IEA INTERNATIONAL ENERGY AGENCY

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in Malaysia 2018

Prepared by:

Sustainable Development Authority Malaysia

PHOTOVOLTAIC POWER SYSTEMS
TECHNOLOGY COLLABORATION PROGRAMME

Cover picture:

425kWp Rooftop Solar by Lean Lee Solar (M) Sdn Bhd in Bukit Mertajam, Penang

WHAT IS IEA PVPS TCP

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA carries out a comprehensive programme of energy cooperation among its 30 member countries and with the participation of the European Commission. The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the collaborative research and development agreements (technology collaboration programmes) within the IEA and was established in 1993. The mission of the programme is to "*enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems*."

In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas. This report has been prepared under Task 1, which deals with market and industry analysis, strategic research and facilitates the exchange and dissemination of information arising from the overall IEA PVPS Programme.

The IEA PVPS participating countries are Australia, Austria, Belgium, Canada, Chile, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Smart Electric Power Alliance (SEPA), the Solar Energy Industries Association and the Copper Alliance are also members.

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WHAT IS IEA PVPS task 1

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2018. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

Authors:

Writing: Wei-nee Chen, Tan Weng Han
Data: Sustainable Energy Development Authority (SEDA) Malaysia, Suruhanjaya Tenaga
Analysis: Nor Azaliza Damiri ; Nur Haziqah Binti Mohd Zaki

DISCLAIMER:

Data for non-IEA PVPS countries are provided by official contacts or experts in the relevant countries.
Data are valid at the date of publication and should be considered as estimates in several countries due to the publication date.

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, PV installations are included in the 2018 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2018, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

In May 2018, Malaysia witnessed a change of government for the first time. The new government demonstrated their commitment to reduce the country's carbon footprint by having an aspirational renewable energy target of 20% in the national installed capacity mix by 2025 and this target includes hydro of installed capacities up to 100 MW. Blessed by ample sunshine throughout the country, the estimated PV potential in Malaysia is 268,9 GW– of which ground mounted is around 210,2 GW[1], rooftop is 42,2 GW and floating is 16,5GW.

In 2018, the PV market in Malaysia is driven mainly by the Large Scale Solar (LSS) and Net Energy Metering (NEM) schemes. Although PV was introduced under the feed-in tariff (FiT) in 2012, by 2017, PV has exited from the FiT and organically progressed to LSS and NEM schemes. The FiT and NEM schemes are implemented by Sustainable Energy Development Authority (SEDA) Malaysia, whereas LSS is implemented by the Energy Commission (EC). There were two tranches of LSS carried out by EC through the open bidding exercise in 2016 and 2017, and the tender for the third tranche of LSS was floated in Q1 2019. Self-consumption (SELCO) and off grid PV, although minute, has also contributed to the PV capacity. The main actors involved in the grid-connected solar schemes are the Ministry of Energy, Science, Technology, Environment, and Climate Change (MESTECC), SEDA, the EC, the distribution licensees, PV developers, and service providers.

1.2 Total photovoltaic power installed

In 2018, the total new PV capacity added was 409,73MW. 26,74MW came under off-grid capacity; decentralized PV installation was 69,27MW with contribution by SELCO, lastly, the centralized capacity comprised of the FiT and LSS schemes and they amounted to 313,72MW. The cumulative PV capacity by end of 2018 is 739,74MW of which ground-mounted PV is 397,42 MW, followed closely by rooftop PV applications of 306,68 MW and off-grid PV at 35,64 MW.

[1] All PV capacities reported is AC-rated.

Table 1: Annual PV power installed during calendar year 2018.

		Installed PV capacity in 2018 [MW]	AC or DC
PV capacity	Off-grid	26,74	AC
	Decentralized	69,27	AC
	Centralized	313,72	AC
	Total	**409,73**	**AC**

Table 2: PV power installed during calendar year 2018.

			Installed PV capacity in 2018 [MW]	Installed PV capacity in 2018 [MW]	AC or DC
Grid-connected	BAPV	Residential	70,92	1,86	AC
		Commercial		17,67	AC
		Industrial		51,39	AC
	BIPV	Residential	1,57	0,91	AC
		Commercial		0,66	AC
		Industrial		-	-
	Utility-scale	Ground-mounted	310,50	310,50	AC
		Floating		-	-
		Agricultural		-	-
Off-grid		Residential	26,74	-	-
		Other		-	-
		Hybrid systems		-	-
Total			**409,73**		**AC**

Table 3: Data collection process.

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	AC value x 120%
Is the collection process done by an official body or a private company/Association?	Sustainable Energy Development Authority (SEDA) Malaysia
Link to official statistics (if this exists)	

Table 4: The cumulative installed PV power in 4 sub-markets.

Year	Off-grid [MW] (including large hybrids) (mandatory)	Grid-connected distributed [MW] (rooftop) (mandatory)	Grid-connected centralized [MW] (Ground Mounted) (mandatory)	Total [MW] (mandatory)
2012	1,00	10,46	15,83	27,29
2013	1,00	56,47	59,00	116,47
2014	1,00	90,75	79,00	170,75
2015	1,00	139,36	80,67	221,03
2016	1,00	197,98	86,92	285,9
2017	8,90	230,19	88,92	328,01
2018	35,64	302,68	399,42	737,74

Table 5: Other PV market information.

	2018 Numbers (optional)
Number of PV systems in operation in your country	Total: 840 systems (382,99 MW) Rooftop: 829 systems (72,49MW) Ground mounted: 11 systems (310,50MW)
Capacity of decommissioned PV systems during the year [MW]	None
Capacity of repowered PV systems during the year [MW]	None
Total capacity connected to the low voltage distribution grid [MW]	10,67 MW
Total capacity connected to the medium voltage distribution grid [MW]	143,32MW
Total capacity connected to the high voltage transmission grid [MW]	229,00 MW

Table 6: PV power and the broader national energy market.

	2017 numbers (mandatory)	2018 numbers (mandatory)
Total power generation capacities [GW]	33,31	33,59
Total renewable power generation capacities (including hydropower) [GW]	6,61	7,04
Total electricity demand [TWh]	146,520[e]	N/A
Total energy demand [ktoe]	62 848	
New power generation capacities installed in 2018 [GW]	N/A	
New renewable power generation capacities installed in 2018 (including hydropower) [GW]		0,41
Estimated total PV electricity production (including self-consumed PV electricity) in [GWh)	0,33*	0,431
Total PV electricity production as a % of total electricity consumption	0,23%	N/A

* National Energy Balance 2017 (draft)

1.3 Key enablers of PV development

From 2006 to 2010, PV development in Malaysia was driven by a United Nations Development Programme (UNDP) project jointly implemented with the Government of Malaysia. The project is the Malaysia Building Integrated Photovoltaic (MBIPV). The Project provided capital subsidies for installation of PV systems on buildings. This Project has successfully spawned the development of the Renewable Energy Act 2011 which saw the implementation of the FiT scheme. The FiT scheme provided further impetus to the growth of PV market. As the price of PV technologies decline, PV no longer requires the FiT for support and PV subsequently exited from the FT scheme in 2017.

The gigawatt-worth sunlight potential in Malaysia is mainly harvested through the utility-scale LSS scheme. The LSS contracts are offered through open bidding exercise to drive down the levelized cost of energy (LCOE).

Other than the LSS scheme, the Ministry enhances the existing NEM scheme such that the compensating rate for surplus solar electricity sold to the grid is higher than the current rate. Starting from 2019, NEM will be compensated on a “one-on-one” energy offset. This would mean that every 1kWh exported to the grid will be offset against 1 kWh consumed from the grid at the gazetted tariff.

In addition to the PV schemes, the other three key financial enablers are the Green Investment Tax Allowance (GITA), Green Income Tax Exemption (GITE), and Green Technology Financing Schemes (GTFS). These three value-added enablers are key considerations for the businesses when investing in green technology. Financing remains an important issue to address and domestic financial institutions are still in need of further capacity awareness in terms of perceived risks associated with investments in PV projects.

Table 7: Information on key enablers.

	Description (optional)	Total Volume (optional)	Source (optional)
Green Investment Tax Allowance (GITA)	Investment tax allowance of 100% of qualifying capital expenditure incurred on approved green technology assets or projects from the year of assessment 2013 until the year of assessment 2020.		http://www.mida.gov.my/home/tax-incentives-for-green-industry/posts/
Green Income Tax Exemption (GITE)	Income tax exemption of 100% of statutory income from the year of assessment 2013 until the year of assessment 2020.		http://www.mida.gov.my/home/tax-incentives-for-green-industry/posts/
Green Technology Financing Scheme (GTFS)	GTFS is a financing scheme offered to investors which is supported by the government offering a 2% p.a. interest/profit rate subsidy for the first seven years and 60% government guarantee of green component cost to financial institutions.	RM 2 billion	https://www.gtfs.my/

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 8: Typical module prices for a number of years.

Year	Lowest price of a standard module crystalline silicon (optional)	Highest price of a standard module crystalline silicon (optional)	Typical price of a standard module crystalline silicon (mandatory) [USD/W]
2015	NA		0,5
2016			0,4
2017			0,35
2018			0,29

2.2 System prices

Table 9: Turnkey PV system prices of different typical PV systems.

Category/Size	Typical applications and brief details	Current prices [MYR/W]
Off-grid 1-5 kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid.	NA
Residential 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes.	6,00
Small commercial 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	5,50
Large commercial 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	4,00
Industrial >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	3,60
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	2,95
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	2,85

Table 10: National trends in system prices for different applications

Year	Residential Grid-connected, roof-mounted, distributed PV system 5-10 kW **[MYR/W] (mandatory)**	Small commercial Grid-connected, roof-mounted, distributed PV systems 10-100 kW **[MYR/W] (mandatory**	Large commercial Grid-connected, roof-mounted, distributed PV systems 100-250 kW **[MYR/W] (mandatory**	Small centralized PV Grid-connected, ground-mounted, centralized PV systems 10-20 MW **[MYR/W] (mandatory)**
2015	8,70	8,11	NA	
2016	7,83	7,61		
2017	7,98	6,40		
2018	6,00	5,50	4,00	2,95

2.3 Cost breakdown of PV installations

The cost breakdown of a typical 5-10 kW roof-mounted, grid-connect, distributed PV system on a residential single-family house and a typical >10 MW Grid-connected, ground-mounted, centralized PV systems at the end of 2018 are presented in Table 11 and

Table 12, respectively.

The cost structure presented is from the customer's point of view. It does not reflect the installer companies' overall costs and revenues. The “average” category in Table 11 and

Table 12 represent the average cost for each cost category and is the average of the typical cost structure. The average cost is taking the whole system into account and summarizes the average end price to customer. The “low” and “high” categories are the lowest and highest cost that has been reported within each segment. These costs are individual posts, i.e. summarizing these costs do not give an accurate system price.

The figures provided are averages of a range of data provided by system integrators (including the soft costs). Median values were derived from the data to best reflect the market’s acceptable prices.

Table 11: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-10 kW.

Cost category	Average [MYR/W]	Low [currency/W]	High [currency/W]
Hardware			
Module	2,70		
Inverter	0,90		
Mounting material			
Other electronics (cables, etc.) Balance of System, and Interconnection	1,80 + 0,60 = 2,40		
Subtotal Hardware	**6,00***		
Soft costs (included in hardware cost)			
Planning			
Installation work			
Shipping and travel expenses to customer			
Permits and commissioning (i.e. cost for electrician, etc.)			
Project margin			
Subtotal Soft costs			
Total (excluding VAT)			
Average VAT			
Total (including VAT)			

*soft cost is already embedded in the hardware component

Note: Currency Conversion, US$1 = MYR4.1385 (31 Dec 2018, http://www.bnm.gov.my).

Table 12: Cost breakdown for a grid-connected, ground-mounted, centralized PV systems of >10 MW.

Cost category	Average [MYR/W]	Low [currency/W]	High [currency/W]
Hardware			
Module	1,38		
Inverter	1,03		
Mounting material			
Other electronics (cables, etc.) Balance of System, and Interconnection	0,86 + 0,17 = 1,03		
Subtotal Hardware	**3,44***		
Soft costs (included in hardware cost)			
Planning			
Installation work			
Shipping and travel expenses to customer			
Permits and commissioning (i.e. cost for electrician, etc.)			
Project margin			
Subtotal Soft costs			
Total (excluding VAT)			
Average VAT			
Total (including VAT)			

*soft cost has been embedded in the hardware component

Note: Currency Conversion, US$1 = MYR4.1385 (31 Dec 2018, http://www.bnm.gov.my).

2.4 Financial Parameters and specific financing programs

There is no special financing for PV projects as PV is still relatively new to most financial institutions. Financing is usually offered on a personal loan package or on the ability of the borrower to pay, not on the merit of the project. This also applies to the larger projects (more than 250kW). However, large scale solar projects (> 30 MW) will typically have access to capital market. Malaysia, being home to the world's largest sukuk market, has pioneered the issuance of green sukuk since 2017. By 2018, Malaysia has issued four green sukuk for large scale solar projects.

Table 13: PV financing information in 2018.

Different market segments	Loan rate [%]
Average rate of loans – residential installations	3.8-5%*
Average rate of loans – commercial installations	7-9%
Average cost of capital – industrial and ground-mounted installations	

*Based on personal loan

** Based on corporate loan

2.5 Specific investments programs

Table 14: Summary of existing investment schemes.

Investment Schemes	Introduced in country (mandatory)
Third party ownership (no investment)	Yes
Renting	No
Leasing	Yes
Financing through utilities	No
Investment in PV plants against free electricity	No
Crowd funding (investment in PV plants)	No
Community solar	No
International organization financing	No
Green Sukuk (Green Islamic Bonds)	Yes

2.6 Additional Country information

Table 15: Country information.

<table>
<tr><td>Retail electricity prices for a household [currency/W] (mandatory) – Peninsular Malaysia</td><td colspan="4">Residential tariff:
https://www.tnb.com.my/residential/pricing-tariffs

Commercial and industrial tariff:
https://www.tnb.com.my/commercial-industrial/pricing-tariffs1/</td></tr>
<tr><td>Retail electricity prices for a commercial company [currency/W] (mandatory) - Sabah</td><td colspan="4">Please refer to:
https://www.sesb.com.my/?q=content/domestic-tariff</td></tr>
<tr><td>Retail electricity prices for an industrial company [currency/W] (optional) - Sarawak</td><td colspan="4">Please refer to:
https://www.sarawakenergy.com/customers/tariffs</td></tr>
<tr><td>Population at the end of 2018 (mandatory)</td><td colspan="4">32,38 million estimates</td></tr>
<tr><td>Country size [km^2] (mandatory)</td><td colspan="4">330 621</td></tr>
<tr><td>Average PV yield in [kWh/kW] (mandatory)</td><td colspan="4">(average and range) 1 314kWh (15%)</td></tr>
<tr><td rowspan="4">Name and market share of major electric utilities (optional)</td><td></td><td>Electricity production in 2017[2] [%]</td><td>Share of grid Subscribers [%]</td><td>Number of retail customers in 2017 [%]</td></tr>
<tr><td>Tenaga Nasional Berhad</td><td>79,1%
123
170,39 GWh</td><td rowspan="3">NA</td><td>87,5%
8 796 165</td></tr>
<tr><td>Sabah Electricity Sdn Bhd</td><td>3,8%
5 979,99 GWh</td><td>5,9%
593 158</td></tr>
<tr><td>Sarawak Electricity Berhad</td><td>17,1%
26 583,57 GWh</td><td>6,6%
659 189</td></tr>
</table>

[2] https://meih.st.gov.my/

3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing or simplifying or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

Table 16: Summary of PV support measures.

	On-going measures in 2018 – Residential	Measures introduced in 2018 – Residential	On-going measures in 2018 – Commercial + Industrial	Measures introduced in 2018 – Commercial + Industrial	On-going measures in 2018 – Centralized	Measures introduced in 2018 – Centralized
Feed-in tariffs*	Expired	-	Expired	-	No	-
Feed-in premium (above market price)	-	-	-	-	-	-
Capital subsidies	-	-	-	-	-	-
Green certificates	-		-	-	-	Nascent Voluntary REC market
Renewable portfolio standards (RPS) with/without PV requirements	-	-	-	-	-	-
Income tax credits	-	-	-	-	-	-
Self-consumption	-	-	-	-	-	-
Net-metering**	Yes	-	Yes	-	Yes	-
Net-billing**	Yes	-	Yes	-	Yes	-
Collective self-consumption and virtual net-metering	-	-	-	-	-	-
Commercial bank activities e.g. green mortgages promoting PV	-	-	-	-	-	-
Activities of electricity utility businesses	-	-	-	-	-	-
Sustainable building requirements	-	-	-	-	-	-
BIPV incentives	-	-	-	-	-	-
Other (specify)	-	-	-	-	-	-

*PV under the Feed-in-tariff (FiT) has exited in 2017

**NEM was introduced in 2016 with net billing concept and in 2018, MESTECC announced payment of the surplus will be compensated on a one-to-one basis with the retail rate (net energy metering).

3.1 National targets for PV

In achieving the aspirational goal of having 20% renewable energy in the country's national installed capacity mix by 2025, the major renewable resource that will contribute to the RE mix is solar energy. This is in line with the sharp declining price of PV technologies that will drive PV towards grid parity with fossil fuel generated electricity. PV agenda can be driven by additional LSS auctions, solar rooftop schemes, and further accelerated by reform of electricity industry and market. SEDA has been tasked by MESTECC to develop a Renewable Energy Transition Roadmap (RETR) 2035 which is due for completion by end of 2019. The roadmap will provide strategies and action plans to achieve the 20% aspirational RE target by 2025 and the various RE scenarios in 2035.

3.2 Direct support policies for PV installations

3.2.1 Description of support measures

Direct policies for PV installations in 2018 are the large scale solar (LSS), net energy metering (NEM) and self-consumption (SELCO) for rooftops PV applications. SELCO does not allow export of excess solar electricity while NEM allows export of excess solar electricity.

3.2.2 BIPV development measures

BIPV was introduced under the FiT by providing bonus for PV installations which qualify for such applications. Outside of the FiT, most rooftop PV applications are retrofitted due to ease of installation.

3.3 Self-consumption measures

In Malaysia, the SELCO scheme would require a private generating licence if the system size is over 72 kW as mandated by the Energy Supply Act. Currently, the largest licensed SELCO application in Malaysia is 13,74 MW. The estimated total SELCO capacity in Malaysia as at end of 2018 is 60 MW. Besides the SELCO, NEM also allows for self-consumption but the excess is permitted to export to the grid. The NEM capacity as at end of 2018 is 10 MW. Table 17 provides a summary of self-consumption for both the SELCO and NEM schemes.

Table 17: Summary of self-consumption regulations for small private PV systems in 2018.

PV self-consumption	1	Right to self-consume	√
	2	Revenues from self-consumed PV	√
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	√
	5	Maximum timeframe for compensation of fluxes	√ (saving can be carry forward up to 24 months)
	6	Geographical compensation (virtual self-consumption or metering)	
Other characteristics	7	Regulatory scheme duration	
	8	Third party ownership accepted	√ (NEM leasing)
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	
	10	Regulations on enablers of self-consumption (storage, DSM…)	√ (NEM/SELCO guidelines)
	11	PV system size limitations	√
	12	Electricity system limitations	√
	13	Additional features	

3.4 Registered PV Investors

At the end of 2018, the Minister of MESTECC[3] also announced that SEDA will be creating a directory to recognize PV investors who will provide leasing or PPA services to customers. Foreign PV investors are allowed but only for PV projects of above 250kW with the following requirements:

- Companies must be incorporated locally;
- Companies must have minimum paid-up capital of at least RM10 million;
- Companies are required to have 100% local Engineering, Procurement and Construction (EPC) and EPC contractors must be locally sourced by engaging local PV service providers;
- In terms of operations, a minimum of 80% local employment is required.

The directory[4] operated by SEDA is open for registration on 1st January 2019.

3.5 Collective self-consumption, community solar and similar measures

In Malaysia, the electricity market is still highly regulated although it is currently in the progress of undergoing electricity industry and market reform. A task given to a special agency called MyPower by the Minister of MESTECC which was announced in September 2018[5]. MyPower has been given 36 months to implement the reform of the electricity industry and market. As such, community solar or virtual net metering schemes are not in place yet although the Government is mulling on a pilot run of a peer-to-peer energy trading among solar prosumers and electricity consumers [6] by early 2020.

3.6 Tenders, auctions & similar schemes

After witnessing the success of LSS 1 and 2 in driving down the bid price (lowest bid was 33,98 RM cent per kWh in LSS 2, down from 39 RM cent per kWh in LSS 1), the Ministry has announced in 2018 that 500MW of capacity will be offered in 2019 through competitive bidding for the LSS 3, which the value of the contracts could be as much as RM 2 billion. The EC is the implementor of the LSS scheme. Joint venture is allowed with the foreign ownership capped at 49%. Capable developers could bid up to 100MW instead of the previous 30MW in LSS2 and 50 MW in LSS1. This is to allow project developers to access capital market for lower cost of financing, and therefore should drive towards grid parity.

3.7 Other utility-scale measures including floating and agricultural PV

As at end of 2018, there were two floating PV projects that are in commercial operation (270 kWp and 108 kWp). In the pipeline, there are 2 floating PV projects under LSS to be commissioned by 2020. Both have capacity of 30 MW each. In LSS 3, technical and financial capabilities of floating solar PV developers will be evaluated. In Malaysia, it is found that the

[3] http://mrem.bernama.com/viewsm.php?idm=33295

[4] http://www.seda.gov.my/directory/2019-registered-solar-pv-investor-rpvi-directory/

[5] https://www.nst.com.my/business/2018/09/412549/electricity-industry-undergo-transformation-mesi-20

[66] https://www.pv-magazine.com/2019/03/22/malaysia-mulls-p2p-energy-trading-and-renewable-energy-certificates/

suitable water area for PV installation is about 2 944km^2, this translates to a technical potential of 16,5GW.

3.8 Social Policies

In 2017, the government has launched a specialized social programme called 'MySuria' to enable those in the B40 (below 40%) income group to benefit from the government support by having a 3 kWp system installed on their homes. The capital expenditure was borne by the government and applicants can earn an average FiT income of RM250/month for a period of 10 years. However, this initiative has been discontinued in 2018 and the total houses installed was 322.

3.9 Retrospective measures applied to PV

None

3.10 Indirect policy issues

3.10.1 Rural electrification measures

The government continues to champion programmes to electrify rural areas with the use of solar PV and hybrid systems. The two main ministries involved are the Ministry of Rural and Regional Development and the Ministry of Education. In Sarawak, the effort is championed by Sarawak Energy Berhad which implements the Sarawak Alternative Rural Electrification Scheme (SARES) programme[7]. SARES aims to provide 24-hour electricity to over 40 000 rural villagers in 8 700 households by 2020. The RM500 million project commenced in 2016 and by the end of 2018, 90 villages are powered up under SARES with another 210 villages by 2020.

3.10.2 Support for electricity storage and demand response measures

There is no support for both energy storage systems and demand response measures. Under the RETR 2035, energy storage is important to provide energy balancing to address the intermittency of solar energy. Beside promoting renewable energy, MESTECC is drafting the Energy Efficiency and Conservation Act (EECA) which should be due for completion by 2020. Under energy efficiency, there is a target to achieve 8% electricity savings by 2025.

3.10.3 Support for electric vehicles (and VIPV)

In December 2018, Malaysia launched its first solar-powered electric vehicle (EV) charging station along the North-South Expressway[8]. This is the result of the collaborative project between PLUS Malaysia Bhd, Malaysian Green Technology Corporation (MGTC), and United Nations Industrial Development Organization (UNIDO). There will be four more PV-powered EV charging stations installed along the North-South Expressway by 2020. As of May 2019,

[7] https://www.sarawakenergy.com/media-info/media-releases/2018/sares-initiative-gets-global-recognition

[8] https://www.thestar.com.my/metro/metro-news/2018/12/19/solarpowered-electric-vehicle-charging-stations-on-highway/

there are 251 public EV charges in Malaysia[9], the number of EVs that are in Malaysia as at end of 2017 is less than 1000[10].

3.10.4 Curtailment policies

Not applicable.

3.10.5 Other support measures

None.

3.11 Financing and cost of support measures

The FiT scheme is supported by the Renewable Energy (RE) fund contributed by electricity consumers of TNB, SESB and NUR Distribution Sdn Bhd. Consumers with electricity consumption of more than 300 kWh per month are obliged to contribute additional charge of 1,6% of their electricity bill to the RE fund. The RE fund is managed by SEDA to support the renewable energy developers who invest in PV, small hydro, biomass, and biogas resources to generate electricity. The NEM and LSS schemes are supported by a passthrough mechanism to the consumer tariffs.

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

Malaysia earned her place as one of the significant PV manufacturers in the world since 2007 when First Solar set up their cadmium telluride PV manufacturing plant in Kulim, Kedah. Since then other renowned international PV brands such as Sunpower, Hanwha Q Cells, and China's LONGI, JA Solar and Jinko Solar have established Malaysia as their manufacturing base. Hence, it is not a surprise when Malaysia emerged an an international hub for the manufacture of solar photovoltaic (PV) cells, wafers and modules [11].

Table 18: Silicon feedstock, ingot and wafer producer's production information for 2018.

Manufacturers (or total national production)	Process & technology	Total Production	Product destination (if known)	Price (if known)
OCIM Sdn Bhd (Poly-Si)	Silicon feedstock [Tonnes]	20 kilo tonnes	NA	
LONGi (Kuching) Sdn Bhd (ingot)	sc-Si ingots [MW]	1100		
LONGi (Kuching) Sdn Bhd (wafer, P-type mono)	P-type mono wafers [MW]	1000		

[9] https://www.chargev.my/

[10] https://www.greentechmalaysia.my/media/MGTC%20AR17_FINAL%20DRAFT.pdf

[1111] https://solarmagazine.com/solar-profiles/malaysia/#Behind-the-meter_solar_energy_incentives_in_Malaysia

4.2 Production of photovoltaic cells and modules (including TF and CPV)

Total PV cell and module manufacture together with production capacity information is summarised in Table below.

Table 19: PV cell and module production and production capacity information for 2018.

Cell/Module manufacturer (or total national production)	Technology (sc-Si, mc-Si, a-Si, CdTe, CIGS)	Nameplate Capacity [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
SunPower	sc-Si	760		NA	
Hanwha Q CELLS	mc-Si	1800			
Jinko Solar	mc-Si	2200	1400		
Longi	sc-Si	800	900		
JA Solar	mc-Si	1100			
Thin film manufacturers					
First Solar	CdTe		2227	NA	
Flextronics (OEM for crystalline)			450		
Panasonic (HIT N-type)	sc-Si		450		
Totals		**6660**	**5427**		

4.3 Manufacturers and suppliers of other components

NA

5 PV IN THE ECONOMY

5.1 Labour places

Table 20: Estimated PV-related full-time labour places in 2018

Market category	Number of full-time labour places
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	21 940
Distributors of PV products	7 626
System and installation companies	

5.2 Business value

Table 21: Rough estimation of the value of the PV business in 2018 (VAT is excluded).

Sub-market	Capacity installed in 2018 [MW]	Average price [MYR/W]	Value [MYR]	Sub-market [MYR]
Off-grid	26,4	NA		
Grid-connected distributed	69,27	6,00	415 620 000	415 620 000
Grid-connected centralized	313,72	3,44	1 069 785 200	1 069 785 200
Value of PV business in 2018				1 485 405 200

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

In Malaysia, the electricity market is split into three main regions:

Peninsular Malaysia

- Vertically integrated with the majority share taken by Tenaga Nasional Berhad (TNB).
- Liberalised generation (largely due to the FiT and LSS programmes and the resulting Power Purchase Agreements (PPAs) signed.
- Retail and transmission under TNB control, with the possible exploration into opening up of the retail segment.
- Regulated by the Energy Commission of Malaysia (EC).

Sarawak

- Sarawak Energy Berhad was delisted in 2011 and is now under 100% control by the Sarawak State Government. This was decided so that SEB could better be aligned to state goals and aspirations in terms of expansion support from foreign direct investment (FDI) for the energy industry.
- Retail users / consumers enjoy the same rates, however the cost of operating the network differs significantly due to the size of Sarawak. (Sarawak is almost the size of Peninsula Malaysia and its population spread out).
- Presently there are no plans to liberalise generation, transmission or retail of SEB.

Sabah

- Sabah Energy Sdn. Bhd. (SESB) was formed in 1998 and is a wholly owned subsidiary of TNB (80%) with the remainder (20%) owned by Sabah State Government.
- SESB is vertically integrated (generation, transmission and distribution) servicing the state of Sabah and the Federal Territory of Labuan.

6.2 Interest from electricity utility businesses

Supply Agreement for Renewable Energy (SARE)

Since 2018, there was a growth of behind-the-meter (BTM) PV businesses whereby PV investors will provide leasing or PPA services to customers who do not wish to go for an outright purchase option. Under the leasing or PPA model, counterparty risks exist when customers do not pay to the PV investors. The national utility, Tenaga Nasional Berhad (TNB) as at end of 2018[12] came up with an innovative package to provide billing, collection and remittance services to PV investors by including the billing of the PV investors in their monthly electricity bills. In doing so, counterparty risks due to customers not paying to the PV investors are reduced. Additionally, SARE provides deed of assignments to allow the payment collected from customers to be channelled to financial institutions that financed the PV investors' projects. In return, TNB charges a small fee for the services provided under the SARE. Under the SARE, TNB, the PV investor and the customer entered into a tripartite agreement and with TNB on board, the project is attractive to the financial institutions as the PPA is bankable and this is helpful for the small medium enterprises/industries (SMEs and SMIs).

[12] https://www.theedgemarkets.com/article/going-green-better-returns-solar-investments-expected

6.3 Interest from municipalities and local governments

The Petaling Jaya City Council, a local authority in the Selangor state currently offers tax rebate for the public who installs PV systems on their premises. The tax rebate covers five green aspects – energy (maximum rebate of 40%), water (40%), waste (40%), transportation (30%) and biodiversity (30%). The maximum rebate awarded under this scheme is 100% or RM500, whichever is lower for an individual house[13]. The aim of this initiative is to encourage the residents of the municipality to "go green". Presently, the other local councils are still focused on recycling, river cleaning and tree-planting initiatives. Government has also led by examples on PV installations. In 2018, the State Government of Selangor installed 50 kW in one of their affordable housing projects[14].

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

The tender for LSS 3 which has allocation of 500 MW will be floated in February 2019 and the call for tender will close by August 2019. This LSS is for projects achieving commercial operation between 2020 and 2021.

The reintroduction of the new NEM scheme in 2019 which operates on the true net energy metering mechanism rather than the previous net billing concept will be one of the PV highlights in 2019.

The Renewable Energy Transition Roadmap (2035) will be concluded by end of 2019 and the outcome of the roadmap will be included in the 12th Malaysia Plan (2021 to 2025). This roadmap will help chart the RE towards achieving 20% in the national installed capacity mix by 2025.

7.2 Prospects

NA

[13] https://www.thestar.com.my/metro/metro-news/2018/01/15/pj-folk-commit-to-eco-culture-more-neighbourhoods-adopt-green-practices-with-mbpjs-rebate-as-added-b/

[14] https://www.thestar.com.my/metro/metro-news/2018/04/28/smart-initiative-helps-reduce-electricity-bill-rm300000-spent-on-installing-solar-panels-in-rumah-se/