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Title **R**einforcing provision of sustainable **EN**ergy services in Bangladesh and Indonesia for Poverty alleviation and sustainable **DEV**elopment

D8 : Needs assessment analysis and market feasibility - *Indonesia*

WP3: **Development of need assessment study and market feasibility**

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D8 : Needs assessment analysis and market feasibility for each country in order to improve widely SE applications - *Bangladesh*

Type (minutes, reports, ..)

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X	**PU**	Public
	PP	Restricted to all participants of the project (including EU Services)
	RE	Restricted to a special group of participants of the project (including EU services)
	CO	Confidential, only for members of the consortium (including services of EU)

The RENDEV project

The RENDEV project aims to explore ways to link microfinance and access to renewable energy, bringing a positive contribution in rural development and poverty alleviation in Bangladesh and Indonesia by increasing access to solar energy, the development of micro enterprise, and the provision of microfinance mechanisms tailored for low income people's needs.

The project started in January 2007 and will last until December 2009. RENDEV is financed by the European Commission under its Intelligent Energy line.

The main objectives of the RENDEV project are:

- To promote development of income generating activities with renewable energy supply;
- To identify measures justifying involvement of Small and Medium Sized Enterprises in the solar energy sector;
- To build synergies between the microfinance sector, the renewable energy sector and the micro enterprises in Bangladesh and Indonesia;
- To better inform stakeholders providing pro-poor sustainable renewable energy services;
- To bring a positive impact on the quality of life in rural districts.

Executive summary

Although the electrification rate in Indonesia reached significant growth in the past decades, there are still an important part of the population (37% as of 2006) without access to electricity. This is due to different factors such as the specific archipelagic geography of the country, the wide dispersion of the potential electricity users and the cost of such electrification.

To remediate this problem, electricity from solar sources has many advantages. The solar irradiation over Indonesia is quite high and regular over the year. Solar home systems (SHS) are specifically designed to provide electricity to individual households without the need of a grid, and reliable when maintained adequately. Their cost is being more and more competitive with traditional fossil fuels, as one's price is continuously declining while the other is greatly fluctuating and meant to be increasing in the future. And the environmental and sociological benefits of are also well known.

Several projects to install SHS have already taken place, showing both the advantages of these systems, but also some of their shortcomings. Pitfalls in the implementation of these systems have been identified, such as the lack of appropriate incentives for the deployment of a dedicated local industry. Dedicated dealers are needed to provide the necessary quality of installations at affordable prices, the after-sales services for the maintenance and repairs of SHS, and educate local communities about appropriate uses. These are necessary to ensure the durability of the systems, together with giving an appropriate and valorising image of the SHS technical possibilities. The proper functioning of SHS also provides the possibility of long term repayment by the users, therefore validating financing credit schemes. Without this, some data show that a significant fraction of SHS become out of order after only a few years.

Based on market surveys in favourable Indonesian regions, it is also shown that part of the population, however with small revenues, is nonetheless interested in buying solar systems for their households. There is also a lack of adequate financial services to provide forms of credit to overcome the initial cost of investment of these systems.

More foreign and governmental incentives should also be directed towards the development of the supply side, i.e. of a local PV industry. Incentives such as feed in tariffs for the urban grid could prove effective, and this urban PV industry could then help the development of PV in rural areas. From a "temporary" and secondary solution to electrifications issues, solar PV could then fulfil its strong potential.

List of Abbreviations

AES	Altari Energi Surya
Ah	Ampere hour
AusAid	Australian Government's overseas aid program
BBPT	Agency for the Assessment and Application of Technology (Ministry of research)
BRI	Bank Rakyat Indonesia
EC	European Commission
GHG	Greenhouse Gases
GOI	Government of Indonesia
IPPs	Independent Power Producers
kW	Kilo Watt
kWh	Kilo Watt hour
KUD	Cooperative Village Unit
NRSE	New and Renewable Energy Source of Energy
PLN	Indonesian utility
PV	Photovoltaic
PSG	Progress Support Group, consultative body established by the World Bank.
RES	Renewable Energy Sources
RES-E	Electricity generated from RES
Rp	Indonesian Rupiah
SHS	Solar home system
SE	Solar Energy
WB	World Bank
Wp	Watt peak

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I. Introduction

The ongoing studies on solar energy market assessment will provide information on the rural consumers and their requirements in the context of solar rural electrification.

A successful programme must be based on the wishes and needs of the people who will use it, and must be driven by their demand for services (light, water pumping, etc), rather than simply focusing on providing energy technologies.

Local input is vital to ensure the appropriateness of a system. Without first investigating the needs, preferences, and abilities of the local people, systems may be badly specified and fall into disuse. Ultimately it is the local people who will use, maintain, guard and take pride in the system. Therefore there must be participation at all stages of the project, starting from concept development.

Many different, well-targeted projects need to be developed, aimed at the needs and situations of thousands of different communities.

Therefore the main outcomes for this deliverable D8 will concern the SE needs assessment analysis (together with barriers, constraints, lack of know-how …), and the SE market feasibility. The existence or the absence of incentive financial schemes from public or private finances will also be discussed.

II. Quantification of the regional development potentials

In each country, the technical or economic needs to be met can be different and related to a specific energy or industrial situation.

From this previous statement, it is suitable to identify the real needs of the country that could lead to the development of the SE sector for rural development.

With the current production and consumption rates of oil, Indonesia has become a net oil importing country. It is not only that the reliance on the conventional energy resources will risk future energy supply sustainability, but it will also increase significantly the long-term environmental burden. The opportunity to utilize indigenous and inexhaustible renewable energy (RE) resources especially when it is applied to local community development is becoming more important in Indonesia's national energy development goals.

The Government of Indonesia (GOI) indicates that in the national energy demand profile, electricity shows the fastest growth compared to other energy forms. During the period 2005-2025, electricity is expected to grow up to 4.5 times and its share in the total energy demand will grow 1.5 times. At present, PLN has at least 4800 units of 100 KW to 2 MW diesel generating sets scattered all over the archipelago totalling around 500 MW. GOI has started to veer away from diesel-based generation particularly for new capacities and prioritize renewable energy wherever applicable and practical.

Unless something is done on the increasing growth of petroleum and other fuels used in meeting the mounting demand for electrification in Indonesia, GHG emissions from the use of these fuels will continue to be unabated. The GOI has introduced some RE based electricity such as mini hydro and micro hydro capacities in its development plan for selected areas as alternative in meeting both energy and environmental objectives. The progress of rural electrification in Indonesia is inherently problematic because of its archipelago geography. The major electricity grid (owned and operated by the state-owned electric company, i.e., PLN) and a number of isolated local grids cannot economically reach many rural areas.

The GOI is expecting the utilization of RE as the main source of energy for rural electricity supply. It has adopted a policy that gives priority to rural electrification with the utilization of RE when it is available in the area. However, there could be a continuing trend in investing on diesel gensets even at high oil prices. Diesel gensets have been widely used in Indonesia, especially in remote areas due to its availability, flexibility and ease to acquire and operate. Many districts are not aware of the opportunities and advantages of renewable resources, in particular solar energy in their areas.

The utilization of these RE resources becomes more strategic recognizing the limited nature of conventional energy and the global concern on environmental conservation. The National Energy Vision 2020 introduced by the Ministry of Mines and Energy (later became Ministry of Mines and Mineral Resources (MEMR) in 1999 states that for long-run energy development, the non-exportable, environmentally clean RE resources, in general, are given top priority in the energy development program.

In June 2002, the GOI through the MEMR launched the Green Energy Program that intends to realize the RE supply and utilization to help secure the sustainability of the long-term national development.

Recently the GOI releases the National Energy Management Blueprint 2005-2025, which conveys a strong message to increase the use of renewable energy, including solar photovoltaic. The Blueprint prescribes a radical change in energy mix that reduces the oil share to 26.6% and increases the New and Renewable Energy Source of Energy (NRSE) up to 4.4%.

The government has established a rather ambitious target for renewable energy use in the national energy mix (20% RE in the energy mix by 2025, including 800 MW for Solar PV) and currently allows increasing budget during the last 3 years.

GOI through the National Technical Committee for Energy has appointed The Agency for the Assessment and Application of Technology (BPPT) to undertake the Focal Point role in the Development of Solar Energy Utilization. As the Focal Point, BPPT is responsible in maintaining the coordination of crosscutting institutions in Solar Energy Technology application, including Photovoltaic project implementation. BPPT has been comprehensively conducting intensive activity in Solar Energy Technology assessment, application and project implementation since the 70’s. During the period BPPT has provided crosscutting issues recommendations and advices to the GoI regarding the utilization of solar energy technology, particularly in Photovoltaic technology.

II.1. Unsatisfied energy needs

Rural electrification has been a major concern of the GOI since the early period of the Long Term National Development Program. At the implementation level, PLN has been the main institution that is responsible in achieving the Government's target of rural electrification. For about two decades from 1978, PLN has shown impressive record of aggressive expansion of main grids as well as development of new small grids in the rural and remote areas mainly using diesel power plant system.

The PLN installed capacity in 2001 was 21 GW, constituting about 63% of the national electric power generation capacity. This includes several large Independent Power Producers (IPPs) that have been in operation since 1997. Some captive power that exists around the country adds up to 14 GW. In 2001, PLN announced 28 locations of critical systems that have started the rotation of power shutdown due to power shortage. PLN is currently unable to expand its power generating capacity due to financial difficulties. The severe devaluation in the beginning of crisis in 1997 of Indonesian Rupiah value against USD left PLN with huge foreign debts and inability to meet the financial obligations to the IPPs. The purchase of fuel and spare parts at the world market in foreign exchange makes PLN even more entrenched in serious financial crisis.

Until the year 2003 the rural electrification program has achieved electrification ratio of 82% for villages and 52% for households. This corresponds to the estimated balance of more than 15,000 villages in the country that are still left non-electrified, which 6,000 villages of them are very hard to electrify due to the remoteness and the pattern of houses are scattered. From those villages there are approximately 38.5 million households around the nation with an electrification ratio of 52%, representing around 20.5 million household with electricity. Therefore, there are still 48% or 18 million houses that are not yet or unlikely be connected to the national grid. However, due to the aforementioned uncomfortable financial situation, PLN is currently unable to perform significant progress in rural electrification; therefore it is becoming the challenge for the GOI to develop alternative indigenous renewable energy utilization.

The following Figures illustrates the growth seen in the rural electrification during the past decades, together with the growth in demand (electricity needs per capita)[1].

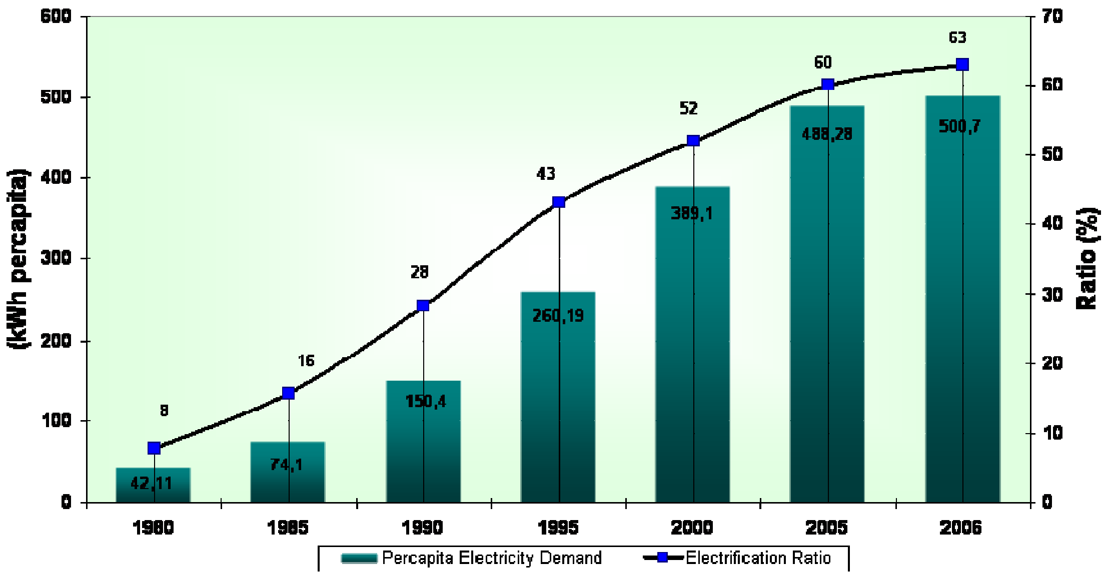

Figure 1: Evolution of the electrification ratio in Indonesia, and of the electricity demand per capita

While Figure 2 shows the strong projected demand of electricity up to 20261.

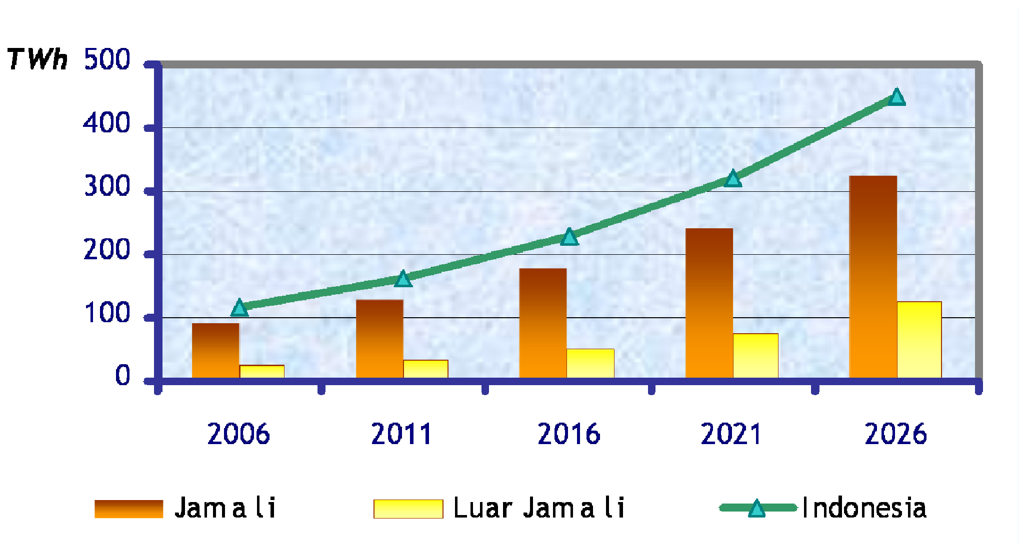

Figure 2: Projection of electricity demand up to 2026, from the RUKN.

[1] From the presentation of the "Directorate General Electricity and Energy Utilization", round table discussion on solar PV development in Indonesia (November 2007).

II.2. Grid quality and availability

The available grid interconnection in Indonesia is limited to the Jawa and Bali Island, while in other island such as Sumatera, Kalimantan, Sulawesi , Papua are not connected yet, and still isolated on each island. Figure 3 illustrates the current and envisioned electricity network in Indonesia.

As mention in the previous paragraph about 6,000 villages are not electrified, meaning that the problem is not only on the grid availability but also simply on the supply of electricity to the village.

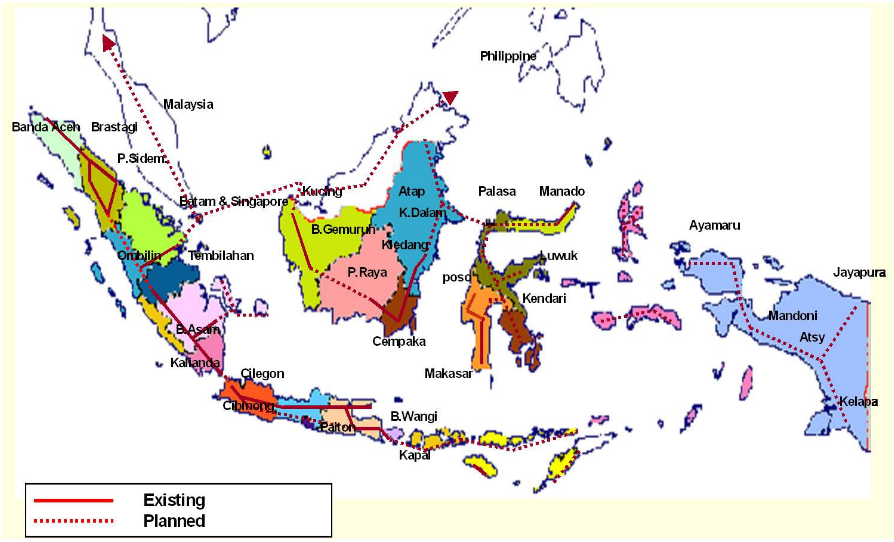

Figure 3: Existing and planned electricity network in Indonesia (after BPPT)

The electrified villages are usually powered by the Diesel generator which always have operational problems due to the big differences between peak load during the night and base load during the day and high diesel oil prices; therefore PT PLN run their Genset system only 6 to 12 hours a day instead of 24 hours.

Because of the above problem, BPPT has been carrying out technology assessment and application efforts in order to introduce solar PV in various applications in Indonesia, to meet the need of local people and the challenging terrain, in particular individual systems, and mini grids (hybrid systems). To build such isolated systems BPPT builds the power plant and also the grid. Several isolated PV-Diesel hybrid system have been installed and until now the quality and availability the system is still running well. For example in the Ponelo island with a mini grid system and in Rote Dao island with a grid connected to PLN.

Another example illustrates problems with grid quality: The installation of SHS at Sukatani was a pilot project in the installations of SHS in 1989. Users continue to express positive appreciations of their systems, even 15 years after their installations. And after the arrival of the electric grid in 2001, the users wished to keep their PV systems as a back up during the grid black outs[1].

II.3. Improvement margins: quality, price, services

II.3.1. Quality

The systems quality varies widely depending on who is making the project specifications. There are presently only a few dedicated PV dealers to provide proper designs and installations (see below the Section concerned with barriers and constrains).

II.3.2. Price

In general solar PV is sold by cash and sometimes by credit scheme in Indonesian Rupiah and has no plan to change to other currency. The breakdown ofSHS selling prices is as follows:

- PV modules: Price ranging from 2.8 to 3.2 million Rp for 50Wp modules, all modules are imported.
- Battery charge controller: from 0.25 to 0.4 million Rp, these controllers are generally locally made.
- Batteries: 70Ah lead acid batteries cost from 0.5 to 0.7 million Rp, while 100Ah cost around 0.8 million Rp (for 100Wp SHS). Car batteries are commonly used for economic reasons, instead of the more adequate deep cycle batteries.
- Battery enclosure: Used to isolate the batteries, it contains also the charge controller, indicator and switches. Price ranging from 0.1 to 0.2 million Rp.
- DC lamps: Price from 0.07 to 0.12 million Rp, the electronic ballasts are made locally. For a 50Wp system 3 lamps are generally used.

In total, typical prices for 50Wp systems range from 3.8 to 4.7 million Rp. For a 100 Wp system, prices are from 6.8 to 8.3 million Rp. This excludes VAT, transportation and installation costs which vary greatly from site to site.

[1] "Off-grid photovoltaic applications in Indonesia: A framework for analysis", Retnanestri & al., 2005.

For marketing research purposes, we divided PV product into two types: direct and indirect PV system. Indirect system requires battery to store energy but are advantageous for their flexibility to suit power consumption and expansion.

The indirect PV system is applied for:

- House lighting,
- Fishing boat / fishermen lighting
- Street light, public facility or other special purposes
- For consumer good or business/productive equipment. In some cases is combined with another generator to form a hybrid system

Direct PV system is simple and cheaper because no expensive batteries are needed. Maintenance is simplified and cheaper, there is no need to replace batteries, and they have a longer durability and probability to last.

- Agriculture pump
- Drinking water
- Other outdoor and daylight applications

It has to be noted that generally direct (retail) sales operations are costly due to geographical factors. Consumer locations are in many cases quite spread out, resulting in relatively high sales and installation costs for PV systems. This problem could partially be overcome by involving local entrepreneurs.

Also, the system price is usually marked up with survey, installation and other various costs that makes it unnecessarily higher than the price normally offered by dedicated dealers.

II.3.3. <u>Services</u>

In general the dealer of solar PV establishes a number of service centres in the field to collect payment as well as providing after sales services. It also gives training installation and troubleshooting for local technicians and product knowledge training for sub-dealers. Unfortunately, at the moment there is only a handful of dedicated dealers with a long term business vision (see the Section on barriers and constrains below), and the availability of after sales service are practically non-existent.

A market survey in the district of Kolaka has reviewed the current state of installed SHS. As shown in the Table below, a quite high proportion of the SHS were either damaged or sold (380 and 443 respectively, out of 1301 systems).

NO.	AREA	INSTALLED SHS			CURRENT CONDITION			
	VILLAGE	PHASE I	PHASE II	TOTAL	OPERATE	DAMAGE	SOLD	TOTAL
1	Tondowolio	24	5	29	2	0	27	29
2	Wolulu	102	139	241	48	108	85	241
3	Watu Bangga	9	35	44	9	10	25	44
4	Polinggona	5	161	166	84	58	24	166
5	Anaiwoi	28	17	45	6	7	32	45
6	Popalia	45	63	108	11	19	78	108
7	Tanggetada	23	11	34	3	6	25	34
8	Lembah Jaya	39	52	91	57	19	15	91
9	Pewisoa Jaya	93	62	155	88	34	33	155
10	Petu Dua	0	47	47	4	8	35	47
11	Lamedai	0	17	17	11	3	3	17
12	Puudongi	0	40	40	33	5	2	40
13	Pomalaa	0	21	21	10	3	8	21
14	Kolaka	0	8	8	8	0	0	8
15	Lamunre	0	15	15	1	9	5	15
16	Tande Bura	0	6	6	1	4	1	6
17	Mowewe	0	7	7	0	0	7	7
18	Longgosipi	0	7	7	1	6	0	7
19	Sani Sani	0	11	11	2	8	1	11
20	Tampa Bulu	0	28	28	21	4	3	28
21	Lasusua	0	22	22	4	18	0	22
22	Batu Putih	0	35	35	29	4	2	35
23	Ladongi	0	63	63	27	36	0	63
24	Towua I	0	61	61	18	11	32	61
	TOTAL	368	933	1301	478	380	443	1301

Figure 4: Results of the survey of the current state of SHS in the district of Kolaka[1].

This illustrates among others the consequences of a lack of dedicated after sales services, to ensure the system durability (spare parts, maintenance, local education...).

[1] From a presentation of BPPT, round table discussion on solar PV development in Indonesia (November 2007).

II.3.4. PV second hand market

The emergence of a second hand market, as seen in the numbers of SHS sold, is an interesting phenomenon. On the one hand this raises the question about the reasons of this selling (technical difficulties and lack of maintenance and services, or financial difficulties), but this also demonstrates a willingness to pay for PV systems in rural communities.

II.4. First identification of the niches favourable to solar energy

Located in the tropics, and straddling the equator, Indonesia is endowed with abundant renewable energy (RE) resources. In the development of RE, Indonesia capitalizes on the utilization of these resources such as geothermal, hydro-energy, biomass, wind energy, and solar energy. In particular, solar energy is available almost evenly throughout the country at about 4.5 kWh/m^2/day.

The geography and topography of Indonesia has created many rural and remote areas. This condition has hindered the national rural electrification program. Therefore photovoltaic technology is a most feasible option to provide an alternative source of energy in areas where building a conventional grid electrification is an issue.

There has been extensive research conducted by the GOI about the PV technology market potential. The market is greatly influenced by geography and topography of local areas and the needs of local population. BPPT has been carrying out technology assessment and application effort to introduce PV in various application in Indonesia to meet the need of local people and the challenging terrain, in particular Solar Home System, Hybrid (PV - Diesel) Energy System, PV Pumping System for drinking water, TV repeater, Public Health Centers, Solar Boat system and more recently Rural PV Public Telephone and Grid Connected PV system have been installed in Indonesia.

Indonesia as a whole has 34 regions, a market survey from the World Bank in 2001 has shown that three regions in particular are of interest. Mainly because of the better ability to pay of the local population. These three regions are the province of West Java (Jawa Barat), Lampung (South Sumatera), and South Sulawesi. The market survey is detailled in the next Section.

II.5. Willingness to pay for type of SE systems.

Types of payments vary from the equivalent of zero percent interest rate over 5 - 10 years divided in equal monthly instalment, to several months to pay for the full price of the SHS. In these cases the prices paid/Kwh electricity is above the utility's rate for the same level of power consumption. "Willingness to pay" should be interpreted in this way, i.e. out of no other economic choices.

In the three targeted provinces it should be noted that although some figures are stating that those households are not covered by the PLN network, they may nonetheless use other means of electricity, such as water turbines or motorized generating sets (diesel or gasoline powered).

II.5.1. Market survey in West Java

One of the most recent market survey was made by the World Bank Project Support Group in the Banten Province by involving the local NGO to do the field survey. This survey was done within the 1997-2003 WB/GEF project.

The Kabupatens ("second level regions" in Indonesia) being selected as the target survey are based on PLN grid and off grid data as follows:

Figure 5: On and Off Grid Data PLN Province of Banten

No.	Kabupaten	District	Village	Village		Households		
				Grid	Off Grid	Grid	Off Grid	% Off G.
1	Serang	26	369	368	1	256,053	578	0
2	Pandeglang	22	335	316	19	161,197	10,291	6
3	Lebak	19	300	261	39	193,066	21,865	11.3
4	Cilegon	4	43	43	0	44,914	0	0
	TOTAL	**71**	**1,047**	**988**	**59**	**655,23**	**32,734**	**5**

Source: World Bank PSG Survey, November 2001, based on PLN Branch Office in Banten Province.

The above figures show that only two Kabupatens can be considered as potential targets for in depth survey, the others being already largely electrified through the PLN grid. Kabupaten Pandeglang was selected with the following results:

Figure 6 District of PANDEGLANG - WILLLINGNESS TO BUY PV - SHS

Sample	Number of House-holds	Number of Respon-dents	**Monthly Income (Rp'000)**			Avg. Monthly Lighting Expenditu re *) (Rp)	**Willingness to buy**	
			1,000 -1,500	500 – 750	< 500		Credit 2 - 4 year	Down Payme nt
1 Desa Curuglanglang Kec. Munjul	482	138	47%	4%	49%	22,000 – 56,000	47%	20%
2 Desa Nanggala Kec. Cikesik	540	209	17%	7%	76%	22,000 – 56,000	15%	20%
3 Desa Curug Kec. Cibaliung	408	44	43%	57%	-	10,000 – 121,500	100%	20%
4 Desa Kiarajangkung Kec. Cibaliung	350	36	69%	31%	-	12,000 – 76,000	100%	20%
TOTAL	**1,789**	**427**						

*) Lighting and electricity expenses: for kerosene, dry cell battery and battery charging to operate TV

Source: World Bank PSG Survey, November 2001

It is interesting to observe the survey at Desa Nanggala with the largest number of respondents representing nearly 40% of total households in this community. Desa Nanggala is of low-medium class of community welfare, which is a typical welfare level with un-electrified rural areas of small holders in Lampung & West Java. While rural areas in South Sulawesi have a better level of welfare than Desa Nanggala.

In this community a majority have low monthly household incomes (76% have below Rp 500,000), and their average monthly expenditure for lighting and electricity is between Rp 22,000–Rp 56,000. Yet, 15 % of them are interested in buying PV-SHS with a credit of 2–4 years at a 20% down payment with monthly instalment varying between Rp 77,350[1] for 48 months and Rp 125,700 for 24 months. Those households with cash income below Rp 500,000 are not willing to buy PV-SHS. In general, these findings are matching with PV-SHS users' income profiles surveyed by AES (Alternative Energy).

Therefore, it was estimated that the figure of 15% average rural un-electrified households willing to buy PV-SHS can be used as a safe evaluation of demand on PV-SHS in the World Bank PSG's target provinces. Of course this estimate is not applicable in the poorest villages of the World Bank's target Provinces.

[1] Calculated by World Bank PSG on 15% flat interest rate p.a. at the 40 Wp system sold at cash price of Rp 2,900,000.- However, is would be difficult to obtain a bank loan that support this 15% p.a. flat interest rate.

II.5.2. Estimate of PV demand in Banten and West Java

Using the above data, AES has made the following identification of Kabupatens in Banten and West Java Provinces (with the exception on Kabupaten Cianjur) to specify the market demand of retail sales on The World Bank's PV-SHS project:

Figure 7: PV Demands in Banten and West Java

Selected Districts	Number of Households in 2000			WB's Sales Forecast/Year				
	Electrified	Un-electrified	Willing to buy*)	2002	2003	2004	2005	2006
- Kab. Pandeglang	161,197	10,291	1,544	**500**	**800**	**1,000**	**1,000**	**1,000**
- Kab. Lebak	193,066	21,865	3,279					
- Kab. Garut	218,786	**)11,041	1,656					
- Kab. Cianjur	n.a.	***)3,000	1,500					
Total			**7,979**	**500**	**800**	**1,000**	**1,000**	**1,000**

*) 15% of the un-electrified household, as explained in the previous paragraph, yet it is dynamic and influenced by the economic fluctuation at each village.

**) This figure is the numbers of PLN grid's application received by PLN Garut Branch office up to October 2001.

***) This figure is just the numbers of fish farms with floating nets at the Cirata lake in October 2001. In this area 50% of the farms become the target of PV traders' marketing mix. However, some farms may purchase more than one 40 Wp module.

II.5.3. Estimate of PV Demand in Lampung and Neighbouring Provinces

Under similar approaches, AES made the following identification of Kabupatens to target, their market demand and optimistic forecast of SHS yearly sales:

Figure 8 : PV Demands in Lampung and Eligible Neighboring Kabupatens

Selected District	Number of Households in 2000			WB's Sales Forecast/Year				
	Electrified*)	Un-electrified	Willing to buy**)	2002	2003	2004	2005	2006
- Kab. Ogan Komering Ilir	54,174	131,446	19,717	**1,000**	**2,000**	**3,000**	**4,000**	**5,000**
- Kab. Ogan Komering Ulu	73,738	152,702	22,905					
- Kab. Tanggamus	78,603	104,705	15,705					
- Kab. Tulang Bawang	50,643	125,872	18,881					
- Kab. Lampung Selatan	34,640	235,487	35,323					
- Kab. Lampung Utara	23,225	185,066	27,760					
- Kab. Way Kanan								
Total		**935,278**	**140,292**	**1,000**	**2,000**	**3,000**	**4,000**	**5,000**

*) Source: Sumatera Selatan in Figure 1999 and Lampung in Figure 2000.

**) 15% of the un-electrified household.

II.5.4. Estimate of PV Demand in South Sulawesi and Neighbouring Provinces

Still with similar approaches, AES made the following identification of Kabupatens to target, their market demand and forecast of SHS yearly sales:

Figure 9 : PV Demands in South Sulawesi and Neighboring Kabupatens

Selected District	Number of Households in 2000			WB's Sales Forecast/year				
	Electrified	Un-electrified	Willing to buy*)	2002	2003	2004	2005	2006
- Kab. Donggala	51,768	110,945	16,642	**4,000**	**5,000**	**6,000**	**6,000**	**6,000**
- Kab. Mamuju	32,859	33,525	5,029					
- Kab. Polewali Mamasa	58,741	40,043	6,006					
- Kab. Luwu Utara	128,952	50,088	7,513					
- Kab. Luwu								
- Kab. Sinjai	24,725	17,195	2,579					
- Kab. Bulukumba	61,165	20,136	3,021					
- Kab. Tana Toraja	48,649	35,143	5,271					
- Kab. Kolaka	28,167	43,761	6,564					
- Kab. Kendari	46,699	54,122	8,118					
Total			**60,743**	**4,000**	**5,000**	**6,000**	**6,000**	**6,000**

*) Source: Sulawesi Selatan in Figures 2000, Sulawesi Tengah in Figures 2000, Sulawesi Tenggara in Figures 2000.

**) 15% of the un-electrified households, but dynamically influenced by the economic fluctuation at each village. One household may purchase more than one unit PV-SHS of 40 Wp

Eventually the 1997-2003 WB/GEF project was strongly affected by the financial crisis in Asia in 1998, with reduced commitments from the participating banks and the government, together with the lower affordability of SHS systems (the Indonesian Rupiah lost 80% of its value against the US dollar). Only in the final year of the projects sales of SHS started to strongly increase, linked also with the increased competitivity of SHS with fossil fuels. In total, only around 8000 SHS were sold during the project duration, with half of it during the final year. Figure 4 shows the fluctuation of the exchange rate and Indonesian GDP per capita, together with a summary of major events.

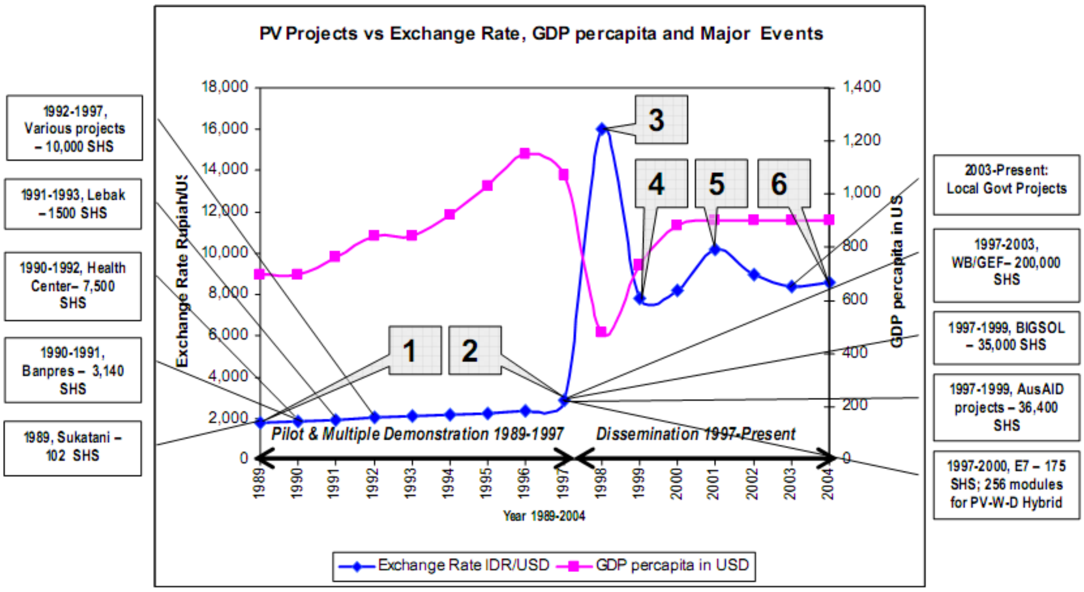

Figure 10 : Fluctuation of the exchange rate, Indonesian GDP per capita, together with major events[1].

This Figure explains for a large part the relative failure of the WB project. But this does not affect the value of their market surveys, which identify potentials in the needs of SHS systems and their affordability for customers.

[1] Ph.D thesis: "The I3A Framework - enhancing the sustainability of Off-grid photovoltaic energy service delivery in Indonesia", Retnanestri, M., 2007.

II.6. Barriers and constrains

There are several barriers and constrains to the development of SHS that can be identified. Some are related to the policy of giving the SHS for free within the governmental projects, or the lack of spending or incentives to develop a local industry in order to have the accompanying after sales services such as maintenance and repairs. The lack of financing options to the potential users, and the absence of urban PV are also identified as constrains to the growth of solar electrification.

In the projects financed by the government to install SHS for rural electrification, the final users are selected and are provided with the systems free of charge. As a result of not paying for the service, several problems can emerge. For instance social jealousy can spread amongst the part of the community which was not chosen, and results in interferences with the deployment of the project, even to the point of inflicting damages to the material. Also, the process and procurement procedures can be prone to corrupt practices.

Another social aspect was the low sense of belonging from the freely acquired systems and the consideration that the systems were entirely government funded, this made it more difficult to obtain compensations from users. In turn this makes it difficult to build up and maintain sustainable PV business in rural areas. The dissemination of PV without requiring some sort of reasonable compensation from the users will not only spoil the commercialization process of the PV industry, it would also handicap the PV technology's own reputation in providing alternative electricity to the rural communities.

Instead, the financing services should also cover the 'supply side' of the PV business chain. It should provide dedicated vendors, system integrators and local component manufacturers with means to make their operations viable and worthwhile to sustain. The government funds alone are not sufficient for the development and maintenance of rural electricity systems in a big way.

Furthermore, many of the country policy makers do not sufficiently and seriously consider PV as potential solution to reduce the country's dependence on fossil energy. In many cases PV is the considered as the last option, if other systems are not viable.

So the PV in general has a low priority, due also to the lack of awareness in the systems capabilities and other merits. This is a problem as currently the number of systems purchased and installed is highly dependent on the government budget on rural electrification.

Additionally PV systems deployment initiatives in the country were made by various government bodies at central as well as regional level. Unfortunately these efforts were not always well coordinated as an implementation of a deliberate policy by the authorities at central government level.

The successful installation of PV systems and administration of credits provided to consumers in rural area must also be followed by the establishment of an effective after sales services system, made available through a commercially based PV industry.

The support of PV utilization has until now been lacking clear and pragmatic government policy. Past projects initiated and run by various institutions to distribute PV-SHS were in many cases considered as a 'temporary' solution. For instance the Government distribution of PV free of charge was without clear direction and planning on meeting the electricity need of the rural population. Hence, there was no incentive for private sector to engage in PV business.

At the time when the PV system was introduced in Indonesia there were over 50 vendors doing business in PV, there are now less than 20 dealing seriously with PV, and only two dealing with commercial retail market offering some sorts of after sales services. Dedicated sales and distribution networks have not been adequately developed, and only a handful of dealers have a long term business vision engaged in this process.

This requires a large capital, for hiring and for capacity building among dealers and local institutions to attain a significant level of technical knowledge to provide adequate services. As a result this leads to insufficient maintenance, especially on the battery system, leading to various system troubles. This availability of service centers in accessible locations, where users can turn to in case of system troubles and obtain spare parts, is absolutely required.

This would also warrant the consumer loan repayments, if applicable, but also would help keep the trust among the users towards PV systems.

Another aspect is the promotion of urban connected PV. People living in urban area were beginning to show interest in using PV to meet some of their electricity need, triggered by frequent power black out experienced during recent years as a result of deteriorating power supply conditions in the country. Unfortunately, this phenomenon was not adequately seen by (and therefore did not get response from) the government.

In order to foster the private sector, including the financial institutions entering into the renewable energy business and particularly the Solar PV, in a big way, the government should consider seriously to allow the demand sector to grow more considerably by introducing 'grid connected' solar PV systems in urban areas.

Another aspect concerns the financial services available to potential users. This lack of financial services in rural areas has also hampered the development of a commercially sustainable market for Solar PV. Affordable financing options to support credit sales were not locally available and only since recently (2004) being offered by Bank Rakyat Indonesia (BRI) with a limited number of vendors participating in the scheme. BRI is currently the only financial institution offering limited consumer credit at commercial interest rate to potential users.

This is despite a recent study commissioned by the World Bank in 2003, indicating a very positive impact of using SHS on the rural socio-economic development. People were generally satisfied with the system's performance, and eager to expand their use if they can obtain some financial support (consumer credit scheme).

Additionally, studies[1] on some existing SHS systems show that none had achieved full self funding status, while attaining different degrees in financial sustainability, and still rely on some direct or indirect subsidies.

Finally, it has been shown that the SHS users in rural areas need some time to learn the use of the solar electricity properly, as most people did not realize the limits of the technology. This leads for example to a tendency to increase electricity consumption beyond the allocated amount, causing system breakdowns. In particular SHS deployed by the government were mostly of small capacity (50Wp). Though it meets the very basic need of electricity, e.g. lighting, in many cases they do not meet the users' need for electricity to catch up with some modern appliances. And even though the price of a typical entry level SHS is still relatively expensive to average potential users in rural regions, there is a clear trend in the increase of demand for bigger systems (100–200Wp), provided suitable and affordable consumers credit scheme is available.

III. Assessment of the exchange potentials (experiences gained, skills, etc.)

When the markets are already developed or pilot achievements have been completed, the experiences gained will be the subject of South-South exchanges. Similarly, the technical or educational resources in the solar energy field will be solicited through regional exchanges.

The development of technology implementation of Solar PV Home System in Indonesia was conducted through a strategy of three phase actions (Dasuki et.al. 2003). The first phase is a demonstration program, followed by the second phase of multiple demonstration program, and then concluded by the third phase of the dissemination program.

Demonstration program phase is intended to introduce the technology to the public, as well as to the related government body. The Dutch – Indonesian Cooperation Program provided funding for 85 SHS unit installed at "Solar Village" Sukatani in West Java Province to initiate the demonstration program in 1989. Multiple demonstration phase is aimed to strengthen the understanding and technology capacity of SHS at larger coverage of target area. The Proyek Bantuan Presiden (Banpres) or Presidential Aid Program was provided by the Government for continuing the program toward multiple demonstration phase in 1991. The One Million rural Solar Home Systems program which was started on 2nd June 1997 using the AusAid soft loan fund was the beginning of the next phase of dissemination stage. The target of this program is to electrify rural and remote areas, increase the living standard of rural communities, strengthen the participation of Cooperative Village Unit (KUD) for managing SHS rural electrification program, establish testing facilities for photovoltaic

[1] Three case studies analysed within the Ph.D thesis: "The I3A Framework - enhancing the sustainability of Off-grid photovoltaic energy service delivery in Indonesia", Retnanestri, M., 2007.

modules and balance of systems, and to support the development of photovoltaic related industries in Indonesia.

III.1. Identification of existing model achievements

BPPT as the government agency who is responsible in technology application assessment implements the three phased activities of SHS Development Program in Indonesia. The strategy is phased in three stages, as explained above:

The implementation assessment serves as a mean to achieve the following four-fold objectives:

1. Techno-economics assessment, and social impact of application various SE system.
2. Promoting SE industrial sector development in Indonesia
3. Facilitating the education activity in rural remote area.
4. Dissemination of SE system application in rural area.

By achieving the objectives, the implementation assessment phases is expected to provide two outputs:

1. Development of SE system model which is technically reliable, economically feasible, and socially acceptable.
2. Impact of a developing SE system industrial capacity in Indonesia.

III.1.1. Demonstration Program Phase

The program phase is aimed to the following goals:

- Assessing the appropriate system model of SE to be applied for rural electrification,
- Studying the system technical reliability of SE
- Researching economical feasibility of RE implementation
- Capacity building of SE stakeholders
- Assessing applicable management model for SE operation and maintenance

During the program, the government through BPPT has implemented several pilot projects of SHS, and other types of Solar PV applications. This include experiences in applying 85 units of SHS 80 Wp in Sukatani vilage, West Java Province, 50 unit of solar boat systems (SBS) 50 Wp in East Java Province, 38 unit SHS 50 Wp for lighting and heating for chicken farms in Lamongan, East Java Province, 1 unit solar public telephone, solar pumping, solar TV repeater, centralized PV plant.

In this stage, the funding was provided by various sources including the Indonesian Government, International Aid, and the private sector. Rural people as the beneficiary is responsible only for the monthly charge for cost of management and maintenance services, which is provided by the community based management organization. The maintenance cost is for purchasing the battery for replacement, while the management fee is mainly for paying the technician salary. The amount of the monthly charge is decided through a community meeting supervised by the community administration.

III.1.2. Multiple Demontrations Phase

During the Multiple Demonstration phase, various aspect of larger scale implementation concerns are observed. The main lesson learned in this phase includes the spare parts distribution control, and after sales service mechanism. While the occasional technical problem generally arise in the field was documented as well.

Some results of the multi demonstration phase shows that several improvement need to be done in the following aspect:

1. Payment scheme
2. Information and reporting mechanism on broken system and components
3. procedure and period of battery replacement.

III.1.3. Dissemination Program Phase

This program is intended to obtain national scale of SHS implementation, hence a massive development of SHS utilization is achieved. The program includes several implementing project funded by the GoI, AusAid, and the World bank.

The GoI and AusAid projects were designed to assist the revolving fund mechanism. In this scheme, the funding serves as seed money to provide the rural people with SHS. The collected money for the SHS instalment, is then used partly for maintenance, and mostly for recovering the investment cost for having new units of SHS for the next project.

During this phase several projects have been implemented, covering mainly eastern part of Indonesia rural area. More than 37,000 units of SHS has been deployed in the area include Maluku, Sulawesi and Nusa Tenggara. The AusAid funding was provided for the project.

The payment scheme that the rural people have to made was previously as follows:

- SHS down payment Rp.60.000,-
- Monthly instalment of Rp.10.000,-, covering:
    - Rp.7.000,- collected for revolving fund
    - Rp.2.000,- reserve fund for battery replacement
    - Rp.1.000,- collected for Cooperative Management fee

Some adjustment was made for the payment scheme for reducing the impact of economic crisis occurred in 1998:

- SHS down payment Rp.215.000,- covering:
    - Rp.200.000,- stored at a special account as the revolving fund
    - Rp.15.000,- collected for working capital for the Cooperative management unit
- Monthly instalment of Rp.20.000,- covering:
    - Rp.15.000,- stored at a special account as the revolving fund
    - Rp.3.000,- reserve fund for batteries replacement
    - Rp.2.000,- collected for Cooperative Management fee

III.2. Analysis of the experiences gained in view of inter-regional visits, of conferences, etc.

Some useful information and opinions for this deliverable were collected from the following workshops:

- Round table discussion on solar PV development in Indonesia, organised by YBUL, November 15th 2007.

- Workshop on Renewable Energy & Sustainable Development in Indonesia. Organised by e8, UNSW-ADRA/AusAID & STTNAS, Jakarta, January 19-20, 2009. http://www.ceem.unsw.edu.au/content/userDocs/WorkshopProgram.htm

- Rural Electrification Workshop. Bangkok, February 23-25, 2005

Summary and Conclusions

Due to the archipelago nature of Indonesia the extent of the electricity grid is likely to remain limited in the future, with a large fraction of villages needing to find alternative sources of electricity. Among them, the deployment of SHS has strong advantages but also pitfalls. Some solar projects have been implemented successfully, while others have failed, for various reasons. For instance in the district of Kolaka a survey indicates that approximately one third of the SHS installed are now out of order, while another third has been sold to the second hand market.

The need and desire of such systems is present, for economic reasons to replace fossil fuels energy with greatly fluctuating prices, but also for the development of rural villages (businesses, education, telecommunications, "infotainment", health, ...). Solar energy can be used in complement of other renewable energy resources such as hydropower, wind or geothermal, but is the only one readily available in all regions.

The proper implementation of SHS requires adequate planning and consultation among actors. In particular the efforts should be more directed towards the building of dedicated local PV dealers. This would contribute to ensure the technical sustainability of SHS in remote locations (proper designs and installations, maintenance, repairs, availability of spare parts), the financial sustainability (lower transportation and installation costs due to local entrepreneurs, repayment by customers), the required users' education to respect limits of these systems, and also to contribute to the trust towards these systems.

Adequate and specific financial services have also been lacking, with only one bank currently delivering its services to offer credits. There is also a lack of well directed governmental and foreign incentives to assure the development of the Indonesian PV manufacturing industry. PV systems in urban areas are also not developed (absence of feed in tariffs or incentives), when they could attenuate electricity black outs and help foster a local PV industry which would then spread in the rural area. The image of PV systems would then shift from a "temporary" solution to a viable and long term response to the electrification needs and fossil fuel replacement.

Notes and References

- Round table discussion on solar PV development in Indonesia (November 2007).
- "Off-grid photovoltaic applications in Indonesia: A framework for analysis", Retnanestri & al., 2005
- Ph.D thesis: "The I3A Framework - enhancing the sustainability of Off-grid photovoltaic energy service delivery in Indonesia", Retnanestri, M., 2007.