CARBON EMISSION STRATEGY FOR MALAYSIA (GREEN BUILDING COMMERCIAL)

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Specially dedicated to:

For my mom, siblings, supervisor and friends who supported me in completing this thesis.

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ABSTRACT

The total amount of carbon emission in Malaysia is estimated at 208 267 thousand tonne metric per year [1]. Based on the high volume of carbon emission, the Malaysian government has committed to improving and to place more emphasis on carbon emission reduction by the year 2020. Several methods or key steps have been taken by the country to help reduce carbon emission. One of the key items that were outline was the introduction and promotion of green building concept into the country environ. The paper written will study the level of effectiveness of the implementation and provide a quantitative overview of the green building strategy for carbon reduction that was executed. To achieve this, a HOMER simulation was conducted with 2 case studies for commercial green buildings. From the simulation, the results shows that the green building strategy was in fact effective where a significant amount of percentage (%) reduction for carbon emission was achieve when compared to the normal office buildings.

ABSTRAK

Jumlah karbon yang dibebaskan di Malaysia yang di anggarkan adalah 208 267 ribu tan setahun [1]. Berdasarkan kepada jumlah tinggi bagi penghasilan karbon ini, kerajaan Malaysia telah nekad memberikan komitmen untuk memperbaiki dan untuk memberikan penekanan yang lebih ke atas pengurangan penghasilan karbon ke udara sebelum 2020. Beberapa langkah utama telah diambil oleh pihak kerajaan untuk membantu mengurangkan penghasilan karbon ke udara. Salah satu daripada langkah yang telah diperkenal dan dipromosi adalah konsep Bangunan Hjau. Penulisan yang dihasilkan akan mengkaji tahap keberkesanan implementasi dan memberikan nilai kuantitatif umum bagi strategi Bangunan Hijau sebagai cara mengurangkan kadar pembebasan karbon ke udara yang telah dilakukan. Oleh itu, simulasi dengan mengunakan HOMER telah dijalankan ke atas 2 subjek kes bagi Bangunan Hijau komersil. Daripada simulasi yang telah dijalankan, didapati jumlah peratusan (%) pengurangan bagi Karbon dibebaskan ke udara bagi Bangunan Hijau adalah signifikan berbangding dengan bangunan komersil biasa.

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LIST OF ABBREVIATIONS

GBI	-	Green Building Index
EE	-	Energy Efficiency
RE	-	Renewable Energy
CO_2	-	Carbon Dioxide
BEI	-	Building Energy Index
PV	-	Photovoltaic

LIST OF SYMBOLS

P_{PV}	-	PV panel power output
Y_{PV}	-	Rated capacity of the PV array for power output under standard test condition [KW]
f_{PV}	-	PVderating factor (%)
G_T	-	Solar radiation incident on the PV array in the current time step [kW/m^2]
$G_{T,STC}$	-	incident radiation at standard test condition [1 kW/m^2]

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The World Carbon Dioxide Emission Statistic in 2008 rated Malaysia as the 28th country with the most Carbon Dioxide emission in the world [1]. Located within the South East Asian region, Malaysia is a developing country that is currently undergoing rapid urbanization in order to improve the quality of life for its denizen. However, in order for the country to achieve modernization, environmental sustainability is also a key factor considered by the Malaysian government. This is shown by the mentioned of sustainability policies in the national development plan as early as in the 1990s and further emphasis by the 40% Carbon emission reduction from the 2005 carbon emission level, commitment made by the Prime Minister of Malaysia Dato Sri Najib Tun Razak during COP15 held in Denmark, December 2009.

With the collaboration of agencies such as Ministry of Green, Technology and Water, Standard & Industrial Research Institute of Malaysia (SIRIM), Ministry of Natural Resources & Environment and Ministry of Housing & Local Authority with cooperation from the professional bodies such as Malaysian Institute of Architects and Association of Consultant Engineer Malaysia, one of the identified areas that could contribute to the carbon level reduction is implementation of Green

Buildings criteria for sustainable building designs. The aspects that these buildings stresses on are the design, construct or new retrofit that is operated and maintained in a method that reduces the total consumption of energy. This in turns reduces the amount of CO_2 produced from the reduction of electrical power consumption.

Setting Green Building as an initiative towards reducing the CO_2 emission a question that arises after is how do we quantify and translate the reduction of energy consumption into reduction of CO_2 emission. Does the implementation of green building give significant impact in terms of the overall reduction in the energy consumed by the building? Or is the impact insufficient and does not warrant delegating large amount of the country's resources. The paper written will explore further into this and provide quantifiable answer to the question.

The paper written provides a quantitative study by conducting a comparison between the green building construction CO_2 emission reductions versus the typical building. The comparative overview between the green buildings against the average building will give a clear picture in terms of effectiveness of the green building strategy for CO_2 emission reduction. Furthermore, the study will also briefly touch upon the reasons why harvesting solar energy via solar panels or Photovoltaic (PV) is the more favoured method of electrification in terms of renewable energy source selection for the buildings shown in latter case studies.

1.2 Problem Statement

In view of plans made and executed for green buildings construction to combat climate change and rapid urbanization in Malaysia, a quantitative study of effectiveness in terms of carbon emission reduction for commercial green building is required. A HOMER simulation based on the identified input variables will help provide the carbon emission comparison between the commercial green buildings vs. the typical commercial building design. Additionally, the study will explain briefly

the reason why solar panels are the favoured method of electrification for renewable energy source selection for the buildings in the case study.

1.3 Objectives

Measurement of the effectiveness for green buildings as a strategy for CO_2 reduction in Malaysia is the emphasis of the study conducted. The case study carried out will help provide a clear overview on whether green buildings should be one of the directions that would provide significant impact if further implementation is conducted. Based on the simulations model of the Green Buildings performance in term of energy consumption and the CO_2 produced is can be obtained. The goals of the research done are summarized as below:

i. To provide a quantitative comparison between CO_2 emission level for a commercial green buildings versus the typical commercial buildings.

ii. To understand the impact of the heavy reliance on fossil fuel towards the increasing trend in CO_2 emission for Malaysia and the need to find a clean and renewable resource as an alternative.

iii. To understand selection of solar energy as the favoured energy source for electrification and the suitability based on the geographical location and natural resources availability and also the resulting advantages and disadvantages of the selection.

1.4 Scope of Study

For the purpose of this study, the scope of the paper will be mainly limited to Green Buildings where, other known factors contributing to carbon emission that does not directly relate to green buildings such as transportation, or community lifestyle will not be delved into. The paper focuses mainly on how reduction of electrical energy consumption by green buildings would help reduce carbon emission. Therefore, only actions that overlap with green building and construction that contributes towards electrical energy consumption will be reviewed. Research methodology is via the application of the HOMER simulation software which would give a more quantitative analysis on the effectiveness of green building and construction. A quantitative view gauges the level of success that would later allow for strategic resource planning in order to maximize carbon reduction initiative results conducted by the country.

1.5 Work Flow

Research for the paper was conducted based on the work flow sequence that is shown in the figure below. Beginning with literature reviewed followed by data gathering and analysis would be within the first phases of the study. This later followed by simulation work, analysis and then the report drafting to conclude the conducted study.

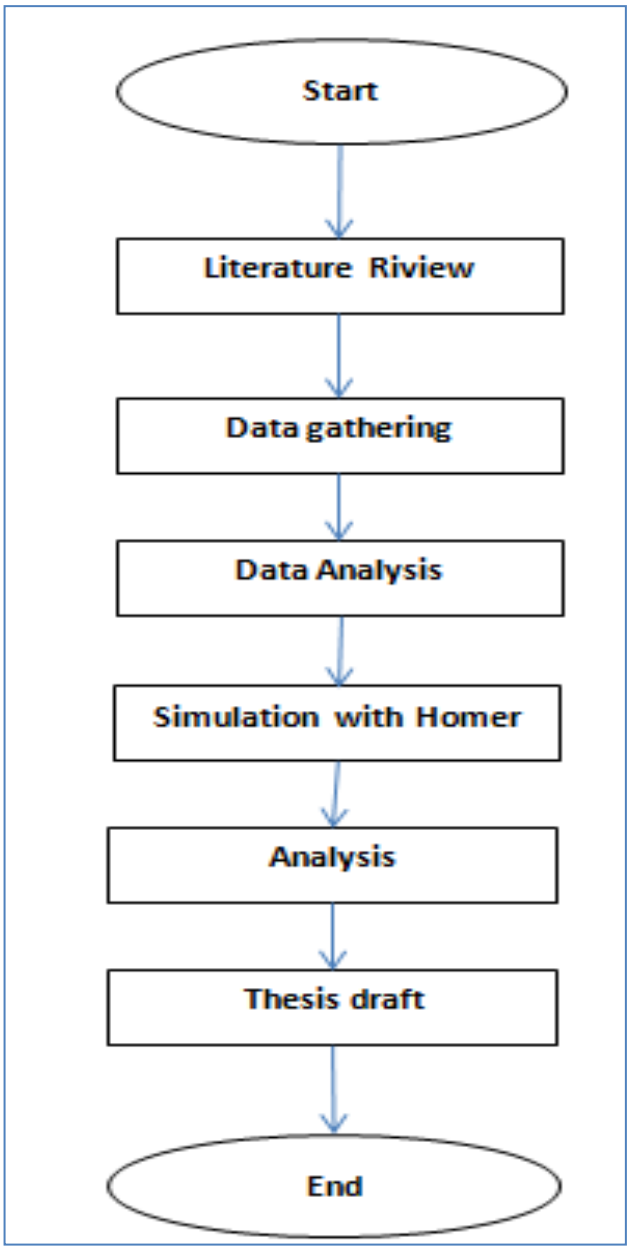

Figure 1.1: Work flow process sequence

1.6 Thesis Outline

The thesis contains 5 chapter, where chapter 1 is the introduction and overview of the whole project and also covers the problem statements as well the

objectives of the research. While chapter 2 covers the literature review of the thesis written. The entails to carbon emission facts and figures and also explanation on green building and why was it selected as a CO2 combat strategy. Chapter 3, covers the methodology for simulation in details while chapter 4 is the results and discussion of the simulation. Chapter 5 contains the final conclusion and for the future studies recommended to extend the research further.

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