

**INTERNATIONAL ENERGY AGENCY  
CO-OPERATIVE PROGRAMME ON PHOTOVOLTAIC POWER  
SYSTEMS**

**Task 1**

**Exchange and dissemination of information on PV power  
systems**

**National Survey Report of  
PV Power Applications in Malaysia  
2009**

**Prepared by**

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## 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<sup>2</sup>, cell junction temperature of 25°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.

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 systems 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, utilities 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 USD, based on exchange rate of USD 1 = MYR 3,3045 (<http://www.bnm.gov.my>, accessed on 17<sup>th</sup> March 2009)

**PV support measures:**

Enhanced feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility) at a rate per kWh somewhat higher 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, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility (often the electricity retailer) source a portion of their electricity supplies from renewable energies (usually characterized by a broad, least-cost approach favouring hydro, wind and biomass)
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
Net metering	in effect the system owner receives retail value

	for any excess electricity fed into the grid, as recorded by a bi-directional electricity meter and netted over the billing period
Net billing	the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity fed into the grid is valued at a given price
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
Electricity utility activities	includes 'green power' schemes allowing customers to purchase green electricity, large-scale utility 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

## 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 21 participating countries are Australia (AUS), Austria (AUT), Canada (CAN), 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), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association and the US Solar Electric Power Association are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, 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](http://www.iea-pvps.org)

## Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems. 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 Malaysia National Survey Report for the year 2009. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website [www.iea-pvps.org](http://www.iea-pvps.org) also plays an important role in disseminating information arising from the programme, including national information.

## 1 EXECUTIVE SUMMARY

Geographically, Malaysia lies between 2° to 7° N of the equator with a population of 28,31 million. The country's position along the Sun Belt meant typical solar irradiation between 1.470 to 1.900 kWh/m<sup>2</sup>. Hence, the technical potential for photovoltaic (PV) is high. Study has shown that an area of 0,6 % of Peninsular Malaysia is sufficient for PV to provide the total electricity consumption as of 2009. Despite the high solar energy potential in the country, fossil fuel which is available in the country is still the main form of power generation. The depletion of fossil fuel and global urgency to mitigate climate change has prompted the Government of Malaysia to focus on a greater use of renewable energy sources such as photovoltaic, hydro, biogas and biomass as alternative and long-term solutions to these issues.

### 1.1 Installed PV power

PV applications in Malaysia are dominated by the off-grid market since 1980s, while the grid-connected PV applications only started in the late 1990s. As of end 2009, Malaysia has a cumulative installed grid connected PV capacity of approximately 1,063 MW and off grid PV capacity of about 10 MW. The grid-connected PV market is driven largely by financial incentive programmes implemented under the national MBIPV Project (such as the SURIA 1000 Programme, Demonstration and Showcase Incentive Programmes). Collectively, these financial programmes will generate an estimate of over 2 MW of grid-connected PV systems by end of 2010. Although the off-grid PV market is the current dominating market, it is envisaged that by the end of the 10<sup>th</sup> Malaysia Plan in 2015, Malaysia should have at least 65 MW of grid-connected PV systems. This quantum leap is expected to come once the proposed national feed-in tariff is introduced in 2011, which is the start of the 10<sup>th</sup> Malaysia Plan. This report covers data mainly for grid-connected PV systems in Malaysia. Currently, there is no consolidated data on off-grid PV installations; hence the reported figure is only an estimate.

### 1.2 Costs & prices

The average turnkey grid-connected PV system cost as at end of 2009 was USD 6,19 per W. Average module pricing was USD 3,71 per W. In Malaysia, the average PV module price has declined by 16 % compared to pricing from 2008 and 58 % from 1998 which is the national baseline for PV in the country.

### 1.3 PV production

By the end of 2009, there are four major foreign direct investments (FDIs) in PV manufacturing in Malaysia. In late 2009, First Solar announced the expansion of another eight production lines at its manufacturing facility in Kedah. This will increase First Solar's annual capacity by another 424 MW by 2011 to 1.282 MW. In 2009, there is one local PV assembly plants established in Malaysia with production capacity of 3 MW with 15 employees. Data on PV production volume for Malaysia is limited to generating capacity. The total PV generating capacity in 2009 is 1,448 MW.

Company	Product	Invested	Nameplate Capacity	Jobs Creation (Current Employment)	State	Status
First Solar	CdTe Modules	605 million	848 MW (exclude capacity expansion)	2.400 (2.400)	Kedah	In operation
Q-Cells	Solar cell, wafering & ingot	1.513 billion	600 MW	3.500 (500)	Selangor	In operation
Sunpower	Solar cell, wafering	1.513 billion	1.000 MW	5.500 (70)	Malacca	Under construction
Tokuyama	Poly silicon	3,78 billion	3.000 tons	500 (N/a)	Sarawak	Initial planning

Figure 1: Major PV FDIs in Malaysia

#### 1.4 Budgets for PV

The Malaysia Building Integrated Photovoltaic (MBIPV) Project is a national development programme implemented by the Ministry of Energy, Green Technology and Water Malaysia under the 9<sup>th</sup> Malaysia Plan (2005 - 2010). The Project has a total fund of USD 24,5 million allocated over a 5-year period. The financiers of the project are Government of Malaysia, Global Environment Facility and the private sector. Under the same Malaysia Plan, a total of USD 67,2 million has been allocated for electrification of rural homes and USD 363 million under the rural schools programme which aims to provide electricity for over 500 rural schools. The funding for rural electrification is provided for solar PV hybrid (with diesel generator set) systems in which PV provides the power between 20 % to 70 %.

## 2 THE IMPLEMENTATION OF PV SYSTEMS

By 2013 Malaysia aims to be almost 100% electrified (100 % in Peninsular Malaysia, 95 % total in Sabah and Sarawak) whereby solar hybrid systems and other renewable energy technologies are expected to provide the electricity in rural and remote areas of Malaysia. As of 2009, the percentage of electrification in Peninsular Malaysia, Sabah and Sarawak is 99 %, 77 % and 67 %, respectively. The implementation of PV systems in Malaysia began in the 1980s largely for rural electrification. Grid-connected PV systems were first implemented as demo projects in 1998 and grew in capacity with the implementation of the national MBIPV Project.

### 2.1 Applications for Photovoltaics

More than 90 % of installed PV systems in Malaysia are off-grid applications. Off-grid applications are mainly for rural electrification and non-building structures; together these constituted nearly 10 MW in installed capacity. Total installed grid-connected PV capacity as of December 2009 was 1,063 MW in 79 installations and this represented 37 % growth compared to 2008. The largest grid-connected PV system commissioned in 2009 in Malaysia is located in the new Energy Commission head office in Putrajaya. The system is 71,5 kWp using thin film PV technology from First Solar. The

installed capacity for grid-connected PV systems is expected to reach nearly 2,000 MW by end of 2010. The off-grid PV systems are expected to reach an estimate of 12 MW by the same period.



Source: New Energy Commission Head office, 71,5 kWp in Putrajaya (2009)

## 2.2 Total photovoltaic power installed

Malaysia has only grid-connected distributed PV systems. The country does not encourage centralized or solar PV farms, and the focus is on urban BIPV applications. Data for off-grid does not segregate between domestic and non-domestic markets.

**Table 1: PV power installed during calendar year 2009 in 4 sub-markets.**

Sub-market/ application	off-grid domestic	off-grid non- domestic	grid-connected distributed	grid-connected centralized	Total
PV power installed in 2009 (kW)	10.000		1.063	nil	11.063

A summary of the cumulative installed PV Power, from 1998-2009, broken down into four sub-markets is shown in Table 2.

**Table 2: The cumulative installed PV power in 4 sub-markets**

Sub-market	Cumulative installed capacity as at 31 December 2009 (kW)											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Stand-alone domestic	5.000									6.375	8.000	10.000
Stand-alone non-domestic												
Grid-connected distributed	16,86	22,85	29,05	407,07	459,1	464,14	468,34	481,48	486	640,48	775,73	1.063
Grid-connected centralised	Nil											
TOTAL (kW)	5.486									7.015,48	8.775,73	11.063

The main market driver for grid-connected PV systems is still the financial incentive programme provided by SURIA 1000 ([www.mbipv.net.my](http://www.mbipv.net.my)). SURIA 1000 works on bidding process which spreads over 6 calls with the final call ending on 1<sup>st</sup> December 2009. Other financial incentive programmes such as the Showcase incentive which provided 100% capital incentive for a 125 kW capacity target, both incentives have been fully awarded, SURIA for Developer which provided 35 % capital incentive for a 340 kW capacity target and Demonstration incentive which provided 25 % capital incentive for a 205 kW capacity target. Table 2b shows the summary of BIPV incentive projects as of December 2009. In the table, the final call for SURIA 1000 which has 340 kW allocated is not reflected in the awarded and commissioned capacity as the call was closed only on 1<sup>st</sup> December 2009. There were 88 submissions for the final call of SURIA 1000 with total PV capacity of 1,058 MW which represented a 2-fold increase over the target volume. At the end of evaluation on March 2010, 56 applicants were successful with a total capacity awarded of 645 kW.

**Table 2b: Summary of BIPV Incentive Projects**

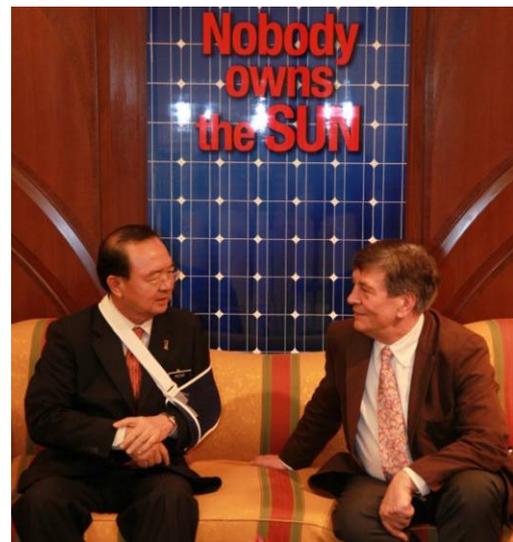
MBIPV Category	Target Capacity (kW)	Awarded Capacity (kW)	Commissioned Capacity (kW)
Showcase	125	140	140
Demonstration	205	391	206
SURIA 1000	1.215	885	283
<b>Total</b>	<b>1.545</b>	<b>1.416</b>	<b>629</b>

On policy matters, 2009 marked a year of verbal commitment as the Prime Minister of Malaysia made several significant announcements concerning renewable energies. On 24<sup>th</sup> July 2009, the Prime Minister in his speech to announce the National Green Technology Policy mentioned that the feed-in tariff mechanism would be implemented in the 10<sup>th</sup> Malaysia Plan (2011-2015) to catalyse RE development in the country. On 23<sup>rd</sup> October 2009, the Prime Minister in his National Budget 2010 speech has also announced the establishment of a Green Technology Fund of Ringgit Malaysia 1,5 billion (USD 454 million) to provide soft loans to companies that supply and/or utilise green technology. The scheme which commenced on 1<sup>st</sup> January 2010 and is expected to benefit 140 companies. To further highlight the country's commitment towards climate change mitigation, the Prime Minister of Malaysia attended the COP-15 meeting in Copenhagen and announced on 17<sup>th</sup> December 2009 that Malaysia would voluntary reduce up to 40 % of carbon emissions intensity of

GDP by 2020, compared to 2005 levels. This commitment is contingent upon receiving the transfer of appropriate technology and sufficient financing from Annex 1 countries.

Capacity Building Programmes on photovoltaics implemented in 2009:

- MBIPV Project in collaboration with Universiti Teknologi Mara (UiTM) conducted four grid-connected PV trainings and two off-grid PV trainings in 2009. Both trainings are ISPQ accredited.
- On 2<sup>nd</sup> March 2009, an IEA PVPS Workshop was conducted in Putrajaya, Malaysia. Nine speakers from IEA-PVPS Task 1 country members presented their country status on PV, market and industry development. The country members were: Australia, Austria, Canada, Denmark, France, Germany, Japan, Spain and the USA. The event attracted over 180 participants.
- On 15<sup>th</sup> June 2009, a seminar on solar energy entitled “Window to the Future” was held in Penang, Malaysia. The seminar was focused on the PV industry and speakers from renowned PV and PV-related companies such as REC Systems, Applied Materials, SolarWorld, M+W Zander presented their views at the seminar. The seminar attracted 350 participants.
- On 17<sup>th</sup> November 2009, the 2<sup>nd</sup> National PV Conference 2009 was organized as part of capacity building on PV Policy and Industry Developments. 1.200 participants registered for the one day event and there were 45 PV companies taking part in the PV exhibition. The event was held in Putrajaya, Malaysia. Dr Hermann Scheer and Prof Dr Martin Green were key speakers at the conference.



*The honourable Dr Hermann Scheer (German Parliamentarian) discussing renewable energy policies with Minister of Energy, Green Technology and Water Malaysia, the honourable Dato' Sri Peter Chin.*

On 1<sup>st</sup> March 2009, the Government of Malaysia reduced the electricity tariff by an average of 3.7 %. The move was in response to the reduction in the subsidised price of natural gas as supplied to the power sector by Petronas from USD 4,33 to USD 3,24 per mmbtu (million British thermal units). The electricity tariff is expected to revise in an upward trend in 2010 of which a small percentage would be channelled to a new renewable energy fund to support the future feed-in tariff implementation.

### **2.3 PV implementation highlights, major projects, demonstration and field test programmes**

By the end of 2009, the SURIA 1000 which began in 2006 came to a close. The analysis on the first 6 calls showed three significant results:

- i) A total of 1.260 kW in PV capacity was achieved against a target of 790 kW.

- ii) Overall 58% drop in price of PV module from a 1998 baseline of USD 8,79 per W to USD 3,71 per W, and 71 % drop in price of grid-connected PV system from a 1998 baseline of USD 21,21 per W to USD 6,19 per W.
- iii) By the final call, bidders' willingness to pay is 70 % of total BIPV price which has increased from 46,7% in the 1<sup>st</sup> call.

## 2.4 Highlights of R&D

The five major areas of R&D in PV conducted by universities in Malaysia are inverters, PV concentrators, cells including thin films, hybrid systems and energy conversion tracking system. The inverter R&D is developed by Universiti Malaya (UM) with seed funding from the MBIPV Project. The inverter is developed to suit tropical climate condition with the objective for commercialisation. On October 2009 UM signed a MoU with the Selangor State Development Corporation for commercialization of inverter prototypes. UM was recognized in 2009 by Ministry of Higher Education as an Engineering Research Cluster on solar photovoltaic (one of the six national Centres of Excellence). The other five key universities in Malaysia involved in PV research are Universiti Teknologi Mara (UiTM), Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), Universiti Sains Malaysia (USM), and Universiti Islam Antarabangsa (UIA). Most of the researches are funded by the Ministry of Science, Technology and Industry (MOSTI) under the national Science and Techno Funds. Universiti Teknologi Malaysia (UTM) is also running an internationally recognised inverter testing centre.

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

A total R&D grant scheme of USD 15 million was allocated in 2009 under the Ministry of Science, Technology and Innovation for renewable energy R&D (e.g. solar PV, solar thermal, wind, pico, micro hydro, biomass). However, there is no specific allocation for solar R&D, whereby the application for the fund is on case by case basis.

**Table 3: Public budgets for R&D, demonstration/field test programmes and market incentives.**

	R & D	Demo/Field test	Market incentives
National/federal	USD 15 million (in 2009)	Not known	USD 5,3 million (2006-2010)
State/regional			Nil
Total			

Under the MBIPV Project, there is USD 5,3 million funding available for market incentives such as SURIA 1000, SURIA for Developers, Showcase and Demonstration incentive categories.

### 3 INDUSTRY AND GROWTH

#### 3.1 Production of feedstocks, ingots and wafers

There is no production of feedstock, ingots or wafers in Malaysia in 2009. Tokuyama which will invest a total of USD 3,78 billion will commence its polycrystalline silicon manufacturing facility only in 2011.

#### 3.2 Production of photovoltaic cells and modules

As of 2009, two main PV manufacturing plants in Malaysia are in operation. They are: First Solar (Malaysia) which produces cadmium telluride thin film PV modules and Q-Cells (Malaysia) which produces solar cells. First Solar (Malaysia) is located at Kulim High Technology Park (Kedah) and so far, sixteen production lines reached full capacity in the second quarter of 2009. By 2010, First Solar (Malaysia) is projected to have 24 lines with annual production capacity of 1.272MW. SunPower (Malaysia) which has a manufacturing plant in Melaka is in the progress of constructing the plant. The plant will start production by end of 2010.

While information on actual production is not available from individual PV manufacturing companies, according to Photon International (3/2010), Malaysia in 2009 produced 784,5 MW of PV which constituted 6,4 % of the world's total PV production. This figure has increased from 2008 of 167 MW which constituted 2,1 %. In 2009, Malaysia ranked 5<sup>th</sup> in total country's PV production, quite likely Malaysia's ranking will escalate by 2011 – 2012 when PV plants such as SunPower and Tokuyama are in full generating capacity.

**Table 4: Production and production capacity information for 2009 for each manufacturer**

Cell/Module manufacturer	Technology (sc-Si, mc-Si, a-Si, CdTe)	Total Production (MW)		Maximum production capacity (MW/yr)	
		Cell	Module	Cell	Module
<i>Wafer-based PV manufactures</i>					
1. Q-Cells	sc-Si, mc-Si			600	
Total				600	
<i>Thin film manufacturers</i>					
1. First Solar	CdTe				848
<b>TOTALS</b>				<b>600</b>	<b>848</b>

### 3.3 Module prices

**Table 5: Typical module prices from 1998 – 2009 (USD per W)**

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Standard module price(s): Typical *	8,79	4,69	5,22	5,99	6,46	5,85	8,07	5,07	5,84	4,88	4,41	3,71

\* Based on average price, figures (1998-2008) adjusted to 2009 using national inflation deflators (-1.7% in 2009). All modules are imported.

### 3.4 Manufacturers and suppliers of other components

Malaysia currently does not produce any PV inverters or DC switchgear. There are productions for storage batteries and battery charge controllers although the volume data is not readily available. Locally made mounting structures are constructed on project basis.

### 3.5 System prices

**Table 6: Turnkey prices of typical applications**

Category/Size	Typical applications and brief details	Current prices per W in USD *
Off-grid up to 1 kW	Data not available	Data not available
Off-grid >1 kW		
On-grid specific case		
On-grid up to 10 kW	There were 79 BIPV installations in Malaysia in 2009. PV Systems range from 3 to 92 kW	6,19
On-grid >10 kW		
Grid-connected (centralized, if relevant)	None	NA

**Table 7a: National trends in PV system prices for on-grid PV applications**

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Price /W: in USD **	21.21	10.75	10.48	9.34	11.42	7.90	11.94	7.52	7.99	7.59	7.11	6.19

\*\* based on average price and figures from 1998 to 2008 which have been converted to 2009 prices using national inflation deflators (-1.7 % in 2009).

As of April 2010 after the evaluation of the final call for SURIA 1000, the average price of grid-connected PV systems in Malaysia has declined further to USD 5,79 per W. The trend for PV systems pricing in Malaysia for grid-connected systems has been on a steady decline from 2006 to 2009. It is believed that over the next few years, Malaysia will continue to see a declining pricing trend for grid-

connected PV systems (barring any unforeseen global price increase in PV) as SURIA 1000 has encouraged competitive pricing among PV service providers.

### 3.6 Labour places

The local PV service industry development is administered by MBIPV Project through a voluntary scheme called Approved PV Service Provider (APVSP), whereby the PV companies are required to fulfil various quality checks in order to be given an annual license and to be listed in PTM directory. By end of 2009, there are 18 additional companies registered as APVSP making a total of 26 APVSPs.

There 26 PV service companies engaging a total of 132 fulltime staff in the PV business. PV manufacturing by First Solar and Q-Cells alone provided job opportunities for a total of 2.970 employees in Malaysia.

**Table 7: Estimated PV-related labour places in 2009**

Research and development (not including companies)	20
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	3.102
Distributors of PV products	
System and installation companies	
Utilities and government	50
Other	
<b>Total</b>	<b>3.172</b>

The total estimated PV-related labour places in 2009 are 3.172 of which the PV manufacturing companies comprised the largest sector of the total. This figure is expected to increase once the FDI completed their expansion plans from 2010 to 2012.

### 3.7 Business value

The PV business in Malaysia as of end 2009 is largely contributed by off grid PV systems. However, the pricing for off-grid PV systems is not available. Budget 2009 extended the incentives to grant exemption of import duty and/or sales tax of solar PV system equipment for third party usage translating to aslight price reduction in the overall system price.

**Table 8: Value of PV business**

Sub-market	Capacity installed in 2009 (kW)	Price per W (from table 7)	Value	Totals
Off-grid domestic	2.000	Not available	NA	Not available
Off-grid non-domestic				
Grid-connected distributed	286	USD 6,19	USD	USD 1.770.340
Grid-connected	None	NA	d	

Sub-market	Capacity installed in 2009 (kW)	Price per W (from table 7)	Value	Totals
centralized				
<b>Export of PV products</b> (including information from Tables 4 & 5)				Not available
<b>Change in stocks held</b> (including information from Tables 4 & 5)				NA
<b>Import of PV products</b> (including information from Tables 4 & 5)				USD 1.239.238 *

\* Based on 70% as imported value (PV and inverters). 30% are due to local costs (manpower, racking system, BOS).

#### 4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

The following table provides a summary of PV support measures in Malaysia and when each measure is activated. The MBIPV Project provides disbursement for capital subsidies, facilitated net metering and fiscal incentives such as the investment tax allowances and waiver of import duty and sales tax.

**Table 9: PV support measures**

	On-going measures	Measures that commenced during 2009
Capital subsidies for equipment or total cost	Nationwide programme for capital incentive since 2006 and concluding in 2010 for grid-connected PV systems for urban applications.	NA
Income tax credits	Investment Tax Allowance & Capital Allowance for PV systems at national level since September 2007.	Waiver of import duty & sales tax since September 2008.
Net metering	Introduced at national level since 2007.	NA
Net billing		

##### 4.1 Indirect policy issues

- a) International policies affecting the use of PV Power Systems;
  - The SURIA 1000 programme which came to an end in December 2009 is a financial incentive programme for the market founded on Japan's Sunshine programme and German's Rooftop programme to remove market barrier.
  - Since 2008, the MBIPV Project has been assisting the Ministry of Energy, Green Technology and Water Malaysia in developing a new Renewable Energy Policy and Action Plan to introduce a new legislation for Renewable Energy. This is to emulate Germany's very successful Renewable Energy Sources Act (EEG) and the feed-in tariff mechanism. The Renewable Energy Act is expected to come into effect in 2011.
- b) The introduction of any favourable environmental regulations;
  - None.

- c) Studies relating to externalities and hidden costs of conventional energy generation when compared to renewable energy;
- None
- d) Taxes on pollution (e.g. carbon tax);
- Although carbon tax is not practiced in Malaysia, CDM (Clean Development Mechanism) programme is promoted in the country as an incentive to reduce carbon footprint for country members who are part of Annex 1 under the Kyoto Protocol. Since 2002, 183 applications for CDM energy projects have been received out of which 53 energy projects applications have been successful. Out of the 53 projects, 5 projects have been issued CERs. It is estimated about 47 % of the CDM projects are from EFB and POME alone, but for total RE (EFB, Wood waste, POME, hydro and etc) is 65 % as of December 2009.
- e) National policies and programmes to promote the use of PV in foreign non-IEA countries.
- Sharing of RE updates to ASEAN country members via ASEAN Centre of Energy and RE Sub-Sector Network (RE-SSN) of which Malaysia Energy Centre (PTM) is the coordinator (<http://www.aseanenergy.org>). In May 2009, MBIPV Project shared the project status and lessons learnt with ASEAN country members at the 16<sup>th</sup> ASEAN Centre of Energy Renewable Energy Sub-Sector Network (ACE RE-SSN) in Vientiane, Laos. A talk on this similar topic was also conducted in July and August 2009 in response to invitations to the ASEAN Energy Business Forum 2009 at Mandalay, Myanmar and Brunei Darussalam respectively.

## 4.2 Standards and codes

A Malaysian Standard, MS1837:2005 on “Installation of Grid Connected Photovoltaic (PV) System” was developed as guidelines to PV service providers on requirements for PV modules, inverters, balance of systems and installation of the grid-connected PV systems. In July 2005, the MS 1837 was published with the objective of providing standards covering a wide range of issues such as electrical safety, quality of products, suitable equipment rating and quality installations for grid-connected PV. The standards are mainly for PV service providers to ensure proper installation of grid-connected PV systems and reference for PV training materials.

## 5 HIGHLIGHTS AND PROSPECTS

PV development in Malaysia is attributed to the commendable number of PV FDIs since 2006. The influx of FDIs has put Malaysia on the PV map giving the country high visibility in terms of PV production and generating capacity. The remaining section will provide the planned expansion capacities of each FDI in the country.

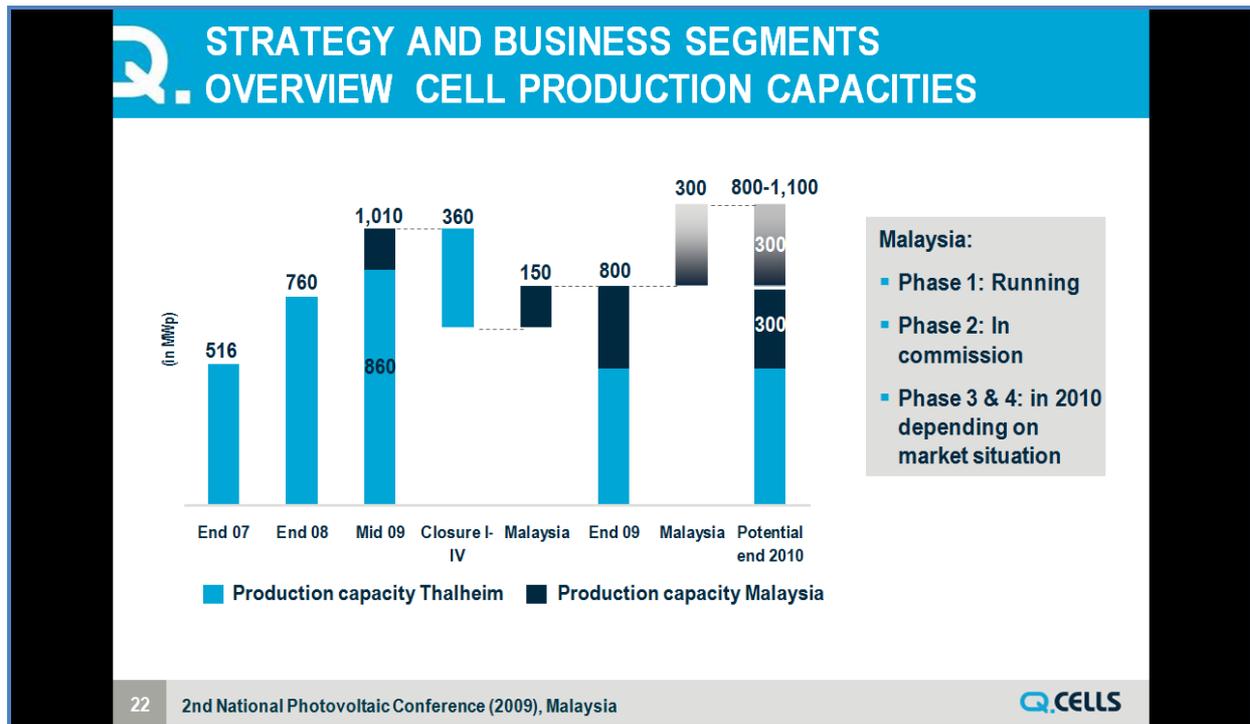
### Sunpower Corp (USA)

Based on the 2009 annual report from SunPower Corp : In 2009, SunPower started the construction of its 3rd manufacturing facility, FAB 3 in Malaysia. Production at the new facility is expected to start

in late 2010 with a total capacity of more than 1 GW when fully complete. FAB3 will be constructed in two phases.

**Q-Cells (Germany)**

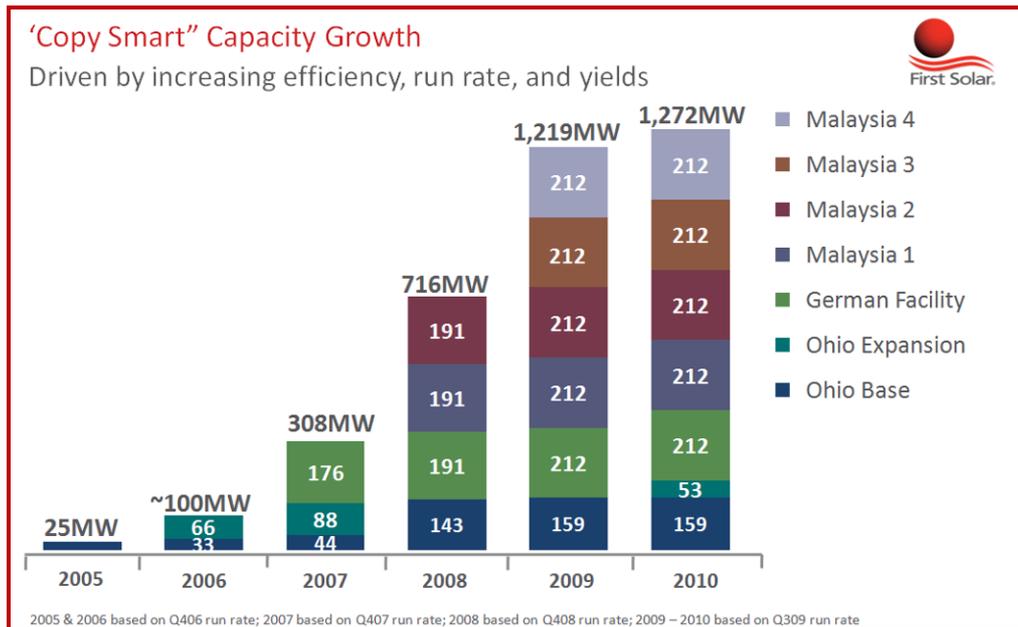
According to Q-Cells’ 2009 annual report : the commissioning of the first production line in Malaysia occurred in mid-2009, in Selangor. In addition to line two, line three and line four will be constructed in year 2009. In the final phase of expansion, the entire annual capacity of the Malaysian plants will come to 600 MW.



Source: Q-Cells AG (2009)

**First Solar (USA)**

Statement from First Solar’s fact sheet (Feb 2010) : Completed in 2009, the four facilities in Malaysia currently produce 854 MW of solar modules based on the 4<sup>th</sup> quarter run rate of 53,4 MW per line. Two new plants are being constructed, increasing the Malaysian production capacity to 1.282 MW of First Solar’s total capacity of 1.709 MW by 2011.



Source: First Solar Inc (2009)

In summary, Malaysia aspires to be a high-technology driven country and the solar PV industry has been identified to have the potential to contribute up to 4 % of the country’s gross domestic product by 2020. Under the 10<sup>th</sup> Malaysia Plan (2011 - 2015), Malaysia targets at least 65 MW in installed PV capacity.



Left to Right: Q-Cells (Selangor), First Solar (Kulim), SunPower (Melaka)

## ANNEX A: COUNTRY INFORMATION

This information is simply to give the reader some background about the national environment in which PV is being deployed. It is not guaranteed to be 100 % accurate nor intended for analysis, and the reader should do their own research if they require more detailed data.

Please provide the following, including a short reference as to the source of the information (for example, author's estimate, electricity supply association etc etc):

1) retail electricity prices - household, commercial, public institution

In 2009, Malaysia had an electricity tariff change effective March 1 when Tenaga Nasional Berhad (country's national electricity utility) announced an average electricity tariff reduction of 3,7 % in tandem with a 25 % reduction in the price of natural gas from USD 4,33/mmbtu to USD 3,24/mmbtu. Latest electricity tariff can be viewed at <http://www.tnb.com.my/tnb/tariff/newrate.htm>.

2) typical household electricity consumption (kWh)

Per capita electricity consumption was 3.732,33 kWh per annum (in 2009).

3) typical metering arrangements and tariff structures for electricity customers (for example, interval metering? time-of-use tariff?)

The utility tariffs comprise the following types:

- Low voltage (LV) block tariffs for residential customers, with varying blocks rates;
- LV tariffs for industrial, commercial and mining customers, with fixed block rates;
- Two-part tariffs for industrial, commercial and mining customers with MV (medium voltage, i.e. 6,6 kV to 33 kV) and HV (high voltage, i.e. above 33 kV) supply. In Sarawak, the two-part tariff also applies to LV supply customers but with a designated minimum monthly consumption limit;
- ToU (time of use) tariffs with Peak and Off-peak rates for energy, coupled with an MD (maximum demand) charge for the MD imposed on the supply system during the peak period only (0800 to 2200 for TNB, and 0700 to 2400 for SESCO) are available to industrial, commercial and mining customers;

Metering facilities employed cover different arrangements to suit the tariff category and consumption magnitude and include:

- Whole current (Class 2) meters for LV, single and 3 phase supply of up to 100 Amps, with CT (current transformer) metering for higher capacity LV supplies (and can include precision meters (of Class 0,5) for the highest consumption customers);
- CT metering for MV and HV supply customers, with single meters (for up to specified monthly consumption) and with two meters (main and check meters) for customers with higher monthly consumption.

The meter accuracy class varies according to consumption and includes Class 0,5 and Class 0,2 for the largest customers

Except for residential and public lighting use, other customers are subject to power factor (PF) penalties (if their average PF during the billing period falls below 0,85), and their metering incorporates kVAr metering to determine the average PF.

## 4) typical household income

The per capita gross national income is USD 7.302 (based on current prices).

## 5) typical mortgage interest rate

Base lending rate (BLR) has been on a downward trend, currently standing at a historic low of 5,55 % (compared to 6,75 % in 2008).

## 6) voltage (household, typical electricity distribution network)

The typical household electricity supply is via a 3 phase 400/230 volt system with 230 volt single phase supply for the smaller customers (up to about 12 kW load) and 3 phase supply for the larger customers. A few of the largest residential customers, whose load demand exceeds about 40 kW, are metered via CT meters. The LV supply is distributed through 11/0,4 kV substations equipped with transformers, predominantly of 1.000 kVA capacity, and with several LV feeders extending several 100 meters from the substations. The 11/0,4 kV substations are themselves fed from 33/11 kV or 132/11 kV substations of varying capacities to suit the load demand for the area concerned.

## 7) electricity industry structure and ownership (eg vertically integrated or separate generation, transmission, distribution?; retailers and network businesses – integrated or separate?; state owned or municipal or private etc?; electricity industry regulator?)

Malaysia initiated deregulation of the Electricity Supply Industry (ESI) with the granting of licences for Independent Power Producers (IPPs) from 1993 as a first step. Currently, the IPPs control about 50% of the total generating plant in Malaysia, while the three main utilities 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 utilities are vertically integrated but with IPPs playing a part in the power generation component of the industry. Further planned deregulation was frozen after the California Power Crisis.

## 8) price of diesel fuel

Price of diesel fuel as of 31<sup>st</sup> December 2009 was USD 0,51 per litre (retail).

## 9) typical values of kWh / kW for PV systems in parts of your country.

The typical values of kWh/kW ranges from 1.000 – 1.400 kWh/kW per annum.