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 2007

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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 21 participating countries are Australia, Austria, Canada, Denmark, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, The United Kingdom and The United States of America. 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. Eleven tasks have been established and currently seven are active. Information about these tasks can be found on the public website www.iea-pvps.org.

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. In parallel, National Survey Reports 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. These guidelines are intended to assist national experts and other participants of Task 1 in the preparation of their annual PVPS National Survey Reports.

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 at least by the middle of the year following the reference year (ie within six months of the collected information).

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 these guidelines. All sections should be completed as comprehensively as possible.

1 Executive summary

This report covers data for grid-connected photovoltaic system (PV) in Malaysia. Data on off-grid PV installations is in the process of compilation. Henceforth, the reported data on off-grid is only estimation until the data has been verified.

As at the end of 2007, the total installed grid-connected PV systems was 640.48 kWp with the average turnkey PV system cost to be US$7.72. Average module pricing was US$4.96. The average PV system cost has declined by 7.3% compared to pricing from 2006.

Malaysia does not produce any PV modules, only production of off-grid PV-related components such as storage battery and charge controllers. First Solar, the world's leading solar thin manufacturer announced on 25th January 2007 that it will expand production with four new manufacturing plants and 16 lines with an expected annual capacity (or nameplate capacity) of 704 MW. The manufacturing plants will be located in Kulim Hi Tech Park located in Kedah, Malaysia. The first ramp up of 176 MW will be in July 2008.

Under the Malaysia Building Integrated Photovoltaic (MBIPV) 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$, based on exchange rate of 1US$ = RM3.3065 (http://www.bnm.gov.my)

2 The implementation of PV systems

2.1 Applications for photovoltaics

Total PV installed capacity as of December 2007 was 640.48 kWp in 32 installations. The largest installation is at the Enterprise Four Building at Technology Park Malaysia accounting for 56.5% of the total PV capacity in Malaysia at 361.9 kWp. The second largest installation was the BIPV systems at the Zero Energy Office for Malaysia Energy Centre, with total PV capacity of 92 kWp which was commissioned in June 2007. Of the 12 new installations in 2007, three were for office buildings, seven for residential, one for university and a school.

2.2 Total photovoltaic power installed

Table 1 - The PV power installed in 4 sub-markets during 2007.

Sub-market/ application ##	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	total
PV power installed in 2007 (kW)	1,375		154.48	-	1, 529.48

Table 2 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	31 Dec 2007 kW
off-grid domestic									5,000	6,375
off-grid non-domestic										
grid-connected distributed	16.86	22.85	29.05	407.07	459.1	464.14	468.34	481.48	486	640.48
grid-connected centralized										
TOTAL									5,486	7,015.48

Notes

Please check that the TOTAL figure given corresponds to the total for the column above.

The cumulative installed power should include power installed before 1992.

***##** A single figure can be provided for <u>total</u> off-grid applications **<u>only</u>** if there are significant difficulties in providing separate figures for domestic and non-domestic; please refer to the amended definitions (page 5) for grid-connected*

applications or contact Task 1 colleagues for assistance to ensure that both distributed and centralized data are apportioned.

Please provide **at least three** paragraphs of text following Table 2:

- Details of key PV deployment activities in 2007, including any major projects, demonstration and field test programmes, and market stimulation programmes in operation during the year (one paragraph for each item). Provide if possible additional discussion on the strengths and weaknesses of key items.

- A descriptive outline of key PV policy initiatives, promotional activities (commercial and non-commercial) or any other market drivers of significance starting in 2007;

- Any interesting electricity utility and public stakeholder developments that were important during the year.

Key PV policy initiatives

On 7th September 2007, the government announced under the Budget 2008 incentive enhancement for companies generating renewable energy for "own-use". Under this incentive, Accelerated Capital Allowance was enhanced to Investment Tax Allowance (ITA) of up to 100% of the Qualifying Capital Allowance. This is equivalent to a "double-tax-allowance" as the ITA is in addition to the normal Capital Allowance granted on all qualifying capital expenditure for conducting business.

Promotional activities

- Media publications via advertisements and press releases in newspapers, magazines (http://www.mbipv.net.my/news.htm)
- Organizing BIPV seminars & workshops (see milestone reports under Component 1 in http://www.mbipv.net.my/MBIPV_project.htm
- Official launching of National SURIA 1000 programme on 22nd June 2007 by the Prime Minister of Malaysia.

Any other **market drivers** of significance

- Financial incentive programmes (see also section 4.1 Support Measures and New Initiatives)

MBIPV Category	Purpose of BIPV Category	MBIPV Incentives
BIPV Showcase Target: 100 kWp	To create BIPV success stories and excellent example for public/ industry references	100% technical and financial incentives (limited to BIPV system), and promotional support

MBIPV Category	Purpose of BIPV Category	MBIPV Incentives
BIPV Demonstration Target: 200 kWp	To stimulate the local building industry (private and government sectors)	100% technical support and limited financial support for BIPV system (1st 100kWp: 28%, 2nd 100kWp: 25%), and promotional support
Suria 1000 Target: 1200 kWp	To catalyse BIPV market by targeting general public to install BIPV at their premises (homes/ buildings) & property developers	Financial incentives from 75% (1st call) reducing to 40% (7th call) over a four-year period, based on a bidding concept; & max 35% for property developers.

For more information on the incentives, please visit their corresponding webpages:

- Demonstration Incentive Category (http://www.mbipv.net.my/C2Demo.html)
- SURIA 1000 (http://www.mbipv.net.my/suria.htm)
- SURIA for Developers (http://www.mbipv.net.my/SDP.htm)

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

Announcement by First Solar to expand their solar thin film manufacturing plant in Malaysia, capacity announced at 704 MW for four four-line plants at Kulim High Technology Park in Kedah.

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

By 31st December 2007, SURIA 1000 has announced three calls (one in 2006, two in 2007) for the bidding of capital-based incentive which is open to members of the public. Together with SURIA 1000 (bidding based), showcase (100% capital rebate) and demo incentives(25 - 28%), the momentum for installation of BIPV systems started to gather at a moderate pace which saw three of the installations in commercial buildings, three in residential houses and one in university. The results of bidding for SURIA 1000 can be viewed from http://www.mbipv.net.my/S3.html

In 2007, Malaysia Energy Centre (Pusat Tenaga Malaysia) decided to provide ISP-accredited grid-connected PV training course in order to achieve the objective of having a pool of competent PV designers and installers. Hence, the second half of 2007 was used to prepare Malaysia Energy Centre for the attaining the ISP accreditation for the grid-connected PV Systems training course. The course was commercialized by Q1 2008.

The establishment of a PV Monitoring Centre by Universiti Technology Mara UiTM) to monitor the performance of grid-connected PV systems implemented under the MBIPV financial incentive programmes. (http://pvmc.uitm.edu.my/pvmc).

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 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 3 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 2007.

Table 4: 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 5: 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)** Cell	Module	Concentrators	**Maximum production capacity (MW/yr)** 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 6 please add year 2007 module prices (excluding VAT/TVA/sales tax): 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 6: Typical module prices for a number of years

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Module price(s): Typical	9.15	4.88	5.44	6.24	6.73	6.09	8.41	5.28	6.08	4.96
Best price										

Based on average price, figures (1998-2006) adjusted to 2007 using national inflation deflators (2.4% in 2007). 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 7 turnkey prices (excluding VAT/TVA/sales tax) per W for the various

Table 7: 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	There are only 7 BIPV installations in 2007. The average price is already weighted with their corresponding PV capacity.	7.72
GRID-CONNECTED >10 kW		

Table 7a: National trends in system prices (current) for grid-connected (up to 40kW) (*specify application, for example from table 7 above*)

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Price /W in US$ *:	22.10	11.20	10.92	9.73	11.90	8.23	12.44	7.84	8.33	7.72

** based on average price and figures from 1996 – 2006 have been converted to 2007 prices using national inflation deflators (2.4% in 2007).*

The trend for PV systems pricing in Malaysia for grid-connected systems is declining through the years from 1998 to 2007. 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.

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 2007 is largely contributed by off grid PV systems.

Table 8: Value of PV business

Sub-market	**Capacity installed *in 2007* (kW)**	**Price per W** *(from table 7)*	**Value**	**Totals**
Off-grid domestic	*X*	*Y*	*a = X x Y x 1 000*	
Off-grid non-domestic			*b*	
Grid-connected distributed	154.48kWp	US$7.72	*US$1,192,686*	*US$1,192,585*
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$1,192,585*

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)

4.1 Support measures and new initiatives

If not already covered in section 2.2, please identify and give a brief description of any support measures from Table 9 that have been launched or identified in your country **during 2007 (or early 2008)**.

Table 9: 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	(ITA & CA) National
Net metering	Regional
Net billing	
Commercial bank activities	
Electricity utility activities	Regional
Sustainable building requirements	

The most significant support by government for PV is the announcement made during the Budget 2008. Under Budget 2008 announcement, environment incentives "double tax" allowances for companies generating electricity from renewable form of energy (Investment Tax Allowance & Capital Allowance).

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 and German's Rooftop programme to remove market barrier.
- 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

c) 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).

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.

e) 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 Building Integrated Photovoltaic (MBIPV) 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 2007 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. First Solar has revealed that it expects annual capacity to reach approximately 704 MW by the end of 2009 with the expected full ramp of all four plants in Malaysia going to plan. Currently, First Solar has completed, slightly ahead of schedule, Plant 1 in Malaysia with equipment installation and line qualification ongoing. Plant 1 is expected to ramp production in the second quarter of 2008. The three other plants are nearing completion with First Solar expecting capital spending to reach approximately US$450 million in year 2008.

- Any significant developments in technologies. None in 2008

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

i) Renewable Energy Policy – to adopt an umbrella policy for all renewable energies

ii) Action Plan – encompasses law enactment, funding mechanism, focus renewable technology (e.g. solar, biomass)

iii) Feed-in tariff for introduction in 10th MP for renewable energy market acceleration

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.

Data on installations for Grid-connected PV systems are largely assumed to be implemented under the financial incentives schemes administered by MBIPV Project. The installations can be viewed in http://www.mbipv.net.my/BIPV%20Installed.htm .

b) An estimate of the accuracy of the data if this is worse than 10 %. The accuracy should be given as a tolerance – 20 kW ± 4 kW or (20±4) kW.

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

Annex B Country information (based on December 2007)

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 (expressed in local currency)

	TARIFF CATEGORY	UNIT	RATES
1.	**Tariff A - Domestic Tariff**		
	First 200 kWh (1 - 200 kWh) per month	sen/kWh	21.80
	Next 800 kWh (201 - 1,000 kWh) per month	sen/kWh	28.90
	Over 1,000 kWh (1,001 kWh onwards) per month	sen/kWh	31.20
	The minimum monthly charge is RM3.00		
1.	**Tariff B - Low Voltage Commercial Tariff**		
	For all kWh	sen/kWh	32.30
	The minimum monthly charge is RM7.20		
2.	**Tariff C1 - Medium Voltage General Commercial Tariff**		
	For each kilowatt of maximum demand per month	RM/kW	19.50
	For all kWh	sen/kWh	23.40
	The minimum monthly charge is RM600.00		
3.	**Tariff C2 - Medium Voltage Peak/Off-Peak Commercial Tariff**		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	29.00
	For all kWh during the peak period	sen/kWh	23.40
	For all kWh during the off-peak period	sen/kWh	14.40
	The minimum monthly charge is RM600.00		
1.	**Tariff D - Low Voltage Industrial Tariff**		

TARIFF CATEGORY		UNIT	RATES
	For all kWh	sen/kWh	29.00
	The minimum monthly charge is RM7.20		
	Tariff Ds - Special Industrial Tariff (for consumers who qualify only)		
	For all kWh	sen/kWh	27.20
	The minimum monthly charge is RM7.20		
2.	**Tariff E1 - Medium Voltage General Industrial Tariff**		
	For each kilowatt of maximum demand per month	RM/kW	19.50
	For all kWh	sen/kWh	22.20
	The minimum monthly charge is RM600.00		
	Tariff E1s - Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month	RM/kW	15.10
	For all kWh	sen/kWh	21.50
	The minimum monthly charge is RM600.00		
3.	**Tariff E2 - Medium Voltage Peak/Off-Peak Industrial Tariff**		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	24.40
	For all kWh during the peak period	sen/kWh	23.40
	For all kWh during the off-peak period	sen/kWh	14.40
	The minimum monthly charge is RM600.00		
	Tariff E2s - Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	21.00
	For all kWh during the peak period	sen/kWh	21.50
	For all kWh during the off-peak period	sen/kWh	12.30
	The minimum monthly charge is RM600.00		

TARIFF CATEGORY		UNIT	RATES
4.	**Tariff E3 - High Voltage Peak/Off-Peak Industrial Tariff**		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	23.40
	For all kWh during the peak period	sen/kWh	22.20
	For all kWh during the off-peak period	sen/kWh	13.30
	The minimum monthly charge is RM600.00		
	Tariff E3s - Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	18.50
	For all kWh during the peak period	sen/kWh	20.30
	For all kWh during the off-peak period	sen/kWh	11.20
	The minimum monthly charge is RM600.00		
1.	**Tariff F - Low Voltage Mining Tariff**		
	For all kWh	sen/kWh	24.50
	The minimum monthly charge is RM120.00		
2.	**Tariff F1 - Medium Voltage General Mining Tariff**		
	For each kilowatt of maximum demand per month	RM/kW	13.60
	For all kWh	sen/kWh	20.10
	The minimum monthly charge is RM120.00		
3.	**Tariff F2 - Medium Voltage Peak/Off-Peak Mining Tariff**		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	19.20
	For all kWh during the peak period	sen/kWh	20.10
	For all kWh during the off-peak period	sen/kWh	11.10
	The minimum monthly charge is RM120.00		

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

2) typical household electricity consumption (kWh)

Per capita electricity 3,136kWh per annum

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

Income is US$5,806

5) typical mortgage interest rate

Base lending rates as at 31st December 2007 is 6.75%

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 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 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

US$0.44/litre (retail), US$0.48 - 0.52/litre (bulk consumers). In 2007 alone, Malaysia's fuel subsidies cost the country about US$12.44 billion.

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

1,150kWh/kW per annum