TRANSITION OF ENGINE POWERED AIR-CONDITIONING SYSTEM TO THE SOLAR POWERED AIR- CONDITIONING SYSTEM IN A BUS: A FEASIBILITY STUDY

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SUPERVISOR VERIFICATION

'I acknowledge that have read this research project and in my opinion this research project is sufficient in terms of scope and quality for the award of Bachelor of Technology Management (Innovation)'

Signature : ……..

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Date : June 2013

DECLARATION

"I declare that all parts of this report are the results of my own work except for the quotations and references, the sources of which have been acknowledge in the bibliography"

Signature : ……..
Name : Muhd Zulpattah Bin Mohd Yusoff
Date : June 2013

DEDICATION

This thesis is dedicated to my parents and my family's

for their endless love, support and encouragement.

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First and foremost, I have to thank my parents for their love and support throughout my life. Thank you both for giving me strength to reach for the stars and chase my dreams.

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ABSTRACT

Developing and generating a better way of the fossil fuel exertion is necessary in today's transportation technology since the fossil fuel is a source that is non-renewable resources. Fossil fuels are of great importance in transport systems because they can be burned and producing significant amounts of energy to move the vehicle along. Generally usage of the air-conditioning system in the transportation will increase the usage of the fossil fuel, since the fuel is used to power the air-conditioning system. The additional energy resources as solar can be used in a vehicle to generate adequate energy to power the air-conditioning system instead of solely depending on the engine which render to the increase of the fuel consumption. In this feasibility study, the solar panel can be implemented in a bus to power the air-conditioning systems. This solar panel allows it to harvest the sun's energy and turn it into the electricity. The research was grounded in an exploratory study. A qualitative case study approach was adopted, backed up by three data collection methods which were interview, observation and document analysis. These data collected was analyzed to get the efficient way to implant the solar application in buses. As the research's conclusion, the solar application will perform extremely well in powered the air-conditioning system in a bus. The consumption of the fossil fuel is lowered and the efficiency of the engine is enhanced since the energy input is maximized for the movement of the bus. Besides, this application also benefits to the environment as it produces lower carbon which minimizes the effect of the greenhouse effect.

ABSTRAK

Membangunkan dan menjana cara yang lebih baik menggunakan bahan api fosil adalah perlu dalam teknologi pengangkutan hari ini kerana bahan api fosil adalah sumber yang tidak boleh diperbaharui. Bahan api fosil adalah sangat penting dalam system pengangkutan kerana mereka boleh dibakar dan menghasilkan sejumlah besar tenaga untuk bergerak kenderaan. Secara umumnya penggunaan system penghawa dingin dalam pengangkutan akan meningkatkan penggunaan bahan api fosil. Sumber tenaga tambahan sebagai solar boleh digunakan di dalam kenderaan untuk menjana tenaga yang mencukupi untuk kuasa system penghawa dingin dan bukan semata-mata bergantung kepada enjin yang menyebabkan kepada peningkatan penggunaan bahan api. Dalam kajian ini, panel solar dilaksanakan untuk bas menjana kuasa bagi system penghawa dingin. Penggunaan panel solar membolehkan ia untuk menuai tenaga matahari dan mengubahnya kepada elektrik. Kajian ini berasaskan kepada satu kajian penerokaan. Pendekatan kajian keskualitatif telah digunakan, dan disokong oleh tiga kaedah pengumpulan data yang temubual, pemerhatian dan analisis dokumen. Data-data yang diperolehi dianalisis untuk mendapatkan cara yang berkesan untuk mencipta system kuasa solar dalam bas. Sebagai kesimpulan kajian ini, aplikasi solar akan melaksanakan sangat baik dalam berkuasa system penghawa dingin dalam bas. Penggunaan bahan api fosil dapat diturunkan dan kecekapan enjin dipertingkatkan kerana input tenaga adalah memaksimumkan bagi pergerakan bas. Selain itu, permohonan ini juga memberi manfaat kepada alam sekitar kerana ia menghasilkan karbon yang lebih rendah yang mengurangkan kesan rumah hijau.

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NOMENCLATURE

UTeM	UniversitiTeknikal Malaysia Melaka
AC	Air-conditioning
DC	Direct Current
PV	Photovoltaic
VFD	Variable Frequency-Driven Compressor
CO2	Carbon Dioxide
PLC	Product Life-Cycle
TLC	Technology Life Cycle
R&D	Research and Development
e.g	Example
HR	Human Resource

LIST OF SYMBOLS

°C = Celsius

°F = Fahrenheit

% = Percentage

P = Significant value

β = Beta

N = Total numbers

V = Voltage

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this modern world, the fossil fuel is one of the important resources of the non renewable energy. This type of the energy sources being used in almost vehicle for burning and produces the enough power to allow the movement of the vehicle. This research addresses the investigation of the transition of the engine powered air-conditioning to the solar powered air-conditioning in a bus. A fresh perspective will be offered, which builds upon the notion of transition. The main motivation for using the notion of transition is that while it link to the concept of sustainable development, it has a better chance of advantages that it shift the attention from a vague end goal of stimulating transition processes as a more concrete step.

According to Mill (1831), the first of the leading 'peculiarities of the present age is, that is an age of transition'. By the times passing by, now we have a better option to use the precious sources of non renewable energy to minimize and enhance the usage of it. A new kind of energy sources or renewable energy such as solar energy can be applied as the substitute of the non renewable energy to support the energy supply to use in

vehicle. White and Bruton(2007) state that entire industries can be created or can disappear quickly because of new technology. By the level of the technologies that we have today, we can enhance the energy generation to be applied in the transportation system which can help us to protect the environment toward the greener world.

According to Solomon (1983), "every community is closely linked to its environment; people live, work and relax in it. They develop new technologies to make their living conditions better~ their ways of thinking, as an example, how they explain everything around them expresses their view of life and is influenced by the environment". The environment is giving us many benefits so far, it was a perfect time for us to pay back them by protecting them with using safest source of power which has almost 0% of the pollution effect.

1.2 Statement of Problem

Almost of the buses that moving on the roads across the globe for hot climate countries have been equipped with the air-conditioning systems that used to create a lower temperature in the bus and make it more comfortable for the passengers. The air conditioning system however gives some bad effect to the usage of the fuel and also produce gases such as carbon dioxide (CO2) that can damage the ozone layer. By using the air-conditioning system, the usage of the fossil fuel will be increased as the engine needs to use many fuels to make the burning process to produce the energy to work the system.

Climates in the different parts of the world vary with the season of the year has changed the level of comfort for human toward the temperature. Thus, there is a need for the control of the environment for human comfort as well for some specific

equipment, material or process. By the knowledge of the human kind, the air-conditioning system has been created. According to Ameen, the first attempt to produce artificial cooling was made in 1755 when Cullen built an apparatus to make ice artificially by vaporization of water at reduced pressure. This experiment was followed by others over the years. By the times goes by, today we have the air-conditioning system in the vehicle.

The air conditioning system in the vehicle used many of the fossil fuel to operate. According to Johnson (2002), the amount of fuel used for air conditioning is significant. In absolute terms, 7.1 billion gallons of gasoline (27 billion liters) are used in the US for air conditioning light duty vehicles. Put in relative terms, the air-conditioning fuel use is equivalent to 6% of domestic petroleum consumption, or 10% of crude oil imports. As the research goes deep into the context of the air-conditioning system of a vehicle, more problems can be found impact of the systems. However it is not a best way to completely remove the system because it was some of a good system but just need some transition to enhance the usage and minimize the side effect to the environment.

In this research, the researcher has set form the specific questions which are:

1) How the solar powered air-conditioning system can replace the engine powered Air-conditioning system in a bus?
2) How the solar powered air-conditioning system can enhance the efficiency of the engine performance of a bus?
3) How to implement the solar powered air-conditioning system in a bus?

1.3 Objective

The objective of this study is to investigate the transition of the engine powered air-conditioning system to solar powered air-conditioning system in buses. The aim of this study is to minimize the usage of the fossil fuel and give some fresh idea of innovative solution for implementing the solar application to power the air-conditioning system in buses.

The objectives of the study are stated as below:

1) To investigate how to implement the solar powered air –conditioning system to replace the engine powered system in bus.
2))To investigate how the implementation of the solar powered air-conditioning system can enhance the efficiency of the bus performance
3) To suggest an innovative solution on the application of the solar air-conditioning system to improve the engine performance.

1.4 Scope

The scope of this study is to investigate the transition of the engine powered air-conditioning system to solar powered air-conditioning system in buses which consider the usage of the fossil fuel for the air-conditioning system, solar application and environmental safety. The result of the study will be analysis to suggest the innovative solution for applying the application of the solar energy to generate power for the air-conditioning system in a bus.

The respondent for this research are mainly divided into two groups. The first category consists the executive from the manufacturer of the bus or the bus operation. This group respondent is the group that decided the innovation in the bus and the system that has build in the buses. The second group consists the group of the maintenance and the driver of the buses. The useful information that's been collected will be taken to conduct a good conclusion.

1.5 Limitation

There are several limitation states in this study. Firstly, the study is to investigate the transition of the engine powered air-conditioning to solar powered air-conditioning in buses. Therefore, the result and the outcomes of the study is only reliable to the air-condition system of a bus only. Secondly, this research only does a research about the transition of energy sources to power the air-conditioning system in bus which two sources of energy will be taken as a variable which are engine power and solar power. Therefore the other sources of the energy will not be included in this research. Besides, the outcomes of this research will be analyses to make an innovative idea to implant the solar power into the buses. Thus, the construction of the buses will not be done. The outcomes of this research will generate the blueprint of the solar power air conditioning in bus only. Lastly, the researcher assumed that all respondents have provided honest and correct answers for this feasibility study.

1.6 Summary

The transition is the best solution to overcome the increasing of the fossil fuel for the air conditioning system in a vehicle. By using the solar power to power the air-conditioning systems in the buses, we can save up about 10 to 20% of the usage of overall fossil fuel in a bus. This research is one of the innovative plans as the solution for the environment pollution and help to sustain the renewable energy to use in the vehicle. According to Pfeiffer (2006), a sustainable system is one which, over its lifetime, produces the energy required to develop and maintain itself.

In this research, the solar power will be taken as the crucial point to replace the engine power to power the air-conditioning system in a bus. The efficiency of the usage of fossil fuel and the environment safety will take to determine the success of the research.