Wind Energy Brazil: Considerations on small, intermediate and large size systems

NEET Workshop - Brasilia
November 2007

www.cresesb.cepel.br
I – Introduction
• Wind energy in the framework of the PNE 2030 and concern with the global heating

II - Small Size Systems
• Situation in Brazil
• Rural Eletrification – LPT (Electricity Universalization Program)

III - Intermediate Size Systems
• An example of feasibility

IV - Large Size Systems
• Summary of the situation

V – Conclusions
• Gone with the wind?
Electrical Mix

2015 (Renewables: 83.7%)

2005 (Renewables: 84%)

2030 (B1 Cenarium) (Renewables: 83.1%)

Electricality: projection of consumption increase

1970 2005
1980 2005

6.7% per year
4.5% per year

(2005-2030)

5.1%  4.3%
4.3%  3.9%
3.9%  3.4%
3.4%

Cenário A
Cenário B1
Cenário B2
Cenário C

361.3 (2005)

TWh
1.243,8
1.045,6
941,2
847,0

### CO2 Emission of Diverse Technologies (ton/GWh)

<table>
<thead>
<tr>
<th>Technology</th>
<th>CO2 Emission (ton/GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (conventional plant)</td>
<td>1000</td>
</tr>
<tr>
<td>Gas</td>
<td>500</td>
</tr>
<tr>
<td>Wind</td>
<td>7</td>
</tr>
<tr>
<td>Large Hydro</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Instituto de Pesquisa ambiental da Amazônia
Wind Energy Applications – Electricity Generation

**Small Size (≤10 kW)**
- Residential
- Farms
- Remote Applications

**Intermediate Size (10-500 kW)**
- Hybrid Systems
- Distributed Generation

**Large Size (500 kW - 2+MW)**
- Wind Farms
- Distributed Generation

II – Small Size Sistems
Wind Energy Applications – Electricity Generation

**Small Size (≤10 kW)**
- Residential
- Farms
- Remote Applications

- High quality wind turbines technically developed and produced in Brazil in commercial scale
- Clientes are not grid connected
- Complete system of 1 kW: R$12,000,00
- Complete system of 5 kW: R$45,000,00
- System of 10 kW: under development
Some initiatives to stimulate this sector:

- Special long term credits with lower interest rates
- Tax incentive policies
- Export incentives
- Legislation for grid connection
- Use of small wind systems at the LPT

Source: CEPEL-DTE Report - 211035/2003 - giannini@cepel.br
<table>
<thead>
<tr>
<th>Region</th>
<th>Accumulated Connections</th>
<th>Number of People</th>
<th>Resources (R$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norte</td>
<td>183,496</td>
<td>917,480</td>
<td>718,352,612,02</td>
</tr>
<tr>
<td>Nordeste</td>
<td>614,919</td>
<td>3,074,595</td>
<td>2,019,508,013,03</td>
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<tr>
<td>Sudeste</td>
<td>292,228</td>
<td>1,461,140</td>
<td>643,597,231,31</td>
</tr>
<tr>
<td>Sul</td>
<td>106,740</td>
<td>553,700</td>
<td>203,594,187,27</td>
</tr>
<tr>
<td>Centro-Oeste</td>
<td>93,789</td>
<td>468,945</td>
<td>387,784,257,47</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,291,172</strong></td>
<td><strong>6,358,420</strong></td>
<td><strong>3,972,836,301,10</strong></td>
</tr>
</tbody>
</table>

**Crescimento da População**

FONTE: Informativo da Eletronuclear - agosto 2001
III – Intermediate Size Systems

Intermediate Size
(10-500 kW)

- Hybrid Systems
- Distributed Generation
A promising feasibility study (preliminary results)

- Costumer: Hospital supplied by the grid
- Load: 380 kW
- Monthly Average Demand:
  - Peak: 345.5 kW
  - Out of Peak: 335.9 kW

- Proposed alternative supply:
  - Wind turbine and grid (peak and out of peak)
  - Diesel Generator as back up in peak hours with no wind
- Total investment: R$ 2,536,410.00
- Yearly Savings: R$ 423,076.63
A promising feasibility study (preliminary results)

- Wind turbine considered

IV – Large Size Systems
Large Size (500 kW - 2+MW)
- Wind Farms
- Distributed Generation

PROINFA
Electric Energy Alternative Sources Incentive Program

Wind: 208.3 MW
5 wind farms

December 2006

PCH
162.34 MW

BIOMASS
414.44 MW

(Fonte: EMME, 2007)
• It is not feasible, with the present technology, to store large amounts of energy generated by a intermittent source of energy as the wind.

• The combined utilization of Hydro and Wind, improves the energetic potential of both sources due to the seasonal complementary characteristics of them.
V – Conclusions
Energy prices for energy generated by large wind farms are approaching the prices of conventional sources (R$ 200,00 – wind; R$ 137,00 – conventional).

With lower prices of equipment and with better wind characteristics than previous expected, the penetration of wind energy in Brazil it will be higher than conservative nowadays forecast.

Intermediate and small systems can be economically feasible in applications even with the present conditions.
OBRIGADO PELA ATENÇÃO!