Bioenergy in Brazil

PANGEA-GBEP
Ensuring Access to Sustainable Bioenergy Globally
European Parliament

Brussels, 24th June 2013
Brazilian Energy Mix (1940 – 2011)
External Dependency on Energy (1970 - 2011)

1975: Proalcohol Program
Main goals in 1975:
- reduce external dependency on oil
- introduce in the market the gasoline-ethanol blend
- stimulate the development of pure ethanol engines

2003: Flexfuel Cars
Main goals in 2003:
- create jobs in rural areas
- reduce the external dependency on diesel
- diversify energy sources
- include the social dimension in an energy program

2005: Biodiesel Program
Main goals in 2005:
- create jobs in rural areas
- reduce the external dependency on diesel
- diversify energy sources
- include the social dimension in an energy program

Different Situations, Different Objectives and Different Policies
Brazilian energy policy has as one of its objectives: to increase the share of biofuels in the national energy mix:

- Mandatory mix: ethanol (E18-25) and biodiesel (B5).
- Tax differentiation regime at the federal level.
- Line of credit for ethanol strategic buffer stocks (conceived to improve off-season supply conditions).
- Public auctions for biodiesel market supply.
- Research funding (CT-Petro, created in 1999 and CT-Energ, created in 2000).
- Agro-ecological zoning for sugarcane (2009) and palm oil (2010) that guides and guarantees that raw-material production will take place only in suitable areas.
Agricultural zoning as a guarantee for public and private investments and a recommendation of suitable areas for harvest

Sugarcane Expansion with Agroecological Requirements

Maximum allowed: 65 million ha or 7,5% (green areas)

Agroecological zoning for Palm Oil

North Region
Focus = arc of deforestation

Northeast Region
Focus = coast areas
Land Use in Brazil *

Total Area

- 851 Total Area
- 100% 100%

Native Vegetation

- 498 Native Vegetation
- 58% 58%

Arable Land

- 338 Arable Land
- 40% 40%

Available

- 103 Available

Pasture

- 172 Pasture
- 51% 51%

Agriculture

- 55 Agriculture
- 16% 16%

Sugarcane

- 8,7 Sugarcane
- 2.6% 2.6%

Others 15

- 2% 2%

* 2009 Data

Source: ICONE, ESALQ and IBGE. Presentation: COSAN and UNICA
Recent Modifications on Biofuels Regulation

- Biofuels are now regulated as fuels and not only as an agriculture product.
- Biofuels have an uniform treatment regarding their role in National Energy Policy. That includes both ethanol and biodiesel, as well as any other new biofuel that eventually will be produced in commercial scale in the future.
- The National Energy Policy Council (CNPE) has, from now on, authority to establish the directions for biofuels imports and exports in the same way that it already has for all oil derivatives such as gasoline, diesel and jet fuel.
IN THIS PERIOD, DUE TO ETHANOL, EMISSIONS OF 1 BILLION TONS OF CO₂ WERE AVOIDED

Effective economy of 1.6 billion boe or 18 months of the current Brazilian oil production*

ESTIMATED SAVINGS OF US$ 67 BILLION** DUE TO OIL AND REFINED PRODUCTS NOT CONSUMED BECAUSE OF ETHANOL

* Considers Daily Production in Brazil of 2,110,000 Barrels of Oil per day

** In dollars of 2011
GRAINS* IN BRAZIL: HARVESTED AREA & PRODUCTION

Production of food doubled in the last decade mainly due to yield gains

Production of grains

Area

Source: IBGE (2010)
Notes: 2010: estimated data.*Grains include rice, corn, wheat, soybeans and beans.
### Livestock Production

<table>
<thead>
<tr>
<th></th>
<th>1960</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herd</strong> <em>(million heads of cattle)</em></td>
<td>58</td>
<td>204</td>
</tr>
<tr>
<td><strong>Pasture area</strong> <em>(million hectares)</em></td>
<td>122,3</td>
<td>170</td>
</tr>
<tr>
<td><strong>Productivity</strong> <em>(cattle per hectare)</em></td>
<td>0,47</td>
<td>1,2</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture, Livestock and Food Supply
Ethanol Fuel Internal Market Forecast

45 billion liters in 2022
The mandatory policy of B5 is the most important incentive and it is guaranteed through public auctions;

Tax policy regime that differentiates the region of the country in which biodiesel is produced and also the type of agriculture that provides all or part of raw material. North or Northeast: 15% discount;

Social Fuel Certificate (SFC) is the mechanism that aims to stimulate the development of small agriculture and tries to include their raw-material production in biodiesel chain.

The biodiesel producer that owns a SFC is allowed to take part in biodiesel auctions competing for 80% of the volume. The remaining 20% is opened also to biodiesel producers that do not have the SFC;

The government is trying to design policies to induce the diversification of raw-materials for biodiesel production (palm oil, jatropha etc.).
Biodiesel Market: Current Situation

✓ 5% (B5) mandatory mixture since 2010.
✓ 56 units authorized by Petroleum, Natural Gas and Biofuels Agency (ANP) with 6.724.000 m³ per year of production capacity (88% with Social Fuel Seal).
✓ 2.717.500 m³ of biodiesel produced in 2012.
✓ The main feedstock used in biodiesel production has been soy (75%, as an average), followed by animal fats (17%) and others (8%) – cotton, palm, sunflower, castor.
✓ The Midwest region is the major producer (43%), followed by South (34%), Northeast (11%), Southeast (9%) and North (3%).
✓ The biodiesel production provided employment to 103.991 family farmers in 2012 (25% in Northeast region).
## Biodiesel Regional Capacity of Production Distribution

<table>
<thead>
<tr>
<th>Region</th>
<th>Plants</th>
<th>Production capacity ($m^3$)</th>
<th>Production capacity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-West</td>
<td>27</td>
<td>3.073.000</td>
<td>45.7%</td>
</tr>
<tr>
<td>South</td>
<td>8</td>
<td>1.818.000</td>
<td>27%</td>
</tr>
<tr>
<td>Southeast</td>
<td>11</td>
<td>890.000</td>
<td>13.2%</td>
</tr>
<tr>
<td>Northeast</td>
<td>6</td>
<td>741.000</td>
<td>11%</td>
</tr>
<tr>
<td>North</td>
<td>4</td>
<td>202.000</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>6.724.000</td>
<td>100%</td>
</tr>
</tbody>
</table>


43 units with Social Fuel Certificate

Units without SFC (Social Fuel Certificate) • Units with SFC (Social Fuel Certificate) ▲
Ministério de Minas e Energia

Social Fuel Certificate Results

Higher levels of income since the mandate period confirms the policy

Source: MDA, MME (2011)
Biodiesel Production (2005-2012)

Source: ANP
Elaboration: MME
Biodiesel Fuel Internal Market Forecast

4 billion liters in 2022
✓ In 2011, the demand for non-fuel ethanol (other uses) has reached 1.1 billion liters.

✓ It is estimated that demand for non-ethanol fuel (other uses) will reach 3.5 billion liters in 2020 (PDE 2020).
  • 14% growth rate.

✓ This growth will be due to the expansion of the ethanol chemistry.
BNDES launched PAISS (Joint Programme of Technological and Innovation Support for Sugarcane Sector), with foreseen investments of R$ 4 billion.

- The PAISS fosters research and development of cellulosic ethanol. If economically viable, the cellulosic ethanol could increase the productivity of the sector in more than 40%.

Among the entities who study the processes of production of ethanol from lignocellulose in Brazil, stand out:

- CENPES-Petrobras;
- CTBE;
- Centro de Tecnologia Canavieira – CTC;
- Embrapa Agroenergia;
- Dedini S/A Indústrias de Base.
2G Ethanol in 2010

Distribution of supported projects (BNDES and Finep)*
(by main research areas)

- New Products: 19%
- Products Use: 16%
- Industrial 2G: 14%
- Agriculture: 36%
- Industrial 1st G: 15%

Both institutions budget directed to tech routes reached almost R$ 100 million

* BNDES – National Development Bank; FINEP – Brazilian Innovation Agency
## 2G Ethanol context in 2010...

### Research Focus in main initiatives

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Raw-Material Pretreatment</th>
<th>Hydrolysis</th>
<th>C5 Fermentation</th>
<th>Pilot-Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Enzimatic (EH)</td>
<td>Acid (AH)</td>
<td></td>
</tr>
<tr>
<td>CTC</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dedini</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Novozymes</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTBE</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Petrobras</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Fapesp-Bioen</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rede de Hidrólise</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>IPT</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Source: BNDES 2013
## Countries in comparison

<table>
<thead>
<tr>
<th>Program</th>
<th>Coordination/Governance</th>
<th>Financial Resources</th>
<th>Main Technological Challenges</th>
<th>Units in Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>High</td>
<td>High</td>
<td>Biomass and Industrial Conversion Routes</td>
<td>8 pilot-plants</td>
</tr>
<tr>
<td>EU</td>
<td>Medium</td>
<td>High</td>
<td>Biomass and Industrial Conversion Routes</td>
<td>9 pilot-plants</td>
</tr>
<tr>
<td>Brazil</td>
<td>Low</td>
<td>Low</td>
<td>Industrial Conversion Routes</td>
<td>2 pilot-plants</td>
</tr>
</tbody>
</table>

Source: BNDES
PAISS

(Joint Programme of Technological and Innovation Support for Sugarcane Sector)

launched in 2011:

Today results, after 2 years...
Commercial Plants

**GraalBio**
- **Capacity:** 82 million liters/year
- **Start-up operation:** 2014
- **Location:** São Miguel dos Campos, AL
- **Investment:** R$ 303 million (BNDES)

**Petrobras**
- **Capacity:** 40 million liters/year
- **Start-up operation:** 2015
- **Location:** Boa Vista Mill, Quirinópolis (GO)
- **Investment:** R$ 202 million (BNDES)

**Raízen**
- **Capacity:** 40 million liters/year
- **Start-up operation:** 2015
- **Location:** Costa Pinto Mill, Piracicaba (SP)
- **Investment:** R$ 206 million (BNDES)
Demonstration Plants

**Capacity:**
3 million liters/year

**Start-up operation:**
2014

**Location:**
Usina São Manoel, São Manoel (SP)

**Investment:**
R$ 55 million (BNDES)

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**Capacity:**
3 million liters/year

**Start-up operation:**
2015

**Location:**
Usina Santa Luzia, Nova Alvorada (MS)

**Investment:**
R$ 150 million (FINEP: R$ 130 million; BNDES: R$ 20 million)
<table>
<thead>
<tr>
<th>Project Initial Phase:</th>
<th>Location:</th>
<th>Investment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>CTBE, Campinas, SP</td>
<td>R$ 22 million (BNDES)</td>
</tr>
<tr>
<td>2013</td>
<td>CTBE, Campinas, SP</td>
<td>R$ 8,7 million (FINEP)</td>
</tr>
<tr>
<td>2013</td>
<td>CTBE, Campinas, SP (Fase 1)</td>
<td>R$ 20 million (BNDES)</td>
</tr>
</tbody>
</table>
**2G Ethanol perspective today**

**2G Ethanol Production Expectation to 2015**

(million liters)*

<table>
<thead>
<tr>
<th>Before PAISSL Program</th>
<th>After PAISSL Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>834</td>
</tr>
<tr>
<td>168</td>
<td>114</td>
</tr>
<tr>
<td>168</td>
<td>168</td>
</tr>
</tbody>
</table>

Sources: Biofuels Digest, FO Lichts and BNDES (*) Data for 2014
Next Gen Biodiesel: several options

- Oilseeds with high energy content
  - Ester of Palm Oil, Jatropha…
- Conversion by bacteria, yeasts and other microorganisms
  - Sugarcane Biodiesel
  - Biodiesel from any sort of cellulose
- Liquefaction, Hydrogenation, Pyrolysis etc
  - Synthetic Biodiesel
- Algae
- Any biomass waste

1 Commercial plant in operation
Ethanol: countries in comparison

![Ethanol Demand Graph](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>36.7</td>
<td>20.9</td>
</tr>
<tr>
<td>2009</td>
<td>41.8</td>
<td>24.0</td>
</tr>
<tr>
<td>2010</td>
<td>48.7</td>
<td>23.3</td>
</tr>
<tr>
<td>2011</td>
<td>48.7</td>
<td>20.6</td>
</tr>
<tr>
<td>2012</td>
<td>49.0</td>
<td>19.0</td>
</tr>
</tbody>
</table>

Elaboration: MME
Sources: MAPA, EIA/DOE
Biodiesel: countries in comparison

Brazil: 2nd world market in 5 years!

Elaboration: MME
Sources: ANP, EIA/DOE, UFOP, INDEC
Bioenergy International Cooperation

Map of International Agreements on Bioenergy sign by Brazilian Representatives

* Includes MoUs, partnerships and other agreements signed directly by any Federal Government Department or Agency or Public Enterprise. It was considered bilateral agreements, cooperation in third countries and agreements signed with economic or regional blocks.

77 countries
Nearly 1/3 of the whole nations

Ministério de Minas e Energia
Bioenergy International Cooperation
Final Conclusions

✓ The regulatory framework for biofuels in Brazil have been implemented to focus on the character of the energy aspect of biofuels, expanding Regulatory Agency powers which shall operate in the entire chain of production and marketing. Government role was (and still is) fundamental!

✓ It is beyond doubt that bioenergy has played a extremely important role in Brazil through energy security, job creation, oil savings and social development.

✓ As well as most of tropical country areas, there are investment opportunities in Brazil for the expansion of bioenergy production, both in new plants and in infrastructure.

✓ International cooperation is of great importance to Brazil because the country defends biofuels as a driver for development in countries with low access to energy.
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