IEA INTERNATIONAL ENERGY AGENCY

National Survey Report of PV Power Applications in MALAYSIA

2017

PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

Prepared by

Sustainable Energy Development Authority Malaysia

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Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its member countries

The IEA Photovoltaic Power Systems Technology Collaboration Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The participating countries and organisations can be found on the www.iea-pvps.org website.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org

Cover picture: 700kWp Self Consumption Setia Aquatic Centre, Penang Island

Introduction

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 2017. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

1. INSTALLATION DATA

The PV power system 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 2017 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2017, although commissioning may have taken place at a later date.**

1.1. Applications for Photovoltaics

Since 2012, the PV market growth has been driven by the Feed-in Tariff (FiT) which has since come to a close in 2017. The concentration of FiT installations in 2017 were on residential rooftops with capacitites less than or equal to 12kWp, the majority in terms of interest and applicants were however located within the Klang Valley of Peninsular Malaysia.

Net Energy Metering (NEM) and Self Consumption (SELCO) have followed suit riding on the momentum of the FiT programme. SELCO has had more success as SELCO documentation and compliance is rather "straight forward" without the added element of selling excess electricity back to a distribution licensee as seen in the NEM scheme. The additional steps in the application or implementation process tend to dampen the adoption rate. SELCO data is at best estimated as installations less than 72kW and they are not required to be licensed by the Energy Commission. At this stage, the NEM Programme has yet to achieve an inroad into the market with a 5% uptake since its introduction in November 2016.

Meanwhile Large Scale Solar (LSS) projects have caught the attention of the Malaysian public as "the next big thing" in Renewable Energy (RE). Two such exercises have been conducted by the Energy Commission of Malaysia (EC) via an open bidding concept. This has also caught the attention of foreign participants who are now entering this particular segment of the market.

In 2017, the main actors involved in the FiT, LSS and NEM are the Ministry of Energy, Green Technology and Water, the Sustainable Energy Development Authority (SEDA) Malaysia, the Energy Commission (EC), the Distribution Licensees, RE developers, and the PV service providers. However, with the launch of the LSS 2 programme, foreign Engineering Procurement and Construction (EPC) companies have made their presence felt.

LSS projects are required to comply with the Distribution Code for Peninsular Malaysia, Sabah and the Federal Territory Labuan, Grid Code for Peninsular Malaysia and Guidelines on Large Scale Solar Photovoltaic Plant for Connection to Electricity Networks.

1.2.Total photovoltaic power installed

By the year 2017, a total of 11.913 applications for PV under the FiT were approved with a total capacity of 440,3434 MW. The breakdown of approved applications is as follows: individuals (10.747 applications 98,5792 MW), community (478 applications 11,5967 MW), and non-individuals (688 applications 330,1675 MW). As at 31 December 2017, a **cumulative installed capacity of 354,03** MW of PV projects under the FiT programme were operational. More information on PV quota, FiT rates and operational capacity can be viewed at www.seda.gov.my.

Table 1: PV Power Installed During Calendar Year 2017

			MW installed in 2017	**MW installed in 2017**	**AC or DC**
Grid connected	BAPV	up to 12kW	26,0124 (FiT) 1,781 (NEM) 1,659(SELCO)	13,5377 0,329 (NEM) 0,213 (SELCO)	DC
		up to 425kW		12,4747 1,452 (NEM) 1,446 (SELCO)	DC
		up to 1MW		0	DC
	BIPV (if a specific legislation exists)	up to 12kW	5,5745 (FiT)	1,0029	DC
		up to 425kW		2,5716	DC
		up to 1MW		2,0000	DC
	Utility-scale	Ground-mounted	14,43 (LSS)	14,43	DC
		Floating	-		
		Agricultural	-		
Off-grid		Residential (SHS)	-		
		Other			
		Hybrid systems	10,5	10,5	DC
		Total	59,9569		

Table 2: Data collection process:

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	-
Is the collection process done by an official body or a private company/Association?	Data jointly collected by the Malaysian Photovoltaic Industry Association (MPIA) and the Sustainable Energy Development Authority (SEDA) Malaysia
Link to official statistics (if this exists)	https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=dDM2enNvM09oTGtQemZPVzRTWENmZz09
Exchange rate of USD1.00 = RM4.06 as at 27th December 2017	http://www.bnm.gov.my/index.php?ch=statistic&task=converter

Table 3: PV power and the broader national energy market

MW-GW for capacities and GWh-TWh for energy	**2017 numbers**	**2016 numbers**
Total power generation capacities (all technologies)	N/A	32. 871 MW
Total power generation capacities (renewables including hydropower)	N/A	6 599 MW
Total electricity demand (= consumption)	N/A	144 TWh
Total energy demand (= final consumption)	N/A	57.219 ktoe
New power generation capacities installed during the year (all technologies)	N/A	NA
New power generation capacities installed during the year (renewables including hydropower)	N/A	NA
Total PV electricity production in GWh-TWh under FiT	N/A	~324 GWh*
Total PV electricity production as a % of total electricity consumption	-	0,225%
***Figures shown above are based only on data extracted for generation of PV electricity under the-FiT (extracted on 31 May 2018 for year 2016**		

Table 4: Other information

	2017 Numbers
Number of PV systems in operation in your country	FIT: Up to 12kW : 1.614 systems (14,5406 MW) NEM: Up to 12kW : 62 systems (0,329 MW) SELCO: Up to 12kW : 71 systems (0,213 MW) FiT: Up to 425kW : 92 systems (15,0463 MW) NEM: > 12 kW Up to 425 kW: 17 systems (1,452 MW) SELCO: > 12 kW Up to 425 kW: 7 systems (0,946MW) FIT Up to 1MW : 2 systems (2,000 MW) SELCO: Up to 1MW : 1 system (0,500 MW) LSS Above 1 MW: 2 systems (14,43 MW) Off Grid Above 1MW: 3 systems (10,5 MW) Total FiT: 1.708 systems (31,5869 MW) Total NEM: 79 systems (1,781 MW) Total SELCO: 79 (1,659 MW) Total LSS: 2 systems (14,43 MW) Total Off Grid: 3 Systems (10,5 MW) **TOTAL: 1.871 systems (59,9569 MW)**
Capacity of decommissioned PV systems during the year in MW	-
Total capacity connected to the low voltage distribution grid in MW	1.863 systems (32,5269 MW)
Total capacity connected to the medium voltage distribution grid in MW	5 systems (16,93 MW)
Total capacity connected to the high voltage transmission grid in MW	None

Table 5: The cumulative installed PV power in 4 sub-markets (MWp)

Sub-market	Off-grid (including large hybrids)	Stand-alone non-domestic	Grid-connected distributed	Grid-connected centralized
Prior 2013	N/A	N/A	31,5437	Nil
2013			107,0118	
2014			65,1457	
2015			60,3458	
2016			77,6171*	
2017	10,5		49,4569*	
TOTAL MW			**401,621**	

***Figures shown above are based on data extracted from e-FiT on 31 May 2018, and thus they may not necessarily reflect the figures reported in the NSR from previous years.**

Data collected from the (MPIA) industry and official reports also differ at present, as industry engagement for SELCO projects may not have been accounted for previously.

1.3.Key Enablers of PV Development

Apart from the current FiT, NEM and SELCO programmes, the two (2) key enablers have been the Green Investment Tax Allowance (GITA) and the Green Income Tax Exemption (GITE). These two elements have now become a "standard feature" when a person intends to install solar PV. 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 solar PV projects.

2. COMPETITIVENESS OF PV ELECTRICITY

2.1.Module prices

Figures provided are for foreign imports with a modest contribution from local manufacturing in way of price impact on the majority of data collected.

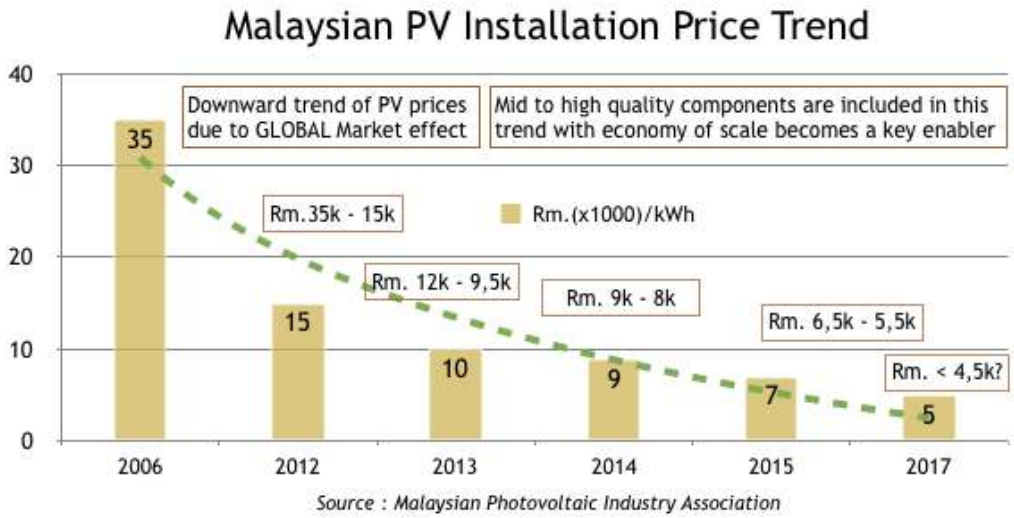
Table 6: Typical module prices for a number of years

Year	2010	2011	2012	2013	2014	2015	2016	2017
Standard module crystalline silicon price(s): Typical (RM/W)	8,06	5,8	6,0	6,0	3,0	3,07	2,56	1,42
Lowest prices	Data unavailable				2,00	2,13	2,47	1,34
Highest prices	Data unavailable					4,80	2,67	1,54

2.2.System prices

Malaysia continues to directly benefit from global prices for modules, inverters, mounting structures as well as Balance of System components. This is often an understated but crucial point to note as this phenomenon allows Malaysian installations to remain reasonably competitive despite being an emergent PV market.

Table 7: Turnkey Prices of Typical Applications – local currency



Category/Size	Typical applications and brief details	Current prices RM per W
OFF-GRID Up to 1 kW (SHS)	This is with reference to 1-2kWp systems with 2-3 lights only with mobile phone charging capability.	7,5 - 8,0*
OFF-GRID > MW scale	**Does NOT take into account logistics involved to transport equipment. In some cases the cost of logistics MAY exceed that of the equipment.*	25- 35*
Grid-connected Rooftop up to 5-10 kW (residential BAPV)	This would represent the bulk of the FiT installations	5,5 - 6,0
Grid-connected Rooftop from 10 to 250 kW (commercial BAPV)	With the advent of the SELCO & NEM, these systems take up rate should improve	4,5 - 5,5
Grid-connected Rooftop above 250kW (industrial BAPV)	With the advent of the SELCO & NEM, these systems take up rate should improve	3,7 to 4,5
Grid-connected Ground-mounted above 10 MW	While commercially the most attractive, implementors still require commercial and technical upgrading to undertake such development	3,5 - 4,4
Other category (hybrid diesel-PV, hybrid with battery…)	*Does NOT take into account logistics involved to transport equipment. In some cases the cost of logistics MAY exceed that of the equipment. Centralised hybrid systems have been the focus in recent times vs multiple stand-alone systems	15 - 25*
Floating PV	No definitive cost currently available	NA
Agricultural PV	Water pumps and lighting most common application, although electrified fences have also been	7,5 - 8,0

	deployed	
Residential BIPV (tiles, or complete roof).	This would represent the bulk of the FiT installations	6,5- 7,5
Industrial BIPV	Similar considerations as roof tops with SELCO & NEM as the main drivers	5,0- 6,0

2.3. Cost breakdown of PV installations

The figures provided are averages of a range of data provide by system integrators. Median values were derived from members of the MPIA to best reflect market acceptable prices. Manufacturer quality, country of origin are only reflected in the categories provided. The categories in the tables below better represent application and size. Overly aggressive prices (20% less than the reported figures here) were omitted as they would skew representation from the majority.

2.3.1 Residential PV System < 1-12 kWp

Table 8: Cost breakdown for a residential PV system – local currency

Cost category	Average (RM/W)	Low (RM/W)	High (RM/W)
Hardware			
Module	1,60	1,40	2,40
Inverter	0,60	0,40	0,80
Other (racking, wiring…)	0,60	0,50	0,70
Soft costs			
Installation	0,40	0,30	0,50
Customer Acquisition	0,50	0,50	0,50
Profit	0,60	0,60	0,70
Other (permitting, contracting, financing…)	0,40	0,40	0,40
Subtotal Hardware	**2,80**	**2,30**	**3,90**
Subtotal Soft costs	**1,90**	**1,80**	**2,10**
Total	**4,70**	**4,10**	**6,00**

2.3.2 Cost range for System Size 13 kWp - 250kWp

Table 9: Cost breakdown for a commercial PV system – local currency

Cost category	Average (RM/W)	Low (RM/W)	High (RM/W)
Hardware			
Module	1,50	1,30	2,30
Inverter	0,50	0,40	0,70
Other (racking, wiring…)	0,50	0,40	0,60
Soft costs			
Installation	0,40	0,30	0,50
Customer Acquisition	0,50	0,50	0,50

Profit	0,60	0,60	0,70
Other (permitting, contracting, financing…)	0,40	0,40	0,40
Subtotal Hardware	**2,50**	**2,10**	**3,60**
Subtotal Soft costs	**1,90**	**1,80**	**2,10**
Total	**4,40**	**3,90**	**5,70**

2.3.3 Cost range for System Size 0,250 MWp - 12MWp

Table 10: Cost breakdown for a commercial PV system – local currency

Cost Category	Average (RM/W)	Low (RM/W)	High (RM/W)
Hardware			
Module	1,40	1,15	2,15
Inverter	0,20	0,10	0,40
Other (racking, wiring…)	0,30	0,20	0,40
Soft costs			
Installation	0,30	0,20	0,50
Customer Acquisition	0,20	0,20	0,20
Profit	0,60	0,60	0,70
Other (permitting, contracting, financing…)	0,20	0,20	0,20
Subtotal Hardware	**1,90**	**1,45**	**2,95**
Subtotal Soft costs	**1,30**	**1,20**	**1,60**
Total	**3,20**	**2,65**	**4,55**

2.4. Financial Parameters and specific financing programs

Currently projects tend to be self-financed. Financing is on a personal loan basis or on the ability of the borrower to pay NOT on the merit of the project. Larger (more than 250kWp) also follow this axiom.

Table 11: PV financing scheme

Average rate of loans – residential installations	**6 -8%**
Average rate of loans – commercial installations	6 -8%
Average cost of capital – industrial and ground-mounted installations	20 - 30%

2.5. Specific investments programs

One of the developers under the Large Scale Solar programme, namely Tadau Energy Sdn. Bhd. has issued a syariah - compliant Socially Responsible Investment (SRI) instrument (https://www.nst.com.my/opinion/columnists/2018/03/346085/malaysias-green-sukuk) to fund their large scale solar development. The RM250 million Green SRI Sukuk Tadau is to finance the construction of large scale solar (LSS) photovoltaic power plants in Kudat, Sabah, with a tenure of

two to 16 years. Investments are presently on a commercial basis with no public schemes available other than the Green Sukuk mentioned above.

Table 12: Specific investment programs

Third Party Ownership (no investment)	**NO**
Renting	YES
Leasing	NO
Financing through utilities	NO
Investment in PV plants against free electricity	NO
Crowdfunding (investment in PV plants)	NO (NEM & SELCO)
Community solar	YES
Green Sukuk (Green Islamic Bonds)	YES

2.6. Additional Country information

Table 13: Country information

Retail Electricity Prices for an household (range)	**Please refer to appendix**
Retail Electricity Prices for a commercial company (range)	
Retail Electricity Prices for an industrial company (range)	
Population at the end of 2017 (or latest known)	32,38^{e} million (est)
Country size (km²)	330.345 km²
Average PV yield (according to the current PV development in the country) in kWh/kWp	1.200 - 1.600

Name and market share of major electric utilities.	There are 3 major electricity utilities in the country split by region: • Peninsular Malaysia (Tenaga Nasional Berhad, Gov't linked company, www.tnb.com.my), • Sarawak (Sarawak Electricity Berhad, 100 % owned by state of Sarawak, www.sarawakenergy.com.my) • Sabah (Sabah Electricity Sdn Bhd, 80 % owned by TNB & 20 % owned by state of Sabah, www.sesb.com.my). More info on these utilities can be found under section 7.1 Structure of the Electricity System
https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=dDM2enNvM09oTGtQemZPVzRTWENmZz09	

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.

3.1.Direct support policies for PV installations

3.1.1 New, existing or phased out measures in 2017

3.1.1.1.Climate change Commitments

While still committed to COP21, the Ministry of Energy Green Technology and Water (KeTTHA) has expressed concerns as to the economics of the increase of RE into the power mix to 30% by 2030. The Ministry continues to engage the industry sector to gather more input before deciding on the appropriate course of action. (https://themalaysianreserve.com/2017/06/21/malaysia-slash-another-25-co2-emission-2030/). One of the strong attributes of the Ministry is their continuous engagement with the RE industry and as a result of this, programmes developed are industry-driven and therefore, implementable in nature and with reduced chances of failure.

3.1.1.2.Description of support measures (excluding BIPV, VIPV and rural electrification)

Increased industrial engagement with the Energy Commission has seen modest implementation of industries' recommendations. Most noteworthy of these is the lifting of the 1 MW limit for SELCO installations.

In year 2017, the Government of Malaysia initiated a specialized programme called '*MySuria*' to enable those in the B40 (below 40%) income group to benefit from the FiT by having a 3 kWp system installed on their homes. The capital expenditure would be borne by the government and recipients would be able to earn an average FiT income of RM250/month, derived from the PV generation for a total of 10 years.

3.1.1.3. BIPV development measures

The end of the FiT for solar PV has seen a pause in the implementation of BiPV. PV systems are instead installed conventionally on metal decks, tiled and concrete roofs. The Malaysian Photovoltaic Industry Association (MPIA) has begun discussions with the Malaysian Green Building Council (MGBC) to study and propose new developments and townships integrated with solar PV into their design and overall planning. Global pricing has enabled these concepts to be more commercially palatable within a Malaysian context.

3.1.1.4.Utility-scale measures including floating and agricultural PV

Large Scale Solar (LSS) projects are mentioned in detail in section 3.4 under tenders and finance schemes. The third phase of the LSS is under review as at the preparation of this report. There are also calls to hold off conventional LSS projects and to implement floating LSS type projects instead where use of good land is avoided for ground-mounted applications. PV investors have already identified relevant water bodies and are keen to pursue this aspect to anchor the market both locally and abroad.

3.1.1.5.Rural electrification measure

The government continues to have programmes to electrify interior areas with Solar PV and hybrid systems. The two main ministries involved are the Ministry of Rural and Regional Develop-

ment and the Ministry of Education. Apart from that, there are also specific projects undertaken by the main utilities namely Sarawak Energy Berhad.

3.1.1.6.Support for electricity storage and demand response measures

It is still early days, however, it is envisioned that by 2020, should current prices maintain their current trend, the next phase of PV integration into the power mix will take place in Malaysia, utilising Energy Storage Systems (ESS)

3.1.1.7. Support for electric vehicles (and VIPV)

Geely holding Group of China, a manufacturer of electric vehicles has signed a strategic partnership with a Malaysian car maker, Proton. With that comes a 49,9% stake in proton and a foot print into ASEAN. Geely seems poised to also expand its EV presence via Malaysia as a platform into the region a possibly farther abroad. (http://www.foxnews.com/world/2017/05/24/chinas-geely-to-buy-lotus-take-stake-in-malaysias-proton.html)

Table 14: PV support measures (summary table)

	On-going measures residential	Measures that commenced during 2017 residential	On-going measures Commercial + industrial	Measures that commenced during 2017 – commercial + industrial	On-going measures Ground-mounted, including floating	Measures that commenced during 2017 – ground mounted, including floating
Feed-in tariffs	YES	YES	YES	YES	NO	NO
Feed-in premium (above market price)	YES	YES	YES	YES	NO	NO
Capital subsidies	YES	YES, under the MySuria Project	NO	YES, A government initiative for their own buildings	NO	NO
Green certificates	NO	NO	YES, Green building Index Certification	YES, Green building Index Certification	NO	NO
Renewable portfolio standards (RPS) with/without PV requirements	NO	NO	NO	NO	NO	NO
Income tax	NO	NO	YES	YES	YES	YES

credits						
Self-consumption	YES	YES	YES	YES	YES	YES
Net-metering	NO	NO	NO	NO	NO	NO
Net-billing	YES	YES	YES	YES	NO	NO
Collective self-consumption and virtual net-metering	NO	NO	NO	NO	NO	NO
Commercial bank activities e.g. green mortgages promoting PV	NO	NO	NO	NO	YES* green islamic bonds	YES
Activities of electricity utility businesses	NO	NO	NO	YES	YES	NO
Sustainable building requirements	NO	NO	YES, Green building Index Certification	YES, Green building Index Certification	NO	NO
BIPV incentives	YES	YES	YES	YES	NO	NO
Other (specify)						

3.2. Self-consumption measures

Apart from NEM, Self-Consumption (SELCO) is another available option for PV installations. 100% of the power is consumed by the building owner. A license application is required if the system size is over 72 kWac as stipulated by the Energy Supply Act. This process is straight forward when compared to the NEM process and is, at this juncture appearing to be the more popular choice of the 2 options.

Table 15: Self-Consumption Schemes

PV self-consumption	**1**	**Right to self-consume**	**YES**
	2	Revenues from self-consumed PV	NO
	3	Charges to finance Transmission & Distribution grids	NO
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	NO, applicable only for NEM
	5	Maximum timeframe for compensation of fluxes	YES
	6	Geographical compensation	NO
Other characteristics	7	Regulatory scheme duration	NO
	8	Third party ownership accepted	YES
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	YES
	10	Regulations on enablers of self-consumption (storage, DSM…)	NO
	11	PV system size limitations	YES, currently unto 75% of site max. demand
	12	Electricity system limitations	NO
	13	Additional features	NO

3.3. Collective self-consumption, community solar and similar measures

The electricity market in Malaysia is still highly regulated and as such, there is no such scheme to accommodate virtual net energy metering or energy trading among prosumers. Presently all installations for self-consumption are for own use. The market itself has to mature to community/ collective use of PV generation. The closest this has come to are condominium management bodies exploring the possibility of self-consumption.

For the community however, SEDA Malaysia continued to offer a special quota for community projects in 2017 under the FiT but this was the last year the quota would be offered. Those eligible under this programme included schools, care centers and places of worship. The challenges faced from such programmes were financing and continuity. As interested communities depended on the generosity of the public or big corporate bodies, most were unable to achieve commercial operation within the stipulated timeframe resulting in a degressed tariff. But the communities were still appreciative of the initiative as the income derived from the monthly generated power from solar PV provided a steady stream of income for the next 21 years.

3.4. Tenders, auctions & similar schemes

Malaysia has implemented the LSS under competitive bidding. The competitive bidding is administered by the Energy Commission of Malaysia and Power Purchase Agreement is signed between the Distribution Licensee and the successful bidders. The electricity is paid via a pass-through mechanism allocated in the electricity tariff. LSS 1 was predominately financed by Malaysian interest with LSS 2 seeing foreign investors entering into the foray.

The exercise conducted by the Energy Commission has been lauded as being reasonably transparent in its execution punctuated by a direct award of 150MW. This exercise was well received and has set a precedence for future large scale tenders. The RM/kWh reverse bidding prices were based on commercial considerations and saw Malaysia enter the LSS market in a slow controlled manner, based on commercial and technical considerations. The lowest bid tariff submitted for LSS 1 was 39 sen per kWh for a installed capacity of 49MW AC and for LSS 2 at 33,98 sen per kWh for an installed capacity of 30MW AC (for tenders conducted in 2017 for commissioning between 2018 to 2020).

Financing for LSS 1 was nearly all or completely by Malaysian investors. With the process tried and proven confidence in this sector rose. LSS2 saw many foreign EPCs and inverters enter the market, such as Hanwha Energy, Scatec, Greencells, BayWa and even Gunkul from neighbouring Thailand.

3.5. Financing and cost of support measures

The FiT is supported by the Renewable Energy (RE) fund contributed by electricity consumers of TNB, SESB and NUR Distribution Sdn Bhd. Electricity consumers with more than 300 kWh usage per month are obliged to contribute 1,6% of their electricity bill to the RE fund. The rest of the fiscal and monetary support draw from the Government's consolidated fund.

Other financing support by the Government includes the Green Technology Financing Scheme (GTFS). The purpose of the Scheme that offers a 60% guarantee of the financing amount and a rebate of 2% on the interest/profit rate charged by the financial institutions is to accelerate the expansion of green investments by providing easier access to financing from the private and commercial financial institutions.

3.6. Indirect policy issues

Several policy enablers that may positively influence the PV market to grow in Malaysia:

(i) Reviewing the displaced cost that is to be bore by distribution licensees under the FiT scheme so the cost is reflective as per its definition meted under the RE Act 2011;

(ii) Fully rationalizing of natural gas subsidy on electricity tariff ;

(iii) liberalizing the electricity market ;

(iv) reduce the planting up of new coal/gas power plants that may potentially crowd out PV in the electricity mix, and

(v) developing an energy transition roadmap to increase the contribution of renewable energy in the electricity mix.

4. INDUSTRY

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

For 2017, Malaysia continues to be a popular manufacturing hub in the region; remaining to be significant in the solar PV manufacturing value chain.

Table 16: Production information for the year for silicon feedstock, ingot and wafer producers

METAL Si & POLY Si		2017		2018 (estimate)	
No.	**Company Name**	**Capacity (kilo ton)**	**Employment**	**Capacity (kilo ton)**	**Employment**
1	OCIM Sdn Bhd (Poly-Si)	9,8	507	14	520
	Total	**9,8**	**507**	**14**	**520**
INGOT/WAFER		**2017**		**2018 (estimate)**	
No.	**Company Name**	**Capacity (MW)**	**Employment**	**Capacity (MW)**	**Employment**
1	LONGI (ingot)	1000	2113	1000	2851
2	LONGi (wafer, P-type mono)	1000		1000	
	Total	**2000**	**2113**	**2000**	**2851**
CELL		**2017**		**2018 (estimate)**	
No.	**Company Name**	**Capacity (MW)**	**Employment**	**Capacity (MW)**	**Employment**
1	SunPower (N-type Mono-Si)	826,4	1597	764,4	1400
2	Hanwha Q-Cells (P-type Multi-Si)	1600	2000	2000	2260
3	TS Solartech (Mono & Multi-Si)	240	200	240	200
4	Jinko Solar (Multi-Si)	1500	4300	1500	4300
5	LONGI	600	Incl above	650	Incl above
6	JA Solar (Multi-Si)	1200	1500	1000	1500
	Total	**5966,4**	**9597**	**6154,4**	**9660**

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

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country. Total PV cell and module manufacture together with production capacity information is summarised in Table 17.

Table 17: Production and production capacity information for 2017

MODULE		2017		2018 (estimate)	
No.	**Company Name**	**Capacity (MW)**	**Employ-ment**	**Capacity (MW)**	**Employ-ment**
1	First Solar (CdTe thin film)	2071	2800	2344	2800
2	Flextronics (OEM for crystalline)	513	600	473	600
3	Panasonic (HIT N-type mono crystal-line)	469	1167	370	1165
4	MSR (Mono & Multi-crystalline)	100	71	120	110
5	Solartif (Multi-crystalline)	0,7	27	1	130
6	PV HiTech (Multi-crystalline)	0	8	3	15
7	LONGi	600	Incl above	900	Incl above
8	Hanwha Q-Cells	1600	Incl above	2000	Incl above
9	Jinko Solar (Multi-crystalline)	1300	Incl above	1300	Incl above
10	Promelight (Mono & Multi-crystalline)	100	33	100	30
	Total	**6753,7**	**4706**	**7611**	**4850**

Malaysia maintains a global sourcing regime in its acquisition of balance of systems (BOS) components. The focus remains on compliance to the stipulated national guidelines and utility code achieved by all available means.

5. PV IN THE ECONOMY

In 2017, the solar PV market piqued the interest of the manufacturers present in the country with the government rolling out the LSS programme. Nevertheless, the market still remained relatively small compared to the global market but the government saw the benefits of promoting the industry. With PV, local talents especially in the service sector were now able to export their services to other emerging markets in the region such as in Cambodia, Vietnam and Bangladesh.

5.1. Labour places

Table 18: Estimated PV-related labour places in 2017

Research and development (not including companies)	**NA**
Manufacturing of products throughout the PV value chain from feedstock to systems, (excluding company R&D)	16.923
Distributors of PV products (sales representative offices)	632
System and installation companies	
Electricity utility businesses and government	NA
Other	NA
Total	17.555

5.2. Business Value

Further to the estimates given in tables 16 and 17 it is estimated that the PV market currently employs 632 people (based on 20 person/MWp installed factor). This number accounts for “last

mile" type businesses (installers, EPCs) and excludes providers of balance of systems, structures, manufacturing etc. However, this indication and the presence of an aggressive RE target would create new opportunities in this space to be capitalized on.

Table 19: Value of PV business

Sub-market	Capacity installed *in 2017* (MW) ***(from table 4)***	**MYR** Price per W installed* ***(from table 8)***	Value	Totals
Off-grid domestic	*10,5*	*25*	262.500.000,00	MYR 252 Mil
Off-grid non-domestic				
Grid-connected distributed	49,4569	5,00	247.284.500,00	MYR 247 Mil
Grid-connected centralized				
				MYR 509 Mil
Export of PV products, average of 95% of total model volume used (95 - 100% of local production is exported. Only module data available)				MYR 2,464 Bil
Change in stocks held * (data presently unavailable)				*NA*
Import of PV products (presently only RM / kWp installed values available)				
Value of PV business (RM)				**MYR 2,973 Bil**

Malaysia presently has a good representation of the value chain, the bulk of the value being in manufacturing. The MPIA is actively pursuing recommendations to grow services for both the domestic and regional market.

INTEREST FROM ELECTRICITY STAKEHOLDERS

5.1. Structure of the electricity system

- Vertically integrated with the majority share taken by Tenaga Nasional Berhad (TNB)
- Liberalised generation (largely due to the FiT programme 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 (Suruhanjaya Teenage ST)
- 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). Some of the more remote townships are paying below operating cost keeping in line with the state goal of providing affordable electricity for all.
- Sarawak's goal is to be 100% electrified by 2025. There are presently townships enjoying rates as low as 30 sen while operating cost exceed RM 1 / kWh (These areas tend to be powered by diesel generators) SEB plans to expand the greater network to reach these sites in the coming years. Presently there are no plans to liberalise generation, transmission or retail of SEB. 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.

5.2. Interest from electricity utility businesses

As mentioned in 2.5, TNB the main distribution licensee, is studying a pilot programme to provide a platform to allow leasing for RE, largely to boost the NEM programme. The initial indications suggesting it will be open to all to use with TNB playing the role of administrator. This programme has yet to be officially launched and is still being tested. However, should it be approved, it will help catalyse the finance sector into providing much needed support to the RE industry as a whole.

5.3. Interest from municipalities and local government

Petaling Jaya City Council presently offers a tax rebate for PV installations (maximum of 40%) or similar equipment installed on premises as part of their eco-friendly house owners' initiative. This is to encourage residents to move the municipality towards a low carbon green city status. Presently, other councils still focus on recycling and similar initiatives (source: 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/).

7. HIGHLIGHTS AND PROSPECTS

The following represents the most expedient that can be taken in the next 1-3 years to further boost the PV market with minimum disruption to existing procedures.

Table 20 : Proposed Enablers to boost PV Market

<table>
<tr><th>Market segment</th><th>Green loan scheme</th><th>Tax Incentives</th><th>Mechanism</th></tr>
<tr><td>Residential</td><td colspan="3">There is currently no incentives other than the now closed Feed in Tariff scheme to encourage installations on residential premises.</td></tr>
<tr><td>Focused Residential Installations (<12kWp)</td><td>90% loan with 2-3% flat interest rate for 5-7 years loan tenure (e.g. Max RM 50000/Installation)</td><td>Proposed Personal Tax Relief</td><td>Feed in Tariff type mechanism</td></tr>
<tr><td rowspan="3">Industrial & Commercial

Small - Medium

Large</td><td colspan="3">Currently the 2 most utilised incentives are the Green Investment Tax (GITA) and the Green Income Tax Allowance (GITE)</td></tr>
<tr><td>80% loan 2-3% flat interest rate for 5-7 years loan tenure (e.g. Max. RM200000 / installation)</td><td rowspan="2">Green Investment Tax Allowance (GITA) until 2020. Subsequently GITA to only apply to Energy Storage Systems.</td><td rowspan="2">TRUE Net Energy Metering</td></tr>
<tr><td>80% Loan with 4-6% effective interest rate similar to property. Mortgage and Loan tenure Maximum 10 years)</td></tr>
</table>

Malaysia may not be the fastest growing PV market in the region but it has proven its worth with national and industrial standards that has enticed foreign direct investment not only in terms of projects investments but also in terms of increased production. Projects in the form of the LSS roll outs, as well as the likes of Hanwa Q Cells increasing their presence by increasing production output via plant expansion **Overall, Malaysia remains an attractive platform from which to launch into the ASEAN and Asia markets**. The successful implementation of the various solar PV initiatives such as the FiT and LSS with economic benefits will continue to foster confidence as the government plans the future of electricity in the country with greater climate considerations.