The Brazilian Flex Fuel

Dr Marcos Amatucci
Associate Dean of Research and Graduate Studies
ESPM
Brazilian Ethanol Path Dependency

Brief History  (some dates are approximate)

- 1500: Portugal reaches Brazilian coast
- 1516: Sugarcane production begins
- 1920s: Ethanol engines experiences
- 1930s: Pure Ethanol Engine Prototype (CTA)
- 1957: 1st Market Ethanol car (Fiat)
- 1979: Pure Ethanol Golden Age
- 1989: Ethanol Shortage Crisis
- 1980-90s: Flex Fuel tech. by Robert Bosh
- 2000s: Flex Fuel software tech. by M. Marelli
- 2003: 1st Market Flex Fuel car (VW)
- 2009: Flex Fuel booming
- 2010: End of Flex subsidies
Brazilian Ethanol Path Dependency

Brief History

• 1500 Portuguese sailors arrive in Brazil
• First economic activity (extractive): brasil wood extraction for red pigment production
• 1516 First regular (non-extractive) activity: sugarcane plantations for sugar production based on African slave workforce
• Byproduct of sugar production: cachaça, ethanol liquor used in slavering trade
Engenho (sugar production)
Engenho (sugar production)

Cesario Lange, São Paulo State
Engenhoca (small engenho) cachaça production
Gasohol as regular gas supply

- 1931: Law 19.717 - 5% of ethanol to all imported gas
- 1933: Creation of IAA - Sugar and Ethanol Institute to foster ethanol from sugarcane production
- 1938: Law 737, extended 5% of ethanol to all gas in Brazil
- Gasohol is in effect ever since
# 1973 Oil Crisis

<table>
<thead>
<tr>
<th>YEAR</th>
<th>GDP (3)</th>
<th>ANNUAL GROWTH (3)</th>
<th>GROSS EXT DEBT (1)</th>
<th>LIQUID EXT DEBT (1)</th>
<th>EXPORTS (2)</th>
<th>IMPORTS (2)</th>
<th>OIL IMPORTS (2)</th>
<th>% OIL/IMP (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>58,539</td>
<td>12%</td>
<td>9,500</td>
<td>5,300</td>
<td>3,991</td>
<td>4,232</td>
<td>469</td>
<td>11.1%</td>
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<tr>
<td>1973</td>
<td>79,279</td>
<td>14%</td>
<td>12,600</td>
<td>6,200</td>
<td>6,199</td>
<td>6,192</td>
<td>769</td>
<td>12.4%</td>
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<tr>
<td>1974</td>
<td>105,136</td>
<td>9%</td>
<td>17,200</td>
<td>11,900</td>
<td>7,591</td>
<td>12,641</td>
<td>2,961</td>
<td>23.4%</td>
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<tr>
<td>1975</td>
<td>123,709</td>
<td>5%</td>
<td>21,200</td>
<td>17,200</td>
<td>8,669</td>
<td>12,210</td>
<td>3,100</td>
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<tr>
<td>1976</td>
<td>152,678</td>
<td>10%</td>
<td>26,000</td>
<td>19,400</td>
<td>10,128</td>
<td>12,346</td>
<td>3,354</td>
<td>27.2%</td>
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<tr>
<td>1977</td>
<td>176,171</td>
<td>5%</td>
<td>32,000</td>
<td>24,700</td>
<td>12,139</td>
<td>11,999</td>
<td>3,660</td>
<td>30.5%</td>
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<td>1978</td>
<td>200,801</td>
<td>3%</td>
<td>43,500</td>
<td>31,600</td>
<td>12,658</td>
<td>13,683</td>
<td>4,093</td>
<td>29.9%</td>
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<tr>
<td>1979</td>
<td>224,969</td>
<td>7%</td>
<td>49,900</td>
<td>40,200</td>
<td>15,244</td>
<td>17,961</td>
<td>6,188</td>
<td>34.5%</td>
</tr>
</tbody>
</table>

US $ 1,000,000
1979 1\textsuperscript{st}. Market Pure Ethanol vehicle
From pure Ethanol to Flex Fuel

• 1989 Ethanol supply crisis
• Consumer abandons pure ethanol
• 2000 Auto Supplier (Magneti Marelli first then Bosch and Delphi) innovation on flex fuel software-based control systems
• 2003 VW Gol Total Flex
• 2009 Flex fuel > 95% new plates
• 2010 Brazilian Govnt withdraws subsidies
VW Gol Total Flex 2003
Brazilian Fuel Cycles

Fig. 1 – Brazilian wholesales (cars, light commercials, trucks and buses) by fuel type (1957-2008)
Source: ANFAVEA [3] (apud Yu et. al., 2009)
Flex Fuel fleet evolution
Flex Fuel fleet evolution

End of most flex subsidies
What do we learn from that

- Path dependency in the technical solution
- Strong institutional presence in the socio-technical innovation
- Industry-supplier-governamental network
- Three gaps to overcome (© Amatucci 2012):
  - Scale gap
  - Performance gap
  - Price gap
Three gaps model

The three gaps and three agents’ model. Source: Amatucci, M. (2012)
Thank you!

marcosamatuucci@espm.br