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Encouraging Solar PV Investment as One of Renewable Energy in Malaysia

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Abstract
Purpose: This is a review on the development of renewable energy, especially in the solar sector.
Design/methodology/approach: A descriptive study on desktop review was done to identify the potential factors encouraging solar PV investment among consumer in Malaysia.
Research limitations/implications: This study is limited to consumer solar rooftop only, those who consumer electricity from grid (TNB). It covers consumers under residential, commercial, industry, and agriculture areas.
Practical implications: This study identifies the main sector, the consumers and that generating electricity is potentially supporting the government vision in 2025 to have mix renewable energy by 20%. The consumer also able to evaluate the degree of cost saving the electricity bill and the expected returned from self-generating electricity.
Originality/value: This study gives an overview for the solar service provider and investor to target participation among consumers in encouraging renewable energy and green technology in Malaysia.

Keywords: Investor, Renewable Energy, Solar PV, Consumption, Malaysia

Introduction

Leading to the new industrial revolution, the government announces many incentives and economic agendas to improve the standard of living. Developing countries like Malaysia must utilize the abundant natural resources, and at the same time to explore the new technology and investment opportunity for all time. Traditionally, key measurement growth only focuses inputs on labor and capital. Both inputs initially cause significant support in growth and survival, however, the value-added must be identified especially in technology and energy support (Malik et al., 2020). Industrial Revolution 4.0 (IR4.0) has required a country to extend the effort in competing at a global level and providing sufficient basic needs to a nation.

Governments over the world are seriously promoting the diversity investments to expand type of electricity sources. In Malaysia, the government have revised the target to achieve higher penetration in Renewable Energy (RE) by 20% in 2025 towards environment sustainability, energy security and affordability (SEDA, 2018). Studies highlight that Malaysia has diverse potential in generating mixed energy involving solar, wind, biogas, and biomass. Sustainable energy means the use of energy is utilized continuously to fulfill the needs of people without ignoring the new generation provides economic development and environmental conservation (Han et al., 2020).

Malaysia ambitiously aims to build the productivity of nations, in terms of economic, social, and environmental goals. To be productive, the Institute for Management Development (IMD) establishes a Global Competitive Index (GCI) to inspire and motivate the global to enhance the standard of living and value of creation for its enterprises. While in Malaysia, Malaysia Productivity Product (MPC) as one of the authorities monitors the competitive performance to achieve a certain target. The competitiveness index was defined by MPC as the degree to which the region (nation) can produce goods and services which meets the test of the international market, outperforming others, while its citizens earn a standard of living that is both rising and sustainable over the long-run (MPC, 2020).

Inside Global Competitive Report (GCR) in 2019 ranked Malaysia at 27 out of 144 countries. One of the main pillars focuses on the infrastructure, which is divided into transportation and utility. In utility infrastructure, Malaysia was ranked at 87/141 countries with 98.2% for electricity access of population, while the quality of electricity supply ranked at 38/141 country 6.9% in 2019. To compare with Singapore, the top country in CGI ranking has been evaluated as 100% in electricity accessibility and 1.6% for electricity supply quality. Hence, Malaysia has improved accessibility of electricity over 32.6 million population, but was left behind in terms of quality supply over output, which refers to the reliable electric power transmission and distribution to consumers. In addition, social and environmental performance reports that 5.2% of share in Renewable energy consumption, which just a warm up in Malaysia.

From the renewable energy perspective, the injection investment potentially gives a diversification of electricity sources and has a greater expected return in terms of economic development and environmentally friendly (Chong et al., 2015). According to the World Economic Forum (2019) states that renewable energy is one way to improve the standard of living. For instance, the encouragement of a solar home system in Bangladesh has eradicated the poverty level and successfully expanded electricity access to rural areas at a lower cost. (Zubi et al., 2019). Electricity access also offers more jobs opportunity, technological innovation, and cost competitiveness. The previous study stresses the importance of investment as a key to identify an opportunity during downturn economy and a remedy for this historical problem. The energy sector is required to shift the resources used for long term survival. Petinrin and Shaaban (2015) highlighted the Government target to substitute generating natural resources is an initiative to reduce demand in coal and fuel. Furthermore, the cost of both oil fossils will become cheaper if there are many choices in generating electricity (Chong et al. 2015; Tang, 2008).

Learning from the shock event of the Covid-19 pandemic, consumers look for the alternative of energy substitution due to high electricity bill changes during Movement Control Order (MCO). From a consumer perspective, energy saving, energy efficiency, and green technology such as Rooftop Solar PV applications are preferred. As can be seen during the Covid-19 pandemic, it created drastic changes in Malaysia, as the government has announced MCO, where people, workers, and students are disallowed to move anywhere to prevent corona infection. Thus, work from home (WFH) and online classes are applied to suit the government's concern. Due to that, the TNB bill had stop reporting meter reading from March 20 to May 14

and started to issue bill after May 15 following the easing restriction MCO condition. As a consequence, the spike of electricity bills during MCO becomes an issue when the residential sector saw the burden to electricity bills increase between 20% and 50%. The increasing electricity usage was accelerated when people in the city was stuck in a village during school holiday, children do not attend school, and new routine and activities are held inside the home (Sivanandam, 2020).

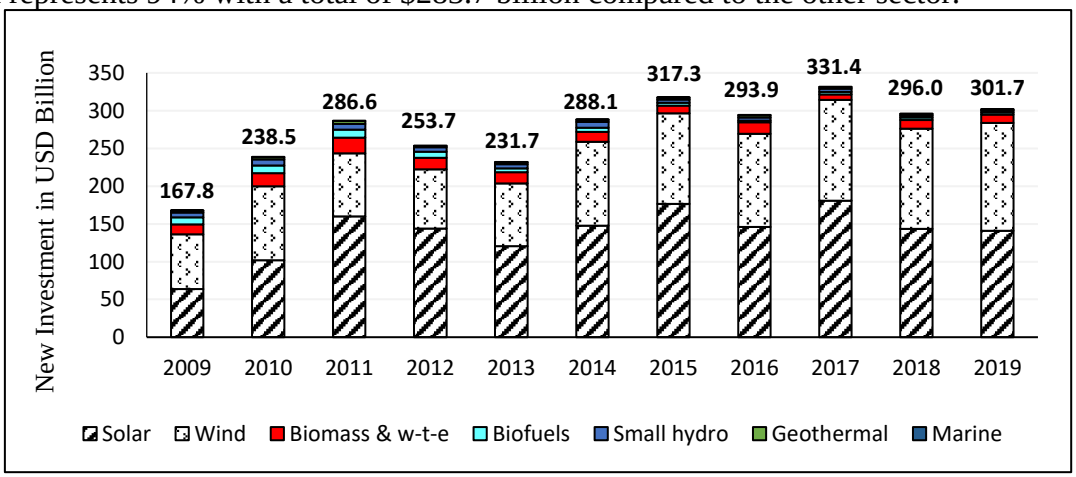
At this moment, we cannot switch off electricity applicants only to save money, but we must proceed to all activities with a new norm to stimulate economic performance and repair the downturn during the pandemic. Thus, Chief of Executive Operation (COE) PLUS Solar Sdn. Bhd. proposed to consider using solar panels to cut electricity energy bills among residential and businesses (Yun, 2020). Via solar power purchasing agreement (PPA), consumers can finance the installation cost at a lower cost in this model. The Ministry of Finance (MoF) introduced the Green Technology Financing Scheme (GTFS 2. 0) in 2018 to finance investment of production, utilization, and asset related to green technology. While for the financial incentive under budget 2020, the government announces the extension of the green investment tax allowance (GITA) and green income tax exemption (GITE) until 2023 (SEDA, 2020).

Therefore objective of this study is to investigate the review of electricity consumption and solar generation. Therefore, the research question is developed to examine how renewable energy investment will play a vital role to support solar generation and benefit to electricity consumption. The need of developing electricity energy in Malaysia's situation has created the electricity supply. It is assumed that more attractive investment offered to stimulate renewable energy will potentially improve consumer benefit (deLlano-Paz, 2017; Garcia, et. al., 2017; Omar et al., 2020).

Literature Review

The Interest in Renewable Energy (RE)

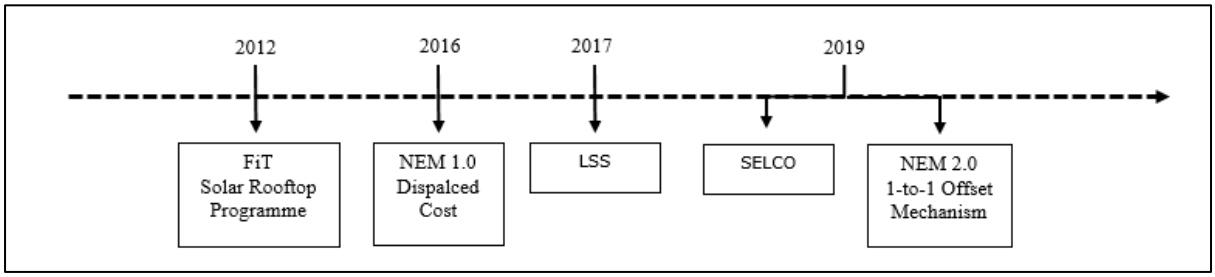
The Sustainable Development Goals (SDG) has driven global to shift producing using RE. German, China, Japan, US and India is the top five countries expanding the investment in solar technology to turn away from fossil fuel. The International Renewable Energy Agency (IRENA, 2020) reports approximately 44.4% increase in Global Investment trend between 2009 ($167.8bil) and 2019 ($301.7bil) in solar, wind, biomass, biofuels, small hydro, geothermal and marine. The impact of the biofuel crisis in 2008 becomes the turning point of a boost investment in solar and wind. At a global level, the sum of investment in both solar and wind represents 94% with a total of $283.7 billion compared to the other sector.



Source: International Renewable Energy Agency (IRENA)

Figure 1: Global Trend Investment in Renewable Energy

Meanwhile, the RE generation in Malaysia was successful achieved 791,911GwH, whereas 46% of RE generation is from solar sources (AGEP, 2019). This national ambition could be achieved with the support of ideas and effort of all parties. Such that, the Sustainable Energy Development Authority Malaysia (SEDA) is one of the government bodies that actively promotes Energy Efficiency (EE) and renewable energy (RE). To support the agenda, the Authority has designed an electricity system that is suitable to incorporate more renewable energy. A few RE schemes have been established to promote solar energy in Malaysia such as Feet-in-Tariff (FiT), Net Energy Metering (NEM), and the Large Scale Solar (LSS) while at the same time, explores the potential to encourage the other renewable resource such as biomass and biogas. The scheme in encouraging solar PV installation have been demonstrated as follow:



Source: Authors' Illustration

Figure 2: Timeline of Solar Scheme in Malaysia

Where:

- FiT is a scheme allow asset owners to generate electricity and sell directly to the grid. The tariff rate is fixed under contract TNB.
- LSS is a scheme to generate electricity via solar PV farm with installed capacity from 1MW to <30MW, and sell to grid.
- NEM is designed to replaced FiT scheme. The consumer is allowed to generate own electrcity and reduce the elctricity bills. Any excess of solar energy will be offset to next month. NEM 1.0 paid the exported energy to the grid at a displaced cost of RM0.31, which not attractive for residential with high electricity consumption. NEM 2.0 scheme is introduced in 2019 to revise the surplus at the retail rate based on 1-to-1 mechanism (Razali et al., 2019).
- SELCO is a scheme that allows consumer to consume self-generating electricity but no energy export to the grid.

As a country with humid and hot weather, solar energy becomes a priority in Malaysia, with an infinite energy source compared to finite fossil fuels (Ridzuan et al., 2020). At this time, the government actively searches for potential space to install solar PV by assigning consultants to approach the commercial sector and residential. For instance, the government has allocated RM45million in budget 2017 for the MySuria program as a long-term investment that focuses on helping the B40 group with the extension of FiT program in developing rural area (Ramli et al., 2018). The MySuria program potentially allows the household to earn extra income around RM250 per month with 3 kW capacity installed in 10 years with Renewable Energy Purchasing Power Agreement (REPPA). As per 2018, MySuria program allows 332 houses to enjoy generating electricity using their rooftop and the focus application is Northern and East Coast Malaysia that have high solar irradiation (SOLARGIS, 2020).

Table 1: No. of houses (MySuria) which have been completed and achieved commercial operations as of 31/12/2018

State	Terengganu	Kelantan	Kedah	Johor	Labuan	Pahang	Perak	Perlis	Melaka	Sabah
No. of House	63	62	45	35	30	29	25	22	13	8

Source: SEDA, 2018

Besides, UiTM Holding Sdn was awarded 50 MW Large Scale Solar in Gambang, Pahang and becomes the world's first university to finance a green project via the issuance of ASEAN Green SRI Sukuk in 2019. The support from green Sukuk eventually promotes broader access in investment and puts priority to preserve the environment and social impact (Wahab & Mohamed Naim, 2019). Both of these cases show the big effort from the government and the public to generate green technology and utilize space for cutting electricity costs in Malaysia. Malaysia is gifted with tropical land and enjoys infinite benefits in solar, wind, and sea energy (Tang, 2008).

Key Players in Enhancing Solar PV

Before solar PV is implemented, the electricity chain is basically between the consumer and large utility (e.g. TNB), where access to electricity is distributed by the large utility. However, national target in energy mix by 20% have allowed consumers to produce electricity, known as prosumer and monitored by SEDA. This eventually expands the electricity chain into four main key players; asset owner; service owner; large utility; and government. All of the parties meet in the solar market, but face different risks and challenges towards the desired motivation and technologies (Bergek et al., 2013).

Asset owner is the main key player of solar PV and will be assumed as the investor who install and own solar PV (Comello & Reichelstein, 2017). The asset owner eventually targets for the return from the investment either through cost saving in electricity bills or the tax income exemption given by the government. The asset owner could be among residential, commercial, industrial and agriculture sector. The second key player, PV service provider is a compilation of the local solar supply chain including manufacturing, system integration, consultants, banks, insurance providers, and training providers under the Malaysian Photovoltaic Industry Association (MPIA). All members are working together to expand solar investment opportunities and bring efficient and professional growth of the solar industry (MPIA, 2020). While, the asset owner approaches the PV service provider to apply solar installation license and technical study Net Energy Metering Assessment Study (NEMAS) as a requirement to generate electricity in their premises (SEDA, 2011).

The third key player, large utility, TNB is the one who owns the transmission and distribution networks for electricity, and also the major production capacity. The large utility endures managing the volatile cost of raw material (e.g. fossil fuel) in supplying electricity to the public. The introduction of solar will be a competition to large utility as the source of electricity expanded. However, the asset owner still need to rely on TNB for electricity, since the capacity install allowed is under the maximum electricity usage. All in all, the government will play powerful authority in monitoring the progress and regulate the solar sector in balancing the energy security and energy equity. The government also drives investment activity through subsidizing, Income taxes, depreciation tax shields, and investment tax credits.

Overall, solar energy is not only creating a new source of energy generation but accelerated supply chain in-country, where more interaction is involved to support the green technology plan.

Technology Investment

Injection of investment is made due to a few reasons such that to develop new potential resources and also historical recovery. By definition, investment is the current spending for a while to derive future payments that will compensate the investor, for the current time committed, expected rate of inflation during this time, and uncertainty for future payment (Brown, 2012). The encouragement of renewable energy investment is a movement to diversify the choice of generating electricity and meet current demand.

Kozlova and Collan (2020) summarized factors that attract investment through cost-benefit analysis proof by Monte Carlo simulation. The benefit of profitability capacity and demand, while the cost of regional accessibility and electric network condition has significant influence to stimulate investment in renewable energy. The cost analysis emphasized the impact of return on consumer gain from the solar program. The optimum analysis method has proven the positive impact in generating electricity and consumers are able to reduce dependent on TNB energy supply. Thus, to sketch the investment intention, Bergek et al. (2013) state the motivation of RE technology adoption as follows:

- Profit oriented, independent power generation that aims for greater cost saving.
- Technology oriented, the innovation of technology that is adopted to deal with pollution and environment preservation.
- Solution oriented, as the problem was identified in terms of environmental or profitability. For instance, a company used a subsidy in solar capital to divert taxable income to real assets.

Wahab et al., (2019) states that the enhancement of Sustainable Responsible Investment (SRI) framework also can encourage investment decision making monetary return and more environmental sustainable infrastructure in Malaysia. Thus, the individual or company willing to have positive value impact in term of well-being, green and sustainability. The return is balancing between responsibility towards environment and profitability. SRI implies that, "Integrating personal values and societal concern with investment planning", where the concern about ethical, moral, religious or political and should allocate the cash according to value and principles. Investment is the spending by users, thus the expenses consist of fixed installation costs, administrative cost, and labor charges for maintenance work (Comello, 2017; Pacudan, 2018).

Table 2: Estimated Cost of Installation per kW

Install Capacity	Estimated Installation Cost (RM/kW)
Below 4kW	6,000.00
4kW to 12kW	4,300.00
12kW to 72kW	3,600.00
72kW to 200kW	3,300.00
200 kW to 500kW	3,000.00
Above 500kW	2,800.00

Source: NEM Calculator, SEDA.

SEDA website provides a guideline for all consumers to install the solar PV at their own space with the given range price in Table 1. The installation cost can be higher and lower, depending on the type of efficiency solar panel and manufacturer. However, this study would use *ceteris paribus*, where assuming all other factors influencing solar installation remain constant to avoid bias. The range installation cost is diminishing when the total kW increasing.

Capacity Factor (CF)

The capacity factor is used to monitor solar performance at a specific time. It measures the reliability of the solar generation over the maximum capacity given. National Renewable Energy Laboratory (NREL) refers to solar capacity as the ability of solar to meet demand. The Generator also leads to breakdown, mechanical failure, planned maintenance, or delay in time delivery generating resources. Thus, this may cause the solar system to fail in reaching the target capacity. Capacity is the maximum output generation of a power plant. The capacity factor equation can be summarized as;

$$CF = \frac{Total\ of\ Solar\ Energy\ Generation}{Total\ of\ Solar\ Capacity} \quad (1)$$

Before installing solar panel, consumer are required to declare the average of maximum demand (kWac) to acquire capacity quota from SEDA. Basically, government only allows consumer generating electricity below the consumption (SEDA, 2019). Therefore, solar capacity are controlled, the solar generation may vary depending on solar irradiation and type of solar (e.g. Monocrystalline, polycrystalline, and thin-film solar panel that have different efficiency).

Electricity consumption

World Bank defined access to energy as reflecting the standard of living especially in eradicated poverty level. Energy sector is proposed to create new investment, innovations, and industries and simultaneously drive job creation, inclusive growth, and share prosperity for entire economies (World Bank, 2020). Electricity consumption reflects how the production process in factory or how household used to live. Ridzuan et al., (2020) stated that high demand electricity is parallel to the rapid economic growth, urbanization, industrialization and the increase household demand. Thus, the important of encouraging solar energy electricity generation eventually fulfill the needs of people.

Meanwhile, Shi et al. (2020) analyzed the economic development assessment based on electricity consumption based on BIRCH Clustering (Balanced Iterative Reducing and Clustering using Hierarchies). The electricity consumption is scoped into the industry (primary, secondary, and tertiary), residential (urban vs. rural), industry (heavy vs. light), and transportation. By scoping to a smaller cluster, the analysis helps the government to target potential investors based on the pattern of developing electricity consumption. On the other hand, Sulaiman et al. (2019) discussed that the changes in electricity consumption will respond to build a generation of renewable energy. The impact of the investment can allow a consumer to substitute using electricity from the normal tariff to renewable energy generation (Spicher, 2019). Table 3 illustrates an increase in final electricity consumption from year 2014 to 2018, where the industrial sector dominance electricity demand more than 40% of each year.

Table 3: Final Electricity Consumption (ktoe)

Sector	2014	2015	2016	2017	2018
Residential	2,346	2,471	2,679	2,610	2,553
Commercial	3,566	3,663	3,817	3,762	3,958
Industrial	5,072	5,200	5,822	6,145	6,547
Agriculture	36	41	47	50	53
Transportation	22	23	29	39	41
Total	11,042	11,398	12,394	12,606	13,152

Source: Malaysia Energy Information Hub (MEIH)

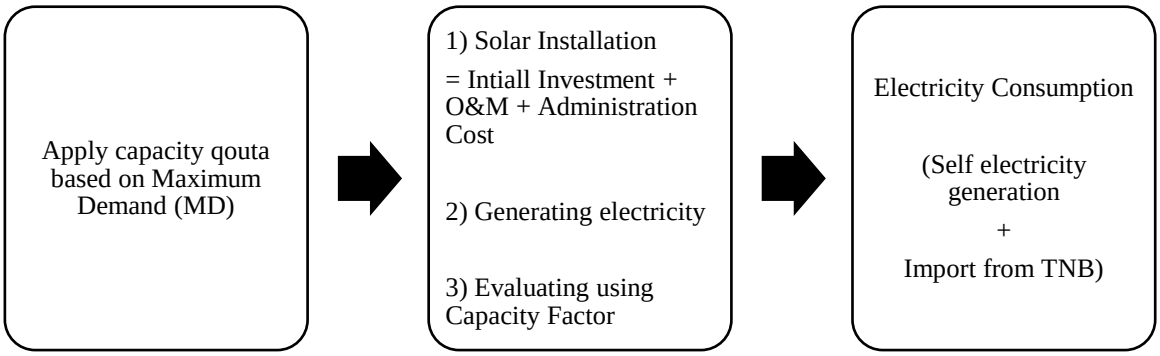
According GCI report, the renewable consumption share in Malaysia is 5.2% during 2018 it is comprised as shown in Table 4, where solar consumption is still in the infant stage compared to hydropower and biofuels. According to SEDA, the introduction of solar PV investment participation is still new to local user, where policies and scheme need to be revised in attracting more investment.

Table 4: Final Renewable Energy Consumption in Terajoule (TJ)

Technology	2017	%	2018	%
Hydropower	89,460	64%	88,051	63%
Solar Photovoltaic	1,406	1%	1,472	1%
Renewable Waste	723	1%	83	0.1%
Solid Biofuels	28,491	20%	30,883	22%
Liquid Biofuels	18,218	13%	18,498	13%
Biogas	723	1%	751	1%
Pellets	577	0.4%	204	0.1%
Charcoal	904	1%	905	1%
Total	139,348		140,847	

Source: IRENA (*extracted as 26-Oct-2020)*

The concept of electricity consumption is summarized in Figure 3, as a guide to new investor in solar energy. After installing solar PV, the consumer are able to import electricity form grid (TNB) when solar generation is less than total usage in particular month. However if there is a surplus solar electricity generation, it will be transfer to grid and used in next month (NEM 2.0). Therefore, the solar energy generation could potentially reduce electricity bill and encourage consumer to independently consume green energy.



Source: Authors' illustration

Figure 3: Concept of electricity consumption for solar user.

Discussion and Conclusion

Today, the increasing population in Malaysia's urge for higher demand has required government to explore energy and ensure electricity supply is sufficient. If Malaysia encourages more producer generating electricity, the market can be competitive in offering lower electricity price compared to the previous practice, only National Utility Company (TNB) supply electricity. The solar installation practice will initially promote more energy self-generation to utilize the resource and idle space. For instance, a rooftop house can potentially

give extra income to the household, while the ocean provides a wide space for floating solar generators compared to limited land.

It is expected that the findings of this research will provide an overview of investment styles in terms of solar technology cost, revenue generation, and environment preservation. This will give exposure to society in investment participation where they can be part of the electricity producer and turn it for consumption. As a consumer, the type of electricity source becomes the main priority to consumers and leads to generating electricity using solar technology. Besides, the finding will make a significant contribution towards both theory and framework, where the relationship of each variable can be used to connect and coordinate all situations. The theory will be used by investors to make an assessment in the energy sector and related technology applications. Last but not least, the study is expected to give benefits to the government, as a guideline identifying strengths and weaknesses of solar PV installation. This study will also highlight the importance of pursuing green growth technology (e.g. solar PV) for sustainability as one of the strategies for national policy in Malaysia.

In conclusion, allocating resources at the right needs will fortunately open greater opportunities and utilize all inches available. The natural resources gifted must be appreciated and it is prohibited to be wasted and used in the wrong way. Simultaneously, new revenue will be explored and bring benefits to all human kinds.

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