the solution and the level of awareness of professional in construction industry against zero energy by using descriptive statistic. Besides, statdisk software will be used to do the rank correlation analysis and hypothesis test.

Chapter 5: Conclusion

This chapter will do the summary of this research based on the data collect and determines whether the objective of this research is achieved or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Zero Energy Building

In general, the term of Zero Energy Building was defined as a building that produces as much energy on-site or off-site by using renewable energy source which equal to the energy required by the building. Torcellini, et al. (2006) provided four definitions of ZEB: net zero energy costs, net zero site energy, net zero source energy, and net zero energy emissions. The definitions had been defined due to the different project goals and the values of the developers or design team. For example, organizations which are only interested in source energy. The designer only interested in on-site or off-site energy use for the building. The building owner only care about the energy cost for the building. For those who are care about the pollution from fossil fuels may be interested in reducing carbon emission.

Net Zero Site Energy: The energy generated on-site by renewable energy is equal to the total energy use of the building.

Net zero source energy: The building generated energy as it uses in a year, when accounted for the sources. The solar energy and biomass are considered as the renewable energy sources applicable on-site to generate energy.

Net zero energy cost: The total cost of purchasing energy is equal to the income from sales the electricity which produced on-site.

Net zero energy emissions: On-site or off-site fossil fuel produces carbon emission will be balanced by the energy produce on-site by renewable energy.

Zero Energy Building is not a single technology, system or material. It is a combination of energy generation technology and energy conservation technologies. Laustsen, (2008) provides a definition for Zero Energy Building “Zero Energy Buildings do not use fossil fuels but only get all their required energy from solar energy and other renewable energy sources”. It mean that renewable energy like solar energy will be used by Zero Energy Buildings to generated energy and not need any fossil fuels to produce energy for cooling, lighting and others.

ASHRAE (2008) pointed out that “the only way to measure if a building is a ZEB is to look at the energy crossing the boundary. Other definitions, including source, emissions, and cost, are based on this measured information and include weighing factors and algorithms to get to the metric of interest.”

In USA, NAHB Research Center (2006) has investigated that the zero energy home were combined the energy generation technology with renewable energy and with energy conservation technologies with high energy efficient design to save as much as the energy use. The design for zero energy home is almost same as the ordinary home but it more comfortable due to better indoor air quality.

2.2 Green building versus Zero Energy Building

Green building and Zero Energy Building both are sustainable building which to achieve high performance energy efficient building. Green building and Zero Energy Building have many similarities which both aim to reduce the damaging to the environment, to reduce the greenhouse gas or carbon (CO₂) emission and to reduce the energy bills.

The main goal of green building is to reduce the negative impact of building to the environment, recycle materials and use resource more efficiently. Green building is using resource efficiently and using recycle building materials which creating healthier environment.

The main goals of Zero Energy Building are to reducing energy use and reduce carbon emission. Zero Energy Building use the renewable source to generated energy for the building required. It is a combination of evolving technologies such as the energy generation technologies and energy conservation technologies. Zero Energy Building may or may not consider as “green”. This is because Zero Energy Building does not using recycle material and reducing waste.(Hui, S.C.M., 2010)

2.3 Current situation of Zero Energy Building in Malaysia

In Malaysia, the public awareness and knowledge against Zero Energy Building are still very low. The public awareness against what Zero Energy Building is really about, which is less than the Green Building. The general scene of green building has made a significant milestone but there is certainly more to be expected in the next few years. (Japheth, 2013) If compare with Zero Energy Building, green building need 5 years then Zero Energy Building maybe need 10 years. Most of the contractor or developers in Malaysia confuse with zero energy and green building because they think that it is same.

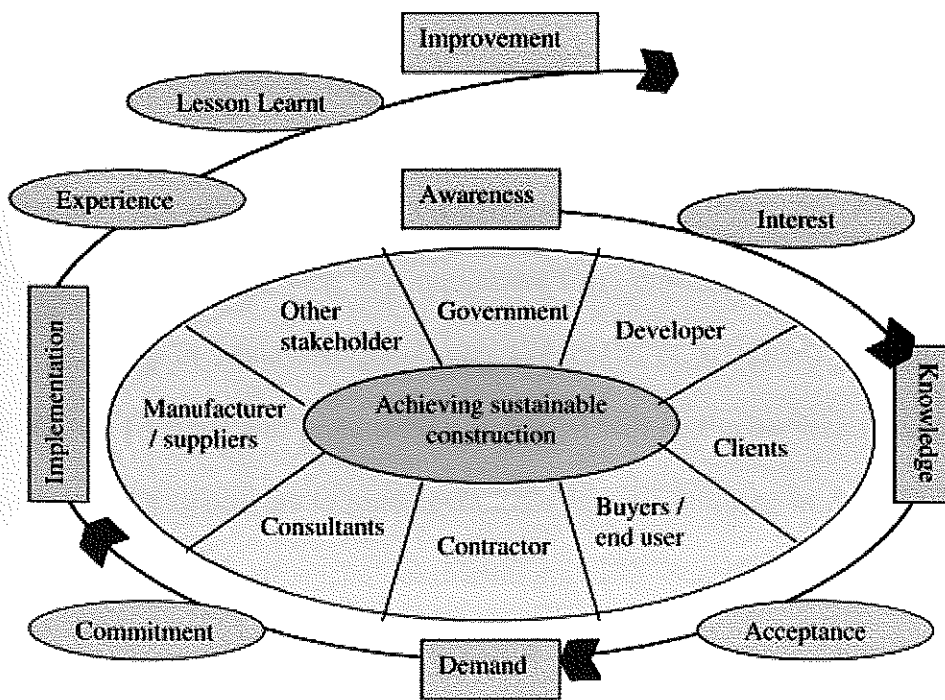


Figure 2.1 The path of achieving sustainable construction. (Source: Japheth, 2013)

From the figure above, it can be proved that the importance of awareness and knowledge against sustainable building. This is because the developers or clients without knowledge on sustainable building, the process won't go which won't construct or build sustainable building. There are 2 good prototypes to increase the awareness and knowledge against Zero

Energy Building, which are ST Diamond Building and GEO Green Energy Office (as a first Green Building Index Certified Building) (Japheth, 2013)

Moreover, Malaysia still at the infancy stage of awareness on sustainable building (Green Building and Zero Energy Building) because of the green building index. This is because the Green Building Index is complexity and it is requires time for the public to learn and digest. For example, the documents required for Green Building Index are chased to submit by the contractor, but the contractor need take time to digest it or understand it for that document. (Japheth, 2013)

2.4 Barriers to Zero Energy Building

Due to the finding of Goh, et al (2013), he has pointed out that lack of awareness, higher construction cost, lack of demand, lack of expertise and technology, lack of enforcement, lack of training and education and lack of commitment from organization were the barriers to the sustainable building in Malaysia. Moreover, Lindkvist, et al (2014) also mentioned that technical, social, financial and organization and legal will be the barriers in decision making process and retrofitting process to implement Zero Energy Building in Sweden and Norway. According to Bond (2012), financial considerations, split incentives, lack of knowledge and experienced workforce and lack of incentives are the barriers to sustainable building in New Zealand.

2.4.1 Lack of awareness

According to Karlsson, et al (2013), lack of knowledge or awareness among professional is one of the barriers to implement Zero Energy Building in EU. Moreover, Landman, M (1999) also pointed out that lack of awareness or education as primary barriers due to the finding.

In Malaysia, sustainable buildings are introduced many years ago but the development of sustainable building are still in infancy stage. Many stakeholders are not aware of this sustainable building. It can be see that in Malaysia, there are only one Zero Energy Building had been constructed.

Moreover, the stakeholder's lack of understanding about the benefit brings from Zero Energy Building. They are only care about the profit. This can see that only large developer will apply sustainable material or technology in their project and accept this kind of sustainable project. Due to the limited understanding, many developers are refusing or reject to this concept in their project.

2.4.2 Lack of demand

Williams &Dair (2007) pointed out that stakeholders are not required to construct sustainable building. The reason why the demand of sustainable building are low is because the stakeholders find out that the conventional building are cheaper than sustainable building. Therefore, unless stakeholders show interest in sustainable building or Zero Energy Building, if not this unlikely will be happen. (Williams &Dair, 2007)

Goh, et al (2013) mentioned that the population of developers also is a barrier to implementing sustainable building in Malaysia. This is because the larger-scale companies are lesser than the small and medium-scale company. To develop a sustainable building, the company must have a large capital in hand. Therefore, small and medium scale companies are not ready for this paradigm shift because they have not large capital in hand. (Goh, et al, 2013)

2.4.3 Lack of product information and technology

Shafii et al (2006) pointed out that, lack of sustainable materials, technologies and method is one of the barriers of implementing sustainable development in housing.

In Malaysia, green technology and materials are difficult to obtain. For example, solar panels of photovoltaic system need to import from other countries. Hence, developers are not interested in sustainable building which is wasting their time to find this kind of green technology and materials.(Goh, et al, 2013)

Due to the lack of product information about the cost and performance of green products, it will force developers or designers to rely on specialized consultants. Moreover, the developers and designers run a risk on cost call-backs to remedy green products that are not performing well (Davis, 2001).Moreover, in case when the project team want to comparing the green product by different building industry but the data about the green products is incomplete or difficult to interpret (Seo, 2002).This was cause by lack of product information

2.4.4 Lack of expertise and labor shortage

Miyatake (1996) mentioned that the knowledge of expert is a key factor to promote sustainable building. Sustainable building required a specialist to implementing sustainable building. Most of the designers are lack of experience and knowledge in design sustainable building. The construction industries in Malaysia are lacked of expertise to suggestion and design for the sustainable building or Zero Energy Building. Moreover, finding qualified workers to undertake certain jobs in the sustainable project will be a difficult task to clients (Goh et al, 2013). Due to the lack of specialist on sustainable building, they may have to import from the other countries such as Sweden, German.

2.4.5 Lack of enforcement

This is due to the government policy and regulatory framework which don't support at all on sustainable building. Government only enforces the developers to install rainwater harvesting systems in the residential. In Malaysia, laws and legislation for "GREEN" still poor and lack of enforcement to implement sustainable building.

Moreover, the Green Building Index and Building Energy Index are introduced in Malaysia few years ago but the developers still refuse to refer to this assessment guideline in development of sustainable building. Due to the government policies keep changing which cause the developers are not willing to take risk to implementing sustainable building. (Goh et al, 2013)