Energy Policies in the Transportation Sector

by

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Summary:

I. Overview of transportation sector in Brazil

II. Brief introduction of the project

III. Reviewing and classifying energy policies in the transportation sector

IV. Energy demand forecasting model

V. Policies scenarios
Transport in Brazil:

- 34.2% of the total energy consumption

Table 1. Final energy consumption by sector (%)

<table>
<thead>
<tr>
<th>ENERGY SEGMENTS</th>
<th>2007</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY SECTOR</td>
<td>10.5</td>
<td>11.3</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>11.0</td>
<td>10.1</td>
</tr>
<tr>
<td>COMMERCIAL</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>PUBLIC</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>AGRICULTURE</td>
<td>4.5</td>
<td>4.7</td>
</tr>
<tr>
<td>TRANSPORTATION</td>
<td>28.9</td>
<td>34.2</td>
</tr>
<tr>
<td>INDUSTRIAL</td>
<td>40.4</td>
<td>34.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

• 2007 – 2014: fleet size increased 61%

• Average age of circulating vehicle fleet

Table 3. Average age of brasilians circulating fleet

<table>
<thead>
<tr>
<th>Age</th>
<th>Year</th>
<th>Acumulated Fleet</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5 years old</td>
<td>2012-2016</td>
<td>14.388.209</td>
<td>34</td>
</tr>
<tr>
<td>6 - 10 years old</td>
<td>2007-2011</td>
<td>13.961.361</td>
<td>33</td>
</tr>
<tr>
<td>11 - 15 years old</td>
<td>2002-2006</td>
<td>6.726.977</td>
<td>16</td>
</tr>
<tr>
<td>16 - 20 years old</td>
<td>1997-2001</td>
<td>5.492.030</td>
<td>13</td>
</tr>
<tr>
<td>+ 20 years old</td>
<td>Under 1996</td>
<td>2.303.837</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>42.872.414</td>
<td>100</td>
</tr>
</tbody>
</table>

• 47% CO$_2$e emission in energy sector

**Table 2.** CO$_2$e emissions from Brazil transport sector in 2000 and 2015

<table>
<thead>
<tr>
<th>Subsector</th>
<th>Transportation</th>
<th>2000</th>
<th>2015</th>
<th>Change between 2000 and 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gg of CO$_2$e</td>
<td>%</td>
<td>Gg of CO$_2$e</td>
<td>%</td>
</tr>
<tr>
<td>Air</td>
<td>9605.043</td>
<td>7.4%</td>
<td>11,042.576</td>
<td>5.4%</td>
</tr>
<tr>
<td>Railway</td>
<td>1402.508</td>
<td>1.1%</td>
<td>3163.404</td>
<td>1.5%</td>
</tr>
<tr>
<td>Waterway</td>
<td>2991.155</td>
<td>2.3%</td>
<td>3124.031</td>
<td>1.5%</td>
</tr>
<tr>
<td>Road</td>
<td>115,338.081</td>
<td>89.2%</td>
<td>187,029.033</td>
<td>91.5%</td>
</tr>
<tr>
<td>Total</td>
<td>129,336.787</td>
<td>100.0%</td>
<td>204,359.044</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Source:** own elaboration, based on SEEG.
**Fig. 1.** Fuel consumption in road transport sector in Brazil

Source: EPE, 2016.
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General Objective:

- To develop a simulation model to help policymakers better design the energy policies and evaluate their importance, effectiveness and efficiency in transportation sector.

- The purpose is to estimate the potential impacts of current and possible future energy policies in transportation sector in Brazil.
Steps

- Energy Police Review
- Classify Energy Policies
- Model Construction
- Policy scenarios
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### Figure 2. Selected countries and the estimated energy savings

<table>
<thead>
<tr>
<th>Policies</th>
<th>Countries</th>
<th>Estimated energy savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel-efficient tyres</td>
<td>European Union, Canada, United States and Japan</td>
<td>5%</td>
</tr>
<tr>
<td>Fuel efficiency standards for LDV</td>
<td>Canada, European Union, South Korea, China, Brazil, United States, India, Russia, Japan, Mexico and Saudi Arabia</td>
<td>12 - 34%</td>
</tr>
<tr>
<td>Fuel efficiency standards for HDV</td>
<td>Japan, China, United States, Canada, South Korea, Russia, European Union</td>
<td>11 - 14%</td>
</tr>
<tr>
<td>Low carbon/sulfur fuels</td>
<td>United States, Brazil, China</td>
<td>10% carbon and 10-50 ppm limit sulfur content</td>
</tr>
<tr>
<td>Tax credit</td>
<td>Brazil</td>
<td>12-19%</td>
</tr>
<tr>
<td>Direct investments</td>
<td>China and Japan</td>
<td>2-14%</td>
</tr>
</tbody>
</table>

**Source:** adapted from ICCT (2014), IEA, 2008; Onoda, 2008; Wagner and Wang, 2009; IEA; 2011; Cheah and Heywood, 2011; Atabani et al., 2011; IEA, 2012.
Figure 3. Classification of energy policy mechanisms

Source: (Santana, 2017)
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Literature:

- It was not found a demand simulation model that embrace uncertainty analysis of fuel consumption from a stochastic approach.

- The main long term models in Brazil are econometric ones, but they are most appropriate for short and medium term projections.
Long term energy demand projection based on sectorial disaggregation models to then simulate different scenarios:

\[
\frac{CE_{j,i}}{VA_i} = \frac{PKM_i}{VA_i} \cdot \frac{CE_i}{PKM_i} \cdot \frac{CE_{j,i}}{CE_i}
\]

\[
\frac{CE_{j,i}}{VA_i} = \frac{TKM_i}{VA_i} \cdot \frac{CE_i}{TKM_i} \cdot \frac{CE_{j,i}}{CE_i}
\]

Where,

- \( j \): fuel type/electricity
- \( i \): transportation category
- \( CE \): energy consumption
- \( VA \): value added
- \( PKM \): passengers . km
- \( TKM \): tones . km
This model will enable us to consider future ruptures that is likely to happen due sudden shifts in critical inputs (efficiency improvements, mode and fuel changes): **scenarios of rupture**

- Historical time series will not be needed
- Obtain data from a reference year (closest as possible from present) and then the model will project the chosen parameters in long term

Create a **baseline scenario** built on econometric equations (simple regression)
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Energy Consumption (KWh)

\[
\frac{CE_{j,i}}{VA_i} = \frac{PKM_i}{VA_i} \cdot \frac{CE_i}{PKM_i} \cdot \frac{CE_{j,i}}{CE_i}
\]
To develop a simulation software to help policymakers better design the energy policies in transportation sector in a long term planning.
Thank you!

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