

**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
2008**

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/m², 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 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, 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 3,6145 (<http://www.bnm.gov.my>, accessed on 30th 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 and the European Photovoltaic Industry 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.

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 2008. 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 EXECUTIVE SUMMARY

Malaysia lies between 2°N to 7°N to the equator with a population of 27 million. Malaysia became a full member of the IEA PVPS on 23rd October 2008. Photovoltaic (PV) applications in Malaysia are dominated by the off-grid market since 1980s, while the grid-connected PV applications only started in 1998. 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.

While the PV market in Malaysia is miniscule, the PV industry in Malaysia is starting to gain significance; this is largely fuelled by the presence of key international PV manufacturers in Malaysia, namely First Solar Inc, Q-Cells AG, SunPower Corporations, and Tokuyama Corporation.

On the policy front, grid-connected PV systems have been receiving capital incentives from the Government since 2006. The capital incentives will end by 2010. By 2011, the Government is planning to implement a new RE policy which will further drive the PV industry development.

While the country is preparing for the implementation of the new RE policy, soft infrastructure is continuously taking shape. These include capacity enhancement for local PV service providers, quality control scheme, and awareness programme for general public and commercial sectors.

It is foreseeable that renewable energies in Malaysia will take centre stage in the years to come as country prepares to wean off fossil fuel towards fuel sources which are truly clean, renewable and safe. This is a three-prong strategy which will address energy security, climate change mitigation and creating a new economy in green technology.

1.1 Installed PV power

As at the end of 2008, the total installed grid-connected PV systems was 775,73 kW and off-grid PV systems is estimated to be 8 MW. The total PV systems installed in 2008 for grid-connected application was 135,25 kW and for off-grid, the estimate was 1,625 MW. Off-grid PV market has been around much longer than grid-connected PV market. However, the off-grid is not a sustainable market as it is supported heavily by the Government for rural applications. The grid-connected PV market began in 2006 and this is attributed by capital subsidies available under the Malaysian Building Integrated Photovoltaic (MBIPV) Project. The Project which receives co-funding from Global Environment Facility will end by 2010. After that, it is envisaged that the feed-in tariff will take over in 2011 to keep the momentum going for PV and other renewable energies in the local market to be viable.

1.2 Costs & prices

The average turnkey grid-connected PV system cost as at end of 2008 was USD 7,23 per W. Average module pricing was USD 4,49 per W. The average PV system cost has declined by 6,3% compared to pricing from 2007.

1.3 PV production

Since 2008, Malaysia through the establishment of several key PV foreign direct investments (FDIs) has begun producing PV modules. These PV FDIs include First Solar Inc, Q-Cells AG, Sunpower Corporation, and Tokuyama Corporation. A grand opening ceremony for the first plant of First Solar was held in July 2008. The plant was located in Kulim Hi Tech Park in Kedah, Malaysia. There will be 4 plants by end of 2009; each plant has 4 production lines with production capacity of 191 MW each. As at end of 2008, 2 plants are already in operation. Q-Cells (wafer & cells) is expected to start their Malaysian production plant by end of 2009 while SunPower (wafer & cells) will only begin their production in 2010.

The total plant capacity for the two plants of First Solar Inc which is already in operation is 382 MW per annum. There is no official report from First Solar on the total PV production from the two plants in Kulim for 2008. Photon International (March 2009 issue) estimated First Solar production in Malaysia to be 167 MW for 2008. ReneSola Ltd which originally operated a poly silicon recycling plant in Johor closed their operation in late 2008 and consolidated their recycling operation back to China. This was due to the economic downturn which forced many companies to re-strategize their international operations.

1.4 Budgets for PV

The Malaysia Building Integrated Photovoltaic (MBIPV) Project is a promotion programme implemented by the Government of Malaysia which has a total fund for the 5-year project of USD 24,5 million. The project started in July 2005 and will end in the year 2010. The financiers of the project are Government of Malaysia, Global Environment Facility and the private sectors.

2 THE IMPLEMENTATION OF PV SYSTEMS

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 8 MW in installed capacity. Total installed grid-connected PV capacity as of December 2008 was 775,73 kW in 54 installations and this represented 21% growth. The largest installation is at the Enterprise Four Building at Technology Park Malaysia accounting for 46,65% of the total PV capacity in Malaysia at 361,9 kW. The second largest installation was a BIPV system at the Zero Energy Office of Malaysia Energy Centre, with total PV capacity of 92 kW. The BIPV system was commissioned in June 2007. Of the 24 new installations in 2008, two were for office buildings and twenty-two for residential. The two commercial buildings made up 40% of the total installed grid-connected PV capacity in 2008. The installed capacity for grid-connected PV systems is expected to reach 980 kW to 1.000 kW by end of 2009. The off-grid PV systems are expected to reach an estimate of 10 MW by the same period.

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 2008 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 2008 (kW) | 1.625 ¹ | | 135,25 | 0 | 1.760,25 |

A summary of the cumulative installed PV Power, from 1998-2008, 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 (kW) | | | | | | | | | | |
|-----------------------------------|--|-------|-------|--------|-------|--------|--------|--------|------|----------|----------|
| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
| Stand-alone domestic | 5.000 | | | | | | | | | 6.375 | 8.000 |
| 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 |
| Grid- connected centralised | Nil | | | | | | | | | | |
| TOTAL (kW) | 5.486 | | | | | | | | | 7.015,48 | 8.775,73 |

The main market driver for grid-connected PV systems is the financial incentive programme provided by SURIA 1000 (<http://www.mbipv.net.my/suria.htm>). SURIA 1000 works on bidding process which spreads over 6 calls with the final call ending on 1st December 2009. Other financial incentive programmes such as the Showcase incentive which provided 100% capital incentive for a total of 100 kW, both incentives have been fully awarded, SURIA for Developer which provided 35% capital incentive for a total of 340 kW and Demonstration incentive (<http://www.mbipv.net.my/C2Demo.html>) which provided 25% capital incentive for a total of 200 kW.

On policy matters, the Government of Malaysia announced the Budget 2009 on 29th August 2008, in which import duty and sales tax will be given an exemption on PV equipment for third party (individual). This should bring the price of PV systems down between 5% to 7% to the end-users. Companies are still able to enjoy the double tax allowances (investment tax and capital allowances) which were announced in Budget 2008 in September 2007. PV systems that are connected to the grid received billing based on net-metering by the

¹ Estimated only.

electricity utilities. Meanwhile, the Government of Malaysia is considering implementing a new RE policy to promote the widespread use of renewable energy and including solar energy in the country, which is planned to be introduced in the next Malaysia Development Plan which will start in 2011.

Capacity Building Programmes on photovoltaics implemented in 2008:

- A one-day forum on finance opportunities in PV technology and in PV business for local stakeholders from finance sector and government agencies was held on 24th March 2008. IEA PVPS Task 1 Swiss country member, Mr Pius Hüsser was one of the speakers at the forum. There were more than 240 participants at the forum.
- A seminar and colloquium on R&D and Quality Control for Photovoltaic was held on 26th May 2008. The event was for local stakeholders to understand the R&D level and capabilities with focus on PV in Malaysian universities and to learn from quality control schemes for PV products. IEA PVPS Task 1 Austrian country member, Mr Roland Bründlinger from Arsenal Research was one of the speakers at the seminar. A total of 120 participants from local universities, industries, government agencies and research institutions participated in the one day events.
- On 14th August 2008, the National PV Conference 2008 was organized as part of capacity building on PV Policy and Industry Developments. One of the highlights of the event was the announcement of the SURIA for Developer's award in which three property developers received financial incentives covering a total PV capacity of over 200 kW. The one-day conference attracted nearly 700 participants.
- Other activities organized included a 4-part series of thin film round table discussions (RTDs) from June to July 2008 as part of industry development programme. The discussions were aimed to provide greater understanding of thin film PV technology, business and networking opportunities. Speakers from Oerlikon Solar, Anwell Technologies, Applied Material and Nano PV spoke and shared information on their thin film technologies. Each RTD attracted almost 60 participants.

On 1st July 2008, the Government of Malaysia revised the electricity tariff so that commercial and industrial customers experienced an average increase of 26%. Low voltage commercial and low voltage industrial consumers consuming up to 200 kWh per month will experience a lower average increase of 18%. This was to adjust the cost of natural gas which was highly subsidized by the Government of Malaysia and the last adjustment for natural gas subsidy was in 1997.

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

By the end of 2008, SURIA 1000 has completed 4 calls out of 6. The analysis on the first 4 calls showed three significant results:

- i) A total of 342 kW in PV capacity was achieved against a target of 300 kW.
- ii) Overall 13% drop in price of grid-connected PV systems from a baseline of USD 8,06 per W.
- iii) By the 4th call, bidders' willingness to pay is 57,8% of total BIPV price which has increased from 46,7% in the 1st 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. MBIPV Project is currently sponsoring Universiti Malaya (UM) in inverter R&D which is suitable for tropical climate conditions with the objective for commercialisation. As of 2008, 3 prototype inverters have been developed and tested with capacity ranging from 1 to 2 kW. In 2009, UM will develop another 5 more prototype inverters with varying capacities.

R&D on PV cells, thin films and concentrators by the universities are at the moment still at fundamental or applied research stage. The key six universities in Malaysia involved in PV are Universiti Teknologi Mara (UiTM), Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), Universiti Sains Malaysia (USM), and Universiti Islam Antarabangsa (UIA). Most of the research is funded by the Ministry of Science, Technology and Innovation (MOSTI) under the National Science and Techno Funds.

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

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 | Not known | USD 5,3 million (2006-2010) |
| State/regional | | | Nil |
| Total | | | |

There is a total R&D grant scheme of USD 15 million 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, the application for the fund is on case by case basis. The fund is to last for the entire 9th Malaysia Plan which is from 2006 to 2010.

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 2008 as the FDIs such as SunPower Corporation, Q-Cells AG and Tokuyama Corporation are not yet operational as of 2008.

3.2 Production of photovoltaic cells and modules

Table 4: Production and production capacity information for 2008 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>Thin film manufacturers</i> | | | | | |
| 1 | CdTe | 167 | | 392 | |
| TOTALS | | 167 | | 392 | |

By the end of 2008, First Solar Inc has completed 2 plants in Kulim High Tech Park in Malaysia. Each plant has nameplate capacity of 191 MW. However, there is no official report from First Solar Inc on the total PV production in these 2 plants. Photon International (March 2009 issue) estimated First Solar production in Malaysia to be 167 MW for 2008. 100% of the production from First Solar is for export market.

Malaysia has a small local PV assembly factory, Solartif Sdn Bhd located in the State of Terengganu which was established in 2008. The factory has completed a trial run of 10 kW PV production in 2008. There is currently no availability of specially designed products (e.g. large size modules, modules with thermal benefits, facade and roof top modules, home system kits etc). Local cable manufacturers have recently adjusted production line and started with UV resistant DC cable for PV application.

3.3 Module prices

Table 5: Typical module prices for a number of years (USD per W)

| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Standard module price(s): Typical | 8,94 | 4,77 | 5,31 | 6,09 | 6,57 | 5,95 | 8,21 | 5,16 | 5,94 | 4,96 | 4,49 |
| PV module price for concentration | Nil | | | | | | | | | | |

Based on average price, figures (1998-2007) adjusted to 2008 using national inflation deflators (5.4% in 2008). 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 24 BIPV installations in Malaysia in 2008. PV Systems range from 3 to 45 kW | 7,23 |
| ON-GRID >10 kW | | |
| GRID – CONNECTED (centralized, if relevant) | None | NA |

Table 7a: National trends in PV system prices for On-Grid BIPV Applications

| YEAR | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|--------------------|-------|-------|-------|-------|-------|------|-------|------|------|------|------|
| Price /W: in USD * | 22,75 | 11,53 | 11,24 | 10,01 | 12,25 | 8,47 | 12,81 | 8,06 | 8,57 | 8,14 | 7,23 |

* based on average price and figures from 1998 to 2007 which have been converted to 2008 prices using national inflation deflators (5.4% in 2008).

The trend for PV systems pricing in Malaysia for grid-connected systems is declining through the years from 1998 to 2008. It is believed that for 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 encourages competitive pricing among PV service providers and proposed introduction of the feed-in tariff with a 6% degression rate.

3.6 Labour places

Table 7: Estimated PV-related labour places in 2008

| | |
|--|--------------|
| Research and development (not including companies) | 20 |
| Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D | 1.200 |
| Distributors of PV products | |
| System and installation companies | |
| Utilities and government | 50 |
| Other | |
| Total | 1.270 |

The total estimated PV-related labour places in 2008 are 1.270 of which the system and installation companies comprised the largest sector of the total. This figure is expected to increase once the FDI completed their expansion plans from 2009 to 2012.

3.7 Business value

The PV business in Malaysia as of end of 2008 is largely contributed by off grid PV systems. However, the pricing for off-grid PV systems is not available.

Table 8: Value of PV business

| Sub-market | Capacity installed in 2008 (kW) | Price per W (from table 7) | Value | Totals |
|--|---------------------------------|----------------------------|----------------|--------------------------|
| Off-grid domestic | 1.625 | Not available | NA | Not available |
| Off-grid non-domestic | | | | |
| Grid-connected distributed | 135,25 | USD 7,23 | USD 977.857,50 | USD 977.857,50 |
| Grid-connected centralized | None | NA | d | |
| Export of PV products (including information from Tables 4 & 5) | | | | USD 8 – 10 million* |
| Change in stocks held (including information from Tables 4 & 5) | | | | NA |
| Import of PV products (including information from Tables 4 & 5) | | | | USD 6.3 – 7.7 million ** |
| Value of PV business | | | | USD 9 – 11 million |

* Estimates derived from recycling of scrap, garden lightings, PV equipment, BOS. PV production from First Solar is not included as there is no official disclosure and the estimated figure may distort the country's PV total value if estimation is inaccurate.

** All PV modules and inverters for local installations are imported. PV modules constituted 60% of the total systems cost and inverters constitute 10%.

By the end of 2008, there were two major PV foreign direct investments (FDIs) in operation in Malaysia. By the end of 2008, the polysilicon recycling operation of ReneSola Ltd in Johor was consolidated back to China in an attempt to manage their cost during the economic downturn experienced in 2008. There is no indication if China will resume Malaysia's operation when the economic climate improves in the future.

Major PV FDIs in Malaysia, 2008

| Company | Product | Investment (USD) | Nameplate Capacity | Jobs Created | State |
|-------------------|--------------------------------------|------------------|--------------------|--------------|-------|
| First Solar | CdTe Modules | 550 million | 764 MW | 2.000 | Kedah |
| ReneSola Malaysia | Reclaiming silicon through recycling | Not available | 1.000 tons | 120 | Johor |

As a measure to enhance the skills of the local PV Service Provider, PTM provides a competency scheme called Approved PV Service Provider (APVSP), whereby the PV companies are required to fulfil various quality checks. The Approved PV Service Provider will be granted an annual license which includes participation in financial incentive programmes administered by the MBIPV Project. There are currently 17 companies

registered as APVSP. The directory of APVSP can be found in <http://www.mbiipv.net.my/APVPS.html>.

4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 9: PV support measures

| | On-going measures | Measures that commenced during 2008 |
|---|--|---|
| Capital subsidies for equipment or total cost | Nationwide programme for capital subsidy since 2006 & terminating 2010 for grid-connected BIPV 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 is a financial incentive programme for the market is based on Japan's Sunshine programme and German's Rooftop programme to remove market barrier.
 - MBIPV Project is assisting the Ministry of Energy, Green Technology and Communications Malaysia in developing a new Renewable Energy Policy that would introduce legislation for Renewable Energy. This is to emulate Germany's very successful Renewable Energy Sources Act (EEG) and the feed-in tariff.
- 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;
- Two studies were carried out in 2008 by Malaysia Energy Centre. They were:
 - i) Photovoltaic (PV) Policy Recommendations for Malaysia on global and local grid-connected PV applications, global PV policies and the overview of the local scenario. Key finding of the study was that the Feed-in Tariff (FiT) is the best choice for rapid growth of market for solar PV as it produced the fastest results at the lowest cost of deployment of RE technologies.
 - ii) Formulation of a Framework for PV Policy and Financing Mechanism, this was an independent policy, regulatory and financial analysis. Key finding of the study was the proposed maximum Feed-in Tariff (FiT) for solar PV in Malaysia at USD 0,61 per kWh is slightly less than the cost of conventional peak electricity at USD 0,66 per kWh (with fuel subsidy

included) and almost 5 times higher than the average domestic electricity tariff* (with fuel subsidy included).

* Note: Assessments were based on the power utility’s tariffs in year 2006 for Peninsular Malaysia only.

- The outcome of these studies were used to support the proposed new RE Policy and Action Plan for the Ministry of Energy, Green Technology and Water.
- 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 incentive to reduce carbon footprints for country members who are part of Annex 1 under the Kyoto Protocol. As of end of 2008, Malaysia registered a total of 12 CDM projects (648,718 CERs issued) and nearly 50% of the CDM projects are from empty fruit bunches (EFB) and Palm Oil Mill Effluent (POME).
- 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>).

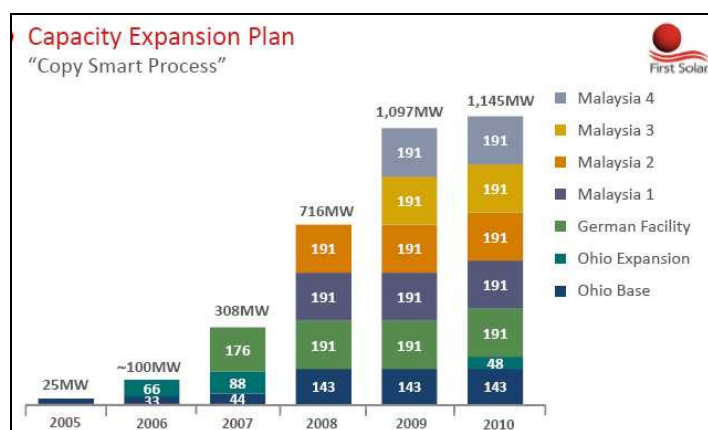
4.2 Standards and codes

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.

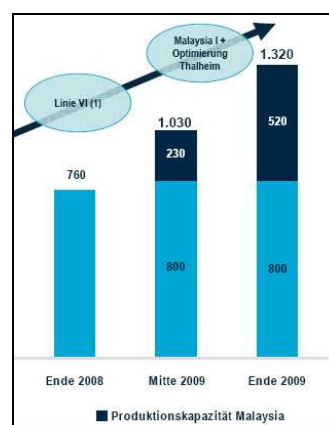
In July 2005, the MS 1837 was published with the objective of providing standards covering a wide range of issues such as electrical safety, quality of products, suitable equipment rating and quality installations for grid-connected PV. The standards are mainly for PV service providers to ensure proper installation of grid-connected PV systems and reference for PV training materials.

HIGHLIGHTS AND PROSPECTS

In Malaysia, the total PV and cell production capacity in 2009 would be expected to come from First Solar Inc (764 MW) and Q-Cells AG (520 MW) giving a total of 1.284 MW. This would be an increase of over 3 fold from 2008. Operations such as Sunpower Corporation and Tokuyama Corporation are expected to only be ready by 2010 and 2012 respectively.



Source: First Solar Inc



Source: Q-Cells AG

Significant developments in technologies

With reference to Chapter 2.4, the local universities are focusing on five major areas of R&D in PV; these included inverters, PV concentrators, cells including thin films, hybrid systems and energy conversion tracking system. Universiti Malaya (UM) has researched and developed prototype inverters which are suitable for tropical climate conditions. UM is currently actively looking for industry partners for commercialisation.

Long term targets for installed PV power capacity, or future energy scenarios

Malaysia plans to introduce a new RE policy in the 10th Malaysia Plan (to start from 2011) for renewable energy market acceleration. By 2011, Malaysia aims to achieve 217 MW for overall RE cumulative target in which PV will constitute 7 MW. By 2015, overall RE cumulative target is expected to reach 975 MW with PV constituting 55 MW. By 2030, total capacity from RE is targeted to reach 3.484 MW (of which PV is 854 MW) or 13% of total installed power capacity.

ANNEX A: COUNTRY INFORMATION

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

On 1st July 2008, the national utility revised the electricity tariff. The commercial and industrial tariffs were increased by 26%. The low voltage commercial and low voltage residential consumers consuming up to 200 kWh per month will experience a lower average increase of 18%. This was to adjust the cost of natural gas which was highly subsidized by the Government of Malaysia and the last adjustment for natural gas subsidy was in 1997.

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 3.587 kWh per annum (in 2008).

3) Typical metering arrangements and tariff structures for electricity customers

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

According to key development indicators, Malaysia is now a high middle-income, export-oriented economy, with per capita GDP (in current prices) of USD 7.479 in 2008.

5) Typical mortgage interest rate

Base lending rates as at 31st December 2008 is 6,75% (unchanged from 2007).

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

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 31st December 2008 was USD 0,47 per litre (retail).

9) Typical values of kWh/kW for PV systems in parts of the country

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