Final Report

GEF PDF-B
(Project Development Facility – Block B)

MBIPV –
Malaysian Building Integrated
PV Application Technology

enecolo
energy ecology

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Project information

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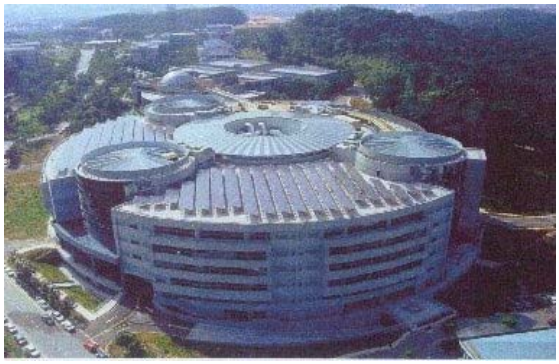


362 kWp PV system Technology Park Malaysia.
The largest installation in south-east Asia.

Summary

The United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) are working together with the Government of Malaysia to develop and implement a national programme on photovoltaic in buildings (BIPV). The approach is a worldwide unique and shall become a showcase for the Asia-Pacific region.

In August 2003, a UNDP-GEF supported PDF-B project (project development facility – block B) was started to systematically develop a sustainable implementation plan for the full BIPV project/national programme. The PDF-B activities were concluded in February 2004 where the developed full project proposal was submitted to the GEF secretariat. Within the six-month PDF-B project duration, the project team had assessed the baseline scenario, carried out logical framework analysis with all key stakeholders, and subsequently developed the full project strategies. The assessments identified several limitations and barriers that are preventing BIPV from penetrating the local market. Some of these limitations are; (a) Limited experienced local PV players, (b) Hit and run approach by contractors (not providing after-sales service), (c) Lack of guidelines on system installation, (d) Quality issues, (e) Overpriced systems and components, (f) Lack of information and training, (g) Non-availability of a control body, (h) Lack of suitable policy, fiscal and financial frameworks. The assessments also identified that BIPV technology cost can be reduced directly by increasing the skills of the service providers, enhancing the procurement process, and eliminating the unnecessary transaction costs.

Malaysia has a strong interest and motivation to become a centre of excellence in RE and EE in the Asia-Pacific region. Hence, it is very timely for Malaysia to develop a national strategy for BIPV technology application. Considering that the national BIPV programme would start with almost zero experience (status in 2003: 450 kWp grid-connected PV installed capacity), it is a unique opportunity to mould the initiatives into a sustainable and replicable programme based on international experiences and lessons learned. This will hopefully avoid the stop-and-go problems that many countries faced in the past while trying to develop PV markets.

The PDF-B project activities were concluded successfully according to the schedule and satisfied the objectives. One of the important project objectives was the preparation of the full BIPV project proposal, which was designed in close co-operation with the Government, the PV industry, the power utility, NGOs and the financing sector.

In May 2004, The GEF Council has approved the full ‘MBIPV’ project proposal. The principal objective of ‘MBIPV’ project is to reduce the long-term cost of BIPV technology within the Malaysian market, which could pass on to its neighbouring markets. Within the 5-year MBIPV project duration, starting from 2005 to 2010, the MBIPV project will address the development of sustainable financing mechanisms to support BIPV applications, and to establish solid institutional and policy frameworks towards sustainable and widespread BIPV applications. The project aims to provide technology demonstrations and development of local BIPV markets, as well as extensive promotion campaigns and capacity building on BIPV application in order to generate awareness and improve the local competency.

In addition, the project will also reduce BIPV technology cost through local manufacturing development and technology transfer. Malaysia has a strong high technology industry (e.g. wafer production) and will be able to support the development of the BIPV technology and can offer excellent environment for R&D activities. The anticipated success story can then be translated to the neighbouring countries. Hence, this will create a significant impact to the overall reduction of GHG emissions, largely due to this unique approach and opportunity provided through the support from UNDP-GEF.

Renewable energy initiatives in Malaysia

The Third Outline Perspective Plan (OPP3) and the Eighth Malaysia Plan (8th MP) are the two main policy references for the promotion and development of renewable energy (RE) in Malaysia. The Third Outline Perspective Plan (OPP3) is Malaysia's ten-year development plan for the period of 2001 to 2010. Under the OPP3, the government shall continue to undertake efforts to manage both non-renewable and renewable energy (RE) resources to cater for the demand of the rapidly growing economy. The main thrusts of OPP3 are as follows:

- To ensure an adequate, secure, quality and cost-effective supply of energy;
- To promote efficient energy utilization and minimize negative impacts on the environment; and,
- To supplement the conventional supply of energy, new sources of energy such as renewable energy (RE) would be encouraged.

In the year 2000, the Government introduced the Fifth-Fuel Policy. The policy identified RE as Malaysia's fifth fuel resource, which includes Renewable Energy such as biomass, solar and wind. With this objective in mind, greater effort is being undertaken to encourage the utilization of renewable resources, such as biomass, biogas, solar and mini-hydro, for energy generation. The Government has set a target to achieve 5% of the nation's electricity production (about 600 MW) through RE by 2005. The strategies adopted to intensify the development of RE will include: (1) Promotion of various RE sources; (2) RE demonstration projects; (3) Research commercialization; and, (4) Extension of financial and fiscal incentives to potential developers.

In line with the Government announcement to adopt RE as the fifth fuel resource, the Small Renewable Energy Power (SREP) Program was launched to encourage and intensify RE utilization. The SREP focus is to facilitate expeditious implementation of grid-connected renewable energy resource-based small power plants. It is envisaged that in the 2001-2005 period, the SREP would provide valuable experiences that could be utilized to develop and fine-tune RE strategies towards long-term increment of RE share in the power generation mix. From the environmental perspective, the utilization of all RE resources in the country would result in a reduction of about 70 million tons of CO_2 by 2020. Hence, in addition to reduction of GHG emissions, the local environment would also be improved due to the reduction of particulate matter in the air. While most of the applicants under SREP are either biomass or mini-hydro based, not a single application has been received for PV based power generation.

The obstacles are due to relatively high investment costs and lack of know-how to implement projects among the targeted potential users and developers.

Although GoM has indicated its preference for Renewable Energy as an alternative source of energy, there are limited fiscal and financial frameworks that directly support the widespread application of BIPV systems. Buy-back policy from utility concentrates on biomass and mini hydro generation sources. The obstacles identified above have a compounded effect that restrains the widespread application of the technology in Malaysia.

Introduction

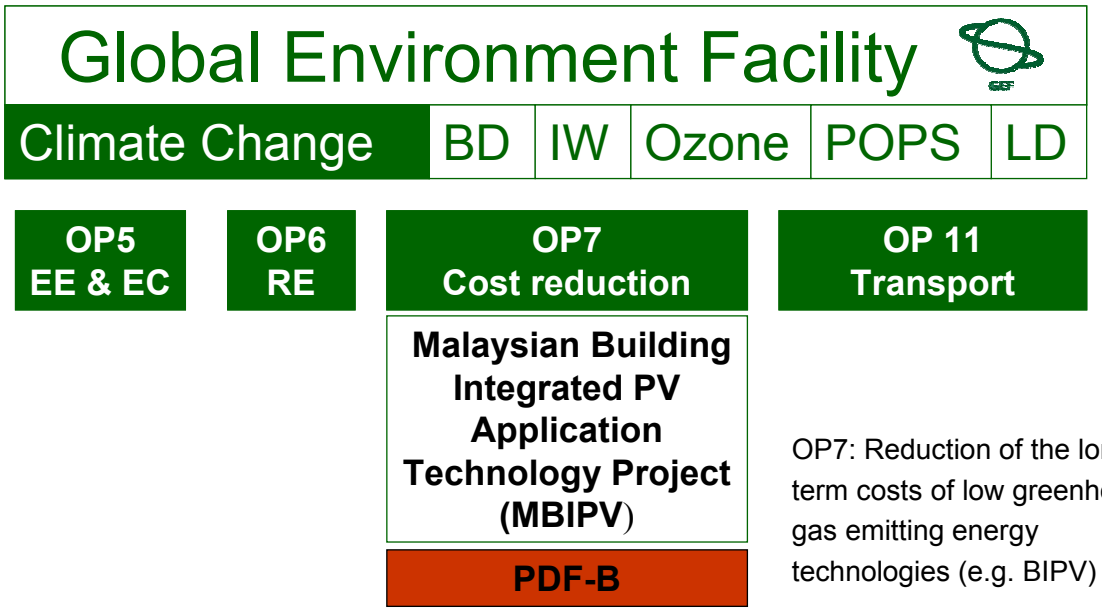
Since independence in 1957, Malaysia has undergone tremendous growth and prosperity by shifting the economic activities from labour-intensive industries to energy and capital-intensive industries, particularly heavy industry. In recent years, Malaysia's energy consumption has increased and become comparable to larger energy consumers worldwide. In 2002 the energy consumption was 2.8 MWh per capita (Switzerland 7.7 MWh/capita) and projections show a significant increase in the energy demand. The electricity supply for the future demand is focused on coal and gas. However, there is a growing awareness and concern in the supply of energy particularly on the issue of carbon emissions and global warming. Under the Third Outline Perspective Plan (OPP3), the government is undertaking efforts to manage both non-renewable and renewable energy (RE) resources to cater for the demand of the rapidly growing economy.

With the Malaysian economy coming out of the recent economic downturn (1997-2000) that hit the ASEAN region, coupled with an optimistic medium term outlook of the Malaysian economy, future demand for electricity is expected to increase significantly. In the next years, the demand is forecasted to grow at an average rate of 6 to 8% per annum. A total of 10 GW of new generation capacity will be planted up and commissioned between 2003 until the year 2010, 6 GW will be coal fired power plants and the remaining 4 GW will be natural gas-fired power plants. This additional coal and gas-fired generators (10 GW in total) will emit from 2010, additional 34 million tons CO_2 (coal) and 8 million tons CO_2 (gas) per year! This will lead to a tremendous increase in GHG emissions, thus causing more serious problem to the global environment.

To mitigate the problem, Malaysia is increasing its efforts to promote renewable energy and energy efficiency, especially in buildings. Malaysia has one of the fastest growing building industries worldwide, where the corresponding energy demand would significantly increase in the next coming years. Conducive conditions such as forecast increase in electricity demand, available building spaces and the huge untapped solar energy potential point clearly towards an implementation of the BIPV (building integrated photovoltaic) technology in Malaysia. Considering the synergies and benefits of BIPV application, the technology will have an important and sustainable impact to the buildings market and is able to substitute part of the conventional fossil-fired electricity generators.

The baseline scenario shows that currently, biomass is being actively developed as RE resource due to its availability. Other RE resource such as solar energy, in general, and solar energy applications like grid-connected BIPV, in particular, has remained in the sidelines mainly due to its relatively high cost. In the case of grid-connected BIPV, there is a perception that the technology is 'exotic' and 'unproven' in Malaysia. Initial assessment indicates that the current business environment does not support widespread adoption of grid-connected BIPV technology as a commercially viable RE technology in Malaysia, despite the fact that the BIPV performance is better and the absolute energy cost is lower than those systems installed in Mid-Europe and Japan. Due to the present high initial price and lack of the enabling environment, the economics of the BIPV technology is unattractive. However, the technology price can only be reduced when there is a sustainable BIPV market.

Without appropriate activities in the establishment of an enabling environment for BIPV – both for the public and private sectors – the current state-of-affairs will undoubtedly lead to uncoordinated efforts, characterized by no improvement in quality issues, policy and institutional deficiencies, inadequate investment in improving the technical skills and no cost reduction for the technology.



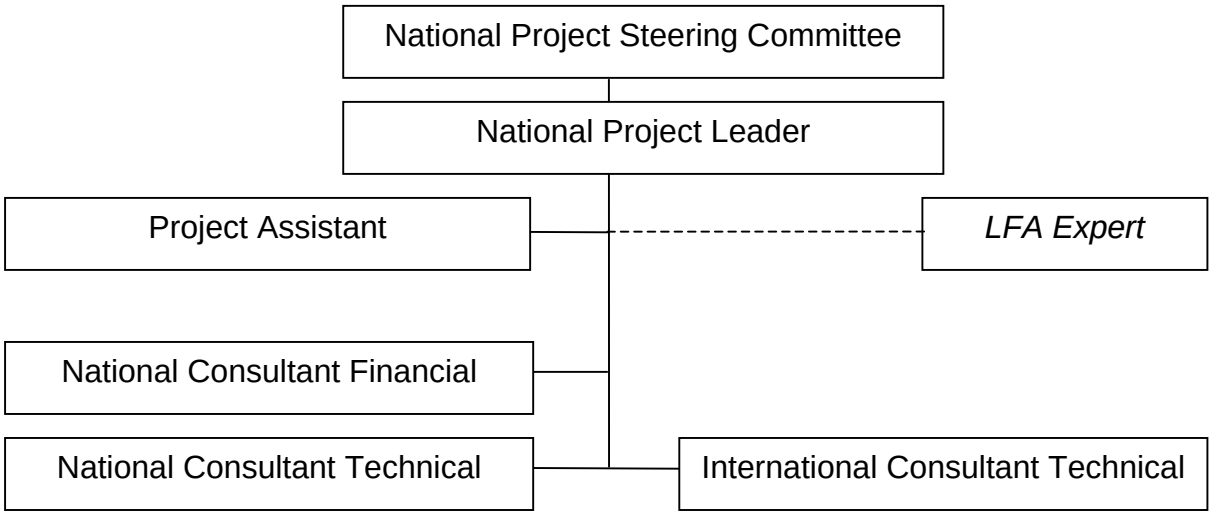
For those reasons, Malaysia proposed under the climate change facility a preparation project (PDF-B) to UNDP-GEF. The GEF PDF-B grant was requested to finance the needed activities to adequately define the full project objectives, deliverables and implementation plan. This PDF-B project ensures a successful and replicable full Malaysian BIPV project. The target was to design a full GEF project on BIPV (under GEF-OP7). The key objective of OP7 is to reduce the long-term cost of RE technology (e.g. BIPV).

Project team structure

A national project steering committee was established in PDF-B Activity 1, with members from various stakeholders, such as government ministries, government departments and agencies, a local utility company, a standard organisation, universities, professional institutions, industry representatives, consumers associations, and NGOs. The committee was set-up to be responsible for overall direction, monitoring and successful implementation of project objectives. The MECM as the executing agency chaired this committee.

MECM established a national PDF-B project team for this project. One full-time personnel, as project assistant, provided by the government of Malaysia, three local and one international consultant, were the members of the project team. The project team executed the PDF-B project activities and the submission of the GEF project brief. Additionally, the PDF-B project engaged also an expert on the logical framework analysis for the national participatory workshops.

Project implementation structure for the PDF-B



Position	Team member	Company
CTA	Ahmad Hadri Haris	TNBR
PA	Mohd Hairol Abdul Latip	PTM
IC	Daniel Ruoss	Enecolo
NCt	Prof Dr Kamaruzzaman	UKM
NCf	Ir Mohd Adan Yusof	Mensilin
LFA Expert Henrik Rytter		*DEM*

The LFA expert lead the two workshops held in September and October.

PDF-B working plan

In June 2003, the Ministry of Energy, Communications and Multimedia Malaysia (MECM) received an approval from the United Nation Development Programme – Global Environment Facility (UNDP-GEF) to implement a 'Project Development Fund – Block B' (PDF-B) study on Building Integrated Photovoltaic Technology Application (MBIPV Project). The project started in August 2003 and was completed in February 2004. The main purpose in this six month project duration was to develop a full project document to be submitted to UNDP-GEF. The main objective is to establish a supportive environment for a sustainable and widespread BIPV technology application in Malaysia.

The project development activities were carried out with the proposed PDF-B grant, and other co-funding sources, like US$ 25'000 from government of Switzerland. The PDF-B activities addressed the design of appropriate mechanisms to facilitate the smooth coordination, implementation, monitoring, and management of the project components. The following describes the performed PDF-B project activities:

- Activity 1: Establishment of a National Project Steering Committee and a National PDF-B Project Team
- Activity 2: Project Design & Co-financing Development
- Activity 3: BIPV Technology Assessments
- Activity 4: Preparation of GEF Project Executive Summary and Draft UNDP Project Document

Outcomes PDF-B

The project team assessed relevant baseline data, developed and confirmed co-financing, conducted logical framework analysis (LFA) workshops to design the full project (FP) and completed the documentation for the proposal to submit to UNDP in February 2004.

Baseline assessment

Following only the summary of the baseline assessment. The detailed reports are attached in the Annex.

Energy and electricity assessment:
The grid connected electricity demand in Malaysia has increased from 4 GW in 1990 to 11 GW in 2001. Before the economic crisis in 1997, the demand grew at 10% per annum. In the next few years, the demand is forecast to grow at an average rate of 6 to 8% per annum. The energy demand trends show a high correlation with the country's Gross Domestic Product (GDP). The sales of electricity of the three main utilities in Malaysia increased by 5.9% from 59 TWh in 2000 to 63 TWh in 2001 while sales of TNB increased by 5.9% from 55 TWh to 58 TWh during the same period.

The forecasted values of electricity sales for the TNB integrated system are 84 TWh in 2005 and 127 TWh in 2010. Out of the sales, 53% was for the industrial consumers, 28% for commercial, 18% for domestic and 1% for others. The total utility grid connected generation capacity in Peninsula at the end of 2001 was about 13 GW of which 4.5 GW or 35% contributed by six IPP's and the remaining owned by TNB. In Peninsula Malaysia, out of the 13 GW installed capacity to the grid, 65% is gas turbine/combined cycle block, 13.5% hydro, 11.4% coal fired plant, 10.3% gas/oil plant (duel fuel) and less than 0.1 diesel engine. In 2001, about 80% of the electricity generated in Peninsula Malaysia was by gas.

Electricity peak demand is forecasted to increase from 10 GW in 2000 to 15 GW in 2005 and 22 GW in 2010 for the peninsula. A total of 10 GW of new generation capacity will be planted up and commissioned between 2003 until the year 2010. By the year 2010, the fuel mix in Peninsular Malaysia will be 50% oil and gas, 40% on coal and the rest is on hydro and other renewable sources of energy. Choice of fuel in generation of electricity must take into account reliability of supply, cost of fuel and future energy mix of the country. The improvement of combined cycle gas turbine technology has made it an attractive option to choose this technology in new power plants. Nevertheless, as clean coal technologies are being developed, the option for coal-fired power plants for future electricity generation will also make these plants a viable choice in power generation. Large hydro power projects are not meeting the direct local need of peak power supply, the losses and the high initial cost make large hydro generators not a considerable option in the due time. Such energy supplier may play a role in the long-term, around 15 years. Combined cycle gas turbines with high efficiencies (up to 60%) and short construction time (3 years) make these system attractive and the first choice of meeting the future peak power demand. The long-term (15 years) perspective from TNB is rather strongly on gas turbines as primary choice of power producers.

Following the current cost for peak power stations and the energy, including O&M and fuel cost:

Gas turbine (gas/distillate) =	0.43 Mio US$/MW	7.1 US cent/kWh
Combined cycle (natural gas) =	0.5-0.75 Mio US$/MW	2.0 US cent/kWh
Thermal conventional (coal/gas/oil) =	0.45 Mio US$/MW	2.2 US cent/kWh
Hydro < 100 MW =	1 Mio US$/MW	2.1 US cent/kWh
Hydro > 100 MW =	1.7 Mio US$/MW	7.8 US cent/kWh

A gas turbine, responsible for the peak demand, runs on the highest O&M and fuel cost. The amortized cost for a gas turbine are the second highest, after the hydro power production. Even with low investment cost, the amortized cost are high because the thermal efficiency is maximal 30%, compared to a combined cycle generator with 50%. Also conventional generators produce with better thermal efficiency (35%). This generation cost include the capital, the energy and the fuel cost! The assumption vary from study to study, thus the difference. But an average of 6 US cent/kWh for the peak power electricity can be considered.

The electricity tariff is structured in 5 modes, (A) domestic, (B) LV commercial, (C1) MV general commercial, (C2) MV peak/off peak commercial and (D) LV industrial tariff. For grid-connected PV system of relevance are only the tariffs A and D. Following the rates per unit for these two categories:

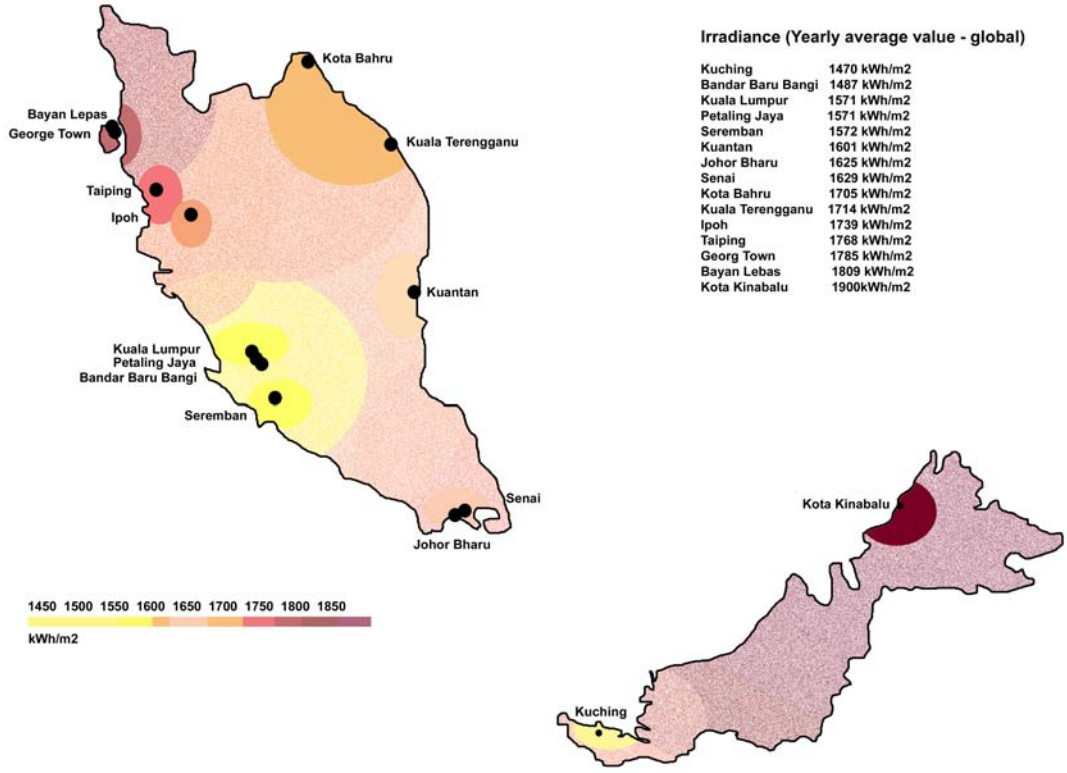
Tariff A – Domestic (first 200 units)	US$ cent/kWh	5.7
Tariff A – Domestic (next 800 units)	US$ cent/kWh	6.8
Tariff A – Domestic (next 800 units)	US$ cent/kWh	7.3
Tariff D – LV industrial	US$ cent/kWh	6.8

The production of electricity is subsidized by the government of Malaysia.

Meteorological data:

Malaysia lies entirely in the equatorial region with an average daily solar radiation of 4,500 kWh/m^2, with sunshine duration of about 12 hours. Ambient temperature remains uniformly high throughout the year. Average ambient temperatures are between 27 to 33 °C. Most locations have a relative humidity of 80 – 88%, rising to nearly 90% in the highland areas, and never falling below 60%.

The Klang Valley (Kuala Lumpur, Petaling Jaya) has the lowest irradiance value, whereas around Penang (Georgetown, north-west coast) and Kota Kinabalu (Sabah) have the highest values measured. However, compared to Germany, an installation in Kuala Lumpur receives 1.3 times higher global solar irradiance. A solar PV installation in Malaysia would produce energy of about 900 to 1400 kWh/kWp per year depending on the locations and the installation. Areas located at the northern and middle part of the Peninsula and the coastal part of Sabah and Sarawak would yield higher performance. An installation in Kuala Lumpur has an maximum energy yield of approximately 1200 kWh/kWp per year.



Irradiance map for Malaysia

BIPV potential in Malaysia

The technical potentials of BIPV in the residential and commercial sectors are huge. Considering the PV capacity value of 1 kWp/10 m^2, the technical potential is around 11 GWp, which could provide more than 12 TWh solar generated electricity. Today, this would cover 20% of the national energy demand. The assessment concludes, that there are no restrictions concerning the building envelope for the future development of BIPV in Malaysia. The building stock offers sufficient surface for the application of BIPV in the long-term.

Technical and commercial results of existing BIPV projects:

Only recently, Malaysia demonstrated several pilot grid-connected solar PV projects. The Malaysia Electricity Supply Industry Trust Account (MESITA), Ministry of Science, Technology and the Environment (MOSTE) and Tenaga Nasional Berhad (TNB) mainly funded these installations. The projects employed mainly add-on PV technology and did not specifically apply improved PV applications such as BIPV. The target of these projects was mainly to showcase the grid-connection of PV systems rather than the reduction of the PV system cost. Since the onset of grid-connected PV applications in the country in 1998, an annual installed capacity of about 90 kWp has been achieved. By end 2003, the installed capacity of grid-connected PV was about 450 kWp, most notably the 362kWp BIPV at Technology Park Malaysia (TPM), realized in 15 applications.

Maintenance is the weakest point at all PV installations. Clients purchase the system but do not include a small budget for the maintenance of the system. Service provider have to improve their after-sale service, many times they have a hit-and-run-strategy. A total loss of approximately US$ 500/year is resulting for all 15 system, based on a residential tariff of 6 US$ cent/kWh. In general the systems are installed according to working codes and meeting the requirements of the city council. No barriers could be found for the building approval or the grid-connection. The local authority is cooperating, even as PV is considered an exotic application.

All systems are relatively high priced, due to higher margin on the products and inexperienced service provider. In 2001, a 3 kWp roof-top system cost 7.50 US$/Wp. The baseline assessment estimated a cost reduction of around 1.50 US$/Wp from 2001 to 2006. Cost reduction will result through market changes and improvements in the procurement process for the products. Further better experienced and skilled service providers (installers) reduce the working effort and therefore reduce the cost for the installation. In 2006, a 3 kWp PV system (roof-top application) will cost in the range of 6.00 US$/Wp. Considering an interest rate of 4%, annual M&O cost of US$ 800 and an energy yield of 1200 kWh/kWp, the price for the solar electricity will be around 0.60 US$/kWh.

Competency, potential of the local BIPV industry– service providers, manufacturer:

The current competency level of existing local PV service providers (17 companies) and one module manufacturer (BP Solar) in Malaysia varies significantly and may be grouped in two categories. Based on the survey, so far there are only two companies that provide very good services to their clients and include training and education for their employees. Many companies lack the capability to improve their service and

quality. Thus, comprehensive installation and maintenance guide, training material and courses are needed. Such activities (capacity building) are important and will enhance the development of the industry. The other important step is to provide the market with quality installation, reliable products and basic awareness for the clients. Hence, this will improve the public confidence in the technology.

Direct & indirect BIPV values:

The monetary examples show higher benefit for a BIPV systems on an office buildings. In such an application, BIPV plays its role as multi-functional element. Beside a sole energy producers, BIPV if rightly applied, can help to reduce the AC load substantially. Commercial buildings (office, government, industry) offer great potential to include indirect values and to bring BIPV competitive into the market. Whereas for residential applications the indirect values play a minor role. Overall the direct and indirect values are heavily offset to the annual cost of the BIPV system. Here packaging is the selling point! Project developers have to bundle the BIPV system in the investment cost of the building.
It is important to consider for all application all the synergies and demonstrate them. Factors to improve are well known and will be also part of the full project activities:

- financial support for new jobs, new start-up companies => lower transaction-cost
- tax incentives => support for the owner or project developer
- define the CO_2 target for Malaysia => in monetary terms (incentives)
- establish a supporting PV program, the program has to differentiate in categories (residential, commercial)
- provide environmental friendly loans => low interest rate
- provide a higher feed-in tariff
- ensure maintenance and operation => increased energy yield
- attract joint ventures => know-how transfer
- establish local manufacturing (inverters, BOS components, long-term modules)

Improvements are also necessary in capacity building, education, ownership and environmental consciousness.

Existing standards or guidelines related to BIPV technology application:

No standards or guidelines cover PV as power supplier or building element. It is a unique chance to develop the needed standards meeting the demand of the users and the industry. Practical standards have to be issued addressing safety aspects of course, but considering really the technical background of the technology and the lessons-learned world wide. Standards don't have to complicate procedures and constructions, thus increasing the cost of the product or the system.

The development of suitable standards is an important key factor in increasing the popularity of the grid-connected BIPV system. It should guarantee the technical requirements necessary to ensure the safety and the reliability of the system, without interfering with the utility grid. Hence, a Working Group on Utility Interfaced PV was established by SIRIM to develop standards for installation of grid-connected PV systems. The code of practice will be ready for public comment by end of 2004 and will be implemented by later part of year 2005.

Policies, financial and fiscal incentives:

Much emphasis is on Energy Efficiency (EE) with programs like Demand Side Management (DSM), Energy Audit in Government Buildings (EAGB) and Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP). The current institutional and policy support regards biomass as the most viable option. Solar energy is not really considered as one of the 5th fuel components. Biomass is today the most valued option and receives therefore the highest attention. See more detailed information also in the chapter Renewable Energy Initiatives in Malaysia.

A BIPV national program requires specially designed fiscal incentives that have an impact in the implementation chain especially the retail end of the market. Unlike biomass, BIPV is much smaller and applicable to different market segments such as industry, commercial complexes and domestic consumers. Hence the current fiscal regime, which is embodied in the Malaysian budget, does not provide specific incentives to encourage and increase the growth rate of BIPV. A customised fiscal incentive program for BIPV is necessary to differentiate BIPV from the rest of the RE resources. Similarly, customised financial incentives need to be developed in order to encourage the development of PV in Malaysia. Experience in other countries can be adapted to the Malaysian context without compromising overall GoM policies and strategies.

The Clean Development Mechanism (CDM) is one of three flexible mechanisms defined under the Kyoto Protocol. These mechanisms enable trading emission reductions between countries in order to help countries achieve their emission reductions at a lower cost. The CDM has been set up to allow industrialised countries to achieve part of their emission reduction target in developing countries, provided that the emission reducing activities contribute to sustainable development in the host country. Public or private parties from industrialised countries will be able to invest in projects leading to emission reductions in developing countries. CDM is a possible mechanism for supporting RE application and may lead to greater investment flows to developing countries for projects that might not have been feasible without this extra source of funding, such as projects involving solar photovoltaic (PV) installations.

For example; BIPV systems are an excellent fit for the CDM because they directly displace GHG emissions while contributing to sustainable urban development. Selling emission reduction credits under the CDM could provide additional revenues for BIPV systems. However, high transaction costs (initial and annual costs) indicates that BIPV system will face an uphill battle. Large scale projects will be required (minimum 2 MWp) to cover transaction costs and a market prices of minimum US$ 5/t CO_2 is needed to make BIPV CDM participation worthwhile. After breakeven the CDM may contribute to approximately 0.06 % of the cost of a BIPV system. Over time, as experience is gained with implementing the CDM procedures, transaction costs will likely go down, enabling more BIPV projects to enter the CDM. Investors will then be eventually financially rewarded for their contribution to protecting the global climate by providing solar energy. Today and in the mid-term CDM is in Malaysia not an option for BIPV. But in the Full Project, the GoM has to follow the development of CDM closely and eventually apply with a larger program for the CDM.

Manufacturer assessment:

- The chemical, glass and plastic industries gained high experiences and were fast growing during the last decades. The labour force in this country has a high level of competency and education. These will provide a cohesive and encouraging backup services for the photovoltaic manufacturing facilities.
- Due to lack of local expertise in the final reliable inverter design and lack of maintenance information, it is recommended that domestic manufacturers work together (joint venture) with foreign inverter manufacturers having a top selling position in the market. Technical support is crucial for the sustainable development of an inverter product, which proves the market requirements and its cost effectiveness. The well-established local electronic industry can supply components to the inverter manufacturers. State-of-the-art materials are available without inherent restriction to the supply chain. Thus, in short to mid-term, a local production of inverter is possible.
- Other Balance-of-system (BOS) components can be easily manufactured in Malaysia today. Know-how on the design and construction of metal mounting structure is largely available and many companies can provide all the required products (e.g. frames). Cables and connectors are readily available and of high quality.
- Cell manufacturing may also be considered and become an option in the long-term (20 years). Depending on the development of the market, the existing wafer manufacturers (e.g., Shin-Etsu Handotai Malaysia Group supplying close to half of the worldwide demand of 8-inch diameter wafers) can adapt to the new business needs.

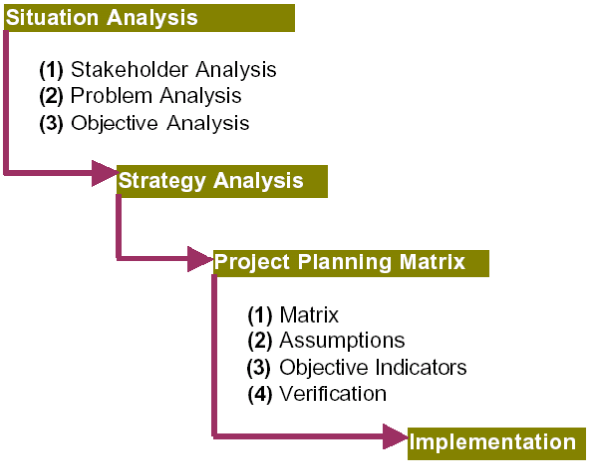
Summarising; the local manufacturing capability can sufficiently meet the requirements for the market introduction of PV. Local companies with support from a foreign manufacturer, either as joint venture or co-operation, can start with manufacturing of BOS equipment in 2-3 years. In long term (15-20 years) the manufacturing opportunities may be broadened to new business fields, like cell production and module assembly.

The climate for business opportunities in the field of PV is encouraging. Malaysia is currently promoting the continued diversification of the industrial base towards high-end manufacturing and the development of the value-added services sector as part of the move towards a knowledge-based economy. In the Malaysian Investments Act 1986, alternative energy sources like the development and production of fuel cells, polymer batteries, PV components and solar cells are specifically mentioned. Possible new PV manufacturing facilities can benefit from the existing infrastructure and well established manufacturing sector in Malaysia such as the precision machining and the production of electronic assemblies.

LFA (Logical framework analysis)

Within the six-month project duration two workshops on the logical framework analysis (LFA) were held. Details concerning the LFA procedure and the outcomes of the workshop are presented in the Annex.
In total around 120 participants from the industry, financial and manufacturing sector, government agencies and many others worked on the strategy for a national BIPV program. The four main components of the proposed UNDP-GEF Full Project (FP) will be presented in the chapter 'Full project design'.

The first workshop was held in September 23rd - 25th and over 65 participants from the PV industry, project developers, architects, policy makers, finance sector and universities participated actively. The audience was evenly sorted in three working groups and started with the situation analysis.



The first workshop concluded with the strategy analysis. The outcomes from the three groups were compared and summarised. UNDP and the MECM were very satisfied with the organisers and the outcomes of the workshop.

In the left picture is the concept of the LFA presented. LFA is one of the favoured tools of UNDP to design a full project.

The second workshop was held in Langkawi from October 21st to 23rd. More than 50 participants were invited to work on the second phase from the LFA. The PPM (project planning matrix) was developed and established the basic work for the design of the full project.

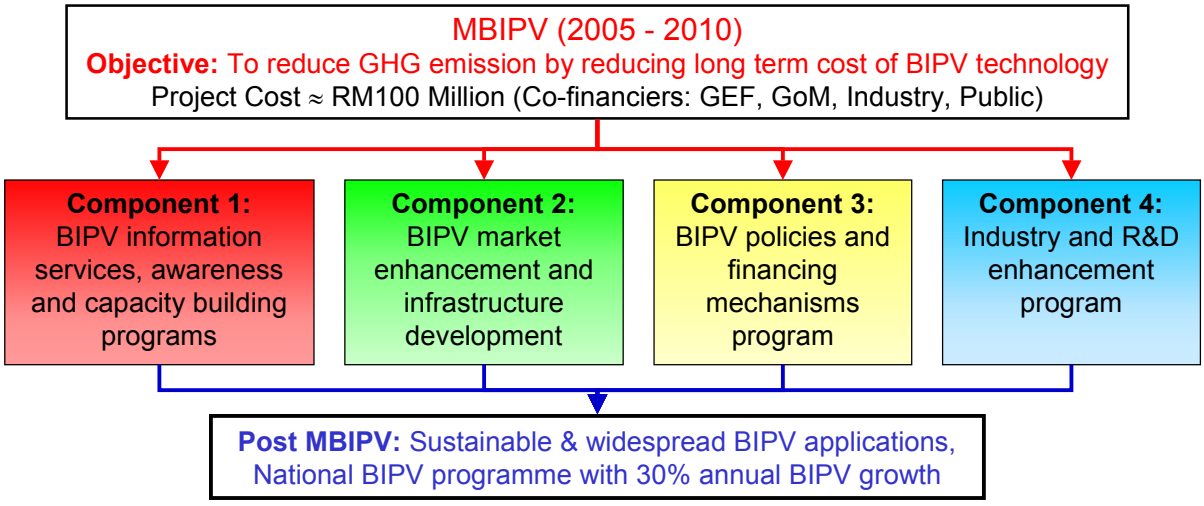
Two pictures from the working group, where individuals from the industry, government, building industry, financial institutes, service providers, architects and academics participated actively. All results were evaluated by the project team and in two additional internal workshops translated into the final project design.

Full project design

The MBIPV project purpose is to improve significantly the overall capacity (technical, policy, planning, institutional, fiscal, financial) both in government and the private sectors, to develop, design and make use of the BIPV energy potential. Further to develop the local industry, leading to cost reduction of the BIPV technology and the desired environment for a national sustainable BIPV market. The project goal is to have a long-term cost reduction of the BIPV technology and adoption of supportive regulatory frameworks to reduce the annual growth rate of GHG emissions from fossil fuel fired power generators through the widespread implementation of BIPV application that will replace part of the current fossil fuel use in Malaysia.

The proposed project will address in an integrated manner the four main components namely:

- BIPV information services, awareness and capacity building programs;
- BIPV market enhancement and infrastructure development;
- BIPV policies and financing mechanisms program; and,
- Industry development and R&D enhancement program.



MBIPV (4 RM = 1 US$)

Each component of the project will consist of several specific activities designed to achieve successfully the overall objective. Following a short description of each component and the activities. Details are presented in the full project brief.

<u>Component 1: BIPV Information Services, Awareness and Capacity Building Programs:</u>

This project component will improve general public and stakeholders acceptance towards BIPV technology. This is to be achieved by enhancing the level of understanding and awareness through extensive education campaigns and capacity building programs, targeting the general public and the decision/policy makers. Hence, this project component will focus on:

- Integrated Information & Awareness Building Programs on BIPV;
- National BIPV Database;
- BIPV Training Courses; Establishment of National PV Council (NPVC);
- Quality Control Programs for Local PV Industry;

- Capacity Building and Awareness Programs for Policy Makers and the Financial Sector;
- International BIPV Event for Decision Makers;
- Dissemination of Information and Lessons Learned to ASEAN Countries; and,
- Impact Assessment of BIPV Technology Development.

Component 2: BIPV Market Enhancement and Infrastructure Development Program:
This project component will highlight different demonstration projects that will serve as showcases and provide a wider level of acceptance and better understanding on the technology and its benefits. A concentrated National BIPV program will enhance local market and further ensure infrastructure optimization. The technical feasibility and economic viability of BIPV technology will be addressed in a number of demonstration projects. The demonstration projects will serve to provide first hand experiences for improvements in the training of the stakeholders as well as increased efforts in R&D activities. This component will also address the technical and non-technical issues related to grid-connection. It will focus on the following activities:

- Standards and Guidelines Development;
- Review and Final Design of the Planned BIPV Showcases;
- Hardware Installation and Operation of the BIPV Showcases;
- Design and Evaluation of Technical and Commercial Viability for Demonstration Projects;
- BIPV Demonstration in Government and Private Buildings;
- Implementation and Operation of National PV Program "*Suria 1000*";
- Monitoring & Evaluation of BIPV Demo Projects;
- Dissemination and Promotion of Demonstration Program Results; and,
- Design of a Sustainable Follow-up Program.

Component 3: BIPV Policies and Financing Mechanisms Program:
This component will involve activities intended to enhance the capacity of policy makers in coming up with appropriate, proactive and integrated plans, and policies that will facilitate a conducive climate for BIPV development that will lead to further cost reduction. Based on various targeted research activities, a suite of policy, legal, institutional, financial and fiscal measures will be developed and proposed to the Government of Malaysia. These frameworks will enable the formulation of a national BIPV target in the 10th Malaysia Plan (2011-2015), supported with suitable and customized mechanisms for the local condition. The sustainability of the GEF supported project will be achieved with the integration of a national BIPV target in the 10th MP and an appropriate environment created for higher penetration of BIPV. The 10th MP target will be significant enough to further accelerate the market development and enhance the PV industry in the country, leading to the long-term cost reduction of the technology. The activities under this project component will focus on:

- Techno-economic Analysis of grid-connected BIPV;
- Design and implementation of Government Incentives to Utility and BIPV Manufacturing Industry;
- Analysis on Existing and New Financial Mechanism and Fiscal Incentives;
- Fiscal and Financial Framework for a Sustainable Follow-up Program;

- Study on Past Experience and Impacts of International Regulatory Schemes;
- Review and Integration of BIPV in Existing Regulations;
- Institutional and Policy Framework for Sustainable Follow-up Program;
- Policy and Financial Framework Implementation, Monitoring and Impact Assessment; and,
- Dissemination of Results of Policy Impacts.

Component 4: BIPV Industry Development and R&D Enhancement Program:
This project component will strengthen the human capacity in R&D and manufacturing of BIPV components, thus providing the opportunity for exporting locally manufactured products and know-how to regional markets. Local manufacturing and product services are crucial parts of the driving force towards cost reduction in many PV programs world-wide, while creating many new job opportunities (see also e.g. PV Rooftop Programs in Europe and Sunshine Program in Japan). In addition, R&D activities in BIPV architectural integration and components such as inverters are important for development of BIPV products. The market products could be made cheaper due to local manufacturing costs, cheaper tax, and meets directly the local BIPV system specification. Once the market is established, the economics of scale would lead to further cost reduction, while good after-sale services would protect the market. Therefore, promotion of local manufacturing and improvement of BIPV product services as well as R&D are very essential in reducing the long-term cost of BIPV technology. Generally, this project component will focus on:

- R&D on Cost Reduction of Local BIPV Products and System Optimization for Local Conditions;
- International Collaboration and Technology Transfer Program;
- Upgrading Local BIPV Industry Capabilities; and,
- Establishment of BIPV Testing Facility.

Budget:
The total estimated program costs are US$ 25 Million. GEF shall provide 19%, the Government of Malaysia 50%, and the private and industrial sector 31% of the overall cost. The fund request from GEF will be utilized in the various capacity building and training activities (US$ 765 k), for the further enhancement of the market and purchase of necessary hardware (US$ 1.2 Mio) and, subcontract costs (US$ 185 k). Personnel and mission cost for all components amount to US$ 2.6 Mio which will be utilized to provide technical assistance in the various cost-reduction activities and also in the endorsement of appropriate frameworks. The costs for the GEF supported incremental activities that will be carried out in each of the project component, amounts to a total of US$ 4.7 Mio.

Time schedule:
The first activity includes the establishment of the National Project Team and the National Steering Committee. By Spring 2005, the MBIPV project is expected to commence with the capacity building course and the information campaign. In parallel the BIPV showcases will give feedback to the training course and will generate public awareness. The national roof-top program 'SURIA 1000' should be launched by end of 2005. Component 3 will run for three years and shall complete by end of 2007. R&D activities have already started and will continue even after project completion. The industry program is planned to start work in early 2007. MBIPV is scheduled to complete by End of year 2009. The outcomes will provide important guidance for the upcoming 10th Malaysian Plan (2011 to 2015) and the implementation of a sustainable national PV program. Throughout the period, information and lessons learned will be disseminated to other ASEAN countries through the New Renewable Energy Sources Sub-Sector Network (NRSE-SSN). This will ensure that other ASEAN countries will benefit from Malaysian experiences and further contribute towards widespread and sustainable BIPV market.

Final seminar

After completion of the baseline assessment and the design of the national programme, all the results were presented in a national BIPV seminar. Various international speakers were invited to present the world-wide perspective and to provide input to the program strategy. The seminar was officiated by the Minister of Energy, Communications and Multimedia, YB Datuk Amar Leo Moggie. The one-day event was held January 6th and with over 250 participants well attended. PTM, the organiser, has sent invitations to the local and international PV industry, engineers, architects, consultant, power utilities, NGO's (Greenpeace, BCSD), housing developers, government agencies, financing sector, embassies and many more. The registered participates represented almost all the groups, unfortunately the interest of banks was low. With focus on Switzerland (or Swiss products) to be highlighted are the participation of Mr. Schweizer, Swiss Ambassador in Malaysia and Mr. Alex Tan, representative of Multi-Contact in Singapore.

The invited speakers were Mr Stefan Nowak from Switzerland, Mr Tjerk Rejinga from the Netherlands and Mr Flemming Kristensen from Denmark. They provided important insights and feedback on the national BIPV program strategy and for the national power utility TNB. Based on the accompanied survey it results that the final seminar (program, value of presentations, flow, etc.) was highly rated and met most participants expectations.

Next day's newspaper printed mainly the press release but two included an article covering the seminar, the MBIPV project and the topic of (BI)PV in a layman language. Hence, the important issue of public awareness building has already started.

8 Environment

The Malaysia Building Integrated Photovoltaic project will look into ways to raise awareness on solar energy and boost local manufacturing of PV equipment.

Tapping into solar power

A multi-pronged project to boost the solar energy sector will kick off next year, writes TAN CHENG LI.

Environment 9

Article in the Star-Newspaper (including some Swiss BIPV examples)

ENVIRONMENT

THE SUN Thursday January 1, 2004 23

ONE FUTURE

A UNDP-IMPLEMENTED PROJECT

Here's 'people power'

A simple system that lets the consumer participate in energy generation spells cheer for the future, S.L. Wong discovers

When you generate excess power, the surplus can be fed into the utility grid

What makes BIPV tick?

Which of these do you think describes the BIPV?

- Only used in rural areas
- It's always a standalone system
- Needs batteries to work
- Requires special tariffs and subsidies
- Is long on payback
- It must be an add-on feature
- It's a solar water heater
- Users don't need supply from utility grid

FUEL FACTS

Article in the Sun-Newspaper (second largest publication in Malaysia)

Conclusions

To meet the future electricity demand, Malaysia has to install new conventional power plants. These additional fossil fuel based power generators will emit tremendously large amount of GHG. To mitigate the environmental pollution caused by the anticipated increased of coal in the country's future energy mix, renewable energy are now being promoted.

The ongoing UNDP-GEF funded MIEEIP and BIOGEN projects are the first manifestations of Malaysia's commitment to reduce GHG emissions from energy-related development and economic activities. The PDF-B project on BIPV further contributes towards the national efforts to reduce GHG emissions. In this case, the efforts will be through the substitution of some fossil fuel based power generators with PV in buildings. The available building spaces (facades and roofs) offer significant untapped potentials for PV application in buildings. BIPV serves dual purposes, as a building element and as an electricity generator. Considering the synergies and benefits of BIPV application, the technology will have an important and sustainable impact to the building industry. Yet, these benefits remain largely untapped. Phasing in BIPV application would therefore require gradual decentralisation of power production.

The potential success for the national BIPV program is promising; Malaysia has a large potential for cost savings of products due to a strong industry (e.g. wafer production) that would be able to support the development of the BIPV technology, and an excellent environment for R&D activities. However, even with a significant technical potential for BIPV application and with the strong interest of Malaysia to play a leading role in biomass and PV development within the Asia-Pacific region, there are still several limitations that will first need to be addressed.

Without concentrated activities to establish enabling environments for BIPV technology, the current state-of-affairs will not lead towards a sustainable long-term BIPV market. UNDP-GEF then was instrumental in providing the necessary support that allow Malaysia to change the status quo. In the first phase (i.e. PDF-B project) UNDP-GEF supported the GoM to undertake baseline assessments and conduct the logical framework analysis. Subsequently, the developed proposal for the national BIPV program was submitted to GEF in mid February 2004 and was approved in May 2004. Nevertheless, to successfully execute the proposal and project plan, close co-operation between the government, the PV industry, the power utility, NGOs, and the financing sector are essential. The MBIPV project is expected to help catalyse the wider adoption of grid-connected BIPV applications not only in Malaysia, but also in the other ASEAN countries.

Critical review

The PDF-B project objectives were ambitiously set and the implementation time was effectively only five months. This demanded full co-operations of the appointed experts. By February 2004, the PDF-B project was successfully concluded on time where all deliverables were endorsed by the National Steering Committee and UNDP-GEF. During the PDF-B exercise, a few problems or barriers were encountered. Nevertheless, excellent co-operations among the stakeholders ensured that the problems were minimised. This allow for the expected outputs of the PDF-B project to be successfully delivered to UNDP-GEF as planned.

Subsequently, all stakeholders from the industry and policy sector are satisfied with the results and the design of the full MBIPV project. It is crucial for the implementation of the follow-up full project/national BIPV program to ensure the needs and expectations from all stakeholders are well addressed. Hence, it is planned to start the MBIPV project with a kick-off workshop for all stakeholders in order to divulge each MBIPV project component and activity for better appreciation and participation by the stakeholders.

One of the key factors for a successful MBIPV project is the long-term commitment of the government to support the BIPV technology and its introduction. The climate for a national BIPV program is encouraging, but there remain some challenges: (a) Lack of awareness; (b) Capacity of local service providers is weak; (c) Suitable policy, fiscal and financial frameworks are absent; and (d) High cost of BIPV system (compared to other markets worldwide), due to taxes, the small market, and the inexperienced consumers and service providers. The lack of awareness on the potential of environmental and long-term economic benefits, led the public to believe that the technology is not ready and will not directly provide benefit. Nevertheless, the PDF-B exercises have created an increasing interest and first education on BIPV technology. The increased motivation among the stakeholders to implement a successful BIPV program is very encouraging. However, this also became a tedious work to the PDF-B project team to try to co-ordinate the enthusiasm of each stakeholder.

The full MBIPV project is expected to commence by Spring 2005. Prior to that date, the first action will be to establish the National Steering Committee (NSC), which will designate an Implementing Agency (IA) to be responsible for the project implementation. Therefore, it is very important that the Project Director of the IA is a strong champion of BIPV technology and the MBIPV project objectives. Malaysia now has the best chance to pave the way towards a sustainable introduction of BIPV technology. However, the GoM first need to ‘level’ the way by removing the hurdles. Then, it is very important for UNDP and the Ministry of Energy to appoint the right project team members to ensure for a successful implementation of the MBIPV project.

To the Swiss consulting company Enecolo, it was valuable and exciting experiences to be part of the PDF-B project team, in designing the full MBIPV project from scratch since 2001. It was through a Business Meeting in Jakarta, sponsored by seco, that Enecolo was able (and interested) to work in the earliest stage of the project preparation. For the PDF-B project, Enecolo participation was supported partly

through the REPIC platform and UNDP-GEF. The support from the REPIC platform was highly appreciated by UNDP and MECM. Certainly because of this support and also due to the good work performance, Enecolo is now able to manifest its position as an International consulting company for the MBIPV project.

The local UNDP representative was very satisfied with the work performed by the project team in the PDF-B exercises and encourages the individual experts to again be part of the full project team. Involvement from other Swiss consultants and especially the Swiss industry is also invited. The Swiss industry (inverter, connectors and metal fabricators) is favoured because of high quality products and the possibilities for joint ventures with local Malaysian companies.

Overall, the MBIPV project in Malaysia presented an excellent opportunity for a Swiss PV company to be part of a challenging but exciting project, and start to establish a longer co-operation with different parties. After 3 years of preparation through several stages, one can say, the development stage is now a success and the future of the full MBIPV project looks promising.

Outlook

After approval of the full MBIPV project proposal in May 2004 at the GEF assembly, the next step will be the signing of the project document by the GoM. The project document contains all the terms of references (TOR) necessary for the establishment of a national project team. Once endorsed, the TORs will be used by UNDP for the recruitment process of the experts, which should start around Sept/Oct 2004. The tender for the different job opportunities will be published via the UNDP-GEF network. Switzerland has good a chance to play a major role in the approved UNDP-GEF MBIPV project, particularly due to the extensive experiences and expertise in grid-connected BIPV, as well as due to the good performance shown during the PDF-B activities. The Swiss contribution was appreciated by all parties and may provide a good reference during the selection process for the MBIPV project team. It is planned to submit in an application with co-ordination betweem the REPIC platform and the proposed Swiss experts for the MBIPV project comsultants. On the Swiss part, much is depending on the willingness to work for a longer period in another country with a different set of culture and environment.

In parallel, the Ministry of Energy will mobilise the MBIPV project national steering committee (NSC). The purpose of the NSC is to provide overall guidance and direction towards a successful implementation of the MBIPV project objectives. The NSC will have members from various key stakeholders, such as Government Ministries, Government departments and agencies, TNB, SIRIM, universities, professional institutions, industry representatives, consumers associations, NGOs and the UNDP. The Ministry of Energy (MECM) as the project executing agency will chair this committee.

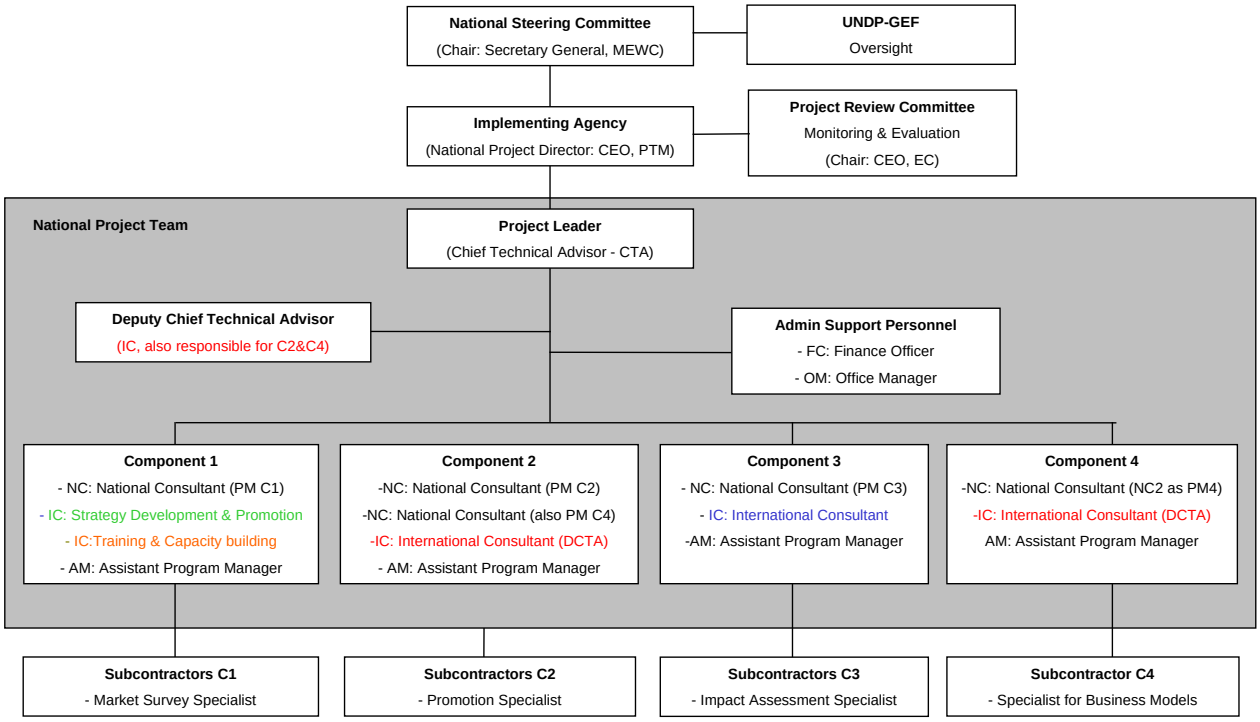
It is expected that by December 2004, a National Project Team (NPT) would have been set-up. The NPT will be responsible for the planning and implementation of the MBIPV project activities, providing mechanisms and technical inputs necessary to integrate the results of various activities, ensuring satisfactory performance of the

project members and contractors, and providing official reports to the NSC. The NPT will be composed of a Project Leader (CTA), several full-time personnel (financial, administrative and assistants to the programme managers), and four full-time national consultants to implement the four components of the MBIPV project. Four international experts and local subcontractors will also support the NPT as and when needed to undertake various project activities.

The first staff of the NPT to be appointed will be the CTA, who will then evaluate the job applications from the national and international consultants together with the local UNDP representative and the Ministry. The contracting process for the national and international consultants is supposed to be completed by end of 2004. Together, the CTA and the appointed project team members will prepare the project inception report by early 2005. Additionally, the project will also engage:

- A market survey agency to undertake market potential and perception study;
- A marketing and promotion agency to implement project promotion and marketing strategy;
- A market research agency to assess the sustainability and replicability impact of the MBIPV project.
- A business development consultant to assist in the development of BIPV business models.

A Project Review Committee (PRC) will also be established to provide technical advice and specific recommendations (if necessary) to improve the project impact and implementation. PRC will monitor and evaluate the successful implementation of the project activities and outcomes.



MBIPV project implementing structure

List of acronyms

ASEAN	Association of Southeast Asian Nations
BIPV	Building Integration of Photovoltaics
CTA	Chief Technical Advisor
DEM	Danish Energy Management
DSM	Demand Side Management
EE	Energy Efficiency
FP	Full Project
GEF	Global Environment Facility
GEF-SEC	GEF Secretary, Washington
GHG	Greenhouse Gases
GoM	Government of Malaysia
IA	Implementing Agency
ICA	Incremental Cost Analysis
IC	International Consultant
LFA	Logical Framework Approach
MBIPV	Malaysian Building Integrated Photovoltaic Application Technology Project
MECM	Ministry of Energy, Communication and Multimedia, Malaysia
MOSTE	Ministry of Science and Technology (GEF Operational Focal Point)
NCf	National Consultant Financial
NCt	National Consultant Technical
NGO	Non-government Organisation
OP	Operational Program
PA	Project Assistant
PD	Project Document UNDP
PDF	Project Development and Preparation Facility
PTM	Malaysia Energy Centre (Pusat Tenega Malaysia)
PV	Photovoltaics
RE	Renewable Energy
Seco	State Secretariat for Economic Affairs (GoS)
SIRIM	Standards and Industrial Research Institute of Malaysia
SME	Small and Medium Enterprises
STAP	Scientific Technical Advisory Panel
TNB	National Power Utility Malaysia (Tenaga Nasional Berhad)
TNBR	National Power Utility Malaysia Research Centre
UKM	Universiti Kebangsaan Malaysia
UNDP	United Nations Development Programme

Annex

CD-ROM including:

- Summary PDF-B working plan
- All reports from activity 3 (baseline assessment)
- Information on LFA
- Outcomes LFA
- Final UNDP-GEF FP Executive Summary
- Final UNDP-GEF FP Brief, including ICA
- Oral Presentation and Paper ‚A whiteboard approach' for the 19th EU PV conference June 2004, D. Ruoss