1ST BRAZIL- U.S. BIOFUELS SHORT COURSE

MARKETS, ECONOMICS AND POLICIES OF BIODIESEL

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www.pensa.org.br
Goals

- Global economic *Biodiesel* scenario.
- Brazilian *Biodiesel* market and its regulations.
- Brazilian case in the State of Ceara.
- Conclusions.
What is Biodiesel?

- Biodiesel is a biodegradable, nontoxic diesel fuel substitute that can be used in diesel engines.
- Biodiesel is now made from:
  - soybean
  - canola
  - palm
  - Castor
  - sunflower
  - Jathropa

"yellow grease"

in the future ...

cellulose
Biodiesel Supply Chain

- Agriculture
- Crushing
- Animal feed
- Meal
- Alcohol
- Byproducts
- Glycerin
- Biodiesel Producers
- Distributor
- Refinery
- Reseller
- B2
- Consumer

Direct commercialization is not allowed
Motivation: why Biodiesel?

- Growing demand for energy worldwide.
  - Outlook of scarcity on the supply side
  - Increasing oil prices

- Importance of environmental impact
  - Burn of fossil fuels → Global warming
  - Kyoto Protocol: reduced emission of carbon dioxide and nitrogen oxides
  - Need for clean energy production

- Results (1990): inclusion of biodiesel in the world energy matrix
Spot Prices of Brent Crude Oil

Source: EIA
Temperature changes in the hemispheres

## World’s reliance on fossil energy

### Energy: fuel

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>35%</td>
</tr>
<tr>
<td>Coal</td>
<td>25%</td>
</tr>
<tr>
<td>Gas</td>
<td>21%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>6%</td>
</tr>
<tr>
<td>Hydro</td>
<td>2%</td>
</tr>
<tr>
<td>Biomass and waste</td>
<td>10%</td>
</tr>
<tr>
<td>Other renewable</td>
<td>1%</td>
</tr>
</tbody>
</table>

### Energy: electricity

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>40%</td>
</tr>
<tr>
<td>Gas</td>
<td>20%</td>
</tr>
<tr>
<td>Hydro</td>
<td>16%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>16%</td>
</tr>
<tr>
<td>Oil</td>
<td>1%</td>
</tr>
<tr>
<td>Renewable</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Carr (2008).
BIODIESEL AROUND THE WORLD
WORLD BIOFUEL PRODUCTION

Ethanol and Biodiesel Production, 2000–2008

Source: REN21, 2009
World Biodiesel Production

World Biodiesel Production, 2005-2017
Millions of gallons

Biodiesel production around the world

- Global biodiesel production: around 13 billion liters per year.
  - European Union: Main producing and consuming market.
- Industrialization process started in the 1990s.
  - Main producers (2008): Germany, the US, France, Argentine and Brazil.
# Features of biodiesel use in some countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Tax Exemption</th>
<th>Type of biodiesel traded</th>
<th>Raw Material</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>Full</td>
<td>Gas stations supply B100 and added diesel oil</td>
<td>Canola</td>
<td>1800 refuelling stations; Biggest producer; Over 2.5 million vehicles approved to run on biodiesel; biodiesel 12% cheaper than diesel.</td>
</tr>
<tr>
<td>Italy</td>
<td>Partial (up to 200 thousand ton/year)</td>
<td>B100: for industry and house heating; B5 and B25: for transportation</td>
<td>Canola and sunflower</td>
<td>17 biodiesel producer</td>
</tr>
<tr>
<td>France</td>
<td>Partial (up to 317 thousand ton/year)</td>
<td>Over half of the traded diesel has 5% of biodiesel (Diester). B30 is more used in captive vehicle fleets</td>
<td>Canola and sunflower</td>
<td>3 biggest biodiesel producers; Of the 13 existing plants 7 blend 5% of biodiesel and diesel oil; 4 thousand vehicles use blend biodiesel more than 5% using B30.</td>
</tr>
<tr>
<td>US</td>
<td>Federal incentive *, besides specific tax for each state</td>
<td>B20 (more common), B2 (used by farms and some States rule that all the diesel traded has 2% biodiesel and B100 (little used)</td>
<td>Soy and residual frying oil</td>
<td>Currently used in urban bus fleets; postal services and governmental agencies; 53 biodiesel plants with a capacity for 1,18 million tons per year; Program based on small producers</td>
</tr>
</tbody>
</table>

*Federal law grants a tax credit of US$ 0,50 / gallon for renewable fuel used in transportation and US$ 1 for use in agriculture.

Source: biodieselbr
Biofuel costs compared with prices for oil and oil products (cents per liter)

<table>
<thead>
<tr>
<th>Oil</th>
<th>Year 2006</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price US$/per barrel</td>
<td>50-80</td>
<td></td>
</tr>
<tr>
<td>Price of oil products (before tax)</td>
<td>35-60</td>
<td></td>
</tr>
<tr>
<td>Retail price of oil products</td>
<td>150-200 Europe 80 US</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biofuel Types</th>
<th>Year 2006 – costs</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar cane ethanol</td>
<td>25-50</td>
<td>25-35</td>
</tr>
<tr>
<td>Corn ethanol</td>
<td>60-80</td>
<td>35-55</td>
</tr>
<tr>
<td>Beetroot ethanol</td>
<td>60-80</td>
<td>40-60</td>
</tr>
<tr>
<td>Wheat ethanol</td>
<td>70-95</td>
<td>45-65</td>
</tr>
<tr>
<td>Ligno-cellulose ethanol</td>
<td>80-110</td>
<td>25-65</td>
</tr>
<tr>
<td><strong>Vegetable oil biodiesel</strong></td>
<td><strong>70-100</strong></td>
<td><strong>40-75</strong></td>
</tr>
<tr>
<td>Azote fuel</td>
<td>90-110</td>
<td>70-85</td>
</tr>
</tbody>
</table>

• In 2007 soaring canola and soy bean oil prices led to increased biodiesel costs and damaged producers’ profits, since the cost of the feedstock determines the profit (represents 82%).

• Thus, the high price of crude oil fostered biodiesel production. With oil peaking at $147 per barrel last summer, biodiesel made economic sense. Note that, in general, biodiesel is economically viable only oil barrel price is over 80 dollars.
International Soybean Oil Price

Source: Chicago Board of Trade - CBOT
International Canola Palm oil prices

Source: Cereals & Oilseeds Review - Statistics Canada
BIODIESEL IN EUROPE
EU’s Biodiesel Production

- Targets: Biofuels blended with oil/diesel:
  - 2005: 2%
  - 2010: 5.75%

- Objectives:
  - Fostering sustainable agricultural production
  - Decreasing cost of policies to rural areas
  - Diversifying energy supply
  - The number of biodiesel plants foreseen in 2009 is 276

- Tools:
  - Revision of the Common Agricultural Policy (CAP) allowing producers to grow grains not destined to food
  - Energy tax exemption
EU AND MEMBER STATES’ BIODIESEL PRODUCTION

Source: European Biodiesel Board.
BIODIESEL IN THE UNITED STATES
US Biodiesel Production

- Main raw material: **Soybean**, plus frying oil.
- Production capacity: up to 280 million litres / year (National Biodiesel Board, 2006)
- **Objective**: 20% (B20) blend in mineral oil.
- **Incentives**:
  - Tax measures
  - Direct production incentives such as the Commodity Credit Corporation Bioenergy Program (support to raw material acquisition for manufacture),
  - Norms establishing minimum biofuel consumption per public agency and commercial fleets (defined in the Energy Policy Act - EPAct).
US Biodiesel Production

Installed and in construction capacity in the US
September 2005

2005: 45 biodiesel plants in the country producing some 24 million litres / year.

54 similar projects are planned for the near future.

Source: biodieselbr.com

Biofuel Production in the US

Millions of gallons

## US Projected Production Costs for Diesel Fuel by Feedstock, 2004-2013
(2002 Dollars per Gallon)

<table>
<thead>
<tr>
<th>Year</th>
<th>Soybean</th>
<th>Yellow Grease</th>
<th>Petroleum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004/05</td>
<td>2.54</td>
<td>1.41</td>
<td>0.67</td>
</tr>
<tr>
<td>2005/06</td>
<td>2.49</td>
<td>1.39</td>
<td>0.78</td>
</tr>
<tr>
<td>2006/07</td>
<td>2.47</td>
<td>1.38</td>
<td>0.77</td>
</tr>
<tr>
<td>2007/08</td>
<td>2.44</td>
<td>1.37</td>
<td>0.78</td>
</tr>
<tr>
<td>2008/09</td>
<td>2.52</td>
<td>1.40</td>
<td>0.75</td>
</tr>
<tr>
<td>2009/10</td>
<td>2.57</td>
<td>1.42</td>
<td>0.76</td>
</tr>
<tr>
<td>2010/11</td>
<td>2.67</td>
<td>1.47</td>
<td>0.76</td>
</tr>
<tr>
<td>2011/12</td>
<td>2.73</td>
<td>1.51</td>
<td>0.76</td>
</tr>
<tr>
<td>2012/13</td>
<td>2.80</td>
<td>1.55</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Source: Radich (Energy Information Administration / Biodiesel Performance, Costs, and Use)
- Movements against increase in the cost of food.
- Deforestation issues prevented mandatory blends from being implemented.
- Financial Crises: underemployment
• 2008, crude oil price plunged, making the green (biodiesel) option uneconomical.

• Recession: biodiesel firms find it difficult to obtain credit for expansion.

• "The market conditions are very, very tough right now," says Joe Jobe, head of the National Biodiesel Board in Jefferson City, Mo. Of the nation's 176 biodiesel operators, "it's very difficult to say how many of them are still operating." (Forbes.com, 2009)
A shifting scenario

- Only five years ago, Europe was the dominant player in the biodiesel industry:
  - 83% of the global installed capacity
  - 93% of world biodiesel production and consumption.

- In 2005, other regions started to develop their own biodiesel industries.

- In 2007: European share had declined to about 46%
  North America and Asia accounted for 23% and 19% of world biodiesel capacity, respectively.
BRAZIL’S BIODIESEL PROGRAM
Brazil’s Energy Matrix – 2007 %

Source: EBC, 2008
Brazil Biodiesel Demand

Brazilian demand for biodiesel (in billion litres)
(em bilhões de litros)

Source: ANP, BiodieselBr
Brazil Biodiesel Program

- Ambitious and complex objectives involving three aspects:
  - **Institutional**: to provide market regulation;
  - **Organizational**: to provide incentives to agents of this chain, mainly rural producers;
  - **Technological**: to improve raw material development.
MCT implemented the Research and Technology Development PROBIO DIESEL National Network.

Interministerial Commission evaluated possibility of biodiesel in Brazil and set recommendations for a program.

First biodiesel specification (ANP 255/03).


Permission to use 2% biodiesel plus 98% diesel blends (B2).
Institutional Aspects

- Brazil’s Law No 11.097 of 13 January 2005 introduces a mandatory increase of a minimum percentage of biodiesel to diesel oil traded to consumers, in any part of the country (progressive biodiesel increment reaching B5 in 2013).
- Implementing a sustainable program fostering social inclusion;
- Ensuring competitive prices, quality and supply;
- Producing biodiesel from different oleaginous sources and in different regions.
The biodiesel “Social Fuel Stamp” is a mechanism created by the Brazilian Government to provide incentives for poorer farmers (family farmers) in disadvantaged areas.

It establishes that biodiesel producers must purchase minimum raw material percentages from family farmers and provide technical assistance. The percentage per Brazilian region is according to the table below:

<table>
<thead>
<tr>
<th>Region</th>
<th>Minimum percentage of Acquisition from family farms</th>
<th>Before</th>
<th>Currently</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>10%</td>
<td></td>
<td>2009/10 Crop 2010/11 Crop</td>
</tr>
<tr>
<td>CW</td>
<td>10%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>NE</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>30%</td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>SE</td>
<td>30%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Social Fuel Stamp Across Brazil

## Map of Brazil with Distribution of Certified and Non-Certified Plants

![Map of Brazil with Plant Distribution](image)

## Table of Installed Capacity

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Plants</th>
<th>Installed Capacity (Thousand m³/year)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>6</td>
<td>185</td>
<td>5</td>
</tr>
<tr>
<td>NE</td>
<td>7</td>
<td>698</td>
<td>19</td>
</tr>
<tr>
<td>CW</td>
<td>15</td>
<td>1167</td>
<td>32</td>
</tr>
<tr>
<td>SE</td>
<td>8</td>
<td>629</td>
<td>18</td>
</tr>
<tr>
<td>S</td>
<td>6</td>
<td>917</td>
<td>26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>3596</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: MME/SPG - 16/06/2009
Key features of the regulatory framework

- Biodiesel producers are granted a reduction on two federal taxes – the social integration program contribution (PIS-PASEP) and the social security contribution (COFINS).

- Biodiesel producers have access to better financing from the National Bank for Social and Economic Development (BNDES) and other financial institutions.

- The Brazilian biodiesel market is regulated by the Brazilian Government through a public auction system which sets the volume of biodiesel that should be produced.

- The auction system gives preference to producers with the “Social Fuel Stamp”, who are eligible for production of 80 percent of the total auctioned volume.
## Federal tax incentives

**North, Northeast and semi-arid regions**

<table>
<thead>
<tr>
<th>Raw material</th>
<th>PIS/Pasep and Cofins (R$/lt biodiesel)</th>
<th>Without Social Fuel Stamp</th>
<th>With Social Fuel Stamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASTOR AND PALM</td>
<td>R$ 0,15</td>
<td></td>
<td>R$ 0,00</td>
</tr>
<tr>
<td>OTHER RAW MATERIALS</td>
<td>R$ 0,218</td>
<td></td>
<td>R$ 0,07</td>
</tr>
</tbody>
</table>

**Midwest, Southeast and South regions**

<table>
<thead>
<tr>
<th>Raw material</th>
<th>PIS/Pasep and Cofins (R$/lt biodiesel)</th>
<th>Without Social Fuel Stamp</th>
<th>With Social Fuel Stamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY RAW MATERIAL</td>
<td>R$ 0,218</td>
<td></td>
<td>R$ 0,07</td>
</tr>
</tbody>
</table>

Source: MDA, 2006
13th Social Fuel Stamp Auction

13th Biodiesel auction – 315 thousand m³
Plants’ share

Supply x Demand
(2008) %

<table>
<thead>
<tr>
<th>Region</th>
<th>Biodiesel Production</th>
<th>Consump B2/B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>45</td>
<td>12</td>
</tr>
<tr>
<td>S</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>SE</td>
<td>16</td>
<td>44</td>
</tr>
<tr>
<td>NE</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>N</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>
Oil crops production in Brazil

- Jatropha curcas
- Castor seed
- Soybean
- Sunflower
- Palm oil
- Cotton
- Peanuts

Source: SEBRAE 2008
Raw Materials Used for Biodiesel Production in Brazil

Source: ANP (May/2009)

- Soybean 81%
- Animal fat 16%
- Others 3%
Biodiesel Supply Chain

Rural Producers
- Small Producers: castor, soy
- Other producers

Oil Crusher

Biodiesel Production

Mixing

Distribution
- Petrobras Contracts
- Petrobras Cooperatives Private Firms
- Petrobras and Private Firms
- Petrobras
BIODIESEL PROGRAM RESULTS

CASE - SERTÃO CENTRAL

(Ceara State’s backlands)
## Ceará backlands Production Scenario

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area (ha)</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castor - Year 2008</td>
<td>40,850</td>
<td>23,999</td>
</tr>
<tr>
<td>Castor - Year 2009</td>
<td>13,468</td>
<td>8,080</td>
</tr>
<tr>
<td>Sunflower</td>
<td>5,000</td>
<td>2,712</td>
</tr>
<tr>
<td>Cotton</td>
<td>2000</td>
<td>1,200</td>
</tr>
<tr>
<td>Peanut</td>
<td>300</td>
<td>360</td>
</tr>
<tr>
<td>Sesame</td>
<td>250</td>
<td>175</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61,868</strong></td>
<td><strong>36,527.67</strong></td>
</tr>
</tbody>
</table>

- Production target- 2009: 33,000 families producing castor crops associated with **bean** and **corn** crops.
Incentive to family agriculture - Ceará backlands

1. Seminar with growers: pre-registration
2. Visits from technicians (Secretariat of Agriculture– Cooptrace e Ematerce – Instituto Agropolos: instructions for planting
3. Reception of seed: castor or sunflower (maximum 5 kg / ha) and corn and bean (GF) and contract signature with Petrobras. Price established by Bahia Stock Exchange.
4. Soil correction: limestone (castor oil) boron (sunflower) and “Tractor Time” (Town hall)
4. Payment of incentive
5. Production forecast. Petrobras provides sacs. Purchase of product (hulled or whole)

- 5-year contract.
- Farmer: opens account at Brazil Bank.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castor oil and sunflower seeds</td>
<td>Up to 150</td>
</tr>
<tr>
<td>Stand + level planting</td>
<td>Up to 200</td>
</tr>
<tr>
<td>Stand + Correction (Limestone + Organic)</td>
<td>Up to 250</td>
</tr>
<tr>
<td>Stand + chiseling / decompaction</td>
<td>Up to 250</td>
</tr>
<tr>
<td>Stand + stone barrier contours, terraces</td>
<td>Up to 300</td>
</tr>
<tr>
<td>Stand + in situ rainwater harvest and direct planting</td>
<td>Up to 300</td>
</tr>
</tbody>
</table>
Results from the interviews

When was the castor crop started?

- 1 year: 31%
- 2 years: 16%
- 3 years: 9%
- +4 years: 44%
Results from the interviews

Family income sources

- Governmental support: 53%
- Only agriculture: 28%
- Other: 19%
Results from the interviews

Nutritional Gains

- Increased number of meals: 39%
- Improved food quality: 19%
- No change: 42%
Conclusions

• The current gloomy scenario illustrates the risks of running a business which is plagued by the price volatility of two commodities – in this case, vegetable oils and petrol.

• Nevertheless, there is room in the vast diesel market for several types of fuels to exist side-by-side. In such a setting, biodiesel, renewable diesel and any new biomass-based diesels could only achieve a high penetration rate using all available biomass resources (e.g., soybean oil, other oils and fats, biomass and algae).

• In Brazil, as seen in the case of Ceara’s producers, high costs are involved in the Biodiesel Program. The question remains as whether other means should be found to support the family farmers enrolled in Brazil's Biodiesel Program.

• New and large markets for biodiesel are expected to emerge in China and India, since the governments of both countries have announced major biodiesel initiatives.
Issues for debate

• As seen here, Biodiesel Programs are designed to promote social development. Is it viable to create a new market with different and complex social and economic objectives?

• The world grapples with finding new sources of clean fuel. However, the large cities are faced with traffic management problems. Is the real issue at hand developing renewable fuels or new transportation matrix?
Thanks!