Renewable Energy Support Policy in Malaysia: A Comparative Analysis with Two Successful Countries

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Abstract

The world is facing depletion of fossil fuel sources thus urged for alternative and renewable energy sources. The conventional energy production raised a concern regarding greenhouse gases (GHG) emission that has led experts to find ways in reducing it. Energy production from renewable energy sources needs efficient support mechanisms to be successful. Many EU (European Union) countries namely Germany, Sweden, Finland and Denmark have been successful in deploying renewable energy sources by enacting judicial policy support mechanisms. Malaysia too has utilized several policies for promoting renewable energy but its success is yet very low. This paper is aimed to analyze renewable energy policies of Malaysia as to compare with selected EU countries successful policies. RETScreen software is used to analyze policies cases for Solar PV and Biomass sources. A comparative analysis is done for Malaysia with Germany and Sweden to obtain the estimation of net present value, internal rate of return and payback period. The finding provides indication why Malaysia renewable energy policy is not efficient as the two EU countries. The paper also discovers that the proposed policy for Malaysia has shown to a better option for future policies embedment.

Keywords
Renewable, Energy policy, Feed in tariff, GHG, Emissions

1. Introduction

Energy sector worldwide has been focusing on ways in reducing fossil fuel dependence and the environmental effects of producing energy (Mekhilef et al. 2012). The conventional way of generating electricity with fossil fuels has become a major concern due to the emission of greenhouse gases (GHG) that mainly contribute to climate change (van Vuuren et al. 2012). The energy demands are also appeared in an increasing trend due to the population growth and rapid industrialization. To overcome the gap between energy supply and demand, as well as taking into consideration the risks from global climate change, a lot of attention was oriented to renewable energy sources (RES) and energy efficiency (EE) measures (Muhammad-Sukki et al. 2012). This necessitates the transition worldwide towards a much greener source of energy with less environmental effects (Abd Wahid et al. 2016). As a result, one of the actions taken in energy sector is adopting renewable energy sources to produce electricity that is clean, abundant and free such as solar, hydro and wind sources.

Malaysian government has already pledged to reduce a 40 percent reduction in carbon emissions intensity by 2020 (Abdmouleh et al. 2015). In Malaysia, the final energy use has risen at an annual growth rate of 6% from year 2000 to 2008 and reached 45 Mtoe in 2008. This proved that Malaysia needs to deploy new energy sources in order to meet the demand as well as reducing the global concerns. Taking successful countries as example, Malaysia also had implemented the renewable energy technology since 2010. Many EU (European Union) member states such as Germany, France, Spain, Italy, Sweden and Denmark have recorded in leading the RES success outcomes in the world. The renewable energy in Malaysia is run based on the policies mechanism similar to the successful countries of European Union and United States. Despite initiative, still renewable energy dissemination in Malaysia has been quite low (Shaikh et al. 2017). Therefore, there is a serious need to review the policies that fail to flourish renewable energy technology in Malaysia. This paper identifies the success conditions for increasing use of RES in two European countries namely Germany and Sweden and evaluates the policy support tools in Malaysia in comparing to EU level two successful countries.

2.1 Renewable energy in Malaysia

Malaysia energy sector includes both fossil as well as the renewable resources. Malaysia is highly dependent on energy for its economic growth (Shaikh et al. 2017). It is blessed with natural resources namely agricultural, forestry and minerals. Malaysia is as one of the top exporters of natural rubber and palm oil. Khor and Lalchand (2014) stated in their paper that Malaysian energy sector was highly dependent on a single source i.e, crude oil before 1980. According to Ong et al. (2011), crude oil is no longer seen as a feasible source of energy supply in Malaysia due to its fast depleting trend. Solar, wind, mini hydropower, and biomass energy are the major candidates of renewable energy in Malaysia. Apart from the conventional sources of energy like natural gas, oil, coal and hydropower, the government of Malaysia has always been looking and studying into other possible renewable sources. Despite high growth rates, renewable energy still represents only a small part of today's energy picture.
Among renewables, the solar power has the highest potential at 6 500 MW capacity followed by biomass potential that is 1340 MW capacity (Mekhilef et al. 2014) . In early period of enhancing solar power in Malaysia, a Building Integrated Photovoltaic (BIPV) was introduced (Shaikh et al. 2017). BIPV provides benefits and contributes to enhancing the attractiveness of a building's design. According to SEDA (SEDA 2015), BIPV systems can be aesthetically integrated into the building from the initial stages or retrofitted to an existing building. Currently, installed solar capacity in Malaysia is 1MW, whereas its estimated potential can reach to 6500MW. The others installed capacities are biogas at 410MW, mini hydropower at 490 MW and solid waste at 360 MW.

Malaysia has been one of the largest producers and exporters of palm oil for the last forty years (Lim et al. 2006). Commonly, oil palm is a well-known biomass source in Malaysia. Off this, empty fruit bunch (EFB) is acknowledged to have potential for energy production. However, biomass sources are not limited to only palm oil wastes. Various biomass sources namely wood and waste wood, leaves of the plants, agricultural waste, and municipal solid waste (MSW) also have the prospects. Biomass power technologies convert renewable biomass fuels to heat and electricity using processes similar to those employed with fossil fuels. At present, the primary approach for generating electricity from biomass is combustion direct firing. Although Malaysia has high potential in electricity generation from renewable resources, the present initiatives and efforts are lower than the country's actual potential (Kadir and Rafeeu 2010). Despite Malaysia having abundant renewable sources potentials, this paper only focuses on two of the major potential sources namely solar and biomass.

2.2 Renewable energy in two Successful EU countries

Electricity generation from renewable energy sources is no longer a new topic in the European Union (EU) countries. Europe succeeded in implementing renewable energy technologies, where almost 90 percent of new power coming from renewable sources. Most of the EU countries have shifted to renewable energy technologies since a few decades ago. Now, countries such as Germany, Sweden, Denmark, and Norway are leading in these technologies. These countries have quite a record of success rate in implementing renewable energy technologies. Of the 24.5 GW of new capacity built across the EU in 2016, 21.1 GW equivalents to 86 percent was from wind, solar, biomass and hydro (Figure 1).

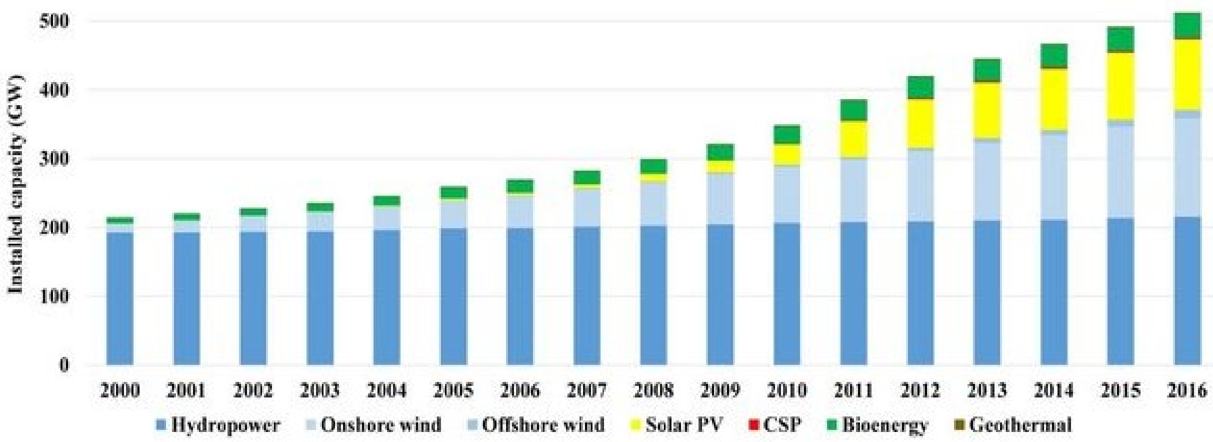

Figure 1. Power generation capacity from renewables in EU.

1.3 Renewable Energy in Germany and Sweden

Europe's energy transition (2017) (Manuel Welsch et al. 2017) stated that Germany possesses 2050 targets for primary energy (50% relative to 2008), final energy (40% relative to 2005), power consumption (25% relative to 2008) and space heating (80% relative to 2008). Germany stands out as of the very successful countries in the world in the development of renewable energy with highest per capita installation (1070 W/cap in 2014). This country is also the world leader in installing photovoltaic (PV) power in terms of installed capacity (38.2 GW by December 2014). This country stands third in wind capacity amounting to 39.2 GW in 2014 (nearly 11% of global capacity) after China and USA. Germany is also European leader in supplying biofuel (biodiesel) to transportation sector (3.4 billion liter per year in 2014) and solar heating system (12.3 GWth per year in 2013)(World Economic Forum). Germany, which already has three times as much wind power as in any other EU country, installed 44 percent of Europe's new wind capacity in 2015. Germany developed one of the largest solar photovoltaic markets in the world, although it is not known to be particularly sunny (IEA 2018).In July 2015, the electricity production from PV was, for the first time, higher than from nuclear power. Figure 2 proved Germany success in producing power from renewable energy sources in which Germany ranked second in the world and first among all EU in installed capacity of solar power.

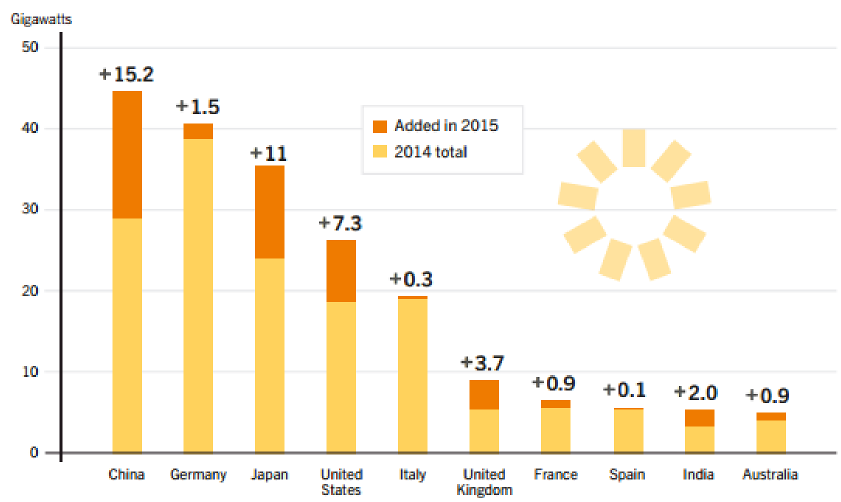

Figure 2. Top 10 countries for solar power in terms of installed capacity 2016 (REN21 2017).

Sweden is selected as one of the references country for biomass policies to compare with Malaysia. This is because; this country has achieved an increasing performance in utilizing biomass into energy production. The use of biomass in the Swedish energy system has increased over the years. Biomass accounted for 11 per cent or 52 TWh of the total energy supply in 1983. In 2015, the use of biomass has increased to 134 TWh, which is equivalent to 24 per cent of the total supply. As a result, Sweden able to produce a 53 percent energy from renewable sources in 2014 (Swedish Energy Agency 2015).

3. Energy policy

3.1 Energy Policy in Malaysia

Energy policy by definition is the manner in which a given entity that often the governmental has decided to address issues of energy development including energy production, distribution and consumption (Mekhilef et al. 2014). Several energy policies have been implemented in Malaysia in order to transit from energy production from non-renewable source to the renewable energy production as shown in Table 1.

Table 1. Energy policies in Malaysia.

Policy or plan	Objectives
National Petroleum Policy (1975)	• Efficient utilization of petroleum resources. • Ensuring the nation exercises majority control in the management and operation of the industry.
National Energy Policy (1979)	• Supply Objective: Ensure adequate, secure & cost-effective energy supply. • Utilization Objective: Promote efficient utilization of energy and eliminate wasteful and non-productive usage. • Environmental Objective: Minimize negative impacts to the environment.
National Depletion Policy (1980)	• To prolong the lifespan of the nation's oil and gas reserves.
Four Fuel Policy (1981)	• Aimed at ensuring reliability and security of supply through diversification of fuel (oil, gas, hydro and coal).
Five-fuel Policy (2001)	• Encourage the utilization of renewable resources such as biomass, solar, mini hydro etc. • Efficient utilization of energy.
National Renewable Energy (RE) Policy + Action Plan (2010)	• To prolong the life span of the nation's oil and gas reserves.

The year 2001 embarks the beginning of utilizing renewable energy resources in Malaysia. Five-Fuel diversification policy was announced in the 8th Malaysian Plan. Hence forward, a National biofuel policy was launched on 2006 (Ölz and Beerepoot 2010). The main reasons that were avoiding the investors to change to renewable electricity generation were technical, economic and institutional challenges as well as disappointment from previous accomplishments (Sovacool and Drupady 2011). With the intention of tackling these challenges, the Sustainable Energy Development Authority Malaysia (SEDA) developed a new plan called National Renewable Energy Policy and Action Plan which focuses on green or named SMART targets by defining fiscal incentives. Subsequently, a feed-in-tariff (FIT) policy was introduced. A total electricity generation of 985MW was to be achieved during 2010 to 2015 which is almost 23 times the 41.5MW of previously installed capacity. Following the 10th Malaysia Plan, Malaysia had adopted the 11th Malaysia Plan in 2011. This plan was focusing on encouraging sustainable energy used to support growth.

A feed-in-tariff (FIT) is a policy used to accelerate investment in renewable energy technology that is centring on supporting the development of new renewable energy project (Abolhosseini and Heshmati 2014). It is offered a long

term purchase agreement for the sale of renewable energy electricity utility or transmission system operator (TSO) at a fixed price (Abdmouleh et al. 2015).
Feed-in-tariff system in Malaysia obliges Distribution Licensees (DL) to buy from Feed-in-Approval Holders (FIAHs) the electricity produced from renewable resources and sets the FIT rate. The DLs will pay for renewable energy supplied to the electricity grid for a specific duration. SEDA mentioned that there are five technologies that will be eligible for tariff payment once the law enters into force, namely waste, biomass, and biogas, small hydro and solar photovoltaic (Rahman et al. 2016).
The resource potential of other technologies, such as wind power, geothermal and tidal power, has not yet been fully assessed. However, those technologies might become eligible for tariff payment at a later stage, once the policy maker has the necessary information regarding the resource availability at hand. In the case of biomass, it might also be necessary at a later stage to determine which type of biomass resources can be used for generating electricity in order to secure a sustainable use of the available resources.

Table 2. FIT rates for solar PV (Non-individual) above 500 kW in Malaysia

Description of qualifying renewable energy installation	FIT rates (MYR/kWh)
Basic FIT rates having installed capacity of	
Up to and including 4 kW	0.7424
Above 4 kW and up to and including 24 kW	0.7243
Above 24 kW and up to and including 72 kW	0.5218
Above 72 kW and up to and including 1 MW	0.5041
Additionally bonus FIT rates with having the following criteria (one or more)	
Use as installation in buildings or building structures	+0.1395
Use as building materials	+0.1060
Use of locally manufactured or assembled solar PV modules	+0.0500
Use of locally manufactured or assembled solar inverters	+0.0500

Table 2 shows the current FIT for solar PV source. Malaysia has set the maximum installed capacity of all eligible RE installations is 30 MW unless special approval is obtained. The FIT rate is lower as installed capacities increase, due to cost optimization from economies of scale. Malaysia FIT also introduced bonus FIT rates according to some criteria. Additionally, any RE installation that meets any criteria entitling it to additional bonus FIT rates. Solar PV renewable energy installation is obliged to 21 years of embedment period.

Table 3. FIT rates for biomass and biomass (solid waste) in Malaysia

Description of qualifying renewable energy installation	FIT rates (MYR/kWh)
Basic FIT rates having installed capacity of:	
Up to and including 10 MW	0.3085
Above 10 MW and up to and including 20 MW	0.2886
Above 20 MW and up to and including 30 MW	0.2687
Bonus FIT rates having the following criteria (one or more):	
Use of gasification technology	+0.0199
Use of steam – based electricity generating with overall efficiency above 20%	+0.0100
Use of locally manufactured or assembled boiler or gasifier	+0.0500

In the case of renewable energy production from biomass sources, the FIT rates are categories into two categories namely biomass and biomass of solid waste that is meant of municipal solid waste (MSW) (Table 3). Renewable energy installation from biomass is subject to 16 years of commissioned period. There are no significant changes in FIT of this technology for both categories. In addition, the feed-in-tariff system in Malaysia is designed with the

main objective of achieving grid parity. SEDA Malaysia mentioned that grid parity will happens when the cost of generating renewable energy is equivalent or lower than the cost of generating electricity from the conventional fossil fuels. Although FIT has a number of benefits, they may lead to some drawbacks if they are not applied properly as well. FIT rates, degression rates and the period in which FIT policy is applied are the most important factors in utilization of this policy. The FIT rates must be high enough to recover the investment cost within a reasonable timeframe (Shahmohammadi et al. 2015).
Besides FIT, Malaysia also introduced other fiscal incentives for clean energy development namely pioneer status and tax allowance. Under this category, include incentives for storage, treatment and disposal of toxic and hazardous wastes, incentives for energy conservation, incentives for energy generation activities using renewable energy resources, tax incentive Green Building Index (GBI) and import duty and sales tax exemption on solar PV equipment.

3.2 Energy Policy in Germany

Various EU countries have implied the FIT mechanism including Germany, Denmark, United Kingdom and Greece. In late 2011, Germany was successful in connecting its one-millionth PV system, mainly driven by the attractive rates of FIT and the expectation that prices would continue to decrease. In Germany, small renewable energy sources plants up to 100 kW are eligible for feed-in tariff as set out in the Renewable Energy Sources Act (EEG) 2017 (Schneider 2017).
Also, the eligibility is coupled to the obligation of the plant operator to feed the electricity into the grid in the months for which he raises the claim of receiving the financial support (Schneider 2017). Next, the amount of tariff depends on the site of production and the installed capacity. Specific building-mounted systems for examples roofs, facades, noise barriers, other building are subjected to the rate given by EEG that is Euro cents 8.91 – 12.70 per kWh minus Euro cents 0.4 per kWh. The tariff payment period is 20 years from the day of assigning (Jacobsson and Lauber 2006).
In addition, the estimation is possible due to the digression in FIT rates for the technology. The digression contains a basis digression rate of 0.5 percent every month. The EEG 2017 has defined a target-corridor for the development of solar power of 2,500 MW per annum. It will be increased from 0.5 percent to up to 2.8 percent in condition that the real development surpasses the corridor (EEG 2018). Moreover, a low interest loans with repayment subsidies are provided for large scale heating solutions for commercial customers or municipal bodies in Germany (Quaschning 2015). Another example is in 2016, Germany enacted a Euro 30 million programme to provide loans and grants to support residential solar PV systems combined with battery storage. Democratic support for a transition from conventional to renewable energy is strong; the use of well-designed feed-in-tariff policy is likely superior to alternative regulatory support mechanisms, especially during the early phases of renewable technology development.

3.3 Energy Policy in Sweden

Sweden has a significantly higher proportion of renewable energy production and has led the way in areas such as district heating and creating a sustainable future for the region. The Swedish Cleantech Hub (Swedish Cleantech 2018) mentioned that over two thirds of their electricity is produced through nuclear and hydroelectric with around 10 percent coming from CHP (Combined Heat and Power) plants.
The main reasons for the Swedish bioenergy sector's phenomenal growth are broad political support and strong incentives such as the CO_2 tax, the green electricity certificates introduced in 2003, and tax exemptions for transport biofuels (Swedish Energy Agency 2015). Next, the development of biomass as a renewable energy source for heat was promoted from the late 1970's to decrease Sweden's dependence on imported oil, mainly by taxation of oil, and investment grants for heat plants using biomass. In 1991 a carbon tax was introduced, and this tax has since then been raised multiple times, mostly on the heating and service sector, and lately also on industries which are not part of emission trading. Alongside the carbon tax, there are also variable energy taxes and fees on Sulphur and Nitrous oxides emissions.
The carbon tax is based on the polluter pays principle, also known as PPP, whereby the fossil fuels pay for their long – term environmental damage and cost. The direct subsidies for any renewable alternative have, in general, been avoided. Based on REN21 (2017), late in 2016, Sweden removed its tax on solar production in order to advance the national target of 100% renewable electricity by 2040.
Bioenergy has not had any direct subsidies but has benefited from the accounting that its greenhouse gas emissions are estimated at zero. In addition, Svebio (Svebio 2017) says bioenergy's success is also due to Sweden's long-

standing tradition of using its natural forest resources – the nation has more forests than any other EU member state – while also protecting and developing these resources.

4. Renewable energy programs

4.1 Solar Photovoltaic (PV)

4.1.1 Solar Photovoltaic success in Germany

An analysis model, RETScreen software is chosen as a tool for projecting output for a selected solar photovoltaic (PV) project. RETScreen is the tool that can be used to techno-economic policy evaluation. A 5 MW solar power plant located at Leipzig is chosen as the location for the reference case. Parameters that are used to run the analysis are based from the information regarding Leipzig solar power plant: 50,000 modules, Shell manufactured solar PV and titled at 30 degree slope. The current feed-in-tariff rate is used to analysis the case that is 0.457 Euro/kWh (Jacobsson and Lauber 2006).
This project requires a 5 Euro/W unit cost of PV installation and able to gain saving of 75 Euro in operation and maintenance cost. Few assumptions were also made in order to complete the required parameters needed. The inflation rate was 2%. The electricity export escalation rate was assumed to be 1% due to the rate of the inflation. The project life is taken as 20 years following Germany feed-in-tariff embedment.

4.1.2 Solar Photovoltaic progress in Malaysia

Melaka state is chosen as the location for the analysis of feed-in-tariff policy. Melaka has a higher distribution of solar radiation in Malaysia proved it to be a suitable location for the case analysis. A 7 MW existing solar PV farm owned by Gading Kencana Sdn. Bhd. is used as the basic template. Parameters used to run the analysis are the power capacity is stated as 7 MW with 29,092 modules of solar PV panel, Yingli Solar manufacturer monocrystalline solar panel and having a 30 degree slope tilt. A total of 33 MYR/W per unit installation cost of PV power is allocated for this project and a 90 MYR saving in operational and maintenance cost.
Project life was considered to be 21 years following the embedment of Malaysia authority of implementing feed-in-tariff project. The debt ratio, debt interest and debt term are assumed based on the existing solar PV project in Malaysia. The inflation rate and electricity export escalation rate are assumed to be 2% and 1%.
The proposed cases are divided in two scenarios. In scenario 1, updated rate of feed-in-tariff was used. The feed-in-tariff stated by SEDA for commercial solar PV in 2017 was 0.5041 MYR/kWh. In scenario 2, a new rate of feed-in-tariff is suggested which is lower than the existing rate, i.e. 0.457 MYR/kWh. This proposed tariff is similar to the current German feed-in-tariff in euro equivalent. Another parameter was added in scenario 2 that is the introduction of the greenhouse emission reduction credit. A minimal rate of 10 MYR/tCO2 is suggested for the case evaluation.

4.1.3 Comparison of Malaysian and German cases

Table 4 is the output from the solar PV case analysis. The result shows the financial analysis worksheet from RETScreen software. Some indicators are taken into consideration in comparing the performance for both the countries. The internal rate of return (IRR), net present value (NPV), simple payback, and benefit-cost (B-C) ratio are some of the indicators that demonstrate the performance.

Table 4. Comparison of financial indicators for solar PV system for all cases.

Indicators	Malaysia (scenario 1)	Malaysia (scenario 2)	Germany
Internal Rate of Return (IRR) equity, (%)	15.4	14.8	12.8
Internal Rate of Return (IRR) asset, (%)	1.4	1.7	1.6
Simple payback (yr)	8.4	9	9.6
Simple payback equity (yr)	7.6	8.6	9
Net Present Value (NPV), (million MYR)	4.28	4.03	6.14
Benefit-Cost (B-C) ratio	1.40	1.38	1.17

The net present values were found to be positive for all cases. Thus, all cases are worthy of investment project. There is a small difference in NPV between two scenarios cases in Malaysia. Scenario 1 is ahead by a 4,280,800 MYR as to compare with Scenario 2 that only presents a NPV worth of 4,034,094 MYR. By comparison of all indicators, it can be said that Scenario 1 gives more approachable output than the other scenario. Hence, based on the data output from the analysis, Scenario 1 is depicted as a suitable project for solar PV investment in Malaysia.
On the other hand, both cases in Malaysia still unable to surpass the net present value of the reference case namely Germany. Higher installed cost brings to a higher total initial cost. In addition, the total initial cost allocated for Malaysia case is 84 million MYR while it is just 5.17 million MYR for Germany case analysis. The total net present value of Malaysia case is still far behind from the Germany reference case by 2 million MYR.
In the analysis, Germany installed cost for a 5 MW power solar farm is lower as to compare with the installed cost for Malaysia for the same amount of solar capacity. The last perceptible aspect that leads to success condition of Germany policy is the feed-in-tariff rate itself. It is obvious that Germany current feed-in-tariff rate is lower than Malaysia. A standard 2.21 MYR/kWh that is only 0.457 EUR/kWh is used as the feed – in – tariff rates in Germany while a 0.5041 MYR/kWh in Malaysia. The introduction of greenhouse gas (GHG) emission reduction credit demonstrates its impact in the proposed case analysis where it helps to rise the payback period of equity to compare with scenario 1 data.

Table 5 Financial indicators with GHG emission reduction credit in Scenario 2

Factors	GHG emission reduction credit (MYR/tCO2)				
	10	20	30	40	50
Internal Rate of Return (IRR) equity, (%)	14.8	15.8	15.9	16.4	16.9
Internal Rate of Return (IRR) asset, (%)	1.7	1.9	2.1	2.3	2.5
Simple payback (yr)	9	8.9	8.8	8.7	8.5
Simple payback equity (yr)	8.6	8.2	7.8	7.5	7.1
Net Present Value (NPV), (million MYR)	4.03	4.50	5.09	5.62	6.15
Benefit – Cost (B-C) ratio	1.38	1.43	1.48	1.53	1.58

It can be seen that the net present value and benefit-cost ratio are increasing with the increasing of the GHG emission reduction credit (Table 5). Also, at least 20 MYR/tCO2 is needed for the case to surpass the current case analysis for Malaysia that is represented by Scenario 1. In addition, in order to make Scenario 2 case a successful case similar to the Germany reference case, at least 50 MYR/tCO2 should be allocated for the GHG emission reduction credit. The net present value of the 50 MYR/tCO2 is estimated to able to surpass the NPV for the Germany reference. Therefore, Scenario 2 can be considered as the better option for Malaysia solar PV policy analysis when the modification is being applied.

4.2 Biomass power

4.2.1 CHP (combine heat and power) plant in Sweden

The second focus of the renewable energy resources is the biomass. The biomass technology is evaluated using a combine heat and power (CHP) analysis in RETScreen. An existing biomass power plant is chosen as the reference success case that is an 11.7MW power capacity located in Karlstad, Sweden. Some assumptions are made following the suitability of the cases.
The project life period is assumed to be 20 years based on the existing power plant in Sweden. The fuel cost escalation rate is set to be the same as the inflation rate while the project entitled for 10 years debt with 70% and 7% interest. Apart from the cost distribution for the case, a contingencies cost of 5% is also included in the cost parameter. For this case, an incentive is provided worth of 4 million euro. Sweden biomass power plant runs on using mix biomass of wood waste and peat coal. The CHP plant allocates 11.7MW electricity with 33.4MW of heating output. It used a boiler that has a pressure of 90 bar with steam flow of 50,600 kg/h and superheated at 510°C. The total cost for the power plant is approximated at 14 million euro.

4.2.2 Biomass plant in Malaysia

Kluang is chosen as the location for the proposed case. This is due to the existence of mass amount of biomass potential resources. The proposed case analysis runs based on the information of the existing biomass power plant in Malaysia that is Maju Intan Sdn Bhd biomass power plant project located in Teluk Intan, Perak.
The CHP plant allocates 12.5MW electricity with 10MW of heating output. It used a boiler that has a pressure of 43 bar with steam flow of 58,000 kg/h and superheated at 435°C. The total cost for the power plant is approximated at 88 million MYR. Some assumptions were made include the project life period is assumed to be 16 years based on the existing power plant in Malaysia. The fuel cost escalation rate is set to be the same as the inflation rate while the project entitled for 10 years debt with 70% and 8% interest. Apart from the cost distribution for the case, a contingencies cost of 5% is also included in the cost parameter. However, no incentives allocated for this analysis.
Malaysia policy evaluation for biomass analysis is proposed with two scenarios where it differs in fuel type operation. Scenario 1 suggested that the biopower plant is a mixture of biomass with the existing fossil fuel. The ratio of the biomass (palm oil waste) to the fossil fuel (coal) is set to be in 90:10. However, in scenario 2, it is suggested that the proposed biopower plant runs in 100 percent on palm oil waste biomass.

4.2.3 Comparison of Malaysian and Sweden cases

Table 6 is the output from the solar PV case analysis. The result shows in the financial analysis worksheet in RETScreen software. Some factors are taken into consideration in comparing the outputs for both countries. The internal rate of return (IRR), net present value (NPV), simple payback, and benefit-cost (B-C) ratio are some of the indicators that impacting the results.

Table 6. Comparison of data biomass analysis for all cases

Indicators	Malaysia (Scenario 1)	Malaysia (Scenario 2)	Sweden
Internal Rate of Return (IRR) equity, (%)	37.5	37.8	4328252.6
Internal Rate of Return (IRR) asset, (%)	11.8	11.9	6144.1
Simple payback (yr)	2.9	2.9	0
Simple payback equity (yr)	5	5	0
Net Present Value (NPV), (million MYR)	74.09	74.90	27 173.00
Benefit-Cost (B-C) ratio	3.79	3.82	1399.92

Table 4 shows the comparison data for the impacting indicators of both the cases. From the Table, it can be seen that all cases give positive values for all the indicators. The net present value (NPV) is also positive for all cases. On the other hand, the net present value for the reference case (Sweden) gives a big difference in compare to both proposed scenarios for Malaysia. Sweden case rose positive output as it immediately gains profit from its first production. This is due to the zero simple payback years. The comparison can be seen clearly where scenario 1 and scenario 2 need 2.9 year simple payback period whereas Swedish payback period ends immediately.
In addition, it is shown that scenario-2 case gives a significant difference in all parameters with compare to scenario 1 analysis. This comparison is important as it indicates that implementing scenario 2 for a future biomass combined heat and power (CHP) is more beneficial. A CHP plant that used 100 percent of fuel from biomass is more successful rather than a mix combined heat and power plant. This is supported by the data comparison of the benefit-cost ratio of both scenarios. The B-C ratio for scenario 2 is slightly higher than scenario 1 where the value is 3.82. Therefore, it can be said that the proposed scenario 2 is a better option for implementing biomass combined heat and power (CHP) plant in Malaysia.

Although, with the significant changes in numbers between scenario 1 and 2, Malaysia is still falls short a lot from Sweden in terms of success. The net present value for the reference case (Sweden) gives a big difference in value in compare to both proposed scenarios for Malaysia. One of the major factors is the investment support from the local authority. The Sweden reference case includes the incentives and grant that cost of 19.36 million MYR. This incentive is worth about 28 percent from the project initial cost. Sweden has not implying feed-in-tariff policy for biomass resources, instead incentives and grants are provided. Therefore, despite the project is obliged by the debt

agreement of 70 percent with 7 percent interest, this project can be considered a huge success due to the strong economic incentive.
On the other hand, there are no incentives nor grant involved in Malaysia biomass CHP case analysis. Malaysia has yet not provided any amount of incentives and grant allocated for biomass power plant. Nonetheless, a feed-in-tariff policy is embedded for biomass policy at the rate of 0.3868 MYR/kWh. This rate is eligible for a plant with capacity above 10MW including 20MW with 16 years embedment. From the comparison data, it can be said that although Malaysia current feed-in-tariff policy implementation gives out a significant success, it is still far behind from the successful energy production from biomass in Sweden.
Another impacting factor of successful condition in Sweden case is the initial cost of the production. From the analysis, it is noticeably observe that Sweden initial cost for a biomass combined heat and power (CHP) plant is much lower as compared to Malaysia. As a consequence, Malaysia biomass power plant project could be less interesting to the investors due to the high investment cost.
Sweden is also successfully reducing a high percentage of GHG emission for the biomass CHP plant (Table 7). This is possible due the policy implemented by the country that is carbon tax. Carbon pricing was first introduced in 1991 in Sweden that provided real incentives for renewables. Unfortunately, Malaysia has yet to introduce carbon tax policy. The tax incentives for Malaysia focuses only on the duty tax exemption in terms of materials and equipment replacement.

Table 7. GHG emission reduction of all cases

Cases	Base case GHG emission (ktCO2	Prosed case GHG emission (ktCO2)	Net annual GHG emission reduction (ktCO2)
Malaysia (Scenario 1)	225	207	17
Malaysia (Scenario 2)	279	214	64
Sweden	77	48	28

5. Conclusions

In order to achieve the renewable energy targets of 2020, Malaysia has undergone stages of improving productions in renewable energy by implementing improvised policies. Over the years, Malaysia has slowly transits from *Four Fuels policy* to Renewable Energy Act 2011. The renewable policies basically aimed to encourage the utilization of renewable energy sources such as solar, wind, biomass, and small hydro. Malaysia has utilized several policies promoting renewable energy. Application of feed-in-tariffs mechanism is the policy that was launched by SEDA Malaysia in 2011 under the 10th Malaysia Plan in order to support RE technologies until the grid parity occurs. Some other fiscal incentives are also added as an encouragement for the involvement in renewable energy production.

Resulting from the long term research, policies embedded to European countries have acted as the contributing factors to the success of the increasing use of renewable energy sources. There are three main support mechanisms employed by their governments to finance renewable energy development programs: feed-in-tariffs (FIT), tax incentives, and tradable green certificates. The feed-in-tariff is proved to be an efficient policy where most countries are able to achieve success. Taking all factors into consideration, the result shown the policies comparison between Malaysia and selected EU countries in solar PV and biomass that Malaysia is still behind in renewable energy production. The solar PV analysis shows that Malaysia could not surpass Germany net present value (NPV) worth with the existing FIT rate where Germany conquers a total of 42 percent in net present value (NPV) worth as compared to the Malaysia proposed cases of Scenario 1 and Scenario 2. One noticeable aspect that leads Germany success is the lower installation cost of the solar PV panels by approximate 5 Euro/W. Also, an adequate debt agreement helps to imply the lower installation cost.
In this paper, it is believed that Scenario 2 of the purposed case in Malaysia for solar PV is the better option provided that at least 50 MYR/tCO2 is allocated for GHG emission reduction credit. With this, the NPV of Malaysia is estimated to surpass the Germany (6,147,017 MYR) that is at 6,156,666 MYR.
The same pattern continued in biomass CHP analysis where once again Malaysia is far behind Sweden in most aspects. Sweden NPV is far ahead with compare to both Malaysia proposed cases. Sweden also tops the chart with

37.2 percent of total reduction of greenhouse gas (GHG) emission. Nevertheless, it is shown that the proposed case of Malaysia using 100 percent biomass as fuel for the power plant is a better option. Major contributing factor Sweden success is the investment from local authorities. Instead of feed-in-tariff policy like embedded by Malaysia for biomass, Sweden has taken different approach by providing incentive that worth about 28 percent from the project initial cost. Higher investment cost is one of the drawbacks of Malaysia biomass energy policy. As a consequence, Malaysia biomass power plant project could be less interesting to the investors. Another important key of biomass success is the greenhouse gas (GHG) emission reduction rate. Sweden shows remarkable result in reducing GHG emission with the support of carbon tax policy in which Malaysia has none. Nevertheless, the analysis made in this paper indicates that there is possibility of utilising and enhancing renewable energy sources in Malaysia.

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