Technical, Institutional, and Financial Issues of PV Development in Indonesia

Case Study: **SHS and Hybrid System**

Presented on:

National Workshop on Solar PV Development in Indonesia: Going to a Sustainable Model

June 18, 2008

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Rural Electricity Condition in Indonesia

- Indonesia Population : 220 million (60-70% live in rural areas)
- Villages : 66 thousand
- Electrified Villages : 78% or 51,000
- Non-electrified Villages : 22% or 15,000
- No of Households : 38.5 million
- Electrification ratio : 53% or 20.4 million households
- Non-electrified households : 47% or 18.1 million households

National Energy Policy in Rural Electrification

National target is to electrify all the village with electrification ratio 95% (year 2025)

Some obstacles to reach the target are:

- The investment to set up an electrical distribution
- The high cost and difficulty of providing fuel in remote and rural areas
- Population is sparse and scattered in wide area

Rural Electricity Development Policy

1. Rural electricity development employs renewable energy sources, e.g. solar, wind, mini/micro-hydro.
2. The utilization of rural electricity is to support productive activities to allows increase of income and welfare of locals.
3. Local Government must participate in the development of rural electrification.

Concept of Village/Rural Energy Supply

- Accessible by the locals and designed to meet local energy demand
- To increase productive activities
- Energy system is designed based on simplicity, and on individual basis, where local participation is included
- Financing mechanism is designed to maximize local ownership through schemes:
  - Low cost credit
  - Micro credit, and or
  - Lease

Strategy of Energy System Application for Villages / Rural Areas

- Technology selection criteria:
  - Meets techno-economy and environmental standard
  - Implementation is in phases:
    - Demonstration phase
    - Multi Demonstration phase
    - Dissemination phase
  - Financing is directed towards achieving independence
  - Set-up appropriate financial and institution mechanism

Concept of PV Rural Electrification Program

The electrification problems in remote and rural area using photovoltaic system can be solved trough tree approaches :

1. Centralized system
2. Decentralized (individual systems)
3. Hybrid PV-diesel system if the population not too sparse and scattered

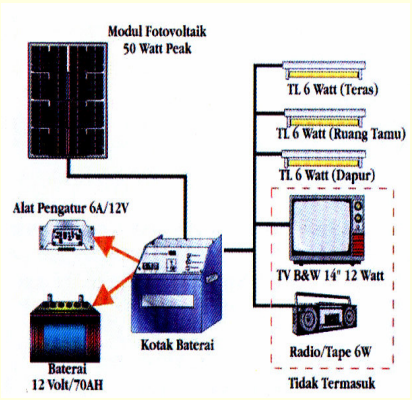
Location criteria for PV Rural Electrification

- Segmenting the consumers
  - s ratio, ratio between economical and investment cost to electrify the location
  - Planning of PLN (National Electricity Company)
  - Area should not be reached by the grid at least for 5 years.

Solar Home Systems in Indonesia

- The SHS have been installed in Indonesia since 1989, a demonstration program in Sukatani village
- Under a Presidential aid program (multiple demonstration) 3445 SHS was installed
- In dissemination program about 37400 SHS have been applied in 8 provinces
- Private sector companies have installed a few thousand SHS in three provinces, the first target of this WB program was 200.000 SHS.

Typical Solar Home System 200 Wh/day and Technical Specifications



Financing Plan : Segmentation of Consumers

Segmentation for consumers of SHS:

- Segment 1, for under developed area. GOI provides SHS, transportation to site and installation
- Segment 2, for the area where the consumers are able to buy SHS by installment for 10 years, GOI contributes for training, transportation fee, installation and interest rate. The consumers have to pay a down payment for balance of system. The SHS is provided by GOI
- Segment 3, the customers are able to pay the installed system by installment within 1-3 years. The SHS will be marketed by dealers (private companies).

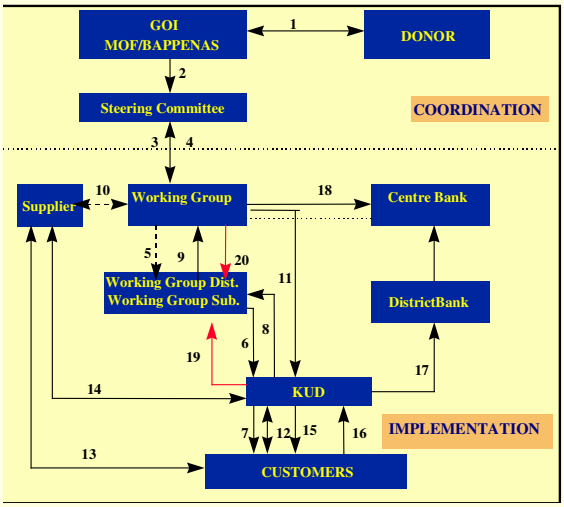
Financing Scheme

- Scheme 1, this scheme is designed for consumers in the first segment and the scheme is as follows:
  - All the cost will be paid by GOI
  - The consumer begin to pay installment after 2 years
  - Cooperative Village Unit will do the technical and financial management
  - Down payment will be used for the first investment of the management
- Scheme 2 is for village with s ratio 1-3, the scheme is as follows:
  - Use lease and purchase contract for 10 years
  - The consumers only pay the hardware
  - The installation, transportation and interest are paid by GOI
  - KUD is responsible for technical and financial management
  - The monthly payment is paid to BPPT

Financing Scheme

- Scheme 3 is directed for segment 3 and it is considered as semi commercial, the scheme is as follows:
  - The down payment is between 20% to 30% of total cost
  - Use lease and purchase contract
  - Payment period is between 1 to 4 years
  - Marketing strategy depends on the dealer policy
  - The interest rate follows the local commercial rate
  - There is some contribution from GEF (US $2/Wp)

Implementation Mechanism



PV – Hybrid Systems in Indonesia

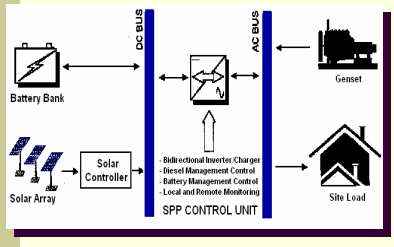
The PV-Diesel Hybrid System have been installed in Indonesia and several demonstration project have been developed.

- Under an Ausaid program 14 units were installed in South East and Central Sulawesi.
- Under a Central Gov. (60%) and Local Gov. (40%) program 1 unit was installed in Gorontalo
- The design concept is to optimize the fuel consumption and increase the electricity services.
- Typical design of Ausaid program, 8 KWp Solar Generator, 25 KVA Diesel Engine, 650 Ah Battery Bank to electrify 200 – 250 houses (50 W, 100 W, and 200 W).
- Typical design of Hybrid System in Gorontalo: 24 KWp Solar Generator, 125 KVA Diesel Engine, 1500 Ah Battery Bank to electrify 400-500 houses (450 watt (R-1)).

Financing Scheme of Hybrid System

- The Hardware will be funded by the Central Government or Local Government or sharing by both Institutions
- Consumers paid a specified installment fee for electricity connection in their own house
- Each house will get a choice of 3 electrical power connection level of 50 watt, 100 watt, or 200 watt
- The energy payment uses prepaid systems (BaDiKa or Smart Card) at an agreed electricity tariff
- Technical and financial management is carried out by Local Government or Local Cooperative Unit (KUD)

Photovoltaic-Diesel Hybrid Systems in Indonesia



14 units of PV-Diesel hybrid system have been implemented in 5 villages in Central Sulawesi, and 6 islands in South East Sulawesi to electrify ± 2,850 houses with 3 choices of electrical level of 50 W, 100 W, 200 W.

Objectives of Conceptual Design:

- Reliability : to ensure high level of continuous power
- Cost-effective: to maintain a balance between initial cost and operating cost of the system
- Efficiency : to maximize the overall system efficiency
- Low Maintenance: to minimize the maintenance of the system

Specifications of the system:

Genset : 25 kVA, PV array : 8 kWp, Battery Bank : 650 Ah,
Bi-directional Inverter : 25 kW, Controller operation : 3 Modes

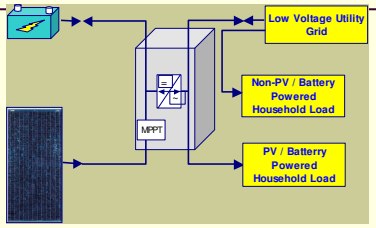
Basic System Operation (3 modes):

- During low loads mode: genset will be off-line, while battery and PV systems will be operating through inverter to cover the loads.
- During medium loads mode: genset will be operating to cover the loads, and charge the battery through inverter.
- During peak loads mode: genset will operating to cover the loads in parallel with inverter witch converts the DC power from battery and PV systems to AC power.

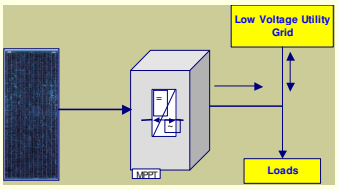
PV – Grid Connected Systems in Indonesia

- Two type of PV Grid Connected System have been installed in Jakarta as demonstration units, consist of:
  - 2 kWp, Battery Back-up Grid Interactive System,
  - 10 kWp, Direct Grid Connected System
- Due to the night-peak electricity Load Profile, the battery back-up is promoted for city residential sector use.
- Direct Grid Connected is intended for office and other commercial building use
- To promote large scale application it is required to introduce favorable policies, such as attractive feed-in tariff, affordable financing, etc.

Technical Features PV Grid Connected



Battery Backed-Up Grid Interactive System



Grid Connected System

Obstacles in Financing

- Financial
  - The target areas usually have low income people
  - The dissemination of SHS need a high initial investment cost
  - Therefore, the program is still managed and financed by GOI
  - To speed up the program, BPPT proposed a financial sharing with local government (50:50)

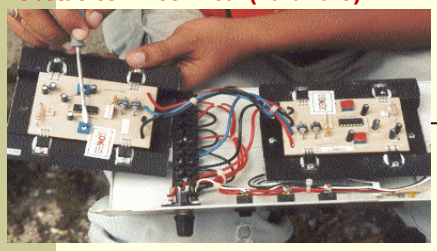
Obstacles in Institutions

- Regional Management:
  - Quality of KUD management
  - Communication
  - Services (technical and repair)
- To solve the obstacle
  - Strong regional management have to be created
  - Create tools for managing the program

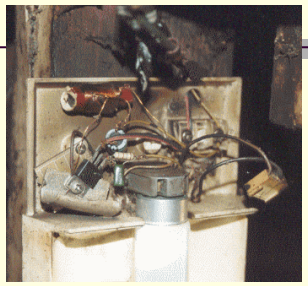
Obstacles in Technical

- PV Supporting Industry:
  - Produce the spare parts in the location
  - Assist the local manufacturers
  - Prepare PV modules and cell industry in Indonesia

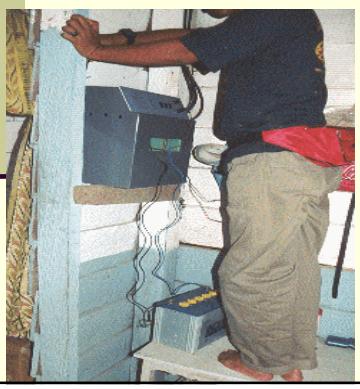
Obstacles in Technical (hardware)

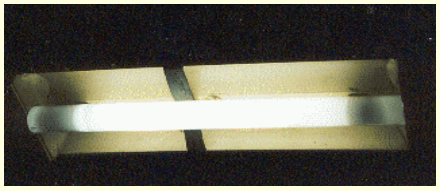


Typical broken inverter and bulb



Negative creativity (paralleling battery)





Indonesia PV System Target Market
Off dan On-Grid 2005 -2025

SHS for *off- grid* remote area electrification target:

- **SHS for low income Household : 615.000 HH**
- **PV System for medium income Household : 1,047 milion HH**

PV System *on- grid* for City and Urban Housing target:

- **PV System for high income (Household 2 kWp) : 314.000 HH**

Installed Capacity Target 2005 - 2025

PV System *off- grid* target:

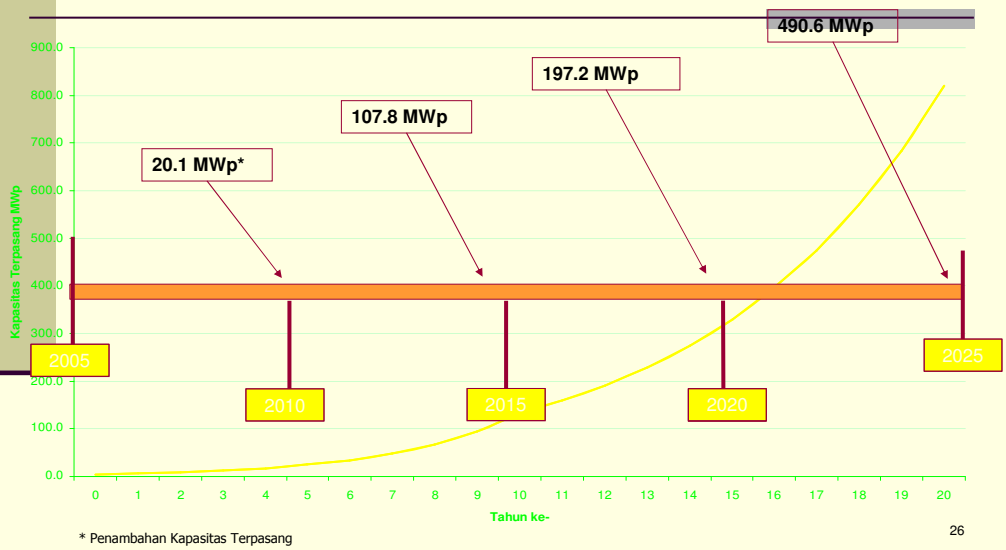
- SHS 50 Wp for low income HH : 30,75 MWp
- PV System by Hybrid and, or Large Module : 157,05 MWp
  SHS 150 Wp

PV System *on- grid* target:

- PLTS on-grid 2 kWp : 628 MWp

Total PV System Installed Target : 815,80 MWp

MILESTONE PV System Implementation 2005 - 2025



* Penambahan Kapasitas Terpasang

Concluding Remarks

- The use PV technology is one of many solution to provide electricity in remote areas and can improve economic activities
- To overcome the high initial investment cost, an appropriate financial mechanism and institution has to be set-up for providing affordable financing.
- Promoting institutional as well as technical capacity building is necessary to support proper program implementation and system sustainability
- The role of the Government is to create proper supporting policies

Conclusions

- It is required to provide a MIS to solve local level management problems
- Local manufacturer development for the BOS as well as Module and PV cell industry are urgent to strengthen the capacity building and achieve the National PV System Target.
- There would be an enormous PV System market around the country that needs contribution and participation of various institutions of government or private company, local or international for industrial and technology development.

THANK YOU

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