Universiti Teknologi MARA
Cawangan Perak

INSPIREd
Virtual Ipoh International Summit on Professionalism, Research and Education 2022

IeGRESAFE 2022

E-PROCEEDING OF

1st INTERNATIONAL E-CONFERENCE ON GREEN & SAFE CITIES 2022

"Sustaining the Resilient, Beautiful and Safe Cities for a Better Quality of Life"

20 & 21 SEPTEMBER 2022

Organisers:

GRESAFE_CITIES
Green Safe Cities, Research Interest Group

The University Of Queensland
AUSTRALIA

Co-organisers:

OFFICE OF RESEARCH, INDUSTRIAL LINKAGES, COMMUNITY & ALUMNI (PJIM&A), SERI ISKANDAR CAMPUS
DEPARTMENT OF BUILT ENVIRONMENT STUDIES & TECHNOLOGY (JABT), FACULTY OF ARCHITECTURE, PLANNING & SURVEYING (FSPU)

https://myse.my/gresafecities2/IeGRESAFE/

e-PROCEEDING OF

1st INTERNATIONAL E-CONFERENCE ON GREEN & SAFE CITIES

"Sustaining the Resilient, Beautiful and Safe Cities for a Better Quality of Life"

ORGANISED BY

Gresafe_Cities RIG
The University of Queensland, Australia
Kampus Hijau UiTM Perak

CO-ORGANISED BY

Research, Industrial Linkages, Community & Alumni Network (PJIM&A)

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e ISBN: 978-967-2776-13-0

Cover Design: Muhammad Falihin Jasmi

Typesetting : Ts Dr Azizah Md Ajis

ORGANISING COMMITTEE

Patron	: Prof. Sr. Dr Md Yusof Hamid
Advisor	: Assoc. Prof. Ts Dr Norhafizah Abdul Rahman
Chairman 1	: Assoc. Prof. Ts Dr Siti Rasidah Md Sakip
Chairman 2	: Assoc. Prof. Sr Dr Nur Azfahani Ahmad
Secretary 1	: Ms Nur'Ain Ismail
Secretary 2	: Ms Nurhidayah Samsul Rijal
Treasurer 1:	: Dr Nor Nazida Awang
Treasurer 2	: Dr Nadiyanti Mat Nayan

MAIN SECRETARIAT

Invitation & Sponsorship	:	Ts Dr Ida Nianti Md Zin (L) Dr Nor Eeda Ali Ms Nur'Ain Ismail Ms Nurhidayah Samsul Rijal Ts Ahmad Haqqi Nazali Abdul Razak
Participation, Registration & Certificates	:	Dr Atikah Fukaihah Amir (L) Ms Marina Abdullah
Graphic & Printing	:	Mr Muhammad Falihin Jasmi (L) LAr Ruwaidah Borhan
Promotion & Website	:	Ts Nur Hasni Nasrudin (L) Ts Sr Dr Asmat Ismail
Information technology (IT & AV) & Media	:	Mr Aizazi Lutfi Ahmad (L) Mr Muhammad Anas Othman Mr Tuan Sayed Muhammad Aiman Sayed Abul Khair
Scientific Reviewers & Publication	:	Assoc. Prof. Sr Dr Thuraiya Mohd (L) – Sc. Reviewer Assoc. Prof. Dr Sallehan Ismail (L) - Journal Assoc. Prof. Sr Dr Siti Aekbal Salleh Assoc. Prof. Dr Kharizam Ismail Assoc. Prof. Ts Dr Siti Akhtar Mahayuddin Assoc. Prof. Sr Dr Nur Azfahani Ahmad Assoc. Prof. Sr Dr Natasha Khalil Dr Puteri Rohani Megat Abdul Rahim Ts Dr Azizah Md Ajis Sr Dr Asmalia Che Ahmad Dr Dzulkarnaen Ismail Dr Lilawati Ab Wahab Ms Marina Abdullah
Event Manager & Moderator	:	Ts. Ahmad Haqqi Nazali (L) IDr Dr Othman Mohd Nor TPr Dr Kushairi Rashid Dr Mohd RofdziAbdullah Ar Haji Azman Zainonabidin
Banquets & Charities	:	Ms Noor Faiza Rasol (L) Mr Afzanizam Muhammad Ms Siti Rohamini Yusoff

EMPOWERING FUTURE GENERATION WITH RENEWABLE SOLAR ENERGY: A CONCEPTUAL PAPER

Alya Atrisyia Binti Azizi Khairul[1], Muhammad Farid Bin Mazlan[2]*, Maisarah Binti Nor Azlan[3], Suriana Ramli[4]
***Corresponding Author**
[1,2,3,4]Arshad Ayub Graduate Business School, Universiti Teknologi MARA

aatrisyia97@gmail.com
*faridmazlan17@gmail.com
msarah.norazlan@gmail.com
surianaramli@uitm.edu.my

Abstract

The government announcement of 100% elimination of taxes on electronic vehicles in Malaysia is aligned with the 12th Malaysian Plan which is to achieve carbon neutrality by 2050. It is the Malaysian government's strategic plan that the new policy would accelerate the development of the Electronic Vehicle (EV) industry. Currently, Malaysia is still way behind its regional peers when it comes to the infrastructure of the EV industry in which the available EV charging stations are still solely dependent on electricity. Malaysia is highly dependent on traditional electricity which relies heavily on fossil fuels. Understanding the potential of the solar renewable energy in the EV industry in Malaysia, the research proposed two objectives. The first objective is to broaden the usage of renewable energy in Malaysia to reduce the dependence on fossil fuels. The second objective is to enhance the usage of electric vehicles in Malaysia by 2050. The study propose that the success of the renewable solar energy program would be highly dependent on the collaboration of government, private solar companies and the major supplier of electricity. The significance of the research to the society and government is that it provide a comprehensive framework that would enable the development of accessible infrastructure of EV charging ports near residential areas or at the local gas station. An accessible charging port may ease market acceptance on the usage of electric vehicles. The increase of EV usage would reduce the reliance on fossil fuels and in the long run would protect the environment. The development of solar renewable energy should remain one of the essential parts of the economic development in Malaysia. In time, the usage of EV will be in mass and it is important for the country to have the best infrastructure to support the growth of the industry.

Keywords: *Automobile, "Environment, Electronic Vehicle, Society, Solar Energy.*

INTRODUCTION

Background of Study

Energy is a major engine for industry and service sectors that influence economic development. Technologies that use traditional electricity rely heavily on fossil fuels. However, they are not only unsustainable but they are also harmful to the environment (Ahmad, Mat, Cheng & Yao, 2017). Its combustion leads to numerous environmental issues, including air pollution and global climate change (Prasad, Radhakrishnan, Kumar & Kannojia, 2019). The escalating negative impacts of fossil fuel combustion on the environment and limited supply

have forced several countries to adapt to environmentally acceptable renewable energy sources to meet rising energy demand. Unlike other countries, Malaysia is highly dependent on traditional electricity.

The rising scarcity of fossil fuels has spurred global interest in harvesting solar energy. Energy from the sun is endless and it provides clean energy with no greenhouse gas emissions. Thus, Malaysia has one of the biggest potentials for solar deployment due to its advantageous location near the equator. Hence, with its hot and sunny weather all year, Malaysia has a lot of potential for solar power generation. So, among various technologies for electricity production that are using renewable fuels, electricity production that is based on solar photovoltaic is labelled as the most environmentally friendly and sustainable (Ahmad et al., 2017).

According to Masood et al. (2020), although there are challenges in terms of highly expensive materials, technological apparatus, as well as achievement barriers, the efficiency of renewable energy has increased exponentially. This is made possible with the development of new effective technology which revolutionise the solar market and bring the confidence to the potential consumer on solar energy. Prospects for solar energy are significantly stronger due to recent interest, development, and invention, and this is in line with Sustainable Development Goals (SDGs) 7 which aim to provide affordable and clean energy. Solar energy is the source of clean energy that would protect the environment. Shifting the demand to solar energy would protect the environment and potentially reduce the effect of climate change, global warming and air pollution.

In addition, it has been predicted in the study done by Deloitte, the market will increase at a compound annual growth rate of 29 percent over the next ten years, with total EV sales increasing from 2.5 million in 2020 to 11.2 million in 2025 and reaching 31.1 million in 2030 (Fang, 2022). EVs would account for about 32 percent of all new car sales during this time. Due to Malaysia's climate, it is simple and feasible to produce solar renewable energy. Therefore, using electric vehicles would ultimately lower fuel prices, increase fuel efficiency, and lower emissions.

Furthermore, it predicted that EVs would account for about 32 percent of all new car sales during this time. Due to Malaysia's climate, it is simple and feasible to produce solar renewable energy, therefore using electric vehicles would ultimately lower fuel prices, increase fuel efficiency, and lower emissions. The two objectives would contribute significantly in achieving the target of becoming a carbon-neutral nation by 2050 as planned in the 12th Malaysian Plan. Hence, the research questions for this study would be what type of renewable energy that Malaysia wants to develop and expand on. Next is how to boost electric vehicles usage in Malaysia to support the plans to be carbon neutral nation in 2050.

STATEMENT OF PROBLEM

The transportation industry is one of the highest contributors to carbon dioxide (CO2) emissions globally (Mustapa, Ishak & Ayodele, 2020). It is further reported that the transportation industry accounts for 19 percent of worldwide final energy demand which is responsible for the emission of approximately 8260 MtCO2 eq. In light of this factor, electric cars (EVs) and other alternative vehicles are expected to help reduce CO2 emissions. Hence, in order to accelerate the development of the EV industry in Malaysia, the government announced a 100% elimination of taxes on electronic vehicles in the 2022 National Budget. This announcement is aligned with the Malaysian government's aim, established in the 12th Malaysian Plan, to achieve carbon neutrality by 2050. However, even with the incentives provided by the government, Malaysian adoption of EV is still low. It has proven that Malaysia tends to depend on non-renewable energy sources.

In order to boost the market acceptance of electric vehicles, it is important to develop a great infrastructure such as a charging port at home or charging stations at a public destination. The availability of charging stations (CSs), user facilities, and convenience all play a role in EV acceptance (Islam, Shareef & Mohamed, 2016). Developing a charging port required a lot of electricity to be generated which involved fossil fuels such as coal and natural gas. They are not only detrimental to the environment but they are also limited resources. Alternatively, using solar energy to generate electricity for the charging port is great for the environment and the energy is free. Thus, the interaction and collaboration between the government, the solar company, and the home developer are important to build the infrastructure for solar energy. So, despite Malaysia's significant growth in solar PV development, the rate of adoption of solar PV is not keeping pace with the market's expansion (Sharifuddin, Zainudin & Sabr, 2022). The lack of involvement in Malaysian's household on the use of solar power are the main concern as it would dampen the effort to transition to clean in energy by 2030.

RESEARCH OBJECTIVES

Energy from the sun is endless and it provides clean energy with no greenhouse gas emissions. The effort to provide clean energy and to shift the market demand towards the renewable energy is the key towards sustainability for Malaysia. Therefore, the first objective of this study is to broaden the usage of renewable energy in Malaysia to reduce the dependence on fossil fuels. Traditional electricity relies heavily on fossil fuels such as coal and natural gas. They are not only detrimental to the environment but they are also limited resources. The second objective is to enhance the usage of electric vehicles in Malaysia within 2050. Electric vehicles are environmentally friendly as they do not emit pollutants. This will be accomplished by developing a great infrastructure such as a charging port at home or charging stations at a public destination that is commonly visited by people.

The two objectives would contribute significantly in achieving the target of becoming a carbon-neutral nation by 2050 as planned in the 12th Malaysian Plan. The research objectives would provide the answer to the following research questions which are:

1. What type of renewable energy would bring greater value to Malaysia?
2. How to enhance electric vehicles usage in Malaysia to support the plans to be carbon neutral nation in 2050?

The next section presents the literature review relevant to the research focus. It discussed the renewable energy, the role of government and household in supporting the goals on achieving affordable clean energy in the near future.

LITERATURE REVIEW

Renewable Energy

Renewable energies are energy sources that are both sustainable and clean. Renewable energy is defined as energy derived from natural resources such as the sunlight, wind, rain, and tides (Muhsen Alhayali, Chew, Salleh, & Abd. Hamid, 2017). The most widely known of energy among the renewable energies is the solar energy. "Solar" is used to describe the sun or in connection with it. Thus, the sun's power output is a factor in the creation of solar energy. Heat and light are the primary energy components of sunlight (Muhibbullah, Afroz, & Duasa, 2021). Malaysia is known as a tropical climate country with daily solar irradiation of 4500 kWh/m2 and an average of 12 hours of sunlight (Hossain & Illias, 2022). The ability of technology to collect solar light is dynamic. Solar Photovoltaic (PV) technology converts light energy into direct current power (DC) (Muhibbullah et al., 2021). Consequently, solar PV has been identified by the Malaysian government as one of the most potential renewable energy technologies for combating climate change as well as reducing reliance on fossil fuels

(Sharifuddin et al., 2022). It is predicted to be four times the world's fossil fuel resources in Malaysia (Muhsen Alhayali et al., 2017). By 2050, solar energy might provide up to 11 percent of the world's energy needs (Muhibbullah et al., 2021). This is because the demand for energy to power our homes, businesses, and communities grows in tandem with the global population. Furthermore, technologies utilising renewable energy sources can also contribute subtly to the supply of electricity for lighting, space heating, and cooking (Muhsen Alhayali et al., 2017). Renewable energy consumption such as solar will likely get a lot of support in developing economies because of its environmental friendliness, with the potential to modernise and improve the quality of life of their population (Stephanie, 2021).

Government's Energy Policies in Malaysia

Since the debate over climate change began, the Malaysian government has made global warming a priority in all of its social and economic programmes (Muhsen Alhayali et al., 2017). Malaysia has pledged to cut emissions and increase the use of clean technology as a developing country. Malaysia government has been concentrating on creating a healthy ecology in order to achieve sustainable growth. Recognizing the rising demand for power, the Malaysian government has incorporated it in the Twelfth Malaysia Plan for the years 2021-2025 to strive for a more reliable, efficient, and long-lasting electrical supply. The planning was also in response to a global pledge to cut greenhouse gas emissions by half by 2050 (Ai ni Teoh, 2020). For solar renewable energy, the Malaysian government has provided incentives for the installation of PV panels, such as a tax break for solar energy users until the end of 2020 which has now been extended until 2023 (SEDA, 2022). According to Sustainable Energy Development Authority Malaysia (SEDA), consumers of solar energy who purchase green technology assets, such as solar air-conditioning equipment, may be eligible for a tax credit. So, businesses that engage in new green technology activities, such as solar energy generation, may be eligible for income tax deductions.

Table 1

The NEM 3.0 new initiatives

Initiative/ Categories	Quota Allocation (MW)	Quota Opening Date
NEM Rakyat Programme	100MW	1st February 2021 – 31st December 2023
NEM GoMEn Programme (Government Ministries and Entities)	100MW	1st February 2021 – 31st December 2023
NOVA Programme (Net Offset Virtual Aggregation)	600MW	1st April 2021 – 31st December 2023

Source: SEDA Malaysia

The government has also launched the net energy metering (NEM) programme, now known as the NEM 3.0, which allows anyone to install solar PV panels to generate electricity for their own use. The government of Malaysia has made a policy that users can sell excess energy produced to an electric utility company for the same feed-in prices as self-consumption tariffs. Thus, the development of renewable energy has gotten a lot of attention, and the use of renewable energy has increased in recent years. The benefit of this programme is that it motivates everyone to contribute to the generation of renewable energy, which has the potential

to address issues with the country's energy security and climate change. Along with lowering greenhouse gas emissions, the NEM also offers protection from any future increases in energy prices (Muhibbullah et al., 2021).

Housing Developer and Solar Energy Companies in Malaysia

In comparison to other Asia Pacific countries, Malaysia is still lagging behind in terms of green construction development. According to Gomez and Yung (2018), Malaysia has a rating qualification known as the Green Building Index which was developed to standardise green housing. This certification programme intends to give builders a plan for designing and building green houses that are energy efficient, conserve water, able to provide a comfortable and healthy indoor atmosphere, and as well as recycling. To project the future development of buildings in Malaysia with green energy, a solar PV panels should be installed in a variety of household and commercial situations, including residences and large structures. A residence can be powered with a PV panel that are joined together. This is where the house developer and solar energy companies came into picture where this study suggests for the future development of housing areas or any commercial building to start a built-in rooftop solar upon the construction of the building. So, this development can also save space instead of finding a massive piece of land to lay out the solar panel (The Star Online, 2017).

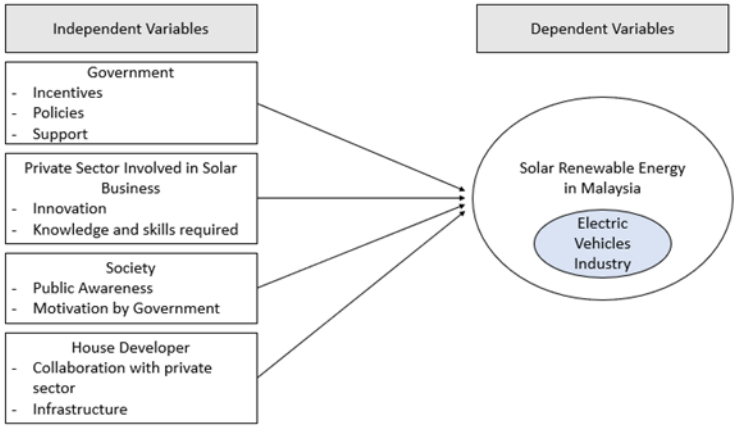
EV Adoption and Charging Infrastructure in Malaysia

Electric vehicle (EV) would be a product that is expected to help reduce pollution (Casals, Martinez & Garcia, 2016). Toyota was the first to offer a hybrid electric vehicle (HEV) to the Malaysian market in 2009, followed by Honda in 2010, then Nissan and Mitsubishi in 2013 (Veza, Abas, Djamari, Tamaldin, Endrasari, Budiman & Aziz, 2022). Currently, global manufacturers in Malaysia, such Nissan, Hyundai, and Mercedes-Benz, have begun to offer a variety of EV types in their product lines. As a result, the annual registration of electric vehicles in Malaysia topped in 2017 as well as 2018, with close to 9000 units. More than 95 percent of registered electric vehicles are plug-in hybrids. There are already over 31,000 licensed EVs on Malaysian roads, with 5 percent of them being BEVs. Although there is improvement, Malaysia's current adoption rate is still quite low (Omar, 2021).

According to a survey performed by the Malaysian Electric Vehicle Owners Club (MyEVOC), the most pressing worry for consumers in Malaysia right now is fuelling infrastructure and pricing, and typical driving distance between 50 to 70 kilometres. The primary concern is travelling outside of the city, as DC rapid charging is only found on the West Malaysian North-South Expressway (Veza et al., 2022). A sufficient DC charging infrastructure would alleviate their concerns about travelling in an electric vehicle while also increasing the uptake and accessibility of electrification in Malaysia. Thus, smart EV charging infrastructure planning in a new commercial building and community would increase the number of charging stations and this charging stations is powered through renewable energy rather than the electric energy.

Theoretical Framework

Figure 1
Independent and Dependent Variables



Note. Adapted from (Muhsen Alhayali et al., 2017)

Figure 1 shows the independent and dependent variables of the study. The dependent variables in this study are the Solar Renewable Energy in Malaysia and the EV industry, whereas the independent variables are the Government, Private Sector involved in the Solar Business, Society and the House Developer. The objectives of this study could be attained through the support from the government and existing solar companies such as Solarvest and Vsolar. The collaboration and commitment of government and private sectors support would enable the achievement of Sustainable Development Goal (SDG) 7. SDG 7 aims in ensuring access to affordable, reliable and sustainable modern energy for all. The involvement of the private businesses is important to the country for the future development of solar renewable energy as well as providing the infrastructure for the EV industry.

Currently, government and businesses goals are not fully aligned in achieving this goal. To overcome these challenges, government could construct a memorandum of understanding (MOU) with regards to the renewable energy implementation. The MOUs should include solar companies, the major supplier of electricity, Tenaga Nasional Berhad (TNB), and the housing developers as the parties with invested interest. This initiative might then contribute to the following idea, in which the entire residential area is solar-powered and the realisation of the concept of Solar Circular Economy system which will be explained further in the next paragraph.

PROPOSED RESEARCH FRAMEWORK

Solar Photovoltaic System

Solar photovoltaic (PV) systems use semiconductors in photovoltaic cells to convert solar energy directly to electrical energy (Florez & Ghazali, 2020). The PV system is made up of a number of panels that are connected in parallel or series to generate the required electricity (Adefarati & Bansal, 2019). Due to Malaysia's location that benefits from abundant sunlight, PV systems offer the greatest potential as a renewable energy source.

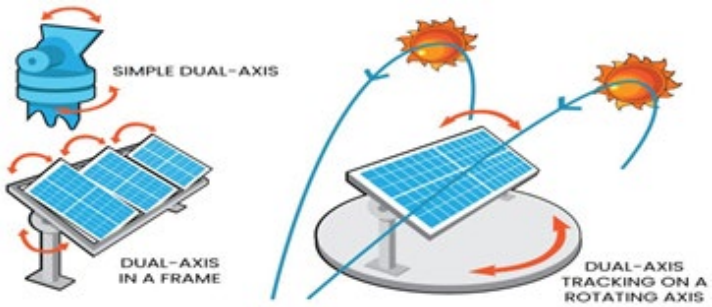
The amount of electricity generated by PV systems is determined by solar irradiation, environment temperature, the direction of the sun in the sky, PV panel sizes, PV panel conversion efficiency, and other input factors from a manufacturer's data sheet (Adefarati et al., 2019). This is necessary for the most efficient design and operation of a power system that uses a PV system for power generation. Malaysia has a significant potential for solar

photovoltaic (PV) systems because of the country's prodigious sunlight, with an average annual irradiation of 1643 kWh/m2. However, fixed type systems are presently the most common form of solar PV installation in this nation. Though it still produces a respectable amount for such installations, having it installed at an angle would impact the annual production owing to the movement of the sun (Chan Men Loon & Zalani, 2020).

So, to maximise the noontime and daily electricity production, PV arrays are normally installed in a fixed position and slanted toward the south. Thus, to catch the maximum energy, the fixed panel's direction should be properly chosen. The PV panels are set to face the sun and commonly put on the roof or near an open area. Hence, it is more convenient and efficient to install a sun tracking system that causes the array's surface to track the sun throughout the day to collect as much solar radiation as possible. The tracking can be conducted on one or dual-axis (Figure 2), with double axis tracking resulting in increased power output. In general, an efficient sun tracker may maximise energy extraction, with up to a 40% increase in output and performance over a fixed panel (Chan Men Loon et al., 2020).

Figure 2

Dual Axis Tracker



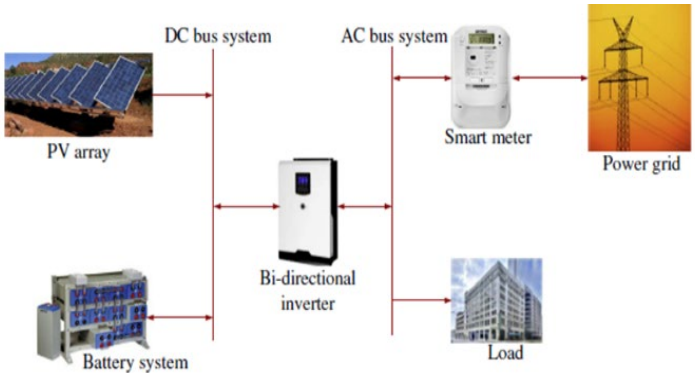
Source. Sinovoltaics (2022)

PV systems are categorised by utilities and consumers based on their purposes, the design of the components that make up the system, operational needs, the type of electrical load, and how the PV systems are connected to other power sources. PV systems are categorised into two major classes, either stand-alone PV system or grid-connected PV system. For this paper, the systems used are grid-connected PV systems.

Grid Connected PV System

Grid-connected PV systems is a system that is connected to the grid through a power conditioning unit and designed to operate in parallel. As shown in Figure 3, the grid-connected PV systems comprise of the PV array that convert sunlight into direct current (DC) power, battery system as a backup to store the energy, bi-directional inverter, smart meter, direct current (DC) bus system, and alternating current (AC) bus system. The use of an inverter creates a bi-directional interface between the PV system and the utility power output.

Figure 3
Grid-Connected Photovoltaic System

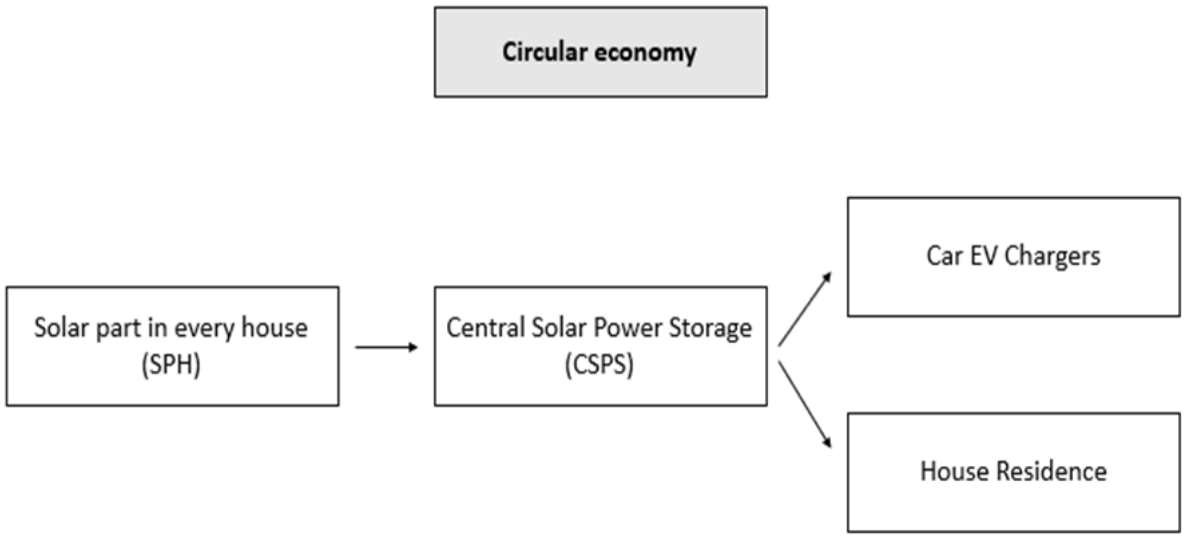


Source. Adefarati & Bansal (2019)

When the electricity generated by the PV panels is more than the electricity required by the consumers, the bi-directional interface introduced into the system allows the electricity generated by the PV panels to supply the load directly connected to the AC bus system and transmits the excess energy to the grid. When the electricity demand exceeds the PV system's output, the opposite would happen. PV power systems have two categories: systems that do not have battery backup, and systems that do have battery backup. During a power outage, the second type of system uses energy storage in the form of a battery to keep circuits running. If the outage happens during the day, the PV array can support the load to provide the energy. To conclude, grid-connected PV systems ensure the consumer is never without electricity. If the PV system generates more electricity than what the household requires, the energy will automatically be restored to the grid based on solar irradiance conditions and actual electricity demand. However, if the consumer requires more electricity than the amount of the solar panels produced, the grid can provide the power.

Implementation Framework - The Solar Circular Economy

Figure 4
The Solar Circular Economy System Implementation Framework



The Solar circular economy system, as seen in the Figure 4 above, is the proposed implementation framework for this study. It depicts the relationship between solar panels in every house (SPH), central solar power storage (CSPS), automobile EV chargers, and house residences that would be constructed in a large residence area and would be the result of a collaboration between the house developer and solar firms. SPH would be installed in every home in the residential neighbourhood. Solar energy would be received from the sun and used to produce electricity. Excess solar electricity could be stored in the CSPS and used later in the day by users, especially if their solar panels are not producing enough electricity to meet their home energy needs. So, renewable energy would be applicable not just for the generation of electricity in homes, but also for EV consumers. Every home would have auto EV chargers, making it easier for those who want to charge their EV instead of having to pay and travel to specific stations with EV chargers, which is tough for them to do.

The implementation framework presented in Figure 4, provide the way in ensuring continuous supply of affordable energy to residential and commercial area at minimal cost. According to Wei (2021), landed residential property households can save anywhere from 30% to 50% on their monthly power costs or at least by 25%. This is supported by the study done by Kennedy (2021) in which the reported that home solar lowers the cost of EVs and cuts emissions. The findings have shown that household solar energy contributed to high cost savings and accelerates the reduction of carbon emissions. It is expected that the maintenance costs of electric vehicles are much cheaper than those of internal combustion engines. When using a public charger, an EV costs roughly $1,058 per year, compared to a standard gas-powered light-duty car's $1,260 annual fuel expense. According Kennedy (2021), EV owners may power their vehicles for as little as $415 per year using home solar. It was calculated that using house solar to charge an EV might result in average savings of $16,250 over a 25-year period, the normal warranty time for home solar. To summarise, by implementing this concept, the country would not only be able to attract consumers who drive electric cars or favour solar energy, but would also be able to reduce its reliance on fossil fuels or coal to create electricity. Currently, there is not many study done on Malaysian market potential. Most of the findings with regard to potential implementation in the household areas was from western countries such as the United States of America. This serve as an opportunity for researchers in Malaysia to explore this area.

DISCUSSION

Firstly, this study aims to contribute to the betterment of future generation with a successful development of solar renewable energy in Malaysia. In addition, the proposed implementation framework should empower and provide direction to many parties such as the society, government and also the solar energy industry in achieving the goal of carbon neutral nation by 2050. The proposed framework aims to provide a comprehensive approach towards sustainable development of the solar renewable energy in Malaysia. Although Malaysia is seen progressing towards the development of the solar infrastructure, in global context we are still falling behind. Currently according to the solar energy capacity in Malaysia from 2011-2020 by Muller (2021), the current capacity for solar energy was approximately 1,493 megawatts in 2020 which converts to only 1.493 gigawatts (GW). The first country to score the best solar energy capacity in 2020 was China with 205 GW in the country followed by United States (76 GW), Japan (63.2 GW), Germany (49.2 GW) and India (38 GW). These are the countries that have successfully implemented their solar development. Therefore, there are still a long road ahead for Malaysia to improve in this area. These countries can also serve as a benchmark for Malaysia in supporting the carbon-neutral target.

According to EDF Energy, which is Britain's largest source of carbon-free electricity, The United Kingdom achieved a new fantastic renewable energy milestone in 2020. For the first time ever, the country celebrated two months of running entirely on renewable energy on Wednesday, June 10th. This is a significant step forward for renewable energy (ENERGY, 2021). Following the footsteps of the developing country, in order to meet its 2025 target, Malaysia has developed many development programmes and incentive schemes. Among them are Large Scale Solar programme and the Net Energy Metering 3.0 scheme with the goal of obtaining 31% of total power capacity from renewables while being aided by significant solar power growth.

The research also intends to visualize the ideas and create awareness to the society to convince them that the reliance on renewable energy is possible in Malaysia. Solar PV penetration rates are often greater in nations with well-defined national targets for the development of renewable energy sources. Solar panels will be more accessible, and consumers will be ready to pay for solar energy as the gross domestic product per capita rises. In addition, the future of the automotive industry is moving toward the EV sector; eventually, the use of EV will be widespread, thus it is critical for the nation to have the greatest infrastructure to support the sector's expansion. The adoption of solar renewable energy will reduce the dependence on fossil fuelled energy which can help to reduce the environmental impact as it is from a sustainable energy source. Thus, the society can enjoy an eco-friendly form of energy that has zero to minimal amount of carbon emissions.

This study also shows that with the government support and intervention in the development of the solar renewable energy, it would help to speed up the implementation process. Hence, the transition into the mass usage of solar renewable energy in Malaysia which is aligned with the target to become a carbon-neutral nation in 2050 as planned in the 12th Malaysian Plan, is possible. Next, the strategies in this study can be used by the government of Malaysia that would enable the development of accessible infrastructure for the EV industry in the country. It is vital for the government to identify the right strategy to move forward into the EV industry as it is the rising form of economy nowadays which can bring in billions of ringgits. The framework proposed by this study can be used as a reference by companies in the solar energy industry and integrated the important factors into the projects. It could also be used as the benchmark for companies which intend to venture into the solar energy business.

CONCLUSION

Private solar power-related companies in Malaysia, such as Solarvest, have been active in organising campaigns, nationwide roadshows, and talks to share the benefits of solar power with the public. Collaboration with local banks had been executed to provide financing solutions to interested households. This will reduce the initial investment cost of installing PV panels. Participation of these private solar companies are important to the country to educate consumers as well as provide the infrastructure for the development of the EV industry. This is because, they have the skills and knowledge in the field area. It is also suggested that green home building agencies in Malaysia strengthen their public awareness campaigns, incorporating the general public, to raise public understanding about the necessity of living a greener lifestyle. The manufacturing sector should promote the use of environmentally friendly products and resources at an affordable price.

In addition, the Malaysian government should promote the notion of "Green Malaysia" by holding an educational campaign for the community to ensure that our country embraces a green lifestyle. It can be seen that the government of Malaysia has been trying to provide more incentives to boost its economic feasibility (K.H Solangi, Saidur, Luhur, Aman, Badarudin & Kazi, 2015). Now, both government and the public must work together to meet the Malaysian government's goals and the global commitment (Ai Ni Teoh, 2020). The most important thing

is that the development of solar energy should remain one of the essential parts of the economic development in Malaysia. Countries that set clear national goals for renewable energy development generally have higher solar PV penetration rates. With higher per capita gross domestic product, solar panels will be more affordable, and people will be more willing to pay for solar energy. Not only that, the future of the automobile industry is progressing towards the EV industry, in time the usage of EV will be in mass and it is important for the country to have the best infrastructure to support the growth of the industry. There is still a lot more to explore in this green technology area. The insufficient understanding on solar renewable energy cannot be entirely overcome. This is due to the fact that this research is a conceptual paper, hence no data or findings have been drawn. Overall, it is entirely conceptual and based on journals. However, this report could be useful as for future research on solar energy to overcome the lack of understanding and information on the use of solar power. Policymakers would play greater role by educating the society about the environment and provide greater assess to correct information. Although developing solar PV requires time and effort, good regulations and stakeholder cooperation could speed up public adoption and help the country reach its renewable energy goal by 2050.

REFERENCES

Adefarati, T., & Bansal, R. (2019). Energizing Renewable Energy Systems and Distribution Generation. Pathways to A Smarter Power System, 29-65. DOI:10.1016/B978-0-08-102592-5.00002-8.

Ahmad, S., Mat Tahar, R., Cheng, J. K., & Yao, L. (2017). Public Acceptance of Residential Solar Photovoltaic Technology in Malaysia. Psu Research Review: An International Journal, 1(3), 242-254. DOI:10.1108/Prr-11-2016-0009.

Ai Ni Teoh, Y. L. (2020). Is Malaysia Ready for Sustainable Energy? Exploring the Attitudes Toward Solar Energy and Energy Behaviours in Malaysia. MDPI.

Casals, L.C.; Martinez-Laserna, E.; García, B.A.; Nieto, N. Sustainability Analysis of The Electric Vehicle Use in Europe for Co2 Emissions Reduction. J. Clean. Prod. 2016, 127, 425–437.

Chan Men Loon, M. Z. (2020). Sensorless dual axis solar tracker using improved sun. *International Journal of Power Electronics and Drive System (IJPEDS),* 1305-1312.

Energy, E. (2021). Edf Energy.Com. Retrieved From https://Www.Edfenergy.Com/For-Home/Energywise.

Fang, K. S. (2022). *No Time to Lose in Electrifying Malaysia's EV industry*. Bernama. Retrieved from https://www.bernama.com/en/thoughts/news.php?id=2046657.

Florez, L., & Ghazali, N. (2020). Barriers to Implementing Solar Energy Systems In

Buildings: The Resident's Perspective in Malaysia. *Proc. 28th Annual Conference of The International Group for Lean Construction (Iglc)* (Pp.829-840). Berkeley, California, Usa: Online at Iglc.Net. DOI:10.24928/2020/0059.

Halmi, S.; (Malaysian Electric Vehicle Owners Club, Kuala Lumpur, Malaysia). Personal Communication, 2021.

Hossain, M. Z., & Illias, H. A. (2022). Binary Power Generation System by Utilizing Solar Energy in Malaysia. Ain Shams Engineering Journal, 13(4), 101650.

Islam, M., Shareef, H., & Mohamed, A. (2016). Optimal Siting and Sizing of Rapid Charging Station for Electric Vehicles Considering Bangi City Road Network In Malaysia. Turkish Journal of Electrical Engineering & Computer Sciences, 24, 3933-3948. DOI:10.3906/Elk-1412-136.

Malaysian Automotive Association. Market Review For 2018 And Outlook For 2019. Kuala Lumpur. 2019. http://Www.Maa.Org.My/Pdf/Market_Review_2018.Pdf.

Malaysian Investment Development Authority. Tax Incentives for Green Industry. 2018. Http://Www.Mida.Gov.My/Home/Tax-Incentives-For-Green-Industry/Posts/.

Malik, S. A. (2020). Solar Energy Technology; The Knowledge, Awareness and Acceptance. Elsevier.

Masood, A., Gonul, E., & Dogan, E. (2020). The Potential and the Bright Future of Solar Energy. Research Gate. Retrieved from https://www.researchgate.net/publication/351706752_The_Potential_and_the_Bright_Future_of_Solar_Energy.

Muller, J. (21 May, 2021). Solar energy capacity in Malaysia from 2011 to 2020(in megawatts). Retrieved from Statista: https://www.statista.com/statistics/873026/solar-energy-capacity-malaysia/#:~:text=The%20solar%20energy%20capacity%20in%20Malaysia%20was%20approximately%201%2C493%20megawatts,from%20one%20megawatt%20in%202010.

Murray, J. (2021, April 21). Ns Energy. Https://Www.Nsenergybusiness.Com/Features/Types-Of-Renewable-Energy/.

Mustapa, S., Mohamad Ishak, W., Ayodele, F. O., & Ayodele, B. V. (2020). Evaluation of Cost Competitiveness of Electric Vehicles in Malaysia Using Life Cycle Cost Analysis Approach. Sustaiability. DOI:10.3390/Su12135303.

Muhibbullah, M., Afroz, R., & Duasa, J. (2021). Solar Photovoltaic Panels in Malaysian Homes: An Economic Analysis and Survey of Public Opinion. *International Journal of Energy Economics and Policy,* 454-464. doi:10.32479/ijeep.11750.

Muhsen Alhayali, Z., Chew, B., Salleh, N., & Abd. Hamid, M. (2017). Implementation Of Renewable Energy Concept In The Automotive Industry In Malaysia: An Exploration Study. *Journal of Technology Management and Business,* 96-115.

Ntanos, S.; Kyriakopoulos, G.; Chalikias, M.; Arabatzis, G. Public Perceptions and Willingness to Pay for Renewable Energy: A Case Study from Greece. Sustainability 2018, 10, 687.

Omar, H.N.; (Malaysian Green Technology and Climate Change Centre, Bandar Baru Bangi, Malaysia). Personal Communication, 2021.

Prasad, S., Radhakrishnan, S., Kumar, S., & Kannojia, S. (2019). Sustainable Energy: Challenges and Perspectives. DOI:10.1007/978-981-13-2772-8_9.

R. R. Kumar And K. Alok, ‘‘Adoption of Electric Vehicle: A Literature Review and Prospects for Sustainability,’’ J. Cleaner Prod., Vol. 253, Apr. 2020, Art. No. 119911, DOI: 10.1016/J.Jclepro.2019.119911.

S. Asadi, M. Nilashi, S. Samad, R. Abdullah, M. Mahmoud, M. H. Alkinani, And E. Yadegaridehkordi, ‘‘Factors Impacting Consumers’ Intention Toward Adoption of Electric Vehicles in Malaysia,’’ J. Cleaner Prod., Vol. 282, Feb. 2021, Art. No. 124474, DOI: 10.1016/J.Jclepro.2020.124474.

Sahid, M. S., Suratman, R., & Ali, H. M. (2022). Land Administration Perspective for Solar Farm Development in Malaysia. Journal of Positive School Psychology, 6(3), 258-266.

SEDA. (2022). Seda Malaysia. Retrieved from Sustainable Energy Development Authority: Https://Www.Seda.Gov.My/Reportal/Re-Incentive/.

Sharifuddin, S. I., Zainudin, N., & Sabr, M. F. (2022). An Extended Model of The Theory of Planned Behavior To Predict Households Response To Net Energy Metering Program In Urban Malaysia. International Journal of Academic Research in Business and Social Sciences, 12(1), 1864-1879.

Solangi, K.H.; Saidur, R.; Luhur, M.R.; Aman, M.M.; Badarudin, A.; Kazi, S.N.; Lwin, T.N.W.; Rahim, N.A.; Islam, M.R. (2015). Social Acceptance of Solar Energy in Malaysia: Users’ Perspective. Clean Technol. Environ. Policy 2015, 17, 1975–1986.

Solarvest (2019). Solarvest And Uob Teaming Up to Promote Solar Energy. 2019. Https: //Solarvest.My/2019/10/11/Solarvest-UOB-Teaming-Up-To-Promote-Solar-Energy/.

Stephanie Kay Ann Chuah, B. L. (2021). The Impact of Public Policy Marketing, Institutional Narratives and Discourses on Renewable Energy Consumption in A Developing Economy. Department of Marketing, School of Business, Monash University Malaysia.

Teoh, An, Go, Yi & Yap, Tc (2020). 'Is Malaysia Ready for Sustainable Energy? Exploring the Attitudes Toward Solar Energy and Energy Behaviors in Malaysia', World, Vol. 1, No. 2, Pp. 90-103. https://DOI.Org/10.3390/World1020008.

The Star Online. Energised by The Sun. 2014. Https://Www.Thestar.Com.My/News/ Environment/2014/02/24/Energised-By-The-Sun/.

The Star Online. (2017, August 15). TNB Gets Rm339mil Financing for Kuala Langat Solar Project. Https://Www.Thestar.Com.My/Business/Business-News/2017/08/16/Tnb-Gets-Rm339mil-Financing-Forkuala-Langat-Solar-Project/.

Veza, I., Abas, M. A., Djamari, D. W., Tamaldin, N., Endrasari, F., Budiman, B. A., & Aziz, M. (2022). Electric Vehicles in Malaysia and Indonesia: Opportunities and Challenges. Energies, 15(7), 2564.

Wan Syakirah Wan Abdullah, M. O. (2019). The Potential and Status of Renewable Energy Development in Malaysia. MDPI.

Wei, N. W. (13 August, 2021). Solar PV can help businesses save at least 25% in electricity cost, says UOB. Retrieved from The Star: https://www.thestar.com.my/business/business-news/2021/08/13/solar-pv-can-help-businesses-save-25-in-electricity-cost-says-uob.

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

UNIVERSITI TEKNOLOGI MARA PERAK
TERIMA
25 JAN 2023
Tindakan
Universiti Teknologi MARA Perak
PEJABAT REKTOR

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR