Renewable Energies at PETROBRAS

9th LAMNET – Ribeirão Preto, Sept 15-16 th 2004

Marcia Leite Drachmann - PETROBRAS – Gas & Energy

Energy Conservation / Renewable Energies
Talk plan:

- PETROBRAS in figures
- Energy overview of Petrobras and Brazil
- PETROBRAS Strategies for Renewables
- PETROBRAS’ plans / accomplishments in Renewables
- Conclusions
PETROBRAS in Figures

PRODUCTION PLATFORMS
98 (68 fixed; 30 floating)

DAILY PRODUCTION
1,701 million barrels per day - bpd (oil and NG)
53 million m³ NG

REFINARIES
16

REFINING CAPACITY
1,732 million barrels per day – bpd

PIPELINES
27,120 km

SHIP FLEET
97 (54 Petrobras’ property)

SERVICE STATIONS
5,074

FERTILIZERS (2 Factories)
2.141 metric tons ammonia, 2.437 metric tons urea
PETROBRAS – R & D Center – CENPES

1300 employees (1/2 university level)
Oil & Gas Production (mboed)

Majors e Petrobras: average production jan-set/2002
Emerging: 2002 prediction, Morgan Stanley

Fonte: PIW, dados de 2001
Petrobras leading oil production growth

(1996-2001)

Petrobras

ENI

Conoco

Phillips

BP Amoco

Repsol-YPF

Chevron Texaco

TotalFinaElf

Shell (RD)

ExxonMobil

Source: Evaluate Energy
PROFITABILITY AND SOCIAL RESPONSIBILITY

“Business committed with sustainable development”

“Improvement of Energy Efficiency linked to mitigation of climate changes”
1- Portfolio on Renewable Energies

2- Large participation on “Pro- Alcool”, world’s largest renewable liquid fuel program (ethanol from sugar cane);

3- Energy Efficiency Internal Program

4- Rational Use of Fossil Fuels Programs
RENEWABLE ENERGIES
BRAZIL- ENERGY PROFILE

Natural Gas 5,5%

Petroleum 47,1%

New Energies 2,2%

Modern Biomass 11,3%

Large Hydroelectric Plants 12,8%

Traditional Biomass ("non-sustainable") 3,4%

Traditional Biomass (renewable) 9,1%

Coal 7,4%

Nuclear 1,2%

Sustainable Renewable energies: 35,4%

Fonte: MME
BRAZIL - INSTALLED CAPACITY (grid / off-grid)

- Hydroelectric ( > 30 MW ) 64.192 MW
- Thermoelectric (*) 11.998 MW
- Nuclear 2.007 MW
- Wind 22 MW
- PCH (< 30MW) 1.740 MW
- Solar PV (PRODEEM) 5.8 MW
- Biomass (**) 1.972 MW
- Imports 8.000 MW

(*) NG: 5.248 MW; Petroleum: 5.288 MW; Mineral coal: 1.461 MW
(**) 57% Sugar-ethanol sector

Fonte: MME
0.5% of Petrobras investments in Renewables (
~ US$ 50,000,000.00 in 2004)

Investment Return Tax < conventional (O&G) -

Target: 10% participation of renewables in Petrobras
Electricity consumption up to 2010.
THERMO-SOLAR

PHOTOVOLTAIC

WIND

BIOMASS

BIO-FUELS (ETHANOL, BIODIESEL)
WATER HEATING IN REFINARIES VESTIARIES & KITCHENS

Replacement of electric systems by thermo-solar
Potential : 2 MW

Installed / under construction:
1345 m² pannels, 85000 liters /day

- BR Service Stations (2.7 MW) – potential

Internal / external “green” culture / image
PV systems total capacity 100 kW:

- Uninhabited oil platforms: process control, communication;

- Oil pumping in low-production wells in remote areas NE

- Comparison between alternative PV thin film technologies – 45 kW - CENPES, PETROBRAS R&D Center, largest installed capacity in Brazil;
WIND ENERGY IN PETROBRAS

- Pilot Plant Macau (RN) - 1,8MW Oper. since Jan 04

- 2 X 3 MW - Environmental licensing stage

NEGOTIATION OF PARTNERSHIPS FOR PETROBRAS
LARGE PARTICIPATION IN PROINFA – wind energy
BIO-ENERGIES IN PETROBRAS

• BIO-FUELS (ETHANOL, BIODIESEL)

• BIOMASS (SUGAR CANE BAGASSE, BIOGAS)
BIODIESEL IN BRAZIL

• High interest from Brazilian Government for implementing biodiesel in large scale;

• B2 (2% biodiesel in fossil diesel to be authorized Jan 2005)

• Petrobras is planning large participation in biodiesel chain, including: production, distribution, transport, commercialization
BIODIESEL IN BRAZIL

• Extensive planted areas /mild climate

• Improvement of Diesel performance (ketane / lubricity)

• Compliance with Kyoto protocol (Carbon credits).

• Descentralized production (mini-plants).

• Social development / Job generation in rural zones.
Infra-Estrutura Logística da Petrobras:
- Representação no Japão, Estados Unidos, Reino Unido, Cingapura, Angola, Nigéria, Argentina, Bolívia, Colômbia

Infra-Estrutura Logística de Transporte:
- 20 Terminais terrestres;
- 23 Terminais marítimos e em rios;
- 9.289 km de dutos;
- Capacidade de estocagem: 9,8 milhões m³
- Manuseia anualmente 250 milhões de m³;

Infra-Estrutura Logística de Distribuição:
- 51 Bases de Distribuição Próprias;
- 9 Bases de Distribuição em Pool;
- 11 Armazenagens em Bases de Terceiros;
- 8 Centros Coletores de Álcool;
- Terminal Ferroviário de Paulínia;
## Biodiesel - Potential of Brazilian seeds

<table>
<thead>
<tr>
<th>Type</th>
<th>Productivity (kg/ha)</th>
<th>Oil content (%)</th>
<th>Oil production (kg/ha.a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babaçu</td>
<td>450</td>
<td>62</td>
<td>279</td>
</tr>
<tr>
<td>Castor bean</td>
<td>1500</td>
<td>50</td>
<td>750</td>
</tr>
<tr>
<td>Sesame</td>
<td>900</td>
<td>48</td>
<td>432</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>1700</td>
<td>39</td>
<td>663</td>
</tr>
<tr>
<td>Sun flower</td>
<td>1300</td>
<td>38</td>
<td>494</td>
</tr>
<tr>
<td>Palm tree</td>
<td>10 000</td>
<td>20</td>
<td>2 000</td>
</tr>
<tr>
<td>Soy bean</td>
<td>2200</td>
<td>17</td>
<td>374</td>
</tr>
<tr>
<td>Cotton</td>
<td>15</td>
<td>15</td>
<td>150</td>
</tr>
</tbody>
</table>
### Castor Biodiesel

<table>
<thead>
<tr>
<th></th>
<th>B2</th>
<th>B5</th>
<th>B10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biodiesel Volume</strong></td>
<td>0,8</td>
<td>2,0</td>
<td>4,0</td>
</tr>
<tr>
<td><strong>(milhões m³)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Seed consumption</strong></td>
<td>1,44</td>
<td>3,6</td>
<td>7,2</td>
</tr>
<tr>
<td><strong>(milhões ton.)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cultivated area</strong></td>
<td>0,48</td>
<td>1,20</td>
<td>2,00</td>
</tr>
<tr>
<td><strong>(milhões ha)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rural Jobs</strong></td>
<td>240.000</td>
<td>600.000</td>
<td>1.200.000</td>
</tr>
<tr>
<td><strong>Imports reduction</strong></td>
<td>280</td>
<td>700</td>
<td>1.400</td>
</tr>
<tr>
<td><strong>(million US$)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO₂ reduction</strong></td>
<td>9,6</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td><strong>(million tons)</strong></td>
<td></td>
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</tr>
</tbody>
</table>
Castor Paraguaçu – Plantation in Monteiro (PB)
Biodiesel

Petrobras Process

Catalyst  Seeds  Ethanol
Petrobras Process: Co-products
Processo Petrobras: Fluxograma da pesquisas

Agronegócio

Processo BR

Co-produtos

Desenvolvimento
- Biodiesel from seed is more attractive economically than classical (no oil extraction/ refining, valorization of co-products)

- Technology requires further development, specially concerning glycerol / ethanol separation / specification
Ethanol
Ethanol Economical Aspects

- Brazil has lowest production cost:
  - Brazil: US$ 0.19/liter
  - USA: US$ 0.33/liter
  - Europe: US$ 0.56/liter
Ethanol Economical Aspects

• Brazil has PRO-ALCOOL largest worldwide liquid renewable fuel program; 25% in gasoline as octane booster, LARGE PARTICIPATION OF PETROBRAS BLENDING / DISTRIBUTION / COMMERCIALIZATION

Environmental pressures are forcing countries worldwide to use renewable fuels: Europe, Japan, USA, etc are potential importers of Brazilian ethanol (octane booster in gasoline)
Ethanol Figures in Brazil (2002)

- Production: 14 million m³/year
- Installed capacity - 16 million m³/year
- World ethanol production: 33 million m³/year
  - Brasil, 37%; EUA, 20%; China, 9%; other, 34%.
Ethanol fueled cars:

1986: 76%  
1998: 0,1%  
2001: 1%

Reasons:

- Supply shortage (competes with sugar)
- Price increase as compared to gasoline


Bosch: 500 000 cars /year by 2005 (30% market)

Jan 2004: 14,9%  
VW: end 2004: 40% sales - flexfuel
Biomass for EE
Governmental program to incentive electricity generation from renewables sources

Licenses (Operation by December 2006):
1100 MW Wind Power
1100 MW Biomass
1100 MW Hydropower < 30 MW

PETROBRAS NEGOTIATES PARTNERSHIPS FOR LARGE PARTICIPATION IN PROINFA
NEGOTIATION OF PARTNERSHIPS FOR PETROBRAS
LARGE PARTICIPATION IN PROINFA - Biomass

Typical case: enlargement / modernization of sugar-ethanol plants (~20 MW), increasing electricity production for auto-consumption / commercialization of exceeding energy - Some case dual fuel bagasse – natural, generating all year round.

Other possibilities: GASIFICATION; etc
CONCLUSIONS

PETROBRAS IS OPEN TO STUDY PARTNERSHIPS IN LARGE RENEWABLES / BIO-ENERGIES ENTERPRISES, IN AGREEMENT WITH ITS COMMITMENT TO SOCIAL RESPONSIBILITY AND SUSTAINABLE DEVELOPMENT
THANK YOU!

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