WIND ENERGY POTENTIAL AND DEVELOPMENT IN INDONESIA

Indonesia Wind Energy Society - IWES
(Masyarakat Energi Angin Indonesia)
Jln. Raya LAPAN Sukamulya – Rumpin
Bogor 16350 – Jawa Barat
Telp. 021-75790378
Fax. 021-75790383
Email : ripnoms@yahoo.com
        ripnoms@gmail.com

The 2nd Clean Power Asia, Denpasar - Bali  May 14-15, 2012
Outline:

- Introduction
- Regulation and Policy
- History on Wind Energy R & D
- Wind Energy Resource Assessment Status
- Wind Turbine Technology Status
- Implementation
- Conclusion
Introduction

• Indonesia is the world’s largest archipelago, which consist of more than 17,000 islands and around 5,700 island only inhabited.
• Indonesia has coastal line as long as more than 81,000 km.
• The characteristics small island is poor resources such as limited freshwater and supply electricity.
• Energy consumption is still dominantly usage costly of fossil fuel however energy consumption growing more and more natural related to the population.
• Wind energy as a one of renewable energy is clean and free
• To realize these, many activity related to wind energy should be done as wind data resources assessment, research and development (R and D) on wind turbine technology and also introducing and disseminating of using wind energy at several site selection.
RE REGULATION AND POLICY

- Government Regulation no 30 year 2007, Energy Law
- Government Regulation no 30, year 2009, Electricity Law
- White paper, for Research, Development and Application of Science and Technology to support the availability of Energy Year 2025
- Ministerial Regulation no 002 year 2006, of Electric Power Exploitation Medium Scale from Renewable Energy up to 10 MW.
- Green Energy, Ministerial Decree: No. 0002/2004
- Presidential Regulation No. 5 year 2006 on National Energy Policy
- Ministerial Regulation no 31 year 2010, About Power Purchase by PT PLN (Persero) From Power Plants Using Small and Medium Scale of Renewable Energy or Excess Power.

- Peraturan Presiden nomor 4 tahun 2010 tentang Penugasan kepada Pt PLN (persero) untuk melakukan Percepatan Pembangunan Pembangkit Listrik yang menggunakan Energi terbarukan, barubara dan Gas.
National Energy Mix 2025 (according to Perpres 5/2006)

- Oil 20%
- Gas 30%
- Coal 33%
- RE 17%
- Bio fuel 5%
- Geo thermal 5%
- Biomasa, Nuclear, hydro, Solar, Wind 5%
- Liquid coal 2%

Current Status 2010

- Oil 50%
- Gas 20%
- Coal 25%
- RE 5%

25/25 Vision (target)

- Oil
- Gas
- Coal
- RE 25%
1979 – 1992
15 lokasi pengukuran dengan wind run dan recorder anemometer

1993 – 2009
118 lokasi pengukuran dengan automatik data recorder
Wind Data Measurement Status

- Wind data and wind map is limited
- Measurement in situ, there are sites:
  - By LAPAN, MEMR: >130 sites
  - By Wind Guard: 12 sites (at East Nusa Tenggara)
  - By Windrock Int: 20 sites (at East Nusa Tenggara)
  - By Soluziona: 3 sites (at South Sulawesi and Central Java)
  - By Nipsa: 2 lokasi (at Nias Island)
- Skunder data from: BMKG, WMO, NCDC, 3TIER and other
- Wind Map by NREL: Sumba dan Timor Islands
- Other sites by several institutions
## Summary Wind Data Indonesia (50 meter)

<table>
<thead>
<tr>
<th>Resources potential</th>
<th>Wind Speed at 50 m, (m/s)</th>
<th>Wind Power density, at 50 m, (W/m²)</th>
<th>Number of sites</th>
<th>Provinces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal</td>
<td>3.0 – 4.0</td>
<td>&lt; 75</td>
<td>84</td>
<td>Maluku, Papua, Sumba, Mentawai, Bengkulu, Jambi, East and West Nusa Tenggara, South and North Sulawesi North Sumatera, Central Java, Maluku, DIY, Lampung, Kalimantan</td>
</tr>
<tr>
<td>Fair</td>
<td>4.0 – 5.0</td>
<td>75 - 150</td>
<td>34</td>
<td>Central and East Java, DIY, Bali, Bengkulu, East and West Nusa Tenggara, South and North Sulawesi</td>
</tr>
<tr>
<td>good</td>
<td>&gt; 5.0</td>
<td>&gt; 150</td>
<td>35</td>
<td>Banten, DKI, Central and West Java, DIY, East and West Nusa Tenggara, South and North Sulawesi, Maluku</td>
</tr>
</tbody>
</table>

Source: LAPAN Wind Data
Wind Data Measurement Sites

PETA LOKASI MONITORING ENERGI ANGIN
TAHUN 1994 - 2008

The 2nd Clean Power Asia, Denpasar - Bali May 14-15, 2012
Indonesia: Wind Energy Potential
Sumba & West Timor: Wind Energy Potential

Wind Mapping of East Nusa Tenggara
<table>
<thead>
<tr>
<th>NO</th>
<th>Site</th>
<th>Province</th>
<th>30m</th>
<th>50m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sidrap</td>
<td>Sulsel</td>
<td>6.19</td>
<td>6.47</td>
</tr>
<tr>
<td>2</td>
<td>UPT Punaga-Laikang-Takalar</td>
<td>Sulsel</td>
<td>4.14</td>
<td>4.58</td>
</tr>
<tr>
<td>3</td>
<td>SBSPIJLAPAN, Parepare</td>
<td>Sulsel</td>
<td>5.97</td>
<td>6.62</td>
</tr>
<tr>
<td>4</td>
<td>Desa Bungaiya Kec. Bontomatene Selayar</td>
<td>Sulsel</td>
<td>5.44</td>
<td>6.02</td>
</tr>
<tr>
<td>5</td>
<td>Appatanah Selayar</td>
<td>Sulsel</td>
<td>7.25</td>
<td>7.92</td>
</tr>
<tr>
<td>6</td>
<td>Dongin, kec. Bantul Banggai</td>
<td>Sulteng</td>
<td>3.10</td>
<td>3.44</td>
</tr>
<tr>
<td>7</td>
<td>Tinobu, Lasolo Kendari</td>
<td>Sultra</td>
<td>2.18</td>
<td>2.42</td>
</tr>
<tr>
<td>8</td>
<td>Kaimbulawa, Buton</td>
<td>Sultra</td>
<td>4.59</td>
<td>5.09</td>
</tr>
<tr>
<td>9</td>
<td>Gerak Makmur, Kec. Sampalawa, Kab. Buton</td>
<td>Sultra</td>
<td>3.10</td>
<td>3.44</td>
</tr>
<tr>
<td>10</td>
<td>Sampuabalo, Lasa Limu Buton</td>
<td>Sultra</td>
<td>3.11</td>
<td>3.45</td>
</tr>
<tr>
<td>11</td>
<td>Poliwei Mandar</td>
<td>Sulbar</td>
<td>3.40</td>
<td>3.92</td>
</tr>
<tr>
<td>12</td>
<td>Bulungkobit, Tinangkung, Kab. Banggai</td>
<td>Sulteng</td>
<td>3.56</td>
<td>3.94</td>
</tr>
<tr>
<td>13</td>
<td>Abason, Tatikum Banggai</td>
<td>Sulteng</td>
<td>4.02</td>
<td>4.45</td>
</tr>
<tr>
<td>14</td>
<td>Sandana Bolaan Uki Bolaan Mangondow</td>
<td>Sulut</td>
<td>2.07</td>
<td>2.29</td>
</tr>
<tr>
<td>15</td>
<td>Desa Libas, Kec. Likupang, Kab Minahasa</td>
<td>Sulut</td>
<td>3.33</td>
<td>3.69</td>
</tr>
<tr>
<td>16</td>
<td>Desa Paudean, Kec. Bitung Selatan, Kab.Bitung</td>
<td>Sulut</td>
<td>2.99</td>
<td>3.31</td>
</tr>
<tr>
<td>17</td>
<td>Kaluwatu, Manganitu Selatan Sangihe Talaud</td>
<td>Sulut</td>
<td>2.30</td>
<td>2.54</td>
</tr>
<tr>
<td>18</td>
<td>Malamenggu Sangihe Talaud</td>
<td>Sulut</td>
<td>5.17</td>
<td>5.73</td>
</tr>
<tr>
<td>19</td>
<td>Kalasuge, Tabukan Utara, Kab. Sangihe Talaud</td>
<td>Sulut</td>
<td>3.45</td>
<td>3.82</td>
</tr>
<tr>
<td>20</td>
<td>Selayar</td>
<td>Sulsel</td>
<td>6.51</td>
<td>6.77</td>
</tr>
<tr>
<td>21</td>
<td>Kota Palu</td>
<td>Sulteng</td>
<td>3.00</td>
<td>3.32</td>
</tr>
<tr>
<td>22</td>
<td>Talaud</td>
<td>Sulut</td>
<td>2.93</td>
<td>3.41</td>
</tr>
<tr>
<td>23</td>
<td>Parigi</td>
<td>Sulteng</td>
<td>3.88</td>
<td>4.30</td>
</tr>
</tbody>
</table>
Several types for small-medium scales WECS capacity (50W to 10 kW) prototypes for electrical and mechanical pumping have been developed i.e.:

- Wind turbines with capacity of 80 W, 250 W, 1000 W, 2500 W, 3500 W, 5 kW dan 10 kW (Lapan, BPPT, ITB, etc).
- Prototype of 20 kW, 50 kW and 100 kW are under development and construction.
- Pre Design for 300 kW WECs
- Multiblade wind mill for water pumping
- Hybrid system with Photovoltaik / Diesel.
WECS Prototypes

50 kW

The 2nd Clean Power Asia, Denpasar - Bali May 14-15, 2012
Many modern concepts have been tried...
Turbine Size has Increased with Time

- Reduction in cost per kWh
- Improved energy capture
- Size stabilizing in recent years

<table>
<thead>
<tr>
<th>Product/Rotor diameter (m)</th>
<th>V15</th>
<th>V17</th>
<th>V19</th>
<th>V20</th>
<th>V25</th>
<th>V27</th>
<th>V39</th>
<th>V44</th>
<th>V47</th>
<th>V52</th>
<th>V56</th>
<th>V80</th>
<th>V90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (kW)</td>
<td>55</td>
<td>75</td>
<td>90</td>
<td>100</td>
<td>200</td>
<td>225</td>
<td>500</td>
<td>600</td>
<td>660</td>
<td>850</td>
<td>1750</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>MWh/year</td>
<td>217</td>
<td>265</td>
<td>301</td>
<td>346</td>
<td>481</td>
<td>647</td>
<td>1304</td>
<td>1581</td>
<td>1947</td>
<td>2530</td>
<td>4705</td>
<td>6768</td>
<td>9152</td>
</tr>
</tbody>
</table>

Source: Vestas
Implementation Status

Technology:
- Tke largest wind Turbine: Enercon E-126 (7 MW)

Implementation:
- World total installed capacity is 196.630 GW, by December 2010
  - China 26.010 /12.210/ 44.733 MW
  - USA 35.195 /25.170/ 40.180 MW,
  - Jerman 25.777 /23.903/ 27.215 MW,
  - Spain 19.145 /16.754/ 20.676 MW,
  - India 10.125 /9.645/ 13.065 MW,
  - Indonesia ~ 2 MW

Sources: GWEC 2010, AWEA

The 2nd Clean Power Asia, Denpasar - Bali May 14-15, 2012
WIND ENERGY IMPLEMENTATION

System Configuration

- **Stand alone systems** consist of several units of small scale WECS (up to 10 kW installed capacity per unit) provided with battery banks as a storage subsystems and inverters, depend on the user requirement.

- **Hybrid system** with other source and combined with diesel generating sets as back-up. Main function of generating sets is to take over the supply of electricity during low wind speed.

- **Grid Interconnection system**, the system can parallel be interconnected to the existing grid or into the power generating using generating sets.
WIND TURBINES IMPLEMENTATION STATUS

- The implementation of wind energy technology in Indonesia is still low.
- The implementation of isolated wind energy systems typically in remote area / location or islands, and they are frequently installed as part of development or research project.
- The biggest capacity of wind turbine installed at the moment is 100 kW. It was implemented by PT PLN and MMER (Ministry of Mines and Energy Resources) at Selayar Island.
WIND TURBINES IMPLEMENTATION

A number of pilot projects have been developed at several locations, these are:

- Hybrid system Wind - PV and Diesel at Rote Ndao East Nusa Tenggara, with 4 unit of 10 kW wind turbine and 36 kWp PV.

- Hybrid system Wind-PV-PLN at Girisari – Bali, consist of 1 unit wind turbine of 2.5 kW and 4.8 kWp of Photovoltaic, for powering Indosat BTS.

- Small isolated grid connection at Nusa Penida island Bali, total installed 735 kW consist of 9 units and at Selayar Island with 200 kW installed for 2 units.

- Utilization by other users, for several application for water pumping, lighting (public and household), communication power supply, battery charging, freezer and other, have been installed of several kilo-Watt WECS installed capacity.
Hybrid System at Futun, Rote Ndao dan Madura

Note:
- Hybrid Wtg+PV at Lombok Island used for battery Charging for house lighting
- Hybrid wtg+PV+diesel at Rote Ndao used for isolated utility grid
- Hybrid Wtg_diesel at Madura used for battery charging for public lighting and houses.
Wind-Solar Hybrid for Ice Production and water pumping at Yogyakarta
Small on grid connection at Selayar

on grid system (micro grid) at Selayar Island

- Installed capacity 200 kW,
- 2 unit x 100 kW
Small on grid connection at Nusa Penida Bali

- Installed capacity: 735 kW, consists of:
  - 6 units of each 80 kW
  - 3 units of 85 kW

Small on grid connection at Nusa Penida Bali -- 24
Hybrid System For BTS

Hybrid Wtg+PV+grid for BTS (Base Transciever Station) at Bali
Example of WECS Implementation (direct used)

- Windmill for water pumping for irrigation of rice plantation at Serang Banten and Kerawang
- Windmill for pumping fresh water at NTT
- Windmill for salt fields at Jepara, Indramayu, Gresik, and Lombok Timur
BARRIER of WIND TECHNOLOGY IMPLEMENTATION

- Wind turbine prices are still relatively expensive
- Electricity tariff for RE is still relatively low
- Most of the wind turbines are technically function with regular maintenances. For this task, spare-parts must be availability
- Maintenance jobs are particularly more problems at the remote areas due to the lack of technical persons and spare-parts delivery
- Some wind turbines do not perform according to the given specifications. Main reason is the sitting or design of operating system due to the lack of wind data and less technical assessment or FS
- More private companies and industry had indicated their interests in marketing and local fabrications, however, they need the stimulus for better contributions
- The better and best wind data actually located at remote area at eastern part Indonesia, but demand and access to location are limited
The Challenge

The contribution of wind energy in Indonesia has to be gained, i.e, by means of:

a) More assessment and identification of wind potential at various area in Indonesia supported by accurate and reliable wind data base. This has to be done nationally with the targets to produce the representative wind map of Indonesia.

b) The comprehensive Indonesia wind mapping is not developed yet, so this is once of challenge for build that.

c) Local fabrication of certain type of WECS using proper technology have to performed for reducing the cost and increasing market achievement.

d) Large WECS implementation have to be initiated in order to realize the contribution of wind energy according to BEPN/Road Map 2025. WECS products of the size of 300kW – 1 MW and are available for implementation.

e) Local governments have the important roles for wind applications; more supports are expected in order to accelerate the achievement.
THE PROSPECT

• Several location have been done by indentified/investigation and some of them have good / excellent wind energy potential. Base on the specific sites on wind resource and demand, the implementation can follow the systems configuration above.

• For the wind potential sites and the remote /small island and small demand, the configuration with stand alone systems are suitable for, with using small size wind turbine on many area / islands.

• The extended for existing electricity generating by adding the wind turbine for hybrid system at several location especially at eastern part Indonesia or at the Islands.

• The feasibility study at several location have been done identified, some of them have prospected to be implementation for grid inter-connection with large wind turbine.
CONCLUSION

• Several sites have been identified and some of them have prospect to implemented of wind energy technology especially at good/ excellent wind potential.

• From a number of pilot project in Indonesia, it can be seen that wind energy has been very useful for these living in remote areas to use their electronic devices such as radio, TV, water pumping, lighting, communication system etc

• Required pilot project with the correct phases from planning through to OM and management systems.

• FIT policy needed to encourage investor to develop wind energy utilization.

• The government is expected to develop a map of the national wind energy potential as soon as possible, nationally or internationally
Thank You