Brazilian Petrochemical Cluster

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Rise in Government Debt:
- From 51% of GDP in 2013 to 70% in 2016
- Brazilian Bonds downgraded to "junk" (September 2015)

Economic interventions (from 2010);
- Uncertainty among producer and investors
Administered prices (2006 to 2016)
- Gasoline prices $+44\%$
- Minimum Wage $+168\%$

Investigations and corruption scandals:
- Accusations against the President and political allies;
- Public Protests (starting in 2013):
- Dilma impeached (August, 2016)

Inflation:
- $6\%$ (2013) $\rightarrow 10\%$ (2016)

Benchmark Interest Rate:
- $7\%$ (2013) $\rightarrow 14\%$ (2016)

Industry Confidence Index:

Unemployment:
- $5.4\%$ (2013) $\rightarrow 11.5\%$ (2016)

Economic contraction ($\Delta$ GDP):
- 2014: $-0.3\%$
- 2015: $-1.9\%$
- 2016: $-2.5\%$
Refineries are chemical plants that transform crude oil into oil products

**Crude oil**

**Refinery**

**Oil products**

**Raw oil** as produced, with varying qualities:
- **Density**: lighter oil yield higher valued products
- **Sulfur content**: sweet (low sulfur) oil can be refined simpler refineries

**Chemical plant** with varying complexity, according to:
- **Oil quality**: lower oil quality can demand more complex refineries
- **Mix of products**: more complex refineries can yield higher valued products

**Fuels and chemical feedstocks** with varying market values, such as:
- Diesel
- LPG
- Jet fuel
- Naphtha
- Fuel Oil
- Asphalt
Timeline

1932 - First Refinery in Brazil
1938 - CNP is Created
1939 - First Petroleum reserve discovered
1946 - First Estate Owned Refinery
1953 - Petrobras is Established
1960 - Brazil is Auto sufficient
1980 - Pro Alcohol Program
Importance of Oil in Brazil’s Economy

- 12th largest producer in the World
  - By 2020 7th largest

- 15th World’s largest reserve in 2015

- 7th largest oil consumer

- 8th largest refining country
  - Petrobras 7th

- Refining growth 7% per year

Oil Participation in Brazil GDP in 2015

- 13%
Strategy, Structure, Rivalry

**INPUTS**

- Crude production
  - Petrobras 80%
  - Private players 20%

**MAIN BUSINESS**

- Refining
  - Petrobras 98%
  - Private players 2%

**SELECTED OUTPUTS**

- Fuels Distribution (85% of revenues)
  - Petrobras 28%
  - Ipiranga 19%
  - Raízen 16%
  - Other private players 37%

- Chemicals (<10% of revenues)
  - Braskem 100%
  - Other private players 0%
**Output & Prices**

### Refining outputs for Petrobras, per volume and revenue (2015)

- **Diesel**: High volume, moderate revenue.
- **Automotive gasoline**: Moderate volume, high revenue.
- **Fuel oil (including bunker fuel)**: Low volume, low revenue.
- **Naphtha**: Low volume, low revenue.
- **Liquefied petroleum gas**: Low volume, low revenue.
- **Jet fuel**: Low volume, low revenue.
- **Other oil products**: Low volume, low revenue.

**Bars**:
- Blue: Volume %
- Orange: Revenue %

### Price composition of Petrobras major outputs (in 2017)

- **Retail margin**: Low cost, high revenue.
- **Ethanol or Biodiesel**: Moderate cost, high revenue.
- **VAT (State Tax)**: Low cost, high revenue.
- **Federal Taxes**: Low cost, high revenue.
- **Petrobras***: High cost, low revenue.

**Bars**:
- Blue: Gasoline
- Orange: Diesel
- Grey: LPG

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**Legend**:
- Retail margin: Low cost, high revenue.
- Ethanol or Biodiesel: Moderate cost, high revenue.
- VAT (State Tax): Low cost, high revenue.
- Federal Taxes: Low cost, high revenue.
- Petrobras*: High cost, low revenue.
Due to Brazil’s oil and fuels balance, refining spreads in the country are significantly higher than that of all major refining regions in the world.

**Oil and fuels balance in Brazil**

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil production</th>
<th>Refining capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2015</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2020</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2025</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Oil and fuels prices**

<table>
<thead>
<tr>
<th>Region</th>
<th>Diesel</th>
<th>Gasoline</th>
<th>Jet fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
<tr>
<td>US Midcontinent</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
<tr>
<td>US Gulf Coast</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
<tr>
<td>Mediterranean</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
<tr>
<td>NW Europe</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
<tr>
<td>Singapore</td>
<td>39.1</td>
<td>34.2</td>
<td>43.2</td>
</tr>
</tbody>
</table>

**Regional refining spreads**

<table>
<thead>
<tr>
<th>Region</th>
<th>USD/bbl, average 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>28.2</td>
</tr>
<tr>
<td>US Midcontinent</td>
<td>13.7</td>
</tr>
<tr>
<td>US Gulf Coast</td>
<td>9.8</td>
</tr>
<tr>
<td>Mediterranean</td>
<td>9.7</td>
</tr>
<tr>
<td>NW Europe</td>
<td>8.3</td>
</tr>
<tr>
<td>Singapore</td>
<td>7.9</td>
</tr>
</tbody>
</table>

1. Transfer price of oil between Upstream and Downstream departments at Petrobras
2. FOB price of domestic oil exports. Transportation explain most of the price gap, but other factors such as difference in oil quality have also impact on the price differential
3. West Texas Intermediate (WTI) is the main benchmark for oil prices in the United States

... however, the industry does not attract private capital, new projects were poorly executed and current operation costs are ~2x higher than benchmarks.

Virtually no private capital is invested in the sector,…

Refining capacity additions, bbl/d

- Petrobras
- Private

- '07 7
- '08 2
- '09 14
- '10 16
- '11 11
- '12 3
- '13 97
- '14 149
- '15 45
- '16 54

... Petrobras' new projects overrun in budget and time, and…

Cost of new refineries, USD billion

- Estimated cost
- Actual cost

RNEST

- 2.4
- 21.5
- 7

COMPERJ

- 6.1
- 21.2
- 9

… the industry underperforms peers on asset operation

Unitary operational cost³, USD/bbl

- Petrobras⁴ 7.5
- Neste oil 5.4
- Petroplus 4.4
- Marathon 4.3
- Tesoro 4.2
- Western 4.2
- Valero 3.6
- Phillips 66 2.3
- Thai Oil 1.6

1 The first half of the refinery is in partial operation since late 2014, however the entire project is expected to start operation in 2018.
2 The projected date for the start-up of the first half of the refinery is 2021.
3 Data varying from 2011 to 2016, adjusted by CPI to 2016. Does not include depreciation and amortization. Petroplus (now bankrupt), Phillips 66 (excludes maintenance) and Valero data refer to operations at Cressier, US Midcontinent and in US North Atlantic, respectively.
4 Although Petrobras reported a refining cost of 2.58 USD/bbl in 2016, other direct OPEX (excluding COGS) and Corporate department costs (prorate) were added.

Source: International Energy Agency (IEA), Empresa de Pesquisa Energética (EPE), Petrobras, O Globo, Exame
Supply dynamics

Source - http://www.argenteraolgas.com/brazil-refineries
## Output per refinery


<table>
<thead>
<tr>
<th>#</th>
<th>Refinery Name</th>
<th>Location</th>
<th>Company</th>
<th>Capacity (bbl/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REPLAN Paulínia</td>
<td>Paulínia</td>
<td>Petrobras</td>
<td>415,000</td>
</tr>
<tr>
<td>2</td>
<td>RLAM</td>
<td>Sao Francisco do Conde</td>
<td>Petrobras</td>
<td>280,000</td>
</tr>
<tr>
<td>3</td>
<td>REVAP</td>
<td>Sao Jose dos Campos</td>
<td>Petrobras</td>
<td>251,500</td>
</tr>
<tr>
<td>4</td>
<td>REDUC</td>
<td>Duque de Caxias</td>
<td>Petrobras</td>
<td>242,000</td>
</tr>
<tr>
<td>5</td>
<td>REPAR</td>
<td>Araucaria</td>
<td>Petrobras</td>
<td>220,000</td>
</tr>
<tr>
<td>6</td>
<td>REFAP</td>
<td>Canoas</td>
<td>Petrobras</td>
<td>201,000</td>
</tr>
<tr>
<td>7</td>
<td>RPBC</td>
<td>Cubatao</td>
<td>Petrobras</td>
<td>170,000</td>
</tr>
<tr>
<td>8</td>
<td>REGAP</td>
<td>Betim</td>
<td>Petrobras</td>
<td>151,000</td>
</tr>
<tr>
<td>9</td>
<td>Lubnor</td>
<td>Fortaleza</td>
<td>Petrobras</td>
<td>82,000</td>
</tr>
<tr>
<td>10</td>
<td>RECAP</td>
<td>Mauá</td>
<td>Petrobras</td>
<td>53,500</td>
</tr>
<tr>
<td>11</td>
<td>REMAN</td>
<td>Manaus</td>
<td>Petrobras</td>
<td>46,000</td>
</tr>
<tr>
<td>12</td>
<td>RPCC</td>
<td>Guamare</td>
<td>Petrobras</td>
<td>35,000</td>
</tr>
<tr>
<td>13</td>
<td>Refinaria Ipiranga</td>
<td>Pelotas</td>
<td>Refinaria Riograndense</td>
<td>17,000</td>
</tr>
<tr>
<td>14</td>
<td>Refinaria Manguinhos</td>
<td>Rio de Janeiro</td>
<td>Grupo Peixoto de Castro and Repsol YPF</td>
<td>13,800</td>
</tr>
<tr>
<td>15</td>
<td>Univen</td>
<td>Itupeva</td>
<td>Univen Petroleo</td>
<td>6,900</td>
</tr>
<tr>
<td>16</td>
<td>DAX Oil</td>
<td>Camacari</td>
<td>Dax-Oil</td>
<td>2,100</td>
</tr>
</tbody>
</table>

**TOTAL**: 2,186,800
Brazil generates the third-highest amount of electricity in the Americas, behind only the United States and Canada. Hydroelectricity provides more than 70% of Brazil’s generation.

**Key Players in the Petrochemical Cluster in Brazil**

**GOVERNMENT INSTITUTIONS**

1. Brazil Council for Competitiveness
2. Ministry of Communications
3. Ministry of Development, Industry Foreign Trade
4. Ministry of Education
5. Ministry of the Environment
6. Ministry of Finance
7. Ministry of Labor and Employment
8. Ministry of Science and Technology
9. Ministry of Transportation

Key Players in the Petrochemical Cluster in Brazil

**RELATED INDUSTRIES AND CLUSTERS**

1. Steel
2. Iron and chemical production
3. Auto assembly
4. Mining and Processing of petroleum products
5. Cement manufacturing
6. Technology based Enterprises

**R & D**

1. EMC Brazil Research and Development Centre
2. Federal Institute of Education, Science and Tech, Guarulhos
3. Universidade de São Paulo
4. Dupont R & D Center
5. Brazil Technology Centre by GE

**FINANCIAL INSTITUTIONS**

The 10 Major Brazilian Banks

1.1. Banco Bradesco Financiamentos
2.2. Caixa Econômica Federal
3.3. HSBC
4.4. Banco J Safra S/A
5.5. Banco Itaú
6.6. Banco do Estado do Rio Grande do Sul S/A
7.7. Banco PanAmericano S/A
8.8. Banco Santander
9.9. Banco do Brasil
10.10. Citibank

**GAS PIPELINES**

1. GASBOL
2. GASENE
3. GASUN
4. Gran Gasoducto del Sur
5. Paraná–Uruguaiana
6. Urucu–Manaus pipeline