Fuel Economy in Harris County-2007

Graciela Lubertino, PhD
Reason for Study

- H-GAC contacted by City of Houston to do a regional fuel economy study for 2007
- Aim is to determine how much fuel is consumed daily and how the mayor’s plan of reducing fuel usage 5% by 2010 can become feasible.
Calculation Methodology -

**Inputs**

- 2006 Harris county registration distribution (TxDOT)- An array of 16 composite vehicle (aggregated diesel and gasoline) for a 25 year period.
- 2006 regional diesel fractions (TxDOT)- represent the fraction of diesel in a composite vehicle category.
- 2007 VMT mix data (TTI)- fraction of VMT per road type and per 16 vehicle types.
- Fuel economy table for MOBILE6 vehicle type (EPA)- per 28 vehicle type and model year.
- 2007 VMT per hour, per vehicle type (H-GAC)
- 2007 VMT per link (H-GAC)
Relation between 16 composite and 28 disaggregated vehicle classes

<table>
<thead>
<tr>
<th>Composite MOBILE6 Vehicle Classes</th>
<th>Disaggregated MOBILE6 Vehicle Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDV</td>
<td>LDGV, LDDV</td>
</tr>
<tr>
<td>LDT1</td>
<td>LDGT1, LDDT1</td>
</tr>
<tr>
<td>LDT2</td>
<td>LDGT2, LDDT2</td>
</tr>
<tr>
<td>LDT3</td>
<td>LDGT3, LDDT3</td>
</tr>
<tr>
<td>LDT4</td>
<td>LDGT4, LDDT4</td>
</tr>
<tr>
<td>HDV2b</td>
<td>HDGV2b, HDDV2b</td>
</tr>
<tr>
<td>HDV3</td>
<td>HDGV3, HDDV3</td>
</tr>
<tr>
<td>HDV4</td>
<td>HDGV4, HDDV4</td>
</tr>
<tr>
<td>HDV5</td>
<td>HDGV5, HDDV5</td>
</tr>
<tr>
<td>HDV6</td>
<td>HDGV6, HDDV6</td>
</tr>
<tr>
<td>HDV7</td>
<td>HDGV7, HDDV7</td>
</tr>
<tr>
<td>HDV8a</td>
<td>HDGV8a, HDDV8a</td>
</tr>
<tr>
<td>HDV8b</td>
<td>HDGV8b, HDDV8b</td>
</tr>
<tr>
<td>HDBS</td>
<td>HDGBS, HDBBS</td>
</tr>
<tr>
<td>HDBT</td>
<td>HDBT</td>
</tr>
<tr>
<td>MC</td>
<td>MC</td>
</tr>
</tbody>
</table>
Methodology

- **Split of composite vehicle categories:**
  - \( \text{Reg\_Dist LDGV} = \text{Reg\_Dist LDV} \times (1 - \text{Diesel\_Fraction LDV}) \)
  
  - \( \text{Reg\_Dist LDDV} = \text{Reg\_Dist LDV} \times \text{Diesel\_Fraction LDV} \)
Methodology

\[
\{\text{Reg. Dist}\} \times \{\text{VMX}\}_{\text{am,md,pm,ov}} = \{C\}_{\text{am, md, pm,ov}} \\
(25 \times 28) \quad (28 \times 15) \quad (25 \times 15)
\]

\[
\{C\}^t_{\text{am, md, pm,ov}} \times \{\text{MPG}\} = \{E\}_{\text{am, md, pm,ov}} \\
(15 \times 25) \quad (25 \times 28) \quad (15 \times 28)
\]

The \{\text{VMX}\} matrix represents the percentage of 28 different vehicle types on the 15 types of roads (urban interstate, urban other freeway, toll roads, ramps, urban principal arterial, urban other arterial, urban collector, local-centroid connector, rural interstate, rural other freeway, rural principal arterial, rural other arterial, rural major collector, rural collector, and local intrazonal)
Methodology

- $\{E\}|_{am, md, pm, ov}$ represents the fuel economy weighting average over the 25 years distribution for the 28 vehicle types on the 15 facility types.

- Each element of this matrix was then inverted to get gallons/mile and multiplied by the hourly VMT (output from IMPSUM program) to get the total fuel consumption for each vehicle category, road type and hour of the day.
Hourly VMT and Fuel Economy

By Hour of the Day

- Total VMT
- Average Fuel Economy
### Fuel Consumption and Fuel Economy for the four time periods

<table>
<thead>
<tr>
<th></th>
<th>VMT(miles)</th>
<th>Gas (gallons)</th>
<th>Diesel (gallons)</th>
<th>Total Fuel (gallons)</th>
<th>Fuel Economy (miles/ gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM</strong></td>
<td>21,838,219</td>
<td>993,682</td>
<td>192,977</td>
<td>1,186,659</td>
<td>18.40</td>
</tr>
<tr>
<td><strong>MD</strong></td>
<td>27,184,364</td>
<td>1,206,852</td>
<td>392,762</td>
<td>1,599,614</td>
<td>16.99</td>
</tr>
<tr>
<td><strong>PM</strong></td>
<td>32,333,615</td>
<td>1,478,568</td>
<td>259,744</td>
<td>1,738,311</td>
<td>18.60</td>
</tr>
<tr>
<td><strong>OV</strong></td>
<td>15,242,478</td>
<td>683,910</td>
<td>157,059</td>
<td>840,970</td>
<td>18.12</td>
</tr>
<tr>
<td><strong>daily</strong></td>
<td>96,598,678</td>
<td>4,363,012</td>
<td>1,002,542</td>
<td>5,365,554</td>
<td>18</td>
</tr>
</tbody>
</table>
Daily Fuel Consumption by Time Period

Fuel Consumption by Time Period

- AM: 16%
- MD: 32%
- PM: 22%
- OV: 30%
### Daily Fuel Consumption and Fuel Economy for each of the aggregated roadway types

<table>
<thead>
<tr>
<th></th>
<th>VMT (miles)</th>
<th>Gas (gallons)</th>
<th>Diesel (gallons)</th>
<th>Total Fuel (gallons)</th>
<th>Fuel Economy (miles/gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freeway</strong></td>
<td>43,504,637</td>
<td>1,957,564</td>
<td>407,909</td>
<td>2,365,474</td>
<td>18.39</td>
</tr>
<tr>
<td><strong>Arterial</strong></td>
<td>43,174,444</td>
<td>1,955,092</td>
<td>446,455</td>
<td>2,401,547</td>
<td>17.98</td>
</tr>
<tr>
<td><strong>Collector</strong></td>
<td>9,919,597</td>
<td>450,354</td>
<td>148,176</td>
<td>598,531</td>
<td>16.57</td>
</tr>
<tr>
<td><strong>Daily</strong></td>
<td>96,598,678</td>
<td>4,363,012</td>
<td>1,002,542</td>
<td>5,365,554</td>
<td>18</td>
</tr>
</tbody>
</table>
Daily Fuel Consumption by Roadway Type

- Freeway: 45%
- Arterial: 44%
- Collector: 11%
### Daily Fuel Consumption by Aggregated Vehicle Classes

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>VMT (miles)</th>
<th>Gas (gallons)</th>
<th>Diesel (gallons)</th>
<th>Fuel Economy (miles/gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDG</td>
<td>87,969,928</td>
<td>4,230,245</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>HDG</td>
<td>1,198,110</td>
<td>132,767</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>LDD</td>
<td>174,506</td>
<td>0</td>
<td>8,769</td>
<td>20</td>
</tr>
<tr>
<td>HDD</td>
<td>7,256,134</td>
<td>0</td>
<td>993,772</td>
<td>7</td>
</tr>
</tbody>
</table>
Daily Fuel Consumption by Vehicle Type

Fuel Consumption by Vehicle Type

- LDG: 79%
- HDG: 2%
- LDD: 0%
- HDD: 19%
Conclusions

- On an average weekday, approximately 5,000,000 gallons of fuel is consumed in Houston.
- Gasoline consumption is approximately four times more than diesel consumption.
- Light duty gasoline vehicles clearly dominate the VMT and the fuel consumption.
- The fuel economy is almost constant during the day, with the best occurring during peak periods and the worst during midday. These facts are primarily due to changes in the proportion of heavy duty and light duty traffic volumes.
- Diesel traffic tends to be highest on collectors, while gasoline vehicles tend to travel the most on freeways.
A copy of the full report is available at:

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