BRAZIL: A PIONEER IN BIOFUELS

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SUMMARY

1. BIOFUELS IN BRAZIL’S ENERGY MATRIX

2. BRAZIL’S ETHANOL: PRODUCTION, POLICIES AND PROSPECTS

3. BIODIESEL: THE NEW CHALLENGE

4. FINAL REMARKS
BRAZILIAN ENERGY MIX

- Oil and oil products: 39%
- Biomass: 29%
- Hydraulic and electricity: 15%
- Natural gas: 8%
- Coal: 7%
- Uranium: 2%

World: biomass 11%; hydraulic and electricity 2%

Source: MME/BEN (2005)
Why BIOFUELS?

- Environmental gains
  - carbon sequestration
  - lower emission levels in consumption

- Renewability
  - short production cycle
  - man-controlled process

- Economic aspects
  - new demand component
  - impacts on trade balance

- Social aspects
  - jobs creation
  - income deconcentration

* Norman Borlaug
BRAZILIAN ETHANOL: PRODUCTION, POLICIES AND PROSPECTS
THE BRAZILIAN SUGAR CANE AND ETHANOL EXPERIENCES

1532: Martim Afonso de Sousa introduces sugar cane in Brazil

1925: First ethanol powered vehicle tested in Brazil

1979: First commercial ethanol moved vehicle in Brazil

2003: Flex fuel motors are launched
SUGAR CANE IN BRAZIL

NORTH/NORTHEAST REGION
15% of national sugar cane production

CENTER-SOUTH REGION
85% of national sugar cane production
PRODUCTION DATA FROM THE BRAZILIAN SUGAR CANE SECTOR

Sugar Cane Destination by Product

<table>
<thead>
<tr>
<th>Year</th>
<th>Sugar</th>
<th>Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>96/97</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>97/98</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>98/99</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>99/00</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>00/01</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>01/02</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>02/03</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>03/04</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>04/05</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>05/06</td>
<td>35.8%</td>
<td>64.2%</td>
</tr>
<tr>
<td>06/07</td>
<td>50.1%</td>
<td>49.9%</td>
</tr>
<tr>
<td>YEAR</td>
<td>PROGRAMS</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>- HYDROUS ETHANOL -</td>
<td></td>
</tr>
</tbody>
</table>
| 1985 | - ANHYDROUS ETHANOL -  
        | FIXES THE MIX LEVEL AT A MANDATORY 22% |
| 2003 | FLEX FUEL VEHICLES |
**ENERGY EFFICIENCY OF ETHANOL IN BRAZIL**

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Energy output / Energy input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat(^1)</td>
<td>1.2</td>
</tr>
<tr>
<td>Corn(^1)</td>
<td>1.3 – 1.8</td>
</tr>
<tr>
<td>Sugar Beet(^1)</td>
<td>1.9</td>
</tr>
<tr>
<td>Sugar Cane(^2)</td>
<td>8.3</td>
</tr>
</tbody>
</table>

\(^1\) F.O. Licht, 2004.
\(^2\) Macedo, I et al., 2004 – Under Brazilian production conditions.

- High photosynthesis efficiency (C4 crop).
- Possibility for using the sugar cane by-products in the production process, avoiding external energy sources.
CO-GENERATION WITH SUGAR CANE BAGASSE IN BRAZIL

CURRENT POWER: ~ 2200 MW
(700 MW are exported to the grid and 1500 MW are consumed in the own mills)

ACTUAL MEASURED POTENTIAL:
3.000 MW – 14.000 MW (extra)
Depending of the technology applied in the generation process.

- Possibility to obtain carbon credits from CDM Projects (Kyoto Protocol)
- Complementary to the hydraulic generation in the Center-South Region
THE USES OF VINASSES IN BRAZIL

Good fertilizer: high amount of potassium (K₂O)
Vinasses can be applied on the soil by irrigation
A new technology is being developed in Brazil: to dehydrate and transform vinasses into a new commercial product
THE FLEX FUEL CAR –
A NEW DOMESTIC ETHANOL DEMAND

• Flex-Fuel Engine: allows the use of ethanol or gasoline in any concentration of these fuels

• Current Manufactures: VW, GM, Ford, Fiat, Renault, Peugeot, Citroen and Honda

• Sales of Flex-Fuel Vehicles in Brazil:
  - 2003: 48,000 units
  - 2004: 330,000 units
  - 2005: 865,000 units
  - 2006: 1,447,000 units

15.5 million gasohol cars (20% anhydrous ethanol blend)
2.6 million flex fuel cars
3.6 million motorbites (20% anhydrous)
- Total production: 18 billion liters
- Production per ton of sugar cane: 82 L/t
- Production per hectare: 7000 L/ha
- Production ratio: 160 thousand ha to produce 1 billion liters ethanol

**EXPORTS: ETHANOL AND GASOLINE PRICE RELATIONSHIP**

<table>
<thead>
<tr>
<th>YEARS</th>
<th>ETHANOL</th>
<th>GASOLINE</th>
<th>PRICE RELATIONSHIP Ethanol x Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million US$ F.O.B.</td>
<td>Liters (Billion)</td>
<td>Average US$/m³</td>
</tr>
<tr>
<td>2003</td>
<td>158,0</td>
<td>0,757</td>
<td>208,56</td>
</tr>
<tr>
<td>2004</td>
<td>498,0</td>
<td>2,408</td>
<td>206,68</td>
</tr>
<tr>
<td>2005</td>
<td>766,0</td>
<td>2,592</td>
<td>295,31</td>
</tr>
</tbody>
</table>

Source: MDIC (Alice System)
THE FUTURE OF ETHANOL

The Brazilian aim is to transform ethanol in a great commodity, together with other countries
HOW TO EXPAND SUGAR CANE WITH SUSTAINABILITY?

AREAS FOR EXPANSION

AMAZON REGION

PANTANAL (SWAMPLAND)

ATLANTIC FOREST

SLOPE < 12%

SLOPE > 12%
# Production, Export and Consumption of Sugar and Ethanol

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th></th>
<th>2015</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production</td>
<td>Export</td>
<td>Consumption</td>
<td>Production</td>
</tr>
</tbody>
</table>
BIODIESEL: THE NEW CHALLENGE
1970: first experiences (obstacle: vegetable oil prices)

1980: first biodiesel patent in the world (Federal University of Ceará)

2002: Government Agenda (Working Group)

Dec/2003: Inter-ministerial Executive Committee and a management group, responsible for a program implementation

Dec/2004: Program launching, with 14 Ministries and various Research Centers

2005: States structure research nets
Basic Objectives of the Biodiesel Program:

- Reduce oil dependency
- Produce environmental gains
- Introduce family agriculture into the raw material production process
- Allowed mixture: up to 800 million liters/year
- 2008: Mixture of 2% made compulsory
- 2013: Mixture increases to 5%
FINAL REMARKS
BIG CHALLENGES

FREE INTERNATIONAL MARKET FOR AGROENERGY

FUTURE PRICE OF PETROLEUM

BIODIESEL EFFICIENCY; AGRICULTURAL AND INDUSTRIAL GOVERNMENT POLICIES

TECHNOLOGY DEVELOPMENT FOR BIODIESEL
GOVERNMENT POLICIES

1. GOVERNMENT SUPPORT AT THE BEGINNING: PROALCOOL (1980s) AND BIODIESEL (NOW!).
2. REGULATION AND SUPERVISION OF THE MARKET
3. FINANCING SUGAR AND ALCOHOL MILLS
4. SOME TECHNOLOGY SUPPORT
5. DRIVE FORCE: MARKET
BRAZIL HAS A GREAT POTENTIAL FOR BIOFUELS PRODUCTION...