

# HYBRID RENEWABLE ENERGY FROM SOLAR AND WAVE IN APPLICATION OF 12 VOLT MOTOR

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## ABSTRACT

The hybrid system is very useful nowadays to generate electrical power for the isolated small network and for the grid-tied system. The standard lifetime batteries are just insufficient to act as the power source and need to add a secondary power to charge the battery in order to increase the operation time. The aim of this project is to construct the hybrid system for an isolated small network and supply the load with solar energy, wave energy and battery. This hybrid system is designed for 12-volt motor to operate continuously using greener source as well as to be used as a back up supply when one of the sources is not functioning. Furthermore, the hybrid generator is more stable compared to single source and very reliable to produce electricity. In the making of a hybrid generator of wave and solar, a few major components are required such as solar panels and permanent magnet direct current motor. From the analysis of this research, the result obtain show that the application of hybrid renewable energy is suitable for the 12-volt motor due to the capability of the system to increase the operating time of the motor throughout the day and night.

**Keywords:** Hybrid energy, Renewable energy system, wave, solar.

## 1. INTRODUCTION

At present, world supply of crude oil is facing scarcity will be depleted at any time. Crude oil is capable of generating substantial hours of electricity supply during this human race and once it is depleted, it will seriously affect the supply of world electricity. So, the researchers today have diverted their discipline for a renewable provision that at some ~~power~~ point might replace the crude oil. Besides, most of the power generated by mistreatment fuel expenditure causes a significant negative impact on the stage setting. Consequently, folks today have gotten additional interest into the clean, greener, free and non-depleting supply. Among the examples of renewable energy are solar, wind, biomass, tidal, moving ridge, ~~and~~ etc. However, the applying of renewable energy for power generation design is clear and therefore the efficiency of the renewable energy systems area unit tough to achieve its atonement standards. Additionally, renewable energy utilization is subjected to the adjustment of weather and setting [1]- [2].

Although the battery can be charged by the primary electrical source by using the adapter, the standard lifetime batteries are still insufficient and need to add a secondary power source. The secondary source can be generated using solar energy and wave energy to charge the battery in order to increase the operational time. The solar energy's coating is an alternative energy which involves the conversion of daylight into electricity. Targeted alternative energy system uses lenses or mirrors and sideline systems to focus an outsized space of daylight into a little low shaft [3]. Electrical phenomenon then converts lightweight into current mistreatment the physical phenomenon impact. Meanwhile, wave energy also known as Ocean Wave Energy, is another type of ocean based renewable energy source that uses the power of the waves to generate electricity. Unlike tidal energy which uses the ebb and flow of the tides, wave energy uses the vertical movement of the surface water that produce tidal waves. Wave power converts the periodic up-and-

down movement of the oceans waves into electricity by placing equipment on the surface of the oceans that captures the energy produced by the wave movement and converts this mechanical energy into electrical power. Waves which originated from wind and storms way design on the ocean surface and travel long distances will generate far steadier electrical power because wave energy contains greater mechanical force. Therefore, it permits smaller and fewer conspicuous devices to provide power. Wave energy varies because of the differences in the succession of wave heights whereas alternative energy varies with the cube line speed. Water being 850 times denser than air ends up in abundant higher power created from waves averaged over time [4]-[6].

In this research, there will be two main sources to focus on which are Solar Energy and Sea-Wave Energy. It as a termination of these vigor area unit wide use and well-known within the humans compare to different renewable resources [7]-[8]. Although renewable sea-waves and solar are considered new, these sources of supply already reach it consistency in generating the voltage.

Theoretically, the renewable energy usually produces a small amount of electricity and that makes the system running on less efficiency [9]-[10]. In this project study, the combination both types of energy could produce higher amount of electricity. The power generated from these renewable sources will then be tested on the catamaran boat. The current trend of the energy system is mainly focused on battery. The effectiveness of the hybrid renewable energy will be compared to the traditional dry cell. Finally, the reliability consumption of power to withstand the operation over certain period of time will be observed. By combining the two renewable energy, it could generate the 12 volt supply to the 12-volt motor and increase the efficiency to charge the storage.

## 2. THE HYBRID ENERGY SYSTEM

A hybrid system is a combination of two or more energy sources in one power system. This system combines different technology and sources of energy to produce power. The component for electricity generation can utilize renewable energy sources like photovoltaic, hydropower, biomass and wave power. In this project, the hybrid system is focusing on solar and wave energy as the source to generate the electrical power as shown in Figure 2.1. The RC buoy has been used as a project prototype and it has a fixed standard lifespan.

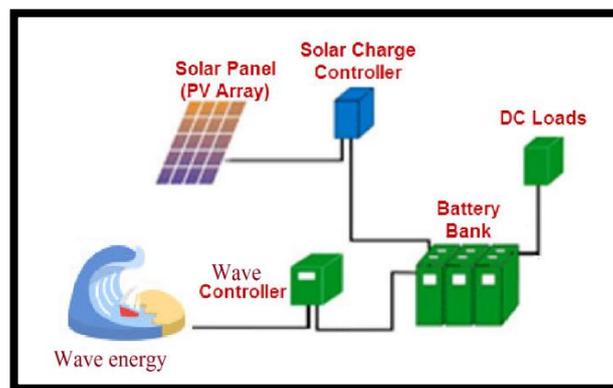


Figure 2.1: Hybrid module

### 2.1 Solar Energy

This photovoltaic system used to transform energy from solar radiation into the electricity. At the center of the solar system is the solar cell which reacts to interconnect to form a solar module and array. The size arrangement of the framework relies on its intended task. Modules and clusters shape are used to charge batteries, an operation of a motor and to control any number of an electrical load. With the proper power transformation hardware, the solar power system can deliver alternating current (AC) compatible with any customary appliances. Among the segments of an entire solar based system power framework might be a DC-AC power inverter, a battery bank, a framework, and battery controller, assistant vitality sources and now and then the predetermined electrical load as shown in Figure 2.2.

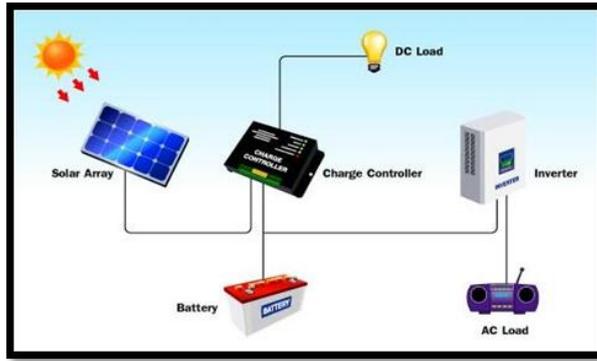


Figure 2.2 : Photovoltaic system

The solar panel specification used in this project is 6 volts 1 watt. The photovoltaic system is to convert the sun energy into electricity. There are 4-unit solar panels being used for this project to generate 24 volts. The solar panels are connected in series to get the 12 or 24 volts as shown in Figure 2.3. The current generated by the unit is directly proportional to the level of the sunlight incident over the surface of the panels. Basically, the solar panels are made up of discrete sections of individual photovoltaic cells. Each of these cells ~~are~~ **is** able to generate a tiny magnitude of electrical power, normally around 1.5 to 3 volts. Many of these cells over the panels are wired in series so that the total effective voltage generated by the entire unit mounts up to a usable 12 volt or 24-volt outputs.



Figure 2.3 : 6 Volts Solar panel



Figure 2.4 : Electromagnetic induction

## 2.2 Wave Energy

The wave energy is produced when the electrical component used is placed on the surface of the sea. The energy will be generated when the wave hit the electromagnetic induction part on the bottom of the hybrid buoy. The electromagnetic induction part will be designed with a floating bopper to put at the behind of the hybrid buoy and collect the wave energy to convert it into the electricity as shown in Figure 2.4. The solar panels and wave energy (electromagnetic induction) are connected to the charging controller to prevent

overcharging and protect against the overvoltage which can reduce the battery lifespan and performance. The components should be soldered respectively with the solar panels and electromagnetic induction. The secondary sources are tested by moving the boat and record the capacity of the secondary sources to charge. The electrical system is successfully fixed and get the correct amount of voltages to charge the battery.

### 2.3. Fabrication of Solar and Electromagnetic Induction

Figure 2.5 shows the solar panel with 4 plates which are connected in series and each panel will produce 6 volts. The solar panels are connected in series because the voltage across the panels are the sum of the voltages across of each panel. For the electromagnetic induction, a neodymium magnet with 36g of pull force and having a diameter of 1.5 cm and length of 8 cm. This allows the magnet to fit inside the housing as well as slide back and forth with relative ease by moving upwards and downwards. The number of turns of the coil for the induction is 150 turns. The solar panels and the electromagnetic induction are fixed on the buoy as the charging sources to extend the lifespan of the battery during the operation time and make the buoy perfect. The project is fixed completely with the renewable energy sources to charge the battery. The buoy is controlled by a controller to move the boat.



Figure 2.5 Complete fabricated RC Buoy

## 3.0 ANALYSIS OF THE RESULTS

### 3.1 Solar Panel Test (angle efficiency).

From the tasks performed, the results obtained from this project will be explained throughout with graphs and tables. The output of this project will be measured using multi-meters. This test is conducted from 8.00 am to 8.00 pm for 10 days to determine the highest and the lowest voltage and current generated from the project work as shown in Table 1. The result shows that the output for voltage and current is not constant. The angle of solar panel is affected to produce a higher output voltage and current. The best angle of tilt solar panel is  $40^\circ$  which produce 12.5 V and 1.8 A. The minimum voltage and current produced are 9.5 V and 1.1 A at  $90^\circ$  angle respectively.

Table 1 : Solar panel data collection

Days	Average of Solar Panel Angle	Average Current, A Produced	Average Voltage, V Produced
1	0°	1.4	10
2	10°	1.45	10.2
3	20°	1.56	10.7
4	30°	1.62	11.82
5	40°	1.8	12.5
6	50°	1.78	11.98
7	60°	1.76	11.95
8	70°	1.52	10.3
9	80°	1.42	10.1
10	90°	1.1	9.5

### 3.2 Solar Panel Test (angle efficiency).

To test the task of this project, solar panels are located in the open space where there is a maximum intensity of sunlight. The output of this project will be measured using a multi-meter. The test will be conducted from 8.00 am to 8.00 pm to determine the highest and the lowest voltage and current generated from the testing. After data collected daily, the average daily flow will be divided into hours to get the amount of time taken for the solar charging battery. The analysis of the results shown in the Figure 2.6. Meanwhile, the average daily data is summarized by taken an average of 7 weeks of the average data. The best temperature is 33° to produce 12.02 V and 1.75 A. The minimum voltage and current produced are 11.66 V and 1.52 A respectively at the temperature of 28° as shown in Table 2.

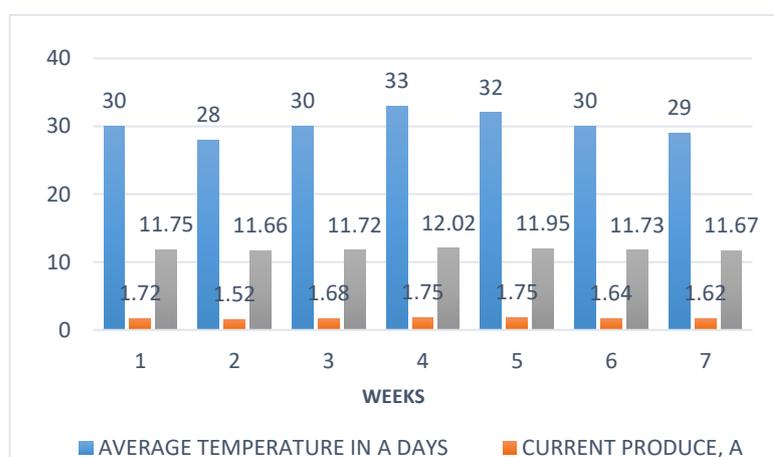


Figure 2.6 : Temperature on Current and Voltage

Table 2: Affect temperature to produce voltage and current

<b>Weeks</b>	<b>Average Temperature in A Week (C)</b>	<b>Current Produced (A)</b>	<b>Voltage Produced (V)</b>
1	30	1.72	11.75
2	28	1.52	11.66
3	30	1.68	11.72
4	33	1.75	12.02
5	32	1.75	11.95
6	30	1.64	11.73
7	29	1.62	11.67

### 3.3 Sea-Wave Generator (Magnetic Induction)

The output of this experiment is measured using a multi-meter. The buoy prototype needs to surf and vibrate to produce mechanical movement upwards and downwards in order to determine the highest and lowest voltage and the current generated from the experiment. The result obtained is shown in Table 3 and Figure 2.7. Meanwhile, the number of coil turns have affected the amount of voltage and current generated. The sea-wave generator needs support by the DC to DC boost converter to increase the output.

Table 3 : Efficiency of electromagnetic

<b>Number of Coil Turns</b>	<b>Current Produced (Ma)</b>	<b>Voltage Produced (Mv)</b>
50	20.05	95.66
100	55.64	244.33
150	83.73	411.05

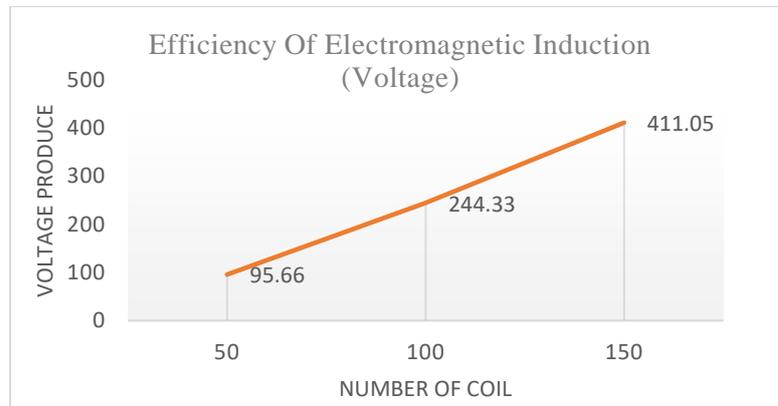


Figure 2.7: Efficiency of electromagnetic graph (voltage)

#### 4.0 DATA ANALYSIS FOR HYBRID SYSTEM

In order to test this project prototype, the hybrid system consistently vibrating and surfing on the water surface at MIMET's slipway where the condition is almost the same as the open ocean. The maximum intensity of sunlight and wave vibration is required. The output of this project will be measured by using multi-meter. The readings are recorded as per Table 4, Table 5 and Figure 2.8. The test is done from 8.00 a.m. to 7.00 p.m. in order to determine the highest and lowest voltage and current produced from the project task. The operation time of the motor to move the buoy is 30 minutes. After 30 minutes the buoy will be moving slowly and recharge the battery.

Table 4 : 12 Volt motor operation

<i>Time (Minute)</i>	<i>Battery Capacity (V)</i>	<i>Battery Current (A)</i>
5	8.4	0.52
10	7.8	0.51
15	6.5	0.5
20	5.8	0.5
25	4.6	0.49
30	3.3	0.47

Table 5 : Hybrid system data

<i>Time</i>	<i>Voltage Produced (V)</i>	<i>Current Produced (A)</i>
08.00 AM	21.35	0.75
09.00 AM	20.45	0.72
10.00 AM	22.35	0.76
11.00 AM	24.02	0.82
12.00 PM	24.03	0.8
01.00 PM	25.39	0.85
02.00 PM	25.03	0.85
03.00 PM	24.03	0.8
04.00 PM	21.03	0.75
05.00 PM	19.25	0.7
06.00 PM	13.15	0.6
07.00 PM	5.35	0.5

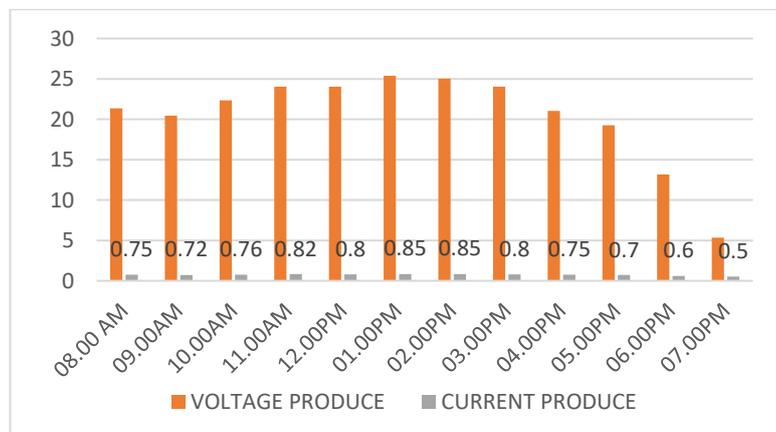


Figure 2.8: Hybrid System Data Collected

The details specification of the prototype is shown in Table 6. The dimension of the buoy body, the solar panels and wave generator are measured accurately. The materials used for the body is PVC which is a sort of strengthened plastic and stable to float at the seawater surface. PVC is a solid lightweight material and is utilized for some items. PVC has high impact strengthens collide with other objects and it also a corrosion resistance such as chemicals on the water surface, seawater and also has low maintenance repair. The solar energy and wave energy used as renewable energy sources for this project to charge the battery while the buoy is moving. Both sources will not cause any pollution. In fact, the electricity is generated by both of sources. The battery is the primary power source used by the buoy. The capacities of the battery is 7.2V, 1800mA. The buoy is powered by 2 motors and 2 shafts to move the boat. The capacity of the motors is 12 volts.

Table 6: Prototype specification

No	Items	Components / Part	Detail Specification
1.	Dimension	Body of the buoy	<ul style="list-style-type: none"> <li>• Width : 850mm</li> <li>• Length : 680mm</li> <li>• Height : 200mm</li> </ul>
2.	Motor	Solar Panel	<ul style="list-style-type: none"> <li>• Overall : 220mm x 280mm</li> </ul>
		Sea wave generator	<ul style="list-style-type: none"> <li>• Overall : 70mm x 20mm</li> </ul>
		2 Electric Motors	<ul style="list-style-type: none"> <li>• Dimension : 40mm x 15mm</li> <li>• 2 Shaft : 1.5mm</li> <li>• Voltage : 12V</li> </ul>
3.	Materials used for the body	PVC	<ul style="list-style-type: none"> <li>• High impact strength</li> <li>• Corrosion resistance</li> <li>• Less weight</li> <li>• Low maintenance</li> </ul>
4.	Primary sources	Battery	<ul style="list-style-type: none"> <li>• 7.2V - 1800mAH</li> </ul>
5.	Renewable energy	Solar energy	<ul style="list-style-type: none"> <li>• Renewable energy</li> <li>• Do not cause pollution</li> <li>• Generate electricity</li> </ul>
		Wave energy	<ul style="list-style-type: none"> <li>• Renewable energy</li> <li>• Do not cause pollution</li> <li>• Generate electricity</li> </ul>

## 5.0 CONCLUSION

A real prototype of the RC Buoy with the renewable energy sources and the PVC body had been successfully fabricated with the selected materials. It follows strictly all the designs and specifications to ensure it is able to recharge the battery for extended battery life. The performance of the completed RC Buoy has been successfully tested and analysed to look for any weaknesses and for future enhancement. The prototype is done with an effective cost suitable with all selected materials and design needs. Using this hybrid system is effective because the hybrid system consists of more than one source of solar panels and wave of the generator are coupled together in one system, compared to a single source. The hybrid system is suitable and can be used in many areas because it does not depend on a single source to support it.

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