

**STUDY ON THE IMPACT OF RENEWABLE ENERGY FOR  
RURAL DEVELOPMENT IN MALAYSIA**

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**STUDY ON THE IMPACT OF RENEWABLE  
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MALAYSIA**

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## ABSTRACT

Malaysia was blessed to fill with abundance of sustainable natural resources. Currently, Malaysia is highly dependence on conventional resources such as coal and natural gas in power generation. However, these resources emit high amount of Greenhouse Gases (GHG) into surrounding, affecting flora and fauna on Earth. These resources too experience depletion years by years and have to import by other country and the price to buy it is too expensive. To meet the energy demand of consumer within Malaysia without jeopardize mother nature, government had initiated a program by marking an aim to generate an energy based on eco-friendly and can be used for the long-term generation. Thus, introducing renewable energy is a best solution to overcome the crisis due to its potential as alternative sources to electrify urban and sub-urban areas. This research will study on estimating the effect that renewable energy could make to rural development, identify, quantify social and economic benefits from renewable energy by studying few case studies, and identify community awareness about implementation of renewable energy in Malaysia. The research was conducted by applying questioner survey to the people on the sites of the project. In addition, this research will analyze the perception and knowledge about these renewable energy resources and technology. To identify the social and economic opportunities in the community using renewable energy as alternative resources in Malaysia, the research will be focusing on both side of advantages and disadvantages on implementation renewable energy technology as an alternative resource other than conventional resources such as fossil fuels, oil, coal and natural gas and observing the outcome and contribution of renewable energy as new alternative energy towards the people in Malaysia.

Keywords: Greenhouse gases, Renewable energy, rural development, Malaysia

## ABSTRAK

Malaysia merupakan salah sebuah negara yang kaya dengan sumber semula jadi. Pada masa kini, Malaysia amat bergantung tinggi terhadap penggunaan sumber konvensional (arang batu dan gas asli) dalam penjanaan kuasa. Walau bagaimanapun, sumber-sumber ini melepaskan kadar Gas Rumah Hijau (GHG) yang tinggi ke udara yang memberi impak besar terhadap hidupan dan bukan hidupan dimuka Bumi ini. Sumber-sumber ini juga kini mengalami pengelesetan dari tahun ke tahun dan perlu diimport daripada negara lain. Demi memenuhi permintaan para pengguna di Malaysia tanpa menjejaskan alam semula jadi, kerajaan telah melaksanakan sebuah program dengan matlamat untuk menjana tenaga berasaskan tenaga hijau dan boleh digunakan untuk jangka masa panjang. Oleh yang demikian, memperkenalkan tenaga yang boleh diperbaharui merupakan jalan penyelesaian yang terbaik untuk mengatasi krisis tersebut. Hasilnya, penyelidikan ini akan mengkaji dan menganalisa kesan penggunaan tenaga boleh diperbaharui terhadap pembangunan luar bandar dan mengenal pasti dan mengukur kemanfaatan dari segi sosio dan ekonomi daripada tenaga boleh diperbaharui ini. Penyelidikan ini telah dilaksanakan dengan menggunakan hasil kaji soal selidik kepada masyarakat di tempat kajian tersebut. Selain itu, penyelidikan ini juga akan menganalisa pandangan dan pengetahuan masyarakat mengenai sumber dan teknologi tenaga boleh diperbaharui ini. Kajian ini akan memberi tumpuan kepada kedua-dua aspek dari segi kelebihan dan kekurangan mengenai pelaksanaan tenaga boleh diperbaharui sebagai sumber alternatif di Malaysia.

Kata Kunci: Gas rumah Hijau, Tenaga boleh diperbaharui, pembangunan luar bandar, Malaysia

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## LIST OF SYMBOLS AND ABBREVIATIONS

EKOMAR	Pusat Penyelidikan Ekosistem Marin
TNB	Tenaga Nasional Berhad
SEDA	Sustainable Energy Development Authority
EC	Energy Commission
RE	Renewable Energy
IEA	International Energy Agency
WHO	World Health Organization
SREP	Small Renewable Energy Program
GoM	Government of Malaysia
KeTTHA	Ministry of Energy, Green Technology and Water
LSSPV	Large Scale Solar Photovoltaic
LSS	Large Scale Solar
MBIPV	Malaysian Building Integrated Photovoltaic
UKM	Universiti Kebangsaan Malaysia
KTR	Kampung Tanjung Resang
KLIA	Kuala Lumpur International Airport
US	United States
USD	United States Dollar
LRT	Light Rail Transit
MRT	Mass Rapid Transit
SMART	Stormwater Management and Road Tunnel
PV	Photovoltaic
GHG	Greenhouse Gases
GDP	Gross Domestic Product
HDI	Human Development Index

FiT	Feed-in Tariff
NEM	Net Energy Metering
kW	Kilo-Watt
MW	Mega-Watt
GW	Giga-Watt
GWh	Giga-Watt hour
mtpa	Metric Tons Per Annum
mmscpd	Million Standard Cubic Feet Per Day

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## CHAPTER 1: INTRODUCTION

### 1.1 Introduction

Malaysia is truly blessed to be a country filled with natural resources due its strategic location. Currently, Malaysia is progressing towards becoming well develop in industrial area as well as an eco-environmental friendly country that generated power from renewable energy. Still, Malaysia is currently highly dependence on conventional energy resources as the main power generation (NEB, 2013). Unfortunately, these resources emit high amount of Greenhouse Gases (GHG) into surrounding. The consequences of emitting high amount of GHG can triggered in increasing the world's temperature (global warming) and thus lead to melting of iceberg (Antarctica), burning forest (United State, China, Australia) and cause major flooding at low areas and affecting human health (Moleshi, 2010). Due to the cause, government have initiated and currently setting an aim to generate an energy based on eco-friendly energy resources and thus making a country free from pollution. Sustainable energy can be classified are solar, wind, water, biomass, biogas, nuclear and geothermal. What benefits can be achieved from these energy is that it promising effect and consequences to living and non-living things. In term of power generation and economic factor, this energy production can be used for the long-term generation with providing low cost in maintenance. In conclusion, usage of renewable energy is the best resolve method since it's bring beneficial potential as an alternative source in electrify generation for urban and sub-urban areas. The aim of the research was to persuade and conduct ananalysis on the influences of renewable energy towards rural development in Malaysia.

This research will be focusing and analyzing from previous research paper that had been conducted based on the criteria of objectives. Previously, the research study was conducted by a group of researchers from Universiti Kebangsaan Malaysia (UKM). One of the researches was Prof. Dato' Dr. Kamaruzzaman Sopian where he was recognized as the pioneer in studying wind energy in Malaysia. They were focusing on outcome of utilizing renewable energy technology at Kampung Tanjung Resang located at Mersing, Johor. Another project was at EKOMAR area but also located within Kampung Tanjung Resang, Mersing, Johor. The resources are wind and solar energy.

In the beginning, the group study on installing wind turbine and years later, utilizing of wind-solar stand-alone hybrid at EKOMAR. Both case studies were conducted by conducting questioners survey regarding on reviewing community perception and acceptance of these renewable energy technology before and after installation. Lastly, the research will be focusing in both side of advantages and disadvantages on implementation renewable energy as an alternative source other than fossil fuels, oil, coal and natural gas and see how beneficial was bringing renewable energy as new alternative energy and how big will the contribution towards the people in Malaysia.

## **1.2 Problem Statement**

As Malaysia currently still in development into an industrial country, more power development will be required as to meet the power demand such as electricity in fulfilling consumer needs throughout the state in Malaysia. On top of that, fossil fuels resources in Malaysia had been occurred in depletion rate thus affecting the count level towards an extinction of resources if it is not being controls efficiently. Thus, renewable energy was introduced as fifth fuel energy under the policy of Five Fuel Diversification Policy established in 1999. The main concern now was how will the Malaysian's consumer willingness to accept the outcome result of renewable energy technology especially for consumer in rural development area (sub-urban). As the utilize and usage of renewable energy grew in Malaysia since initially introduced under 8th Malaysia Plan until know, some of the community or the consumer still having doubted in term of its reliability and the outcome of socio and economic towards the society especially in rural area hoping to give them an opportunity to less fortune people when compare to people living in urban area.

## **1.3 Objectives**

The objectives of the research are classified as below:

1. To estimate the effect that renewable energy could contribute to rural development in Malaysia.
2. To identify and quantify social and economic benefits from renewable energy in Malaysia.
3. To examine the contribution of renewable energy towards rural community.

## CHAPTER 2: LITERATUR REVIEW

### 2.1 Overview

Over the last thirty decades, Malaysia have become a nation that massively in development with outstanding landmarks such as the PETRONAS Twin Tower, Kuala Lumpur International Airport (KLIA), Light Rail Transit (LRT), SMART tunnel system and new Mass Rapid Transit (MRT) with much more to anticipate in the future (Energy Commission, 2017). The nation boasts large-scale buildings and infrastructures, expanding its real estate sector while providing ample job opportunities. High-rise buildings and housing sectors are also sprouting tremendously throughout Malaysia especially in Penang.

Malaysia currently owning as the 14th largest gas reserve and 27th biggest crude oil reserve globally. Malaysia are surely undoubtedly to be blessed with abundance of conventional, but also renewable energy sources. However, as representative of the global oil and natural gas suppliers, Malaysia is incessantly coping with huge domestic and international demands thus making the nation vulnerable to energy security issues. As of 2016, Peninsular Malaysia alone is dealing with an electricity demand of up to 82% from Malaysia's population of 31 million, with an average increment at a 1.8% rate annually (IEA,2016). Electricity generating capacity, on the other hand, is adequate with comfortable margin to meet demand.



## 2.2 Supply and Demand

Over the years, demanding of electricity has continued to growth rapidly in Malaysia. Estimation of total capacity establishment at present stands around 30 gigawatt (GW) in year 2016. Majority of highly heavily industrialize factory and population are located on Peninsular Malaysia especially the region of Selangor and Kuala Lumpur. The states of Sabah and Sarawak are highly powered up by hydropower and solar because of favorable geographical terrains and rain forest. Back in 2009, there's been an increment of 20.92% out of 74,583 ktoe from total major energy supply in Malaysia and it was recorded in 2015 achieved to 90,187 ktonne of oil equivalent (ktoe).

According to (Lip-Wah Ho, 2016), if Malaysia is really serious about utilizing renewable energy in its power generation mix, the study of grid connectivity and integration shall start immediately, especially for identified areas with high renewable energy potential. In addition, there must be coordinated efforts from the Ministry of Natural Resources and Environment in terms of fast and accurate EIA approval for renewable energy projects. On the other hand, the tax on coal implemented by India and the ROC used by the United Kingdom (UK) should be implemented to reflect the true environmental and socio cost of the fossil fuel power generation in Malaysia. Annual renewable energy targets must be set to drive and measure the renewable energy development effort properly. Finally, the renewable energy industry in the country could not be possibly developed without a sufficient pool of renewable energy expertise. Therefore, local talent must be nurtured and retained, coupled with the help of foreign experts and technology transfer to jump start the renewable energy industry in Malaysia. The development of renewable energy and its purpose relates very much to quality state education, something which Malaysia is still struggling with.

According to (Energy Commission, 2017) had stated that sudden and unusually high temperature occurred in between December 2015 to May 2016 caused a sudden surge in electricity demand due to attributed of El Nino phenomenon. Maximum peak demand was recorded on 20<sup>th</sup> April 2014 and the amount obtained was surpassing the initial target of 17,317MW. In 2014 also was recorded as the highest daily energy generation of 372 GWh against previous record of 355.8GWh. Total sales recorded for 2016 is 108.858 GWh compared to 104.653 GWh in 2015. Although Tenaga Nasional Berhad (TNB), Malaysia's state-owned power utility company has stated that the optimum margin for the Peninsula's grid system is between 20–25%, if the generation capacity does not increase, it is almost certain that a reserve margin crisis will occur soon. To meet the projected margin shortfall, an additional 6 GW of new generation capacity is anticipated to come online from 2015 to 2020.

### 2.3 Current Energy in Malaysia

Malaysia are essentially blessed with abundant generation of mix energy resources varying from conventional sources into renewable energy resources. Malaysia is located on the Equatorial line at coordinate of  $4.2105^{\circ}$  N,  $101.9758^{\circ}$  E located in Southeast Asia. The country consisting of thirteen states and three federal territories with the total landmass of 330,803 square kilometers (127,720 sq. mi). Malaysia is divided into Peninsular Malaysia and East Malaysia by the South China Sea forming two similarly sized regions. At Peninsular Malaysia side, the land shares with maritime Thailand border at the north and maritime Singapore border at the south while with Vietnam at the northeast, and Indonesia in the west side of Peninsular Malaysia. East Malaysia shares land and maritime borders with Brunei and Indonesia and a maritime border with the Philippines and Vietnam. The capital city of Malaysia known as Kuala Lumpur, while the seat for federal government located at Putrajaya. Malaysia is listed as the 44th most populous inhabitant country with the population of over 30 million people.

During the period of 1990 to 2016, more than 90% of electricity generated for Peninsular Malaysia majorly generated from conventional resources such as fossil fuel, coal and natural gas. In 2016 alone, coal resources provided up to 52% of the energy generation while gas contributed accounted 44%. But within period of 2014 to 2016, the gas consumption had been decreased as shown in Table 2.1 whereas coal consumption shows oppose from the gas consumption where the count increased year by year (2014-2016) as shown in Table 2.2 with each location of power plant. Thus, currently Malaysia was driven to crisis on fossil fuel depletion and affecting the development of the country. This will consequently push Malaysia to resort to importing fossil fuel at a marginally higher market price which comes with the hazard of purchasing energy resources in a volatile and foreign fuel market. Few expertise deduces a hypothesis

stated that the storage of natural gas could be demolished within 70 years and also expected the same as oil consumption about 16 years in Malaysia.

**Table 2.1: Gas consumption from 2014-2016**

<b>YEAR</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
AVERAGE DAILY (mmscfd)	1,290	1,218	1,125

**Table 2.2: Coal consumption from 2014-2016 (mtpa)**

<b>YEAR</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
KAPAR	3.5	3.7	4.1
MANJUNG	7.1	10.4	9.5
JIMAH	3.2	4.1	4.3
TANJUG BIN	4.9	6.5	7.6
TOTAL (mtpa)	18.7	24.6	25.4

The current existing power system in Malaysia are inefficient and reconsidered as non-environmentally friendly as it has tendency to emit high ratio of greenhouse gases (GHG). Thus, leading to climatic change, burning forest, melt down of iceberg in Antarctica, rises of sea level, major flood at low region and affecting to human health and caused ecological damages. There's been an estimation measurement of statistics by World Health Organization (WHO), stated that the impacts of climate change towards living mankind could led to the death of 160,000 people per year. Plus, the number of death may be presumed to be doubled by arriving of 2020. Thus, an action must be taken, and the consequences of climatic changing must be pay fully attention as the impact from it will jeopardizing the ecosystem. on Earth.

Malaysia and other country such as USA, China, Germany, Bangladesh and Iran had taken their initiative step in promoting and emphasizing the society to acknowledge the beneficial of using renewable energy as their new power generation resources rather than dependence much on conventional resources as well in overcoming too much of GHG emissions as well improvising power quality of power generation (Mizanur, 2016). Back in 2001, renewable energy was recognized and was placed under Fifth-Fuel policy by the Government officially. Solar Photovoltaic (PV), mini-hydro, wind, biomass, biogas, etc. are remarks as resources of renewable energy in Malaysia. The Small Renewable Energy Program (SREP) was promoted by the government, which a market driven platform is providing the private developers to build a power plant based on renewable energy resources with capacity less than 30 MW. Table 2.3 layout all renewable energy project that have been achieved commercial operation from 2012 to 2016. Power generated from renewable energy will be sell to the electricity generated utility company such as Tenaga Nasional Berhad (TNB). Back in April 2010, the Government had authorized National Renewable Energy Policy and Action Plan where renewable energy will be added to fuel mix with contribution of 2,000 MW by 2020. Occasionally, Feed-in-Tariff programmed was introduced.

**Table 2.3: Energy Generation from RE Projects that have Achieved Commercial Operation (2012-2016)**

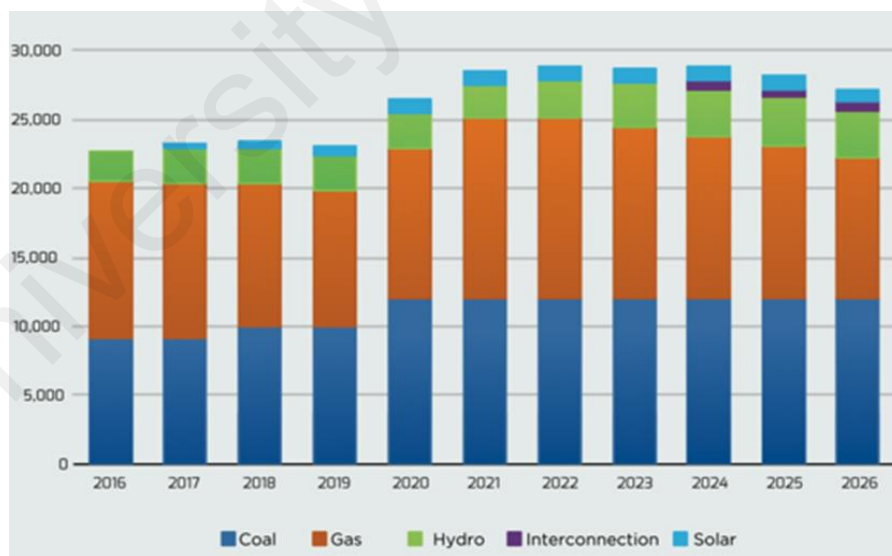
RENEWABLE ENERGY SOURCES	YEAR (MW)						PERCENTAGE OF TOTAL (%)
	2012	2013	2014	2015	2016	TOTAL	
BIOMASS	105.54	220.55	215.41	236.32	197.57	974.40	45.39
BIOGAS	4.71	51.51	184.79	258.21	232.39	731.61	34.08
SOLAR PHOTVOLTAIC	25.63	73.03	72.34	52.21	29.45	252.66	11.77
SMALL HYDRO	7.56	21.69	51.27	62.40	44.95	187.88	8.75
TOTAL	142.45	366.79	523.81	609.14	504.35	2,146.35	100.00

Energy import numbers have increased at a fast rate of 7.2% per year, to cope with growing energy demands of up to 5.8% per year according to the International Energy Agency (IEA). These issues expose a liability on an energy security front for the nation. Another challenge for the energy sector in achieving security in Malaysia's energy supply is to ensure power plants maintain the required reliability and efficiency levels. Apart from that, there is also the added task of increasing the use of renewable while ensuring competitive supply to consumers, the end-user through a reliable supply and affordable tariff.

Furthermore, Dependency on fossil fuels is expected to continue until renewable plus storage technologies can be commercially integrated into the system, with the Energy Commission continually monitoring its development and progress. The use of renewable is also encouraged through programmes such as FiT, Large Scale Solar (LSS) and Net Energy Metering (NEM). Currently, more than 20% of the total installed capacity in Malaysia is from renewable which is inclusive of off-grid installation and cogeneration.

**Table 2.4: Malaysia’s Electricity Generation Capacity, Demand and Reserve Margin**

	<b>GENERATION CAPACITY (MW)</b>	<b>PEAK DEMAND (MW)</b>	<b>RESERVE MARGIN (%)</b>
PENINSULAR MALAYSIA	22,919	17,788	29
SABAH	1,279	945	35
SARAWAK	4,126	3,040	36

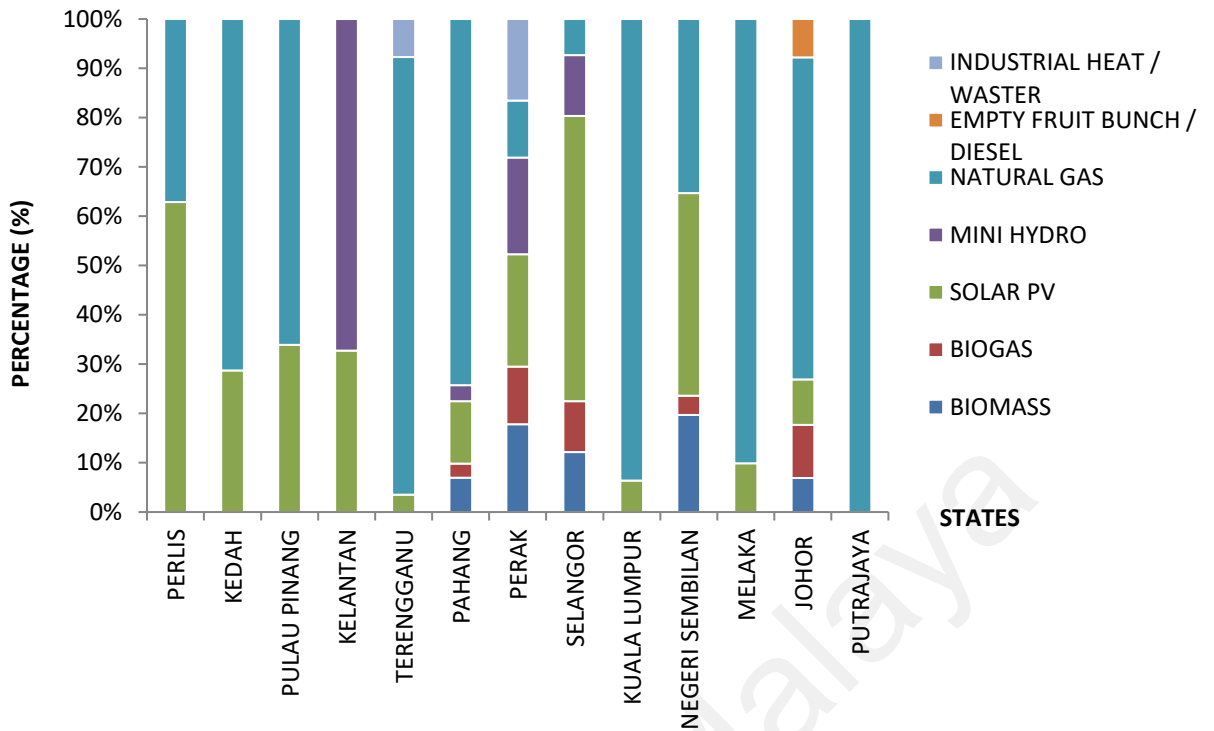


**Figure 2.1: Capacity mix in Peninsular Malaysia (Source: Energy commission, 2017)**

## **2.4 Existing Generation Capacity**

The predominant aim of current era is to generate energy that is based on eco-environmental friendly, where it either doesn't emit at all or emitted only in small amount of GHG. The global acknowledge and accepting renewable energy as resolving in preventing greenhouse emissions and acknowledge climatic factors while at the same time concerning the need of energy demand especially in urban communities, industry and sub-urban communities throughout the global. In present era, the largest share of world electricity generation is from combustion of coal and natural gas comes in second place. In Malaysia, the current main resources are from coal and natural gas. However, since the oil reserves estimated to last for another 18 years and 35 years for gas reserve, the Government of Malaysia (GoM) is making frantic action in exploiting the use of renewable energy as one of the main pillars in Malaysia's energy generation. Renewable energy was added as the fifth source of energy when the Four Fuel Diversification Policy was replaced with the Five Fuel diversification Policy in 2000. Renewable energy than again being enactment with more progressively under the Ninth Malaysia Plan (2006-2010).





**Figure 2.2: Summary of total power generated in Peninsular Malaysia**

A program known as FiT was established in allowing consumers to generate their own electricity and sell it back to utility companies such as TNB. A Feed-in Tariff is a policy or program created to increase investment in renewable energy sources in Malaysia. The program offers a long-term agreement up to 21 years and guaranteed to producers in return investment based on their pricing and generation costs of each technology they used. FiT scheme was established to encourage more individuals to generate their own electricity. Under this scheme, the generators will receive payback cash as promising as an amount for the renewable energy their system has produced depending on the rate set by Sustainable Energy Development Authority (SEDA).

According to (M. Ray, 2017), renewable energy offers a beneficial to people living in rural areas where it offers a promising job and environmental benefit. Taking an example of country who is modern with advance technology in this current era, United State of America (USA). America also experience the same situation as Malaysia where a country highly dependent on coals for power generation. Location with less populated regions are often dependent on natural resources such as coals as their main source of electrification. Unfortunately, the coal resources decrease over the past few years due to high demand of electricity by the community. Therefore, renewable energy offers to replace those industries and supply those jobs. Families in rural areas not only gain employment and job security, but also, they may receive reduced heating and electric bills and a boost to their local town's economy. The benefits of renewable energy that can help revitalize and renew rural America can be divided into two sections; the environment and the local economy.

In term of environment beneficial, solar and wind, the two most common choices for business and residences in America, produces almost zero global warming emissions and does not cause water resources or drinking water to be polluted. Use of renewable energy for electricity and heating helps to lower the US's global warming emissions. Right now, electricity releases a third of the country's global warming emissions. Coal-powered sources provide 25% of those electricity emissions. If the US generated 80% of its electricity from renewable sources like wind or solar, it reduces its emission by more than 80%. Rural areas are ideal locations to begin that large-scale energy production because they offer wide spaces of open land that could be used for energy farms while maintaining the global deployment of renewable energy has been expanding rapidly.

## **2.5 Malaysia Diversify Policy**

The Malaysian fuel diversification policy is reviewed on a regular basis to avoid dependency on a single source of energy. Renewable energy was initially get recognition when was listed under the Five-Fuel Diversification back in 1999. With the aim in encouraging consumer in implementing renewable resources such as biomass, solar and mini-hydroelectric stations to generate electricity was allocated under the 8th Malaysia Plan (2001–2005) with an aim to achieve energy generation of 5%. Other than that, another program was launched by the government to bring out investing in small power generation for the private sector. The program was called Small Renewable Energy Power (SREP). Table 2.5 reviewed all the establishment policy the government in promoting and enhancing usage of renewable energy resources in Malaysia.

**Table 2.5: List of policy in Malaysia**

<b>YEAR</b>	<b>POLICY AND ACTS</b>	<b>KEY FEATURES</b>
1974	PETROLEUM DEVELOPEMNT ACT	To provide for the establishment and regulations towards exploration and exploitation of national petroleum resources by a national corporation (PETRONAS) including its role, rights and exclusivity for all related activities
1975	NATIONAL PETROLEUM POLICY	Regulating the oil and gas industry to ensure adequate supply at reasonable prices to support national economic development objectives, with ethical stewardship of national resources
1979	NATIONAL ENERGY POLICY	To ensure adequate, secure, cost-effective and efficient utilization of energy from conventional and renewable resources
1980	NATIONAL DEPLETION POLICY	Regulation of national oil reserves to prevent over exploitation due to increased production capacity
1981	FOUR FUEL DIVERSIFICATION POLICY	Complementing the 1980 National Depletion Policy about preventing over reliance on oil as a main energy source. Diversification of energy mix to include gas, hydropower and coal.
1990	ELECTRICITY SUPPLY ACT	Regulation of the electrical supply industry to ensure adequate supply at reasonable prices, installation, licensing, infrastructure, safety and efficient utilization of electricity.
1993	GAS SUPPLY ACT	Safeguarding the interest of residential and commercial users of supplied gas concerning adequate supply at reasonable prices, installation, licensing, infrastructure, and safety.
1999	FIVE FUEL DIVERSIFICATION POLICY	To supplement National Energy Policy 1979 by diversifying the energy mix to include renewable energy on top of oil, gas, coal, and hydroelectric energy.
2001	ENERGY COMMISSION ACT	To provide for the establishment of the Energy Commission with powers to regulate energy supply activities and to implement the energy supply laws, as well as promoting renewable energy and conservation of non-renewable energy.
2005	NATIONAL BIOFUEL POLICY	Promoting the use of biofuels through incentives, as well as making available 5% diesel and 5% palm olein biodiesel blend.
2009	NATIONAL RENEWABLE ENERGY POLICY AND ACTION PLAN	Promotion and diversification of energy mix through utilization of indigenous renewable resources to achieve electrical supply security and sustainable socio-economic development.
2011	RENEWABLE ENERGY ACT	Allocation for the establishment of a special tariff system to promote the generation of renewable energy and funding for its related activities.

By the year of 2005, the program was a total failure where the program unable to meet the target as mention in Eight Malaysia Plan. Only 0.3% was accounted from the overall generation of electricity, far from beyond the target as mentioned in 8<sup>th</sup> Malaysia Plan. This may priory due to reasonable fuel price and low amount in financing by private sector. During the ninth Malaysia Plan, government decided to establish an advance policy known as Ministry of Energy, Green Technology and Water (KeTTHA). This action driven the government in promoting greater employment of greener technology in Malaysia. In 2009, Federal Government had launched another action plan known as National Renewable Energy Policy and Action. All five main objectives are listed as following:

1. To alleviate the development of renewable energy industry
2. To alleviate partaker of renewable energy in national power generation mix.
3. To ensure sensible in financial cost of renewable energy,
4. To economize the environment for future generation
5. To enhance orientation on the role and significant of renewable energy.

Under the Eleventh Malaysia Plan (2016-2020), green growth will be a fundamental shifting towards greener technologies. There are four main focuses areas on green growth. Within this five years, government will be focusing on strengthening and promoting more on sustainable consumption and production, conserving natural resources from extinction and lastly, strengthening resilience against climatic changes and mitigate natural disasters. An overview of the focus areas and their associated strategies are listed as below:

1. Strengthening the enabling environment from greener growth:
  - strengthening governance for driven transformation
  - enhancing people awareness
  - establishing sustainable in financial mechanism
  
2. Adopting the sustainable consumption and production concept:
  - implement greener markets
  - increasing share of renewable energy in energy mix
  - improvise the demand of side management
  - promoting low carbon mobility waste holistically
  
3. Conserving natural resources for current and future generations:
  - ensuring natural resources security
  - enhancing alternative livelihood for indigenous and local communities
  
4. Strengthening resilience against climatic change and natural disasters
  - strengthening disaster risk management
  - improving flood mitigation
  - enhancing climatic change adoption

## 2.6 Renewable Energy Initiatives

Ministry of Energy, Green Technology and Water (KeTTHA) was appointed legitimate sector for all things that related to energy including implementation, provision, evolution, research, services, enactment and stability of the organization ongoing basis. All the capabilities of renewable energy sources installation in Malaysia are summarized in Table 2.6. Places that have access to long and drift rivers are encourage in development of hydropower facilities. Since Malaysia is located at the equator and provides suffice sunlight throughout the year proven that solar energy is the best option as a renewable energy source. Furthermore, biomass also prove it capable to be one of the renewable energy resource in providing electricity and fuel since Malaysia is one of the biggest palm oil exporter in global. However, with the Five-Fuel Policy, the government is looking forward in broadening sustainable clean fuel energy to maximize available of natural resources.

**Table 2.6: Potential of RE in Malaysia**  
(Sources: Malaysia Energy Centre's National Energy Balance).

<b>RENEWABLE ENERGY</b>	<b>POTENTIAL (MW)</b>
MINI-HYDRO	500
BIOMASS/ BIOGAS (OIL PALM MILL WASTE)	1,300
MUNICIPAL SOLID WASTE	400
SOLAR PV	6,500
WIND	Averagely low speed

### 2.6.1 Small Scale Hydropower

Small-scale hydroelectric dams are more convenient when comparing to large-scale size. The installation of the dams is cheap and generate low cost of electricity. Plus, the dams are free maintenance and can be implement for long duration of time. In addition, small-scale hydroelectric does not caused major impact to the surrounding due to smaller dam's size and required little space to build it. Thus, the dams don't affect much on the surrounding. Fortunately, the dams only have capability to generate power up to 10 GW only. About 26 applications was approved under SREP. Most of these projects are highly implemented and located in the midlands regions of the Sabah and Sarawak because of geographical terrains and long fast river flow. The majority part of Sabah and Sarawak are inhabitants populated and are off-grids connectivity. Small-scale hydropower's installation brought upon an impact and major contribution to Malaysia especially to communities that are located beyond established grid lines.

**Table 2.7: Installed capacity of Mini-Hydro Power Stations in Malaysia**

STATE		INSTALLED CAPACITY (MW)
PENINSULAR MALAYSIA	KEDAH	1.556
	PERAK	3.207
	TERENGGANU	1.936
	KELANTAN	3.158
	PAHANG	3.504
	SUB TOTAL	13.361
EAST MALAYSIA	SABAH	8.335
	SARAWAK	7.297
TOTAL		28.993



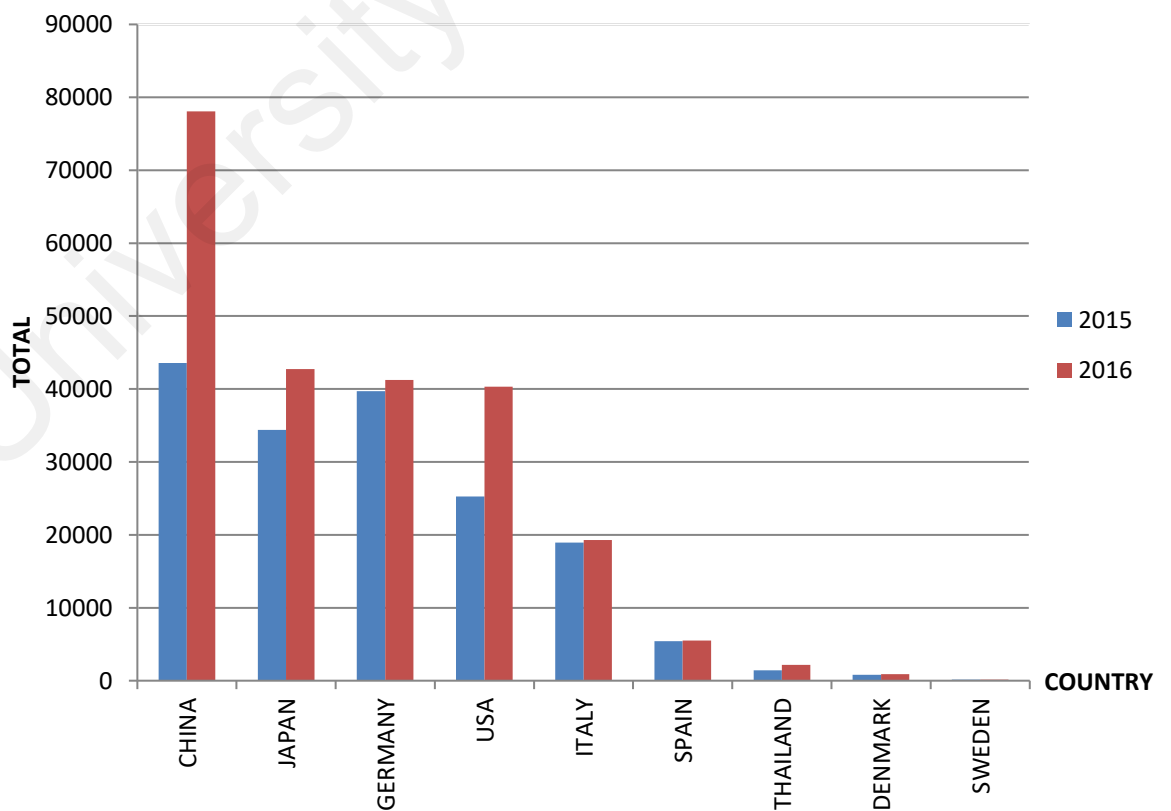
### 2.6.2 Solar

Malaysia received abundance of sunlight on daylight since the location was strategic and located on equatorial of Earth. Malaysia received range from 400–600MJ/m<sup>2</sup> averagely per month. This huge amount of number displayed huge opportunity in establishing of large-scale solar power (LSSPV) plants. In the earlier years, solar originally used for water heating in residence and usually placed on the roof top. Earlier effort by the government to promote the use of solar energy, which was deemed successful, came from the Malaysian Building Integrated Photovoltaic (MBIPV). Solar power is a major beneficiary from this scheme as solar PV's are easy to install and free-low maintenance cost.

In between 2011 and 2016, FiT scheme was brought down the growing demand with overall cost of the PV system by 23% from RM9000 per kW (USD2093 per kW) to RM6900 per kW (USD1605 per kW). Solar PV annual installed capacities from 2012 to 2016 were 31.56 MW, 105.96 MW, 64.91 MW, 60.25 MW and 68.55 MW and its share in the renewable energy installed capacity mix has been above than 66% since 2013. As of April 2017, solar PV generating capacity from the FiT scheme stood at 314MW. All these are about to increase substantially after the government introduced the implementation of LSSPV farms, targeting to add 200 MW capacity every year starting from 2017 to 2020.

**Table 2.8: Irradiance (Yearly Average Value) by towns in Malaysia**

TOWNS IN MALAYSIA	KWh/m <sup>2</sup>
KUCHING	1470
BANDAR BARU BANGI	1487
PETALING JAYA	1571
KUALA LUMPUR	1571
SEREMBAN	1572
KUANTAN	1601
JOHOR BHARU	1625
KUALA TERENGGANU	1705
IPOH	1714
TAIPING	1739
KOTA KINABALU	1900
BAYAN LEPAS	1809
GEORGE TOWN	1785



**Figure 2.3: Growth Trends in PV**

### 2.6.3 Wind

Wind energy is not fully yet to play a significant role in energy production in Malaysia. When comparing back to 1999 until 2017, there's limitation research study on wind energy compared to other resources such as PV and hydropower plant. This may be possible due to Malaysia still lack expertise and knowledge skills in this energy and it required some time to obtain and analyze the wind data of the location. However, the present study tends to disagree with the magnitude of power densities obtained for most locations in the work. Many other parameters such as capacity factor, and production cost of energy, will not considered in the work. (Islam et al.,2006) estimated the wind energy potential at two sites located in the East Malaysia with three-year (2006–2008) wind speed data, using the standard air density at the sea level – 1.225 kg/m<sup>3</sup>.

However, it found in this study that the actual value for this parameter based on the Malaysia weather data is 1.17 kg/m<sup>3</sup>. This would obviously influence the accuracy of the obtained results. Similarly, (Zaharim et al., 2012) evaluated the two-year data obtained from a university for Kuala Terengganu database. In another study by (Exell and Fook, 2003), 20 locations across West and East Malaysia were investigated to study assibilate the wind power potential in Malaysia. Study found that the density changes from less than 100 W/m<sup>2</sup> to greater than 300 W/m<sup>2</sup> when placing the pole 600 meters above the ground level.

Last but not the least, (Sung, 2008) had collected 20-year wind speed data (1989–2008) for 15 towns covering West and East Malaysia. Using a lay man approach, he attempted to roughly estimate the amount of electricity Malaysia could generate from wind energy. However, the approach used in the work is not technically professional, as it is devoid of a thorough data analysis. Due to this reason, the results obtained unqualified to be accurate and reliable.

## CHAPTER 3: METHODOLOGY

### 3.1 Introduction

To understand more the outcome contribution of renewable energy towards Malaysia rural society, reviewing past researchs will be conducted to understand, explained and elaborated the results of utilizing renewable technology in term of social and economic at the applied location. In this research, two case studies will be used as reference in analyzing the result obtained by past researchers regarding and based on this research's objectives. Both of the case study was conducted by group of researchers from Universiti Kebangsaan Malaysia (UKM) located at Bangi, Selangor. Within these researchers, Prof Dato' Dr Kamaruzzaman Sopian was well known as among pioneer researches to study wind energy in Malaysia. Both of research study from the past was taken place at Kampung Tanjung Resang located in Mersing, Johor. The case will be focusing on Kampung Tanjung Resang as well as EKOMAR community perception and acceptance on installation of renewable energy technology in conjugating the government effort to promote and improve community life support such as electricity utility. Wind turbine will be the focus of this study from both past researcher study. Wind regime of the location was affected by the land and sea breezes and the wind speed varies from time to time and having difficulty in obtaining the result for the abbreviated period. Malaysia has high glance of chance in implementing wind energy technology as alternative electrification sources to rural area or urban community.

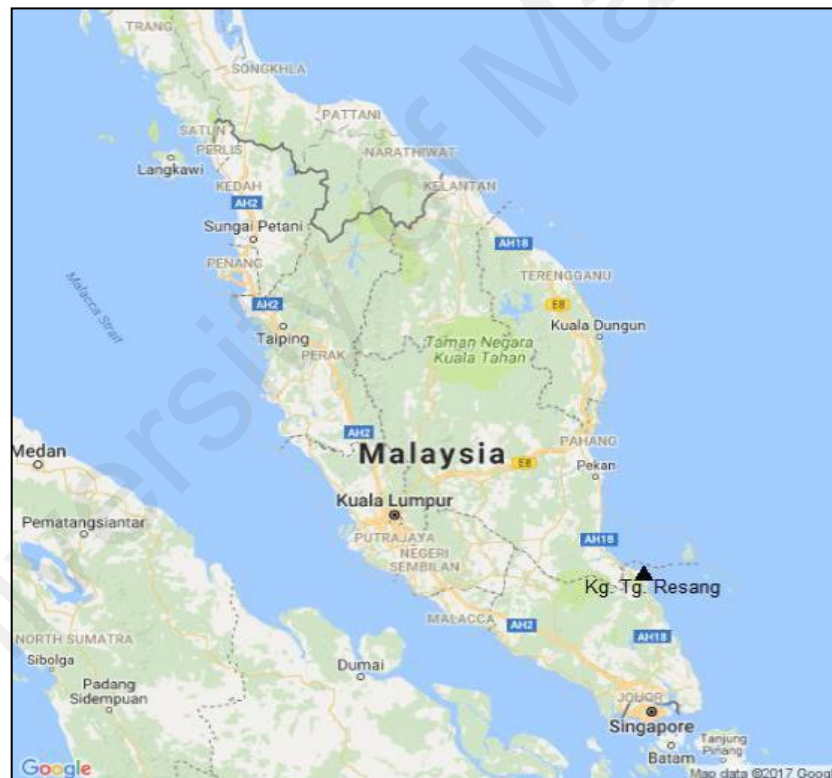
### 3.2 Method of study

A simple survey questioner was created based on the past study to determine the factor that contribute to the impact of renewable energy to the people in rural area:

- a) **Case 1:** Qualitative method through survey sampling non-directive interviews was done to obtain and gather information about the villager's perception on installing wind turbine as their new reliable source of electricity. The questions consisting seven factors in evaluating community perception towards wind turbine. The seven elements were knowledge and acceptance, visibility, life quality, socio and economic, environmental issues, pro-existence of wind turbine and pollution.
- b) **Case 2:** Qualitative method through questioner survey sampling was conducted. in determining community perception before and after utilization of the system. The survey was conducted by taken number of survey before and after the utilizing of wind-solar stand-alone hybrid system in EKOMAR. The question was asked based on the knowledge of the community on renewable energy availability, installation and the consequences once the utilizing is complete. In addition, the affect of the system towards the environment and scenery will be asked.

### 3.3 Case 1: Installation of Wind Turbine

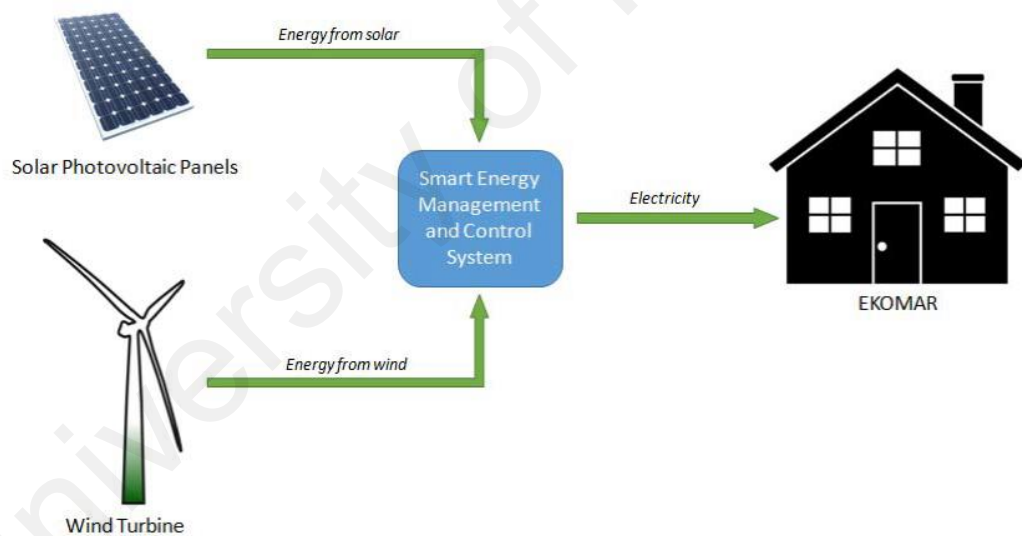
Currently, the community in Mersing are supplied by grid power source which was supplied by Tenaga Nasional Berhad (TNB). Since it was located near the sea, Mersing are potential enough to develop wind turbine due to its location which filled with abundant and consistent wind speed throughout the year. To initiate the project, Solar Energy Research Institute (SERI) and Universiti Kebangsaan Malaysia (UKM) has developed wind turbine in Kampung Tanjung Resang, Mersing, Johor. The study presents the acceptance and impact of wind energy of the people of Kampung Tanjung Resang.



**Figure 3.1: The equilateral triangle marks indicates the location of Kampung Tanjung Resang.**

### 3.4 Case 2: Utilizing of Wind-Solar Stand-Alone Hybrid System

This study was established in investigates the rural public acceptance on stand-alone Renewable Energy project for the utilization of the Pusat Penyelidikan Ekosistem Marin (EKOMAR), which is located at Kampung Tanjung Resang, Mersing. This study was mainly focused on people perception in rural areas about their knowledge, attitude, acceptance and important of renewable energy technology. In this project, the hybrid renewable energy generation system consists of 3kW solar photovoltaic (PV) panels and 2kW wind turbine as shown in Figure 3.2. Overall mission of the project will underline a smart, energy saving measures and economic benefits with improved socio-economic values for a nano-grid standalone 5kW hybrid wind-PV turbine system.



**Figure 3.2: The illustration of a hybrid wind-solar renewable energy generation system at EKOMAR.**

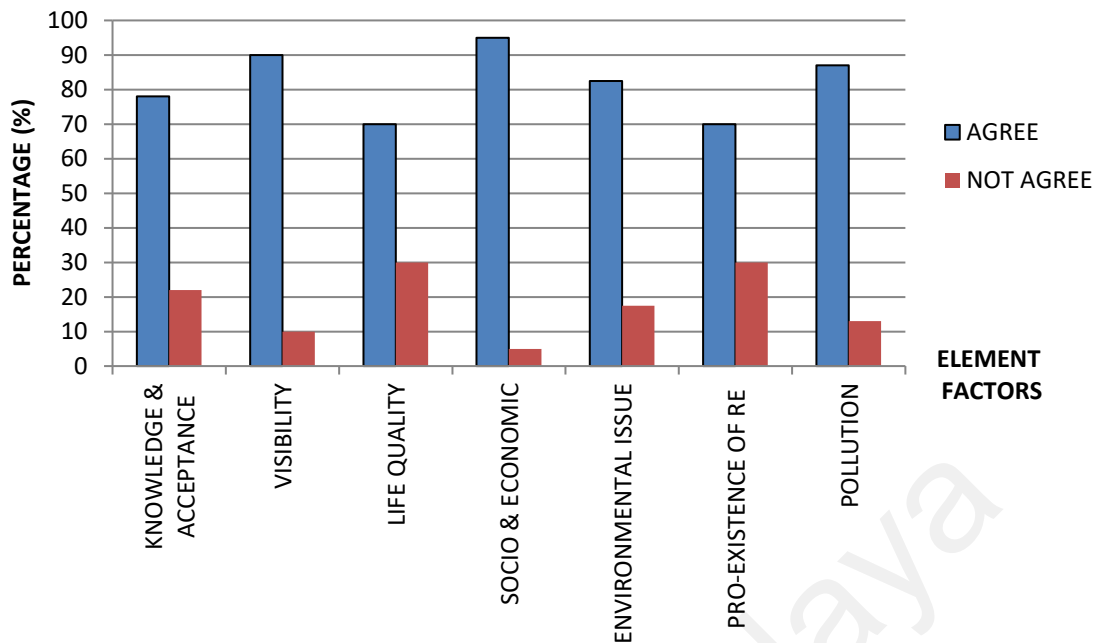
## CHAPTER 4: RESULTS AND DISCUSSIONS

### 4.1 Introduction of Case 1

Back in November 2016, a survey questioner was conducted by the researchers from UKM to investigate the community's perception regarding on installing wind turbine located at Kampung Tanjung Resang, Mersing, Johor. The survey questioner is based on the seven impacts; knowledge and acceptance, visibility, life quality, socio and economic, environmental issue, pro-existence of Wind Turbine and pollution. Reviewing these seven impacts, installing wind turbine do bring strong impact towards Kampung Tanjung Resang community.

A simple questioner survey was created based on past study in order to determine the factors that contribute the impact of renewable energy towards the people resident in rural area. The survey was mainly focused on the outcome installation of wind turbine located on the onshore of Kampung Tanjung Resang. This onshore wind farm is important due to its consistency of wind flow due to its location near the pond cost of Johor sea facing South China Sea region. Once the survey was conducted, the researches re-examined the survey and evaluated the result onto “agree” and “disagree” section. The result obtained from the survey was summarize as shown in Figure 4.1





**Figure 4.1: Summary of survey conducted at Kampung Tanjung Resang**

#### **4.1.1 Knowledge and Acceptance**

For starters, their knowledge on renewable energy had grown and expanded at least knowing and understand the basic skill on how the turbine operated, assembling the part and maintaining the operation once they were briefed and explained by the researches. Nevertheless, these people still lack expertise and consulting currently. Result in Figure 4.1 indicated high percentage of the respondent to be agreed that knowledge plays major role in renewable energy as well as installation of wind turbine. Education helps to enhance people awareness regarding on the beneficial of renewable energy technology towards the outcome their life. Once they understand the outcome of the renewable energy, they will accept the renewable energy as their alternative generating power sources. From Figure 4.1, overall of the survey found that 78% of respondent accept the presence of wind turbine in Kampung Tanjung Resang as well their knowledge in term of the theory, installation and maintenance of the wind turbine operations.

#### **4.1.2 Visibility**

Visibility indicate the presence of wind turbine affected the scenery and environment at Kampung Tanjung Resang. Within the questioner survey, the question was asked regarding on visibility sight of wind turbine at the Kampung Tanjung Resang. From the Figure 4.1 shows that 90% of respondent agree that wind turbine does not affecting the environment as well the sight of the community nor the people living close to the turbine. On the other side of visibility outcome stated that some respondent commented that wind turbine do creates disturbing noises.

#### **4.1.3 Life Quality**

The development of wind technology may give positive changes towards the people of Kampung Tanjung Resang hoping to improvise a better quality of life. About 70% of the respondent agree that installation of wind turbine also helping them by minimum their cost expenditure in electricity bill. However, they are agreed that the wind turbine can be attractive in term of new scenery since Mersing is very strong with tourism. This impact could be advantages to attract more tourist and increase more community income. Other than that, respondent agree with the statement that the wind technology had capability to improve their quality of life even further.

#### **4.1.4 Socio and Economic**

Judging from the result obtained in Figure 4.1, 90% of respondent significantly indicated that wind turbine contributed positive economic and social towards the community as well as the village of Kampung Tanjung Resang. Since the village is reconsidered as one of the top tourism location in Malaysia due to be the port departure to other beautiful island, respondent agree that wind turbine do create an attractive features and capability to attract more tourist and thus adding more attractive sight for tourism purposes. Thus, enchanting the local tourist industry. This will promote the tourist to come and visit the place with new scenery sight.

#### **4.1.5 Environmental Issue**

Within the questioner, question was asked whether installation of wind turbines do helps in reducing oil dependency as well as reduction of releasing harmful gases. Respondent respond with 82.5% agree wind turbine could help in reducing dependency of oil as their energy resources. If the dependency of oil decrease, it will consequently reduce the releasing of harmful gases from oil. The project conducted the fellow researches really helps overcoming environmental issue.

#### **4.1.6 Pro-existence of Wind Turbine**

Another impact of wind turbine is the sensitivity of the people toward the change of development. The community of Kampung Tanjung Resang unaware the existence of wind turbine until it fully operated once the installation is completed. About 70% respondent agree that they aware the project during the fully operation of wind turbine while only small percentage of respondent aware and knew the construction of wind turbine.

#### **4.1.7 Pollution**

Presence of wind turbine may slightly affect the environment of Kampung Tanjung Resang. The project concerning on the location and sight effect towards the community. From the Figure 4.1, 87% of respondent agree that wind turbine does not affect the pollution at Kampung Tanjung Resang. Within the disagree 23% respondent stated that the wind turbine is displeasing them due to its visibility and the noise disturbance from wind turbine for the respondent stay near the wind turbine. Unfortunately, not everyone within the community agreed 100% on pollution. Almost everyone agreed that wind turbine generate a loud sound causing disturbance and making the people living near the turbine to be uncomfortable. For overall impact of wind technology, the community reviewing the project with positive feedback although the sound created may cause disturbance.

## **4.2 Introduction of Case 2**

Another project was conducted also at the same location where it was mainly about in rural public acceptance on hybrid wind-PV turbine system project for the utilization of Pusat Penyelidikan Ekosistem Marin (EKOMAR). The project initiate at middle of December 2016 and finally completed at the end of January 2017. This project was conducted two questioner surveys, before and after the installation of wind-solar hybrid renewable energy. From the result obtained from the survey, majority of the respondents were aware with the implementation of wind and solar at EKOMAR.

First survey was conducted on the middle of November 2016 while the second survey was carried out at the end of January 2017. The first survey was carries out before the installation process of the hybrid technology generation system at EKOMAR, which approximately installed at the early of December 2016. Direct interview was applied to the respondents with each question given in detailed of explanations by the interviewers. The questioners began with the question asked based on respondents; gender, age, education level, ethnic group and residency status.

#### 4.2.1 Demographic Profile of the Respondent

The distribution of demographic profile of the respondent for the first and second survey listed in Table 4.1:

**Table 4.1: Demographic profile of the respondents**

VARIABLES	OPTIONS	FIRST SURVEY		SECOND SURVEY	
		COUNT	PERCENTAGE (%)	COUNT	PERCENTAGE (%)
GENDER	FEMALE	36	56.3	45	56.3
	MALE	28	43.7	35	43.7
AGE	15-25	12	18.8	13	16.3
	26-40	19	29.7	30	37.5
	41-60	23	35.9	31	38.7
	60>	10	15.6	6	7.5
ETHNIC	MALAY	64	100	80	100
	CHINESE	0	0	0	0
	INDIANS	0	0	0	0
	OTHERS	0	0	0	0
EDUCATION	JUNIOR MIDDLE SCHOOL OR BELOW	28	43.8	40	50.0
	SENIOR MIDDLE SCHOOL	32	50	28	35.0
	DIPLOMA OR EQUIVALENT	2	3.1	11	13.7
	DEGREE OR ABOVE	2	3.1	1	1.3
RESIDENCY STATUS	LOCALS	52	81.2	75	93.7
	NON-LOCALS	12	18.8	5	6.3

#### 4.2.2 Data Analysis for First Survey

Result obtained from first questioner survey was summaries as shown in Figure 4.2. About 54.7% of respondents were aware and knowledgeable about the renewable energy such as wind and solar energy, while the remaining 45.3% of them remains unaware. However, with the explanation provided by fellow interviewers about renewable energy technologies, 89.1% of respondents agreed that renewable energy technologies such as wind and solar energy can give benefit to human life. The result from respondent indicates that the residents at Kampung Tanjung Resang might have high tendency to welcome the renewable energy technologies.

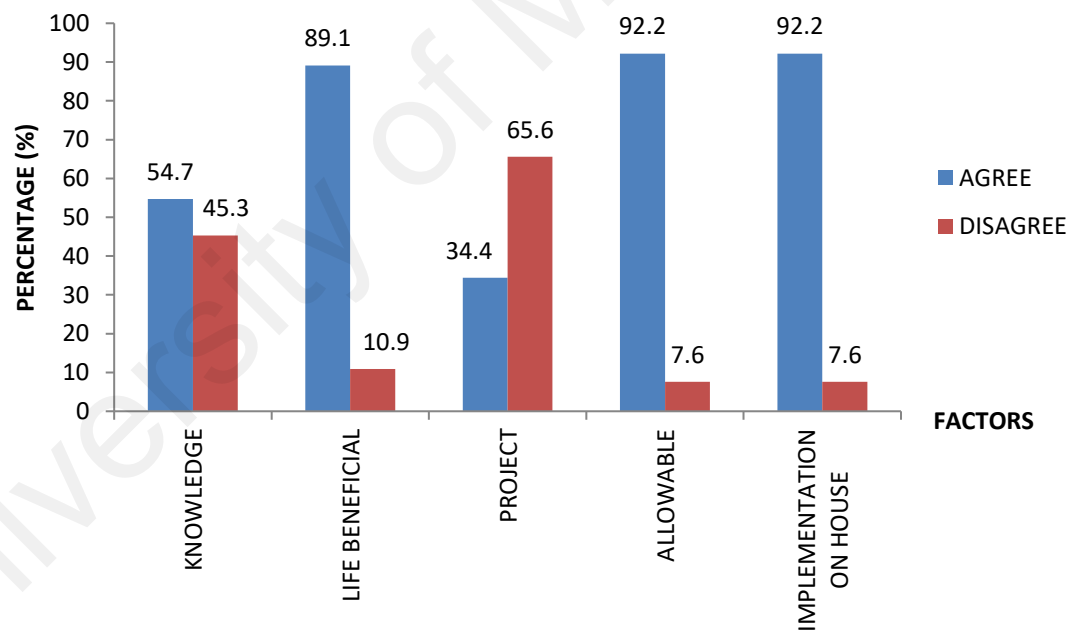
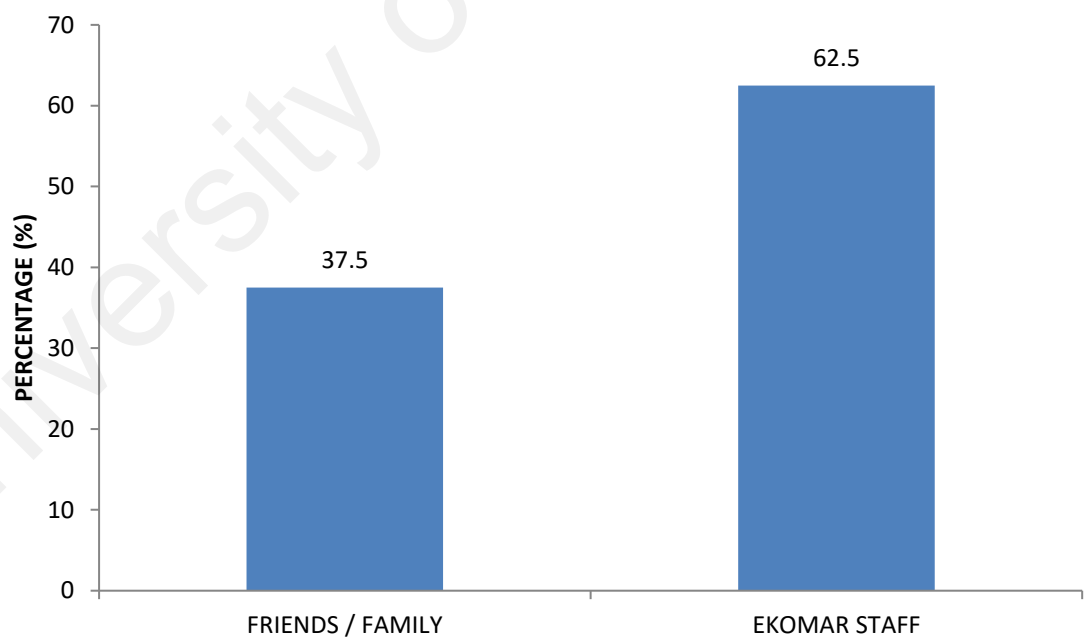


Figure 4.2: Result from First Survey

By attaining information either from the staff or relative or neighbor, this indicates that most of them do not know about the renewable energy project even though the headman of Kampung Tanjung Resang had made an announcement in village committee member meeting. However, this result was as expected by the authors, as the project has not started yet at EKOMAR. In the questioner survey, the respondent was asked whether they knew or aware the project of utilizing solar-wind hybrid system was conducted at EKOMAR. From the result obtained, about 34.4% knew about the project while 65.6% of respondent were unaware. Within 34.4% of respondent, about slightly 37.5% respondent knew about this project where the information was obtained from friends or family members while as for other 62.5% among of them knew via EKOMAR staff as shown in Figure 4.3.



**Figure 4.3: Percentage of Kampung Tanjung Resang Awareness on Hybrid System Utilizing in EKOMAR**

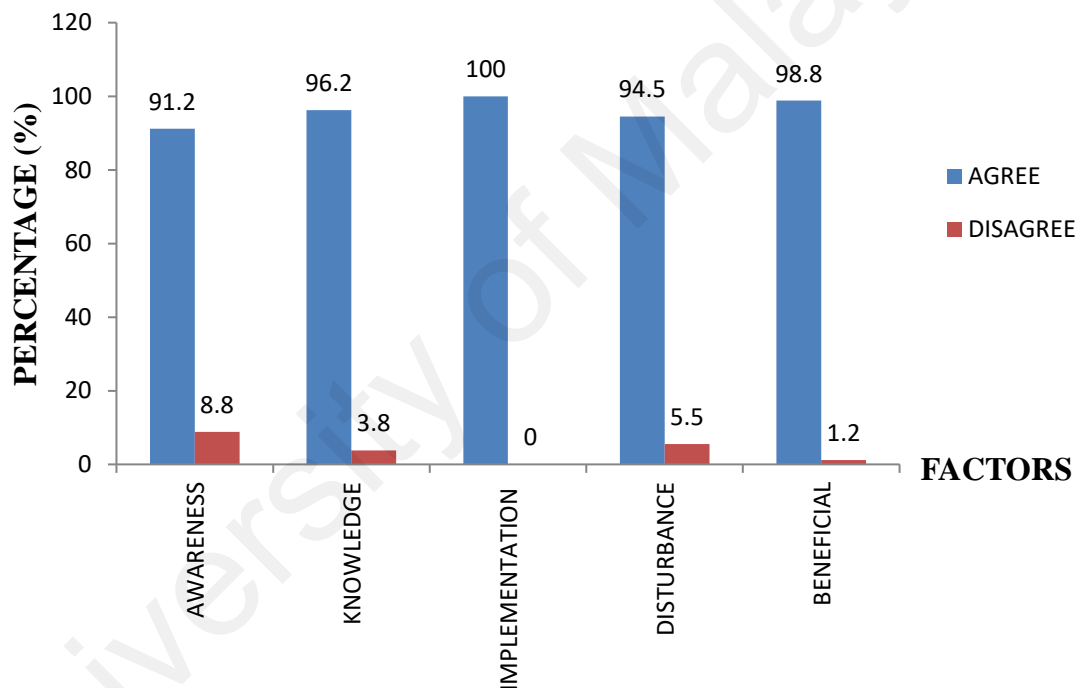


Apart from that, survey shows that 92.2% of respondent that Mersing is suitable area to develop wind and solar energy due to its location near to the South China Sea for wind and daily due to ambient temperature and average humidity for solar implementation. Another questioner was asked in determine their opinion regarding on implementation of wind and solar energy at their house. For this question, respondent of 92.2% responded agree in willingness to implement both wind and energy on their house in electricity generation. Overall, in the first survey, the residents of Kampung Tanjung Resang show a positive response toward the acceptance on renewable energy such as wind and solar.

#### **4.1 Data Analysis for Second Survey**

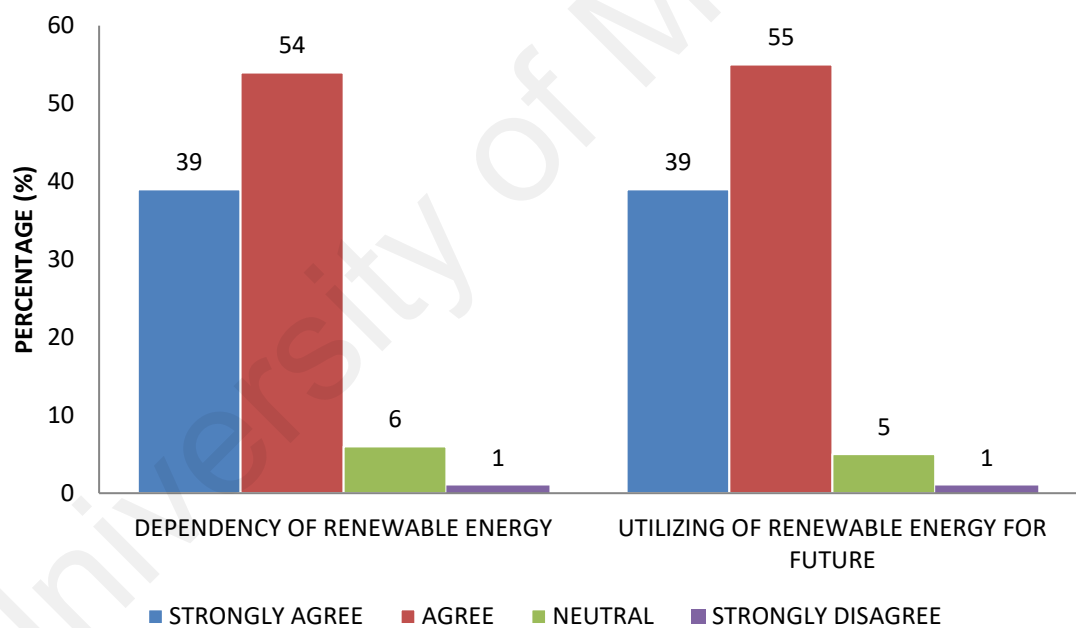
In second survey, about 91.2% almost majority of the respondents were aware with the implementation of wind and solar energy at EKOMAR while with balance of 8.8% respondent were unaware about the implementation of renewable energy project as shown in Figure 4.4. Result show that everyone of the respondent agree with the implementation renewable energy technologies at EKOMAR. Moreover, among those who aware with the implementation of wind and solar energy at EKOMAR, 94.5% of them agreed that wind turbine and solar panels installation did not interfere with their views. Based on Figure 4.4, almost all respondents (96.2%) are knowledgeable about renewable energy technologies especially in wind and solar energy once the implementation started at EKOMAR.

The result from second survey shows that almost half of them unfamiliar with renewable energy due to not attained higher education. This is proved the facts that people with higher education plays a critical role in increasing the awareness, knowledge, skills and values to create a sustainable future. As mentioned by (Stephens *et al.*, 2012), the higher education has the potential to be a change agent in accelerating society's transition toward sustainability. This might be because they realized, it is essential to receive proper education in order to understand some significant concept as most of them did not attained higher education.



**Figure 4.4: Result from Second Survey**

Regarding the importance for a community to rely on renewable energy technologies, results shows in Figure 4.5 that approximately 39.0% of respondents strongly agreed, 54.0% agreed, 6.0% neutral and 1.0% strongly disagreed with the statement. This might be due to the explanation from the interviewers which explaining to the respondent that the existing fossil-based energy will be totally exhausted eventually as the demand increasing every year. As a result, approximately 39.0% of respondents strongly agreed, 55.0% agreed, 5.0% neutral and only 1.0% strongly disagreed in utilizing renewable energy as alternative for the future. In the end, majority of the respondent agreed that utilization of renewable energy will provide a sustainable energy production in future and with promising benefit.

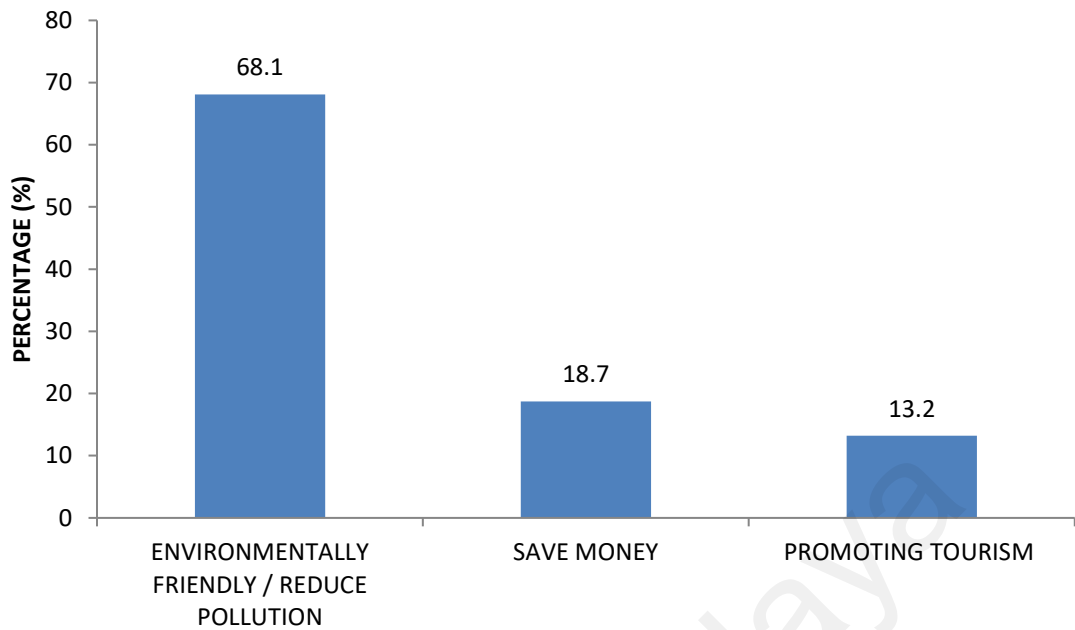


**Figure 4.5: Beneficial of Renewable Energy Based on Consumer Review**

Another part of the questioner survey consisting question regarding on the advantages of renewable energy technologies applied at Kampung Tanjung Resang. Based on Figure 4.6, most of the respondents agreed that renewable energy technologies are reconsidered as environmental friendly and reducing pollution receiving respondent about 68.1%. This shows that the people are generally aware of the difference between fossil fuels and renewable energy significantly. The respondents also agreed with the term of "save money" from the utilization of renewable energy technologies with receiving vote of 18.7%

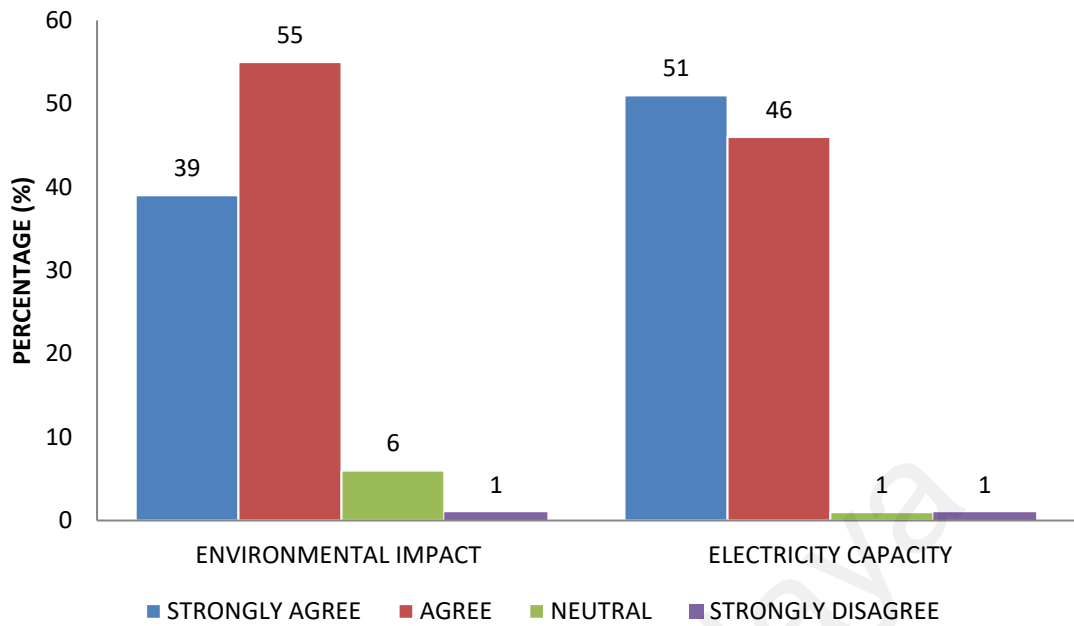
Some of the respondents believed by utilizing renewable energy they can save their money from the payment of monthly electricity bill. This might be because, the residents of Kampung Tanjung Resang have relatively low monthly income to pay electricity bill as most of poor people in Malaysia live in the rural areas. The remaining 13.2% vote shows the respondents agreed renewable energy technologies can act as catalyst in "promoting tourism". As mentioned earlier, Kampung Tanjung Resang has a beautiful beach facing the South China Sea. Hence, by implementing the renewable energy technologies, some of the residents think it may promote Kampung Tanjung Resang as attractive tourist destination.

Result from Figure 4.6 found that majority of the respondents agreed with the suggestion regarding as Mersing is one of the preferred area for implementation of wind energy in Peninsular Malaysia. In addition, there also should be no problem for development of solar energy, as Malaysia receives abundant of sunshine throughout the year with more than 10 hours daily.



**Figure 4.6: Respondent's Answer on the Advantages of Renewable Energy Technologies**

Apart from that, approximately 39% of respondents strongly agreed while majority of the respondent only to be 55% agree that the implementation of renewable energy technologies have less environmental impact such as pollution. This result was consistent with respondent's answer on the main advantages of renewable energy technologies in which they agreed renewable energy is environmental friendly technologies. This indicates that, the respondents are aware of the main goal of the development of renewable energy technologies which to produce sustainable energy. Then, approximately 51% responded strongly agree where state renewable energy technology can contribute more capacity of electricity generation especially for rural area and location far-off from National Grid connectivity in Malaysia. In the end, results from the survey obtained was 46% respondent agree, 1% for neutral and 1% for strongly disagree with the statement.



**Figure 4.7: Advantages of Renewable Energy Technology Implementation**

Alas, when comparing between the first and second survey, there is an increment of percentage regarding on beneficial of renewable energy towards human life as well as other advantages. All the result obtained from both two-case study were almost the same with overall result obtained were responded with majority of positive feedback. Thus, implementation of renewable energy technology able to gain Kampung Tanjung Resang community trust with promising beneficial outcome.

## CHAPTER 5: CONCLUSION AND FUTURE WORK

### 5.1 Conclusion

This research presents an overview of Malaysia past and current energy sector, energy policy revolution and the power sector expansion. Increasing of population, fluctuation of energy demand, depletion of conventional resources and climatic change in Malaysia causes government to seek alternative resources that can consumed and generated for the long term, low cost, easily to obtain and does not emit GHG much to surrounding. Due to the abundance of renewable energy resources in Malaysia, renewable energy is one of the best alternatives solution that will play essential roles in Malaysia's energy mix in the future.

This research also studies on the impact of renewable energy on rural development in Malaysia from previous research paper. Based on the result obtained from each case study, both were respondent by the communities with majority of positive feedback. Although there slightly negative review but the community of Kampung Tanjung Resang strongly agree on the installation of both wind turbine and hybrid wind-PV turbine system and they show very satisfaction signed. This showed that the community seemed to welcome the implementation in rural areas. Furthermore, the implementation of both wind and solar energy have played important roles in rising awareness about renewable energy to residents. Lastly, to allow the project to be successes, government plays major role in this situation in promoting and developing the concept renewable energy in Malaysia such as establishment new ground rule, policy and body of statutory in controlling, monitor and execute the program other than SEDA, KeTTHA and Energy Commission in attracting more investor in and out of Malaysia.

## 5.2 Future Works

Regulatory support for renewable energy in Malaysia is still very immature, even though it has been 30 years of renewable energy development. Compared to the rest of the world, the only regulatory support for renewable energy in Malaysia currently is through the newly introduced FiT since the FiT for wind energy is to be determined by the wind mapping exercise which is still in progress. However, it would be interesting to know some of the regulatory framework from other countries that may be suitable to Malaysia's conditions, particularly for wind energy. In terms of the wind mapping exercise, SEDA should be given the authority to coordinate the wind mapping exercise among all the relevant parties, the federal government, state and local governments to facilitate the consent for mast installation. Moreover, they should have the means, through coordinated efforts between relevant government agencies to provide site access, logistics to the equipment used in the mapping exercise, especially to hard-to-reach places for example, top of ridges, mountain and etc. Furthermore, tax exemption should be given for imported advanced equipment beneficial to the wind mapping exercise. On top of that, innovative incentives and grants should be created for innovation and high impact studies that are able to measure winds at mesoscale, accurately.



## REFERENCES

- Borneo Post Online*. (2015, October 27). Retrieved February 28, 2017, from <http://www.theborneopost.com/2015/10/27/govt-supports-renewable-energy-development-in-sabah/>
- Chong, C., NI, W., Ma, L., Liu, P., & Li, Z. (2015). The Use of Energy in Malaysia: Tracing Energy Flows from. *energies* , 2822-2866.
- Dincer I, Environmental impacts of energy, *Energy Policy* 1999;27(14); 845-854
- H. Borhanazad, S. M. (2013). Potential application of renewable energy for rural electrification in Malaysia. *Renewable Energy* , 210-219.
- Hosseini, S. E., Wahid, M. A., & Aghili, N. (2013). The scenario of greenhouse gases reduction in Malaysia. *Renewable and Sustainable Energy Reviews* , 400-409.
- Izadyar, N., ong, H. C., Chong, W. T., & Mojumder, J. C. (2016). Investigation of potential hybrid renewable energy at various rural. *Journal of Cleaner Production* , 61-73.
- Kardooni, R., Yusoff, S., & Kari, F. (2016). Renewable energy technology acceptance in Peninsular Malaysia. *Energy Policy* , 1-10.
- Mahmud, A. M. (2010). Evaluation of the Solar Hybrid System for. *IEEE International Conference on Power and Energy* , 628-632.
- Mustapa, S. I., Peng, L. Y., & Hashim, A. H. (2010). Issues and Challenges of Renewable Energy. *IEEE* .
- N.Gomesh, I. M. (2013). Study on Malaysian's Perspective towards Renewable Energy. *TerraGreen 13 International Conference 2013 - Advancements in Renewable Energy* , 303-312.
- Oh, H. T., Hasanuzzaman, M., Selvaraj, J., Reo, C. S., & Chua, C. S. (2018). Energy policy and alternative energy in Malaysia: Issues and challenges for. *Renewable and Sustainable Energy Reviews* , 3021-3031.
- Pei, Y. O., Christina, M. M., & Eng, Y. H. (2016). Reviewing Malaysia's Renewable Energy Policies: A. *Journal of Clean Energy Technologies* , 448-452.
- Petintin, J. O., & Shaaban, M. (2015). Renewable energy for continuous energy sustainability in Malaysia. *Renewable and Sustainable Energy Reviews* , 967-981.
- Rahman, M. M., Saat, A., & Wahid, M. A. (2016). Renewable energy policy in Germany and Malaysia: Success. *International Conferene on Industrial Engineering and Operations Management* , 1085-1091.

- Roslizar, A., Alghoul, M. A., Asim, N., & Sopian, K. (2014). Annual Energy Usage Reduction and Cost Savings of. *The Scientific World Journal* , 8.
- Samiran, N. A., Jaafar, M. N., Ng, J. H., Lam, S. S., & Chong, C. T. (2016). Progress in biomass gasification technique – With focus on Malaysian. *Renewable and Sustainable Energy Reviews* , 1047-1062.
- Shafie, S. M., Mahlia, T. M., Masjuki, H. H., & Andriyana, A. (2011). Current energy usage and sustainable energy in Malaysia: A review. *Renewable and Sustainable Energy Reviews* , 4370-4377.
- Shafie, S. M., Mahlia, T. M., Masjuki, H. H., & Andriyana, A. (2011). Current energy usage and sustainable energy in Malaysia: A review. *Renewable and Sustainable Energy Reviews* , 4370-4377.
- S. Mekhilef, (2010). RENEWABLE ENERGY RESOURCES AND TECHNOLOGIES PRACTICE IN. *5th International Symposium on Hydrocarbons & Chemistry (ISHC5)* , 1-8.
- S. Mekhilef, A. S. (2012). Solar energy in Malaysia: Current state and prospects. *Renewable and Sustainable Energy Reviews* , 386-396.
- Urmee, T., Harries, D., & Schlapfer, A. (2009). Issues related to rural electrification using renewable energy in developing. *Renewable Energy* , 354-357.
- Yasin, R. M., Rahman, M. N., Sopian, K., Razak, J. A., Ismail, A. R., & Zaharim, A. (2008). Initial Study of Renewable Energy System in Rural Malaysia. *2nd WSEAS/IASME International Conference on RENEWABLE ENERGY SOURCES (RES'08)* , 26-28
- Zaharim, A., Mat, S., Sopian, K., Jedi, A., Mohd Safari, M. A., & Masseran, N. (2017). Public Acceptance on Stand-Alone Renewable Energy. *IEEE* .
- Zaharim, A., Mat, S., Sopian, K., Jedi, A., Masseran, N., & Safari, M. A. (2017). The Impact of Wind Technology Among Rural. *IEEE* .