PLN - Solar PV DEVELOPMENT PLAN

Moch. Sofyan
Head of New & Renewable Energy Division
PT PLN (Persero)

Solar WORKSHOP
JAKARTA, INDONESIA, FEBRUARY 8TH, 2013
Indonesia as an archipelago country, a thousands of island are not electrified yet

7 Provinces with the electrification ratio (ER) of less than 60%, PLN has set up a plan to accelerate the ER target using renewable energy include solar PV.

Generated power in the remote area mostly supplied by diesel power, with an expensive transportation cost and fuel supply security problem

71 Locations of small and medium isolated system currently supplied by diesel power.

PLN - high generation cost at the remote island

Trend of cost reduction and efficiency improvement on PV technology
PLN Electricity Development Plan

• The electricity demand growth by 8.5 % annually, supplied by various energy resources. Fossil power plant remain dominant ( 81 % ), mainly Coal Steam Power Plant with 63 % share by 2020.

• To reduce oil consumption from 21 % ( 2011 ) to 3 % by 2015.

• Development of renewable energy resources will be first priority, include solar PV.
Electrification Ratio (as of June 2012)

<table>
<thead>
<tr>
<th>Region</th>
<th>2012 Target</th>
<th>2012 Realisasi Sem I</th>
<th>2012 Pred</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLN</td>
<td>71.2%</td>
<td>70.5%</td>
<td>73.3%</td>
</tr>
<tr>
<td>(PLN+ Non PLN)</td>
<td>73.7%</td>
<td>72.8%</td>
<td>75.9%</td>
</tr>
</tbody>
</table>

- RIAU: 73.4%
- KALBAR: 68.4%
- KALTIM: 71.1%
- SULUT: 74.0%
- GORONTALO: 54.9%
- MALUT: 62.8%
- SULBAR: 63.2%
- SULTENG: 62.8%
- SUMUT: 84.8%
- SUMBAR: 74.8%
- JAMBI: 67.4%
- BENGKULU: 65.1%
- SUMSEL: 63.0%
- LAMPUNG: 65.2%
- BANTEN: 77.1%
- JABAR: 72.8%
- JATENG: 78.1%
- DIY: 76.0%
- JATIM: 72.2%
- BALI: 71.0%
- NTB: 49.0%
- NTT: 43.5%
- PAPUA: 30.4%
PLN Plan on Solar PV

- Solar PV Development will be progressed intensively due to its potential, technology development, trend of cost reduction and economic viability.
- PLN has set up the policy to develop Solar as an hybrid system with existing Diesel, Biomass or other RE potentials in a remote area and small island, to respond with GOI policy to reduce oil consumption.
PLN - PV Development Plan

PV Development Program up to 2020: 620 MW
PLN plan to developed Solar as an hybrid system with existing Diesel, Biomass or other RE potentials in a small islands, to respond with GOI policy to reduce oil consumption.
PLN - PV Design Configuration Options

- DEVELOPED BY PLN

  - **Off Grid System (cap: 50 – 100 kW)**
    - Off grid: PV Stand Alone System (connected to LV feeder, 230 V/400 V or MV line 20 kV, PV and Storage Bank/Battery)

  - **On Grid System (cap: 100 - 1000 Kw)**
    - Hybrid System with Exist.Diesel or Ohers Power Plant + PV+Battery (connected to new or existing MV Line)
    - On grid System (connected to existing MV line and without battery)

- DEVELOPED BY IPP

  - **On grid system (cap: 1 – 10 MW)**
    - On grid System (connected to existing MV line and without battery)
Least Cost Supply Options (case study)

- For 100 percent availability/reliability least cost option is PV-diesel hybrid
- However, for 80 percent availability, PV stand-alone system has least electricity cost – but the system suffers from low reliability and high customer dissatisfaction
- For a marginally higher expense, a PV-diesel hybrid offers high system reliability, and availability, and a much more satisfied customer base

<table>
<thead>
<tr>
<th>Annual Demand (kWh/Year)</th>
<th>Lipu</th>
<th>Kinipan</th>
<th>Karitana</th>
<th>Hangga</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>341,640</td>
<td>138,335</td>
<td>60,590</td>
<td>55,115</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Levelized Financial Electricity Cost (IDR/kWh)</th>
<th>Lipu</th>
<th>Kinipan</th>
<th>Karitana</th>
<th>Hangga</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV: 80% Availability</td>
<td>3,135</td>
<td>4,088</td>
<td>4,332</td>
<td>4,099</td>
</tr>
<tr>
<td>PV-diesel hybrid: 100% Availability</td>
<td>3,514</td>
<td>4,544</td>
<td>4,442</td>
<td>4,353</td>
</tr>
<tr>
<td>Differential</td>
<td>11%</td>
<td>10%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>PV: 100% Availability</td>
<td>4,087</td>
<td>5,258</td>
<td>5,772</td>
<td>5,286</td>
</tr>
<tr>
<td>Diesel: 100% Availability (Base Case)</td>
<td>6,991</td>
<td>7,024</td>
<td>6,135</td>
<td>6,438</td>
</tr>
</tbody>
</table>

Electricity Cost from PV-diesel hybrid with 100 percent availability, only marginally higher
Least Cost PV-Diesel Hybrid Option – Case Study
(dramatically reduces reliance on diesel)

- Diesel required for PV diesel hybrid is about 6-20% of stand-alone diesel
- Diesel supplies 6-13% of electricity, the balance from PV
- Less frequent and lower quantities of diesel would be required
Operational implications of PV-Diesel Hybrids

• Has greater operating flexibility in responding to demand variations and near-term demand growth – there is time for investing in additional PV as demand grows

• Fuel delivery network manageable
  – Fuel quantities are significantly less than in diesel-only option
  – Most of the fuel is required in months with lower solar radiation (rainy season with challenging sea conditions), therefore sufficient storage needs to be maintained

• Diesel generator maintenance manageable
  – Frequency of maintenance much less as diesels operate fewer hours/year
  – PV hybrid system operation are more complex
    • strong capacity building required
    • especially for PV-diesel hybrids in load following mode, automated controls are required to facilitate hybrid operations management – however more advanced operators skills are required.
FEED-in TARIFFS Policy (FIT)

- FIT policy for PV, plan to be issued by GOI.
- Qualified IPP Developer selected based on administration criteria and quality of technical proposal.
- Technical specification should comply with National and or PLN Standard.
- Tariff incentive available to attract the use of local content.
- Bank or equity deposit required in the form of escrow account or others form of Bank certificate at the National Bank by IPP Developer before PPA signed
- PPA will be signed with PLN for 20 years contract period using the tariff listed in FIT. PLN will prepare a standard contract.
Proposed Location Criteria of PV - IPP

- Small & medium isolated system which currently supplied by Diesel power
- The maximum PV capacity limited by 20% of the average system demand, ranges between 1 MW up to 10 MW.
- PLN average generation cost at the location higher than the proposed FIT tariff.
- System configuration: on grid, no battery and operate as an hybrid system with existing power plants.

67 Location of Isolated system with total capacity of 150 MW proposed for the first phase of IPP - solar development
### On Grid - Hybrid Solar System base for IPP

| Electricity is produced and directly connected to the PLN grid. |
| Design as PV – hybrid system to provide continuous, reliable power and comfortable. |

| No battery storage required |
| PV Capacity ranges 1 up to 10 MW |
| PV-diesel hybrids in load following mode, required automated controls to facilitate hybrid operations management |
| Comply with National or PLN standard specification. |
Summary and Conclusion

- PLN has set up a plan to develop 620 MW of Solar PV up to 2020.

- Solar - hybrid system with existing Diesel, Biomass or other RE potentials selected as least cost option in a small islands, to respond with GOI policy to reduce oil consumption.

- PV - Diesel Hybrid operation manageable, drastically reduce oil consumption but strong capacity building for operational staff required.

- GOI plan to issued the FIT policy to attract IPP participation on PV development and about 150 MW capacity of PV - on grid system has been allocated for the first phase of PV Base IPP development.

- An incentive policy for domestic product are available to encourage the development of domestic solar PV industries.
Terima Kasih