

DESIGNING A SOLAR ENERGY SYSTEM FOR
ROAD SIGNAGE

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This report is submitted to partial fulfillment of term for
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“I hereby admit that this report is based on my own efforts except for summarized items and paragraphs that each and every one of them has been pointed out its original sources.”

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ABSTRACT

The use of solar energy as an alternative to conventional energy to generate power and produce electricity can be said as a wise move since that it could lead to a bright long term effects. This is due to the availability of the solar energy at most of the time. This project is based on the findings and research that was carried out to detects the effects of the system implementation to a road signage system. Certain aspects will be carefully considered and further researched to make sure whether the system can be implemented on real life since that sometime the on-paper and real life results is not always the same. Cost, size and weather conditions will play important roles in determining the overall ability of the solar system to cope with the conventional method. Researches and studies will be based from the previously done experiments and implementations. All the data and information is very crucial in building a proper system. Comparisons between type of cells will be conducted and certain aspects will be considered to determine the suitability of the system implementation to a road signage system. The use of extra tools and equipment is necessary to aid the system building. For example, the use of SolidWorks software is crucial to design the whole system. A couple of design variation will be made to find an exact configuration match that is suitable to be used by the system.

ABSTRAK

Penggunaan tenaga solar sebagai tenaga alternatif untuk menjana kuasa bagi peralatan elektrik boleh dikatakan sebagai langkah yang bijak kerana ia membawa kesan jangka masa panjang yang baik. Ini kerana sumber matahari boleh didapati secara meluas dan percuma. Laporan projek ini adalah berkaitan dengan kajian yang dijalankan terhadap kesan penggunaan sistem ini terhadap sistem isyarat jalan raya. Beberapa aspek penting akan diketengahkan dan dikaji untuk memastikan samada sistem ini boleh diaplikasikan. Kos, saiz dan keadaan cuaca memainkan peranan yang penting dalam menentukan keupayaan pemasangan sistem ini secara keseluruhannya. Kajian dan semakan terhadap kajian-kajian yang pernah dijalankan sebelum ini akan dilakukan untuk mengumpul semua data-data dan informasi yang penting dalam membina sistem tersebut. Perbandingan di antara jenis-jenis panel solar akan dilakukan dan beberapa aspek akan diambil kira untuk menentukan penggunaan panel solar yang sesuai dengan sistem isyarat jalan raya. Penggunaan alat-alat tambahan akan diambil kira dalam membuatkan sistem tersebut dapat berfungsi dalam keadaan yang paling optimum sepanjang masa. Kekurangan yang terlibat akan dikaji supaya ia dapat dikurangkan dengan membuat penambahbaikan terhadap sistem tersebut. Kos kasar dalam mereka bentuk sistem ini akan dibandingkan dengan sistem konvensional dan perbandingan akan dilakukan. Dalam melaksanakan projek ini, penggunaan alatan dan perisian tambahan akan terlibat seperti penggunaan perisian SolidWorks untuk mereka bentuk sistem tersebut. Beberapa variasi reka bentuk akan dilakukan untuk mencari padanan konfigurasi yang paling sesuai untuk digunakan terhadap sistem solar tersebut.

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LIST OF SYMBOLS AND ABBREVIATIONS

FYP	=	Final Year Project
LED	=	Light Emitting Diode
MPPT	=	Maximum Power Point Tracker
P_{max}	=	Maximum Storage Power
PV	=	Photovoltaic
PV/T	=	Photovoltaic-photothermic
RM	=	Ringgit Malaysia
ROI	=	Return of Investment
UTeM	=	Universiti Teknikal Malaysia Melaka
W_{ut}	=	Actual Operating Energy
η	=	Efficiency $\eta = W_{ut} / P_d$
α	=	Maximum Discharge Power
τ (s)	=	Maximum Power Discharge Duration

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

In this age, the demand for electricity has rise to a very high level. The dependencies to conventional energy sources have cause the reserves to be much and much lesser. In order to curb with the problem, developments and researches of renewable energies has become so common causing people to start change to using these types of renewable energy sources. The benefits of renewable energy compared to conventional sources such as fuel has become obvious. One of the renewable energies involved is the solar energy. The solar energy, which comes from the sun, is a type of energy that has a lot of advantages. It has a lot of usage such as producing electricity and heating up water in tanks for hot water system. In this project, studies on solar energy system have been conducted to implement it on current electrical system. The pros and contras are highlighted throughout the project to find that whether the implementation of the system in real life is practical or not. For this project, the road signage has become the target system where the systems are implemented due to use of this signage to road users. The dependencies of this system to the current energy sources (cables and batteries) can be minimize if the system is paired up with a solar panel system. Since this sign needs to be operating almost continuously, relying to conventional sources will be such a waste. The excess energy could be contributed to other usage.

1.2 Objective

The objectives of this project are:

- a) To design solar energy system to generate electricity power for road signage.
- b) To study the cost of implementing the system
- c) To fabricate a model of the design

1.3 Project scope

During both semester of the Final Year Project, numerous studies are conducted regarding to the solar energy concept. Several types of solar panels are studied and comparisons between all of them are decided. As enough information is obtained, the solar panel are applied on a road signage and its suitability is observed in term of the cost, design, power generated and other related factors. Multiple designs are made and the best one are choose based on the suitability of the solar panel system to be paired with the road signage.

1.4 Problem statement

The running cost for road signage system is about to be reduced by the mean of installing a solar panel system. Several factors will be taken into consideration and the suitability will be determined based on the results. The main criterion that are look over is the cost and available power. The suitability of the system are questioned here, whether it is suitable to be used. Several factors such as the placement and design of the solar panel and road signage are analyzed. The main efficiency and durability of the solar panel are taken into consideration other than the right choice of panel to be used.

CHAPTER 2

LITERATURE REVIEW

2.1 Energy Consumption

The cost for alternative sources of energy are dropping every year since that there is a lot of development has been made in order to fully utilize the available source. People now tends to use a lot of energy resources due to their lifestyle and needs causing the current energy resources cannot cope with the usage. Because of this, alternative energy resources have become such important things that need to be taken care so that the supplies for energy would not be cut off in the future. As now we are depends on oil, fossil and such sources, these has become scarce nowadays and the price has also been steadily increase. Some of the factors that contribute to the price of global oil are the subsidies that are given to the nuclear or fossil forms are energy has now becoming phased out. This where the alternative energy sources will starts to benefits a lot of peoples. The benefits will not be only felt by certain people such as those who live in the country' or urban areas only, but also to those places such as the sub-urban as the resources are not restricted to certain areas. The numbers of people who can benefits the alternative energy sources are almost infinite as they are widely available throughout the whole world. For now, it is debatable to replace the current conventional forms of energy resources with an alternative due to the economic reasons, but seeing the trends of the developments right now, it is sure that alternative energy will have upper hands compared to the conventional methods in the future.

There are a lot of advantages for alternative sources compared to the

conventional in many ways such as the sustainability is higher. Other than that, the sources of the energy can be obtained almost everywhere on the world. Taking examples as the Sun's energy, it can be found almost all over the world throughout the whole year. But for fossils and minerals, it can be acquired at certain places only and the source can't be obtained from places where the population of human is high. The most important advantages of the alternative energy; they are environmentally friendly and clean which is a very good criterion due to the condition of our Earth nowadays. But, despite of having such advantages, the alternative sources also has certain disadvantages such as the variability, low density and a high initial cost for implementing those systems. And since that there are a numbers of alternatives ways to obtain energy, the method and system used are also different which will pose other problems such as pollution and odor from biomass, the avian with wind plants and also brine from geothermal sources. Comparing to the use of conventional energy resources, it is much safer and protects the earth from ruined as it preserves the environmental and atmospheric cleanliness.

Taking another example from fossil fuels, they are basically the stored solar energy from the geological ages. One of the problems of fossil fuels are they will run out in the future. The process of fossil fuels to be created took thousands of years and the supply for oil, natural gas and coals, even though large, would not last long enough, as the demands for the sources increased day by day.

Table 2.1: Demands of Fossil Fuels and Energy Sources (Source: Zekai, 2008)

Sources	Shares
Petroleum	38%
Coal	30%
Natural Gas	20%
Hydropower	7%
Nuclear Energy	5%

From Table 2.1, we noticed that the demands for petroleum is the highest since that the petroleum is widely used to move vehicles or machineries in factories. The ever increasing number of machineries everyday contributes to the largest usage of petroleum. Hydropower (power generated from water) such as turbine used at dams, only contributes 7% of the total energy sources. Hydropower is one of the main power sources that we used. It caters for the use of electrical appliances at

home, offices, factories and also outdoor usage such as street lights and electronic signboards. By observing the trend of today's resources usages, it is estimated that the current world oil and natural gas will last for certain decades while coal reserves can sustain the energy requirements for certain decades. This shows that the current energy sources reserves can't hold for a very long time, hence alternatives methods must be search and develop to replace the current sources.

According to Zekai (2008), there are several possible reasons why new alternatives has been more and more accepted and further developed to replace the current energy system:

1. The ever increasing demands and usage of equipments that requires a lot of energy resources. From researches that has been done so far, within the next five decades, the use of fossil fuels will not be sufficient enough to support these usage.
2. Unavailability of fossil fuels in every country. Since that the fuels are not evenly all across the world, there will be countries that don't have enough supply to cater their needs. Unlike fossil fuels, renewable energies, such as solar radiation and wind are available at all over the world which makes it perfect to be a substitute for the current energy sources.
3. The effects of fossil fuel to the environment such as atmospheric pollution due to the Carbon Dioxide (CO₂) gas emissions and environmental problems including air pollution, acid rain, oil spills, climate changes, greenhouse effect, *etc.* Even with the advance of technologies, the bad effects can't be properly avoided. In this case, the use of solar energy is very efficient replacing the fossil fuel usage.