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 2006

Prepared by
Malaysia Building Integrated Photovoltaic (MBIPV) Project,
Malaysia Energy Centre,
No.2, Jalan 9/10,
Persiaran Usahawan, Seksyen 9,
43650 Bandar Baru Bangi,
Selangor Darul Ehsan
Malaysia

April 2007

National Report Authors:
Ir Ahmad Hadri Haris
Lalchand Gulabrai
Daniel Ruoss
Wei-nee Chen

Table of Content

i 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 nineteen participating countries are Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), The Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), 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 research projects (tasks) is the responsibility of Operating Agents. Ten tasks have been established and currently six are active. Information about these tasks can be found on the public website www.iea-pvps.org. A new task concerning PV environmental safety and health is now being developed.

The objective of Task 1 is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems.

ii 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. This report gives information on trends in PV power applications in the PVPS member and other countries and is largely based on the information provided in the National Survey Reports which are produced annually by each Task 1 participant. The public PVPS website also plays an important role in disseminating information arising from the programme, including national information. This template is intended to assist national experts and other participants of Task 1 in the preparation of their annual PVPS National Survey Reports.

As the ***Trends in photovoltaic applications*** report is based on the National Survey Reports it is important that experts follow this template when preparing their national reports. The ***Trends*** report is an external publication of the IEA-PVPS Implementing Agreement so it must not contain confidential information. Similarly, the National Survey Reports are now presented on the public PVPS website and Task 1 participants should make their own arrangements with their sources on how to treat confidential information (e.g. by ensuring anonymity of the data).

National Survey Reports should be produced before the end of May to enable the ***Trends*** report to be published by the end of August.

When preparing their national reports, experts must ensure that all the data are as accurate and correct as possible and follow the definitions given in this template. All sections must be completed as comprehensively as possible.

1 Executive summary

This report covers data for grid-connected building integrated photovoltaic system (BIPV) in Malaysia. There is no consolidated data available on off-grid PV installations, although the unofficial estimate stood between 5 - 6MWp.

As at the end of 2006, the total grid-connected BIPV systems was 486kWp with the average turnkey BIPV system cost to be US$8.13 (<10kWp). Average module pricing was US$5.94. It must be noted that due to the low number of grid-connected BIPV systems installed, the prices per installation fluctuated and hence the average BIPV component costs did not follow closely to the global pricing.

Also, as at the end of 2006, there is no PV production; only production of off-grid PV-related components such as storage battery and charge controllers.

Under the Malaysia BIPV Project, the total fund for the 5-year project is US$24.5m. 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.

Currency used in this report is based on US$, based on exchange rate of 1US$ = RM3.600.

2 The implementation of PV systems

2.1 Applications for photovoltaics

Total BIPV installed capacity as of December 2006 was 486 kWp in 20 installations. The largest installation is at the Enterprise Four Building at Technology Park Malaysia accounting for 74.5% of the total BIPV capacity in Malaysia at 361.9 kWp.

2.2 Total photovoltaic power installed

Table 1 The cumulative installed PV power in 4 sub-markets.

Sub-market/ application ##	31 Dec. 1998 kW	31 Dec. 1999 kW	31 Dec. 2000 kW	31 Dec. 2001 kW	31 Dec. 2002 kW	31 Dec. 2003 kW	31 Dec. 2004 kW	31 Dec. 2005 kW	31 Dec 2006 kW
off-grid domestic									
off-grid non-domestic									
grid-connected distributed	16.86	22.85	29.05	407.07	459.1	464.14	468.34	481.48	486

grid-connected centralized									
TOTAL	16.86	22.85	29.05	407.07	459.1	464.14	468.34	481.48	486

Notes

Descriptive outline of key PV policy initiatives, promotional activities (commercial and non-commercial) or any other **market drivers** of significance in 2006

Key PV policy initiatives

- Utility agreements for grid-connection of the PV systems to the local distribution grid,
- Utility agreement to adopt the "net-metering" concept for PV generated electricity fed into the utility grid,

Promotional activities

- Media publications via advertisements and press releases in newspapers, magazines (http://www.ptm.org.my/bipv/news.htm)
- Organizing BIPV seminars & workshops (see milestone reports under Component 1 in http://www.ptm.org.my/bipv/MBIPV_project.htm)

Any other **market drivers** of significance

- Financial incentive programmes (see also section 4.1 New Initiatives)
  - Showcase Incentive Category
  - Demonstration Incentive Category (http://www.ptm.org.my/bipv/dload/Guideline_demo__080906__final.pdf)
  - SURIA 1000 (http://www.ptm.org.my/bipv/suria.htm)

Highlight of any interesting electricity utility and public **stakeholder** developments that were important during the year.

- Establishment of 1st grid-connected BIPV Training at Universiti Kuala Lumpur, Malaysian British Institute which is ISP compliant (http://www.bmi.edu.my/bipv/index.php)
- Formation of Malaysian Photovoltaic Industry Association (http://www.ptm.org.my/bipv/MPIA.html)

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

2006 was a year of preparation of soft infrastructure for PV growth in Malaysia. Soft infrastructures including promoting PV awareness, capacity building and developing the financial incentive programme. As a result, the net growth of PV was very low, only 4.52kWp. A much higher PV growth is expected in year 2007 with the completion of some showcase, demo and SURIA 1000 projects.

2.4 Highlights of R&D

Please provide a brief overview of key R&D activities within your country related to PV power systems.

Most of the PV-related R&D activities are carried out by public universities. To-date, the type of R&D activities include:

- Developing of grid-connected (3kW) inverter by University of Malaya
- Developing solar cell by University Science Malaysia
- Developing organic cell by the National University
- Developing (5kW) grid-connected inverter and solar car by University Technology of Malaysia
- Developing of concentrator PV technology by University Tun Abdul Rahman
- Developing charge controller and PV systems by University Technology Mara
- PV Systems by TNB Research Sdn Bhd (subsidiary of main electricity utility)

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

Table 2 Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test	Market
National/federal		Collectively over US$1m	US$4.16m
State/regional			nil
Total	*	Over US$1m	US$4.16m

* There is a total R&D grant scheme of US$241m under the Ministry of Science, Technology and Innovation of which it also caters for solar R&D. 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 – 2010.

3 Industry and growth

3.1 Production of feedstocks, ingots and wafers

There is no production of feedstocks, ingots or wafers in Malaysia in 2006.

Table 3: Production and production capacity information for the year for silicon feedstock, ingot and wafer producers

Producers	Process & technology	Total Production	Maximum production capacity	Product destination?	Price??
	Silicon feedstock	*none*	*tonnes/year*		
	sc-Si ingots.	*none*	*tonnes/year*		
	mc-Si ingots	*none*	*tonnes/year*		

	sc-Si wafers	*none*	*MW/year*
	mc-Si wafers	*none*	*MW/year*

Give in Table 3 the following information for the year:

a) List by name all manufacturers (if possible).

b) Type of process and technology eg polysilicon, silicon ingots, EFG ribbon wafers, silicon wafers and so on.

c) Total production of each manufacturer for 2006.

d) Maximum production capacity.

e) Where does this production go? Eg Export? Subsidiary of company in Table 4? etc

Note : GEWD is a silicon wafer trading house based in Kuala Lumpur (Malaysia) and is wholly owned by Solar-Fabrik AG. GEWD buys recyclable wafers from the semiconductor industry, opening up a new source of raw material previously unavailable to the solar power sector. The actual recycling process is carried out in Chennai (India).

3.2 Production of photovoltaic cells and modules

There is none in Malaysia at the moment.

Table 4: Production and production capacity information for the year for each manufacturer (*a-h, x, y are examples)*

Cell/Module manufacturer	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**			**Maximum production capacity (MW/yr)**		
		Cell	Module	Concentrators	Cell	Module	Concentrators
1		***a***			***b***		
2		***c***	***d***		***e***	***f***	
3 etc							
Thin film manufacturers							
1		***x***	***x***		***y***	***y***	
2 etc							
Concentrators							
1				***g***			***h***

TOTALS		**a+c+x**	**d+x**	**g**	**b+e+y**	**f+y**	**h**

The following additional information may also be provided in text:

a) Whether the manufacturer produces their own cells in-house or whether they are purchased on the international market, or both.

b) An indication of the amount of production (cells, modules, other components, systems) exported from the country.

c) Availability of specially designed products (large size modules, modules with thermal benefits, facade and roof top modules, home system kits etc.).

d) New developments and new products that arrived on the market during 2006.

In Table 4a please add year 2006 module prices: for small (typical?) and large (best price?) orders, if possible; OR an indicative national figure. **Please clarify whether you are reporting an average price, a representation of all known prices, a typical example, or so on.**

Table 4a: Typical module prices for a number of years

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
Module price(s): Typical	8.94	4.77	5.31	6.09	6.57	5.95	8.21	5.16	5.94
Best price									

Based on average price, adjusted to 2006 using national inflation deflators. All modules are imported.

3.3 Manufacturers and suppliers of other components

Balance of system component manufacture and supply is an important part of the PV system value chain. Please briefly comment on the nature of this industry in your country, paying particular attention to recent trends and industry outlook, under the headings of:

- PV inverters (for grid-connection and stand-alone systems) and their typical prices. No production.
- Storage batteries – yes, but production volume data is not readily available.
- Battery charge controllers – yes, but production volume data is not readily available.
- DC switchgear No production.

- Supporting structures - Locally made mounting structures constructed on project basis.

3.4 System prices

Please give in Table 5 turnkey prices (excluding VAT/TVA/sales tax) per W for the various

Table 5: Turnkey Prices of Typical Applications

Category/Size	Typical applications in your country and brief details	Current prices per W (to one decimal point) in US$ *
OFF-GRID Up to 1 kW	Data not available	Data not available
OFF-GRID >1 kW		
GRID-CONNECTED Specific case		
GRID-CONNECTED Up to 10 kW	Typically for R&D purposes at Universities (total 46.16kWp at 10 sites), commercial (total 37.89kWp at 2 sites) & remaining capacity at private residential homes.	8.13
GRID-CONNECTED >10 kW	The largest PV installation was at Technology Park Malaysia - 361.9kWp	Not available

Table 5a: National trends in system prices (current) for grid-connected (up to 10kW) (*specify application, for example from table 5 above*)

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006
Price /W in US$ *:	21.58	10.94	10.66	9.50	11.62	8.04	12.15	7.65	8.13

** based on average price and converted to 2006 prices using national inflation deflators.*

3.5 Labour places

Provide an estimate of labour places in the following (where these are mainly involved with PV):

a) Research and development (not including companies); Around 20

b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D; None

c) All other, including within electricity companies, installation companies etc. Around 50 labour places

3.6 Business value

Provide an estimate of the value of PV business in your country by the Gross Domestic Product approach, using Table 6 and as described in the Swiss discussion paper previously circulated (further copies from Task 1 OA).

The PV business in Malaysia as of end of 2006 would be negligible (see table below) when compared to our GDP. PV in Malaysia is still very much in the pre-infancy stage and much focus is on market incentive and public awareness in year 2006 until 2010.

Table 6: Value of PV business

Sub-market	**Capacity installed *in 2006* (kW)**	**Price per W** *(from table 5)*	**Value**	**Totals**
Off-grid domestic	*X*	*Y*	*a = X x Y x 1 000*	
Off-grid non-domestic			*b*	
Grid-connected distributed	4.52kWp	US$8.13	*US$36,748*	*US$36,748*
Grid-connected centralized			*d*	
				a+b+c+d
Export of PV products *(including information from Table 3)*				*e*
Change in stocks held *(including information from Table 3)*				*f*
Import of PV products *(including information from Table 3)*				*g*
Value of PV business				*US$36,748*

If possible, please provide some brief comment on the industry value chain in your country or provide references to articles, reports dealing with this topic.

No production in any value chain

4 Framework for deployment (Non-technical factors)

Please complete the following table to summarize what PV support measures were in place in your country during 2006:

Table 7: PV support measures

	National / Regional (State) / Local
Enhanced feed-in tariffs	
Direct capital subsidies	National
Green electricity schemes	
PV-specific green electricity schemes	
Renewable portfolio standards (RPS)	
PV requirement in RPS	
Investment funds for PV	
Tax credits	
Net metering	Regional
Net billing	
Commercial bank activities	
Electricity utility activities	Regional
Sustainable building requirements	

4.1 New initiatives

The most significant initiative was the physical execution of the MBIPV project with its attractive financial support mechanisms under the three categories as shown below.

No.	Category	PV Capacity	Capital rebate support (%)
1	Showcase	100 kWp	100% of capital cost
2	Demonstration	200 kWp	25% to 28% of capital cost
3	SURIA 1000 (1st call – 40 kWp)	1,200 kWp	Up to 75%, reducing by 5% for each call which is every 6 months.

This initiative was based on the local utility's support in permitting grid-connection to its low voltage (415/240 volt) distribution network supplying residential and commercial customers. The utility in Peninsular Malaysia, TNB (Tenaga Nasional Berhad) also agreed on a "net-metering" concept whereby the electricity generated form BIPV installation and fed into its distribution grid was valued at the same rate as the highest block of the supply tariff for the customers concerned.

TNB incorporated a few clauses in its supply agreement with such customers to cater for the relevant safety and commercial issues involved.

Please describe any other support measures that are significant in your country.

The electricity supply industry Regulator, the Suruhanjaya Tenaga (ST, or Energy Commission) supported the MBIPV project implementation by agreeing to seek the Ministry of Energy, exemption for regulatory licensing fees and "Competent Control" requirements for BIPV generation systems from licensing requirement and payment of the associated annual fees.

4.2 Indirect policy issues

Please give one paragraph on any policy initiatives that may influence the implementation of PV power systems in your country. This could include details of:

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 Project/Solar Photovoltaic Programme.
- MBIPV Project is targeting to emulate Germany's Renewable Energy Act, EEG feed-in tariff. At the moment, only net metering is allowed.

b) the introduction of any favourable environmental regulations; None

studies relating to externalities and hidden costs of conventional energy generation when compared to renewable energy; Yes, at least 2 reports (prepared by Malaysian-Danish Environmental Cooperation Program Renewable Energy and Energy Efficiency Component, Q4 2006, Q1 2007).

c) 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.

d) national policies and programmes to promote the use of PV in foreign non-IEA countries.

The Government of Malaysia (GoM) established a Five Fuel Policy for Power Generation incorporating RE as the Fifth Fuel in the 8th Malaysia Plan (8MP), which is one of the sequential 5-year national economic development plans, in 2001. Under the Plan, the GoM also initiated a Small RE Power (SREP) Programme to promote the development of the RE power generation projects, including solar energy. Malaysia BIPV Project was formed under the renewable energy segment of the 9th Malaysia Plan (9MP).

The UNDP/GEF supported MBIPV project is also included as an initiative in the National Industrial Master Plan and the 10-year "Outline Perspective Plan"

4.3 Standards and codes

Please give one paragraph maximum on any new issues relating to Standards and Codes of Practice. Areas to be considered include:

- Technical regulations for PV plant construction and operation (d.c. working voltage, safety and control devices, supporting structures, etc.); As per MS1837:2005.
- Availability of standards and grid interconnection rules for PV systems (protection; islanding; harmonic distortion, power factor, safety, etc.)

  In July 2005, the Malaysian Standard on Installation of Grid-connected photovoltaic systems (MS1837:2005) 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.
- Specific rule problems to be solved in order to facilitate PV system diffusion;
- Building and wiring codes

5 Highlights and prospects

Please highlight key aspects of PV deployment or production in your country during 2006 that you consider should be reported in the ***Trends*** report. None.

Please give one paragraph maximum on forward looking issues within your country (not covered elsewhere in your report) such as:

- Details from industry of planned increases in PV module production capacity. 0kWp for 2008
- Any significant developments in technologies. None in 2008
- Long term targets for installed PV power capacity, or future energy scenarios.

The Ministry of Energy, Water and Communications (MEWC) commissioned Pusat Tenaga Malaysia (PTM, or Malaysia Energy Centre) to conduct a study to develop a "Solar, Hydrogen and Fuel Cell Roadmap" for the country covering a period up to 2050.

The roadmap was prepared and submitted to the MEWC in 2006 and was under deliberation by the Ministry. It is anticipated that the Roadmap will form an input to the nation's long-term planning for future energy needs to drive the planned economic development.

The MBIPV project envisages the installation of about 1,500 kWp of BIPV systems by 2010 (equal to an increase of about 330% over the project period of 2006 - 2010). The MBIPV project is expected to generate sustained growth in BIPV installations to achieve an estimated installed capacity of about 20,000 kWp by 2020, giving an annual growth of about 30% from 2010 to 2020.

Annex A Method and accuracy of data

When preparing the **Trends** report, it is necessary to know the accuracy of the data provided in the NSRs. Therefore, in this Annex please give:

a) A summary of the methods used to gather, process and analyse the data given in the NSR.

As grid-connected BIPV capacities in Malaysia is still very small, most installations were carried out by universities as R&D project, or residential homes as part of demonstration project and a few other known commercial projects. The data was collected via interview with owners of the BIPV systems and also if the installers (if they are still in operation).

Other sources of information are:

- Statistics from Electricity Supply Industry in Malaysia Year 2006 Edition by The Energy Commission
- The Costs of Doing Business in Malaysia – Malaysian Industrial Development Authority, February 2006 http://www.mida.gov.my/beta/pdf/CODB2006_eng.pdf
- Market Status Report on BIPV in Malaysia – Pegasus Business & Market Advisory Sdn Bhd, January 2007 http://www.ptm.org.my/bipv/dload/MBIPV%20Reports/C1/milestone%20for%201.9/Market%20Survey.pdf

b) An estimate of the accuracy of the data if this is worse than 10 %. The accuracy can be given as a tolerance (either 20kW ± 20% or 20kW ± 4 kW) or as a range (e.g. 16kW to 24kW).

c) If a country cannot provide the necessary data please give the reason here. Not applicable.

Annex B Country information (based on December 2005)

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

Visit http://www.tnb.com.my/tnb/tariff/newrate.htm

2) typical household electricity consumption (kWh)

Per capita electricity 3,193kWh

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

The utility tariffs can be accessed from the following web-site for all utilities in Malaysia.http://www.st.gov.my/statistic.html

The 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

Income is US$5,030

5) typical mortgage interest rate

Base lending rates as at 31st December 2006:
Commercial banks - 6.20%
Finance companies - 7.03%

6) voltage (household, typical electricity distribution network)

The typical household electricity supply is via a 3 phase 415/240 volt system with 240 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 form 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 3 main utilities control about 50% of the 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 P.

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

US$0.44/litre (retail), US$0.48 - 0.52/litre (bulk consumers)

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

1,150kWh/kW per annum