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Trabajo Fin de Grado

ANALYSIS AND STUDY OF THE ABILITY TO SET UP AN ENERGY SERVICE COMPANY (PHOTOVOLTAIC SYSTEM SUPPLIER)

Análisis y Estudio de Habilidad Para Crear Una Empresa de Servicios Energéticos (Proveedor de Sistemas Fotovoltaicos)

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MEMORIA

ANALYSIS AND STUDY OF THE ABILITY TO SET UP AN ENERGY SERVICE COMPANY (PHOTOVOLTAIC SYSTEM SUPPLIER)

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1. ABSTRACT

Before elaborating the feasibility study to set up a solar PV system service provider company, a study on figuring out and understanding the policies that have been implemented by the government is conducted first. It is crucial as it sets as a platform to view the current situation of the renewable energy and its impact on the business on the future. The methodology of the renewable energy analysis is done by researching and referring to academic journals that provide deep analysis on the policies and further elaboration on the status of the renewable energy. The same process also is done to investigate the solar PV concept and application, limitations on the public acceptance to install the solar PV system at their house and the actual situation of the solar PV industry in Malaysia. After figuring out all the sources of existing non-renewable energy and potential sources of renewable energy, further research on the impact of the policies or programs related on the public that participate in the renewable energy program is conducted. By doing so, the public especially the homeowners that install the solar PV system could understand the advantages from economic aspect when they participate the renewable energy program; Feed-in Tariff (FiT) and Net Energy Metering (NEM). The methodology of this analysis is conducting the estimation of the profit calculation from the investment in the programs stated before in Microsoft Excel and calculating the savings that they could expected from the new electric bill once they participate in the program. This analysis reveals that Malaysia has several potential renewable energy resources that can exploited to the maximum potential with condition, its backed by the government's continuous and serious effort to implement the policies related.

Apart from that, once the investigation on the actual whole situation of the renewable energy and solar energy in Malaysia is done, the study on the feasibility to set up the solar PV system service provider is conducted. During the market feasibility study, the methodology for this study is executed by researching and referring to the websites of actual solar PV system service provider companies in Malaysia, government agencies, local newspaper and journals or articles related that open for the public. Once all the information is gathered, the whole structure and business operation of the company SolarNext as the solar PV system service provider company can be constructed. The same process is done to the analyses and studies on the technical feasibility, organizational structure feasibility and economic and financial feasibility to set up the solar PV system service provider company. In additional, the calculation

simulation for the economic and financial feasibility study is done by using the Microsoft Excel software.

As the result of the whole feasibility study, it is estimated that to set up the solar PV system service provider company, it is viable to do so as the current situation of the renewable energy market particularly the solar energy market in Malaysia is very promising and highly promotes and encourages the growth of the business. The raising awareness of the public, government's commitment to encourage the usage of the solar energy and decreasing price of the solar PV technologies despite the technology is getting better years by years will directly and give huge impact to the profitability of the company.

1.1. KEY WORDS

Solar photovoltaic (PV) system, renewable energy policies, Feed-in Tariff, Net Energy Metering, Malaysia, feasibility study.

2. RESUMEN

Antes de elaborar el estudio de factibilidad para establecer una empresa proveedora de servicios de sistemas de energía solar fotovoltaica, primero se realiza un estudio sobre cómo entender y comprender las políticas que ha implementado el gobierno. Es crucial ya que establece como una plataforma para ver la situación actual de la energía renovable y su impacto en el negocio en el futuro. La metodología del análisis de energía renovable se realiza investigando y haciendo referencia a revistas académicas que proporcionan un análisis profundo de las políticas y una mayor elaboración sobre el estado de la energía renovable. El mismo proceso también se realiza para investigar el concepto y la aplicación de la energía solar fotovoltaica, las limitaciones de la aceptación pública para instalar el sistema solar fotovoltaico en su casa y la situación actual de la industria solar fotovoltaica en Malasia. Después de descubrir las fuentes de energía no renovable existente y las posibles fuentes de energía renovable, se realizan más investigaciones sobre el impacto de las políticas o programas relacionados con el público que participa en el programa de energía renovable. Al hacerlo, el público, especialmente los propietarios que instalan el sistema de energía solar fotovoltaica podrían entender las ventajas desde el aspecto económico cuando participan en el programa de energía renovable; Feed-in Tariff (FiT) y Net Energy Metering (NEM). La metodología de este análisis es la estimación del cálculo del beneficio a partir de la inversión en el programa mencionado anteriormente en Microsoft Excel y el cálculo de los ahorros que podrían haber esperado de la factura eléctrica una vez que participan en el programa. Este análisis revela que Malasia tiene varios recursos potenciales de energía renovable que pueden explotarse al máximo con su condición, respaldado por el esfuerzo continuo y serio del gobierno para implementar las políticas relacionadas.

Además, una vez que se realiza la investigación sobre la situación actual de la energía renovable y la energía solar en Malasia, se lleva a cabo el estudio sobre la factibilidad de establecer el proveedor de servicios del sistema de energía solar fotovoltaica. Durante el estudio de viabilidad del mercado, la metodología para este estudio se ejecuta investigando y haciendo referencia a los sitios web de las compañías proveedoras de servicios de sistemas solares fotovoltaicos actuales en Malasia, agencias gubernamentales, periódicos y revistas locales o artículos relacionados que se abren al público. Una vez que se haya recopilado toda la información, se puede construir toda la estructura y el funcionamiento comercial de la empresa SolarNext como empresa

proveedora de servicios de sistemas de energía solar fotovoltaica. El mismo proceso se realiza para los análisis y estudios sobre la viabilidad técnica, la viabilidad de la estructura organizativa y la viabilidad económica y económica para establecer la empresa proveedora de servicios del sistema de energía solar fotovoltaica. Además, la simulación de cálculo para el estudio de viabilidad económica y financiera se realiza utilizando el software Microsoft Excel.

Como resultado de todo el estudio de viabilidad, se estima que para establecer la empresa proveedora de servicios del sistema de energía solar fotovoltaica, es viable hacerlo ya que la situación actual del mercado de energía renovable, particularmente el mercado de energía solar en Malasia es muy prometedor. altamente promueve y alienta el crecimiento del negocio. La sensibilización del público, el compromiso del gobierno para fomentar el uso de la energía solar y la disminución del precio de las tecnologías de energía solar fotovoltaica a pesar de que la tecnología está mejorando cada año, tendrá un impacto directo en la rentabilidad de la empresa.

3. INTRODUCTION

As the tittle of the Final Year Project or *Trabajo Fin de Grado* is "the election of the ability analysis and study to set up an energy service company or specifically a solar photovoltaic (PV) system service provider company", this project is conducted after being inspired by the commitment of the Malaysian government to increase the usage of the renewable energy especially the solar energy in the fuel mix for electricity generation in Malaysia. Despite having ample, bright solar radiation every day throughout the year in Malaysia, the capacity of the solar PV system installation in residential sectors is still small. Therefore, in this project, the solar PV market specialized in the company of installation of the solar PV system in residential units is chosen to forecast whether it is viable or not, because by providing the service as the solar PV system service provider, the public can obtain the solar PV system as the solar energy is the only renewable energy that can be generated at large by the public especially the homeowners.

Malaysia is bestowed with several renewable energy sources that have not been fully potentialized including the solar energy. In this analysis, after identifying the sources of the non-renewable and renewable energy, it has been observed that there had been numbers of important policies and programs, to strengthen the position of the renewable energy for electricity generation as the supply of the non-renewable energy is at stake and keep depleting over years. Besides, an analysis and comparison on the return of the investment of the solar PV energy related schemes or programs implemented to attract the public interest on the renewable energy and the viability to install the stand-alone solar PV system at residential units have been included in this project.

Once the actual situation of the solar energy market in Malaysia and the limitations of the solar PV system installation in the residential units in Malaysia as well as the basic concept and applications of the solar PV technology are figured out, the analysis in this project continues to the investigation of the market feasibility to set up a solar PV system service provider company. An analysis on the business of the company, SolarNext has been conducted that ranges from the identity and business entity of the company, current situation of the solar PV system installation market, SWOT's and marketing strategies.

On the technical feasibility, the study on the services provided, components of the solar PV system that include in the installation packages, suppliers, distribution channel and the company's location and installation plan has been done as a part of the whole feasibility analysis and study to set up the solar PV service provider company. On the other hand, the organizational structure feasibility study focuses on the human resources aspects such as the positions of the employees, description of the positions, working conditions and initial salary.

Finally, the most important part of the feasibility analysis to set up the solar PV system installation service provider company, which is the economic and financial feasibility study is realized by figuring out the initial investment of the company, capital allowance owned by the company, financing aid received, incomes, expenses and the income statement as well as the cash flow of the company. The calculations of each of the economic-financial aspects stated before are done by the help of Microsoft Excel. By doing so, the feasibility and viability of the company SolarNext can be forecasted and predicted within the first 4 years of its operation.

As a conclusion of the introduction, the focuses of this analysis and study of the feasibility to set up an energy service company or specifically a solar photovoltaic (PV) system service provider company can be simplified as the objectives of this project;

- To recognize the sources of the non-renewable energy available in Malaysia and renewable energy that have potential ready to be exploited for electricity generation.
- To elaborate the government's efforts on the renewable energy through the implementation of the policies, programs and schemes of the renewable energy.
- To investigate the current solar energy technology and market in Malaysia.
- To analyze the economic advantages through investment under the renewable energy programs or schemes (FiT and NEM) and economic viability to install stand-alone solar PV systems at home.
- To identify the market feasibility and market condition to set up the solar PV system service provider company and investigate the company's background.
- To determine the technical feasibility of the company (services, products, suppliers, distribution channel, location, etc.)
- To define the organizational structure feasibility of the company through its human resources.

- To review the economic-financial feasibility by estimating the sales projection, initial investment, expenses and cash flow of the company.

4. DEVELOPMENT

4.1. CURRENT ENERGY SOURCES IN MALAYSIA

As a developing country, Malaysia's population of 29.17 million in 2012 with average annual growth rate of 1.5% will reach to 32.4 million by the year 2020 and approximately 36.1 million in 2030. Malaysia is one of the fast-growing economies in Southeast Asia which its development is partially driven by government's policy on industrialization in order to become a developed nation by the year 2020. Malaysia is one the most rapidly developing countries among ASEAN countries next to Singapore, with GDP of US$ 22,707 per capita (PPP basis), and steady GDP growth of 5.5% in 2012. The Malaysian economy grew by 5.6% in 2012 and final energy demand was expected to increase at an average rate of 6% per annum.

A reliable and adequate electricity supply is regarded as one the principal propellers of economic development in Malaysia. The tremendous pressure is exerted on the energy infrastructures in order to generate electricity continuously and meet the growing energy demand in Malaysia. In 2012, Malaysia's total installed electricity generation capacity as of 31st December 2012 was 29,143 MW and the electric consumption was 116,353 GWh. The gross electricity generation registered was 134,375 GWh and the demand is expected to increase by 4.7% per annum to 274 TWh by the year 2030. It will be heavily influenced by strong demands from the industrial and residential sectors as Malaysia enters an industrialized nation, whereby per capita electricity demand is expected to reach 7571 kWh/person in the year 2030.

As the consumption of energy is growing, Malaysia has becoming increasingly dependent on fossil fuels such as coal, oil and gas. According to the estimation of International Energy Agency (IEA), by the year 2030, global energy demand will increase at a rate of 1.6% and approximately 65% of the increase will be due to developing countries. The rising price of oil and gas and their possibility of depletion in the future leave the question mark about the security and reliability of energy supply needed to sustain the economic growth. The search for alternative fuels such as renewable energies has become inevitable on the verge of the diminution of the fossil fuels. Furthermore, the existing use of the energy, including its production and distribution, particularly fossil fuels (coal, natural gas and petroleum) and traditional biomass have significant environmental impacts in Malaysia. The current power system

tends to emit greenhouses gasses (GHG) which cause climate change, reduction of carbon emissions, ecological damage and can also affect human health. Malaysian government has been introducing various energy policies and programs to reduce the overdependence on fossil fuels and maintain stability in power supply while considering the environmental consequences of energy production.

In 2012, the total primary energy supply in Malaysia has increased by 5.9% compared 3.2% during the previous year. The final energy consumption has increased by 7.5% to settle at 46,711 ktoe in the same year. The total energy input in power stations has increased slightly by 4.8% in 2012 to 29,252 ktoe. Total energy input in power stations has increased slightly by 4.8% in 2012 to 29,252 ktoe. Cole and coke are the main fuel sources for electricity generation with 48.3% of the total fuel inputs, followed by natural gas at 39.4%, hydropower at 7.4%, diesel and fuel oil at 4.7%, while renewable was at 0.2%, as shown in Figure 1. The electricity consumption pattern in Peninsular Malaysia for 2012 is presented in Figure 2. The sectors with the highest consumption are the commercial, residential, agriculture and transport sectors, in that order.

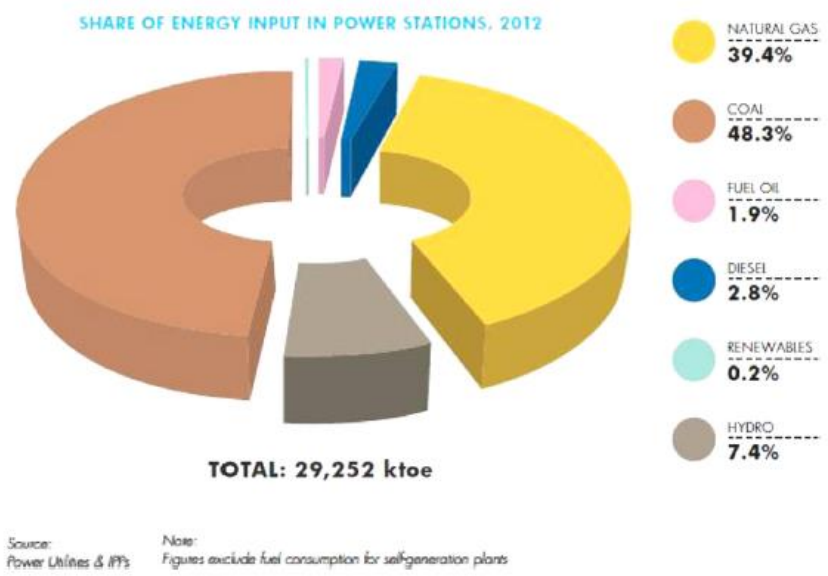

Figure 1: Share of energy input in power station, 2012. Source: Malaysia energy strategy towards sustainability: A panoramic overview of the benefits and challenges, 2014.

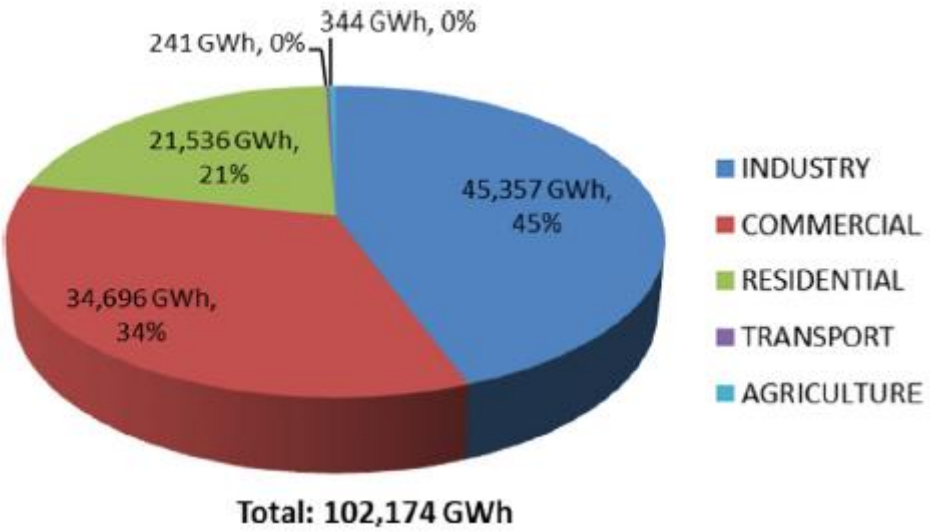

Figure 2: Electric consumption by sector in 2012. Source: Malaysia energy strategy towards sustainability: A panoramic overview of the benefits and challenges, 2014.

4.1.1. Natural Gas

In 1983, natural gas was discovered in Malaysia. Petroliam Nasional Berhad (PETRONAS) held the responsibility of management of the natural gas which includes the management of exportation and distribution to national sectors including power sector. In 2010, Malaysia natural gas proven reserve stands at 83 trillion cubic feet (Tcf), which 38% is found off the east coast of Peninsular Malaysia and 48% offshore Sarawak, and the remaining 14% offshore Sabah. Natural gas reserves in Malaysia are the second largest in South East Asia and the 12th largest in the world. The production has been declining at about 10% per annum because the gas fields are scattered in distribution even though Malaysia is a net gas exporter. Therefore, the high extraction cost at some gas fields making some may not be economically feasible.

The natural gas supply comes from Kerteh, Terengganu and a joint development area between Malaysia and Thailand through the Peninsular Gas Utilization (PGU). The PGU pipeline completed in 1998 is one of the most extensive natural gas pipelines in Asia. The PGU system spans more than 880 miles and has the capacity to transport 2 billion cubic feet per day (Bf/fd) of natural gas. The PGU pipeline also contribute to regional expansion of natural gas trade, especially with neighboring countries like Thailand, Indonesia and Singapore.

In 2012, the natural gas production dropped to 62,581 ktoe compared to previous year at 69,849 ktoe. This was due to lower production from Peninsular Malaysia and

Sarawak gas fields. In order to fulfill the local demand, Malaysia imported natural gas through pipeline from Thailand and Indonesia. The natural gas is also supplied from Bintulu liquid natural gas (LNG) processing complex in East Malaysia which is the largest in the world with a total liquefaction capacity of 22.7 million metric tons per year.

A study in 2010 indicates that the natural gas could contribute as the main source of energy in Malaysia's energy mix or the next 36 years. However, PETRONAS and an analysis in the Economic Transformation Program (ETP) report in same year showed that oil and gas reserve will deplete at the rate of 4% per annum and will decline faster after 10 years. The additional supply of imported natural gas is indispensable to maintain the practicality and the relevance of the national natural gas reserve for power expansion plans in the future. Malaysia has benefited the natural gas exploration and development in the Malaysia-Thailand Joint Development Area since the delivery of natural gas from Thailand into Malaysia started in the first quarter of 2005. Apart from that, the natural gas was also imported from West Natuna, Indonesia beginning in 2002. In addition, new oilfields off Sarawak are also being developed with huge investments form foreign companies such as Murphy Oil and Shell that would add to the production capacity at least the next 10 years.

Currently, Malaysia has 22 gas-fired power plants, which in Peninsular Malaysia has 18 power plants with combined capacity of 12,182 MW while 4 power plants are located in East Malaysia with capacity of 839 MW.

4.1.2. Coal

Malaysia has enormous coal reserves, but most of them are found in inland area which lack the infrastructures and high cost of the extraction will only add-up the fuel's cost. Total measured coal reserves in Malaysia was calculated to be 562 million tons in 2013 in which consists of inferred reserves of 1938 million ton has an R/P ratio of 285 years. Most reserves of coal are found in Sarawak (69%) and Sabah (29%), whereas only 2% in Peninsular. Local coal was mainly produced in from Mukah, Balingian area in Sarawak. This area alone produced 78% of the total production of coal in Malaysia. In Peninsular Malaysia, the coal supplies are mainly imported from Australia, Indonesia, Russia and South Africa. Total import of coal in 2012 increased by 6.7% to register at 14,220 ktoe. Currently, there are seven coal-fired power plants in operation supplying about 7680 MW pf power to the national electricity grid.

The share of coal in the electricity generation has increased from 9.7% in 1995 to 48.3% in 2012 as a result of reducing dependence on natural gas and oil consumption for electricity generation and the increasing number of new coal fired power station by the independent power producers (IPPs). Figure 3 shows the fuel mix trend including the share of coal in power generation. Another factor that contributes to an increase in coal consumption is its relatively reliable worldwide reserve and stable price. It shows that there was an increase of about 934% in net import of coal which from 1.3 Mtoe in 1999 to 13.98 Mtoe in 2013. Up to 2012, coal consumption was around 20 million ton every year and after Suruhanjaya Tenaga (Energy Commissioner) awarded new licenses for two 1G W units of supercritical coal-fired power plants at Tanjung Bin and Manjung, the consumption was expected to increase to more than 25 million ton annually. These plants will operate at supercritical levels when commissioned by 2016 which would increase steam cycle efficiency, reducing the amount of coal required thus lowering carbon dioxide and NO_x emission per megawatt.

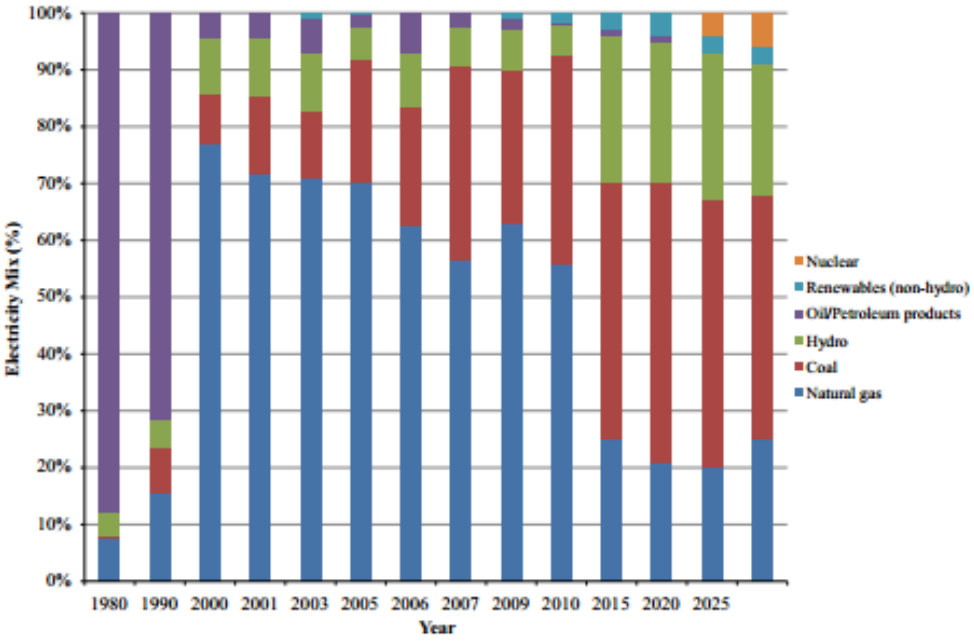

Figure 3: Fuel mix for electricity generation trend. Source: A review on sustainable power generation in Malaysia to 2030: Historical perspective, current assessment and future strategies, 2013

The ability to maintain the imported supplies of coal as is quite challenging as it exposes Malaysia to interruption in supply and increases in coast of coal. Malaysia has to compete with major coal consumers such as China, USA and most recently Japan who switched to non-nuclear power after the tragedy of Fukushima nuclear accident. Although coal is the cheapest and most abundant fossil source, the price and supply are

fully controlled by suppliers, depending on the global demand which increases each year. Efforts have been made to explore and develop the potential local mines, particularly in Sarawak as well as securing the imported supplies.

4.1.3. Hydropower

Malaysia is a country which is blessed with abundance of water. The average annual rainfall is about 3540 mm per annum. In Malaysia, hydropower is by far the largest renewable energy that commercially contribute to the national energy mix. It is least costly way of storing the amount of electricity produced, and it can easily adjust the amount of electricity produced to the amount required and produces insignificant amounts of greenhouse gasses. Apart from that, hydropower dams are also vital in socio-economic development such as irrigation to farmland, providing ample water supply especially during drought seasons, flood control during the monsoon season and improvement of crucial river navigation routes. The most significant advantage of the hydropower is; it is a renewable energy and the power generated is less affected by fluctuation in fuel prices. Nevertheless, developing a hydroelectric power plant includes an immense cost and overwhelmingly complex because it not only involves the design, considerable land for water storage, construction, and operation of dams but also requires substantial environmental, social and political ramifications. An average of 75,000 hectares of reservoir land area and 14 trillion Liter of water are required per 1 billion kWh/year produced. However, this should be balanced against the long life and operating costs of hydropower plants and the strong fact that there is almost no consumption of fuel for energy generation. The share of hydroelectric power in the energy mix was 10% in 2000 and it declined in 2005 to 5.5% and reached to 7.3% in 2012 as the share of coal in fuel mix ratio increased. Nevertheless, in 2030, the hydropower share is expected to increase to 35%. In 2012, the combined installed capacity of hydroelectric power in Peninsular Malaysia was 1911 MW from 4 hydroelectric plants that involve 16 power stations with 21 dams in operation.

The Bakun Hydroelectric Project which had a total capacity of 2400 MW has increased the share of hydro to 9% in 2012. The Bakun Dam is one of the largest in South East Asia with a 207m high rock filled concrete dam creating a 70,000 hectares reservoir (roughly the size of Singapore). This project has been reduced the size or capacity several times and the completion were delayed due to Asian financial crisis and disputes with the native tribes on the construction sites. Despite the setbacks, when

the Bakun hydropower start operating, the hydropower was planned to be connected to grid in Peninsular Malaysia by Sarawak Interconnection Project via undersea cables.

4.1.4. Oil

As of 1st January 2012, Malaysia's crude oil reserves stood at 5.954 billion barrels compared to 5.858 billion barrels in the previous year. This increase was due mainly from Peninsular Malaysia and Sarawak totaling 4.013 billion barrels compared to that in previous year at 3.866 billion barrels. Majority of Malaysia oil reserves are in the east coast of Peninsular Malaysia, where high quality oil is found. Petroliam Nasional Berhad (PETRONAS) holds the exclusive rights to all oil and gas exploration and production projects in Malaysia, as PETRONAS is the national oil and gas company. Due to the geological structures of offshores reservoirs associated with crude oil production have matured and the majority the oilfields discovered either had been developed or have been in production for more than 30 years, the country's oil production has been gradually decreasing since reaching its peak of 882,000 barrels per day in 2004. The remaining fields are generally lower in quality due to high carbon dioxide contents, smaller in size as well as scattered in distribution causing pending in new discoveries and high exploration cost.

Before the international oil crisis in 1973 and 1979 and the implementation of Four-fuel Diversification Strategy in 1981, contribution of oil in Malaysia energy mix was once up to 87.9%. The contribution of oil in the energy mix was declined sharply to merely 10% in 2003 and is only 1.9% in 2012. The fast depleting oil reserves has prompted a need to reaffirm the sustainability of their supplies. The government is focused on opening new investment opportunities by enhancing output from existing fields and developing new fields in deep water areas offshore Sarawak and Sabah. On the other hand, under the Economic Transformation Program (ETP), there has been efforts to attract international oil companies for exploration activities, particularly in waters deeper than 200m and in ultra-deep into matured fields to increase domestic petroleum. Without proactive and progressive actions taken for the medium and long terms, maintaining the present level of oil production at 630,000 barrels per day could be grueling.

Malaysia has mainly 5 oil-fired power plants; Gelugor Power Station in Penang with generation capacity of 398 MW, while in Saba, Melawa Power Station, Sandakan Power Corporation Plant, Stratavest Power Station and Tawau Power Plant with a total generation capacity of 180 MW.

4.2. RENEWABLE ENERGY SOURCES IN MALAYSIA: POLICIES, PROGRAMS AND POTENTIAL SOURCES

4.2.1. Energy Policies in Malaysia

Energy policy is defined as "The way a given entity (often government) has decide to address issues of energy development including energy production, distribution and consumption". The main goals for enacting the renewable energy policies are to convince societies and individuals to adopt the renewable energy an as alternative source of energy. Among the steps in the policies taken to encourage the renewable energy in the energy mix of our country are by facilitating technological barriers, addressing market failures and minimizing associated costs. Energy policies in Malaysia are supervised by the Economic Planning Unit (EPU) and the Implementation and Coordination Unit (ICU). All policies are controlled directly by the Prime Minister of Malaysia. The major thrusts of Malaysia's energy policies have been sustainability of energy in the future, efficient resource utilization and environmental safeguarding. The various initiatives and strategies undertaken by the government reflect these approaches as expounded through the policies and plans explained next.

4.2.1.1. National Energy Policy 1979

The National Energy Policy was adopted in 1979 in which was timely in view of the global oil crises in 1973 and 1978 that cause the economic growth worldwide was severely affected by the sudden rise of oil prices. Malaysia was not well prepared of these effects since it relied mainly on oil as its main energy source. Since this policy was enacted, the dependence on oil in the energy mix had been reduced significantly over the years. The National Energy Policy was formulated with 3 principal energy objectives which are vital in shaping the future of energy sector;

- The supply objective - To ensure the provision of adequate, secure and cost-effective energy supplies through developing indigenous energy resources both non-renewable and renewable energy resources reusing the least cost options and diversification of supply sources both form within and outside the country.
- The utilization objective - To promote the efficient utilization of energy of energy and to discourage wasteful and non-productive patterns of energy consumption.

- The environmental objective - To minimize the negative impacts of energy production, transportation, conversion, utilization and consumption on the environment.

4.2.1.2. National Depletion Policy 1980 and Four-Fuel Diversification Strategy 1981

The National Depletion Policy 1980 was aimed at safeguarding the country's finite and non-renewable petroleum resources from over-exploitation and to prolong the lifespan of oil reserves for future security and stability of oil supply. In 1996, the policy was extended to include natural gas reserves. The gas and oil production were limited to certain amount per day to control rapid depletion. Complementing the National Depletion Policy was the Four-Fuel Diversification Strategy which the focus was to reduce overdependence on oil as the main energy resource and ensure energy reliability and security. This strategy aims to emphasis a balanced energy supply mix of oil, natural gas, hydropower and coal for electricity generation and to minimize over-dependence on any one fuel. To the extent possible, local sources of these fuels are used to enhance supply security. As a result, this strategy leads to a significant shift from oil to natural gas, thus compliment the supply and environmental objectives as stated in the National Energy Policy. Therefore, since the early 1980s, the natural gas was the major fuel in electricity generation.

4.2.1.3. Five-Fuel Diversification Strategy 2000

The Government of Malaysia launched the Five-Fuel Diversification Policy in 2000 under the Eighth Malaysia Plan which named renewable energy as the fifth fuel in the supply mix and the new alternative source with the target to contribute 5% of the demand by 2005. The Government of Malaysia recognized that the conventional energy sources such as oil and natural gas are non-permanent and not long lasting thus emphasis has been placed on renewable energy sources such as biomass, municipal waste, solar and mini-hydroelectric stations to generate electricity. The new diversification objectives are;

- To encourage the utilization of renewable resources such as biomass, solar, mini hydro, etc. as additional sources of energy/electricity generation.
- To reduce over dependence on conventional source of energy i.e. oil, gas, hydro and coal.
- To contribute towards the preservation of the environment.

4.2.1.4. National Biofuel Policy 2006

In continuation of supporting and encouraging the Five-Fuel Diversification Policy, the National Biofuel Policy was officially introduced on 21st March 2006 to encourage the use of biofuels from palm oil as an alternative and environmentally friendly energy source. Thus, from the implementation of this policy, which addressing the use of 5% diesel and 5% palm olien blend, the country's dependence on fossil fuels were aimed to minimize and the emission of the greenhouse gases will be able to reduce.

However, despite of subsidizing the installation costs and providing the incentives to the public, this policy was ultimately unsuccessful due to lack of expertise in optimization of biomass utilization, cheap oil prices and relatively high price of palm oil. There were also issues with the low awareness of the benefits of the biofuels among the industries and public as well as unclear policy and directive by the government. Therefore, most industries are reluctant to take the risk of utilizing biofuels for power generation.

4.2.1.5. National Green Technology Policy 2009

Malaysian Government has launched the Green Technology Policy in July 2009 to show the government's commitment in facilitating the development of knowledge society, which would encourage and promote the public to embrace the renewable energy for power generation and adopt green products for diverse applications. This policy also was dedicated in promoting low carbon technology, ensuring sustainable development while conserving natural environment and resources as the main principles. The objectives of the National Green Technology Policy are;

- To reduce energy consumption growth while enhancing economic development.
- To facilitate the growth of the Green Technology industry and enhance its contribution to the national economy.
- To increase national potential and capacity for innovation in Green Technology development and enhance Malaysia's competitiveness in Green Technology worldwide.
- To ensure sustainable development and conserve the environment for future generation.
- To enhance public education and awareness on Green Technology and encourage its widespread use.

On the other hand, the National Green Technology Policy served as a platform for business opportunities through collaboration with local and multi-national companies in diverse applications such as green buildings, environmentally-benign water and waste management practices, manufacturing processes with low carbon footprints, and transportation with low carbon emissions.

4.2.1.6. National Renewable Energy Policy 2009

This policy was also introduced in 2009 as a step to rectify and correct the failure of achieving the target of 5% renewable energy in the energy mix. With the implementation of this policy, the utilization of indigenous renewable energy resources through the increased contributions of renewable energy in the national power generation mix will be able to enhance apart from ensuring reasonable renewable energy generation cost and facilitating the growth of the renewable energy as well as creating public awareness of the importance of sustainability and clean technology.

The impacts of this policy by 2020 are expected to be seen in a minimum of RM 2.1 billion of external cost to mitigate CO_2 emissions (Total avoided 2011-2020 = 42 million tons x RM 50/tons), a minimum of RM 19 billion of loan values for renewable energy projects as new revenue sources for local banks and a minimum RM 70 billion of renewable energy business revenues generated that will subsequently generate RM 1.75 billion in tax to the government. Last but not least, a minimum of 50,000 jobs opportunity created to construct, operate and maintain these renewable energy power plants.

4.2.1.7. New Energy Policy 2010

Under the Tenth Malaysia Plan, the New Energy Policy plan was embedded and was described as an expansion the energy horizon to encapsulate all efforts to economic efficiency, environmental, and social considerations while elevating security of energy supply through alternative resources. The New Energy Policy identified five strategic pillars as the fundamental areas of focus to achieve the policy objectives, namely;

- Energy pricing – Adopting energy pricing gradually to match market price by considering current economic situation and affordability to the citizen.
- Strategic supply side developments – Applying a more strategic development of energy supply by diversifying energy resources, including renewable energy sources. Emphasizing all measures necessaries to encourage the renewable energy.

- End use energy efficiency – Enhancing the implementation of energy efficiency initiatives in the industrial, residential, and transport sectors.
- Energy governance and regulation – Strengthen and improving governance to support the transition to market pricing, while aiding mitigate impact on the low-income group.
- Management of change and affordability – Ensuring that the New Energy Policy is implemented based on an integrated approach and according to schedule to manage and secure energy supply.

4.2.1.7.1. National Green Energy Policy

The New Energy Policy also emphasizes on National Green Energy Policy, under which special consideration was included in the renewable energy development plan. Short term goals included in this policy are as follows;

- Spread public awareness and commitment for the adoption and implementation of green technology through advocacy programs.
- Boost foreign and domestic direct investment in green technology manufacturing and services sector.
- Maximize availability and recognition of green technology in terms of products, appliances, equipment, and systems in the local market through standards, rating, and labeling programs.
- Expansion of local research institutes and institutions of higher learning to develop and broaden research, development and innovation initiatives in green technology towards commercialization through appropriate mechanisms.
- New Renewable Energy act and Feed-in Tariff (FiT) mechanism to be implemented and established.

4.2.2. Renewable Energy Programs

To support the renewable energy policies that have been mentioned above, several programs and measures have been launched by the government. After the establishment of Five-Fuel Policy, various renewable energy programs were established and improved from time to time to increase the renewable energy contribution in the energy mix. The following sections will present the main renewable energy programs that approved by the Malaysian government.

4.2.2.1. Small Renewable Energy Power Program (SREP)

To complement these efforts and accomplish all the objectives of the Fifth-Fuel Policy, the Small Renewable Energy Power Program has been introduced to encourage private sectors to invest in small power generation utilizing almost all renewable energy sources such as solar, wind, biomass, mini-hydro, biogas and municipal waste by granting them the SREP licenses. SREP program also offered reasonable renewable energy tariffs to promote financially viable investments for prospective developers. Through SREP Program, the independent small renewable energy power plants could sell generated electricity to the grid, as the developers sign a Renewable Energy Power Purchase Agreement (REPPA) with utilities purchasing renewable energy generated from them, particularly Tenaga Nasional Berhad (TNB), the national power utility company. Under this program, renewable energy generated form biomass and biogas was paid RM 0.21/kWh and that from mini-hydroelectric at RM 0.17/kWh, whereas energy from photovoltaic (solar) was based on net metering with residential installation at up to RM 0.44/kWh and commercial up to RM 0.44/kWh. The special Committee on Renewable Energy (SCORE) supervised by the Ministry of Energy, Green Technology and Water has set up a series of guidelines on how to supply electricity generated from the renewable energy to the grid. According to the estimation, the maximum capacity for each small renewable plant should be 10 MW for sale to TNB via the national grid for up to 21 years.

However, unfortunately, the outcome of the SREP program has been mediocre as by 2005, the target of 5% (about 500 MW) of generation electricity did not achieved and only 0.3% or 12 MW capacity of renewable energy was achieved and accounted of the total electricity supplied to the country. The introduction of Renewable Energy Act and Sustainable Energy Development Authority (SEDA) in 2011 signifies the end of SREP program. As of February 2013, a total of 43 projects were approved under SREP generating a capacity of roughly 290 MW of grid-connected power. The main factors of poor performance are;

- Relatively cheap fuel prices as high subsidies were given in contrast to the low incentives for renewable energy based projects.
- High capital expenditure with long payback period and low tariff causing low private investment into renewable energy initiatives.
- Stringent conditions and long duration of negotiations as well as approval involved in REPPA.
- Uncertain biomass price and availability as fuel for the long term.

4.2.2.2. Malaysia Building Integrated Photovoltaic Technology Application Project (MBIPV)

In 2004, the Global Environment Facility (GEF) together with the United Nations Development Program (UNDP) approved the support to initiate the development of the Malaysian Building Integrated Photovoltaic Technology Application Project (MBIPV). The project was launched for the period of 5 years between 2005 and 2010. It was established to catalyze BIPV technology acceptance among the public, policy makers, financiers and building industry, parallel with the overall objective of the project which was to reduce greenhouse gas (GHG) emissions from the electric generation. On the other hand, the project also aimed to lower the cost of systems through wider application of MBIPV systems and the adoption of supportive regulatory frameworks to establish a sustainable BIPV market. BIPVs are solar energy systems that are integrated into the design of a structure that serve to replace conventional building materials. The MBIPV project was specifically focus on the market development for BIPV technology in three major areas;

- Policy and education
- Technical skills and market implementation
- Technology development support.

Under MBIPV program, SURIA 1000 project was introduced and the target were the residential and commercial sectors. Therefore, SURIA 1000 was exclusively for property developers to promote the widespread use of solar photovoltaic systems on buildings. The objective of this program was to provide a direct chance to protect the environment and participate in the renewable energy programs. The funds for the program were granted by the government via Energy Commission, photovoltaic manufacturers and householders. Under the MBIPV project, applicants can contribute to the program based on a bidding process which is open to the public each six month. In this project, limited numbers of grid-connected photovoltaic systems are put up for auction, where the winning bidders will be allowed to install the PV system on their premises at a subsidized price.

The unit cost of the PV installations and systems has dropped by 16% in average since the MBIPV was introduced. Considering the BIPV is appropriately sized, it is predicted that can displace purchase of electricity, with possibility to export the surplus to the grid. On the other hand, the utilization of the solar energy through the PV systems has an immense potential and offering various advantages as the MBIPV program did not require extra lands, and it generated electricity at the point of use, thus reducing

electricity transmission losses. In view of only the lower PV capacity value of 1 kWp for every 10m of available building roof surfaces in these sectors, the technical potential that will be generated is around 11,000 MWp or 11 GWp, which could produce more than 12,000 GWh solar-generated electricity which equivalent to 20% of the national energy demand.

The result of this project had been outstanding and impressive as the achievement of the majority of project target were overachieved such as the project overachieved the main target of 539% increase in BIPV capacity against baseline despite off the target to only achieve only 330% increase. Apart from that, the MBIPV project managed to overachieve 50% reduction of BIPV unit cost from baseline instead of the main target to achieve only 20% reduction. The most significant outcome from this project was the foreign direct investment in the photovoltaic sector spiked up at +4 billion USD along with ~5000 new job opportunities. Lastly, the awareness of photovoltaic systems within the target group had been increasing as various effective measures such as benchmarking, best practices and monitoring were taken to demonstrate the BIPV technology and its cost reduction benefits.

4.2.2.3. Feed-in Tariff (FiT)

The experience from the establishment of the Small Renewable Energy Power (SREP) program as well as the Malaysian Building Integrated Photovoltaic Technology Application (MBIPV) were used as a foundation for the implementation of the Feed-in Tariff (FiT) system for the renewable energy generated electricity that was regulated under the authority and administration of the Sustainable Energy Development Authority of Malaysia (SEDA). The Sustainable Energy Development Authority of Malaysia (SEDA Malaysia) is a statutory body formed under the Sustainable Energy Development Authority Act 2011. The key role of SEDA is to administer and manage the implementation of the feed-in tariff mechanism which is mandated under the Renewable Energy Act 2011.

The Renewable Energy Act which was established in 2010 acted as a platform to provide for the implementation of the FiT in which guaranteed the access to the power grid and is a mechanism that an individual can sell the power generated priorities electricity generated from indigenous renewable energy resources to be purchased by power utilities at a fixed premium price and for a specific duration; 16 years for biomass and biogas resources, and 21 years for small hydropower and solar photovoltaic technologies. Table 1 shows the early proposed tariff structure for FiT implementation in the way to attract the companies and individual to participate and invest. The act also

specified that the power distributors (i.e. Tenaga Nasional Berhad for Peninsular Malaysia) will sign a long-term contract to buy the electricity. To enhance the promotion of this scheme, financial support was also granted to the renewable energy producers (non-individual category). The FiT rates for all renewable energy (except for mini hydro) will decrease with time according to their respective annual digression rates because the cost of the renewable energy technologies is expected to drop as the technologies mature.

RE TYPE	TARIFF (RM/kWh)	DURATION (YEARS)
Solar PV		
<4 kW	1.23	
>4 kW <24 kW	1.20	
>24 kW <72 kW	1.18	
>72 kW <1000 kW	1.14	
>1 MW <10 MW	0.95	21
>10 MW <30 MW	0.85	
Bonus for rooftop	0.26	
Bonus for BIPV	0.25	
Bonus for loval modules	0.03	
Bonus for lovcal inverters	0.01	
Biomass		
<10 MW	0.31	
>10 MW <20 MW	0.29	
>20 MW <30 MW	0.27	16
Bonus for gasification	0.02	
Bonus for steam generation > 14% ef	0.01	
Bonus for local manufacturers	0.01	
Bonus for municipal solid waste	0.1	
Biogass		
<4 MW	0.32	
>4 MW<10 MW	0.30	
>10 MW<30 MW	0.28	16
Bonus for gas engine > 40% effic.	0.02	
Bonus for local manufacturers	0.01	
Bonus for landfill or seweage gas	0.08	
Minihydro		
<10 MW	0.24	21
>10 MW< 30 MW	0.23	

Table 1: Proposed Malaysia's Feed-in Tariff (FiT) in 2011. Source: Current energy usage and sustainable energy in Malaysia: A review, 2011

The goals of the Act are to increase the renewable energy contribution in the national power generation power mix, facilitate the growth of the renewable energy industry, ensure reasonable the renewable energy generation costs, conserve the environment for future generation, enhance the awareness on the role and importance of the renewable energy and encourage bridging the gap between the cost of the fossil fuels and renewable sources. By 2030, with the implementation of the FiT system, the

contribution of the renewable energy to the generation capacity mix are expected to increase progressively to a high of 11%. The positive results of the FiT scheme from the beginning of the implementation until now are shown in Table 2, showing a promising future for then renewable energy in Malaysia as the renewable energy annual power generation has significantly increased. The FiT scheme is the effective policy to promote rapid and sustainable development of the renewable energy as it has been proven that as at 2012, about 65 countries have implemented some form of FiT, driving 64% of the world wind installations and 87% of the photovoltaic capacity has been installed worldwide.

Year	Biogas	Biogas (Landfill / Agri Waste)	Biomass	Biomass (Solid Waste)	Small Hydro	Solar PV	Geothermal
2017	5648.02	76408.00	173794.70	11135.64	36742.85	175058.84	0.00
2016	8039.99	39364.59	133488.84	22404.26	31976.94	278965.36	0.00
2015	16988.66	41122.39	197207.62	18090.07	55406.38	259242.26	0.00
2014	19772.25	31844.44	226196.38	4347.83	64549.65	181642.79	0.00
2013	12962.68	9804.10	209407.59	11144.25	79081.75	50647.97	0.00
2012	98.11	7465.40	101309.87	3234.52	25629.78	4720.16	0.00

Table 2: Annual Power Generation (MWh) of Commissioned RE Installations. Source: Statistics and monitoring, SEDA, www.seda.gov.my, 2017.

4.2.2.4. Net Energy Metering (NEM)

Net Energy Metering (NEM) program was first start commencing on 1st November 2016 and will be continuing to commence until 2020 with 100 MW capacity limit in Peninsular Malaysia and Sabah. This program is to complement the current Feed-in Tariff (FiT) scheme and also another step in encouraging the deployment of renewable energy as meted out in Malaysia Eleventh Plan (RMK-11). The NEM is executed by the Ministry of Energy, Green Technology & Water, regulated by the Energy Commission (EC), with Sustainable Energy Development Authority (SEDA) Malaysia as the implementing agency.

The concept of NEM is that the energy produced from the solar PV system installed will be consumed first, and any excess to be exported and sold to the distribution licensee which is Tenaga Nasional Berhad (TNB) for Peninsular Malaysia and Sabah Electricity Sdn Bhd (SESB) for Sabah at the prevailing Displaced Cost prescribed by the Energy Commission. The PV systems are allowed to be installed at available rooftops or car porch only within their own premise. Based on FiT experience, solar PV is a

technology that requires minimal construction and with high take up rate compared to other RE technologies. One factor driving such growth is the declining cost of solar PV systems in recent years. As solar PV technology is more applicable to the NEM, it is the only technology whereby the public at large can play their role in addressing climate change by generating the clean energy, hence reduce the energy consumption from electricity generated by fossil fuel powered generators. By generating their own clean energy, consumer will contribute to the reduction of CO2 emission, hence reducing the carbon foot print and mitigating climate change.

The energy generation by NEM consumer will be consumed first which implies less energy import from the utility. The more energy generated from the solar PV system is self-consumed; the more NEM consumers can save their electricity bills (by reducing the electricity imported from the utility). The NEM meter will record energy usage and excess energy produced. The connection to the distribution licensee's (TNB/SESB) network shall be done only through indirect connection, i.e. within the owner's internal distribution board only. Under the NEM, any excess energy generated will be exported to the utility grid and will be paid at the prevailing Displaced Cost as prescribed by the Energy Commission. The surplus energy supply to NEM consumers will be determined based on the leading displaced cost of the necessary voltage level supplied at the existing coupling point. The net electricity billing shall be calculated based on the following criteria;

Net Billing = (Energy Consumed from Distribution Licensee (kWh) x Gazetted Tariff) – (Energy Exported to Distribution Licensee (kWh) x Displaced Cost).

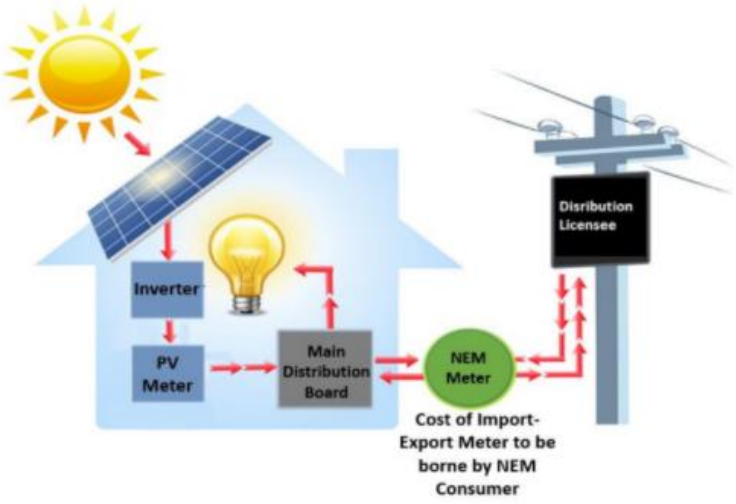

Figure 4: How the NEM works

4.2.3. Potential Renewable Energy Sources

Considering the climate changes and pollution issues, the renewable energy was considered as the fifth energy for the new alternative source in Malaysia energy mix and act as a significant contributor of the country's total electricity supply under the Fifth-Fuel Policy which was launched in 2000. The renewable energy is an energy derived from resources that are regenerative, and do not deplete over time unlike fossil fuels. The power sector in Malaysia still very much dependent on fossil fuels and with ever-increasing energy demand, it is undeniable that CO_2 and SO_2 emissions will continue to climb as long as fossil fuels remain the main contributor in the country's energy mix. Numerous amount of investigations and research and development (R&D) in renewable energy sources have shown that the renewable energy has an excellent and outstanding potential as a better alternative energy and could perform as a form of supplementary contribution to conventional power generation system.

The establishment of the Ministry of Energy, Green Technology and Water (KeTTHA) in 2009 to replace the Ministry of Energy, Communications and Multimedia was a proof of the continuous commitment of the government in promoting the efficient use of the renewable energy as a new energy source and driving the message that 'clean and green' is the way forward towards creating an economy which is based on sustainable solutions. On the other hand, the privatization of Independent Power Producers (IPPs) further increase the development of distributed generation of electricity. The main goal is none other than to supply energy that is environmentally friendly, which supports a relatively low carbon energy. These two strategies taken were parallel with the globally acceptance of the renewable energy as a better way of mitigating greenhouses emissions, controlling environmental and climate factors whilst simultaneously meeting the need of increasing energy demand especially in rural communities.

Due to the geographical attributes of Malaysia, large rivers with suitable elevation encourage the development hydropower facilities. Apart from that, being close to the equator also provides ample sunlight all year around that also makes solar power a viable option as a renewable energy source. Furthermore, being one of the world's largest exporters of palm oil also provides bountiful supply of biomass that can be utilized to produce both electricity and fuel. The list of the policy targets of the installation capacity and electricity generation for renewable energy in Malaysia are shown in Table 3 and Table 4, summarized the target of the renewable energy potential

in Malaysia in the long run. Hydropower and solar PV are the suitable renewable energy for Malaysia. However, hydropower is the only renewable energy technology that is commercially viable on a large scale in Malaysia.

YEAR	RENEWABLE ENERGY INSTALLATION CAPACITY (MW)						SHARE IN ELECTRICITY GENEREATION CAPACITY
	BIOMASS	BIOGAS	MINI-HYDROPOWER	SOLAR PV	SOLID WASTE	TOTAL	
2015	330	100	290	55	200	975	6%
2020	800	240	490	175	360	2065	10%
2030	1340	410	490	854	390	3484	13%
2050	1340	410	490	8874	430	11,544	34%

Table 3: Renewable energy installation capacity target. Source: The use of energy in Malaysia: Tracing energy flows from primary source to end use, 2015.

YEAR	ANNUAL ELECTRICITY GENERATION (MTOE)					
	BIOMASS	BIOGAS	MINI-HYDROPOWER	SOLAR PV	SOLID WASTE	TOTAL
2015	2024	613	1450	61	1223	5374
2020	4096	1472	2450	194	2208	11,229
2030	8217	2514	2450	1019	2392	16,592
2050	8271	2514	2450	13,540	2637	29,358

Table 4: Annual electricity generation target. Source: The use of energy in Malaysia: Tracing energy flows from primary source to end use, 2015.

By 2020, the target is for renewable energy to compromise 10% or 2065 MW of overall electricity generation in the country and to achieve much long ambitious target of 34% of total usage of renewable energy by 2050. Figure 5 shows identified resources based on their availability and utilization prospects.

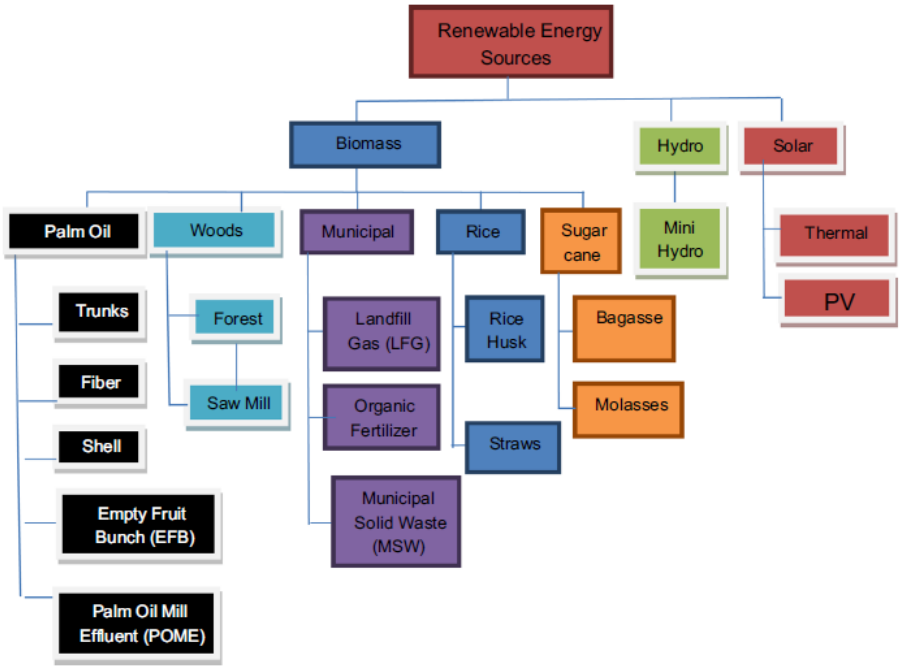

Figure 5: Major renewable energy resources in Malaysia

4.2.3.1. Biomass

Malaysia is bestowed with significant amount of the fourth largest energy resource in the world which is biomass resources. In fact, the government launched the Fifth-Fuel Policy that stated; "To supplements the conventional supply of energy, new sources such as renewable energy will be encouraged and biomass resources such as oil palm and wood waste as well as rice husks, will be used on a wider basis mainly foe electricity generation". The biomass is seriously being considered and one of the most important potential sources of the renewable energy in Malaysia because of the environment-friendly characteristics and its ability to supply much more energy than conventional energy resources. Also, it has most promising and viable option compared to others various source of renewable energy in Malaysia. Due to favorable climatic conditions and an economy that is still reliant on some form of mass agriculture, there is abundant supply of agriculture waste or post-harvest processing waste to provide significant portion to the biomass energy, mainly from oil palm waste, wood waste and paddy residues (husk and straw). For power generation, the oil pam industry generates the highest waste with 59.8 million tons, followed by paddy with 2.14 million tons and sugar with 1.11 million tons. Table 5 and Table 6 show the potential of biomass electricity in Malaysia and their estimated energy potential in Malaysia.

PRODUCT	QUANTITY (KTON/YEAR)	POTENTIAL GENERATION (GWh)	POTENTIAL CAPACITY (MW)
Rice mills	424	263	30
Wood industry	2177	598	68
Palm oin mills	17,980	3197	365
Bagasse	300	218	25
Palm oil mill effluent	31,500	1587	177
TOTAL	**72,962**	**5863**	**665**

Table 5: Biomass electricity potential in Malaysia. Source: Renewable energy for continuous energy sustainability in Malaysia, 2015.

TYPE OF INDUSTRY	PRODUCTION (MTON)	TYPE OF BIOMASS	RESIDUE GENERATED (MTON)	CALORIFIC VALUE OF BIOMASS (KJ/KG)	POTENTIAL ENERGY GENERATED (MTON)*
Oil palm	59.8	Empty fruit bunches	12.3	18,838	553
		Fronds and trunk	21.1	-	-
		Fiber	8.75	19,068	3.99
		Shell	3.94	20,108	1.89
Paddy	2.14	Palm kernel	2.11	18,900	95.00
		Rice husk	0.47	15,324	0.17
		Rice straw	0.86	13,620	0.28
Sugar	1.11	Bagasse	0.36	8021	0.069
Wood	1.67	Sawdust	0.96	19,008 - 19,188	0.44
	0.3	Plywood residue	0.069	10,000 - 19,000	0.024
Municipal waste	11,940 ton/day	Municipal solid waste	-	9500	-

*Potential energy generated (ton) = residue generated (ton) = 1000 kg x calorific value (kj/kg)/41868000 kj

Table 6: Biomass resources and their estimated energy potential in Malaysia. Source: Renewable energy for continuous energy sustainability in Malaysia, 2015.

Malaysia is the world second largest producer and exporter of crude palm oil. The development of palm oil plantation is expected to expand to 5.2 million ha in 2020. Therefore, the expansion of the palm oil industry is expected to generate huge quantities of biomass wastes from fruit fibers, palm kernel, shell empty fruit bunches, trunks and fronds that could be used as a potential source of the renewable energy. This is because, 1 ha of palm oil plantation can produce 50-70 tons of biomass residues. Apart from that, oil palm also has good potential in producing biomass energy due to its calorific contains. Malaysia produces about 15 million metric tons of palm oil per year in. One ton produces about 414 kg of biodiesel. With a calorific value of about 40,000 kJ/kg, it can generate a total energy supply of about 7.8 GW /year from palm oil. As shown in Table 7, is the residue product ratio and potential power can be generated from palm oil wastes. Currently, the main use of palm oil biomass is in the form of cogeneration charcoal production, timber drying and electricity generation.

PRODUCTION ('000 TON)	RESIDUE	RESIDUE PRODUCT RATIO (%)	RESIDUE GENERATED ('000 TON)	POTENTIAL ENERGY (PJ)	POTENTIAL ELECTRICITY GENERATION (MW)
59,800	EFB at 65% MC	21.14	12,641.70	57	521
	Fiber	12.72	7606.6	108	1032
	Shell	5.67	3390.7	55	545
Total solid			16,670.60	220	2098

Table 7: Residue product ratio and potential power from palm oil wastes. Source: A review, on existing and future energy sources for electrical power generation in Malaysia, 2012.

Agriculture crops from paddy can also be viewed as a potential biomass resource stream. A paddy consists of 20% of husk, rice husk in turn contains 16-22% ash and 90-96% of the ash is composed of silica (silicon dioxide, SiO_2). By 2020, it is estimated that Malaysia will produce 768,290 tons of rice husk. 1kWh can be generated from1.5 kg of rice husk, which as a result by 2020 Malaysia can produce 512 TWh using rice husk residue. From these data, it is clearly shown that the increasing amount of paddy production has high potential in the technology to convert the paddy husk residue for energy purpose.

On the other hand, the sugarcane bagasse is another significant agriculture crops that can be used to generate electricity thus, can assist in reducing the dependency on fossil fuels sources to another level. The annual production of sugarcane bagasse, which is the fibrous waste that remains after recovery of sugar juice via crushing and extraction, reaches a few million tons. Nearly 30% of that number will turn into bagasse when it is crushed in a sugar factory. A ton of bagasse (50% mill-wet basis) is equal to 1.6 barrels of fuel oil on energy basis. The caloric value for dry bagasse equals to 17.22 MJ/kg, therefore, for example, for every 300,000 tons of sugarcane are produced per year, with a moisture of 50%, we can get 150,000 tons of dry bagasse annually. As an outcome, the total energy potential of 0.421 million boe per year can be generated. At the time, all the bagasse is being used as boiler fuels in sugar mills operating in the country.

4.2.3.2. Biofuel and biodiesel

Biodiesel is biologically produced from vegetable oil and animal fats using a trans-esterification process. In Malaysia, palm oil is the main raw stock for biodiesel production, which boasts the most active palm industry globally. However, the use of biofuels is relatively small in Malaysia despite the establishment of the National Biofuel Policy in 2006 to promote the usage of biofuel from the palm oil as an alternative, environmentally friendly energy source for electric generation and renewable transportation fuel. The potential of utilizing biodiesel is quite attractive and promising

as it can save costs for taxpayers and private business since it can be produced by farmers that grow various fuel crops. The palm oil is one of the few vegetables oils in the market with a crop-specific sustainable certification standard, the Roundtable on Sustainable Palm Oil. Indonesia and Malaysia are the largest producers of the world's palm oil, which is about 85%. Malaysia has the potential to utilize palm resources into the potential renewable energy especially biofuel from the palm oil plantation industry as the palm oil plantation in Malaysia make up of 77% of agricultural land or about 15% of total land area. Also, with the tropical weather and average rainfall reported to be 200-250 cm per year, palm trees from which the palm oil is extracted, can be grown easily in Malaysia.

In 1980, the government designed a palm diesel program and the biodiesel based on the palm oil was programmed to have 5% palm oil and 95% diesel blended for vehicles and industries in 1982. The proactive commitment from the government to promote the production and the usage of the biodiesel also reflected via the establishment of the Malaysian Palm Oil Board (MPOB) in 2000. Its principal objectives are to conduct and promote research and development in the palm oil tree breeding, palm oil nutrition and potential oleo-chemical use. The government also is prepared to support and subsidized development of technology that will convert palm oil into biodiesel and lignocellulose onto bioethanol. Palm wastes in East Malaysia and some parts of the Peninsular had been utilized to produce bioethanol or drop in fuels as well as paddy waste for thermochemical conversion into bio oils. The price of using E10 blend was estimated to be RM 1.37/l based on gasoline price at RM 1.50/l and the cost price of bioethanol at RM 1.50/l. Although oil prices have changed a lot since, the fact that Malaysia heavily subsidizes its fuel for public consumption makes blending with a slightly higher costing biofuel a feasible option to reduce its subsidizing bill. Besides that, palm based-biofuel refineries have been constructed in rural area especially (which is where the palm oil plantation is situated) with the main goal to displace petroleum fuels and fulfill domestic energy demand. In addition, these initiatives have provided the opportunity to expand the capacity of rural electrification. If only 8% of the land area used for palm cultivation is used to provide biofuel, it is estimated that Malaysia can only fully utilize the palm biomass to fulfill 35.5% energy demand in the country.

4.2.3.3. Mini hydroelectric

Mini hydroelectric projects have become attractive and viable alternative compared to conventional and large scale hydroelectric dams due to lower capital cost, maintenance and reliability. In term of environmental friendliness, smaller sized of

operations of the mini hydroelectric dams contribute a lot in reducing the environmental impact of clearing lands to build the dams and flooding forest areas for reservoirs. Normally, a mini hydroelectric dam generates up to 10 MW of electricity. There were 26 approved applications of mini hydroelectric projects under SREP with a total generation capacity of 102 MW and 97 MW grid connected capacity. The rural regions of East Malaysia (Sabah and Sarawak) are sparsely populated and some communities are not connected to any energy grids, therefore, most of these projects under SREP are located in those rural areas, which total capacities generated are 8.3 MW in Sabah and 7.3 MW in Sarawak. For an instance, besides providing an ample supply of the electricity from a cleaner and a more sustainable source of energy to the residents of Long Lawen, Sarawak, an installed station of mini hydroelectric project also able to eliminate the consumption of 1000 gallons of diesel per year. By 2020, under the Malaysia renewable plant, the targeted installed capacity for mini hydroelectric is expected to increase to 490 MW.

4.2.3.4. Municipal solid waste (MSW)

Municipal solid waste in Malaysia is managed mainly through the disposal of wastes to open landfills. The local authorities and waste management consortia manage approximately 17,000 tons of the MSW everyday throughout the country. However, due to rapid development and lack of new space, the big cities and islands are considering incineration as a new method to tackle this problem. The calorific value of Malaysia MSW ranges from 1500 to 2500 kcal/kg and the energy potential from an incineration plant operating based on 1500 tons of MSW/day with an average calorific value of 2200 kcal/kg is 640 kW/day. Apart from generating energy via the incineration method, biogas energy also can be generated from the MSW as it is also an effective and profitable method for solid waste disposal. The first MSW power station connected to the national grid is Jana Landfill Gas (LFG) which is situated at a landfill area known as Air Hitam Sanitary Landfill. The 2 MW power plant receives about 3000 tons of daily domestic wastes form major areas of Klang Valley. In future, the Jana LFG power plant will undergo major expansion due to its potential to produce energy for a period of 20 years. It is estimated that the amount of the MSW will reach to 9 million tons per year by 2020 due to rapid population growth. From that figure, average amount of MSW generated on daily basis is expected to reach 24,650 tons; which has the potential to generate 500 MW of electricity.

4.2.3.5. Solar

Malaysia is bestowed with abundance of sunshine throughout the year as being an equatorial country. Malaysia is situated on the South China Sea and lies between 1° and 7° in North latitude and 100° and 120° East longitude with an average solar radiation of 400-600 MJ/m^2 per month as shown in Figure 6. Besides, Malaysia has uniform temperature and its climate is generally hot all year long with the mean daily solar radiation in most places in Malaysia is approximately 4700-6500 Wh/m^2. The lowest solar radiation was estimated at 610 Wh/m^2 while the highest was 6800 Wh/m^2 in August and November. The states in the northern region of peninsular Malaysia and several areas in East Malaysia have high solar radiation throughout the year as stated in Table 8. The annual mean temperature varies from 26° C to 28° C and as it is wet climate country, there is abundant solar radiation, although the cloud cuts off a substantial amount of sunshine. Considering that Malaysia gets on average 4-8 hours of free and bountiful sunshine every day, the potential for solar power generation in Malaysia is very high and solar energy is estimated to be 4 times more than the world fossil fuel resources. Thus, along with other essential characteristics features of the climate in Malaysia such as light winds, high humidity, and copious rainfall, the solar energy is definitely a promising source of clean energy in Malaysia.

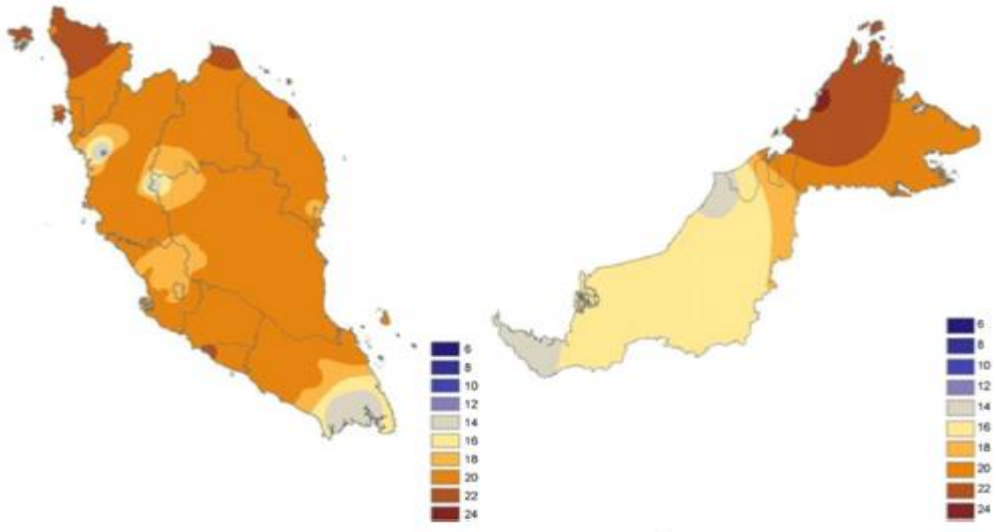

Figure 6: Annual average solar radiation (MJ/m^2/day). Source: Renewable energy for continuous energy sustainability in Malaysia, 2015.

TOWN	YEARLY IRRADIANCE (kWh/m2)
Bandar Baru Bangi	1487
Bayan Lepas	1809
Geaorgetown	1785
Ipoh	1739
Johor Bahru	1625
Kota Baru	1705
Kota Kinabalu	1900
Kuala Lumpur	1571
Kuala Terengganu	1714
Kuantan	1601
Kuching	1470
Petaling Jaya	1571
Seremban	1572
Senai	1629
Taiping	1768

Table 8: Yearly average solar radiation in major towns in Malaysia. Source: Renewable energy for continuous energy sustainability in Malaysia, 2015.

Energy radiated from the sun is about 3.8 x 1023 kW, which is 1.082 Mtoe per day. Approximately, 70% is absorbed by the ocean, land masses and clouds while the rest is released back into space. Sunlight absorbed by land masses and the ocean keeps the earth surface at the average of 14° C. Through the process of photosynthesis, green plants convert solar energy (also known as photovoltaic, PV) into chemical energy, which produces food, wood, and biomass from where fossil fuel is derived. However, all the renewable energies derive their energy from the sun except for tidal and geothermal energy. The continuous scientific challenge that need to be faced for this renewable energy resource is to find the most efficient way to collect, convert, store, and utilize it at an affordable cost. That is the main reason why at present, the solar PV applications in Malaysia is constricted to rural electrification, street and garden lighting, and telecommunications, while solar water heaters are basically used for small food and beverages industries, heating purposes in hotels and upper-class urban homes. However, the real harnessing of this renewable energy source for commercial and domestic use is way below its actual potential due to the very high cost to produce mass generation of electricity systems from the PV systems as well as most of the materials are imported from overseas.

Even though the advantages of the solar energy system are tremendously beneficial towards the environment as there is no pollution due to the production of the greenhouse gasses and it could be modular, there is still lack of efficiency and penetration of the solar energy utilization as one form of the alternative energy to the

highest potential especially for residential sectors. The implementation of the Feed-In Tariff (FiT) and Net Energy Metering (NEM) scheme could potentially assist in the increase of the solar PV. The solar energy is expected to surpass other renewable energy sources by 2020 if the price continues to decline and the technology turns into more financial and economical feasible for the commercial use.

4.3. ACTUAL SITUATION AND POTENTIAL OF SOLAR ENERGY

In this section, we will discuss the current situation of solar energy scenario all around the globe and in Malaysia as well as its potential. As we discussed in the previous section, the solar energy is one of the cleanest form of energy resources as it does not compromise or add the matter worst to the global warming. Although there is potential in biomass, biogas, municipal waste and mini hydro, the solar energy has been identified as the alternative energy source to replace fossil fuel energy sources such as oil and coal along with the highest potential in satisfying the energy needs worldwide, and of Malaysia, particularly. The solar energy does not deplete natural resources, does not cause CO_2 or the other gaseous emission into air or generates liquid or solid waste products. Apart from that, the following list below are the main direct or indirectly derived advantages of solar energy:

- No emissions of greenhouse (mainly CO_2, NO_x) or toxic gasses (SO_2, particulates)
- Reclamation of degraded land
- Minimizing the transmission lines from electricity grids
- Improvement of quality water resources
- Increasing of regional/national energy independence
- Diversification and security of energy supply
- Acceleration of rural electrification in developing countries

At present, PV power from the solar energy generates only 1% of total electricity supply worldwide and it covers merely a minor portion of global energy demands. According to the 2015 IRENA Renewable Capacity Statistics, the world cumulative installed solar energy capacity was 222,360 MW, a change of 26.8% compared to 2014. Meanwhile, solar photovoltaic technology is capable to harness the sun's energy to provide large-scale, domestically secure, and environmentally friendly electricity. In 2015, global solar markets reached US$ 65 billion. Demand for silicon for solar cells is expected to increase from 120,000 tons in 2010 to 400,000 tons in 2015

The early history of the application of solar photovoltaic began in 1970s yet its technology development only started in 1990s, when various countries realized its potential and started to introduce incentives to support it. Japan and Germany were among the first countries to show their support by including 70,000 solar roof program

in 1995 and 100,000 solar roof program in 1999 respectively. The solar energy became the fastest-growing renewable energy worldwide due to the supportive policy in these countries. At the end of 2015, there is total capacity of roughly 260 GW of solar PV installed on Earth, with China ranked in the first place with 15.15 GW of solar capacity added in 2015 thus maintained its position as leader of the massive market. The rapid decline of PV costs in the last three decades contributes to the boom of solar PV market, as a learning rate of 19.3% was recorded, which signifies the cost reduction of 19.3% for every capacity building. The trend is expected to continue, parallel with the development and improvement from time to time in the PV manufacturing and production process. It is predicted that the PV will achieve the competitive cost to retail electricity price in the markets soon, thus by 2030, it will be competitive along the wholesale electricity price.

The solar electricity will be the largest of all electricity sources and it is believed that it will contribute to 25% of global energy production. Therefore, the world now is on progress to make the solar energy as the main alternative in power generation in the future with the help of the encouraging policies towards the development of the solar energy and the drop of solar PV generation costs. For the time being, the mini-grid and off-grid solar PV systems are competitive enough with other electricity alternatives, while in some situations, the small-scale solar PV systems are competitive with others.

According the findings of an investigation on sunlight measurement, it was found that the annual energy output for selected Malaysian cities (Kuala Lumpur, Johor Bahru, Melaka, Kuantan, Kota Bahru, Kuching, Penang and Kota Kinabalu) varies between 1170 to 1600 kWh/kWp for roof-top PV systems and 630-839 kWh/kWp for façade PV systems. Those cities underwent similar measurement to conduct this study and as a result, when compared to 41 cities from 26 countries, the average annual energy output of roof top PV systems from these cities is among the top half for the roof-top solar panel systems. The outcomes from this study has provided ample information for the government to promote the solar energy systems application by introducing the Malaysia Building Integrated Photovoltaic (MBIPV) Technology Application Project which launched in July 2005 to 2010. The FiT program has been receiving a growing acceptance by public and the cumulative installed capacity in Malaysia financed by this program has reached 295.54 MW MW end of 2016 which solar PV leads all the renewable energy sources with highest capacity installed, 32.46 MW capacity. The Net Energy

Metering also will likely boost the number n solar power plants and demand in the coming years.

Another factor that could contribute to the potential of solar energy in Malaysia is the well positioned of Malaysia to become one of the major key in solar cell industry. Malaysia's participation as a full member of the International Energy Photovoltaic Power System Program (IEAPVPS) since 2008 also established the importance of Malaysia's position in the international solar PV industry. Third Industrial Master Plan (IMP3) was launched by the government and solar PV was identified as one of the focused technologies. The IMP3 was launched as the government recognized the potential of Malaysia to fulfill the global demand for and produce the solar PV modules and silicon. Regardless of the limits and constraints such as the solar PV market in Malaysia is extremely small, the solar PV industry has gained such a huge confidence and significance internationally due to the presence of key international PV manufacturers in Malaysia, namely First Solar Inc, Q-Cells AG, SunPower Technology Corporations, Tokuyama Corporations GEWD of Solarfabrik (Germany), ReneSola (China), Hanwha Q-Cells (Korea) and Au Optronics Company (Taiwan).

Ranked as the world's third largest producer of solar PV cells and modules, Malaysia has an ecosystem comprising 250 companies, involved in upstream activities such as poly silicon, wafer, cell and module production such as inverters and system integrators. In 2016, export and local sourcing activities undertaken by the top solar companies in the country was valued at RM 11.1 billion and RM 1.42 billion respectively. Many leading global solar PV module producers and companies has attracted to Malaysia because Malaysia offers the relatively low cost and English-speaking workforce and generous tax breaks. Malaysia also is benefitting from the anti-dumping duties levied by the USA and European Union on leading solar PV manufacturing countries such as China and Taiwan. Thus, Malaysia is set to become a hub for production of solar PV modules worldwide. Due to the high trust of the international solar PV manufacturers in the solar PV industry in Malaysia, it is estimated that the solar PV industry will contribute up to 4% to the national GDP by 2020 through revenues exceeding RM 500 billion (USD 154.5 billion).

Large scale solar is another implementation that increase the growth of the solar industry in Malaysia. By date, many solar PV service providers and international companies have been participating in the construction of the large scale solar farm such as Huawei which the construction work of 50 MW of solar PV site will become the largest installation of solar farm in Malaysia once it is completed. Gading Kencana Sdn Bhd also

has been contributing to the installation of large scale solar farm 8 MW in Melaka and during the first of its commencement in 2015, Gading Kencana was the pioneer of this kind of project in Malaysia. All the large scale solar farm will supply the energy produced from the solar PV power plant to Tenaga Nasional Berhad (TNB) or other distribution licensee via the connection to the national grid under the FiT scheme to supply electricity nationwide. Besides, other local solar PV manufacturers such as Polytool, Solartif, Channel Systems and Compo Enterprise also play their own vital roles in the solar PV industry from products manufacturing, supply to trading. Apart from that, to further develop and improve the solar PV industry to its highest potential, the government has been introducing the capital incentives to ensure the soft infrastructure of the solar PV industry is continuously taking shape. A three-prong strategy which includes capacity enhancement for local PV service providers, quality control scheme, and awareness program for public and commercial sectors has been implemented to address energy security and creating a conducive economy in green technology.

Finally, the involvement of research institutions and universities have helped tremendously in exploring the potential of solar energy and observing or predicting any possible changes or trends in the utilization of solar energy. Various and ongoing research and development (R&D) of the renewable energy are conducted by the research institutes such as SIRIM Berhad, the government research agency as well as four prominent research-oriented public universities; University of Malaya (UM) which dedicates on energy conservation in industries and alternative fuels, Universiti Putra Malaysia on solar and biomass, Universiti Sains Malaysia on solar energy, PVs, and rural energy planning, and Universiti Kebangsaan Malaysia (UKM) on solar energy and fluidized bed combustion.

4.4. LIMITATIONS AND BARRIERS DEVELOPING SOLAR ENERGY IN RESIDENTIAL SECTOR IN MALAYSIA

In this section, we will discuss the limitations and the barriers on developing solar energy in Malaysia, particularly regarding low penetration on the purchase of solar photovoltaic (PV) panel system among the Malaysian, especially the homeowners. The extraction and utilization of sun light power is relatively less for a country like Malaysia which is rich in sunshine throughout the year with about 4.0-4.9 kW h/m^2/day of solar radiation and a daily sunshine duration ranging from 4 to 8 hours. It is important to identify and determine all the reliable factors and potential solutions to each of the barriers in order to increase the participation of the public in the usage of solar energy as the new energy in the future thus, increase the electric capacity from the solar energy in electricity supply industry in Malaysia. Apart from that, knowing the limitations and the barriers in this issue will assist the government to make any significant changes in the energy policies to cope with the environment issues related to the change of climate due to environmental pollution from excessive usage of the non-renewable energy resources such as oil, natural gas and coal.

4.4.1. Environmental Concerns

Environmental awareness is the key factor for purchase intention of green products or in this case, the solar PV panel system. In this context, the environmental concerns refer to the level of individual's concern to the environmental surroundings which leads to conscious action of purchasing the solar PV panel system. Lack of social awareness and lack of understanding in the knowledge of solar energy at all levels in society pose a major setback in the utilization of solar PV panel system. The public's ignorance of the environmental benefits attributed to the less consumption of solar energy. However, surprisingly, despite the high cost for installation of the solar PV panel system, environmental concern consumers are willing to pay more to address the environment issues. The government must take the lead and find ways to generate public will in supporting the solar energy agenda. The continuous efforts from the government and non-governmental organization (NGO) to increase awareness regarding the renewable energy and green campaign to protect our environment are

highly required especially in stressing the benefits of solar energy, legal requirements, financial aspect and environmental advantages.

4.4.2. Technology Barriers

Another factor that contributes to the challenge of developing solar energy in Malaysia is the lack of local technical experts in solar PV panel system. Malaysia has insufficient amount of skilled labor entering the profession to retain the skills among local human resources. Even though foreign labor can get the installation job done, but the competency is not on par as the skilled local solar installers. Thus, the level of confidence among the potential customers is relatively low specially to install the solar PV panel system in the long run due to lack solar installers that are hardly available to assist them immediately whenever related technical issues rise. The technology barriers like grid installation, rust formation in cable wires and metal grid also might create minor maintenance problems in the long run usage. To add matter worse, the cost factor for maintenance could be a recurring problem if the solar panel parts are not available on time as most of the spare parts are imported from developed countries such as Japan and Germany. Even though the technology of the solar PV system especially the solar cells are highly advance and rapidly changing for the last several years ago and does not show any sign to slow down, the minimal problems stated below still give blurry perspective on the solar PV system.

To increase the level of acceptance of the utilization of solar PV panel system among the public, a high level of technology awareness is necessary to enable the public to make firm decision regarding the installation of the solar PV panel system and the consumption of solar energy. To make all the necessary information is accessible by the public, the government has provided details of information regarding implementation of the solar technology and build technical capacity. Another step to encourage the individuals in Malaysia to install the solar PV panel system on the rooftop of their houses, several showcases of energy-efficient buildings have been built complete with the demonstration of the solar PV technology. These buildings demonstrated the feasibility of high energy efficiency, combine with the renewable energy generation from the building itself. Also, large scale training and community awareness programs can be carried out to facilitate an easy and smooth transition from conventional to modern renewable energy solutions. Recently, Malaysian Photovoltaic Industry Association (MPIA), Universiti Teknologi Malaya (UiTM) and the Sustainable Energy

Development Authority Malaysia (SEDA) are working together to get as many qualified solar installers in Malaysia.

4.4.3. Economic Barriers

The main challenge that contributes to the slow growth of the solar energy in Malaysia, even though Malaysia has a strong potential of utilizing solar energy in large scale based on the location at equatorial region which has continuous supply of sunlight is due the huge amount of capital investment required. Although the price of the solar PV system installation decreases over time, even the cost of installation of 12 kWp solar PV system now is below RM 60,000, the public still feel doubtful to invest their money or obtain loan to install the solar PV system due to lack of awareness that the installation of the solar PV system could be another form of investment for the future and alternative to save their electric consumption. Although they understood that they will be benefitted for the long run investment in solar PV system installation, the uncertainty of technology and existing debts of the majority of the public act as the barrier towards the investment. Therefore, the government and local bank could establish dedicated credit or financial loans facilities with low interest rate to make solar power or in this case, the solar PV panel system installation attractive to the public. Presently, only one local bank which is Alliance Bank is ready to offer loans facilities to the public who interested to start the investment in the solar energy.

Another significant alternative to attract the public to involve in the installation of the solar PV panel system is implementation of Feed-in Tarif (FiT) and Net Energy Metering (NEM) program. To promote further the installation of the solar PV panel system, any interested Malaysian can use their opportunity to use their Employees' Provident Fund (EPF) contribution withdrawal to involve in the investment in solar energy thus contributing to the high rate of green energy application.

Finally, as a crucial step to boost the development of solar technology and develop a market for solar energy with attractive prices for users as well as suppliers, the government should imply subsidies to the solar energy. The withdrawal of the subsidies on the fossil fuels does not always worsen the economy, in fact it could boost it to efficient use of energy. When the subsidies on the fossil fuels are removed, offset mechanism should be introduced by giving other financial incentives to increase the usage of the renewable energy especially the solar energy such as tax exemption for the utilities that suffer from increase of production cost.

4.4.4. Aesthetics Aspects

Size of the roof could be one of the challenge why the landed house owners are not interested enough to install the solar PV panel system on the rooftop of their homes. This is because, at times when birds release their droppings or perch on the solar panels, it creates a mess on the solar panel resulting unpleasant sight and reducing the efficiency of the solar panels. Some of the homeowners have their own opinion that the solar panel are ugly as the TV aerials or satellite dishes in some houses. Hence, the aesthetics aspects also are identified as a barrier for solar PV panel system installation.

4.5. APPLICATIONS OF SOLAR PHOTOVOLTAIC (PV) ENERGY

Solar energy is known as a promising source of clean, green and renewable energy. The solar energy produces less negative impacts on the environment than other energy sources like fossil fuels, which are often produced with harmful side effects, thus making it as the most prominent among other renewable sources. Due to its status as an inexhaustible and safe source of renewable energy, the environmental pollution and global warming problems can be reduced using the concept of photovoltaic technology. The photovoltaic is used to convert solar energy (sunlight) to electrical direct current (DC) energy. The conversion of sunlight into electricity using solar cell installed in a solar panel happens when the solar cell converts energy in the photons of sunlight into electricity by means of the photoelectric phenomenon. This phenomenon can be found in certain types of semiconductor materials such as silicon and selenium. Normally, typical photovoltaic (PV) device utilizes an individual junction type of cell to generate electricity. A solar PV system includes PV modules or known as solar panels. A module consists of small solar cells and a typical single silicon cell can produces 1 to 2 W of power. The efficiency and stability of solar cells in the solar PV panel system relies on the chemical and structural stability of the device which are subject to weather conditions like humidity, temperature, insolation and spectral characteristics of sunlight (light exposure). Presently, the efficiency of photovoltaics cells is about 12% to 19% at the most promising condition. Eventually, by applying this concept of technology in the electricity production capable to reduce environmentally hazardous gasses which are commonly produced in electricity generation using the conventional energy sources.

The conventional solar cells are made of crystalline silicon that has atoms arranged in a three-dimensional array thus making it an efficient semi-conductor. Producing solar cells involves a very huge amount of cost and it creates several drawbacks even though the silicon is commonly used for electricity generation due to high material costs for silicon, costly processes for purifying silicon and manufacturing wafer, additional processes for assembly of modules and the bulky and rigid nature of the photovoltaic panels. Figure 7 depicts a typical PV cell under illumination. There are two kinds of PV modules that are usually used in the solar cells; monocrystalline silicon and polycrystalline silicon. Monocrystalline silicon is a crystalline in which the crystal lattice of the entire silicon sample is continuous and unbroken at the edges of the sample, with

no grain boundaries. Meanwhile, polycrystalline silicon (also known as poly-silicon or poly-Si) is made up of many smaller crystals known as crystallites. The crystallites are the combination of monocrystalline and polycrystalline technologies. The performance of monocrystalline silicon and polycrystalline silicon are optimum when they are under hot sun. This efficiency of the crystalline silicon is due to the ability of providing high cell efficiency. However, among these two groups of silicon, the monocrystalline silicon is the most efficient PV module compared to the polycrystalline silicon.

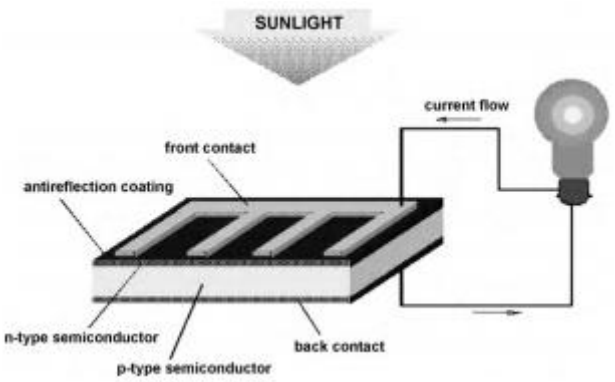

Figure 7: Photovoltaic cell under illumination

In Malaysia, the photovoltaic systems are generally categorized into 2 main groups or sub market; namely stand-alone PV power system and on-grid PV power system as shown in Figure 8. Stand-alone systems are the systems which are not connected to the grid which is known as off-grid non-domestic PV power system. The energy produced by the stand-alone system is usually matched with the energy required by the load. The stand-alone systems normally are equipped and supported by energy storage systems such as rechargeable batteries to provide electricity when there is no light. In some situations, wind or hydro systems are supporting each other, where there are called "photovoltaic hybrid systems". Meanwhile, on-grid PV power systems consist of grid-connected distributed PV power system and grid-connected centralized PV power system. The on-grid PV power systems work by demanding energy from the grid when there is not enough power generation on the panels and feeding in the power to the grid when there is more than required power by the systems. This principle is known as "net-metering".

Figure 8: Solar PV system solutions; grid-connected and off grid PV system

Normally, the grid connected systems are growing in the developed countries and urban housing area in the developing countries while the stand-alone systems in remote or rural areas in the developing and non-developed countries. That is why there are some villages are called as "solar village" due to widely operated of solar energy systems in majority of the houses where there is huge cost of wiring and transferring electricity to the rural areas. Small PV power systems are usually used in building industries where they can generate electricity for lights, water pumps, TVs, refrigerators and water heaters. Other applications for stand-alone systems are traffic lights, parking ticket machines, solar vehicles, gardening and landscaping equipment and solar pump systems and desalination. The operation of the stand-alone PV power systems depends on the power extracted from the PV panels.

The advantage of the PV system is that it does not require any moving parts or emissions of any kind during operation. Besides low maintenance is required as the solar panels need to clean occasionally using mop and no pollution is produced, the photovoltaic technology has its own renowned reputation as it is preferred to be power technology for many remote applications for both space and on the ground.

4.5.1. Solar PV Panel System Basic Components for Residential Installation

In this section, we will discuss the four basic components which are typically installed in the solar PV panel system for residential installation to convert the solar energy into electricity; known as solar panel, solar inverter and solar PV battery storage

4.5.1.1. Solar panel

As we discussed earlier, solar panel consists of solar cells which made up from crystalline silicon to convert photons of the sunlight to electricity. The solar panels can be found in different types and sizes, depending the electricity usage in each building or particularly in this case, houses. This is because, there are various types of homes as well as various tiers of electricity in each home. Before choosing the right solar panel to install, it is crucial to understand the different types of solar panels and to consider how much power to be generated per area of the rooftop as choosing the type of solar panel merely based on its cost is not practical and reliable. In order to increase current capacity and power generation, it is recommendable to install multiple solar panels on the rooftop especially which can be wired in parallel with tilt angle of 30° (normal tilt angle for the solar panels on the rooftop in Malaysia). The following are the types of solar panels that available in the market;

- Monocrystalline Panels – Monocrystalline panels are considered as the most efficient among other types of panels due to its composition which is made up from pure silicon. Thus, the monocrystalline panels are capable to absorb the sunlight efficiently. Besides, the entire cells in this type of panels are aligned only in one direction to assist in the sunlight absorption at the right angle. However, due to its high efficiency, these panels are unsurprisingly more expensive. Contrarily, the monocrystalline panels are ideal to install at space-limited area for example on rooftop of the house which not a lot of panels are required to generate the electricity. This is due to the shape of these panels are octagonal in shape with uniform blacker color which typically consists of smaller solar cells.
- Polycrystalline Panels – Polycrystalline panels are made from polycrystalline silicon which is widely known as the most common and the cheapest type of solar panels. The efficiency of these panels is not on par as the monocrystalline panels as the cells are formed in blocks which are

not necessarily perfectly aligned. In terms of appearance, this type of panels typically has inconsistent color (sort of granite) as the cells are arranged randomly in squares. The crystallites on the polycrystalline panels are branched into many smaller crystals and are not uniform. The polycrystalline panels are suitable for the installation at the larger area such as farms or fields.

- Hybrid Panels – Hybrid panels are considered as the most efficient solar panels available in the market. These panels have a thin layer of amorphous thin film behind the monocrystalline cells. The hybrid panels are recommended on the spacious area where maximum amount of energy can be generated from there. These panels are far more expensive than other types of panels due to its high efficiency and more energy generation from available sunlight even though in low light conditions.

Apart from understanding the types of the solar panels, distinguishing types of solar panel mounting system will also help in facilitating the installation of the solar panels for residential space. The types of the solar panel mounting systems can be divided into two groups; adjustable solar panel mounts and tracking solar panel mounts. The adjustable solar panel mounts allow to modify and set the tilt angle according to seasons while the tracking solar panel mounts which is way much more efficient yet expensive, able to follow the sun's path during the day to maximize the sunlight absorption.

To understand the solar PV system installation, it is important to understand several important terms as follows;

- kWh – kilowatt hour
- kW – kilowatt in DC rating
- kWp – kilowatt peak. Rated kWp in relation to a PV installation means the maximum direct current power such installation can produce under standard test conditions of 1000 watts per square meter of solar irradiation and 25-degree Celsius ambient temperature.
- A number of individual *cells* are combined in a panel or module.
- A number of PV modules in *series* is a string.
- A number of strings in parallel is an *array.*

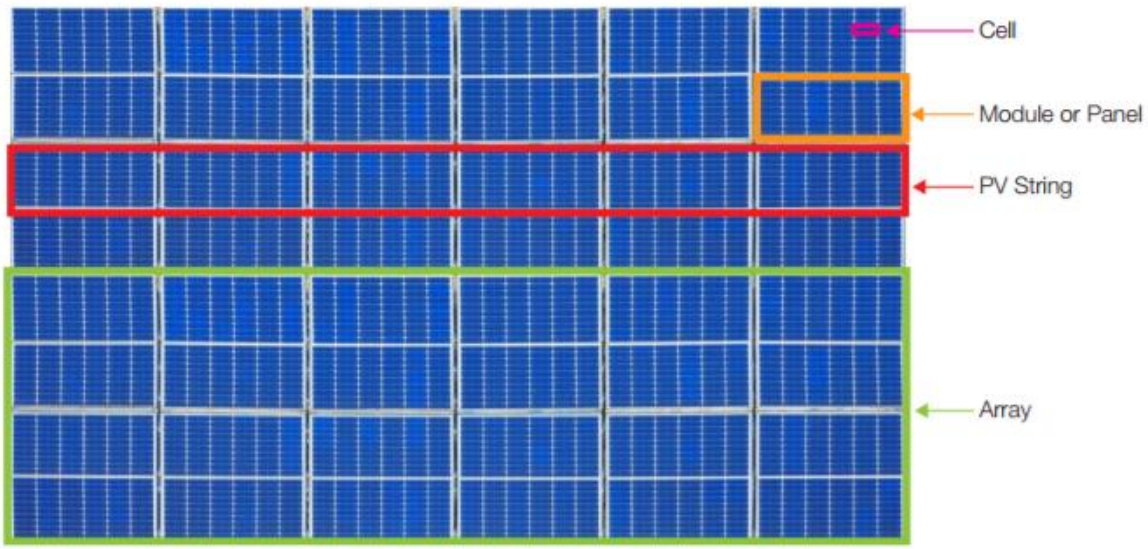

Figure 9: Photovoltaic module structure explained.

How solar PV systems work;

- Solar PV cells are made from semi-conductor materials which convert solar (light) energy into DC electricity.
- Solar PV cells are connected in series to form a PV module.
- To generate higher power PV modules are connected in series to form a PV string.
- PV strings are connected in parallel often by means of a combiner box to generate higher current.
- The DC voltage /current is inverted into an AC voltage/current and fed into the grid.

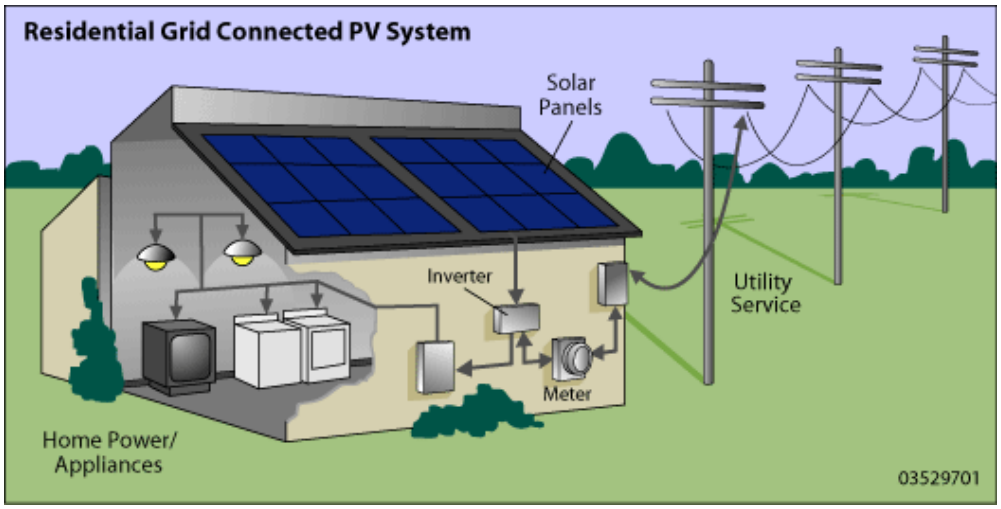

Figure 10: How residential grid connected solar PV system works.

4.5.1.2. Solar inverter

Solar inverter is a device that converts direct current (DC) power to alternate current (AC) power to be able to run any common appliances in the house. That is because, most electric loads (i.e. lights, appliances, tools, etc.) operate on AC. The size of solar inverter may vary, depending on the daily electricity usage of the electrical equipment or appliances in the house and the duration of the electricity usage. Normally, the average house requires around 4000-5000 watts continuous power. The used inverter must be able to handle the maximum expected power of AC loads. Therefore, it can be selected as 20% higher than the rated power of the total AC loads that present in the house. Otherwise, the inverter will start to limit the amount of power transfer to the grid when the power exceeds the nominal power rating.

Several criteria that can assist to choose the correct inverter in order to function smoothly are as follows;

- The selection on the wider input Maximum Power Point (MPP) voltage range of the inverter that can accept more or longer modules in serial per strings can be connected.
- The inverter's MPP voltage range limits must be matching with the operating DC voltage of the PV array (A PV array consists of any number of PV modules and panels).
- Suitable condition for operating ambient temperature range in actual field.

Types of the solar inverters that widely available in the market to choose from are;

- Micro-Inverter – This type of inverter converts direct current (DC) to alternate current (AC) directly from behind each solar module. It allows installer to create easier and cost-effectively solar systems. Typically, the micro-inverter has 15 years of warranty and is considered as reliable and highly efficient in producing more power.
- String Inverter – With this type of inverter, the solar panels are wired in series, thus maximizing the voltage and keeping the current low in order to minimize the size of wire and keep the wiring simple. The string inverter is widely use and has a typical 10-20 years of warranty.
- Central Inverter – Central inverter is similar with the string inverter, but it is specifically used in large scale applications and has a much easier installation compared to the normal size string inverter. It offers high

efficiency, resulting to a much higher cost and 5 years (extendable up to 20 years) of warranty period.

4.5.1.3. Solar charge controller

Although it is not necessarily to use solar charge controller, still, it plays vital role to keep all the components in the solar PV system, particularly the stand-alone solar PV system in check to maintain the solar panel runs smoothly and efficiently for a long period of time. This is because, the higher the absorption of the sunlight, the more voltage produced by the solar panel. Therefore, extremely excessive voltage may damage the solar PV batteries. Therefore, the solar charge controller need to be installed along with other main components; to keep the right charging voltage on solar PV batteries and prevent the solar PV batteries from overcharging. Also, the solar charge controller helps to prolong life of the solar PV system as it regulates the charge to the solar PV batteries. The solar charge controller goes through 3 different stages of charging cycle as follow;

- First Stage: Bulk - While the solar PV batteries extract maximum current, voltage slowly rises to bulk level (up to 16.6 V). When it reaches the bulk current, second stage begins.
- Second Stage: Absorption - At this stage, the voltage is kept at a bulk level for about 1 hour while the current slowly decreases as the battery is charging.
- Third Stage: Float – After the absorption stage, the voltage now is lowered to a float level (up to 13. 7 V) while the battery draws a small maintenance currents that will be enough until the next charging cycle.

There are two types of solar charge controllers, namely; maximum power point tracking (MPPT) and pulse width modulation (PWM). The MMPT reduces battery's charging time and turns extra voltage to amperage while the PWM slowly reduces the battery's power supply without overcharging, thus, minimizing stress to the battery. The components of the solar charge controller include battery system monitor, automatic voltage selection, on/off battery charging, field adjustment parameters, temperature compensation, lighting protection and LED digital indicator light.

4.5.1.4. Solar PV battery storage

Solar PV battery storage is equally important as other components of the solar PV system especially for the stand-alone power system. Although the cost of the solar PV battery storage is relatively expansive, it is worthy to have it along with the solar charge

controller because it signifies guaranteed power even without the sunlight or generator running. This is due to the function of the solar PV battery storage that stores direct current (DC) when there is an excess generated energy by the solar modules and distributes the energy back when it is required. The following are the four basics types of batteries;

- RV/Marine Type – It is a deep cycle battery which is commonly used for boats and campers as it is suitable only for small systems. The deep cycle batteries are lead acid batteries. They are often used in stand-alone power system and wind power applications. They are designed to be regularly deeply discharged to a greater depth.
- Flooded Type – One of the three heavy industrial batteries type; the lead acid batteries which have caps to add water or release gas when it is fully charged.
- Gel Type – Another heavy industrial battery type which basically has no vent system and does not release gas during charging process occurs.
- AGM Type – Absorbed Glass Mat or AGM batteries are the most expensive compared to the other types of batteries, but it is unlikely leak or spill and, it does not release gas while being charged.

To maintain the battery charge, the solar PV system continues to recharge the batteries every day to be able to still provide continuous flow of power supply even in the case of a power failure.

4.6. INVESTMENT PROJECTION FOR SOLAR PV SYSTEM CONSUMERS

In order to attract more new consumers of solar PV system in residential sectors, the government has established and implemented 2 major programs or schemes; Feed-in Tariff (FiT) and Net Energy Metering (NEM) that allow the public to generate their own electricity from the solar PV system and at the same time, has the access to the grid and supply and sell the electricity generated to the Distribution Licensee; Tenaga National Berhad at favorable price per unit. Therefore, in this section, we will discuss the investment projection and economic advantages for the consumers who installed the solar PV system at their own houses and participate in these 2 programs. We will compare also the price of electric bill between the conventional electric consumers and the consumers who have their own electricity generated at their houses using the installed solar PV system.

As we discussed before, Malaysia is bestowed with several sources of renewable energy namely, biomass, biogas, mini-hydro and solar that are eligible for the public to generate electricity from them and thus participating in the Feed in Tariff program. However, for the Feed-in Tariff (FiT) program, the only renewable energy that is eligible for the individuals or the domestic consumers to generate the electricity from is the solar PV energy. The other resources of the renewable energy; biomass, biogas and mini hydro are normally specified for non-individual categories. Generally, the Feed-in Tariff (FiT) program is a viable and long-term investment for the consumers who installed the solar PV system at their houses.

Meanwhile, the Net Energy Metering (NEM) program is a program that is dedicated for the solar PV only. The participants of the Net Energy Metering (NEM) program can save their electric bills by consuming first the electricity generated by the installed solar PV system, therefore reducing the electricity imported from the utility.

4.6.1. Investment Returns in Feed-in Tariff (FiT)

By using 12 kWp solar PV system as an example, assuming the cost of investment is as the cost of solar PV system installation offered by the SolarNext company, which is RM 58,340 and 21 years duration of FiT period, first, we will calculate the return of investment with the data of FiT rates as shown below;

FiT Rates for Solar PV (Individual) (21 years from FiT Commencement Date)

Description of Qualifying Renewable Energy Installation	FiT Rates (RM per kWh)
(a) Basic FiT rates having installed capacity of :	01-JAN-2017 ▼
(i) up to and including 4kW	0.7424
(ii) above 4kW and up to and including 12kW	0.7243
(b) Bonus FiT rates having the following criteria (one or more) :	
(i) use as installation in buildings or building structures	+0.1395
(ii) use as building materials	+0.1060
(iii) use of locally manufactured or assembled solar PV modules	+0.0500
(iv) use of locally manufactured or assembled solar inverters	+0.0500

Table 9: FiT rates from 1st January 2017 for solar PV (Individual). Source: FiT rates, SEDA, www.seda.gov.my, 2017.

Though the sun is up for 12 hours every day in Malaysia, the solar panels only work with direct sunlight, thus in the early mornings and evenings, the solar panels are not so effective in absorbing the sunlight and converting energy in the photons of sunlight into electricity. Therefore, it is estimated that the solar panels absorb the sunlight for 4 hours (average peak sun hours) on average per day.

- System capacity: 12 kWp
- Cost of investment: RM 58,340.00
- Feed in tariff rates (RM per kWh): RM 0.7243 (up to 4 kW and up to and including 12 kW) + RM 0.1395 (use as installation in buildings or building structures) = RM 0.8638 ≈ RM 0.90
- The electricity received based on 12 kWp solar PV system installed = 12kWp x 4 hours/day = 48 kWh per day.
- Investment calculation; 12 kW x 4 hours/day x RM 0.90 x 30 days/month = RM 1,296.00 per month.
- In one year; RM 1,296.00 x 12 = RM **15,552.00**
- Return on investment; RM 15,552.00 / RM 58,340.00 = 26.66% per year and it takes 3.75 years to return on investment.

- Projected net yield; RM 15,552.00 (each year earning) x 21 years – RM 58,340 = RM 268,252.00
- After the system is paid off, the consumer will receive pure profit for; 21 years – 3.9 years = 17.1 years.

The calculation above is quite straight forward as it does not take account if the consumer obtains loan from bank to install the solar PV system and does not include the inflation rate. However, assuming the average inflation rate is 4% set by Bank Negara Malaysia, the projected net yield for each year may reduce into half on 18th year of the Feed-in Tarif (FiT) investment, according to the rule of 72; (72/ inflation rate = 72/4 = 18 years). Therefore, it is estimated that that the *value* of the investment earning is RM 7776.00 on years 18, half from the original value of the earning on the first year of the investment due to the inflation. Thus, the *value* of the amount of the return of investment is likely to decrease over years even though the investment earning received by the consumer every year is RM 15,552,00.

The more details of calculation if the consumer obtains the loan from the bank to install 12 kWp solar PV system are as follows;

- System capacity: 12 kWp
- Cost of investment: RM 58,340.00
- Assuming the consumer obtains the loan from the bank with the value;

Own resources	20%	RM 11,668.00
External resources (bank loan)	80%	RM 46,672.00

Table 10: Consumer's financing. Source: Prepared by the author.

- The characteristics of the loan;

Capital	RM 46,672.00
Number of years	6
Annual interest	7%
Fraction (m)	12
Number of periods	72
Monthly interest	0.5262%

Table 11: Characteristics of the loan. Source: Prepared by the author.

- Breakdowns of the interest and loan's amortization by year;

PERIOD	INTEREST	AMORTIZATION
YEAR 1	RM2,721.78	RM7,778.67
YEAR 2	RM2,230.63	RM7,778.67
YEAR 3	RM1,739.48	RM7,778.67
YEAR 4	RM1,248.33	RM7,778.67
YEAR 5	RM757.19	RM7,778.67
YEAR 6	RM266.04	RM7,778.67
TOTAL	RM8,963.44	RM46,672.00

Table 12: Breakdowns of the interest and loan's amortization by year. Source: Prepared by the author.

- The income statement of the 12 kWp solar PV system installation includes the expenses of the solar PV system installation which are the operation costs (maintenance, insurance), capital allowance (technical amortization) and tax as shown in the Table 13 and Table 14 below. Note that the tax imposed is only 2.5% as it is an initiative provided by the government to encourage the public to invest in the renewable energy.

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Energy(KWh/Year)	0	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458	15,458
Power installed (12.1 kWp)																						
Price RM/KW (RM 0.90)	RM -	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98
TOTAL INCOME	RM -	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98
OPERATION EXPENSES	RM -	RM 463.73	RM 500.83	RM 540.90	RM 584.17	RM 630.90	RM 681.38	RM 735.89	RM 794.76	RM 858.34	RM 927.00	RM 1,001.16	RM 1,081.26	RM 1,167.76	RM 1,261.18	RM 1,362.07	RM 1,471.04	RM 1,588.72	RM 1,715.82	RM 1,853.08	RM 2,001.33	RM 2,161.44
Maintenance cost (1.5%)	RM -	RM 231.87	RM 250.42	RM 270.45	RM 292.08	RM 315.45	RM 340.69	RM 367.94	RM 397.38	RM 429.17	RM 463.50	RM 500.58	RM 540.63	RM 583.88	RM 630.59	RM 681.04	RM 735.52	RM 794.36	RM 857.91	RM 926.54	RM 1,000.67	RM 1,080.72
Insurance (1.5%)	RM -	RM 231.87	RM 250.42	RM 270.45	RM 292.08	RM 315.45	RM 340.69	RM 367.94	RM 397.38	RM 429.17	RM 463.50	RM 500.58	RM 540.63	RM 583.88	RM 630.59	RM 681.04	RM 735.52	RM 794.36	RM 857.91	RM 926.54	RM 1,000.67	RM 1,080.72
AMORTIZATION	RM -	RM 19,835.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
6 years	RM -	RM 19,835.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
TOTAL EXPENSES	RM -	RM 20,299.33	RM 8,668.43	RM 8,708.50	RM 8,751.77	RM 8,798.50	RM 8,848.98	RM 735.89	RM 794.76	RM 858.34	RM 927.00	RM 1,001.16	RM 1,081.26	RM 1,167.76	RM 1,261.18	RM 1,362.07	RM 1,471.04	RM 1,588.72	RM 1,715.82	RM 1,853.08	RM 2,001.33	RM 2,161.44
GROSS MARGIN	RM -	RM (6,387.36)	RM 5,243.54	RM 5,203.48	RM 5,160.21	RM 5,113.47	RM 5,063.00	RM 13,176.09	RM 13,117.22	RM 13,053.64	RM 12,984.97	RM 12,910.81	RM 12,830.72	RM 12,744.22	RM 12,650.80	RM 12,549.90	RM 12,440.94	RM 12,323.25	RM 12,196.16	RM 12,058.89	RM 11,910.64	RM 11,750.54
FINANCE EXPENSES																						
Loan	RM -	RM (2,721.78)	RM (2,230.63)	RM (1,739.48)	RM (1,248.33)	RM (757.19)	RM (266.04)	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
CASH-FLOW	RM -	RM (9,109.13)	RM 3,012.92	RM 3,464.00	RM 3,911.87	RM 4,356.29	RM 4,796.96	RM 13,176.09	RM 13,117.22	RM 13,053.64	RM 12,984.97	RM 12,910.81	RM 12,830.72	RM 12,744.22	RM 12,650.80	RM 12,549.90	RM 12,440.94	RM 12,323.25	RM 12,196.16	RM 12,058.89	RM 11,910.64	RM 11,750.54
EARNINGS BEFORE INTEREST & TAXES	RM -	RM (9,109.13)	RM 3,012.92	RM 3,464.00	RM 3,911.87	RM 4,356.29	RM 4,796.96	RM 13,176.09	RM 13,117.22	RM 13,053.64	RM 12,984.97	RM 12,910.81	RM 12,830.72	RM 12,744.22	RM 12,650.80	RM 12,549.90	RM 12,440.94	RM 12,323.25	RM 12,196.16	RM 12,058.89	RM 11,910.64	RM 11,750.54
Tax (2.5%)	RM -	RM (227.73)	RM 75.32	RM 86.60	RM 97.80	RM 108.91	RM 119.92	RM 329.40	RM 327.93	RM 326.34	RM 324.62	RM 322.77	RM 320.77	RM 318.61	RM 316.27	RM 313.75	RM 311.02	RM 308.08	RM 304.90	RM 301.47	RM 297.77	RM 293.76
EARNINGS AFTER INTEREST & TAXES	RM -	RM (8,881.41)	RM 2,937.59	RM 3,377.40	RM 3,814.08	RM 4,247.38	RM 4,677.04	RM 12,846.69	RM 12,789.29	RM 12,727.30	RM 12,660.35	RM 12,588.04	RM 12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77

Table 13: Income statement of the consumer who installed 12 kWp solar PV system. Source: Prepared by the author.

CASH-FLOW

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
INITIAL OUTLAY	RM -	RM (11,668.00)	RM (8,492.47)	RM (5,165.95)	RM (1,399.62)	RM 2,803.39	RM 7,439.70	RM12,505.68	RM25,352.36	RM38,141.65	RM 50,868.95	RM 63,529.30	RM76,117.34	RM 88,627.29	RM 101,052.90	RM 113,387.43	RM 125,623.58	RM137,753.50	RM 149,768.67	RM 161,659.92	RM 173,417.34	RM 185,030.22
EARNINGS AFTER INTEREST AND TAXES	RM -	RM (8,881.41)	RM 2,937.59	RM 3,377.40	RM 3,814.08	RM 4,247.38	RM 4,677.04	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77
Technical amortization	RM -	RM 19,835.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM 8,167.60	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Financing expenses	RM -	RM 2,721.78	RM 2,230.63	RM 1,739.48	RM 1,248.33	RM 757.19	RM 266.04	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
CASH-FLOW FOR DEBT PERIOD	RM -	RM 13,675.97	RM 13,335.82	RM 13,284.48	RM 13,230.01	RM 13,172.16	RM 13,110.68	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77
CASH-FLOW FOR CUMULATIVE DEBT	RM -	RM 2,007.97	RM 4,843.35	RM 8,118.53	RM 11,830.39	RM 15,975.56	RM 20,550.38	RM25,352.36	RM38,141.65	RM50,868.95	RM 63,529.30	RM 76,117.34	RM88,627.29	RM 101,052.90	RM 113,387.43	RM 125,623.58	RM 137,753.50	RM149,768.67	RM 161,659.92	RM 173,417.34	RM 185,030.22	RM 196,486.99
Interest of loan	RM -	RM (2,721.78)	RM (2,230.63)	RM (1,739.48)	RM (1,248.33)	RM (757.19)	RM (266.04)	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Amortization (Loan repayment installment)	RM -	RM (7,778.67)	RM (7,778.67)	RM (7,778.67)	RM (7,778.67)	RM (7,778.67)	RM (7,778.67)	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Amortization capital free loan	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
CASH-FLOW FREE PERIOD	RM -	RM 3,175.53	RM 3,326.53	RM 3,766.33	RM 4,203.01	RM 4,636.31	RM 5,065.97	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77
CASH-FLOW FREE CUMULATIVE	RM -	RM (8,492.47)	RM (5,165.95)	RM (1,399.62)	RM 2,803.39	RM 7,439.70	RM 12,505.68	RM25,352.36	RM38,141.65	RM50,868.95	RM 63,529.30	RM 76,117.34	RM88,627.29	RM 101,052.90	RM 113,387.43	RM 125,623.58	RM 137,753.50	RM149,768.67	RM 161,659.92	RM 173,417.34	RM 185,030.22	RM 196,486.99
Total investment	RM (58,340.00)																					
Loan formalization	RM 46,672.00																					
Free loan formalization	RM -																					
RESIDUAL OUTLAY	RM (11,668.00)	RM (8,492.47)	RM (5,165.95)	RM (1,399.62)	RM 2,803.39	RM 7,439.70	RM 12,505.68	RM25,352.36	RM38,141.65	RM50,868.95	RM 63,529.30	RM 76,117.34	RM88,627.29	RM 101,052.90	RM 113,387.43	RM 125,623.58	RM 137,753.50	RM149,768.67	RM 161,659.92	RM 173,417.34	RM 185,030.22	RM 196,486.99
ANNUAL CASH-FLOW	RM (11,668.00)	RM 3,175.53	RM 3,326.53	RM 3,766.33	RM 4,203.01	RM 4,636.31	RM 5,065.97	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77

SUMMARY OF ECONOMIC-FINANCIAL ANALYSIS OF SOLAR PV SYSTEM 12 kWp

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Installation income	RM -	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM13,911.98	RM13,911.98	RM13,911.98	RM 13,911.98	RM 13,911.98	RM13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98
Annual income	RM -	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM13,911.98	RM13,911.98	RM13,911.98	RM 13,911.98	RM 13,911.98	RM13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98	RM 13,911.98
Operation expenses	RM -	RM (463.73)	RM (500.83)	RM (540.90)	RM (584.17)	RM (630.90)	RM (681.38)	RM (735.89)	RM (794.76)	RM (858.34)	RM (927.00)	RM (1,001.16)	RM (1,081.26)	RM (1,167.76)	RM (1,261.18)	RM (1,362.07)	RM (1,471.04)	RM (1,588.72)	RM (1,715.82)	RM (1,853.08)	RM (2,001.33)	RM (2,161.44)
Financing	RM -	RM (2,721.78)	RM (2,230.63)	RM (1,739.48)	RM (1,248.33)	RM (757.19)	RM (266.04)	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Technical amortization	RM -	RM (19,835.60)	RM (8,167.60)	RM (8,167.60)	RM (8,167.60)	RM (8,167.60)	RM (8,167.60)	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Annual expenses	RM -	RM 23,021.11	RM 10,899.06	RM 10,447.98	RM 10,000.10	RM 9,555.69	RM 9,115.01	RM 735.89	RM 794.76	RM 858.34	RM 927.00	RM 1,001.16	RM 1,081.26	RM 1,167.76	RM 1,261.18	RM 1,362.07	RM 1,471.04	RM 1,588.72	RM 1,715.82	RM 1,853.08	RM 2,001.33	RM 2,161.44
EARNINGS BEFORE INTEREST AND TAXES	RM -	RM (9,109.13)	RM 3,012.92	RM 3,464.00	RM 3,911.87	RM 4,356.29	RM 4,796.96	RM13,176.09	RM13,117.22	RM13,053.64	RM 12,984.97	RM 12,910.81	RM12,830.72	RM 12,744.22	RM 12,650.80	RM 12,549.90	RM 12,440.94	RM 12,323.25	RM 12,196.16	RM 12,058.89	RM 11,910.64	RM 11,750.54
Tax (2.5%)	RM -	RM (227.73)	RM 75.32	RM 86.60	RM 97.80	RM 108.91	RM 119.92	RM 329.40	RM 327.93	RM 326.34	RM 324.62	RM 322.77	RM 320.77	RM 318.61	RM 316.27	RM 313.75	RM 311.02	RM 308.08	RM 304.90	RM 301.47	RM 297.77	RM 293.76
EARNINGS AFTER INTEREST AND TAXES	RM -	RM (8,881.41)	RM 2,937.59	RM 3,377.40	RM 3,814.08	RM 4,247.38	RM 4,677.04	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77
ANNUAL PERIOD CASH FLOW	RM -	RM 3,175.53	RM 3,326.53	RM 3,766.33	RM 4,203.01	RM 4,636.31	RM 5,065.97	RM12,846.69	RM12,789.29	RM12,727.30	RM 12,660.35	RM 12,588.04	RM12,509.95	RM 12,425.61	RM 12,334.53	RM 12,236.16	RM 12,129.91	RM 12,015.17	RM 11,891.25	RM 11,757.42	RM 11,612.88	RM 11,456.77
RESIDUAL CASH FLOW	RM (11,668.00)	RM (8,492.47)	RM (5,165.95)	RM (1,399.62)	RM 2,803.39	RM 7,439.70	RM 12,505.68	RM25,352.36	RM38,141.65	RM50,868.95	RM 63,529.30	RM 76,117.34	RM88,627.29	RM 101,052.90	RM 113,387.43	RM 125,623.58	RM 137,753.50	RM149,768.67	RM 161,659.92	RM 173,417.34	RM 185,030.22	RM 196,486.99

Table 14: Cash flow and summary of economic-financial analysis of 12 kWp solar PV system. Source: Prepared by the author.

4.6.2. Saving the Electric Bills by Net Energy Metering (NEM) Program

Through the Net Energy Metering, the consumer could save their electric bill as the consumer who installs a solar PV system primarily for his own use probably has the excess energy to be exported to the grid for which credit to be received that may be used to offset part of the electricity bill for energy provided by the Distribution Licensee (TNB/SESB) to the electricity consumer during the applicable billing period. This is because, the solar PV system installed on the rooftop, may generate more electricity than the home uses. The extra electricity produced will provide a credit against electricity that is consumed. The credit (excess energy) to NEM consumer will be based on prevailing Displaced Cost for the relevant supply voltage level at the Point of Common Coupling. The calculation for the net billing of electricity will be based on the following calculation;

Net billing = [Energy Consumed from DL (kWh) x Gazetted Tariff] – [Energy Exported to DL (kWh) x Displaced Cost]

As an example, according to the Illustration 11 below which is a sample of electric bill of the consumer's house under the NEM program, the electricity consumed from the distribution licensee in that billing period from 2.2.2106 to 4.3.2016 (as shown in 6, Figure 11) is 874 kWh (as shown in 7, Figure 11). The current billing charge of the imported energy of that billing period is RM 391.96 (as shown in 8, Figure 11) after deducting the Imbalance Cost Past Through (ICPT) and implementing the Good an Service Tax as well as Kumpulan Wang Tenaga Boleh Baru (KWTBB). ICPT is a mechanism that allows TNB as the utility to reflect changes (either increase or reduction) in fuel and other generation-related costs in the electricity tariff every six months while on the other hand, KWTBB is a fund collected by the government through the consumer's electricity consumption and the fund will be used to promote growth of electricity generation from the renewable energy resources.

The billing charge of the exported energy to the distribution licensee (TNB) is the product of excess electricity generated by the consumer who installs the solar PV system at his house (which the electricity is consumed first by the consumer) and the displaced cost. This the point where the consumer could save his electricity bill as the billing charge of the exported energy to the distribution licensee (TNB), RM 126.14 (as shown in 9, Figure 11) will be deducted from the current billing charge of the imported energy

of that billing period. As a result, the net amount of billing charge of that billing period is RM 265.82 (as shown in 10, Figure 11). Instead of paying RM 391.96 or probably more, the consumer who installs the solar PV system, consumes the electricity generated from it and export the excess electricity generated to the distribution licensee manages to save 32.18% of his electricity bill under the Net Energy Metering (NEM) program.

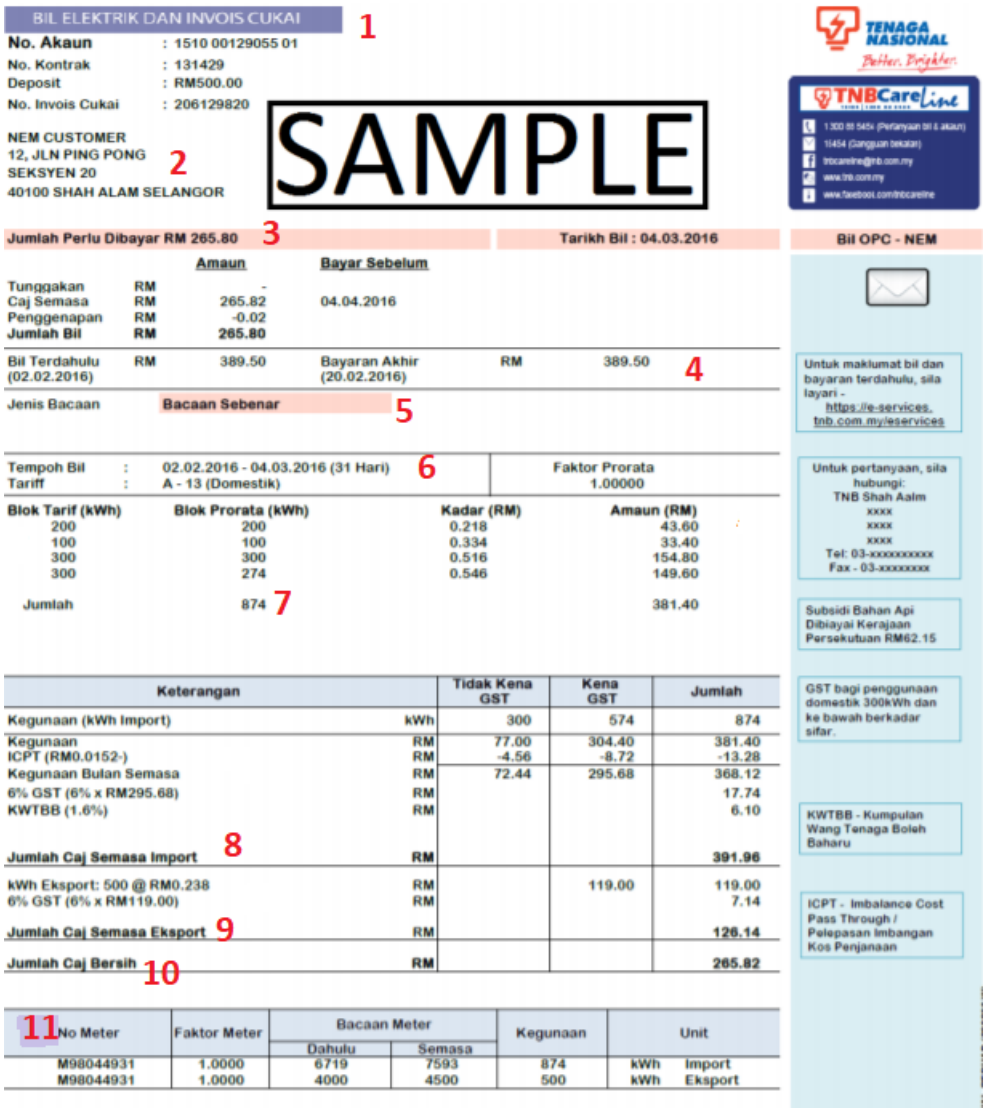

Figure 11: Sample of electric bill from TNB

Bill format;

- 1 – Bill invoice details and payment status
- 2 – Customer's details

- 3 – Current billing amount and payment
- 4 – Previous billing amount and payment
- 5 – Types of meter reading
- 6 – Billing period
- 7 – Current billing details
- 8 – Current billing charges
- 9 – Current electricity exported to the distribution licensee (TNB)
- 10 – Net amount of billing charges
- 11 – Regular meter and NEM meter reading

4.6.3. Review on Stand-alone Solar PV System in Malaysia

Stand-alone solar PV system is also known as off grid solar PV system. The stand-alone solar PV system supplies electricity to properties that are not connected to the public electricity network provided by Tenaga Nasional Berhad (TNB) especially at rural areas. The components of the stand-alone solar PV system consist of solar panels, charge controller, inverter and battery. Basically, the electricity generated by solar panels either directly powers the electrical loads and batteries via an inverter or charger controller as shown in the Figure 12. At night, the inverter supplies the energy stored in the battery bank and when the sun comes up the next day, the cycle begins again. Normally, the stand alone solar PV system provides regular 220 V – 240 V electricity for all regular household electrical appliances.

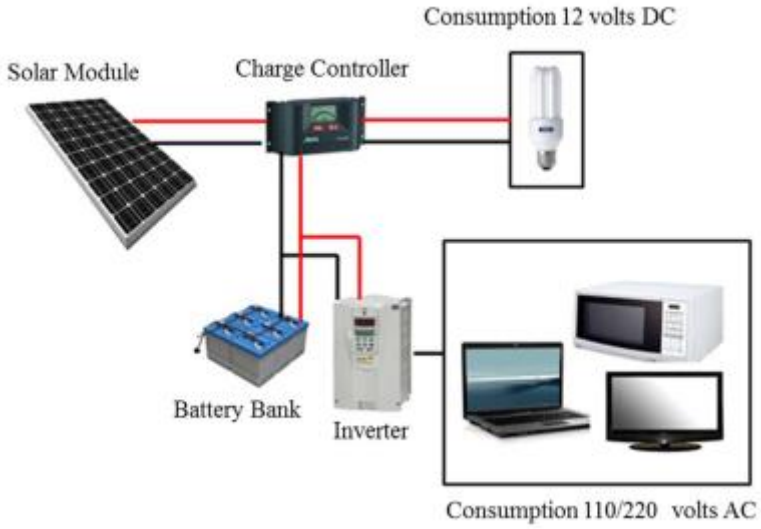

Figure 12: How stand-alone solar PV system works

The advantages of the installation of the stand-alone solar PV system are; the installation only requires minimal maintenance cost for a long period of time as the solar PV panels are guaranteed for 20 – 25 years and the other components such as charge controller and battery could last for 7 – 10 years. Besides that, the installed stand-alone solar PV system is environmentally friendly because, the electricity generated and consumed by the consumer will indirectly reduce power transmission losses and the stand-alone solar PV system displaces the conventional source of energy that requires 24 hours a day fossil burning proses to sustain the national grid. The stand-alone solar PV system installation also will lower the carbon footprint while providing clean electricity.

The main advantage of installing the stand-alone solar PV system is, once the consumer installed the stand-alone solar PV system at his house, he could be satisfying to own his own proper and complete equipment to generate electricity knowing that he will be immune from ever increasing grid installation cost and increasing utility rates or electricity kilowatt hour (kWh) tariff rates. Thus, the consumer is likely to enjoy free electricity by eliminating the electricity bills for a very long duration, which depends on the remaining lifetime of the stand-alone solar PV system installation after reaching the payback period.

However, in Malaysia, there is no incentives or subsidy available provided by the government for the installation of the stand-alone solar PV system at residential units. The installation of the stand-alone solar PV system at residential units per kilowatt hour is extremely expensive for the consumers especially the homeowner even though they may enjoy the advantages stated before. The payback period may take longer than the lifetime of the of the stand-alone solar PV system installation and the investment in the stand-alone solar PV system installation offers unappealing rate of return of investment. The calculation of the payback period of the stand-alone solar PV system installation at residential unit to prove whether it is viable or not is shown in the following paragraphs below.

Assuming the load profile which is the total watt hours (Wh) per day for each appliance used in a small house is 1880 Wh. The total power and energy consumption for all loads come from the regular, normal electrical appliances in the house such as fluorescent lamp, fan, refrigerator and television. The system designed for the stand-alone solar PV system for this house consists of 4 solar panels, an inverter of 1000 W, a charge controller of 720 W and two batteries with usable capacity of 250 Ah.

Considering the total Wh per day is equal throughout the whole month, the total of load profile per month of the house is **56.4 kWh**.

The cost of the installation of the all the components of the stand-alone solar PV system could be higher than the cost of the grid connected solar PV system installation due to high cost of charge controller and batteries and may also contributed by higher price of the solar panels which the consumer may be purchases without the wholesale or retail price unlike the solar PV system service providers. Capital costs of the system are as follows;

- Initial costs = Cost of solar panels + cost of inverter + cost of charge controller + cost of batteries + cost of balance of system and installation = (RM 1525/solar panel x 4 solar panels) + (RM 1200/inverter x 1 inverter) + (RM 741/charge controller x 1 charge controller) + (RM 970/battery x 2 batteries) + System wiring price and installation (RM 430) = **RM 10,411.00.**
- Installation costs over system life cycle (for 25 years) = (RM 1525/solar panel x 4 solar panels) + (RM 1200/inverter x 4 inverters) + (RM 741/charge controller x 4 charge controllers) + (RM 970/battery x 6 batteries) + System wiring price and installation (RM 760) = RM 20,444.00. *This calculation is for estimation only and does not include in the calculation of the payback period; assuming no inflation throughout the system life cycle.

The total initial cost to install the stand-alone solar PV system that generates electricity of 56.4 kWh per month is RM 10,411.00. As a comparison, the cost to install the 4-kWh grid connected solar PV system that could generates electricity 480 kWh per month is RM 20,660.00 (according to the price of installation package by SolarNext). It is shown that the cost of the installation of the stand-alone solar PV system is extremely pricey for the time being for the consumer to enjoy the advantage of free electricity bill in the long run after the payback period.

The payback period for this situation is as the calculation following; assuming the consumer does not obtain loan from the bank to finance the installation. Firstly, we need the calculate the amount of electric bill monthly from the electricity consumption of the house per month which is 56.4 kWh. The current tariff rates of the electricity consumption up to 200 kWh determined by Tenaga Nasional Berhad (TNB) is RM 0.218. Therefore, the electric bill per month is; 56.4 kWh x RM 0.218 = RM 12.2952 ≈ RM 12.30 and the total of the electric bill of the year is **RM 147.60**, assuming the electricity

consumption is equal every month throughout the year. The total of the electric bill of the year is considered as the savings per year as the stand-alone solar PV system will provide free electricity for the consumer without paying the electric bill to TNB. Therefore, the payback period = Initial costs (installation costs) / annual benefits (annual savings) = RM 10,411.00 / RM 147.60 **= 70.5 years.**

As a conclusion, the economic viability of the stand-alone solar PV system is not attractive enough to encourage the consumer in Malaysia to install the stand-alone solar PV system and enjoy the free electricity bill as the payback period overpass almost 3 times the lifetime of the stand-alone solar PV system. Despite that, the stand-alone solar PV system installations are normally take place in rural areas in Malaysia such as villages in islands or jungles because many communities exist in rural areas suffer from the lack of electricity. Providing electricity for them is a difficult task as connecting the electricity grid to these rural areas may be technically impossible due to the geographical reasons or economically too expensive as there will be cabling costs and high cost to put up electricity substations nearby.

However, the consumer still can consider installing the grid connected solar PV system at reasonable costs and participate in the Feed-in Tariff (FiT) or Net Energy Metering (NEM) programs to invest in the solar energy technology while saving the electric bill and contributing to the environment by consuming the green and clean renewable energy especially solar energy. Furthermore, if the monthly electric bill of the house provided by Tenaga Nasional Berhad (TNB) is below and up to RM 20.00, the consumer could enjoy the subsidy provided by the government, therefore receives the free electric bill. The consumers may find that this subsidy which has been offered since October 2008 is much more appealing rather than installing the stand-alone solar PV system to enjoy the free electric bill after the payback period even though the average of the electric consumption is much lower than they might think.

4.7. DESCRIPTION OF COMPANY

SolarNext Sdn Bhd is a new company that ready to join other well established key players in the sector of specializing in solar photovoltaic (PV) system installation in Malaysia, particularly in Melaka. SolarNext is a company owned and operated by the partnership of two experienced mechanical engineers; Amirul Ahmad and Akif Razid. Both of them have left their respective jobs in order to dedicate and specialize in consulting the installation of solar PV system in residential buildings. They recognized the potential of the installation of solar PV system service in residential area in Melaka since Melaka is targeted to achieve status as a Green Technology City-State by 2020. Melaka government is committed and proactive in encouraging the installation of the solar PV system at any types of building especially at the rooftop of the residential buildings to achieve the target and widen the applications of solar energy in Melaka. The company will target the homeowners that intent and interested to install the solar PV system at their own houses within the state of Melaka and surrounding areas such as Muar and Port Dickson.

SolarNext acknowledge the rising concern of government and public on solar energy utilization by offering wide area of services across the diverse, ever revolving solar PV system industry including consultancy, project management, design, supply, installation and testing as well as commissioning of complete solar PV system that fulfills Malaysian Feed in-Tariff (FiT) and Net Energy Metering (NEM) requirements in residential category. SolarNext starts with only 14 workers under the direction and management of 2 Directors of the company and a manager. Yet, with a core staff of engineers, SolarNext is ready to offer expertise and knowledge in solar PV system installation to customers and dedicated in ensuring that solar energy is accessible to everyone. Besides, as a reliable and trusty Engineering, Procurement and Construction (EPC) service provider that offer full service innovative solar power solutions, the company ensures that all staffs are regularly kept up-to-date on the latest technology and are given hands-on training, so the customers get to reap the benefits of solar energy in a truly hassle-free manner from beginning to end. SolarNext also provides turnkey project of exceptional quality and cost effective for our customers.

To reaffirm the assurance in service and strive to achieve the balance of co-existing between business and the green environment by providing excellent quality solar PV system and exceptional services to the customers, SolarNext is approved as one of the registered Photovoltaic Service Providers by Malaysian Photovoltaic Industry

Association (MPIA) and Sustainable Energy Development Authority Malaysia (SEDA). SolarNext is operated from a shop lot that operates and functions as the office room and technical space in Ayer Keroh, Melaka near to Ayer Keroh's Industrial Area which is considered as a strategic area to reach to the homes of potential customers for the solar PV system installation. The 20 feet x 70 feet area of shop lot that serves as the operation area for SolarNext is leased and will accommodate the necessary office equipment such as computers, fax machine and other engineering or technical equipment.

The primary objectives of SolarNext over the next year are to;

- Achieve 5% of market share in the installation of solar PV system in the residential sector in Melaka.
- Generate a net profit of RM 2 million in the first year of operations by developing a strong client base.
- Create networking with key industry leaders, PV system manufactures, conducting seminars and workshop to educate the public and joining key environmental agencies.
- Achieve the ISO 9000 certification by improving constantly to establish position of the company.
- Create partnership with customers to provide innovative solutions to meet their needs and demands.
- Provide reliable services and excellent customer service to achieve customers' satisfaction.

Vision of SolarNext – To be at the forefront of the installation of solar PV system market in Melaka through tactical planning, incisive strategies, market share gain while striving to meet the growing green energy demand in the community as well as educating and creating awareness on benefits of venturing into solar energy.

Mission of SolarNext – The company strive to improve performance over times through enhance technology and management system. Our mission is to commit ourselves to our customers by providing the best quality solar PV system and exceptional services at competitive price while working hard to meet their needs through combined effort and innovation. We strive to be the most favorable solar energy service provider in Melaka.

4.7.1. Business Entity of the Company

SolarNext Sdn Bhd is a private company that limited by shares. SolarNext carries "Sendirian Berhad" or "Sdn Bhd" behind the name of the company according to Section 22(4) of the Companies Act, 1965. Every activity related to the registration of the company must be done at Companies Commission of Malaysia (SSM). A Sendirian Berhad or Sdn Bhd company is translated as a Private Limited Company which means the liabilities of its shareholders are limited to the number of shares they hold in the company. Any amount of debts beyond their shareholdings, they are not liable but provided there is no fraud or other malpractices.

The requirements to form the Sdn Bhd company are;

- A minimum of two subscribers to the shares of the company (Section 14).
- A minimum of two directors (section 122).
- A company secretary who can be either; An individual who is a member of a professional body prescribes by the Minister of Domestic Trade Cooperative and Consumerism and an individual licensed by the Companies Commission of Malaysia (SSM).

Both director and company secretary shall have their principal or only place or residence within Malaysia. The director must declare under oath that he/she is not a bankrupt and has not been convicted and imprisoned for any prescribed offences. A part form that, the Sdn Bhd company can only be incorporated if its memorandum and articles;

- Restricts the right transfer its shares subject to the approval of its directors
- Limits the number of its members to not more than 50 (requires a minimum of 2 natural persons, but allow another company to wholly own 100% of its issued shares).
- Prohibit any invitation to the public to subscribe for any shares or debentures of the company.
- Prohibits any invitation to the public to deposit money with the company for fixed periods or payable at call, with or without interest.

There is no minimum paid-up capital requirement to set up the Sdn Bhd company in Malaysia to fund the day to day operations such as to pay salary, debts and other expanses. However, to apply for a loan, license, tender or any business dealings between the Sdn Bhd company and the government agencies, banks or other entities,

it is important that the company may require meeting a minimum amount of paid-up capital.

The Sdn Bhd company needs to register its authorized capital upon its incorporation with by the Companies Commission of Malaysia (SSM). The authorized capital also known as the authorized share capital, the nominal capital or the registered capital of the Sdn Bhd company in Malaysia. The authorized capital is the maximum amount of the share capital in which the Sdn Bhd company is allowed to issue to its shareholders. The amount of the authorized capital will be stated in the Memorandum of Association of the company. The Sdn Bhd company will only be allowed to issue the paid-up capital up to the maximum amount of the authorized capital that registered with the SSM. The change of any amount of the authorized capital can be done anytime with the SSM 's permission. At the beginning of the company operation, SolarNext has RM 385,130.00 of authorized capital therefore, the registration fee for application for the incorporation of the company with the authorized capital up to RM 400,00.00 is accompanied with payment RM 1,000.

The Sdn Bhd company's financial information and affairs will be available for the public access. At the end of every year, the Sdn Bhd company must perform annual audits on its financial statements and present it during the company's Annual General Meeting (AGM). To transfer existing shares or issue additional shares to new investors, the existing members can transfer their shareholdings, wholly or partially through selling of their shares which is subjected to the directors' approval. Regarding the taxation, the tax rates for the Sdn Bhd company are shown in Table 15. Meanwhile, the shareholders of the Sdn Bhd need to pay their personal income tax as usual.

Company Tax		
Resident and non-resident companies		24%
Resident companies with paid-up capital of RM2.5 million and less at the beginning of the basis period for a year of assessment:		
*	on the first RM500,000 chargeable income	18%
*	on subsequent chargeable income	24%

Table 15: Company tax in Malaysia. Source: Cost of doing businesses, MIDA, www.mida.gov.my, 2017.

Most of the small and medium enterprises (SMEs) prefer to choose to incorporate as the Sdn Bhd company once the scale and needs of the business get bigger in line with the increase of revenue and business volume. The company might request the

suppliers and bankers to extend their credit liabilities which means higher liabilities as the customer requests the companies for longer credit term and higher credit limit that will increase credit risk. That is why the company realize the need to protect shareholders from personal liability and the need to raise funding from external investors.

4.8. MARKET FEASIBILITY

4.8.1. Solar PV System Installation Market

The growth of the solar PV system installation market goes back to 2005 when the government initiated the Malaysian Building Integrated Photovoltaic (MBIPV) project with the support from United Nations Development Program – Global Environment Facility to promote grid-connected solar PV system to support growth of the solar PV system in the country. Before that, the application of the solar energy only limited to the off-grid PV installations which were funded by the government under rural electrification project. Thanks to MBIPV, approximately 2 MW of grid-connected solar PV systems were successfully installed on residential and commercial buildings from 2006 to 2010.

MBIPV can be considered as a stepping stone in the development of solar PV system installation market in Malaysia and it was pivotal in formation of National Renewable Energy Policy and Action Plan (NREPAP). NREAPAP was approved in 2010, followed by introduction of Feed in-Tariff (FiT) scheme as a key stimulus for development of renewable energy landscape, including solar energy. Under NREPAP, Malaysia aims to install cumulative solar PV capacity of 399 MW by 2025 and 854 MW by 2030. In 2014, under the implementation of FiT mechanism, it was recorded that the total photovoltaic power installed for the grid-connected under the individual's category was 13.35 MW while 73.27 MW under the non-individual's category. For the off-grid connection, the PV power installed under the residential category was 0.15 MW. The total PV electricity production that contributes to the national electricity production in 2014 was 119.1 GWh. With an average price of installation of solar PV for the grid-connected rooftop up to 12kW was RM 8.5 per Watt in 2014, the residential market size (under the individual's category) was about RM 113 million annually.

In 2016, Malaysia has started the Net Energy Metering program and it is targeted to implement 500 MW of capacity until 2020. With 100 MW capacity limit in a year and the domestic solar PV installation is 23% from the targeted capacity, it is expected that the market for solar PV installation in residential sectors will reach RM 200 million per year; considering the average price of 1 kWh = RM 5.08. The NEM is likely to attract the public to install the solar PV system in their houses thus, the market for installation of solar PV system in residential sector is very promising.

4.8.2. Target Market

SolarNext specifies the installation of the solar PV system to the residential units around Melaka and neighboring areas. SolarNext focuses on the installation of the solar PV system on the residential units because the demand for the solar PV system installation projects was on smaller scale compared to industrial units that majority of the industrial solar PV installations are conquered by the established players of the solar energy service providers. SolarNext focuses to the homeowners of the residential areas that built with specified types of house namely; terraced house, semi-detached house and bungalow. The reason of focusing to these types of house is quite straightforward as the homeowners of these types of houses have a wide area and space of the rooftop for the solar PV system installation.

Melaka is chosen as SolarNext's target market due to the proactive commitment by the Melaka government to achieve the status as a Green Technology City-State by 2020 by promoting the environment, economic and social benefits of the application of renewable energy especially solar energy to the public. The Melaka World Solar Valley Project is planned on 7248.43 hectares of area in Rembia, Alor Gajah is the only Solar Industry Hub in Malaysia which involves research, development, innovation and commercialization activities that built based on the solar energy technology and approach as the primary alternative energy. As a new player in the solar energy service provider, SolarNext targets to generate and create new customers from the homeowners of the residential units at the Solar World Valley Project, at least 5% of the installation of the solar PV system project is conducted by SolarNext. From there, SolarNext could shift the target market to the surrounding housing areas that indirectly has received impact from the development of the Solar World Valley Project. It is also a vital step for SolarNext to take this opportunity to strengthen the portfolio of SolarNext as the established solar energy service provider in the future.

Apart from that, Melaka with the area of 1664 km^2 (642 sq mil) receive the average daily solar radiation of 20 MJ/m^2 for about 4 to 8 hours per day. However, the installed capacity of solar PV system in the residential units is possibly relatively low as the solar PV system installed nationwide even though receive ample amount of solar radiation daily. SolarNext views this situation positively as a challenge to achieve the target market as the implementation of the Feed in-Tariff scheme and soon the Net Energy Metering (NEM) which offer much more benefits to the homeowners to generate side passive income will boost the demand of the installation of solar PV system.

4.8.3. SWOT Analysis

SWOT analysis is a fundamental analysis for a company to determine its characteristics in the business and market to develop a full awareness of all the factors involve before making any kind of decision for the company. The SWOT analysis also serves as a precursor to any sort of company action such as exploring new initiatives, making decisions about new policies, identifying possible areas for change or refining and directing efforts. The SWOT analysis of SolarNext company are as follow;

4.8.3.1. Strengths

- Quality system products – SolarNext ensures that the materials used for the solar PV system products are of top notch quality as the company gets the supply from the well-known and reputable solar panels company worldwide at the reasonable price to ensure the services rendered to the customers are excellent and suitable for their needs.
- Technical capability – Even though SolarNext is new player in the solar PV system installation market and start with small number of team members, SolarNext is equipped with dedicated staffs who are technically enhanced with up to date solar energy technology and core engineers with ample experiences and precise skills in the industry.
- Customer oriented – SolarNext team up with the customers to meet their needs and to customize the solar PV system installation suits for household needs. From the initial consultation stages to the installation and subsequent maintenance of the solar PV system, SolarNext is committed to improve customer experience through the partnership with the customer.
- Post sales services – SolarNext offer the after sales services such as daily monitoring of the solar PV system to make them different from other companies. The customer will get a glimpse of their power usage and monitor statistical performance data that could be used to pinpoint any anomalies and overcome any issues.
- Effective project management – With extensive knowledge and professional technical, SolarNext provides support and assistant to the customers in managing the entirely their solar PV systems from economical to environmental aspects.

- Focus on residential market in Melaka – SolarNext understands well the household electricity requirements and capacity as well as the real situation of solar energy industry in Melaka, therefore they could focus to their customers and could compete with other companies that mostly have wide variety of services and lack understanding of the local situation.
- Approved and certified – SolarNext is approved and certified as solar energy service provider by Photovoltaic Service Providers by Malaysian Photovoltaic Industry Association (MPIA) and Sustainable Energy Development Authority Malaysia (SEDA).

4.8.3.2. Weakness

- No partnership – SolarNext does not form any partnership with other established solar energy service provider or solar PV system producers during the first year of its operation thus, they need to find alternative ways to expand their customer base. Besides, SolarNext is a single company without any subsidiary connection at the initial stage of its formation therefore they could encounter challenges in managing the entire company.
- Limited services – SolarNext's services only limited to any activities related to the installation solar PV system including the engineering, procurement and construction. SolarNext does not offer one stop center that provides ample services for example other renewable energy technology services or environmental friendly electric installation or financial assistance for the customer to install the solar PV system that could increase the competitiveness of the company.
- Reputation – SolarNext faces the obstacles to place the company at the same level with the established players of the solar PV system installation market. Lack of experience, innovation and portfolio as well as performance that has yet to be established to the public and potential customers might affect the company's growth at the beginning.
- High cost of the services - According to market study, the customer might need to pay a little higher cost of the solar PV system installation, higher than the average cost of the installation in the market. This is due to compensation of the total cost, to obtain a considerable of profit margin as well as to make the service reliable and worthy to the customers.
- If SolarNext fails to establish and maintain the relationships with suppliers, SolarNext may not be able to meet increasing demands in the future. The

pricing and services that the customers receive may be affected by any delay, shortage or price change of solar components. Therefore, in the future, it is recommended for SolarNext to establish new relationships with multiple suppliers to ensure SolarNext able to offer adequate solar systems with economical and low price, suits with the increasing demand. As SolarNext purchases part of solar PV components from foreign suppliers, any change in exchange rate could result in the fluctuation of solar PV system installation packages.

4.8.3.3. Opportunities

- Availability of the solar radiation – SolarNext takes the opportunity to enter the solar PV system installation market because Malaysia and Melaka especially are bestowed with the ample solar radiation throughout the year; with 4700-6500 Wh/m^2 of mean daily solar radiation. The nature of solar energy that will never run out and is a clean source of alternative energy making SolarNext anticipates staying in the market for a very long time.
- Net Energy Metering – The implementation of Net Energy Metering (NEM) system that allows the consumer to consume the energy first with only the excess energy flowing to the grid has attracted the public to participate in the program besides the benefit of gaining passive income will drive the growth of solar PV system installation. The demand to install the solar PV system is believed to increase in line with the increasing number of participations of NEM over the years and SolarNext is ready to fulfill the demand.
- Initiatives and effort from the government – According to Solar PV Roadmap 2030 Program, the government targets to achieve 12% of the total national electricity consumption is supplied by solar PV energy in 2030. Also, under the National Renewable Energy Policy and Action Plan, Malaysia aims to achieve 2080 MW of renewable energy by 2020 where 1250 MW is in the form of solar power capacity which is connected to the grid. SolarNext could benefit from this plan by providing the solar PV system installation service on the rooftop of the houses that directly connected to the national electricity grid.
- Declining cost of the solar PV system installation – The cost of installing solar PV system on a landed property has dropped by about 40% since 2012 due to the decline in solar module pricing. It is believed the cost of

the solar PV system will continue to decline due to the improvement of the technology over the years thus, will attract more homeowners to install the solar PV system. Indirectly, this factor will attract more potential customers in the future to get the installation service from SolarNext.

4.8.3.4. Threats

- Financing resources for the potential customers – Lack of confidence of the local banks to give out loans to the interested customers to venture in the solar PV system installation affects SolarNext indirectly. Even the local banks willing to approve the loans, the term and rates for green investments might not really be that attractive, thus preventing the potential customer to purchase and get the installation of solar PV system from SolarNext.
- Lack of public awareness – The awareness regarding the economic, environmental and social benefits on investing into the green technology particularly solar PV system is relatively low compared to the immense growth of the solar market in Malaysia. The installed solar PV capacity is quite minimal though Malaysia is blessed with abundant solar energy potential. SolarNext could overcome this matter by putting much effort into educating the public the importance and advantages of the solar PV technology while promoting their services.
- Solar PV market – Even though Malaysia is ranked as the world's third largest producer of solar PV cells and modules after European Union and China, the cost of the solar PV system is still high and highly affected as 80% of the solar PV cells and modules production are exported to Europe, USA and several countries in Asia. Only 20% of the solar PV cells and modules are specified for the local manufacturers of solar PV system. Still, other components of the solar PV system have to be imported from overseas and this situation making the price of the solar PV system produced in Malaysia is not competitive as the solar PV system produced from Germany, USA or Taiwan. SolarNext offers the solar PV system products that supplied from international companies that have office sales in Malaysia and overseas (India, Korea) to offer the customers reasonable and affordable cost of services.

4.8.4. Analysis of Competitiveness

To survive and grow in the solar PV system installation market, an analysis of competitiveness is conducted to understand the strengths and weaknesses of the fellow competitors. For SolarNext's current situation and position as a new company in the sector, the competitors that compete with the company are classified as the indirect competitors. This is because, these competitors are well established and provide various types of products and services including the installation of the solar PV system service whereas SolarNext only dedicates to the service of installation of the solar PV system for the residential units only. In this section, we will discuss and identify the characteristics of the competitors from their achievements, range of products and services and strategies. The main three competitors of SolarNext are; Gading Kencana Sdn Bhd, Pekat Teknologi Sdn Bhd and Solarvest Energy Sdn Bhd.

4.8.4.1. Gading Kencana Sdn Bhd

Even though Gading Kencana does not operate and not a Melaka-based company, they gain reputable position in Melaka due to their numerous successful solar projects on residential, industrial or community purposes including a huge scale solar facility with 8MW system capacity known as Kompleks Solar Hijau which located in Ayer Keroh, Melaka and is expected to generate 10,120 MWh of electricity per year. Apart from that, Gading Kencana offers a wide array of services from installation of solar street lights and light emitting diode (LED) to electrical works and maintenance services. They also have expertise in energy management consulting and energy audit services. Their reputation to conduct energy management system diagnose service has gained confidence to many types of clients all over Malaysia including public hospitals, government agencies and industrial factories.

Gading Kencana has been operated since 1993 and with their vast experience in the solar energy market, in 2013, they gained revenue exceeding RM 100 million. Gading Kencana has expanded their market internationally such as in Saudi Arabia, Indonesia, Turkey and African countries by successfully generated a total of 75.7 MW solar energy. Gading Kencana is the first Malaysian solar PV service provider to have ISO 9001: 2008 and OHSAS 180001: 2007 certifications. The top-notch technical expertise that Gading Kencana possess also is contributed by the area of innovation that makes Gading Kencana truly distinguish themselves. Recently, they successfully innovate the shape of the rooftop for solar PV systems using the "A-shape" of the traditional Malay house roof to enhance cooling effects for buildings in tropical climates.

Apart from their notable achievements, Gading Kencana has set up two strong strategies to stay relevant and be sustainable throughout the market in solar energy industry by implementing "project means business" strategy and "trade and barter" strategy. The "project means business" strategy signifies the huge profit from the promising solar project that gained by Gading Kencana could sustain them for a very long period without worrying the company's income when there is little offer or demand of the solar projects. On the hand, the "trade and barter" strategy is the consistent income of Gading Kencana because on the daily basis, they simply run the business by selling the products to compensate the overall cost.

4.8.4.2. Pekat Teknologi Sdn Bhd

Pekat Teknologi was founded in 1999 and started as competent solution provider specializing in the design, supply, distribution and installation of lightning protection, earthing system and surge protection technology. Today, Pekat Teknologi also known as the biggest pile cap earth-bed earthing specialist in Malaysia with portfolios covering up to 50 job sites at any given time and a workforce of 40 professionals. Only in 2006, Pekat Teknologi has started the new venture into the solar PV technology. Since then, they have become one of the notable player in the solar energy market. Their range of installation services are wide including solar PV system installation, pile cap earth-bed system installation and earthing, lightning and surge system installation. They have strong client base because they have advantage on their wide types of services provided by them. Apart from providing solar PV system installation service for regular residential units, their outstanding reputation also based on the solar PV system installation projects at prestigious residential projects such as Setia Eco Park and Sunway Property projects. Numerous petrol stations nationwide and government buildings are also among their strong portfolio of solar PV system installation service. Equipped with 100 staffs in the company, Pekat Teknologi also strengthen their position as the high profile solar energy service provider by building a strong networking and creating partnership with leading international PV component manufacturers including CSUN, BYD, Darfon and Noark. Strategic partnership with international companies which are leaders in the solar PV industry worldwide is a smart strategy to sustain the growth of Pekat Teknologi in the market and the same time the company receives technical support from them.

Due to the company's prominent experience and expertise in lightning protection, Pekat Teknologi has combined the technology of lightning protection with the solar PV system. The innovation of their own innovative brand of solar PV surge protection makes Pekat Teknologi evolved into a specialist in solar PV technology. The

innovation is a solution as PV modules need to be exposed to direct sunlight, they are often at risk to lightning strike during thunderstorms, and therefore the inverter is the most vulnerable electronic device needs protection against the power surges induced via the exposed cables linking the external PV modules. Even though they do not really have strong portfolio in installation of solar PV system in Melaka compared to Gading Kencana, the innovation of solar PV surge protection could affect SolarNext indirectly as SolarNext's development in the innovation is yet to be proven and still not fully grow.

4.8.4.3. Solarvest Energy Sdn Bhd

Solarvest Energy was formed in 2012 and started small like any other solar energy service provider in the industry. From only 4 workers at the beginning, now Solarvest Energy is equipped with 70 employees with 3 branches all over Malaysia. Initially, they only focused on the installation in the solar PV system service in residential units. Now the installation service has expanded to the commercial units, industrial units and community facilities. The installation of the solar PV system service covers the engineering, project management, procurement and construction which are familiar with the installation service provided by SolarNext.

The strategy of SolarNext by focusing on the solar projects on the residential sector paid off when the revenue gradually increased since 2013 and now the company is targeting revenue of RM 80 million in 2017 after gaining RM 40 million of the revenue in 2016. To date, Solarvest Energy has successfully installed solar PV system in 523 projects, recording more than 40 MW projects throughout Malaysia which is sufficient to supply power to 4500 houses every day and as a result, they have achieved a strong 15% market share in the country. Solarvest Energy has started the new project for two 2 MW solar farm in which is sufficient to generate power supply for some 300 houses per day. It is another stepping stone for Solarvest to become one of the leaders in the solar PV market in Malaysia. SolarNext considers Solarvest Energy as its competitor due to its stable growth of the company within the first 5 years in the market. The potential customer might have their trust with Solarvest Energy performance even though they just started 5 years ago compared to SolarNext.

4.8.5. Marketing Strategies

To survive the challenges at the beginning of the operation and sustain the growth, SolarNext decides to apply several strategies on marketing aspects. The strategies include scopes on price, products or services, place and promotion. These marketing

strategies are important as all four P's before will reflect on the revenue which becomes the income of the company. After studying the market situation and the characteristics of the company, all the strategies act as driving factors to stably place SolarNext in the installation of solar PV system industry among its competitors.

4.8.5.1. Price

SolarNext sets the prices of system installation packages after taking into account the prices of each of components of the solar PV system. SolarNext considers the prices of the components according to what the suppliers recommend the company and at the same time, adds an installation fee to establish the packages price to the customers. The total price of all the solar PV system's components in the installation packages appears much lesser compared to when the customers buy all of them without the packages. The prices of the components are also adjusted based on the cost-pricing method which considers the fixed and variable costs to obtain the final sale price of all the system's components. The prices offered by SolarNext might a little bit higher yet do not exceed the purchasing power of the market; than the price of installation packages offered by the competitors which are the established companies since they probably buy all the components of the system in large volume or quantity thus the suppliers offer them the products at the best prices and have established strong relationship with the suppliers. However, the advantage of the price offered by SolarNext to the customers relies on the ability of SolarNext to provide all necessary services that take care of each of the phases of installation of solar PV system in the residential units including engineering, construction and ongoing monitoring. Therefore, the prices of the installation packages contribute to customer's service experience and their satisfaction dealing with the company.

4.8.5.2. Products

SolarNext offers the top-notch quality of components of the solar PV system from the well-known and reputable solar panels company worldwide at the reasonable price to the customers. SolarNext chooses the components from the foreign companies as the reputation and the technology of the components are guaranteed and able to run efficiently in the system installed according to the customize system design at the customers' residential units. What makes the components of the system difference from the ones that other companies offer is that all the components are specifically only for the residential units use. Other companies might purchase the same components that compatible with the commercial or industrial purposes to install at the residential to lower the capital cost and increase the profit as they also offer the installation of the

solar system at the commercial and industrial buildings. Besides, SolarNext is a solar service provider that offers all the services related to the installation solar PV system at the residential units from the beginning; from the consultation phase, project planning, installation testing and commissioning to maintenance phase. Therefore, the customers can depend on technical capability of SolarNext from the beginning. The ongoing relationship with the customers even at post-installation stage make the customers feel safe and worries-free as SolarNext is responsible in assisting them especially throughout the warranty period of the system installation and the long warranty period of the components thus will increase the chances of gaining loyalty from the customers.

4.8.5.3. Place

Since SolarNext is the solar PV system service provider and most of the operations or the installation works are done at the residential buildings, the SolarNext's office not necessarily need a big area as the office is dedicated for the administration purposes. Therefore, SolarNext rents a shop lot at Ayer Keroh, Melaka that can occupy the space as the office room for that purposes at the first floor. Besides, the shop lot also acts as the area for products storage or technical space at the ground floor. The shop lot is strategically situated in Ayer Keroh, Melaka as the city of Ayer Keroh is a well-developed city and a great location to start any business venture. Due to the location of the office where is near to the housing area and main road of the city, as well as the area round the shop lot is busy with various type of industrial related business, the customers can easily access to find the company and it is reachable by the potential customers as well.

The shop lot also serves as the place for the service of free consultation to take place. The potential customers who are interested with the solar PV system installation service provided by SolarNext may walk in to the office for the free consultation session provided if the engineers that act as the consultants are available at that time. During the free consultation, the customers will be introduced to the service offered by SolarNext and further explanation or education regarding solar energy.

4.8.5.4. Promotion

Promotion is another strategy applied by SolarNext to attract new customers and communicate with them. It is crucial for SolarNext to deliver the messages and promotion through the most effective channels to bring down the price that charges from the customers. Nowadays, it is common for the companies to build a website to reach their potential customers effectively. SolarNext also is actively offering the solar PV system installation service online through official website and social media such as

Facebook and Instagram. The official website is the main channel to present the service offered and examples of successful installation project to potential and existing customers. The website also is a great platform for SolarNext to educate the public regarding the solar energy and rise customers' interest in going solar by releasing related solar industry news. The potential customers may reach SolarNext for free consultation or any inquiries via the request form provided there. Additionally, SolarNext keeps Facebook and Instagram as platforms for people to join the social network and spread news of solar.

Apart from that, SolarNext's promotion is also run by participating in renewable energy and green technology exhibitions or exposition that held from time to time. Furthermore, at the same time the exhibition allows promotion of the solar PV system installation service to the potential customers, it can also be a platform for sales channel or particularly as direct outside sales force. Normally, the direct outside force for SolarNext resides and works within all market areas that SolarNext is serving which in Melaka. The regional potential customers will have face-to-face interaction and be introduced to SolarNext's services and solar knowledge as well. Conducting seminars regarding solar energy at the targeted housing areas could provide the opportunity to perform the promotion activity. This is because, SolarNext realizes that educating customers about solar is the key to expand solar industry. Advertising the SolarNext's services at Melaka state weekly newspaper or magazines related to renewable energy and green technology and giving out the flyer to the homeowners at the targeted housing areas are another promotion approaches by SolarNext to communicate and attract the potential customers.

4.9. TECHNICAL FEASIBILITY

4.9.1. Services Descriptions

SolarNext is an Engineering, Procurement and Construction (EPC) solar service provider that offers full service of the solar PV system installation, meaning the installation service of the solar PV system in residential sector covers from the beginning where the consultation process with the potential customers starts until any activities related with the maintenance of the solar PV system during the warranty period. The process of the installation of the solar PV system in the residential property of the customer are divided to six phases; consultation, procurement and purchasing, installation, testing and commissioning process, operation and maintenance. The consultation started whenever the customers approach SolarNext to get free quotation or any information related to the installation service of solar PV system for their residential units. This process can be done via sending the information request form through the web site of SolarNext or contacting telephone number of the SolarNext office which is provided particularly to attend the potential customers' inquiries. SolarNext responds to the customers' inquiries within 24 hours after receiving the notification of information request from them. The customers can also walk in to the office of SolarNext and have face-to-face interaction and be introduced with the services offered. From there, the process of the installation of the solar PV system starts to develop and the next phase of the consultation which consist of site study as soon as the customers agree and decide to acquire the entire installation services from SolarNext.

4.9.1.1. Consultation

SolarNext provides necessary consultation and advice to facilitate every single stage of realization the solar PV system installation from the Feed-in Tariff (FiT) or Net Energy Metering (NEM) scheme acquisition, technical requirements to financial advice. SolarNext thinks that it is essential to conduct the site study as a part of the consultation process to determine the technical feasibility and estimate the cost of connecting the solar PV system installation to the electricity distribution network. The site study will also assist in determination of the connection point and any network reinforcement works or technical requirements which are required to be undertaken by the distribution licensee (Tenaga Nasional Berhad) once the solar PV system is installed in the future. The scopes of the site study include energy audit, shading assessment and site survey.

The results and findings of the side study will be able to obtain the technical information required in respect of the solar PV system installation and identify details of the installation generator are as follow;

- The solar radiation data at the proposed site of the installation.
- The type of module (monocrystalline, polycrystalline, thin film, etc) and system size
- The inverter specifications
- The plant configuration
- The rated kWp

At the beginning, SolarNext will conduct energy audit of the home of the customer to identify the annual electric consumption. The approach of the energy audit process is quite direct as the customer only need to gather the monthly electric bills for the past 12 months. The appointed engineer for the consultation phase will make a list of the months and kWh that the customer charged for and finally, find the total of electric consumption. To make the estimation of annual electric consumption much better predicted, a power cost monitor or also known as Kill-A-Watt is used to calculate the annual electrical expenses of the house. The annual usage figure becomes the 100% offset around which the solar PV system will be sized. Normally, SolarNext will recommend the customer to buy an array that offsets between 30% and 75% of the kWh calculated.

After performing the energy audit, SolarNext will check the conditions of the residential unit via site survey. There are a few restrictions that preclude the installation of the solar PV system even though some of the obstacles can be worked around, for instance the location of the proposed installation. SolarNext will examine if the residential unit is located in a place where trees, tall buildings or other significant shade obstacles could prevent the solar panel from receiving enough sunlight each day to produce sufficient kilowatt hours (kWh). SolarNext will inform the homeowner how much irradiance and kilowatt production they can expect according the shading assessment. The shading assessment aims to gather information on the impact of any potential obstruction to sunlight throughout the year and typically generated by the special device that comes up with software that can spit out a detailed report explaining the shade risk and anticipated power output based on the annual sun hours.

The site survey also will determine the condition of the roof where if the homeowners have an old or deteriorating roof, or its underlying structure is weak, SolarNext will advise them to addresses that problems first or else, SolarNext will not

be able to install the solar PV system due to security reason. Apart from the status of the roof, the site survey will identify the best spot for solar PV array, status and size of the home's main electric panel and available locations for mounting electrical components. With the help from 2 electrical technicians, the engineer of SolarNext will make a quick sketch of the area for the proposed installation which includes;

- Overall roof dimensions
- Slope angles
- Locations of the chimney and vents
- Available array spaces
- Compass orientation of the array spaces of roof slopes
- Thickness of the roof
- Tall trees or other obstructions on or the residential unit

The data provided on the quick sketch before allows the responsible engineer to draw a more formal site layout later for further the site study assessment. Once the engineer figured out the dimensions of the rooftop space, the numbers of solar modules fit in the space available will be identified. In conjunction with the energy audit, shading assessment and the site survey data, the engineer may proceed to the next step which is identifying the size of the solar PV array and modules suitable for the installation at the residential unit in the project planning stage.

4.9.1.2. Project planning

SolarNext acts as system designer that provides project planning service to the customer once the engineer responsible for the consultation satisfies with the condition of the proposed location for the solar PV system installation. The customer will receive full report on the results and findings of the consultation. From there, the project planning starts by identifying the size of the solar PV array and modules. The selection of the correct size of the solar PV array and modules, inverter and other components that will make up the electrical circuit is determine by measuring or estimating power, voltage, current, area dimensions and other variables which the process of all the calculations is known as system sizing. The system sizing also vital in choosing the solar PV system that works best for the customer's circumstances and budget.

The system sizing starts with determining the total array power output (in Watts) needed to power the appliances, lights and other electrical loads in the home. Consequently, the system size is based on the result of the energy audit which is the annual electrical consumption of the house. Besides that, the sunlight available also

known as insolation, daily peak sun hours at the proposed site of solar PV system installation is also required to conduct the system sizing. Once the system sizing is done and the size of the of solar PV array is identified, SolarNext will inform to the customers and customize the results from the system sizing with the solar PV system installation service packages that suits together. Each installation package will also include other important components for the solar PV system along with the solar PV array, which are inverter, combiner box, solar cable and balance of system (BoS). All these components are compatible with the size of the solar PV array installed and compliance to the SEDA rules and regulations.

After determining the right racking and mounts system to hold the PV modules in place and designing the wiring system for the installation, SolarNext will assign an installation team which consist of engineer, electrical technician and solar PV system qualified installer. The number of each position in the team member of the installation work depends on how large the installation project is. The timeline and budget of the installation work is measured and estimated accordingly during the project planning by the responsible engineer and accountant of the company. The project planning also is considered as the pre-installation phase where a safety plan for the installation work is properly devised as well as the site drawing and full system design are completed with technical requirements and details which act as a reference once the installation work start.

The project planning service also includes the preparation of submitting the Feed-in Tariff or Net Energy Metering scheme application. SolarNext will help and guide the customer throughout the application process for both scheme. SolarNext will provide any technical information or documents such as system design, site assessment and other details related to the installation of the solar PV system for the customer to facilitate the application process. Normally, the application will be processed within 30 days from the date of complete submission. Once the customer receives verification and approval of the application by SEDA, the installation work of the solar PV system at the proposed site will begin. Note that since the service of the installation of the solar PV system in the residential units offered by SolarNext is not more than 12 kWp, the customer does not need to generate or apply license from the Energy Commission under Section 9 of the Electricity Supply Act 1990.

4.9.1.3. Solar PV system installation

After receiving the permission to install the solar PV system under the Feed-in Tariff (FiT) or Net Energy Metering (NEM) scheme, the installation work starts at the

proposed site. The installation work by setting up a staging area at the location where the solar PV system will be installed. The staging area act as a central place where equipment and tools are kept while construction in progress. All the equipment and tools are transferred from the SolarNext's technical space to the installation work site by lorry. The installation work at the residential units normally take one to three days depending the conditions at the proposed site with a crew of 2-3 qualified solar PV system installers and an electrician.

Once the staging area is set up and complete with all the equipment and tools, the work of the racking mounts and rails installation starts. The racking mounts and rails are the components of the Balance of System (BoS). The racking mounts or attachments are attached to a rafter or beam that holds up the roof. Once all the required racking mounts are secured to the rafter and the tiles around them, the rails will be connected to the mounts. The rails are fastened to the mounts using L-brackets. The installers will make sure that the rails line up accordingly to ensure the modules fit together correctly when they are installed. After the rails are secured into place, the electrician will connect a short grounding wire from one rail to the next. The ground wire will eventually be connected to the junction box or combiner for the array.

The installation work proceeds to installing the modules to the rails. Before that, the clamps that hold the modules onto the rails should be inserted. The installers ensure that when moving and installing the modules, they need to be careful not to scratch the glass or bump the modules around too much to avoid excessive vibration that could loosen the internal electrical connections. Besides, any cables or wiring will be fastened to the rails so that the wind would not disengage them from their connections. Other important equipment for the solar PV system such as inverter, junction or combiner box which consists of AC/DC breaker and fuse links as well as AC/DC surge protection devices that carries wire between the array and the home's main service panel are installed once the installation of the modules completed. The junction or combiner box is connected close to the array while the inverter and other components are usually placed on the ground, within proximity of the main panel. The PV meter will be installed by the Distribution Licensee (TNB) after the installation work is completed before the testing and commission process.

The final phase of the installation work is to run the wire and make all electrical connections. However, before that, all wiring from the array, after it leaves the junction box, is ensured travel in conduit until it enters the main service panel. The conduit is the metal pipe which is easy to shape and is secured to the roof and walls using clamps

and mounts. The actual wire connections will be conducted to the electrician. The job includes connecting array cables and home runs, inside the junction or combiner box, inside the inverter and inside the main service panel. To finalize the installation work, all the components of the solar PV system and in the circuit, should stay in the off position until it is time to testing and commissioning the solar electric system.

4.9.1.4. Testing and commissioning

SolarNext will perform the testing and pre-commissioning procedure after distribution licensee (TNB) installed the PV meter. The pre-commissioning checks are performed by the SolarNext's engineers and wiremen who are competent persons to conduct the checks whilst adhering to the relevant laws and regulations. Then, SolarNext submits a copy of the completed pre-commissioning checklist and test results to SEDA and the distribution licensee (TNB) for application of testing and commissioning. Basically, the test and pre-commissioning is to test the system and ensure no problems such as incorrect wiring that could potentially do some damage and fail to launch. To start, the responsible engineers or wiremen will do a simple visual inspection to verify;

- The number of modules wired in series and parallel is correct.
- The mounts are fastened securely to the roof and all the bonding clips and jumpers are tightly secured on the array.
- All the module leads are snapped securely together, and the array wiring is neatly fastened to the rails.
- All connections inside electrical enclosures (junction or combiner box, inverter, etc.) are complete and the designated amount of torque applied to the screws.
- The conduit is securely clamped to the walls and all fittings fastened or cemented as needed.
- The inverter and other electrical components are mounted securely in place and an awning constructed (if needed).

During the pre-commissioning checks, the solar PV system shall not be engaged to the grid. The pre-commissioning checks consists of the following;

- Information about project
- Checklist for general inspection
- Checklist for PV module mounting structure and civil foundation
- Checklist for DC junction box or string monitoring box
- Checklist for earthing and lightning arrestor

- Checklist for PV module
- Checklist for inverter
- Checklist for AC distribution box
- Checklist of cable identification and cable routing inspection
- Cable insulation test
- String fuse continuity and string open circuit voltage test
- String DC short circuit current test
- Isolation device functional test

Once the pre-commissioning check is done, SolarNext will propose for the SEDA's testing and commission date. Once the testing and commission date is verified, SEDA will allow SolarNext to conduct the testing and commissioning checks without the presence of SEDA representative to ensure all inter-connections of the component are satisfactory. In this procedure, all tests must be done in sequence and if one test in sequence fails, the next test shall not be performed. Failure of any test nullifies the entire Testing and Commissioning. The commissioning test comprises the following;

- Information about PV module
- Information about PV array
- Information about inverter
- Inverter functional test
- Acceptance test

Once completed, SolarNext will hand over the full report of the testing and commissioning check stating that the solar PV system installation and interconnection facilities have been designed, constructed, installed and tested accordance with prudent utility practices for the customer send to SEDA for the commencement date verification. On the official date of commencement, the solar PV system installers and the engineer will run the solar PV system and the customer will start the Feed-in Tariff (FiT) or Net Energy Metering (NEM) scheme officially.

4.9.1.5. Operation and maintenance

When the Feed-in Tariff or Net Energy Metering scheme has started after the completion of all stage of the solar PV system installation as discussed above, the PV meter will start reading and recording solar PV generation. The customer also may start receiving the electricity bill for each billing period form the distribution licensee (TNB). SolarNext continues to offer post installation and maintenance to the customers. The customer of SolarNext have comprehensive manufacturer's warranty for each of the

solar PV system components and all-risk insurance package that was included in the packages of the solar PV system installation offered by SolarNext. The free maintenance service is offered to the customer for 1 year includes the PV module cleaning, performance test and cable check. From time to time, SolarNext's engineer also will monitor the status of the solar PV system and the electrical consumption of the customers via the monitoring system. A computerized analysis of the solar PV system will help SolarNext to solve any issues related immediately and ensure the customer satisfies with the entire service from SolarNext.

4.9.1.6. Service flowchart

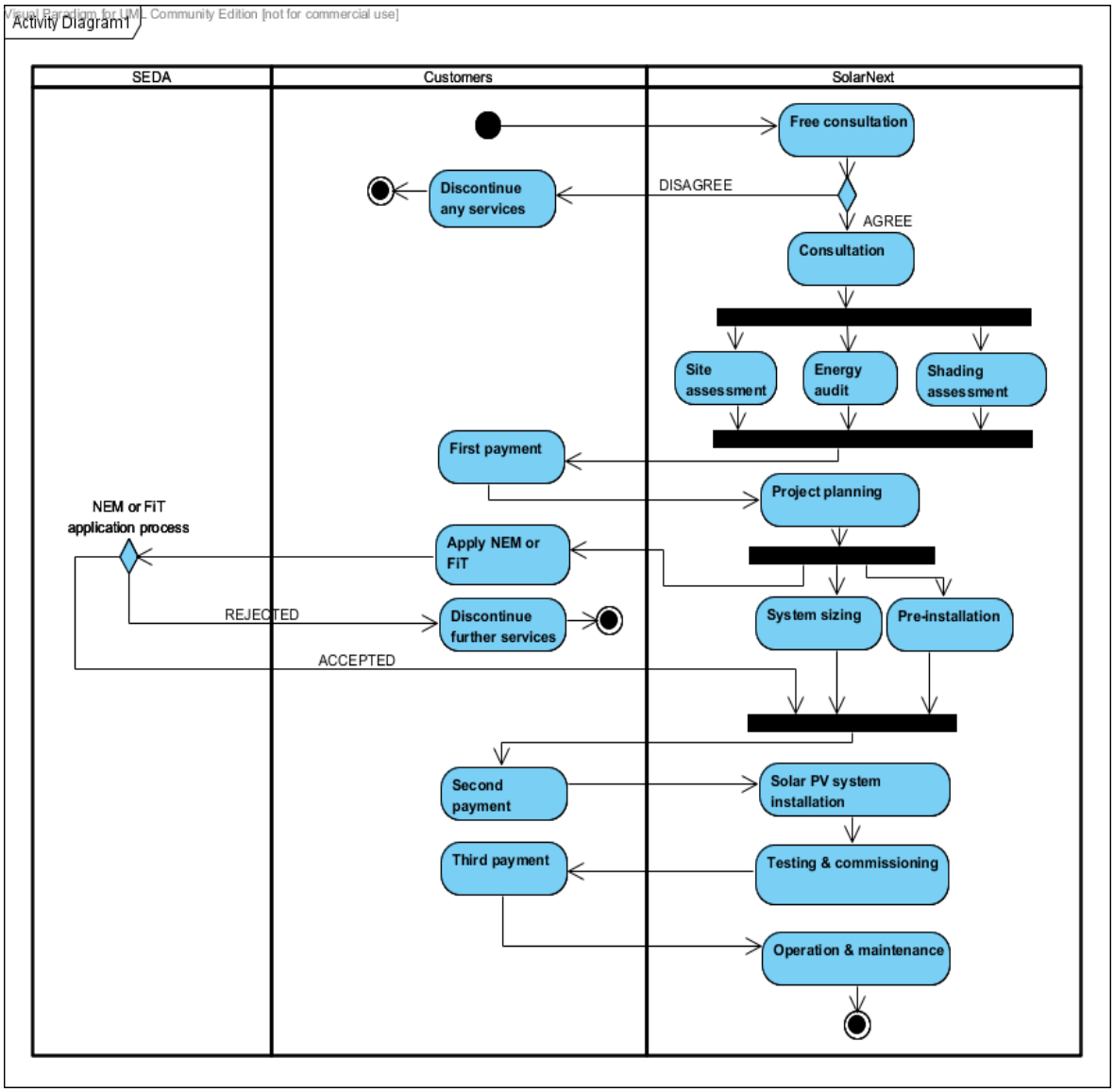

Figure 13: Service flowchart. Source: Prepared by the author.

- Whenever the customer shows interest to the packages or services offered by SolarNext, they will get in touch with the company by sending quotation form in SolarNext's website or call directly the company. SolarNext's will respond to the quotation or any information request by giving the details regarding price quotation and any general information related to the customer's request.
- Once they agree to receive further services from SolarNext, the company will arrange the consultation process at the customer's house which includes site assessment, energy audit and shading assessment. If the customer disagrees, no further action taken by the company and the customers.
- SolarNext will forward the findings from the consultation earlier and first payment will be made by the customers according to the price of the suitable solar PV system installation package that will be installed soon.
- SolarNext proceed to the project planning stage that covers the identification of system sizing and pre-installation phases. At this stage, SolarNext will assist the customer to fill the form of the NEM or FiT application for them to send to SEDA.
- If the application of the NEM and FiT scheme is approved by SEDA, the customer will inform to SolarNext and proceed with the second payment before starting the installation of the solar PV system at the customer's house or the proposed site. If the application of the NEM and FiT scheme is rejected by SEDA, there will be no second payment or further services by SolarNext.
- Once the solar PV system has completely installed including the PV meter installation the Distribution Licensee, the testing and commission phase will take place and the customer will start receiving the electricity produced by solar energy via the system. Finally, SolarNext will receive the third and last payment from the customer. Noted that the customer might choose to pay to SolarNext three times of payment (also known as installments) or pay at once the price of the installation package.
- From time to time, SolarNext will conduct the maintenance or any operations related to solar PV system installation throughout the period of consumption of electricity produced from the system installed by the customer which now they turn into the consumer.

4.9.2. Products Descriptions

SolarNext offers the installation service of the solar PV system which indirectly play the role as "supplier" of the solar PV system components to the customers. SolarNext is the system designer that carries the duty to take several components, frequently from different manufacturers and assembles them into a system. The explanation regarding the general concepts of the basic solar PV system has been discussed in the section 4.5.1. In this section, we will discuss the physical or technical description of the components of the solar PV system that SolarNext offers and assembles them into a system suits with the customer's demand or needs.

4.9.2.1. Solar panels

SolarNext installs Hanwha solar panels at the customers' houses. There are four types of the solar panels that SolarNext chooses to incorporate in the solar PV system, that range from 255W to 300W of power class. The Hanwha solar panels are made from polycrystalline silicon. The reason why SolarNext chooses polycrystalline solar panel is due to its lower price compared the monocrystalline solar panel. The monocrystalline solar panel might have better performance in absorbing the sunlight than the polycrystalline solar panel but thanks to the innovation and engineering quality that possess by Hanwha, the polycrystalline solar panel also produce high performance result and better optimization in output yield. Besides, the Hanwha solar panels are built using in-house produced cells that undergo rigorous materials testing before and during module production that makes the Hanwha solar panels are certified by UL and IEC worldwide certifications. Each solar panel have their own specifications and advantages that can suits with the installation solar PV system packages offered by SolarNext.

- 250W Solar Panel Hanwha Q-cells Q PRO G3-255
  Product features;
  Anti-reflective glass surface.
  Maximum yields with excellent low-light and temperature behavior.
  Maximum power peak (Wp): 250W DC
  Maximum power voltage: 29.57V
  Module efficiency: 15.3%
  Cells per module: 60
  Glass: 0.16 inches (4.0 mm) thermally pre-stressed solar glass with anti-reflection technology
  Dimensions: 1670 mm x 1000 mm x 35 mm

Cost per watt: RM 2.35 per watt

Price per unit: RM 587.50

Warranty: 12-year product warranty and 25-year liner performance warranty

- 255W Solar Panel Hanwha Q-cells Q PRO G3-255

  Product features;

  Anti-reflective glass surface.

  Maximum yields with excellent low-light and temperature behavior.

  Maximum power peak (Wp): 255W DC

  Maximum power voltage: 30.77V

  Module efficiency: 15.3%

  Cells per module: 60

  Glass: 0.16 inches (4.0 mm) thermally pre-stressed solar glass with anti-reflection technology

  Dimensions: 1670 mm x 1000 mm x 35 mm

  Cost per watt: RM 2.43 per watt

  Price per unit: RM 619.65

  Warranty: 12-year product warranty and 25-year liner performance warranty

- 275W Solar Panel Q-cells Q PLUS BFR G4.1-275

  Product features;

  Anti-reflective glass surface

  Maximum yields with excellent low-light and temperature behavior.

  Maximum power peak (Wp): 275W DC

  Maximum power voltage: 31.36V

  Module efficiency: 16.5%

  Cells per module: 60

  Glass: 0.13 inches (3.2 mm) thermally pre-stressed solar glass with anti-reflection technology

  Dimensions: 1670 mm x 1000 mm x 32 mm

  Cost per watt: RM 2.52 per watt

  Price per unit: RM 693.00

  Warranty: 12-year product warranty and 25-year liner performance warranty

- 280W Solar Panel Q-cells Q PLUS BFR G4.1-280

  Anti-reflective glass surface

Maximum yields with excellent low-light and temperature behavior.
Maximum power peak (Wp): 280W DC
Maximum power voltage: 31.76V
Module efficiency: 16.8%
Cells per module: 60
Glass: 0.13 inches (3.2 mm) thermally pre-stressed solar glass with anti-reflection technology
Dimensions: 1670 mm x 1000 mm x 32 mm
Cost per watt: RM 2.61 per watt
Price per unit: RM 730.80
Warranty: 12-year product warranty and 25-year liner performance warranty.

- 300W Solar Panel Q-cells Q PEAK BLK G4.1-300
  Anti-reflective glass surface
  Maximum yields with excellent low-light and temperature behavior.
  Extreme weather rating
  Maximum power peak (Wp): 300W DC
  Maximum power voltage: 32.41V
  Module efficiency: 18.0%
  Cells per module: 60
  Glass: 0.13 inches (3.2 mm) thermally pre-stressed solar glass with anti-reflection technology
  Dimensions: 1670 mm x 1000 mm x 32 mm
  Cost per watt: RM 2.78 per watt
  Price per unit: RM 834.00
  Warranty: 12-year product warranty and 25-year liner performance warranty (At least 97% of nominal power during 1st year. Thereafter maximum 0.6% degradation per year. At least 92% of nominal power after 10 years. At least 83% of nominal power after 25 years).

4.9.2.2. Solar inverter

Figure 14: Solar inverter Kaco Blueplanet

To allow the customer to use electricity from a solar PV array that has been installed, SolarNext selects solar inverter from Kaco brand to convert electricity from direct to alternating current. There four types of solar string inverter from Kaco that SolarNext use in the solar PV system in the residential units; Kaco Blueplanet 3.7 TL 1, Kaco Blueplanet 4.0 TL and Kaco Blueplanet 4.6 TL 1. The solar inverter chosen by SolarNext are roughly match the target array watts to the inverter watt size. Therefore, in some cases, for example, in the 6-kW solar PV system installation, 2 units of Kaco Blueplanet 3.7 TL 1 are needed to roughly match the array watts. The KACO solar string inverter is selected because it is light, easy to install and equipped with a small, maintenance-free, interior cooler which achieves uniform cooling without taking in ambient air. Therefore, there is no hassle for the Kaco solar string inverter to achieve maximum output. With 2 MPP trackers, the Kaco solar string inverter can process the whole AC power and system layout functions smoothly. Other interesting feature for the Kaco solar string inverter is the standard incorporation of Ethernet and USB ensures the customer to communicate and monitor conveniently the current operating data as it provides the clearly laid out and graphical display and also has the integrated data logger with web server.

- Kaco Blueplanet 3.7 TL 1
  MPP voltage range: 170V to 510V
  Recommended maximum PV array power: 3.8 kW
  Maximum input current: 2 x 11.0A
  Rated output: 3680 VA
  Rated output current: 16.0A
  DC switch: Integrated
  Maximum efficiency: 97.2%
  Connections: DC via solar connector, AC via connection plug

Dimensions: 560mm x 367 mm x 225 mm
Weight: 18 kg
Price per unit: RM 5471.38

- Kaco Blueplanet 4.0 TL 1
  MPP voltage range: 185V to 510V
  Recommended maximum PV array power: 4.1 kW
  Maximum input current: 2 x 11.0A
  Rated output: 4000 VA
  Rated output current: 17.5A
  DC switch: Integrated
  Maximum efficiency: 97.2%
  Connections: DC via solar connector, AC via connection plug
  Dimensions: 560mm x 367 mm x 225 mm
  Weight: 18 kg
  Price per unit: RM 5535.67
- Kaco Blueplanet 4.6 TL 1
  MPP voltage range: 215V to 510V
  Recommended maximum PV array power: 4.7 kW
  Maximum input current: 2 x 11.0A
  Rated output: 4000 VA
  Rated output current: 20.0A
  DC switch: Integrated
  Maximum efficiency: 97.2%
  Connections: DC via solar connector, AC via connection plug
  Dimensions: 560mm x 367 mm x 225 mm
  Weight: 18 kg
  Price per unit: RM 6133.80

4.9.2.3. Combiner box

To ensure the installation of the solar PV system is safe, it is necessary to install junction box or combiner box near the array site to protect the solar PV system and operating environment from moisture, wind, sunlight, friction and critters. The combiner box typically consists of DC switch disconnect, fuse protection and PV surge protection. The combiner box provides the added function of combining wires from multiple module strings into one beefier pair of positive and negative wires. This reduces the time and expense of running the multiple sets down to the inverter in a larger diameter of a

conduit. The separate circuits may be transporting energy at different voltages, thus combining the currents before they reach the inverter could result in less power production.

SolarNext inludes the installation of the combiner box in the solar PV system from Cooper Bussman that has over 100 years of experience in fuse manufacture and technology. The Cooper Bussman combiner box has special features that include the superior thermal characteristics resulting from intelligent spacing and cable layout eliminate the need for forced ventilation in extreme ambient temperature environments. It is suitable for any kilowatt of the solar PV system installed as it covers up to 1000Vdc/400A ratings for 4-24 strings of PV panels. For added quality, the combiner box is designed in accordance to Pollution Degree III (Industrial) to provide increased safety and doubled insulated PV wiring is used for low loss of power. Price per unit of the Cooper Bussman combiner box is RM 488.70. Solar PV electrical components include in the combiner box are as follows;

- DC switch-disconnectors
  To guarantee insulation during maintenance works, the DC switch-disconnectors isolate the PV array from downstream equipment. The DC switch-disconnectors have lockable feature, rate voltage to 1000Vdc and is up to 400A.

Figure 15: DC switch-disconnectors

- Overvoltage surge protective devices
  To protect the sensitive PV panels against overvoltage surges for example in case of the lightning strikes. The Cooper Bussman overvoltage surge protection devices have specific range of rated voltage from 600 Vdc to 1200 Vdc and has visual monitoring identification.

Figure 16: Overvoltage surge protective devices

- PV fuse protection

Consist of complete range of 10 x 38 PV fuse links specifically for solar applications. The fuse ranges from 1A to 20 A of current ratings and has rated voltage up to 1000Vdc.

Figure 17: PV fuse protection

- PV modular fuse holders
  Protect the electrical system and simple installation thanks to 10 x 38 DIN-Rail mount fuse holders. They come in smaller size than any other modular fuse holder, thus reducing installation space required. Compatible with fuse that ranges from 1A to 20A has rated voltage up to 1000Vdc.

Figure 18: PV modular fuse holders

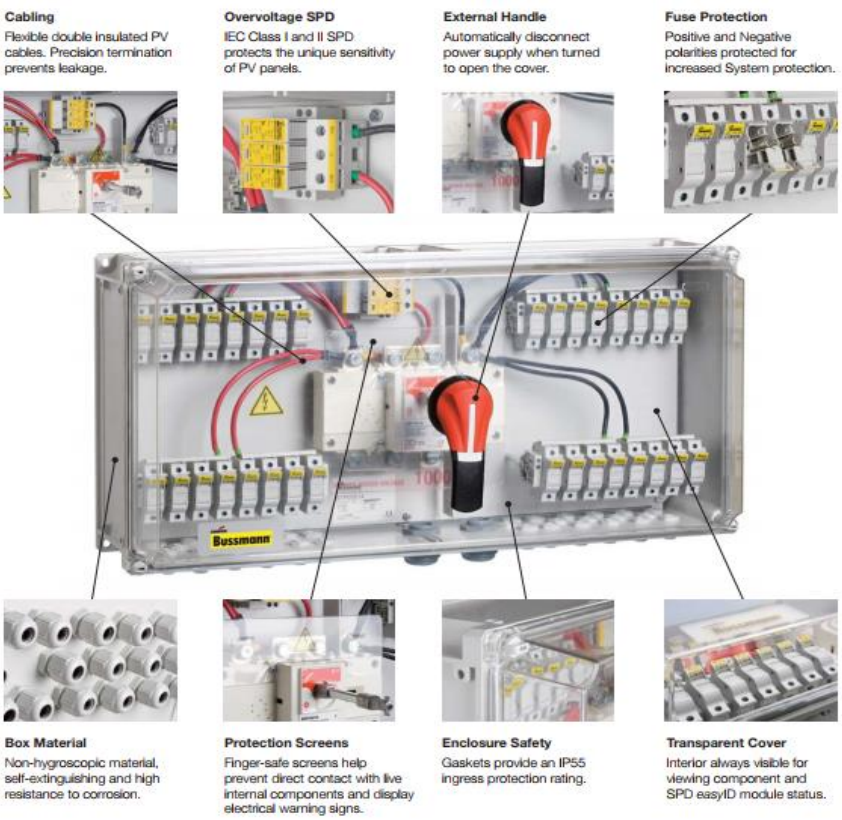

Figure 19: Whole structure of combiner box

4.9.2.4. Balance of system

To mount the solar panels on the rooftop of the customers' houses, SolarNext selects racking and mount system from Milleon Micron Precison (MMP) Sdn Bhd. The racking and mount system is known as balance of system as this system make the solar panel, inverter and other hardware are user friendly and compliant with the Electricity Supply Act 1990 (Act 447). Apart from MMP is a local company, SolarNext chooses to the racking and mounting system from MMP because it provides the durability and versatility to handle the residential rooftop at competitive price. Besides, it protects against buckling problem that commonly happens to other racking and mounting system and safely and efficiently transfer loads into the building structure. MMP racking and mounting system backed by a 20 year of warranty and also easy to assembly thanks to the versatile and adjustable components that simplify any array design. SolarNext does not mix and match components of the balance of system and only relies on the racking and mounting system from MMP.

Traditionally, solar modules are grounded by attaching lugs, bolts or clips to the module frame, then connecting these to a copper conductor that runs throughout the array. This process adds time and cost to the installation, and often results in improper grounding, creating significant long-term safety risks. SolarNext is interested with The MMP Integrated Grounding System solves these challenges by bonding modules directly to the mounting rails. The Grounding Mid Clamp uses "teeth" to pierce through the anodized coatings of both the module frame and the mounting rail. This approach eliminates separate module grounding hardware, and it creates many parallel grounding paths throughout the array, providing greater safety for solar system owners. This forms a secure electrical bond that is repeated throughout the array.

The important features of the racking and mounting system are as follows;

- Clamps - Mid clamps simultaneously fasten and ground the solar panels. Each clamp bonds with the module frame and the rail to form a parallel grounding paths that is repeated throughout the array.
- Rails - MMP rails have unique curved profile that increases structural strength and spanning capability, allowing for fewer roof penetrations and more cost-effective system designs. For the solar PV system at the residential units that does not require high load capability, SolarNext prefers XR10 rail which is light and sleek mounting rail that suitable and designed for regions with no snow.

The additional parts of the racking and mounting system are as follows;

- Standoffs – To raise flush or tilted systems to various heights.
- Slotted L-feet – Drop-in design for rapid rail attachment.
- Tilt-legs – Tilt assembly to desired angle, up to 45 degrees.
- Adjustable tilt legs – Fixed and adjustable tilt legs allow adjustment in all three axes.
- End clamps – Slide in clamps and secure modules at ends of rails.
- T-bolt lug – A single grounding lug connects an entire row of PV modules to the grounding conductor.
- End caps – To provide a finished look for rails.
- Wire clips – To organize both DC and AC wiring along the rails.

4.9.2.5. System monitoring

Figure 20: SolarLog system monitoring

For any installation size of the solar PV system offered by SolarNext, a system monitoring device is installed to monitor any problems that might occur to the solar PV system and a loss of power output may result. Therefore, SolarNext chooses to install the monitoring system from Solar-Log to show the installation and operation status which can be shown on the LCD-Status-Display and the self-consumption which can be measured and displayed as a graph with an energy meter. Smart Energy feature in the monitoring system will active and deactivate individual appliances depending on the amount available energy. This feature also records the self-consumption control for the optimization of the self-consumption. The Solar-log is easy to install as the inverter detection and the internet log on start immediately.

SolarNext and the customers will be able to access the data and monitor the status of the solar PV system installation via the Solar-Log web that shows comprehensive reporting options in the form of graphs and table via the internet. Besides, Solar-Log APP allows the customer to access easily the data and graphical reports anytime from

anywhere in the world. The large and external display used in combination with the Solar-Log can visually present live data or local monitoring from the solar PV system. All these display options are obtained from various connections between the Solar-Log monitoring system to inverters, sensor that measure solar irradiation, temperature and speed wind, USB connection and ethernet. The Solar-Log monitoring system also can record the data volume up to 20 years. The micro SD card is used to protect against any loss of data in the event of a power failure. The price per unit of SolarLog system monitoring is RM 1515.25.

4.9.2.6. Installation packages

SolarNext offers five different solar PV system installation packages to the customer depending the suitable system sizing of the customers' houses. The solar PV system installation packages starts from 4 kWp system to 12 kWp system. Each installation packages are equipped with important components in the solar PV system; 1 unit of Cooper Bussman combiner box, site specific solar cables and connecters and complete racking and mount system from Milleon Micron Precison (mounting rails, mid-clamps, standoff, slotted L-feet, etc.) which all of them are compliance to the SEDA rules and regulations along with the customized size system of solar panels and inverter as follows;

- 4 kWp system
  16 units of 255W Solar Panel Hanwha Q-cells Q PRO G3-255
  1 unit of Kaco Blueplanet 3.7 TL 1 solar inverter
- 5 kWp system
  20 units of 250 W Solar Panel Hanwha Q-cells Q PRO G3-250
  2 unit of Kaco Blueplanet 3.7 TL 1 solar inverter
- 6 kWp system
  20 units of 300W Solar Panel Q-cells Q PEAK BLK G4.1-300
  2 units of Kaco Blueplanet 3.7 TL 1 solar inverter
- 7 kWp system
  36 07 units of 280W Solar Panel Q-cells Q PLUS BFR G4.1-280
  2 unit of Kaco Blueplanet 3.7 TL 1 solar inverter
- 8 kWp system
  25 units of 300W Solar Panel Q-cells Q PEAK BLK G4.1-300
  2 units of Kaco Blueplanet 3.7 TL 1 solar inverter
- 9 kWp system
  30 units of 300W Solar Panel Q-cells Q PEAK BLK G4.1-300

2 unit of Kaco Blueplanet 4.6 TL 1 solar inverter

- 10 kWp system
  36 units of 280W Solar Panel Q-cells Q PLUS BFR G4.1-280
  2 units of Kaco Blueplanet 4.6 TL 1 solar inverter
- 11 kWp system
  40 units of 275W Solar Panel Q-cells Q PLUS BFR G4.1-275
  3 unit of Kaco Blueplanet 4.0 TL 1 solar inverter
- 12 kWp system
  44 units of 275W Solar Panel Q-cells Q PLUS BFR G4.1-275
  3 units of Kaco Blueplanet 4.0 TL 1 solar inverter

Figure 21: Example of solar PV system installation at residential unit

4.9.3. Suppliers

SolarNext obtains all the supply of the products that we have been discussed before from international manufacturers via their certified distributors or sales offices in Malaysia or other countries in Asia as SolarNext does not engaged in the manufacture stage directly with the suppliers. This method allows SolarNext to lower capital cost which ensures to provide electricity at reasonable price to the customers. It is typical for other solar service providers in Malaysia to export the solar PV products from developed countries such as Germany, Japan, China and the USA. SolarNext identified and searched the suppliers by several characteristics;

- The supplier with high number of promotions of the wholesale.
- The suppliers that manage the flexible and non-complicated payment.
- The suppliers that meet the expected costs.
- Product warranty
- Variety of product options especially in the technical aspects.
- The punctuality in the distribution in market
- Flexible delivery or shipping period.

Regarding the delivery period or shipping duration for the components of solar PV systems to reach to the company, SolarNext ensures that the components purchased arrive in Malaysia via the cargo shipping through the sea transportation within 2-3 weeks after the payments have been made which highly determined by quantity of orders. Normally, the payment deadline to the suppliers may varies from 30 to 45 days. Once the orders of the solar components arrive in Port Klang, SolarNext needs to make declare the orders to the Royal Malaysian Customs Department (RMCD) within 30 days after the arrival of the imported solar PV system components. There is no import duty implemented on electrical equipment that imported to Malaysia. Therefore, SolarNext will only make the payment on delivery or shipping cost to the suppliers or the couriers. The price of the components of solar PV system that will be paid by the customers in the installation package price is recommended by the suppliers and also include the Good and Service Tax which is 6% from the determined price.

SolarNext has identified several international companies that can supply solar PV products with high quality and performance with competitive price to offer best deals to the customers.

- Hanwha Q Cells

Hanwha Q Cells is a part of the Hanwha Group which is based in Seoul, South Korea. Hanwha Q Cells is the world's largest cell production capacity that the production scope ranges from midstream of ingots, to wafers, cell, and modules to downstream solar solutions for residential, commercial buildings and solar power plants. Even though Hanwha Q cells is from South Korea, the solar engineering technology and R&D is based technology and innovation headquarters in Thalheim, Germany. The technology infrastructure enables Hanwha Q Cells to differentiate in the technology innovation among the competitors via the strong R&D and as a result, Hanwha Q Cells is the world's leading company with annual 5.2 GW of cell production capacity. Hanwha Q Cells has manufacturing plants and marketing offices worldwide including in Canada, Chile, Italy, Australia, China, India, Turkey, USA and UK. One of the manufacturing plant of the solar PV products is locate at Selangor, Malaysia. SolarNext corporates with Hanwha Q Cells Solar Power Sdn Bhd that acts as the sales office in Malaysia to purchase all the Hanwha solar panels from Q Plus, Q Peak and Q PRO series at competitive price to suit with the solar PV system installation packages. As an addition, Hanwha Q Cells also offers technical support on the regional level.

- KACO New Energy

  KACO New Energy is a German company that aims to become the leader in solar inverters for the solar PV system. In 2014, KACO New Energy has invented the solar PV inverter Blueplanet TL1 series that is developed as a solution to all contemporary demands for PV systems which SolarNext chooses to install in the solar PV system. KACO New Energy also manufactures solar inverters in the USA, Canada and South Korea to stay close to the overseas markets. The R&D team in South Korea works in close corporation with the headquarters in Neckarsulm, Germany to ensure the "Made in Germany" quality meet the highest standard. While maintaining the main priority of the company in the production of the solar inverters, KACO New Energy also produces other solar PV products such as solar energy storage systems, battery inverters and solar PV accessories for specific purposes that includes evaluation and visualization purpose as well as for data logging and grid management. Since there are no certified distributors of KACO New Energy in Malaysia, SolarNext purchases and

imports the solar inverter Blueplanet TL1 series from the sales office in South Korea.

- Milleon Micron Precision Sdn Bhd

  Milleon Micron Precision Sdn Bhd is the only local supplier for SolarNext that supplies the racking and mounting system for solar array which is known as the balance of system. MMP was founded in 2002 as an aluminum extrusion manufacturer for specialized aluminum products and has expanded the business ventures into engineering solutions for solar modules frames and solar racking and mounting system. MMP has developed its regional offices across the Southeast Asia including Philippines, Thailand and Singapore. MMP has wide experience in the racking and mounting system as the company has installed the racking and mounting system for more than 40 kWp of solar PV system nationwide. SolarNext purchases the racking and mounting system after designing the solar PV system at the purposed location or the customer's house and MMP will supply the suitable racking and mounting system that suits with the dimensions of the rooftop and solar PV panels. The major innovation of MMP in Integrated Grounding System that allows the bonding modules directly to the mounting rails makes MMP as good as foreign companies which offer the same system yet at the much lower costs compared to its competitors.

- Cooper Bussman

  Copper Bussman is one of the major business division owned by Eaton which originated from United Kingdom that focuses on development and manufactures critical circuit protection, power management and electrical safety products designed to provide innovative circuit and power electronics protection. Utilising over 100 years of circuit protection experience, Cooper Bussman produces wide ranges of products that serve circuit protection for various purposes from automotive, telecom, power distribution, solar, vehicle to wireless mobile machine. Cooper Bussman expands its portfolio by producing technical products into technical solutions. One of its significant products is the photovoltaic combiner box that SolarNext purchases to optimize solar power generation capacity through the reliability and expertise of the Copper Bussman protected electrical system. Rigorous testing is conducted to ensure maximum system protection and all the products meet the global standards. Copper

Bussman sell products to customers in more than 175 countries worldwide. SolatNext purchase the combiner box from its representative in India.

- Solare Datensysteme GmbH (SDS)

  Solar-Log monitoring system is manufactured by Solare Datensysteme GmbH (SDS) which is one of the leading companies for solar monitoring, smart energy and feed-in management where its headquarters is in Geislingen-Binsdorf, Germany. Solar-Log hardware and software products are used all over the world in 100 countries for monitoring PV plants. Solare Datensysteme GmbH (SDS) is represented in more than 30 countries worldwide by branch offices, service partners, sales offices and distributors in France, Italy, Switzerland, United Kingdom, India, China and Southeast Asia and many more. Due to its success in the early identification of global market needs, Solare Datensysteme GmbH (SDS) manages to offer the customers innovative energy system solutions which is reflected on several series of Solar-Log software, hardware and components. There are 270,610 solar plants worldwide that produced 5239 TWh energy that install Solar-Log monitoring system as a part of the solar PV system. Strong corporate principles and values help Solare Datensysteme GmbH (SDS) to make a significant contribution to the successful integration of renewable energy into a smart grid and protect the environment. SolarNext are truly inspired by the commitment of Solare Datensysteme GmbH (SDS) and want to be a part of it by purchasing the Solar-Log monitoring system from sales office in India and install them at the customers' houses and the customers's will enjoy the product's advantages.

4.9.4. Distribution Channel

Before discussing the position of SolarNext in distribution channel, it is important to understand what type of business relationship between SolarNext and the customers. SolarNext is a company that conduct the business by using the B2C concept. B2C or business to consumer is a business model that conducted directly between a company and consumers who are the end-users of its product or services. In SolarNext's situation, the customers who also act as or at the end turn into the consumers because they consume the electricity generated by the solar PV system installed at their houses which the service of the solar PV system installation is performed by SolarNext.

For the distribution channel of the company as shown in Figure 21, SolarNext is a company that acts as a "packager" or final manufacturer of the solar PV system at the customers' houses. Even though the homeowners are the customers or at the end, the consumer of electricity which produces by solar energy, SolarNext does not appear at the first glance as the traditional retailer selling the end product. In addition to that, SolarNext is the system designer that plays a critical decision-making role to install the solar PV system. It is SolarNext's responsibility to decide which type of components required, how to install them and how many components needed, which frequently from different manufacturers and assemble them into the complete solar PV system. Thus, it is not a final product which flows through the channel to the installer or the service provider which in this case is SolarNext, but rather a group of components. That is why SolarNext could be thought as the final manufacturer of the solar PV system while other members of the distribution channel (e.g.: manufacturers, distributors) are suppliers of the components of the solar PV system.

From the homeowners' view, SolarNext could also be viewed as another supplier of components of the solar PV system along with as the service provider, since the solar PV system is the final end use product, which is the residential units. The homeowners do not purchase the solar PV system as the end use product, and in technical sense SolarNext is the "manufacturer" more than a conventional retailer. Therefore, the relationship of the homeowners as the consumer to SolarNext is not the same as the normal consumer-retailer relationship for consumer durable goods.

Figure 22: Distribution channel. Source: Prepared by the author.

4.9.5. Location and Installation Plan

The business operation, storage and technical space of SolarNext are conducted at a rented shop lot near to the Industrial Area of Ayer Keroh. To be exact, the direction of the shop lot is 261, Lorong Setia 1, Ayer Keroh Heights, 75450, Ayer Keroh at latitude and longitude 2.257193, 102.291501 as shown in Figure 22. The shop lot area is dedicated to various type of businesses and commercial activities and within the radius of 3km from the SolarNext's office are where the Industrial Area of Ayer Keroh, Melaka International Trade Center and housing areas.

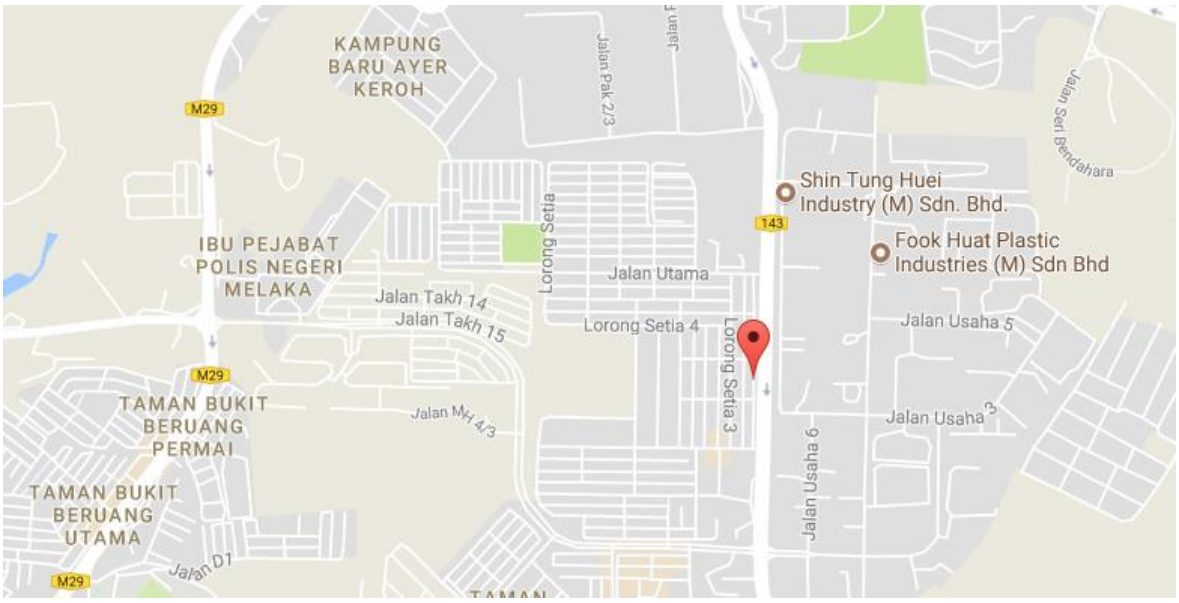

Figure 23: Location of SolarNext's office and operational base in Google Map. Source: Google Map.

SolarNext rents a shop lot that consists of the technical or storage area at ground floor and the office space at first floor. Originally, the storage area is a space dedicated for shop and due to the economical as well as administration reasons, SolarNext dedicated the shop area for the technical or storage area as it is spacious for storage purpose and easy to manage as it is at the same shop lot unit. The area for both each space is 20 feet x 70 feet. The installation plans for both areas are as follows;

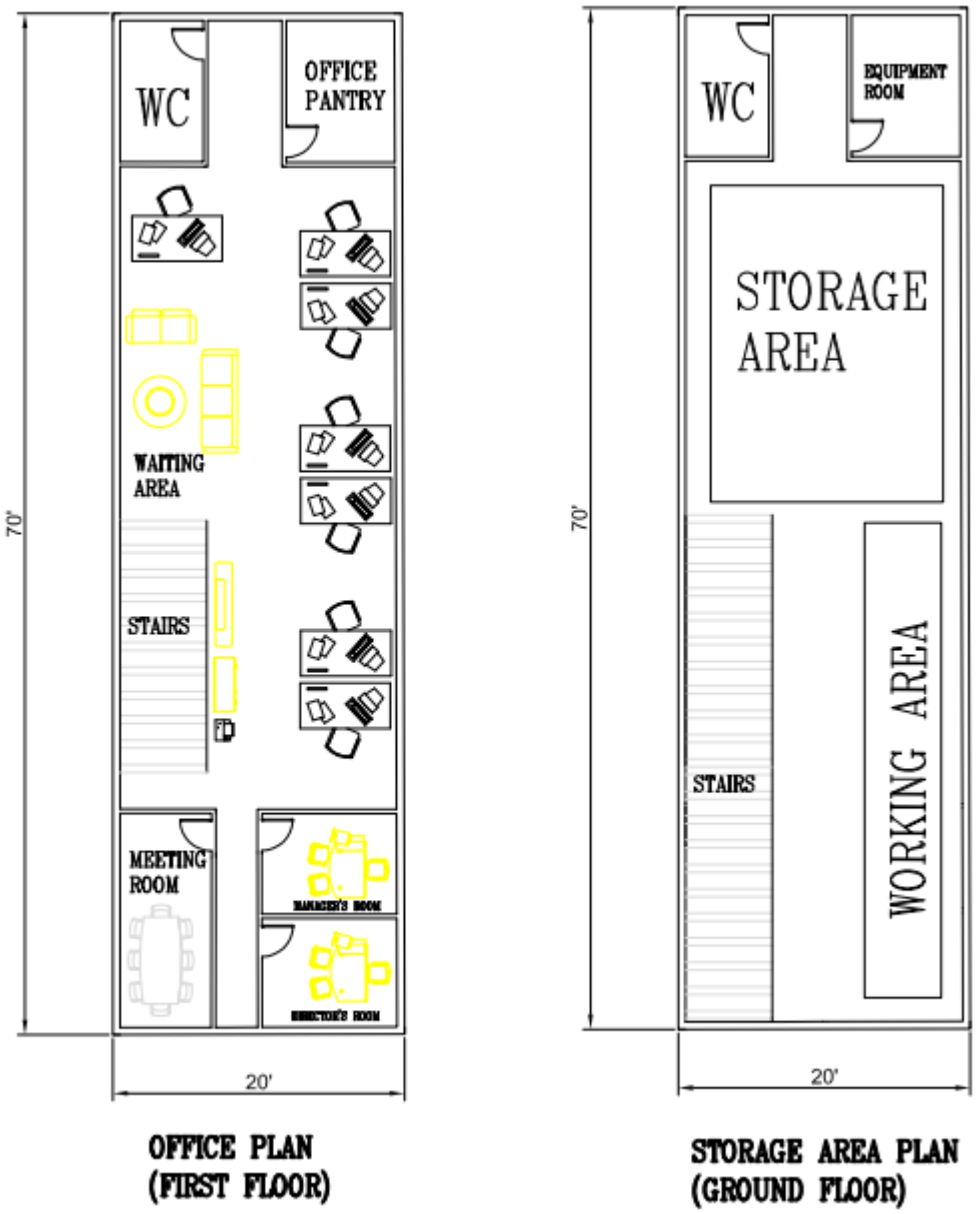

Figure 24: Installation plans for office and storage or technical area. Source: Prepared by the author.

4.10. ORGANIZATIONAL STRUCTURE FEASIBILITY

Another important element to guarantee the ability of the company to grow, evolve and survive in a very long time is its strong foundation organizational structure. The organizational structure may be reflected and displayed by principles or practices of the business that are carried by its human resources. The human resources are the main backbone to run and perform in the business. The business's strengths come from the talent, skills and experience of those running the company. SolarNext identifies its human resources as the team members of the business who are capable to fulfill the company's mission and vision by constantly improving and pursuing the excellence thus becoming the foundation of SolarNext's success. In the beginning of its formation, SolarNext is led by 2 Directors and is assisted by a manager. Under their direction, there are 5 departments namely as administration department, business development department, financial department, human resources department and projects department. Each department has 1 executive except for projects department which consists of 3 engineers and are backed by 4 solar installers and 2 electricians. The organizational chart of SolarNext is as follow;

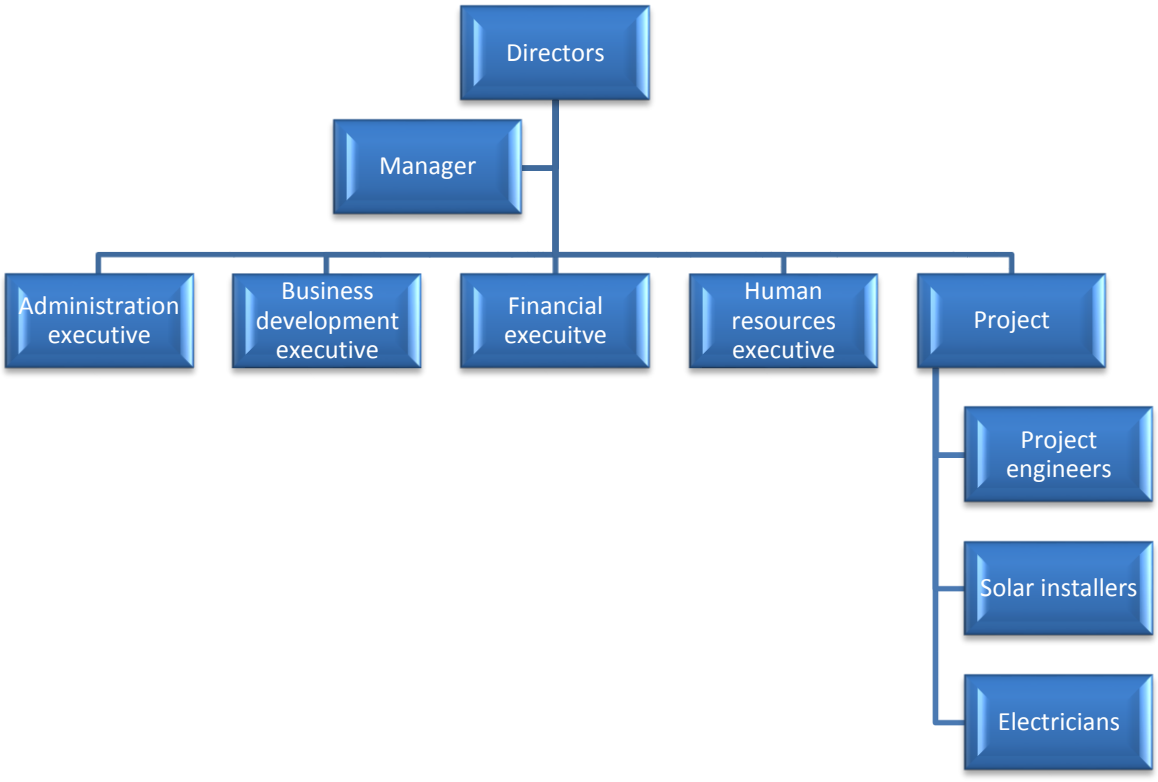

Figure 25: Organizational chart of SolarNext. Source: Prepared by the author.

4.10.1. Organizational Structure Description

SolarNext has 5 departments that drive the business operational on daily basis and each department supporting each other while playing the equal roles for the company's survival. The 5 departments which are the pillars of SolarNext are administration department, business development department, financial department, human resources department and projects department. All these departments function accordingly under the direction and management of Director and manager of the company. Before discussing the roles and function of each of the departments in SolarNext, we will discuss the responsibilities of the Director of the company and

SolarNext has 2 directors of the company as it is one of the requirements to form the Sendirian Berhad or Private Limited Company. The Directors as the head of the SolarNext have great responsibilities ahead of them. The Directors need to determine the direction of SolarNext, evaluate the performance of the business, ensure that any business plans are implemented properly, ensure the revenue sources are used wisely and make decisions according to the interests of the company. From the provisions and laws perspective, the duties of the Director of the company may be classified into fiduciary and statutory duties. Under Section 132 (1) of the Companies Act 1965, it is compulsory for the Director to carry out its fiduciary and statutory duties faithfully. A part form that, the duties of the Director of the company in accordance with statutory obligations are set out in the Companies Act 1965, namely;

- Hold AGM (Annual General Meeting); Section 13, Companies Act 1965.
- Prepare and submit to the Registrar the Annual Return Statement of the company; Section 165, Companies Act 1965.
- Keep the accounting records properly; Section 167, Companies Act 1065.
- Present the accounts, balance sheets and director's report in the AGM; Section 169, Companies Act.
- Appoint first Auditor; Section 172, Companies Act 165.

In addition, according to Article 73, the Director is given power to operate the business of the company. The Director shall be responsible for the management of the company and shall not abuse such power for the benefit of the individuals or parties. Among the powers and duties assigned to the Director in accordance with the Article 73 are as follows;

- Pay all expenses in the registration of the company.

- Exercise all the powers of the company in relation to any official seal for use outside Malaysia and in relation to branch listings.
- Appoint any party to be a representative by a power of attorney.
- Sign, issue, accept and confirm all checks, memorandum of agreement, drafts, bill of exchange and other instruments by any two directors of the company or such manner may be decided from time to time.

In relation to the Directors' allowances, no provision specifies that the Directors' allowances are necessary or mandatory in the Memorandum and Articles of Association. Usually this matter is discussed during the General Meeting to set and decide the amount of allowances and remuneration payments method for each of the Directors. The Directors of SolarNext receive RM 6000 for their salary. In general, if the Directors comply with all provisions and laws, the company's journey will be smooth, and the success of the company can be achieved.

Manager is responsible for overseeing and supervising the company's activities and employees. He is also known as the head of all executives of the company. He accomplishes the departments' objectives by managing the employees besides planning and valuating all department activities. The manager ensures the employees aligned with the goals of the company to strive the excellence. He is also responsible on developing and implementing the company's budgets. Besides, he needs to prepare and submit reports on the performance and progress of the company to the Directors. As SolarNext is a small company during its first year of establishment, the manager has responsibilities on managing and assessing each of the departments in SolarNext. For example, his responsibilities on human resources department are; he oversees the activities of all the employees as well as hire, train and evaluate new employees. The duties and responsibilities of the manager of the company are as follows;

- Accomplishing employees' results by communicating job objectives or expectations; planning, monitoring and appraising job results; developing, coordinating and enforcing systems, policies, procedures and productivity standards.
- Establishing strategic goals by gathering pertinent business development, financial, human resources and projects information; identifying and evaluating trends and options; choosing a plan of action, defining objectives and evaluating outcomes.

- Accomplishing financial objectives by forecasting requirements; preparing annual budget; scheduling expenditures; analyzing variances and initiating corrective actions.
- Maintaining quality service by enforcing quality and customer service standards, analyzing and resolving quality and customer service issues and recommending system improvements.
- Maintaining professional and technical knowledge to contribute to team effort and achieving related results as needed.

Skills and qualifications required for the administration executive position are;

- Education: Possess at least Professional/ Bachelor Degree, Post Graduate Diploma in Administration, Marketing, Business Management or equivalent.
- At least three years of relevant working experience.
- Skills: Performance management, project management, coaching, supervision, quality management, results driven, developing budgets, developing standards, foster teamwork, handling pressure and giving feedback.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 4700.00

4.10.1.1. Administration department

Department of administration is a department dedicated to ensuring the efficient performance of all departments in the company. The administration plays a role advising and assisting other departments of the company as the department also act as a connecting link between the upper management and the employees. Generally, the role of this department within SolarNext is to process all the administration affair and documents for the entire company. Besides, the administration department also will be responsible for keeping all information and details of the company confidential. It is an important department for the company as the administration executive work across all departments with all kinds of work meanwhile contributing to team effort by accomplishing related results as needed. The administration executive appointed in SolarNext are responsible for numerous duties and charges, for example;

- Producing information by transcribing, formatting, inputting, editing, retrieving, copying and transmitting text, data and graphics.

- Welcoming guests and customers by greeting them, in person or on the telephone; answering or directing inquiries.
- Preparing reports by collecting and analyzing information.
- Securing information by completing data base backups.
- Maintaining executive's appointment schedule by planning and scheduling meetings, conferences or any hotels for business trips that may be needed.
- Ensuring that all records and documents such as purchases and expanses that pass through the department are filled correctly and easy to access and at disposal whenever they become necessary.
- Maintaining office supplies inventory by checking stock to determine inventory level, anticipating needed supplies and process paperwork for suppliers.
- Ensuring operation of equipment by completing preventive requirements.

Skills and qualifications required for the administration executive position are;

- Education: Possess at least a Professional Certificate, Diploma, Advanced/ Higher/ Graduate Diploma in Business Studies, Secretarial, Administration, Management or equivalent.
- At least one year of relevant working experience.
- Skills: Writing skills, reporting skills, scheduling, supply management, Microsoft Office skills, organization and time management, presentation skills, equipment maintenance, travel logistics and verbal communication.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 2520.00

4.10.1.2. Business development department

Business development department is responsible for several key objectives inside and outside the company by analyzing business environment, including regulations, restricting and competition that could impact SolarNext and at the same time focuses on customer acquisition. Working with customers is important to create solutions for their needs and consult through the sales process. Besides, the business development department always search for better ways to improve the performance of sales and marketing. Market research is always a reliable method to conduct and enhance the analysis from the business development department. Strategic planning in developing key marketing strategies to grow the SolarNext's business is also the responsibility of

the business development department. Identifying the suppliers, organizing purchase policy and its execution and controlling purchasing budgets are also another crucial role which carries out by this department. The duties and responsibilities of business development executive of SolarNext are as follows;

- Identifying, qualifying and securing business opportunities as well as accounts by collaborating with sales and leadership.
- Planning and overseeing new marketing initiatives.
- Developing customized targeted sales strategies and coordinating business generation such as promotion and sales channel as well as collaborating with management on sales goals, planning and forecasting to achieve exceed annual sales.
- Building business relationships with current and potential customers' by responding to customers' requests for proposals, answering potential client questions and follow-up questions and understanding customers' needs and offering solutions and support.
- Researching organizations and individuals online (especially on social media) to identify new leads and potential new markets.
- Ensuring adequate stock levels, review inventories and order as required.
- Working closely with suppliers to ensure effective support.
- Recording all transactions and authorizing receipts.

Skills and qualifications required for the business development executive position are as follows;

- Education: Possess at least a Diploma, Professional/ Bachelor Degree in Retail Management, Marketing, Business Studies, Management or equivalent.
- At least one year of relevant working experience.
- Skills: Closing skills, prospecting skills, motivation for sales, sales planning, market knowledge, meeting sales goals, presentation skills to customers and suppliers, negotiation and problem-solving skills and professionalism

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 2750.00

4.10.1.3. Financial department

Financial department of SolarNext specializes in managing money, generally. The functions of the financial departments typically include planning organizing, auditing, accounting and controlling the company's finances. This department also usually tracks of all transactions and produces the company's financial statements and returns. The financial department is also responsible for management of the company's cashflow and ensuring there are enough funds available to meet the day-to day payments as well as advising and sourcing longer term financing. Besides, the financial department will be responsible in measuring and reporting regularly key numbers crucial to guarantee the success of SolarNext. Therefore, SolarNext will never overlook or ignore any irregularities in the business operation as the management of accounting information provided by this department help the Director and manager of the company to monitor the situations and decide where further attention may be required. Apart from that, the financial department will work with the manager to prepare the company's budgets and forecasts, and to report back the progress. This information can be used to plan staffing levels, cash needs, asset purchases and expansions. Finally, the financial department also could contribute to key strategic decisions making in previewing or forecasting the payback periods for large capital purchases or projects to pursue. The job description for financial executive appointed in SolarNext are as follows;

- Determining cost of operations by establishing standard costs and collecting operational data.
- Preparing monthly and annually statements by collecting data, analyzing and investigating variances, summarizing data, information and trends.
- Complies with federal tax filing requirements by studying regulations, adhering to requirements, advising management on required actions and assembling data for annual tax filings.
- Providing financial advice by studying operational issues, applying financial principles and practices thus developing recommendations such as changes in methods and materials.
- Identifying financial status by comparing and analyzing actual results with plans and forecasts.
- Maintaining database by entering, verifying and backing up data.
- Protecting operations by keeping financial details confidential.
- Accomplishing finance and organization mission by completing related results as needed.

Skills and qualifications required for the financial executive position are as follows;

- Education: Possess at least Professional/ Bachelor Degree, Post Graduate Diploma in Mathematics, Commerce, Economics, Finance, Accountancy, Banking or equivalent.
- At least one year of relevant working experience.
- Skills: Deadline-oriented, managing profitability, accounting, audit, financial skills, analyzing information, planning and strategy, researching skills, reporting research results, statistical analysis, and business knowledge.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 2670.00

4.10.1.4. Human resources department

Human resources department is a department in a company that could provide structure and ability to meet business needs through managing the company's most valuable resources; its employee. Generally, there are five aspects in human resources disciplines that this department in SolarNext applied, namely employee relations, remuneration, recruitment, compliance and safety. For the employee relations scope, the human resources department in SolarNext ensures that the employer-employee relationship is strong and on check through measuring job satisfaction, employee engagement and resolving workplace conflict effectively. It is crucial to maintain a conducive working environment that is largely affected by the employer-employee relationship. The human resources department functions also include setting remuneration structures and evaluating competitive pay practices. Compliance with labor and employment laws is also another critical function of the human resources department. The human resources department must be aware of federal employment laws such as Working Act of 1955. This is because, noncompliance conditions and general dissatisfaction with working condition can affect productivity and ultimately, profitability. The safety of the employees is the main priority if the company. Therefore, the human resources department is to ensure the provided working environment is safe for the employees. The company's workers compensation matter is also a responsibility of this department. The human resources play a key role in developing the company's workforce. When it comes to the recruitment period, this department will advertise job postings, source candidates, screen applicants, conduct preliminary interviews and coordinate hiring efforts with manager responsible for making the final selection of candidates. The human resources executive responsibilities are as follows;

- Providing job candidates by screening, interviewing and testing applicants, notifying existing staff of internal opportunities and maintaining personnel records.
- Implementing human resources programs by providing human resources services, including employment processing, compensation, health and welfare benefits, safety and health, records management and employer-employee relations.
- Maintaining a play plan by conducting periodic pay surveys, scheduling and conducting job evaluations, preparing pay budgets and planning and implementing pay structure revisions.
- Ensuring legal compliance by monitoring and implementing applicable human resource federal or legal requirements, enforcing adherence to requirements and advising management on needed actions.
- Guiding management and employee actions by researching, developing, writing and updating policies, procedures, method and guidelines, communicating and enforcing organizational values.
- Maintaining employee confidence and protects operations by keeping human resources information confidential.

Skills and qualifications required for the human resources executive position are as follows;

- Education: Possess at least Professional/ Bachelor Degree, Post Graduate Diploma in Human Resource Management, Administration, Management, Business Studies or equivalent.
- At least one year of relevant working experience.
- Skills: Human resources management, welfare and benefits management, compensation and wage structure, communication process, employment law, management proficiency, orienting employees, confidentiality and reporting skills.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 2620.00

4.10.1.5. Projects department

Projects department is where all the services or activities related to solar PV system installation service provided by SolarNext are planned, supervised, controlled

and monitored. Under the projects department, there are 3 projects engineers, 4 solar installers and 2 electricians. The projects department is a department that determines, controls, and maintains the standards and process related to project management within the company. The idea of this department consists in allowing managing multiple solar PV system installation projects from a single, centralized location by establishing the structure required to standardize project management practices, maintain portfolio management and implement methodologies for repeatable workflows and processes for all activities related to solar PV system installation service. Within the project department, the proper guidelines and advice such as pre-installation works are provided to the solar installers and electricians. Developing and implementing a consistent and standardized process of managing solar PV system installation service projects according to a chosen methodology is another crucial function of this department. In order to assist all the functions stated before, a specific software; AutoCAD and Professional PV software for designing solar PV system is used to facilitate the projects implementation. The project engineers as the head of the department will ensure the correct management of solar PV system installation projects are conducted properly as well as defining the necessary roles and responsibilities for the solar installers and electricians. The rest of responsibilities of the project engineers as follows;

- Developing installation project objectives by reviewing project proposals and plans.
- Developing installation processes by designing and modifying plans or equipment, if necessary.
- Determining system installation responsibilities by identifying project phase and elements and assigning personnel to phases and elements.
- Determining solar PV system installation project specifications by studying product suitability, customer requirements and performance standards and completing technical studies.
- Determining and maintaining project schedule by studying project plan and specifications, calculating time requirements, monitoring project progress, coordinating activities and resolving problems.
- Assuring solar system installation quality by designing testing methods and testing the whole system performance or capabilities.
- Preparing project status reports by collecting, analyzing and summarizing technical information and details.
- Maintaining safe and clean working environment by enforcing procedures, rules and regulations.

Skills and qualifications required for the project engineer position are as follows;

- Education: Possess at least Professional/ Bachelor Degree, Post Graduate Diploma in Civil Engineering, Electrical or Electronic engineering, Mechanical Engineering or equivalent.
- At least two years of relevant working experience.
- Skills: Solar PV system installation knowledge, electric and electronic systems, CAD, CAD/CAM circuit design, technical understanding, project management, process improvement, safety management, supervision, analyzing information and reporting projects results.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Salary: RM 3300.00

The solar installers will be responsible for assisting directly in solar PV system installation from beginning to end and will be working with crew members to complete the projects within established procedures and period. Their specific duties and responsibilities are as follows;

- Pulling inventory for installation projects and pre-assembling components.
- Assembling the solar array racking (racking and mounting system), properly sealing all roof penetrations and installing all relative components.
- Install all rack grounding and DC wiring to inverters and installing and connecting solar PV modules according to plans.
- Diagnosing and troubleshooting solar PV system malfunctions and operational issues.
- Cleaning and maintaining equipment.
- Maintaining high levels of quality assurance and quality control with an emphasis on safety.
- Communicating with customers in a professional, considerate and respectful manner.

Skills and qualifications required for the solar installer position are as follows;

- Education: Possess at least Certificate or Diploma in Electrical or Electronic engineering.
- At least one year of relevant working experience.
- Must have a valid drivers' license.
- Must able to lift 25 kg.

- Skills: Solar PV system installation knowledge, basic in engineering, basic electricity understanding such as the difference between alternating current (AC) and directing current (AC), basic computer skills including familiarity with Microsoft Office programs, safety standards and written and verbal communication skills.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Work in extreme environments (example: hot sun, crawl spaces, different configurations or type of roof or surfaces for different houses)
- Must be willing and able to climb ladders, stairs, work on rooftops and able to work on feet for long periods of time.
- Salary: RM 1460.00

The electricians are responsible for any wire connections including connecting array cables and home runs, inside the junction or combiner box, inside the inverter and inside the main service panel. The electrical connection work is done once all installation works of all components of solar PV system are completed. Apart from that, the electricians are expected to work along the project engineers during the testing and commissioning phase. The duties and responsibilities of electricians are as follows;

- Performing installations, alterations, additions, and/or repairs of electrical system and associated solar PV system components within the solar PV system installation projects site.
- Performing troubleshooting and remediation communication measures.
- Assisting the projects engineers in testing and commission phase.
- Maintaining high levels of quality assurance and quality control with an emphasis on safety.
- Communicating with customers in a professional, considerate and respectful manner.

Skills and qualifications required for the solar installer position are as follows;

- Education: Possess at least Certificate or Diploma in Electrical or Electronic engineering or Certificate from the Suruhanjaya Tenaga for AO qualification.
- At least one year of relevant working experience.
- Must have a valid drivers' license.

- Skills: Solar PV system installation knowledge, basic in engineering, basic electricity understanding such as the difference between alternating current (AC) and directing current (AC), ability to read and accurately interpret electrical construction drawings, terminate cables, install and trouble shoot control wiring from schematics, basic computer skills including familiarity with Microsoft Office programs, safety standards and written and verbal communication skills.

Working conditions and remuneration;

- Monday to Friday, from 8 am until 5 pm.
- Work in extreme environments (example: hot sun, crawl spaces, different configurations or type of roof or surfaces for different houses)
- Must be willing and able to climb ladders, stairs, work on rooftops and able to work on feet for long periods of time.
- Salary: RM 1360.00

4.11. ECONOMIC AND FINANCIAL FEASIBILITY

The economic and financial feasibility analysis the fundamental analysis among other feasibility studies as the result from the feasibility analysis will determine the viability and profitability of the business in the long run, predict the growth as well as financial necessity along the business expansion. Even though the data and value in the economic and financial study will not be the same as the data and value in the real situation, the outcome and findings from this study may act as the reference and guidance for the company or in this case, SolarNext to achieve the financial goals and maintain the company's position on the good track. The time horizon for the economic and financial feasibility of SolarNext is 4 years. This study takes into account all the company's expenses starting from the initial investment to set up the business to variables expenses and also the company's income from the run business. Every single expenses and income of the company will be accompanied with the all data required as the evidence of the calculation.

4.11.1. Initial Investment

There are several important aspects in initial investment to be considered before starting the company. The initial investment of Solarnext consists of;

- Registration company
- Company's building rental deposit
- Opening stocks
- Installation and equipment required to start the operation

SolarNext spends RM 2,333,767. 80 for the total initial investment. The total spent for each components of the initial investment are shown in the Table 16 below;

INITIAL INVESTMENT	COST
Registration of the company	RM2,060.00
Company's building rental deposit	RM7,200.00
Opening stocks	RM1,712,000.00
Installation and equipment	RM612,507.80
TOTAL	RM2,333,767.80

Table 16: Initial investment of SolarNext. Source: Prepared by the author.

4.11.1.1. Registration of the company

SolarNext obtains the service of the registration of the company to Companies Commission of Malaysia (SSM) from NBC Group, a company that dedicates in assisting the companies in Malaysia to manage their administration and financial operation such as company's registration, taxation and audit. The cost of the registration of the company package service is RM 1,060.00 and the package service includes the following;

- Name application fee
- Appointment of first company secretaries
- Issue of share certificates to 1 or 2 shareholders
- Preparation of minutes for First Board Meeting
- Certified copied of Super Form and Notice of Registration

Apart from that, SolarNext needs to pay the registration application fee to Companies Commission of Malaysia (SSM) according to the authorized capital of the company. Since SolarNext's authorized capital is RM 385,130.00, the registration application fee that needs to pay by SolarNext is only RM 1,000.00. Therefore, the total of the registration of the company is RM 2,060.00.

4.11.1.2. Rental deposit

SolarNext pays 3 months rental deposit to the owner of the shop lot that functions as the administration base on the first floor as well as the technical and storage area at the ground floor. The rental deposit acts as the security deposit to protect the ownerif the tenant breaks or violates the terms of the lease or rental agreement. It may be used to cover damage to the property, cleaning, key replacement, or back rent. The total of the rental deposit by SolarNext to the owner is RM 7,200.00

4.11.1.3. Opening stocks

To launch the business operation of the company, SolarNext need to provide initial stocks of the components of the solar PV system in order to be ready whenever the company starts receiving the demand of the installation service from the customers. Although the demand of each of the solar PV system installation package at the initial phase of the business operation is unknown, SolarNext prepares the opening stocks according to the prediction of the demand of the first 3 months. The Table 17 below shows the allocation of the quantity for each installation package service;

Opening stocks	Unit	Price per package	Total Price
4 kWp system	10	RM20,660.00	RM206,600.00
5 kWp system	5	RM29,340.00	RM146,700.00
6 kWp system	5	RM35,200.00	RM176,000.00
7 kWp system	5	RM37,090.00	RM185,450.00
8 kWp system	5	RM42,140.00	RM210,700.00
9 kWp system	5	RM46,680.00	RM233,400.00
10 kWp system	3	RM48,210.00	RM144,630.00
11 kWp system	3	RM55,050.00	RM165,150.00
12 kWp system	3	RM58,340.00	RM175,020.00
TOTAL			RM1,643,650.00

Table 17: Opening stocks for SolarNext. Source: Prepared by the author.

4.11.1.4. Installation and equipment

Installation of the administration area of SolarNext consists of basic office furniture and computers to accommodate all of the employees while the technical and storage area are filled with the all necessary equipment and mood of transportation to install the solar PV system at the proposed site. The overall cost for installation and equipment for initial investment is RM 612,507.80. The installation and equipment acquired by SolarNext are shown in the tables below;

Motor vehicle	Unit	Price per unit	Total Price
Crane	1	RM 178,000.00	RM 178,000.00
Lorry	1	RM 186,000.00	RM 186,000.00
Panel van	1	RM 189,800.00	RM 189,800.00
TOTAL			RM553,800.00

Table 18: Motor vehicles owned by SolarNext. Source: Prepared by the author.

Computer software	Unit	Price per unit	Total Price
Autocad Inventor LT suite commercial	1	RM 2,340.00	RM 2,340.00
Professional PV software	1	RM 2,955.00	RM 2,955.00
TOTAL			RM5,295.00

Table 19: Computer software. Source: Prepared by the author.

Office furniture	Unit	Price per unit	Total Price
Office cabinet	2	RM 2,645.00	RM 5,290.00
Steel office cabinet with sliding door	1	RM 743.00	RM 743.00
Office table set with side cabinet set	2	RM 1,530.00	RM 3,060.00
L-shape office table with drawer	5	RM 540.00	RM 2,700.00
Office table set with partition	1	RM 1,670.00	RM 1,670.00
Meeting table	1	RM 1,620.00	RM 1,620.00
Swivel, mesh backrest office chair	7	RM 175.00	RM 1,225.00
Leather managerial office chair	2	RM 192.00	RM 384.00
Swivel, mesh backrest meeting chair	7	RM 124.00	RM 868.00
Visitor's sofa set	1	RM 900.00	RM 900.00
Visitor's coffee table	1	RM 230.00	RM 230.00
TOTAL			RM18,690.00

Office equipment	Unit	Price per unit	Total Price
Printer and photostat machine	1	RM 2,860.00	RM 2,860.00
Office telephone	1	RM 1,380.00	RM 1,380.00
Wireless security alarm system	1	RM 769.00	RM 769.00
TOTAL			RM5,009.00

Computer hardware	Unit	Price per unit	Total Price
PC set for office	7	RM 2,200.00	RM 15,400.00
TOTAL			RM15,400.00

Equipment and furniture	Unit	Price per unit	Total Price
Boltless rack storage	8	RM 250.00	RM 2,000.00
Workbench with tyres	3	RM 190.00	RM 570.00
Steel cabinet	1	RM 465.00	RM 465.00
TOTAL			RM3,035.00

Table 20: Furniture, equipment, computer and installation of office and storage area. Source: Prepared by the author.

Plant and machinery	Unit	Price per unit	Total Price
Measuring tape	4	RM 24.00	RM 96.00
Solar Pathfinder	1	RM 650.00	RM 650.00
Angle finder	2	RM 277.00	RM 554.00
Torpedo level	6	RM 45.00	RM 270.00
Chalk line	3	RM 39.33	RM 118.00
Cordless drill	4	RM 288.00	RM 1,152.00
Drill bits	4	RM 123.00	RM 492.00
Hole saw	3	RM 100.00	RM 300.00
Hole punch	3	RM 26.67	RM 80.00
Torque wrench	4	RM 220.00	RM 880.00
Nut driver	4	RM 62.00	RM 248.00
Wire stripper	4	RM 94.00	RM 376.00
Pliers set	4	RM 110.00	RM 440.00
Cable cutter	4	RM 120.00	RM 480.00
Hacksaw	3	RM 33.33	RM 100.00
Heavy duty extension cords	2	RM 358.50	RM 717.00
Caulking gun	3	RM 26.67	RM 80.00
Fuse pullers	4	RM 2.20	RM 8.80
Solar connector crimping tool set	3	RM 235.00	RM 705.00
Solar connector spanner tool set	3	RM 45.00	RM 135.00
Digital multimeter	3	RM 118.00	RM 354.00
Power cost monitor Kill-A-Watt	3	RM 100.00	RM 300.00
Soldering iron cordless	4	RM 68.00	RM 272.00
Canvas sheet	4	RM 12.00	RM 48.00
Sack truck	1	RM 230.00	RM 230.00
Heavy duty folding ladder	3	RM 220.00	RM 660.00
Safety helmet	9	RM 8.00	RM 72.00
Safety gloves	9	RM 10.00	RM 90.00
Security harness	3	RM 250.00	RM 750.00
Safety boots	9	RM 69.00	RM 621.00
TOTAL			RM11,278.80

Table 21: Technical equipment, machinery for solar PV system installation. Source: Prepared by the author.

4.11.2. Amortization

In Malaysia, amortization is commonly known as capital allowance which signifies the gradual expensing of an asset over a number of years which usually relates to immobilized material and intangible assets. This normally involves an assumption for the useful life of the asset within the company, and then depreciating it over that useful life. SolarNext is entitled to claim capital allowance as long as the capital expenditure of the asset is incurred in the basis period, SolarNext is the owner of the asset at the end of the basis period and the asset is used for the business. The rates of capital allowances in Malaysia are as follows;

Asset type	Useful life for tax	Type of tax depreciation method	Applicable tax depreciation rate	Comments
Heavy machinery	4 years	Straight line	IA=20%; AA=20%	
Plant and machinery	6 years	Straight line	IA=20%; AA=14%	
Motor vehicle (licensed for commercial transportation of goods or passengers)	4 years	Straight line	IA = 20% AA = 20%	Must be licensed by appropriate authority.
Motor vehicle	4 years	Straight line	IA=20%; AA=20%	Qualifying expenditure on private motor vehicle is restricted to RM50,000. However, if the vehicle is new and the total cost does not exceed RM150,000, the qualifying expenditure will be restricted to RM100,000.
Buildings (Industrial Buildings)	30 years	Straight line	IA = 10%; AA = 3%	Allowances can be claimed when a building is used as an industrial building (see Part 2, B for further details).
Furniture, fittings or fixtures	8 years	Straight line	IA=20%; AA=10%	
Computer hardware Computer software	1 year 1 year	Straight line Straight line	IA=20%; AA=80% IA=20%; AA=80%	This accelerated capital allowance (ACA) rate is applicable up to YA2018 and only applies where certain conditions have been met.
Aircraft	4 years	Straight line	IA=20%; AA=20%	
Transport other than motor vehicle	4 years	Straight line	IA=20%; AA=20%	
Car parks	6 years	Straight line	IA=20%; AA=14%	Generally, car park buildings are not eligible for capital allowances. However, in a recent Malaysian tax case, it was held that car park buildings are qualified as plant based on certain circumstances.
Office equipment (including office furniture and fixtures)	8 years	Straight line	IA=20%; AA=10%	
Agricultural machinery and equipment	2 years	Straight line	IA=20%; AA=40%	This rate applies where certain conditions have been met.
Building used for research	30 years	Straight line	IA=10%; AA=3%	Research must be approved by the Minister.

Table 22: Capital allowance rate and assets that qualify for tax depreciation. Source: Worldwide Capital and Fixed Assets Guide, EY, 2016.

The calculation method for capital allowance is the straight-line method and is calculated starting from the year of acquisition. In the first year of the useful life for tax, initial allowance along with annual allowance are both calculated and for the next years of the useful life for tax, only annual allowance is applied. The capital allowance or amortization of the assets of SolarNext is shown in the Tables below;

	INVESTMENT	USEFUL LIFE FOR TAX	Initial allowance (IA)	Year 1	Annual allowance (AA)	Year 1	Residual value	Year 2	Residual value	Year 3	Residual value	Year 4	Residual value	Year 5	Residual value	Year 6	Residual value	Year 7	Residual value	Year 8	Residual value
Office furniture	RM 18,690.00			RM 3,738.00		RM 1,869.00		RM 1,869.00		RM 1,869.00		RM 1,869.00		RM 1,869.00		RM 1,869.00		RM 1,869.00		RM 1,869.00	
Office cabinet (2)	RM 5,290.00	8 years	20%	RM 1,058.00	10%	RM 529.00	RM 3,703.00	RM 529.00	RM 3,174.00	RM 529.00	RM 2,645.00	RM 529.00	RM 2,116.00	RM 529.00	RM 1,587.00	RM 529.00	RM 1,058.00	RM 529.00	RM529.00	RM 529.00	RM -
Steel office cabinet w sliding door (1)	RM 743.00	8 years	20%	RM 148.60	10%	RM 74.30	RM 520.10	RM 74.30	RM 445.80	RM 74.30	RM 371.50	RM 74.30	RM 297.20	RM 74.30	RM 222.90	RM 74.30	RM 148.60	RM 74.30	RM 74.30	RM 74.30	RM -
Office table set w side cabinet set (2)	RM 3,060.00	8 years	20%	RM 612.00	10%	RM 306.00	RM 2,142.00	RM 306.00	RM 1,836.00	RM 306.00	RM 1,530.00	RM 306.00	RM 1,224.00	RM 306.00	RM 918.00	RM 306.00	RM 612.00	RM 306.00	RM306.00	RM 306.00	RM -
L-shape office table with drawer (5)	RM 2,700.00	8 years	20%	RM 540.00	10%	RM 270.00	RM 1,890.00	RM 270.00	RM 1,620.00	RM 270.00	RM 1,350.00	RM 270.00	RM 1,080.00	RM 270.00	RM 810.00	RM 270.00	RM 540.00	RM 270.00	RM270.00	RM 270.00	RM -
Office table set with partition (1)	RM 1,670.00	8 years	20%	RM 334.00	10%	RM 167.00	RM 1,169.00	RM 167.00	RM 1,002.00	RM 167.00	RM 835.00	RM 167.00	RM 668.00	RM 167.00	RM 501.00	RM 167.00	RM 334.00	RM 167.00	RM167.00	RM 167.00	RM -
Meeting table (1)	RM 1,620.00	8 years	20%	RM 324.00	10%	RM 162.00	RM 1,134.00	RM 162.00	RM 972.00	RM 162.00	RM 810.00	RM 162.00	RM 648.00	RM 162.00	RM 486.00	RM 162.00	RM 324.00	RM 162.00	RM162.00	RM 162.00	RM -
Swivel, mesh backrest office chair (7)	RM 1,225.00	8 years	20%	RM 245.00	10%	RM 122.50	RM 857.50	RM 122.50	RM 735.00	RM 122.50	RM 612.50	RM 122.50	RM 490.00	RM 122.50	RM 367.50	RM 122.50	RM 245.00	RM 122.50	RM122.50	RM 122.50	RM -
Leather managerial office chair (2)	RM 384.00	8 years	20%	RM 76.80	10%	RM 38.40	RM 268.80	RM 38.40	RM 230.40	RM 38.40	RM 192.00	RM 38.40	RM 153.60	RM 38.40	RM 115.20	RM 38.40	RM 76.80	RM 38.40	RM 38.40	RM 38.40	RM -
Swivel,mesh backrest meeting chair (7)	RM 868.00	8 years	20%	RM 173.60	10%	RM 86.80	RM 607.60	RM 86.80	RM 520.80	RM 86.80	RM 434.00	RM 86.80	RM 347.20	RM 86.80	RM 260.40	RM 86.80	RM 173.60	RM 86.80	RM 86.80	RM 86.80	RM -
Visitor's sofa set (1)	RM 900.00	8 years	20%	RM 180.00	10%	RM 90.00	RM 630.00	RM 90.00	RM 540.00	RM 90.00	RM 450.00	RM 90.00	RM 360.00	RM 90.00	RM 270.00	RM 90.00	RM 180.00	RM 90.00	RM 90.00	RM 90.00	RM -
Visitor's coffee table (1)	RM 230.00	8 years	20%	RM 46.00	10%	RM 23.00	RM 161.00	RM 23.00	RM 138.00	RM 23.00	RM 115.00	RM 23.00	RM 92.00	RM 23.00	RM 69.00	RM 23.00	RM 46.00	RM 23.00	RM 23.00	RM 23.00	RM -
Office equipment	RM 5,009.00			RM 1,001.80		RM 500.90		RM 500.90		RM 500.90		RM 500.90		RM 500.90		RM 500.90		RM 500.90		RM 500.90	
Printer and photostat machine (1)	RM 2,860.00	8 years	20%	RM 572.00	10%	RM 286.00	RM 2,002.00	RM 286.00	RM 1,716.00	RM 286.00	RM 1,430.00	RM 286.00	RM 1,144.00	RM 286.00	RM 858.00	RM 286.00	RM 572.00	RM 286.00	RM286.00	RM 286.00	RM -
Office telephone (1)	RM 1,380.00	8 years	20%	RM 276.00	10%	RM 138.00	RM 966.00	RM 138.00	RM 828.00	RM 138.00	RM 690.00	RM 138.00	RM 552.00	RM 138.00	RM 414.00	RM 138.00	RM 276.00	RM 138.00	RM138.00	RM 138.00	RM -
Wireless security alarm system (1)	RM 769.00	8 years	20%	RM 153.80	10%	RM 76.90	RM 538.30	RM 76.90	RM 461.40	RM 76.90	RM 384.50	RM 76.90	RM 307.60	RM 76.90	RM 230.70	RM 76.90	RM 153.80	RM 76.90	RM 76.90	RM 76.90	RM -
Computer hardware	RM 15,400.00			RM 3,080.00		RM 12,320.00		RM -		RM -		RM -		RM -		RM -		RM -		RM -	
PC set for office (7)	RM 15,400.00	1 year	20%	RM 3,080.00	80%	RM 12,320.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Equipment and furniture	RM 3,035.00			RM 607.00		RM 303.50		RM 303.50		RM 303.50		RM 303.50		RM 303.50		RM 303.50		RM 303.50		RM 303.50	RM -
Boltless rack storage (8)	RM 2,000.00	8 years	20%	RM 400.00	10%	RM 200.00	RM 1,400.00	RM 200.00	RM 1,200.00	RM 200.00	RM 1,000.00	RM 200.00	RM 800.00	RM 200.00	RM 600.00	RM 200.00	RM 400.00	RM 200.00	RM200.00	RM 200.00	RM -
Workbench with tyres (3)	RM 570.00	8 years	20%	RM 114.00	10%	RM 57.00	RM 399.00	RM 57.00	RM 342.00	RM 57.00	RM 285.00	RM 57.00	RM 228.00	RM 57.00	RM 171.00	RM 57.00	RM 114.00	RM 57.00	RM 57.00	RM 57.00	RM -
Steel cabinet (1)	RM 465.00	8 years	20%	RM 93.00	10%	RM 46.50	RM 325.50	RM 46.50	RM 279.00	RM 46.50	RM 232.50	RM 46.50	RM 186.00	RM 46.50	RM 139.50	RM 46.50	RM 93.00	RM 46.50	RM 46.50	RM 46.50	RM -
Motor vehicle	RM 553,800.00			RM110,760.00		RM 110,760.00		RM 110,760.00		RM 110,760.00		RM 110,760.00		RM -		RM -		RM -		RM -	
Crane (1)	RM 178,000.00	4 years	20%	RM 35,600.00	20%	RM 35,600.00	RM106,800.00	RM 35,600.00	RM 71,200.00	RM 35,600.00	RM35,600.00	RM 35,600.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Lorry (1)	RM 186,000.00	4 years	20%	RM 37,200.00	20%	RM 37,200.00	RM111,600.00	RM 37,200.00	RM 74,400.00	RM 37,200.00	RM37,200.00	RM 37,200.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Panel van (1)	RM 189,800.00	4 years	20%	RM 37,960.00	20%	RM 37,960.00	RM113,880.00	RM 37,960.00	RM 75,920.00	RM 37,960.00	RM37,960.00	RM 37,960.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -

Table 23: Amortization of immobilized material 1. Source: Prepared by the author.

	INVESTMENT	USEFUL LIFE FOR TAX	Initial allowance (IA)	Year 1	Annual allowance (AA)	Year 1	Residual value	Year 2	Residual value	Year 3	Residual value	Year 4	Residual value	Year 5	Residual value	Year 6	Residual value	Year 7	Residual value	Year 8	Residual value
Plant and machinery	RM 11,278.80			RM 2,255.76		RM 1,579.03		RM 1,579.03		RM 1,579.03		RM 1,579.03		RM 1,579.03		RM 1,579.03		RM -	RM -	RM -	RM -
Measuring tape (3)	RM 96.00	6 years	20%	RM 19.20	14%	RM 13.44	RM 63.36	RM 13.44	RM 49.92	RM 13.44	RM 36.48	RM 13.44	RM 23.04	RM 13.44	RM 9.60	RM 13.44	RM (3.84)	RM -	RM -	RM -	RM -
Solar Pathfinder (1)	RM 650.00	6 years	20%	RM 130.00	14%	RM 91.00	RM 429.00	RM 91.00	RM 338.00	RM 91.00	RM 247.00	RM 91.00	RM 156.00	RM 91.00	RM 65.00	RM 91.00	RM (26.00)	RM -	RM -	RM -	RM -
Angle finder (2)	RM 554.00	6 years	20%	RM 110.80	14%	RM 77.56	RM 365.64	RM 77.56	RM 288.08	RM 77.56	RM 210.52	RM 77.56	RM 132.96	RM 77.56	RM 55.40	RM 77.56	RM (22.16)	RM -	RM -	RM -	RM -
Torpedo level (6)	RM 270.00	6 years	20%	RM 54.00	14%	RM 37.80	RM 178.20	RM 37.80	RM 140.40	RM 37.80	RM 102.60	RM 37.80	RM 64.80	RM 37.80	RM 27.00	RM 37.80	RM (10.80)	RM -	RM -	RM -	RM -
Chalk line (3)	RM 118.00	6 years	20%	RM 23.60	14%	RM 16.52	RM 77.88	RM 16.52	RM 61.36	RM 16.52	RM 44.84	RM 16.52	RM 28.32	RM 16.52	RM 11.80	RM 16.52	RM (4.72)	RM -	RM -	RM -	RM -
Cordless drill (4)	RM 1,152.00	6 years	20%	RM 230.40	14%	RM 161.28	RM 760.32	RM 161.28	RM 599.04	RM 161.28	RM 437.76	RM 161.28	RM 276.48	RM 161.28	RM 115.20	RM 161.28	RM (46.08)	RM -	RM -	RM -	RM -
Drill bits (4)	RM 492.00	6 years	20%	RM 98.40	14%	RM 68.88	RM 324.72	RM 68.88	RM 255.84	RM 68.88	RM 186.96	RM 68.88	RM 118.08	RM 68.88	RM 49.20	RM 68.88	RM (19.68)	RM -	RM -	RM -	RM -
Hole saw (3)	RM 300.00	6 years	20%	RM 60.00	14%	RM 42.00	RM 198.00	RM 42.00	RM 156.00	RM 42.00	RM 114.00	RM 42.00	RM 72.00	RM 42.00	RM 30.00	RM 42.00	RM (12.00)	RM -	RM -	RM -	RM -
Hole punch (3)	RM 80.00	6 years	20%	RM 16.00	14%	RM 11.20	RM 52.80	RM 11.20	RM 41.60	RM 11.20	RM 30.40	RM 11.20	RM 19.20	RM 11.20	RM 8.00	RM 11.20	RM (3.20)	RM -	RM -	RM -	RM -
Torque wrench (4)	RM 880.00	6 years	20%	RM 176.00	14%	RM 123.20	RM 580.80	RM 123.20	RM 457.60	RM 123.20	RM 334.40	RM 123.20	RM 211.20	RM 123.20	RM 88.00	RM 123.20	RM (35.20)	RM -	RM -	RM -	RM -
Nut driver (4)	RM 248.00	6 years	20%	RM 49.60	14%	RM 34.72	RM 163.68	RM 34.72	RM 128.96	RM 34.72	RM 94.24	RM 34.72	RM 59.52	RM 34.72	RM 24.80	RM 34.72	RM (9.92)	RM -	RM -	RM -	RM -
Wire stripper (4)	RM 376.00	6 years	20%	RM 75.20	14%	RM 52.64	RM 248.16	RM 52.64	RM 195.52	RM 52.64	RM 142.88	RM 52.64	RM 90.24	RM 52.64	RM 37.60	RM 52.64	RM (15.04)	RM -	RM -	RM -	RM -
Pliers set (4)	RM 440.00	6 years	20%	RM 88.00	14%	RM 61.60	RM 290.40	RM 61.60	RM 228.80	RM 61.60	RM 167.20	RM 61.60	RM 105.60	RM 61.60	RM 44.00	RM 61.60	RM (17.60)	RM -	RM -	RM -	RM -
Cable cutter (4)	RM 480.00	6 years	20%	RM 96.00	14%	RM 67.20	RM 316.80	RM 67.20	RM 249.60	RM 67.20	RM 182.40	RM 67.20	RM 115.20	RM 67.20	RM 48.00	RM 67.20	RM (19.20)	RM -	RM -	RM -	RM -
Hacksaw (3)	RM 100.00	6 years	20%	RM 20.00	14%	RM 14.00	RM 66.00	RM 14.00	RM 52.00	RM 14.00	RM 38.00	RM 14.00	RM 24.00	RM 14.00	RM 10.00	RM 14.00	RM (4.00)	RM -	RM -	RM -	RM -
Heavy duty extension cords (2)	RM 717.00	6 years	20%	RM 143.40	14%	RM 100.38	RM 473.22	RM 100.38	RM 372.84	RM 100.38	RM 272.46	RM 100.38	RM 172.08	RM 100.38	RM 71.70	RM 100.38	RM (28.68)	RM -	RM -	RM -	RM -
Caulking gun (3)	RM 80.00	6 years	20%	RM 16.00	14%	RM 11.20	RM 52.80	RM 11.20	RM 41.60	RM 11.20	RM 30.40	RM 11.20	RM 19.20	RM 11.20	RM 8.00	RM 11.20	RM (3.20)	RM -	RM -	RM -	RM -
Fuse pullers (4)	RM 8.80	6 years	20%	RM 1.76	14%	RM 1.23	RM 5.81	RM 1.23	RM 4.58	RM 1.23	RM 3.34	RM 1.23	RM 2.11	RM 1.23	RM 0.88	RM 1.23	RM (0.35)	RM -	RM -	RM -	RM -
Solar connector crimping tool set (3)	RM 705.00	6 years	20%	RM 141.00	14%	RM 98.70	RM 465.30	RM 98.70	RM 366.60	RM 98.70	RM 267.90	RM 98.70	RM 169.20	RM 98.70	RM 70.50	RM 98.70	RM (28.20)	RM -	RM -	RM -	RM -
Solar connector spanner tool set (3)	RM 135.00	6 years	20%	RM 27.00	14%	RM 18.90	RM 89.10	RM 18.90	RM 70.20	RM 18.90	RM 51.30	RM 18.90	RM 32.40	RM 18.90	RM 13.50	RM 18.90	RM (5.40)	RM -	RM -	RM -	RM -
Digital multimeter (3)	RM 354.00	6 years	20%	RM 70.80	14%	RM 49.56	RM 233.64	RM 49.56	RM 184.08	RM 49.56	RM 134.52	RM 49.56	RM 84.96	RM 49.56	RM 35.40	RM 49.56	RM (14.16)	RM -	RM -	RM -	RM -
Power cost monitor Kill-A-Watt (3)	RM 300.00	6 years	20%	RM 60.00	14%	RM 42.00	RM 198.00	RM 42.00	RM 156.00	RM 42.00	RM 114.00	RM 42.00	RM 72.00	RM 42.00	RM 30.00	RM 42.00	RM (12.00)	RM -	RM -	RM -	RM -
Soldering iron cordless (4)	RM 272.00	6 years	20%	RM 54.40	14%	RM 38.08	RM 179.52	RM 38.08	RM 141.44	RM 38.08	RM 103.36	RM 38.08	RM 65.28	RM 38.08	RM 27.20	RM 38.08	RM (10.88)	RM -	RM -	RM -	RM -
Canvas sheet (4)	RM 48.00	6 years	20%	RM 9.60	14%	RM 6.72	RM 31.68	RM 6.72	RM 24.96	RM 6.72	RM 18.24	RM 6.72	RM 11.52	RM 6.72	RM 4.80	RM 6.72	RM (1.92)	RM -	RM -	RM -	RM -
Sack truck (1)	RM 230.00	6 years	20%	RM 46.00	14%	RM 32.20	RM 151.80	RM 32.20	RM 119.60	RM 32.20	RM 87.40	RM 32.20	RM 55.20	RM 32.20	RM 23.00	RM 32.20	RM (9.20)	RM -	RM -	RM -	RM -
Heavy duty folding ladder (3)	RM 660.00	6 years	20%	RM 132.00	14%	RM 92.40	RM 435.60	RM 92.40	RM 343.20	RM 92.40	RM 250.80	RM 92.40	RM 158.40	RM 92.40	RM 66.00	RM 92.40	RM (26.40)	RM -	RM -	RM -	RM -
Safety helmet (9)	RM 72.00	6 years	20%	RM 14.40	14%	RM 10.08	RM 47.52	RM 10.08	RM 37.44	RM 10.08	RM 27.36	RM 10.08	RM 17.28	RM 10.08	RM 7.20	RM 10.08	RM (2.88)	RM -	RM -	RM -	RM -
Safety gloves (9)	RM 90.00	6 years	20%	RM 18.00	14%	RM 12.60	RM 59.40	RM 12.60	RM 46.80	RM 12.60	RM 34.20	RM 12.60	RM 21.60	RM 12.60	RM 9.00	RM 12.60	RM (3.60)	RM -	RM -	RM -	RM -
Security harness (3)	RM 750.00	6 years	20%	RM 150.00	14%	RM 105.00	RM 495.00	RM 105.00	RM 390.00	RM 105.00	RM 285.00	RM 105.00	RM 180.00	RM 105.00	RM 75.00	RM 105.00	RM (30.00)	RM -	RM -	RM -	RM -
Safety boots (9)	RM 621.00	6 years	20%	RM 124.20	14%	RM 86.94	RM 409.86	RM 86.94	RM 322.92	RM 86.94	RM 235.98	RM 86.94	RM 149.04	RM 86.94	RM 62.10	RM 86.94	RM (24.84)	RM -	RM -	RM -	RM -
TOTAL AMORTIZATION INMOBILIZED MATERIAL				RM121,442.56		RM 127,332.43		RM 115,012.43		RM 115,012.43		RM 115,012.43		RM 4,252.43		RM 4,252.43		RM 2,673.40		RM 2,673.40	

Table 24: Amortization of immobilized material 2. Source: Prepared by the author.

	INVESTMENT	USEFUL LIFE FOR TAX	Initial allowance (IA)	Year 1	Annual allowance (AA)	Year 1	Residual value	Year 2	Residual value	Year 3	Residual value	Year 4	Residual value	Year 5	Residual value	Year 6	Residual value	Year 7	Residual value	Year 8	Residual value
Computer software				RM 1,059.00		RM 4,236.00		RM -		RM -		RM -		RM -		RM -		RM -		RM -	
Autocad Inventor LT suite commercial	RM 2,340.00	1	20%	RM 468.00	80%	RM 1,872.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
Professional PV software	RM 2,955.00	1	20%	RM 591.00	80%	RM 2,364.00	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -	RM -
TOTAL AMORTIZATION INMOBILIZED ASSETS				RM 1,059.00		RM 4,236.00															

Table 25: Amortization of intangible assets. Source: Prepared by the author.

4.11.3. Financing

SolarNext has RM 385,130.00 as authorized capital or share capital of the company. The authorized capital forms about 17% of the total capital acquired by the SolarNext and is divided between 2 shareholders of the company. The other 83% of the capital is in the form of business loan that SolarNext obtains from Maybank, one of the prominent banks in Malaysia.

TOTAL INVESTMENT	RM2,265,417.80
LOAN GRANTED	RM1,880,300.00

Table 26: Total investment and loan granted to SolarNext. Source: Prepared by the author.

SolarNext identifies business loan offered by Maybank under New Entrepreneur Fund (NEF) which is a government-aided fund with the objective to stimulate the growth of small and medium-sized Bumiputra enterprises like the company of SolarNext itself. The characteristics of the loan are as follows;

Capital	RM 1,880,300.00
Number of years	8
Annual interest	5%
Fraction (m)	12
Number of periods	96
Monthly interest	0.4074%

Table 27: Characteristics of the loan granted to SolarNext. Source: Prepared by the author.

The conditions of the loan heavily effect and influence the earnings and cash flow of the company. With all the characteristics of the loan as stated above, the total of the interest of the loan is;

TOTAL INTEREST	RM371,537.89
TOTAL (LOAN GRANTED + INTERESTS)	RM2,251,837.89

Table 28: Total interest and total amount of loan repayment. Source: Prepared by the author.

The breakdowns of the total interest and total of amortization by years within the repayment period are as follows;

PERIOD	INTEREST	AMORTIZATION
YEAR 1	RM86,660.25	RM235,037.50
YEAR 2	RM75,169.39	RM235,037.50
YEAR 3	RM63,678.53	RM235,037.50
YEAR 4	RM52,187.67	RM235,037.50
YEAR 5	RM40,696.80	RM235,037.50
YEAR 6	RM29,205.94	RM235,037.50
YEAR 7	RM17,715.08	RM235,037.50
YEAR 8	RM6,224.22	RM0.00
TOTAL	RM371,537.89	RM1,880,300.00

Table 29: Breakdown of total interest and total amortization by years. Source: Prepared by the author.

4.11.4. Revenue

The income of SolarNext comes from the sales projection of the solar PV system installation packages. The solar PV system installation packages not only consist of the components of the solar PV system but also include the consultation service, project planning, solar PV system installation work, testing and commissioning and maintenance operation. As an example, Figure 25 below shows the cost distribution of 12 kWp solar PV system.

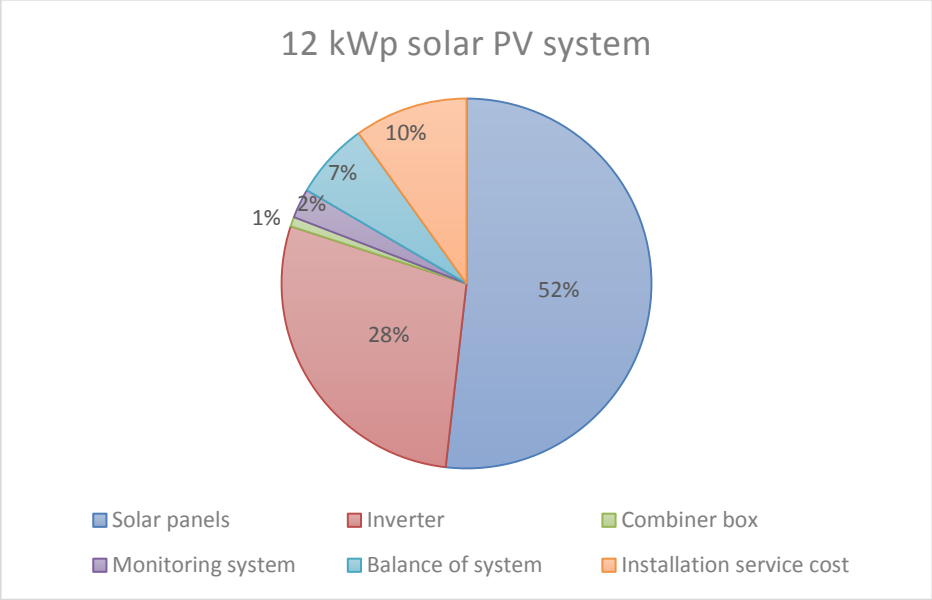

Figure 26: Cost distribution of 12 kWp solar PV system installation package. Source: Prepared by the author.

Before analyzing the sales projection of each year, it is important to determine the price for each of the installation packages every year as shown in the table below. Note that SolarNext revises the price of each system installation packages every year and the price of each installation drops 4% constantly every year as the average global price of solar modules and other important components such as inverter and solar PV monitoring system is expected to drop 4.4% every year. The revised price of the installation packages from Year 1 to Year 4 is shown in the Table 30 below.

INSTALLATION PACKAGES	YEAR 1	YEAR 2	YEAR 3	YEAR 4
4kWp	RM 20,660.00	RM 19,900.00	RM 19,200.00	RM 18,500.00
5kWp	RM 29,340.00	RM 28,300.00	RM 27,300.00	RM 26,300.00
6kWp	RM 35,200.00	RM 33,900.00	RM 32,600.00	RM 31,400.00
7kWp	RM 37,090.00	RM 35,700.00	RM 34,400.00	RM 33,100.00
8kWp	RM 42,140.00	RM 40,600.00	RM 39,100.00	RM 37,600.00
9kWp	RM 46,680.00	RM 44,900.00	RM 43,200.00	RM 41,600.00
10kWp	RM 48,210.00	RM 46,400.00	RM 44,700.00	RM 43,000.00
11kWp	RM 55,050.00	RM 53,000.00	RM 51,000.00	RM 49,100.00
12kWp	RM 58,340.00	RM 56,100.00	RM 54,000.00	RM 52,000.00

Table 30: Installation packages price every year. Source: Prepared by the author.

The sales demand of each solar PV system installation packages SolarNext from Year 1 to Year 4 are shown in the table 31 below. The demand of the system installation service is expected to keep increasing each year as the result of gaining high confidence of the new customers to get the installation of solar PV system service from SolarNext due to the successful marketing, lower system installation package price, wider customer base and stronger project portfolio. Besides, the increasing awareness of the public on participating the Net Energy Metering (NEM) program could save their electric bill and gaining long term profits through renewable energy investment by joining the Feed-in Tariff program also are the factors of the increasing demand years by years.

INSTALLATION PACKAGES	YEAR 1	YEAR 2	YEAR 3	YEAR 4
4kWp	93	127	186	293
5kWp	25	38	98	165
6kWp	13	29	66	142
7kWp	21	34	81	113
8kWp	19	31	60	97
9kWp	14	28	54	84
10kWp	18	25	45	73
11kWp	15	24	37	65
12kWp	18	26	33	59
TOTAL	236	362	660	1091

Table 31: Sales demand from Year 1 until Year 4. Source: Prepared by the author.

After knowing the price and demand for each solar PV system installation package every year, the sales projection for every year can be determined. The total sale projection of solar PV system installation packages is important to forecast and predict the earnings of the company in the future as SolarNext only offers the installation service on various size of solar PV system thus determine whether participating the

business in solar PV system installation market is viable or not viable. Within 4 years of operating, SolarNext is expecting to gain total sales RM 34,499,200.00 on the fourth year, which is 4.25 times from the total sales in the Year 1 as shown in the Table 32 below.

INSTALLATION PACKAGES	YEAR 1	YEAR 2	YEAR 3	YEAR 4
4kWp	RM 1,921,380.00	RM 2,527,300.00	RM 3,571,200.00	RM 5,420,500.00
5kWp	RM 733,500.00	RM 1,075,400.00	RM 2,675,400.00	RM 4,339,500.00
6kWp	RM 457,600.00	RM 983,100.00	RM 2,151,600.00	RM 4,458,800.00
7kWp	RM 778,890.00	RM 1,213,800.00	RM 2,786,400.00	RM 3,740,300.00
8kWp	RM 800,660.00	RM 1,258,600.00	RM 2,346,000.00	RM 3,647,200.00
9kWp	RM 653,520.00	RM 1,257,200.00	RM 2,332,800.00	RM 3,494,400.00
10kWp	RM 867,780.00	RM 1,160,000.00	RM 2,011,500.00	RM 3,139,000.00
11kWp	RM 825,750.00	RM 1,272,000.00	RM 1,887,000.00	RM 3,191,500.00
12kWp	RM 1,050,120.00	RM 1,458,600.00	RM 1,782,000.00	RM 3,068,000.00
TOTAL	RM8,089,200.00	RM12,206,000.00	RM21,543,900.00	RM34,499,200.00

Table 32: Sales projection of SolarNext from Year 1 to Year 4. Source: Prepared by the author.

4.11.5. Expenses

4.11.5.1. Fix costs

Fix costs are also known as general expenses. The general expenses for the company of SolarNext are the expenses that spent on basic needs to sustain the daily basis operations of the company SolarNext identifies all the general expenses as follows;

- Electricity and water supply – The most basic needs for every business to run as almost all the business operations rely on the electric supply throughout the business operational period such as the computers, printer, others office's electrical appliances and electrical equipment for solar PV system installation. Even though the water does not play a big role in the business operation of SolarNext, it is still necessary to fulfill the employees' basic need for drinking or cleansing.
- Transport expenses – Transport expenses range from the license or road tax renewal annually, the consumption of diesel as the fuel for vehicles to function on daily basis and the cost of the vehicles parking sites monthly.
- Publicity and promotion – The publicity and promotion are run twice a year by conducting the free seminars at the target housing areas, distributing flyers or brochures to the potential customers at the target housing areas and displaying advertisement regarding the installation service on Melaka state's monthly magazine or renewable energy magazine or by renting the billboard.
- Office material – Example of the office material required in the business operations are papers, ink of the Photostat and printer machine, staplers, files, folders, anti-virus application for computers, and etc.
- Wi-Fi and telephone service – In order to organize the administration of the company, Wi-fi and telephone play a big role to allow the employees to access and connect to each other on business matters and also with the suppliers, customers, governments representatives, etc, such as to obtain operational data, designing and monitoring the solar PV system, organize the salary of the employees, invoice of the orders, financial data and so on.
- Web server – SolarNext obtains the web hosting service to run the company's website from the web server provider to allow the public to communicate with SolarNext. The web server designs, create domain and provides web hosting for the website keep functioning.

- License and permits – SolarNext renews the business license and permits annually at Ayer Keroh Melaka City Hall to allow the company operates smoothly.
- Shop lot rental – Every month, on the first week, SolarNext pays the rent to the owner of the shop lot via the e-banking transactions.
- Insurance premiums – Insurance is essential to protect the company and its business against any unexpected events or unforeseen mishaps such as property damage caused by fire or burglary, financial risks, or even against loss arising from employee dishonesty.
- Professional services – Occasionally, SolarNext reaches professional services to help the company to face any problems related to administration, solar PV system design, customer's service, etc. The professional services also provide seminars for the employees to increase their professional image and competencies.
- Maintenance and others – The maintenance expenses cover SolarNext's expenses on fixing any damages in any departments of the company such as vehicle damage, non-functioning computers or electrical appliances in the office, buying the new equipment and so on. The expenses on others are the expenses that SolarNext spends on complementary activities of the company such as Annual Dinner or obtaining extra temporary workers if there is high demand of solar PV system installation service.

The Table 33 below shows the breakdown of general expenses of on current expenditure of SolarNext by years.

Current expenditure of company	Year 1	Year 2	Year 3	Year 4
Water supply	RM 337.56	RM 351.12	RM 365.28	RM 378.12
Electricity supply	RM 24,979.19	RM 26,217.25	RM 27,983.44	RM 29,163.77
Transports expenses	RM 58,612.56	RM 63,912.04	RM 72,348.71	RM 88,349.32
Publicity and promotion	RM 3,050.21	RM 5,534.88	RM 6,210.63	RM 6,871.54
Office material	RM 6,255.00	RM 7,789.55	RM 8,213.11	RM 8,890.76
Licenses and permits	RM 60.00	RM 60.00	RM 75.00	RM 75.00
Company's building rental	RM 28,800.00	RM 28,800.00	RM 31,200.00	RM 31,200.00
Insurance premiums	RM 30,580.00	RM 32,109.00	RM 33,939.20	RM 36,314.50
Web server	RM 2,500.00	RM 2,500.00	RM 2,500.00	RM 3,000.00
Professional services	RM 16,386.00	RM 20,586.00	RM 22,275.00	RM 25,936.00
Wifi and telephone	RM 4,950.00	RM 4,950.00	RM 4,950.00	RM 5,100.00
Maintenance	RM 12,305.00	RM 22,678.73	RM 30,494.65	RM 46,798.23
Others	RM 8,000.00	RM 8,000.00	RM 10,000.00	RM 12,800.00
TOTAL EXPENSES	RM 196,815.52	RM 223,488.57	RM 250,555.02	RM 294,877.24

Table 33: Breakdown of general expenses of on current expenditure of SolarNext from Year 1 to Year 4. Source: Prepared by the author.

4.11.5.1. Variable costs

A variable cost is a cost that varies in relation to changes in the volume of the activity. A variable cost increases as the level of activity increases; for example, the cost of raw materials goes up in conjunction with increase in production volume. In this case, the variable costs are closely related to the sales projection. SolarNext offers the price of components of solar PV system to the customers according to the recommended price by the suppliers. Taking into account the installation work is 10% from the total price of each of the solar PV system installation package, the total price of all components of solar PV system holds 90% from the total system installation price as shown in the Table 34. The Table 35 shows that on the first year of operation, SolarNext sets 33% as the profit margin while the variable cost is at 67%. The profit margin increases to 35% on the second year where the variable cost is at 65%. On the third and fourth year, the profit margin remains at 40% and the variable cost is at 60%.

INSTALLATION PACKAGES	YEAR 1	YEAR 2	YEAR 3	YEAR 4
4kWp	RM 1,746,626.49	RM 2,293,440.49	RM 3,229,708.75	RM 4,891,980.27
5kWp	RM 349,561.71	RM 510,897.88	RM 1,266,902.65	RM 2,051,009.98
6kWp	RM 415,959.29	RM 892,220.37	RM 1,952,471.63	RM 4,039,204.13
7kWp	RM 707,995.44	RM 1,102,190.70	RM 2,524,814.66	RM 3,386,800.30
8kWp	RM 727,736.26	RM 1,141,691.50	RM 2,124,736.04	RM 3,302,874.94
9kWp	RM 594,088.54	RM 1,142,477.96	RM 2,118,606.10	RM 3,168,855.28
10kWp	RM 788,882.39	RM 1,053,528.84	RM 1,823,415.29	RM 2,844,216.16
11kWp	RM 750,561.88	RM 1,154,710.58	RM 1,711,710.39	RM 2,891,402.69
12kWp	RM 954,561.93	RM 1,325,780.46	RM 1,618,001.30	RM 2,781,529.04
TOTAL	RM7,035,973.92	RM10,616,938.77	RM18,370,366.82	RM29,357,872.79

Table 34: Total sales projection of solar PV system installation service package price without the cost of installation work. Source: Prepared by the author.

INSTALLATION PACKAGES	YEAR 1	YEAR 2	YEAR 3	YEAR 4
4kWp	RM 1,170,239.75	RM 1,490,736.32	RM 1,937,825.25	RM 2,935,188.16
5kWp	RM 234,206.35	RM 332,083.62	RM 760,141.59	RM 1,230,605.99
6kWp	RM 278,692.72	RM 579,943.24	RM 1,171,482.98	RM 2,423,522.48
7kWp	RM 474,356.94	RM 716,423.95	RM 1,514,888.80	RM 2,032,080.18
8kWp	RM 487,583.29	RM 742,099.48	RM 1,274,841.63	RM 1,981,724.96
9kWp	RM 398,039.32	RM 742,610.67	RM 1,271,163.66	RM 1,901,313.17
10kWp	RM 528,551.20	RM 684,793.74	RM 1,094,049.18	RM 1,706,529.70
11kWp	RM 502,876.46	RM 750,561.88	RM 1,027,026.24	RM 1,734,841.61
12kWp	RM 639,556.49	RM 861,757.30	RM 970,800.78	RM 1,668,917.43
TOTAL	RM4,714,102.53	RM6,901,010.20	RM11,022,220.09	RM17,614,723.67

Tabla 35: Variable costs from Year 1 to Year 4. Source: Prepared by the author.

4.11.5.2. Personal costs

Human resources in the company is the backbone of any kind of business as they are carrying responsibilities on various departments to run the business of the company. Therefore, giving them salary or remuneration monthly, ensuring the guarantee of their safety by paying the social security rates of contribution every month to PERKESO (Social Security Organization) and paying the rate of contribution of Employees' Provident Fund (EPF) as their "force savings" for the future are how the companies in Malaysia including SolarNext take care of the welfare of their human resources or employees. The salary, PERKESO and EPF are included in the personal costs of the company every month.

The salary of the employees of SolarNext are determined by their positions and degree of responsibilities in the company. On the second year, the salary of the employees increases RM 100.00 only as the company just started their operation. On the third year, the salary increases up to 15% and maintains the same afterwards on the fourth year. SolarNext ensures that the salary of the employees of the company is around the average salary of their specific positions in Malaysia. The salary of the employees is paid 12 times in a year and is defined as the total of basic pay, fixed allowance and paid salary on 14 days of public holidays in Malaysia. As an example, the salary of each position of the employee from Year 1 is shown in the Table 36 below;

POSITIONS	DIRECTOR	MANAGER	ADMIN EXEC.	BD EXEC.	FINANCIAL EXEC	HR EXEC	PROJECT ENGINEER	SOLAR INSTALLER	ELECTRICIAN
Basic pay	RM 5,500.00	RM 4,230.00	RM 2,200.00	RM 2,320.00	RM 2,250.00	RM 2,200.00	RM 2,850.00	RM 1,160.00	RM 1,080.00
Fixed allowance	RM 500.00	RM 470.00	RM 320.00	RM 430.00	RM 420.00	RM 420.00	RM 450.00	RM 300.00	RM 280.00
Total monthly	RM 6,000.00	RM 4,700.00	RM 2,520.00	RM 2,750.00	RM 2,670.00	RM 2,620.00	RM 3,300.00	RM 1,460.00	RM 1,360.00
Public holiday (14x)	RM 2,566.67	RM 1,974.00	RM 1,026.67	RM 1,082.67	RM 1,050.00	RM 1,026.67	RM 1,330.00	RM 541.33	RM 504.00
Total annual	RM 74,566.67	RM 58,374.00	RM 31,266.67	RM 34,082.67	RM 33,090.00	RM 32,466.67	RM 40,930.00	RM 18,061.33	RM 16,824.00

Table 36: Salary table of the employee in Year 1. Source: Prepared by the author.

The company of SolarNext is also responsible on paying the specific rates of contribution to Social Security Organization in Malaysia or commonly known as PERKESO. Besides, the rates of contribution are also paid by the employees themselves. The principle of PERKESO is, whenever the employees have lost their abilities due to accidents or diseases that have reduced their abilities to work, PERKESO will provide free medical treatment, facility for physical or vocational rehabilitation, and financial assistance to the effected employees. The rates of contribution of each of the employee are different from one another as the rates depends on the range of amount of their own monthly salary. If the amount of their salary increases, the rates of contribution paid by the company and employees increase as well.

Another incurred cost that includes in the personal costs of the company of SolarNext is the rates of contribution of Employees' Provident Fund (EPF). EPF provides retirement benefits for members through management of their savings in an efficient and reliable manner. The company or the employers are required to meet their statutory and moral obligations to their employees through the monthly payment of the rates to EPF. Similarly, to PERKESO, the amount is calculated based on the monthly wages of an employee. Current contribution rate is in accordance with wage/salary received. For employees who receive salary of RM5,000 and below, the portion of employee's contribution is 11% of their monthly salary while the company contributes 13%. For employees who receive salary exceeding RM5,000 the employee's contribution of 11% remains, while the company's contribution is 12%. In additional, EPF is also another form of investment as it guarantees a minimum of 2.5 per cent dividend annually. As an example, the rates of contribution of PERKESO and EPF of the employees in Year 1 are shown in the Table 37 below;

nº	POSITIONS	ANNUAL GROSS	RATE OF CONTRIBUTION PERKESO (EMPLOYEE)	RATE OF CONTRIBUTION EPF (EMPLOYEE)	GROSS FOR PERKESO	RATE OF CONTRIBUTION PERKESO (COMPANY)	RATE OF CONTRIBUTION EPF (COMPANY)	TOTAL COST
2	DIRECTOR	RM 74,566.67	RM 19.75	RM 660.00	RM 74,566.67	RM 69.05	RM 720.00	RM 75,355.72
1	MANAGER	RM 58,374.00	RM 19.75	RM 517.00	RM 58,374.00	RM 69.05	RM 611.00	RM 59,054.05
1	ADMIN EXEC.	RM 31,266.67	RM 12.75	RM 278.00	RM 31,266.67	RM 44.65	RM 328.00	RM 31,639.32
1	BD EXEC.	RM 34,082.67	RM 13.75	RM 304.00	RM 34,082.67	RM 48.15	RM 359.00	RM 34,489.82
1	FINANCIAL EXEC	RM 33,090.00	RM 13.25	RM 295.00	RM 33,090.00	RM 46.35	RM 349.00	RM 33,485.35
1	HR EXEC	RM 32,466.67	RM 13.25	RM 289.00	RM 32,466.67	RM 46.35	RM 341.00	RM 32,854.02
2	PROJECT ENGINEER	RM 40,930.00	RM 16.25	RM 368.00	RM 40,930.00	RM 56.85	RM 435.00	RM 41,421.85
4	SOLAR INSTALLER	RM 18,061.33	RM 7.25	RM 161.00	RM 18,061.33	RM 25.35	RM 190.00	RM 18,276.68
2	ELECTRICIAN	RM 16,824.00	RM 6.75	RM 150.00	RM 16,824.00	RM 23.65	RM 177.00	RM 17,024.65

Table 37: Rates of contribution of PERKESO and EPF paid by the company and employees. Source: Prepared by the author.

The summary of breakdowns of the personal cost of SolarNext by salary, EPF and PERKESO from Year 1 to Year 4 are as the Table 38 following;

PERKESO (SS)	Year 1	Year 2	Year 3	Year 4
PERKESO Total period	**RM 10,984.80**	**RM 11,338.80**	**RM 15,253.20**	**RM 18,156.00**
c/Company	RM 8,542.80	RM 8,818.80	RM 11,863.20	RM 14,121.00
c/Employee	RM 2,442.00	RM 2,520.00	RM 3,390.00	RM 4,035.00
ACcumulated PERKESO	RM 10,984.80	RM 22,323.60	RM 37,576.80	RM 55,732.80
Payments PERKESO	RM 10,984.80	RM 11,338.80	RM 15,253.20	RM 18,156.00
Accumulated payments	RM 10,984.80	RM 22,323.60	RM 37,576.80	RM 55,732.80
PERKESO BALANCE	RM -	RM -	RM -	RM -

KWSP (EPF)	Year 1	Year 2	Year 3	Year 4
EPF Total period	**RM 130,776.00**	**RM 134,964.00**	**RM 185,652.00**	**RM 216,696.00**
c/Company	RM 70,164.00	RM 72,420.00	RM 99,480.00	RM 116,292.00
c/Employee	RM 60,612.00	RM 62,544.00	RM 86,172.00	RM 100,404.00
Accumulated EPF	RM 130,776.00	RM 265,740.00	RM 451,392.00	RM 668,088.00
Payments EPF	RM -	RM 130,776.00	RM 134,964.00	RM 185,652.00
Accumulated payment	RM -	RM 130,776.00	RM 265,740.00	RM 451,392.00
EPF BALANCE	RM 130,776.00	RM 134,964.00	RM 185,652.00	RM 216,696.00

PERSONAL COSTS	Year 1	Year 2	Year 3	Year 4
Net salary	RM 620,480.00	RM 639,680.00	RM 859,694.00	RM 1,007,642.00
PERKESO (SS)	RM 8,542.80	RM 8,818.80	RM 11,863.20	RM 14,121.00
KWSP (EPF)	RM 70,164.00	RM 72,420.00	RM 99,480.00	RM 116,292.00
s-social on company	RM 78,706.80	RM 81,238.80	RM 111,343.20	RM 130,413.00
Total	RM 699,186.80	RM 720,918.80	RM 971,037.20	RM 1,138,055.00
Accumulated	RM 699,186.80	RM 1,420,105.60	RM 2,391,142.80	RM 3,529,197.80

Table 38: Breakdowns summary of salary, rates of contribution of PERKESO and EPF. Source: Prepared by the author.

4.11.6. Income Statement

Once all the company's expected revenues and expenses are obtained and gathered, an income statement or statement of financial performance of the company can be published to show whether SolarNext could potentially make or loss money during the 4 years period of its initial operations.

	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Net amount of turnover (Revenue)	**RM 8,089,200.00**	**RM 12,206,000.00**	**RM 21,543,900.00**	**RM 34,499,200.00**
Sales income	RM 8,089,200.00	RM 12,206,000.00	RM 21,543,900.00	RM 34,499,200.00
Expanses	**RM 5,864,174.84**	**RM 7,960,430.01**	**RM 12,358,824.75**	**RM 19,162,668.34**
1. General costs (Fixed cost)	RM 196,815.52	RM 223,488.57	RM 250,555.02	RM 294,877.24
2. Variable costs	RM 4,714,102.53	RM 6,901,010.20	RM 11,022,220.09	RM 17,614,723.67
3. Personal costs	RM 699,186.80	RM 720,918.80	RM 971,037.20	RM 1,138,055.00
4. Amortization	RM 254,069.99	RM 115,012.43	RM 115,012.43	RM 115,012.43
OPERATING INCOME	**RM 2,225,025.16**	**RM 4,245,569.99**	**RM 9,185,075.25**	**RM 15,336,531.66**
FINANCIAL EARNINGS	**RM (86,660.25)**	**RM (75,169.39)**	**RM (63,678.53)**	**RM (52,187.67)**
Financial income	RM -	RM -	RM -	RM -
Financial expenses	RM 86,660.25	RM 75,169.39	RM 63,678.53	RM 52,187.67
1. Financing interests	RM 86,660.25	RM 75,169.39	RM 63,678.53	RM 52,187.67
EARNINGS BEFORE INTEREST AND TAXES (EBIT)	**RM 2,138,364.91**	**RM 4,170,400.60**	**RM 9,121,396.73**	**RM 15,284,343.99**
Corporate income tax (24%)	RM 513,207.58	RM 1,000,896.14	RM 2,189,135.21	RM 3,668,242.56
EARNINGS AFTER INTEREST AND TAXES (EAT)	**RM 1,625,157.33**	**RM 3,169,504.46**	**RM 6,932,261.51**	**RM 11,616,101.43**

Table 39: Income statement of SolarNext from Year 1 to Year 4. Source: Prepared by the author.

It is estimated that, if the sales projection hits the target, SolarNext will be able to make money every year and the earnings will keep increasing, parallel with the increasing sales of the solar PV system installation service packages. Note that, SolarNext must pay 24% of corporate income tax or company tax if the earnings before interest and taxes are positive.

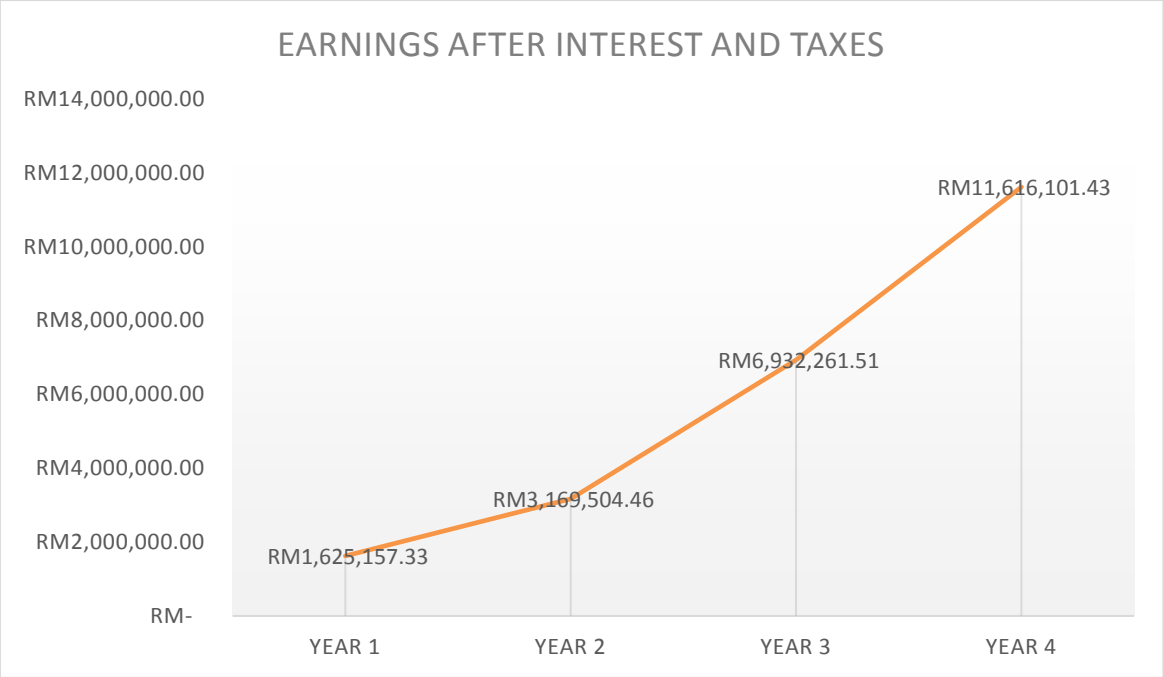

Figure 27: Earnings after interest and taxes from Year 1 to Year 4 of SolarNext. Source: Prepared by the author.

4.11.7. Cash Flow

Cash flow is the net amount of cash moving into and out of a business and it shows the liquidity of the business. It is a difference in amount of cash available at the beginning of a period, which in this situation, SolarNext's Year 1 of operations and the amount at the end of that period which is Year 4. Positive cash flow indicates that the company's liquid assets are increasing, enabling it to settle debts, reinvest in its business, return money to shareholders, pay expenses and provide a buffer against future financial challenges. Negative cash flow indicates that the company's liquid assets are decreasing.

Despite the price of the solar PV system installation packages are reducing every year, the cash flow of SolarNext increases year by year as SolarNext is expected to be able to sell more system packages every year. Other alternatives to increase the cash flow is by selling as asset, reducing costs, taking a loan or bringing in more equity.

CASH FLOW					
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4
INITIAL OUTLAY		**RM (1,880,300.00)**	**RM (236,110.18)**	**RM 2,813,369.21**	**RM 9,625,605.65**
EARNINGS AFTER INTEREST AND TAXES		RM 1,625,157.33	RM 3,169,504.46	RM 6,932,261.51	RM 11,616,101.43
Technical amortization		RM 254,069.99	RM 115,012.43	RM 115,012.43	RM 115,012.43
Financing expenses		RM 86,660.25	RM 75,169.39	RM 63,678.53	RM 52,187.67
CASH-FLOW FOR DEBT PERIOD		RM 1,965,887.57	RM 3,359,686.28	RM 7,110,952.47	RM 11,783,301.53
CASH-FLOW FOR CUMULATIVE DEBT		RM 85,587.57	RM 3,123,576.10	RM 9,924,321.68	RM 21,408,907.18
Interest of loan		RM (86,660.25)	RM (75,169.39)	RM (63,678.53)	RM (52,187.67)
Amortization (Loan repayment installment)		RM (235,037.50)	RM (235,037.50)	RM (235,037.50)	RM (235,037.50)
Amortization capital free loan					
CASH-FLOW FREE PERIOD		RM 1,644,189.82	RM 3,049,479.39	RM 6,812,236.44	RM 11,496,076.36
CASH-FLOW FREE CUMULATIVE		RM (236,110.18)	RM 2,813,369.21	RM 9,625,605.65	RM 21,121,682.02
Total investment		RM -	RM -	RM -	RM -
Loan formalization		RM -	RM -	RM -	RM -
Free loan formalization		RM -	RM -	RM -	RM -
RESIDUAL OUTLAY	**RM (1,880,300.00)**	**RM (236,110.18)**	**RM 2,813,369.21**	**RM 9,625,605.65**	**RM 21,121,682.02**
ANNUAL CASH-FLOW	**RM (1,880,300.00)**	**RM 1,644,189.82**	**RM 3,049,479.39**	**RM 6,812,236.44**	**RM 11,496,076.36**

Table 40: Cash flow of Solar Next from Year 1 to Year 4. Source: Prepared by the author.

5. CONCLUSION

Based on the study and analysis that have been done throughout of this project, it can be concluded that it is viable to set up the energy service company or specifically, the solar PV system service provider company. The promising conditions due to the huge geographical advantage in Malaysia which receive free, ample and clean solar energy as one of throughout the year and the stable current situation of the solar market in Malaysia as well as the government's commitment to take this advantage to encourage more solar PV system installation among the public especially clearly contribute to the suitable and convincing situation to set up SolarNext as the solar PV system service provider company. After figuring out all the necessary information, data and details to run the solar PV system service provider company from business identity, technical aspects and most important from economic and financial aspects, the result of the analysis reflects that the business requires huge amount of investment at the beginning yet offers big profitability and cost effectiveness in the future, or to be exact, according to this project, for the first 4 years of its operation.

The profitability increases each year due to the increasing demand of the public after their awareness regarding numerous benefits and advantages that can be received by installing the solar PV system at their houses and consuming the electricity generated from the system boosts every year, thanks to the continuous efforts from the government to promote the usage of the solar energy at much bigger scale. Even though the cost of the components of the solar PV system especially the solar panels decreases every year due to the revolution of the technology, the profitability of the business is affected positively as the demand keep increasing because the public get interested with the lower cost of the system installation thus, ready and willing to install the solar PV system at their houses.

However, in order to survive in the market and establish a much better position among the well-established and strong competitors, SolarNext needs to adapt continuously. This signifies that SolarNext can not necessarily depends on the sales of the solar installation packages at the residential units only. SolarNext probably needs to expand its business venture into offering the solar PV system installation packages at bigger scale such as for community, commercial or industrial purposes. As the technology of the components of the solar PV system keep evolving, SolarNext could offer up to date and advanced technology of its installation packages to the potential customers for example, the businesses and factories owners. For the long term, as the

position of SolarNext is stable and strong enough with the vast experience in the solar PV systems installations, the company also could explore the new business opportunity in involving directly in the manufacturing of its own solar PV system. Thus, SolarNext sets to become pioneer as the local company that produces the entire solar PV system components and indirectly expanding the availability for the public to easily purchase the solar PV system components and finally, helps the government to achieve more solar PV system installation throughout the country and reduces the reliance on the non-renewable energy to generate electricity in the future.

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