Technology Strategies for the Transportation Sector: The View from Mexico

Adrián Fernández Bremauntz, PhD.
President
National Institute of Ecology – México

NARSTO Executive Assembly
April 9th, 2008
Current situation in Mexico
Air quality in urban areas: current situation

<table>
<thead>
<tr>
<th>Metropolitan Areas</th>
<th>Population$^3$</th>
<th>Ozone</th>
<th>$PM_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico City (ZMVM)</td>
<td>18,396,677</td>
<td>222</td>
<td>17</td>
</tr>
<tr>
<td>Guadalajara (ZMG)</td>
<td>3,669,136</td>
<td>87</td>
<td>17</td>
</tr>
<tr>
<td>Monterrey (ZMM)</td>
<td>3,299,302</td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td>Cd. Juárez</td>
<td>1,218,817</td>
<td>4$^{(1)}$</td>
<td>N.A.</td>
</tr>
<tr>
<td>Toluca (ZMT)</td>
<td>1,451,801</td>
<td>6</td>
<td>173$^{(2)}$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28,065,733</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1): 2006 data
(2): 2005 data
Source: INE, 2008
Anthropogenic emissions by source type percent contribution (1999)

Source: INE, 2007
HD diesel emissions in Mexico

- HD diesel vehicles vs. motor vehicles total (national)
  - 62% NOx, 46% PM$_{10}$, 7% HC, 17% SOx, 5% CO

Source: Mexico National Emissions Inventory, 1999 (in press)
HD diesel emissions in MCMA

- HD diesel vehicles vs. motor vehicles total (MCMA)
  - 38% NOx, 87% PM$_{10}$, 11% HC, 17% SOx, 4% CO

Source: MCMA emissions inventory for 2004 (draft)
Vehicle distribution - MCMA

Private cars 82%

LD* 14%

Diesel 77%

Gasoline 23%

HD ** 4%

Source: MCMA emissions inventory for 2004
Vehicle distribution by fuel use

- Gasoline: 93%
- Diesel: 6%
- LPG: 1%
- HD: 57%
- LD: 43%

* LD - Includes taxis, combis, microbuses, pick ups and V<3 ton.
** HD - Includes trucks, buses and y V > 3 ton.

Source: MCMA emissions inventory for 2004
Institutional framework in Mexico

- SEMARNAT (Under-secretariat of Environmental Regulation) issues federal regulations pertaining to emission limits from mobile sources (new and in-use vehicles).

- Local environmental authorities are in charge of enforcing regulations applicable to in-use vehicles (through I/M programs); have authority to impose more stringent standards than the federal regulation.

- INE (technical branch of SEMARNAT) provides technical support to design/modify/justify regulations, contingency programs, I/M & “one day without a car” programs, Metrobús implementation, etc.
Regulatory framework

• Fuel quality standard (incl. sulfur content)
  – NOM–086-SEMARNAT-SENER-SCFI-2005

• Emission standards for new vehicles
  – NOM-044-SEMARNAT-2006: heavy-duty diesel vehicles

• Emission standards for in-use vehicles
  – NOM-041-SEMARNAT-2006: light-duty gasoline vehicles, based on the BAR 97 test procedure
  – NOM-045-SEMARNAT-2006: diesel vehicles, based on the SAE J1667 test procedure (opacity)
Vehicle regulations (light-duty)

- For new vehicles, the latest passenger car standards in Mexico (NOM-042-SEMARNAT-2003) are based loosely on US and EU standards, and they do not include a test procedure for the durability requirement, making it impossible to verify compliance.
Vehicle regulations (heavy-duty)

• EPA and EURO emission standards, test procedures and compliance certifications are acceptable, according to the following rules:
  – EPA 2004 and EURO IV: 2008 onwards

• Certifications should include information on:
  – Durability, according to EPA and EURO standards
  – Fuel quality for compliance tests
**USA**

- **Vehicle technology**
  - Tier 1 is introduced
  - Tier 1: 100,000 miles durability
  - Tier 2 – light-duty: 120,000 miles durability
  - Tier 2 – heavy-duty

- **Sulfur content in gasoline**
  - 0 – 1,000 ppm
    - 300 ppm average
  - 120 ppm average
  - 80 ppm average
  - 30 ppm average

**México**

- **Vehicle technology (AMIA/CAM/INE agreement)**
  - Tier 1 is introduced
  - Tier 1: 80,000 Km durability

- **Sulfur content in gasoline (NOM-086)**
  - Magna: 700 ppm national avg
  - Magna: 400 ppm avg in metropolitan areas
  - Premium: 250 ppm national avg
  - Magna: 30 ppm avg in met areas
  - Premium: 30 ppm nat'l avg
  - 30 ppm nat'l avg

**Fuel quality regulation**
Fuel economy has not improved in the past few years in Mexico.

Source: INE, 2008
• **89.4%** increase in the 1994-2007 period.

• Light truck sales increased market share starting in 2006.

Source: INE, 2008 with information from AMIA
• Gasoline sales in México

- Gasoline demand increased 50% between 1996 and 2007
- Nearly 40% of gasoline in Mexico is imported
The future
The future…

Expected growth of the vehicle fleet in Mexico

Annual growth rate = 4.4%

Million vehicles

Año

Current emission standards: increased emissions over time
• Projected GHG emissions (CO$_2$ eq)

<table>
<thead>
<tr>
<th>Sector</th>
<th>1996</th>
<th>2010</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>49</td>
<td>66</td>
<td>9.3%</td>
</tr>
<tr>
<td>Industrial</td>
<td>88</td>
<td>149</td>
<td>21.1%</td>
</tr>
<tr>
<td>Transport</td>
<td>103</td>
<td>237</td>
<td>33.4%</td>
</tr>
<tr>
<td>Services</td>
<td>33</td>
<td>54</td>
<td>1.7%</td>
</tr>
<tr>
<td>PEMEX (X 1.6)</td>
<td>6</td>
<td>12</td>
<td>7.6%</td>
</tr>
<tr>
<td>Electricity (X 2.3)</td>
<td></td>
<td>192</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td>363.8</td>
<td>709.5</td>
<td></td>
</tr>
</tbody>
</table>
Technology strategies for the transportation sector in Mexico
Case study

Light-duty diesel vehicles in the MCMA
Current situation of LDD in Mexico

- Small portion of the light duty fleet (< 1%) and of new car sales in Mexico.
- Mexico City holds almost half of the market for new car sales in Mexico.
- There are currently very few diesel pumps available for light-duty refueling and very few shops for LDD maintenance.
- Diesel sulfur content is currently 15 ppm in the border region, 300 ppm (max) in main urban areas, 500 ppm in the rest of the country.
- ULSD (15 ppm) should be available in the whole country by the end of 2009.
But…

• High performance and improved fuel economy make diesels very attractive for commercial fleets

• Diesel fuel has a preferential tax rate, which makes it approximately 30% cheaper than gasoline.

• Auto makers are demanding incentives equivalent to those available for gasoline vehicles in the MCMA.
Current situation of LDD in Mexico (3)

- MCMA has an agreement with AMIA (car manufacturers association) whereby in-use LDD are waived from the one-day-without-a-car program for up to four (utility vehicles) or eight years (passenger vehicles), as long as they comply with specific opacity values (1.0 and 0.76m$^{-1}$, respectively).

- CAM recently launched an incentives program for gasoline vehicles, whereby the cleaner, but also most efficient vehicles are waived from the I/M program for up to six years.

- The MCMA-AMIA agreement expired December 31st, 2007. AMIA is requesting incentives for diesel vehicles (similar to the ones recently issued for gasoline vehicles) on the grounds of better fuel economy.

- CAM requested support from INE to identify the technical elements to be considered when analyzing incentives for LDD.
What would happen if…?

Hypothetical MCMA Scenario (2008-2020):
- Steady rate introduction of LDD, 20% of the new car sales in 2020
- Current regulatory framework

Nearly 4,000 additional tons of PM$_{10}$ would be released within the 2008-2020 timeframe.

PM$_{10}$ emissions from mobile sources would increase by almost 50 percent within this timeframe.
Roadmap for LDD in Mexico

- Discourage LDD car sales in Mexico prior to the availability of ULSD, i.e. restrict access of LDD to incentives in the MCMA.

- Revise the current NOM-042 towards achieving a fuel-neutral emission standard, equivalent to either the California LEV II program or a modified U.S. Tier 2 program (max emissions at the Bin 5 level).

- Introduce durability of emission levels to 190,000 km, and adequate durability test procedures to verify compliance.

- Regulate gaseous emissions from in-use LDD vehicles, including adequate test procedures to accurately monitor compliance, especially with PM$_{10}$ and NO$_x$ emission limits.
Proposed CAM agreement

• Grant the “0” sticker at the I/M centers to those LDD vehicles which pass the opacity test (through the procedure described in the NOM-045-SEMARNAT-2006) with a light absorption coefficient value of 1.0 and which:
  – are at most three years old
  – comply with EURO IV, EURO V or TIER 2 bin 7 and lower bins, for model-years 2010 and beyond
  – comply with EURO V or TIER 2 bin 5 and lower bins, one year after low sulfur diesel is available in the MCMA.
Case study

Low-sulfur gasoline and diesel
Fuels – vehicle technologies

Cleaner vehicles require better fuels

Source: Blumberg, K. 2007
Results
Emission Reduction

- **Hidrocarburos (HC)**
  - Year: 2006-2020
  - Reduction: 28%

- **Óxidos de nitrógeno (NOₓ)**
  - Year: 2006-2020
  - Reduction: 50%

- **Partículas menores a 2.5 micrones (PM₂.₅)**
  - Year: 2006-2020
  - Reduction: 45%

- **SO₂ Línea Base**
  - Year: 2006-2020
  - Reduction: 91%
INE estimates indicate that health benefits due to the introduction of low sulfur fuels (per NOM 086) amount:

- **Premature mortality**
  
  Adults
  Children
  \[56,000\] cases avoided

- **Morbidity**

  Chronic bronchitis
  \[165,000\] cases avoided

- **Productivity loss**

  Work loss days and restricted activity days
  \[78\] million days
Cost-benefit analysis:
Net present value per year (pesos)

Health benefits

4,830 million

Net benefits (per year)

2,900 million

Investment

1,930 million

Benefits are 2.4 times the costs
Cost-benefit analysis:
Total Net present value (2004-2030) (pesos)

Benefits

- 120 billion
- Investment and operating costs
  - 48 billion
- $11,373 USD

Net present value

- 72 billion

Benefits are 2.4 times the costs

Investment and operating costs are $4,683 USD
Improved technologies

improved emission standards and better fuel quality
The road ahead

• Modify the current regulations for new and in-use vehicles, to introduce Tier 2, Bin 5-equivalent and EPA 2007-equivalent emission limits, according to availability of low-sulfur fuels

• Establish durability test procedures and gaseous emission limits for diesel vehicles

• Ensure low-sulfur fuels availability nationwide, as soon as possible

• Inform public about fuel economy, to influence purchasing decisions

• Establish fuel economy requirements (long-term)
Thank you

afernand@ine.gob.mx