IEA INTERNATIONAL ENERGY AGENCY

National Survey Report of PV Power Applications in MALAYSIA 2013

PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

Prepared by

T1 Representatives of Malaysia

TABLE OF CONTENTS

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 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems 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 24 participating countries are Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), China (CHN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Thailand (THA), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association, the US Solar Electric Power Association, the US Solar Energy Industries Association and the Copper Alliance are also members.

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: 5 MW PV power plant located in Malacca, owned by Kumpulan Melaka Berhad.

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 2013. 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 2013 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2013, although commissioning may have taken place at a later date**.

1.1 Applications for Photovoltaics

PV market in Malaysia started in the early 1980s and the market was focussed on rural electrification projects i.e. off-grid PV systems that were fully funded by the Government. The first grid-connected PV system in the country was introduced in August 1998 with a 3,15 kW and 5 kW pilot systems in local universities, University Tenaga Nasional (UNITEN) and National University Malaysia (UKM). In January 1999, the New Energy and Industrial Technology Development Organization (NEDO) sponsored a 2,4 kW PV system for the Standards and Industrial Research Institute of Malaysia (SIRIM). In 2006, the Ministry of Energy, Communications and Multimedia Malaysia together with the support of United Nations Development Programme (UNDP) and Global Environment Facility (GEF) initiated the Malaysia Building Integrated Photovoltaic (MBIPV) Project which spanned over the 9th Malaysian Plan (2006-2010).

One of the objectives of the project was to spur the local grid-connected PV market in the country. The project has a modest target, at the end of 2010, a total of 174 grid-connected PV systems with total capacity of 1.516 kW was installed. Because of the nature of the project, all PV systems were in buildings and largely of residential type. In 2011, the Ministry of Energy, Green Technology and Water tabled before the Parliament the Renewable Energy Bill 2010 and Sustainable Energy Development Authority Bill 2010. Both bills were passed at the end of April 2011, the bills enabled to establishment of a new statutory body called Sustainable Energy Development Authority (SEDA) Malaysia on 1st September 2011 and the Renewable Energy Act 2011 mandated the implementation of the Feed-in Tariff (FiT) programme in Malaysia. The FiT is subsequently implemented on 1st December 2011; the programme is managed and administered by SEDA.

1.2 Total photovoltaic power installed

In 2013, a cumulative total of 73,3 MW of PV achieved commercial operation, however there is no breakdown available to satisfy the format as required in Table 1.

Table 1: PV power installed during calendar year 2013

			MW installed in 2013 - AC value	MW installed in 2013 - DC value
Grid-connected	BAPV	Residential		
		Commercial		
		Industrial		
		Total BAPV		
	BIPV	Residential		
		Commercial		
		Industrial		
		Total BIPV		
	Ground-mounted	cSi and TF		
		CPV		
		Total Ground-mounted		
Off-grid		Residential		
		Other		
		Hybrid systems		
		Total off-grid		
		Total		48,28

Table 2: Data collection process:

Are the installation data reported in AC or DC?	DC
Is the collection process done by an official body or a private company/Association?	SEDA, the implementation agency for the FiT
Link to official statistics (if this exists)	www.seda.gov.my
Remark	This report focuses on grid-connected PV systems under the FiT programme. Although off-grid PV market exists, the data is not readily available.

Table 3: PV power and the broader national energy market.

MW-GW for capacities and GWh-TWh for energy	2013 numbers	2012 numbers
Total power generation capacities (all technologies)	Not available	29.143 MW[1]

[1] *Source: National Energy Balance 2012*

Total power generation capacities (renewables including hydropower)	Not available	134.375 GWh
Total electricity demand (= consumption)	Not available	116.353 GWh
New power generation capacities installed during the year (all technologies)	Not available	None
New power generation capacities installed during the year (renewables including large hydropower)	49,4 MW (FiT)	300 MW (Hydro) +98,53 MW (FiT)
Total PV electricity production in MWh	47.639,7	4.714,01
Total PV electricity production as a % of total electricity consumption	Negligible	Negligible

Table 4: Other informations

	2013 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	**Domestic:** 1.215 systems **Commercial & Industrial:** 57 systems
Capacity of decommissioned PV systems during the year in MW	**None**
Total capacity connected to the low voltage distribution grid in MW	**Domestic :** 13,33 MW **Commercial & Industrial :** 34,95 MW
Total capacity connected to the medium voltage distribution grid in MW	
Total capacity connected to the high voltage transmission grid in MW	**None**

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

Sub-market	1998	….	2006	2007	2008	2009	2010	2011	2012	2013
Stand-alone domestic										
Stand-alone non-domestic										
Grid-connected distributed	0,486			0,64	0,775	1,063	1,516	2,5	25,02	73,3
Grid-connected centralized										
TOTAL (MW)										

2 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.

2.1 Direct support policies

Table 6: PV support measures (summary table)

	On-going measures	Measures that commenced during 2013
Feed-in tariffs (gross / net?)	Gross Feed-in tariff	
Capital subsidies for equipment or total cost		
Green electricity schemes		
PV-specific green electricity schemes		
Renewable portfolio standards (RPS)		
PV requirement in RPS		
Investment funds for PV		
Income tax credits	Investment Tax Allowance for companies investing in power generation from renewable energy	
Prosumers' incentives (self-consumption, net-metering, net-billing…)		
Commercial bank activities e.g. green mortgages promoting PV		Local banks (e.g. Alliance Bank, Bank Muamalat) offering financing for domestic PV systems.
Activities of electricity utility businesses		
Sustainable building requirements	Green Building Index (promotes PV in buildings, www.greenbuildingindex.org/)	

2.2 Direct Support measures

2.2.1 Support measures exiting in 2013

From Table 6 above, there was no support measure exiting in 2013. For this reason, there is nothing to report from Sections 2.2.1.1 to 2.2.1.5.

2.2.1.1 Description of support measures excluding prosumers, BIPV, and rural electrification

None

2.2.1.2 Prosumers' development measures

None

2.2.1.3 BIPV development measures

None

2.2.1.4 Rural electrification measures

None

2.2.1.5 Other measures including decentralized storage and demand response measures

None.

2.2.2 Support measures phased out in 2013

As reported in earlier section (2.2.1), there was no support measure that was phased out in 2013.

2.2.3 New support measures implemented in 2013

At the start of the FiT implementation (1st December 2011), the take up rate of solar PV for the residentials was particularly low. One of the key reasons for the slow take up rate was the difficulty for residentials to access capital from financial institutes. 2013 also marked a turning point whereby a few local banks launched financing for solar PV systems. As a result of these initiatives by these banks the take up rate of solar PV for residentials improved tremendously.

2.2.4 Measures currently discussed but not implemented yet

Net-metering is still under consideration by the Ministry of Energy, Green Technology and Water. This measure will require discussion with distribution licensees (DLs) and a framework for consistent policy across all DLs in the country.

2.3 Indirect policy issues

None.

2.3.1 International policies affecting the use of PV Power Systems

There is no direct international and regional policies affecting the use of PV power systems in Malaysia. Although in 2009, the Prime Minister of Malaysia at COP15 in Copenhagen made a commitment to reduce 40% in terms of GDP emission intensity by 2020 compared with 2005 levels. Constant liaisons with international and regional groups such as the IEA PVPS, ASEAN Renewable Energy Sub-Sector Network (RE-SSN), and Asia-Pacific Economic Cooperation (APEC) provide first-hand knowledge on renewable energy policies on country members and a chance for other countries to conduct peer review on sustainable energy policies in Malaysia.

2.3.2 The introduction of any favourable environmental regulations

None.

2.3.3 Policies relating to externalities of conventional energy

None.

2.3.4 Taxes on pollution (e.g. carbon tax)

None.

2.3.5 National policies and programmes to promote the use of PV in foreign non-IEA countries

None.

3 HIGHLIGHTS OF R&D

3.1 Highlights of R&D

The table below shows the list of universities and research institute and their research area involvement in solar PV in Malaysia.

UiTM	Performance of Selected Stand-Alone PV Systems, Impact of Ambient Parameters on PV Systems Output in Equatorial Climate, Stabilization Period and Assessment of Design Techniques for Thin-Film PV modules under Malaysian Weather, Sizing of Stand-Alone PV systems using ANN, and Development of SCADA for Application on PV Systems.(http://www.uitm.edu.my/index.php/en)
UM	Design of Grid-connected PV inverter 3-10 kW, Inverter - performance testing, PV integration and monitoring, Photocells testing. (http://www.um.edu.my/)
SERI, UKM	Advanced Solar Cell (Thin Film Silicon, CdTe, CIGS and organic solar cell including dye-sensitized solar cell), Solar Hydrogen Production System, Grid Connected Photovoltaic, Solar PV Hybrid Systems, Solar Power Regenerative Electrolyzer/Fuel Cell System, Charge controllers, Inverters, power quality, and Impact study on PV technology. (http://www.ukm.my/seri/)
UTAR	Pre-Commercialized Project on Grid Connected Dense Array Concentrator Photovoltaic System (CPV). (http://www.utar.edu.my/main.jsp)
UPM	Solar CPV pilot project. (http://www.upm.edu.my/)
UTM and UTEM	Inverter quality control center: to test grid-connected PV inverter for power less than 10 kW., Study of partial shading problem for PV in tropical countries, Development of MPPT for PV inverters using soft computing methods, Design and construction of PV charging station for Electric Vehicle., Monitoring of performance of various PV technologies under tropical environment, Development of new "inverter efficiency index" for PV inverters for tropical regions., Partial shading solution based on hardware energy harvesting., http://www.utm.my/ ; http://www.utem.edu.my/web2012/ , Solar Resource Assessment and Forecasting, Characterization, Forecasting, Mapping (Ground Observed & Remote Sensing), and PV Performance and Reliability.

TNB research	Design Optimization of PV Plant, Operation & Maintenance of PV Plant, PV Performance model, Optimization of PV Performance, Advanced PV Power Plant Design, and Solar Hybrid systems for rural electrification.(http://www.tnbr.com.my/)

3.2 Public budgets for market stimulation, demonstration / field test programmes and R&D

Not available.

Table 7: Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test
National/federal		
State/regional		
Total		

4 INDUSTRY

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

Table 8: Production information for the year for silicon feedstock, ingot and wafer producers

Manufacturers (or total national production)	Process & technology	Total Production (Nameplate Capacity)	Product destination (if known)	Price (if known)
Japan Silicon Malaysia[2]	Metallurgical Silicon	Under construction		
Elpion Silicon [3]	Metallurgical Silicon	Under construction		

[2] http://sarawakbusinessconnect.my/modules/web/investor_profile.php?invid=30

[3] http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=130379070

Manufacturers (or total national production)	Process & technology	Total Production (Nameplate Capacity)	Product destination (if known)	Price (if known)
Cosmos Chemicals[4]	Poly-Si ingots	Under financing negotiation		
Tokuyama Malaysia[5]	mc-Si ingots	Under trial operation in 2013		-
MEMC	sc-Si wafers	397 MW		
	mc-Si wafers			

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.

Capacity reported in this section refers to production capacity and not actual production. The actual production data is confidential to the companies and only nameplate capacities are cited.

Total PV cell and module manufacture together with production capacity information is summarised in Table 9 below.

[4] Cosmos Chemicals is a subsidiary of Cosmos Petroleum and Mining Sdn Bhd, the subsidiary is a polysilicon manufacturing plant to be located in the state of Sarawak. The targeted annual production capacity is estimated to be 25.000 tonnes [Source: http://www.pv-magazine.com/news/details/beitrag/gtat-agrees-336-million-polysilicon-supply-deal-in-malaysia_100014495/#axzz366J8noxJ].

[5] Tokuyama will be fully operational by 2014 and estimated production capacity in 2014 to be 6.200 tonnes.

Table 9: Production and production capacity information for 2013

Cell/Module manufacturer (or total national production)	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**		**Maximum production (Nameplate) capacity (MW/yr)**	
		Cell	Module	Cell	Module
Wafer-based PV manufacturers					
1. Hanwha Q-Cells	mc-Si			900	
2. AUO-Sunpower	Sc-Si			685	
3. Flextronics	OEM in PV assembly				400
4. Panasonic Corporation	HiT				199
5. Malaysian Solar Resources	Sc-Si & mc-Si				85
6. TS Solartech	mc-Si				60
7. PV Hi-Tech Solar	mc-Si				15
8. Solartif	mc-Si				1
9. EXT Technologies					*70*
Total				*1.585*	*830*
Thin film manufacturers					
1 First Solar	CdTe				*1.300*
TOTALS				**1.585**	**2.130**

Panasonic Corporation produces HiT PV modules; the manufacturing plant is an integration of wafers to solar cells and modules, the manufacturing plant is located in Kulim, Kedah (Source: http://panasonic.co.jp/corp/news/official.data/data.dir/2013/08/en130830-2/en130830-2.html).

Malaysian Solar Resources imported their solar cells and assembled these cells into PV modules in their manufacturing plant located in Pahang. TS Solartech is reportedly into solar cells and PV assembly, the manufacturing plant is located in Penang. PV Hi-Tech Solar and Solartif are both PV assembly plants, the manufacturing plant is located in the Negeri Sembilan and Terengganu respectively.

In the 2013 annual report by the Performance Management Delivery Unit (PEMANDU) under the Prime Minister's office, under Entry Point Projects (EPP) 5 for Increasing the Number of Silicon Producers, the targets were:

- To increase Malaysia's silicon production to 170 kilo tonnes by 2020.

- To increase the production for wafers and/or solar cells to 23 GW by 2020.
- To focus on downstream maintenance, repair and overhaul activities and BoS businesses.

4.3 Manufacturers and suppliers of other components

According to data compiled by Malaysia Industry Group for High Technology (MIGHT), Malaysia has a growing supporting industry for the solar PV manufacturing ecosystem. There are over 50 companies involved in chemical, industrial gas, production supply, and equipment and machines. For instance, SGL Carbon Sdn Bhd manufactures isostatic graphite parts and these parts are predominantly used in the production of silicon for solar energy. In the chemical sector, some of these companies included SPCI Malaysia, Dou Yee Manufacturing Sdn Bhd, Nagase (M) Sdn Bhd, May Chemical Sdn Bhd, Specialized Technology Resources (STR) Sdn Bhd, Kong Long Huat (KLH) Chemicals Sdn Bhd and Titan Petrochemical (M) Sdn Bhd.

In the industrial gas, examples of companies included Linde Malaysia Sdn Bhd and Air Products (M) Sdn Bhd. Companies into equipment/machineries included ATS Automation (M) Sdn Bhd, Tokyo Rope (M) Sdn Bhd, Kiswire Saw-tech Sdn Bhd, Invenpro (M) Sdn Bhd, Ultimate Machining Solutions (M) Sdn Bhd, and Stoppani systems Sdn Bhd. Under production supply (including packaging), some of the companies included Super Starnix Sdn Bhd, HexaChase Packaging Sdn Bhd, Namhwa Paper Industries (M) Sdn Bhd, Standard Box Industry Sdn Bhd, GH Packaging Sdn Bhd, Federal Packages Sdn Bhd, and Ire-Tex (M) Sdn Bhd. There are more than 15 companies in the BoS sector, some of these included Huber & Suhner (M) Sdn Bhd, ABB Malaysia Sdn Bhd, Schneider Electric (M) Sdn Bhd, Innotech Synergy Sdn Bhd, Superspan Sdn Bhd, and Barysol (M) Sdn Bhd.

5 COMPETITIVENESS OF PV ELECTRICITY

5.1 Module prices

Table 10: Typical module prices for a number of years

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Standard module price(s): Typical (MYR per W)	21,39	17,25	16,00	14,57	9,81	8,06	5,8	6,00	6,00
Best price									
PV module price for concentration (if relevant)									

5.2 System prices

Table 11: **Turnkey Prices of Typical Applications**

Category/Size	Typical applications and brief details	Current prices (MYR per W)
OFF-GRID Up to 1 kW		-
OFF-GRID >1 kW		-
Grid-connected up to 72 kW (residential)		7,5
Grid-connected from 72 to 180 kW (commercial)		7,1
Grid-connected from 180 to up to 425kW (industrial)		6,85
Grid-connected above 1 MW and up to 5 MW		6,28
Other category existing in your country (hybrid diesel-PV, hybrid with battery…)		-

Table 12: National trends in system prices (current)

Price (MYR perW)	2005	2006	2007	2008	2009	2010	2011	2012	2013
PV systems	31,41	27,55	23,19	22,41	20,44	19,12	11,00	9,00	7,50

5.3 Financial Parameters and programs (leasing…)

Table 13: PV financing scheme

Cost of capital	In the calculation of suitable degression rates for PV, 80% of capital financing is assume to be debts, loan interest estimated 6% p.a.
Description of a specific PV financing scheme (leasing, renting…)	Green Technology Financing Scheme (GTFS) - 2% interest buy down by Government www.gtfs.my/ for PV systems > 72 kW

5.4 Additional Country information

Table 14: Country information

Retail Electricity Prices for an household (range)	MYR 0,3166 per kWh (average), MYR 0,2180 – MYR 0,5710 per kWh (range) http://www.tnb.com.my/tnb/residential/pricing-and-tariff/tariff-rates.html
Retail Electricity Prices for a commercial company (range)	MYR 0,4792 per kWh (average) MYR 0,224 – MYR 0,509 kWh (range) http://www.tnb.com.my/tnb/business/for-commercial/pricing-tariff.html
Retail Electricity Prices for an industrial company (range)	MYR 0,3615 per kWh (average) MYR 0,175 – MYR 0,441 per kWh http://www.tnb.com.my/tnb/business/for-industrial/pricing-tariff.html#industrial
Population at the end of 2013 (or latest known)	Approx. 30 mio
Country size (km^2)	329.847 km^2
Average PV yield (according to the current PV development in the country) in kWh/kWp	1.200 kWh/kWp
Name and market share of major electric utilities (% of total installed capacity)	Tenaga Nasional Berhad, TNB (www.tnb.com.my), 83,4 % Sarawak Energy Bhd, SEB (www.sarawakenergy.com.my/), 12 % Sabah Electricity Sdn Bhd, SESB (www.sesb.com.my), 4,6%

6 PV IN THE ECONOMY

6.1 LABOUR PLACES

Table 15: Estimated PV-related labour places in 2013

Research and development (not including companies)	80
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	9.280
Distributors of PV products	1.207
System and installation companies	
Electricity utility businesses and government	100
Other	
Total	**10.667**

The employment targets set by Performance Management Delivery Unit (PEMANDU) under the Electrical and Electronics National Key Economic Area (NKEA) for 2020 were:

- Entry Point Project (EPP) 5 for Increasing the Number of Silicon Producers of 20.000 jobs,
- Entry Point Project (EPP) 6 for Growing Wafer and Cell Producers of 21.000 jobs, and
- Entry Point Project (EPP) 7 for Increasing Solar Module Producers of 14.000 jobs.

Under the Oil, Gas and Energy NKEA, under the Entry Point Project (EPP) 10 for Buildling up Renewable energy and Solar Power Capacity, the employment target for this is 1.906 jobs by 2020.

6.2 Business value

Table 16: Value of PV business

Sub-market	**Capacity installed *in 2013* (MW)**	**Price per W** *(from table 7)*	**Value**	**Totals**
Off-grid domestic				
Off-grid non-domestic				
Grid-connected distributed	58,7584	RM7,5	*MYR 448,2 mio*	*MYR 448,2 mio*
Grid-connected centralized				
				MYR 448,2 mio

Sub-market	Capacity installed *in 2013* (MW)	Price per W *(from table 7)*	Value	Totals
Export of PV products				*not available*
Change in stocks held				*not available*
Import of PV products				*not available*
Value of PV business				*MYR 448,2 mio*

7 INTEREST FROM ELECTRICITY STAKEHOLDERS

7.1 Structure of the electricity system

Short description of the electricity industry landscape	Electricity supply industry is divided into 2 regions; (i) Peninsular Malaysia and Sabah, and (ii) Sarawak Electricity regulator for Peninsular Malaysia and Sabah is the Energy Commission (www.st.gov.my). The state of Sarawak remains autonomous in governing their own electricity supply via their State Electricity Ordinance IPPs control about 50% of the total generating plant in Malaysia, while the three main utilities (GLCs) control about 50% of the generation capacity. Malaysia has also granted licences to "Independent Distribution Companies" for distribution of electricity to consumers in selected areas, mainly for industrial areas, and large commercial facilities with captive customers (usually their tenants and sub-tenants). The overall transmission grid in Peninsular Malaysia is under the control and management of TNB the main utility, which also supplies electricity to the bulk of consumers in Peninsular Malaysia, including some of consumers who have been granted licences as independent distributors. In the states of Sabah and Sarawak, the electricity utilities are vertically integrated with IPPs playing a part in the power generation component of the industry. Although electricity structure is vertically integrated, the Energy Commission has under the Incentive-Based Regulation (IBR) required TNB to split their generation, transmission & distribution into separate accounting entities for greater transparency.

7.2 Interest from electricity utility businesses

The electricity utilities operate under a highly regulated industry and the Government is obliged to provide electricity at as low a cost as possible. Electricity tariff is still highly subsidized in the country. For this reason, electricity utilities are obliged to source for power generation with low (direct) cost. Whilst hydro power serves as one of the base load in the country, other forms of renewable energies such as PV are deemed as too high as cost to bear and variability of the supply is still an issue of concern. In addition, PV has to contend with nuclear energy, a power generation option being considered by the Government for the future source of energy security.

Currently the electricity utilities (distribution licensees) are only engaged in managing off-grid PV systems that are almost fully funded by the Government. Under the FiT programme, the PPAs are standardized by SEDA and can be downloaded from www.seda.gov.my. From grid-connected PV systems perspective, none of the electricity utilities (distribution licensees) have any PV systems of utility scales in their portfolio of generating power plants.

7.3 Interest from municipalities and local/federal governments

The FiT programme in Malaysia is funded by electricity consumers of TNB; a 1 % additional charge is imposed on the electricity bills as contribution to the Renewable Energy (RE) Fund. Domestic electricity consumers with not more than 300 kWh of electricity usage per month are exempted from such contribution. On average per year, the total collection from this additional charge is MYR 300 mio. In this regard, the amount of quota that can be released under the FiT programme commensurates with the amount of available and uncommitted RE Fund. Since the RE Fund is required to span over other RE sources (such as small hydro, biogas and biomass), the quota for PV is very much limited. On the 2nd December 2013, the Minister of Energy, Green Technology and Wter announced the increase of the additional charge from 1 % to 1.6 % commencing 1st January 2014. Two additional electricity utilities (or distribution licensees) are obliged to collect the additional charge commencing 2014; they are Sabah Electricity Sdn Bhd and NUR Distribution Sdn Bhd. The net effect of the increase of additional charge is an estimated annual collection of MYR 333 mio or a total additional charge of MYR 633 mio per annum from the three electricity utilities (distribution licensees). This additional source of RE Fund will help small amount of PV quota to be released from 2014 – 2017 (estimated total of 237 MW). The Ministry is cognizant of the limitation of the RE Fund in spawning a local PV market; in view of this the Ministry is considering several other policy mechanisms such as net-metering and reverse bidding. The decision on these mechanisms is expected to be meted out in 2014.

8 STANDARDS AND CODES

Under the FiT programme, there is a subsidiary legislation on *Renewable Energy Technical and Operational Requirements (T&O) Rules 2011* which defines all technical rules pertaining to grid interconnection with the major electricity utilities (distribution licensees) such as TNB and SESB. The *Guidelines and Determinations of SEDA* also provide additional guidelines pursuant to the T&O Rules 2011. Both these documents are available for public viewing under www.seda.gov.my.

There are two standards on PV have been established by SIRIM; they are (i) MS 1837: 2010 *Installation of Grid-connected PV Systems* (First Revision), and (ii) MS2440: 2012 *Design, Installation, Maintenance and Inspection of PV Mounting System*.

In 2013, the *Procedure for the Testing and Commissioning Procedure of Grid-Connected Photovoltaic Systems in Malaysia* was developed by SEDA to streamline acceptance test, reliability run, and testing and commissioning of grid-connected PV systems. The guideline is currently under review and will be completed in 2014.

9 HIGHLIGHTS AND PROSPECTS

- Details from industry of planned increases in PV module production capacity

The Government is in the midst of reviewing its 11th Malaysia Plan, RMK-11 (2016-2020) which is due for announcement in mid-2015. The RMK -11 will include strategies to increase the PV manufacturing capacity and the service sector in the PV industry.

- Any significant developments in technologies

None.

Under the National RE Policy and Action Plan (2010), PV has technical potential to reach a conservative target of 6.500 MW by 2030. However, the target is contingent upon fulfilment of several assumptions. As highlighted in Section 7.3, the Government is exploring net-metering and reverse bidding to increase the local PV market in the country. Unless some PV measures are put in place in the near future, the target of 6.500 MW by 2030 might not be easily attainable.

Definitions, Symbols and Abbreviations

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40 W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/m^2, cell junction temperature of 25^{o}C, AM 1,5 solar spectrum – (also see 'Rated power').

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

CPV: Concentrating PV

Hybrid system: A system combining PV generation with another generation source, such as diesel, hydro, wind.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'mini-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV power system'.

Grid-connected distributed PV power system: System installed to provide power to a grid-connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated

with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunication system in a remote area are excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, electricity utility businesses etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is MYR (Malaysian Ringgit). Exchange rate of MYR 1 – EUR 0,2209 (http://www.bnm.gov.my, accessed on 31st December 2013).

PV support measures:

Feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh that may be higher or lower than the retail electricity rates being paid by the customer
Capital subsidies	direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost
Green electricity schemes	allows customers to purchase green electricity based on renewable energy from the electricity utility business, usually at a premium price

PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility business (often the electricity retailer) source a portion of their electricity supplies from renewable energies
PV requirement in RPS	a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside)
Investment funds for PV	share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends
Income tax credits	allows some or all expenses associated with PV installation to be deducted from taxable income streams
Compensation schemes (self-consumption, net-metering, net-billing…)	These schemes allow consumers to reduce their electricity bill thanks to PV production valuation. The schemes must be detailed in order to better understand if we are facing self-consumption schemes (electricity consumed in real-time is not accounted and not invoiced) or net-billing schemes (the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity account is reconciled over a billing cycle). The compensation for both the electricity self-consumed and injected into the grid should be detailed. Net-metering schemes are specific since they allows PV customers to incur a zero charge when their electricity consumption is exactly balanced by their PV generation, while being charged the applicable retail tariff when their consumption exceeds generation and receiving some remuneration for excess electricity exported to the grid

Commercial bank activities	includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems
Activities of electricity utility businesses	includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models
Sustainable building requirements	includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development