Brazilian experience with biofuels

Department of Sugar Cane and Agroenergy
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 distribution

- Energy Security
  - diversification;
  - reduction on imports.
AGRICULTURE IN CURRENT CONTEXT

• Historic challenge: food security

• 1960s: focus on technical progress – gains in productivity

• 1980s: focus moves to food safety

• 1990s: new concern - environmental safety

• 2000s: biofuels as a new demand

• Current challenge: agriculture must supply four “f” (food, feed, fibers and fuels), competitively and in a sustainable way.
PERSPECTIVES TO BIOFUELS MARKET

• Increase in global demand
• Strengthen socio-environmental concerns
• Development of trades
• However, there are important challenges:
  - Biodiesel: development of new raw materials (algae, for example), reducing dependence on conventional oilseeds;
  - Ethanol: new technological pathways (hydrolyses of cellulosic materials);
  - New possibilities: synthetic diesel; biological diesel; etc.

➢ Technical progress will be helpful to harmonize energy security and food security.
WORLD CHALLENGE

INTEGRATION

Food Market

Energy market

Food Agriculture

Energy Agriculture

Environmental sustainability
Biofuels can be considered an excellent opportunity to the tropical countries…
BRAZILIAN AGROENERGY PLAN:
- BIODIESEL
- ETHANOL
- WASTES OR RESIDUES
- ENERGETIC FORESTS
Brazilian challenge: how to promote sustainable production and use?

Priorities:

- Agro-Ecological Zoning
- Research and Development
- Support to Household Farmers
ETHANOL FUEL HISTORY IN BRAZIL
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

2003: Flex fuel motors are launched

1979: First commercial ethanol moved vehicle in Brazil
Brazilian Experience: nowadays…

1) Since 2003, more than 100 new models of Flex-Fuel Vehicles, by eleven automakers: it can use any mixture of gasoline and alcohol, from 0 to 100%, without any action of car driver.

2) Since 2007, Flex Fuel vehicles sales has represented more than 80% of total light vehicles sold (8,4 million of units).
Sugarcane is the main renewable source.
Ethanol and environmental impacts in Brazil.

921 million of boe saved, or 16 months of domestic production of oil, considering current capacity (*). During this period, ethanol gave the condition to save the emission of 851 MILLION TONS of CO₂

*It considers daily capacity of 1.996 mil barris (average Jan-Mar/2009)
## Land use in Brazil

<table>
<thead>
<tr>
<th>USES</th>
<th>Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million ha</td>
<td>%</td>
</tr>
<tr>
<td>Amazon Rain Forest</td>
<td>357</td>
<td>42.0%</td>
</tr>
<tr>
<td>Pastures</td>
<td>172</td>
<td>20.2%</td>
</tr>
<tr>
<td>Annual Crops</td>
<td>55</td>
<td>6.5%</td>
</tr>
<tr>
<td>Perennial Crops, except sugarcane</td>
<td>9</td>
<td>1.1%</td>
</tr>
<tr>
<td>Sugarcane (for sugar and ethanol)</td>
<td>7.8</td>
<td>0.8%</td>
</tr>
<tr>
<td>Planted Forests</td>
<td>6</td>
<td>0.7%</td>
</tr>
<tr>
<td>No exploited</td>
<td>115</td>
<td>13.5%</td>
</tr>
<tr>
<td>Cities</td>
<td>21</td>
<td>2.5%</td>
</tr>
<tr>
<td>Protected areas</td>
<td>71</td>
<td>8.3%</td>
</tr>
<tr>
<td>Other uses</td>
<td>38</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>851</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Brazilian Energy Matrix - perspectives

Source: MME / EPE (PDE 2030)
What about this success of ethanol?

- It is easy to be produced in large scale;
- It has competitive costs, compared to present oil prices;
- It can be produced from different raw materials;
- It is a way of promoting the economic development in rural areas;
- It has excellent perspectives in the world market.
What about this success of ethanol?

- **Renewable:**
  - Zero Carbon Balance
  - Not dependent on petroleum
  - Large scale of production

- **High miscibility with gasoline and it is a perfect substitute for tetraethyl lead**

- **Oxygenated Compound:**
  - Reduces whole emission

- **Low toxicity**

- **Sulfur free**
Why choosing sugar cane?

- It allows the highest productivity (liters/hectare);
- It has exceptional thermal and environmental balances;
- It allows an increase in the competitiveness of the mills (flexibility, higher quality and lower costs of sugar);
- It leads to an increase in agricultural yield (industrial residues transformed into fertilizers).
STRAW: includes sugar cane leaves

1/3 JUICE  1/3 BAGASSE  1/3 STRAW

SUGAR (153 kg/t)  ETHANOL

MOLASSES

276 kg/t  50% humidity

165 kg/t  15% humidity

STRAW: includes sugar cane leaves

Celluloses ethanol revolution: when??
## 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>9.3</td>
</tr>
</tbody>
</table>

\(^1\) F.O. Licht, 2004.
\(^2\) Macedo, I et al., 2008 – Under Brazilian production conditions.

- High photosynthesis efficiency (C4 crop).
- Possibility of using the sugar cane by-products in the production process, avoiding external energy sources.
EMISSIONS OF GREEN HOUSE GASES

Avoided emissions by the use of ethanol as a gasoline substitute

Note: estimate data
Data compiled by Icone and Unica – Brazil.
Main advances:

- Soil conservation
- Soil chemistry
- Agrochemical inputs
- Expansion frontiers
- Harvest practices
- Labor
1 ton of sugarcane = 82 liters of alcohol
1 hectare of sugarcane = 7.4 m³ of alcohol
Main advances:

✓ The usage of water;
✓ Indirect usage of residues;
✓ Energy generation using crop residues;
✓ New technologies;
✓ Carbon market (Kyoto Protocol).
Water treatment station – Usina Santa Elisa – São Paulo
Capacity: 3 million liters/hour
Dry cleaning process for sugarcane- Usina Quatá – São Paulo.
Reducing GHG emissions means investing in different possibilities, including biofuels;

Bioenergy is going to be a great opportunity to tropical countries, like in Brazil;

Brazilian experience suggests that it is possible to harmonize food and biofuels production, in a sustainable way;

However, each country must identify its vocation and designing its own programs to promote the production and use;

Brazilian experience is available to others, which will not have to commit the same mistakes we committed in the past.
THANK YOU!

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