The Ethanol and Biodiesel Programmes in Brazil: A Brief Discussion
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1. The Energy Crises and The Brazilian Biofuels Initiative

Figure 1: Per capta Consumption of Energy Along time

- USA (6% world population) Consumes 35% of the world energy
- XIX Century: Human Effort = 94% of industrial work in the USA
- Today: Human Effort = 8% of industrial work in the USA

(Source: Goldemberg, 2003)
1973 and 1979: First and Second Petroleum Crises
Brazil Hardly Affected (more than 80% of oil was imported)

1970’s: Brazil Initiated PROÁLCOOL and PRODIESEL
Brazil is the world leader in production and consumption of Renewable Energy

Brazilian Experience can contribute to MDG (poverty reduction) and to the Kyoto Protocol (GHG reduction)
2. The Brazilian Programme of Alcohol (PRÁLCOOL)

- History of Alcohol and Sugar Production in Brazil

  XVI Century: Sugar produced in Brazil was the responsible for most of the international trade. Ancient and well-established sugar-cane oligarchy (big land property and slave work);

  1920’s: INT carried out the first experiments aiming the production and use of alternative fuels in Brazil;

  1920’s-1930’s: Modernization of the sugar mills – Industrial Plants;

  1960’s: Retake of sugar exports in consequence of the American-Cuban Crisis.
The 1970’s and the Petroleum Crises

Figure 4: Brazilian External Dependence on Energy

Source: www.mme.gov.br/site/menu/select_main_menu_item.do?channelId=1432&pageId=4060 (Sept. 7, 2005)
1975: The Birth of PROÁCOOL

Main motivation: Economic and Strategic

• Political and Economic Background of 1970’s Brazil:
  
  - Hard Time of Military Dictatorship: Close Association with the multinational capital and to the big Brazilian agrarian and industrial capital;
  
  - The Economic Miracle (A Sand Castle): The Good Transactions and the Financial Deficits grew strongly in function of the elevation of Oil Prices;
  
  - II National Development Plan (1974-78): **Copious infra-structure investment** by means of abundant and cheap national and international financing;
  
  - The Paradigm of a Strong State.
• PROÁLCOOL took advantage of:
  - A fast growing and strong economy dominated by government intervention → Abundant credit;
  - A previously organized alcohol and sugar productive chain;
  - An agrarian and industrial technological basis previously existent;
  - A strong and politically powerful oligarchy;
  - Cheap labor;
  - The urgent need to diminish the countries dependence on expensive imported petroleum;
  - Low Prices of sugar in the international market;
Difficulties to Implement PROÁLCOOL:

- Opposition from the powerful Oil Industry and associated governments;

- The car’s engines and other parts had to be adapted to the new fuel;

- Lack of interest from the automobile industry (Ethanol cars limited only to the Brazilian market)
The 1980s: The Rise and Fall of the PROÁCOOL

Figure 5: Sales of New Alcohol Cars in Brazil

1990s: The Ethanol Re-birth

Figure 6: Ethanol Learning Curve

1997: The End of Ethanol Subsides

Source: NASTARI, 2005
NOWADAYS

Great Enthusiasm in the sector;

World car: FlexFuel (huge national & international market);

Climate Change – Kyoto Protocol: Environmental Appeal;

Ever Increasing Petroleum Prices;

The technology has improved considerably:
  More than 350 million tones sugar cane/year;
  6000 L Ethanol/hectare (13.2 billion L in 2003-2004)

Co-generation of electricity (high pressure and gas turbine tech.);

Steady growth in ethanol exports
Some of the Advantages of Ethanol Cars:

- Drastic 5 times reduction of CO$_2$ emissions;

- Lower Toxicity and biodegradable fuel;

- More efficient burning ("lean" combustion; less CO emissions);

- Zero emission of SO$_x$;

- No particulate emissions;

- Less volatile than gasoline, causing less evaporative emissions during storage, transportation and handling
3. The BRAZILIAN BIODIESEL PROGRAMME

Forms of use of Vegetable oils

- In Natura
  - Necessity to Adapt the Engines
- Modified
  - Transesterification
    - BIODIESEL
    - Direct Use in Conventional Engines
  - Catalytic Cracking
    - ECO-OIL

Source: Coelho, 2002
So, What is Biodiesel?

- Vegetable Oils or Animal Fat
- Alcohol
- Base or Acid

**Biodiesel**

**Glycerin**

Source: Parente, 2005

\[
\begin{align*}
\text{Triglyceride} & \quad \text{Alcohol} & \quad \text{Monoalkyl Esters mixture} & \quad \text{Glycerin} \\
R, R', R'' &= \text{Fat Acid Carbon Chain} \\
R &= \text{Alcohol Carbon Chain (Me; Et)}
\end{align*}
\]
The History of Biodiesel in Brazil

• 1920s: First registered experiments;

• 1960-1980s: Government Incentives for Biodiesel Research
  Main motivation: Strategic (national security)

• 1970s: PRODIESEL Programme (a few years latter than PROALCOOL)

• 1979: First international patent on biodiesel productive process;

• 1980-1984: Performance tests in automobile engines and air plane turbines;

  PRODIESEL had the advantage of no need in engine modification and also the industrial productive structure for alcohol;

• 1985-…: Death of PRODIESEL (Apparent reason: Price; lack of government financial resources; end of the National Security doctrine)
2000s: The retake of Biodiesel, now as PROBIO DIESEL programme

Main motivations: Economic; Environmental; Strategic

• 2002 – MST established a national network to study biodiesel from soybean and ethanol;

• 2003 – The new government installed an Interministerial Committee (IC) for Biodiesel;

• IC concluded that that introduction of Biodiesel could bring Social, Environmental, Economic and Strategic benefits;

Social Inclusion and Reduction of the Regional inequities as Guiding Principles
Legal Milestones in PROBIONESE

• Law 11116 (May 2005) and Decree 5297 (Dec. 2004):

  Exemption to pay IPI tax;
  Tax Reduction (PIS/PASEP & COFINS) for biodiesel producers:
    Overall 0.6763 aliquot reduction
  Incremental Reduction if:
    - The raw materials are purchased from family agriculture;
    - The raw material is from Palm or Castor trees coming from
      the North, the Northeast or the semi-arid region of the country;
    - Zero PIS/PASEP & COFINS tax for the combination of the
      above factors;

To get full tax exemption (representing ~ USD 90/m^3) the
biodiesel producer should be awarded with the SOCIAL FUEL
STAMP – SFS (from MDA).
• Law 11097 (Jan. 13, 2005)
  Introduces Biodiesel in Brazil’s Energetic Matrix

  and also:

  - Fix mandatory 5% mixture of Biodiesel (B5) from 2013;
  - Fix 2% (B2) from 2008 (800 million Liters/Year);
  - Authorizes B2 from 2005;
  - Encourages labor cooperative arrangements;

• Resolution # 3 (Sept. 23, 2005) from National Council for Energetic Policy:

  - Obliges oil producers and importers to purchase all biodiesel produced from companies or associations awarded with SFS, from January 1, 2006;

  - This Biodiesel will be sold through public auctions promoted by The National Agency for Petrol, Natural Gas and Biodiesel (ANP).
Vegetable Oil – Regional Potentialities, Demand & Installed Capacity

<table>
<thead>
<tr>
<th>Region</th>
<th>Diesel Consumed (t$^{10}$)</th>
<th>Biodiesel Demand (B5)</th>
<th>Oil Industry Instal. Cap. (B5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sul</td>
<td>6.836</td>
<td>342</td>
<td>3.400</td>
</tr>
<tr>
<td>Sudeste</td>
<td>15.028</td>
<td>751</td>
<td>1.300</td>
</tr>
<tr>
<td>Centro Oeste</td>
<td>3.899</td>
<td>195</td>
<td>1.700</td>
</tr>
<tr>
<td>Nordeste</td>
<td>5.120</td>
<td>256</td>
<td>400</td>
</tr>
<tr>
<td>Norte</td>
<td>2.717</td>
<td>136</td>
<td>150</td>
</tr>
<tr>
<td>TOTAL</td>
<td>33.600</td>
<td>1.680</td>
<td>6.950</td>
</tr>
</tbody>
</table>

Source: Elaborated from ANP / ABIOVE
<table>
<thead>
<tr>
<th>Oil Plant</th>
<th>Average Production (litters/hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm</td>
<td>6.000</td>
</tr>
<tr>
<td><em>Caryocar brasiliense</em> (Piqui)</td>
<td>3.200</td>
</tr>
<tr>
<td>Peanut</td>
<td>2.100</td>
</tr>
<tr>
<td>Castor</td>
<td>2.000</td>
</tr>
<tr>
<td>Babassu (feather palm)</td>
<td>1.600</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>800</td>
</tr>
<tr>
<td>Seed</td>
<td>800</td>
</tr>
<tr>
<td>Soya</td>
<td>400</td>
</tr>
<tr>
<td>Cotton</td>
<td>280</td>
</tr>
<tr>
<td>Corn</td>
<td>160</td>
</tr>
</tbody>
</table>

(Source: JESUS, 2005)
**Table 2: Some biodiesel plants, their capacity, regional insertion and labor relationships**

<table>
<thead>
<tr>
<th>Company</th>
<th>Nominal Capacity (million L/year)</th>
<th>Region</th>
<th># Family Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brasil Ecodiesel</td>
<td>25</td>
<td>Northeast</td>
<td>15.000 with castor oil</td>
</tr>
<tr>
<td>Agropalma</td>
<td>6</td>
<td>North</td>
<td>100 with palm oil</td>
</tr>
<tr>
<td>Ecomat</td>
<td>8.4</td>
<td>Centre-West</td>
<td>0</td>
</tr>
<tr>
<td>Soyminas</td>
<td>10</td>
<td>Southeast</td>
<td>2.000</td>
</tr>
<tr>
<td>Adequim</td>
<td>10</td>
<td>Centre-west</td>
<td>500</td>
</tr>
<tr>
<td>Biolix</td>
<td>10</td>
<td>South</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Carmélio, 2005
Not Everything is Pink: PROBIODIESEL Challenges

- The doctrine of the Minimum State (and the false premise that the market can solve anything): The secret for PROÁLCOOL success can be related to strong government intervention at the beginning;

- The lack of cheap credit;

- No previous technological arrangement as in PROÁLCOOL;

- The use of many raw material introduces more complexity;

- The inexistence of an organized Biodiesel Productive Chain;

- Insufficient fiscal incentives (and restricted to few raw materials and regions of the country);
• Government incentive restricted to palm or castor oil can lead to monocultures (e.g. PROÁLCOOL);

• Few companies producing biodiesel equipments;

• The lack of a long term strategy, taking into account:
  - The technological structure;
  - The financing availability;
  - Market and managing strategies and policies;

• The lack of a minimum price definition for Biodiesel, causing insecurity in potential investors;

• The lack of a non-traditional biodiesel cost structure methodology that takes into account the environmental and social costs.
POSITIVE ASPECTS

• The huge national and international market will set up the conditions for an economy of scale, reducing the expected high prices;

• The large amounts of available agricultural lands; the high yields of oil production; the high agriculture technology and the co-products (bran and glycerin);

• The increasing prices of petroleum;

• The need to implement the kyoto protocol;

• The high potential for diminishing regional disparities as well as the generation of jobs and income in the country;

• The environmental benefits, making it possible to reduce expanses in the public health system.
4. Final Remarks

• Biofuels can give important contribution to:
  - MDG (poverty reduction);
  - GHG reduction (less expenses with public health)

• Brazil has a privileged position: 850 million ha (5th world)
  - only 7% being used for agriculture (0.6 for sugar cane);
  - at least more 90 million ha available with low environmental impact (without deforestation);

• Possibility of carbon credits through CDM;

• The European countries target for biofuels opens up excellent export opportunities for countries like Brazil (e.g. India)
• Developing countries should be responsible for 71% increase in oil consumption up to 2030 (IEA projection): Biofuels would be a good strategy to reduce “petrodependance”;

Lesson Learnt from PROÁCOOL:

• MUST HAVE LONG TERM PERSPECTIVE;
• The programme cannot depend on the “market humor”, until it can survive by itself.

• Finally:
  The enormous potential of Brazilian agro-industry;
  The previous experience with the more challenging PROÁCOOL; and
  The familiarity of Brazilian entrepreneurs to survive in hostile environments, make us to believe that

PROBIODIESEL WILL BE A GREAT SUCESS
THANK YOU VERY MUCH

Paulo T. de Sousa Jr

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