# MOBILE5-Mexico: An Emission Factor Model for On-Road Vehicles in Mexico

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# Overview of Today's Presentation

- Project Background
- General Model Concepts
- Comparison of Model Performance
- Areas for Improvement

# Project Background

- Part of Mexico Emissions Inventory Development Program sponsored by Western Governors' Association (since 1994)
- Mexico-specific motor vehicle emission factor model
- Model framework based upon U.S. EPA's MOBILE5 model
- Uses Mexico emissions testing data

# Previous Models

- MOBILE-MCMA (Mexico City Metropolitan Area - MOBILE4- and MOBILE5-based)
- MOBILE-MMAp (Monterrey Metropolitan Area)
- MOBILE-Juárez (Ciudad Juárez)
- Similar MOBILE-based models in other countries

# General Concepts of MOBILE5-Mexico

- Applicable to entire country of Mexico with ability to select specific region types
- Capability to include effects of U.S.-registered vehicles
- Mexico-specific basic emission rates (BERs) based on data collected in Mexico

# Specific Region Types

- Mexico City
- Interior Urban (>75,000 people and >50 km from border - e.g., Monterrey, Guadalajara)
- Interior Rural (<75,000 people and >50 km from border)
- Border Urban (>75,000 people and <50 km from border - e.g., Ciudad Juárez, Mexicali)
- Border Rural (<75,000 people and <50 km from border)

# U.S.-Registered Vehicles

- Fleet in U.S.-Mexico border region consists of both U.S.- and Mexico-registered vehicles
- Previous modeling required two separate model runs
- Fraction of Mexico-registered vehicles (not Mexico-manufactured vehicles) can be set in external data file (lower limit of 50%)
- Only applicable for border urban and border rural

# Mexico-Specific BERs

- BERs for Mexico City module based upon "technology equivalence matrix" for Mexico City
- BERs for interior urban and border urban modules derived directly from emissions testing data from Aguascalientes and Ciudad Juárez (only for exhaust)

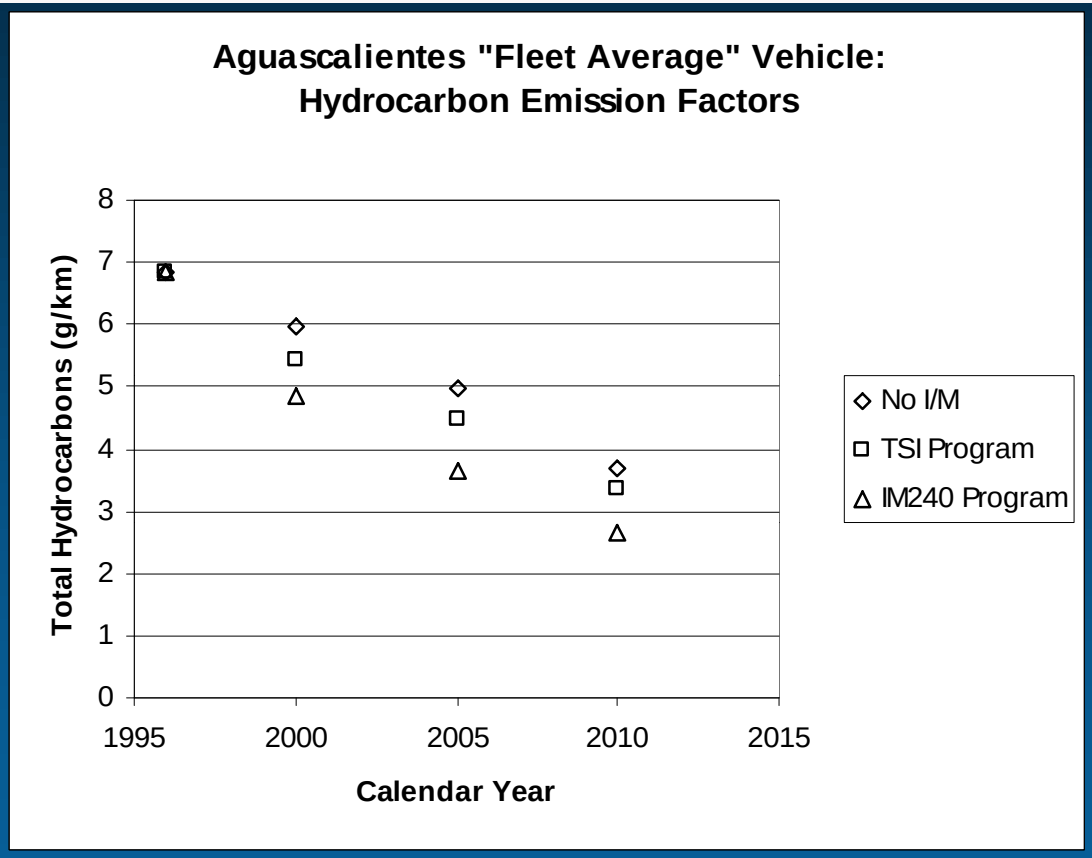
# Comparison of Model Results

- Interior urban module: 3 different I/M scenarios
- Different modules: Mexico City, interior urban, and border urban
- Mexico-U.S. scenarios: Mexico City and Denver, Colorado

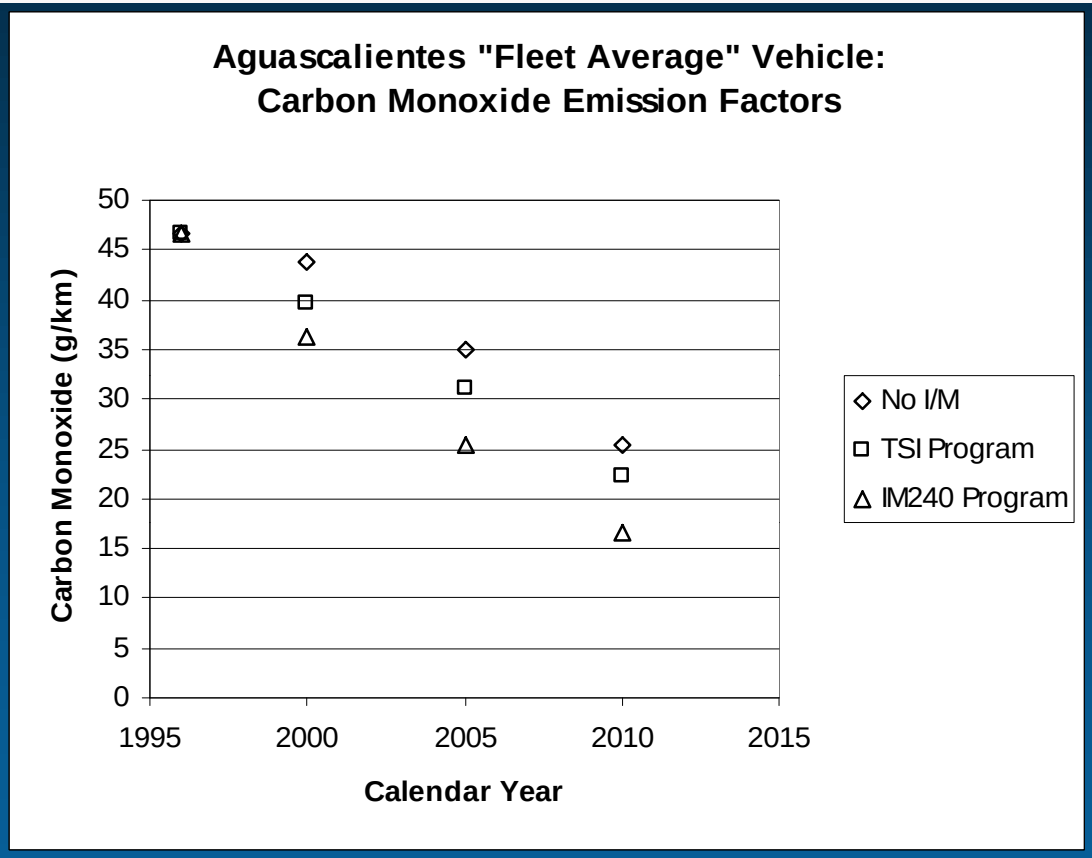
# Interior Urban Module - Scenarios

| Parameter | Value | Comment |
|---|---|---|
| **Common Input Parameters** | | |
| Region | High altitude | Higher than 5000 feet |
| Reformulated gasoline | No | No oxygenates added |
| Reid Vapor Pressure | 6.5 psi | Fuel volatility |
| Average Speed | 31.5 km/hr | All vehicle types |
| VKT Fractions | LDGV = 0.592, LDGT1 = 0.336, LDGT2 = 0.011, HDGV = 0.013, LDDV = 0.001, LDDT = 0, HDDV = 0.033, MC = 0.015 | |
| **TSI Scenario I/M Parameters** | | |
| First I/M Year | 1996 | |
| Model Years Covered | 1968 – 2010 | |
| Cutpoints | HC = 220 ppm<br>CO = 1.2% | Annual test |
| Vehicle Types Covered | All gasoline-powered vehicles | |
| Anti-Tampering Program | Yes | Catalyst, evaporative system, gas cap |
| **IM240 Scenario I/M Parameters** | | |
| First I/M Year | 1996 | |
| Model Years Covered | 1968 – 2010 | |
| Cutpoints | HC = 1.2 g/mi (0.75 g/km)<br>CO = 20 g/mi (12.4 g/km)<br>$NO_x$ = 2 g/mi (1.24 g/km) | Annual test |
| Vehicle Types Covered | All gasoline-powered vehicles | |
| Anti-Tampering Program | Yes | Catalyst, evaporative system, gas cap |

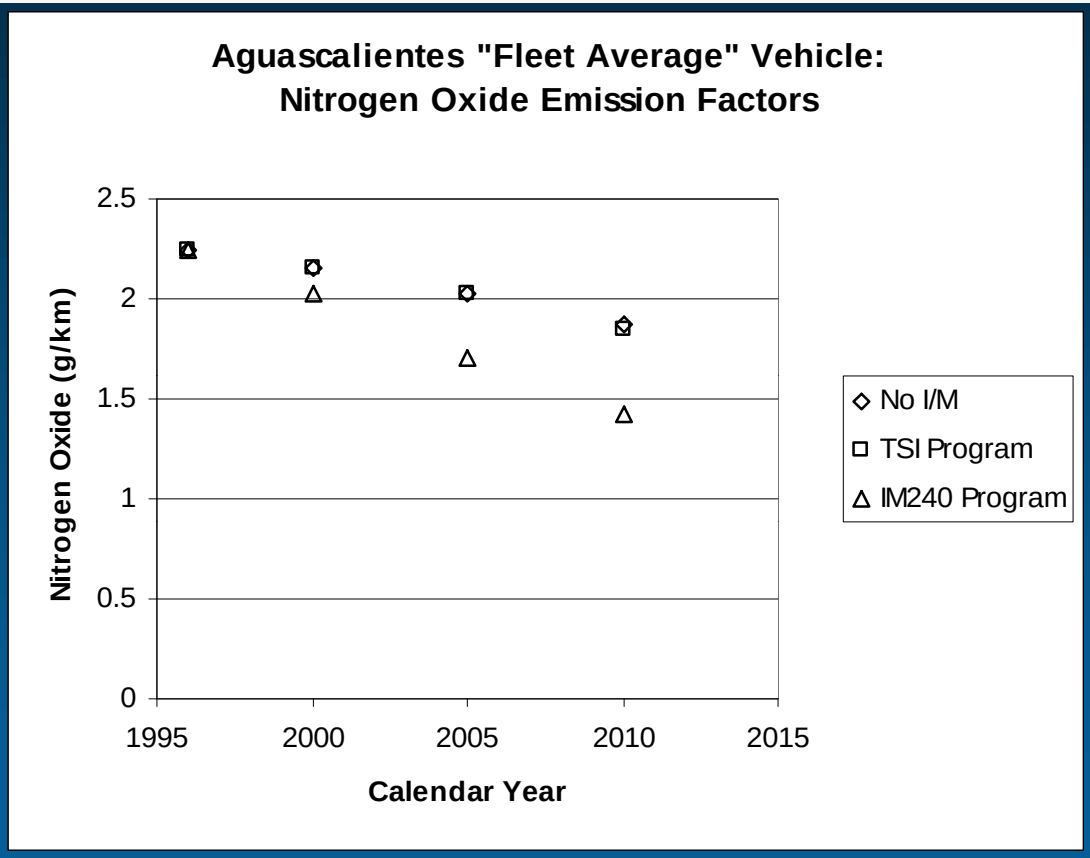
# Interior Urban Module - HC Results



# Interior Urban Module - CO Results



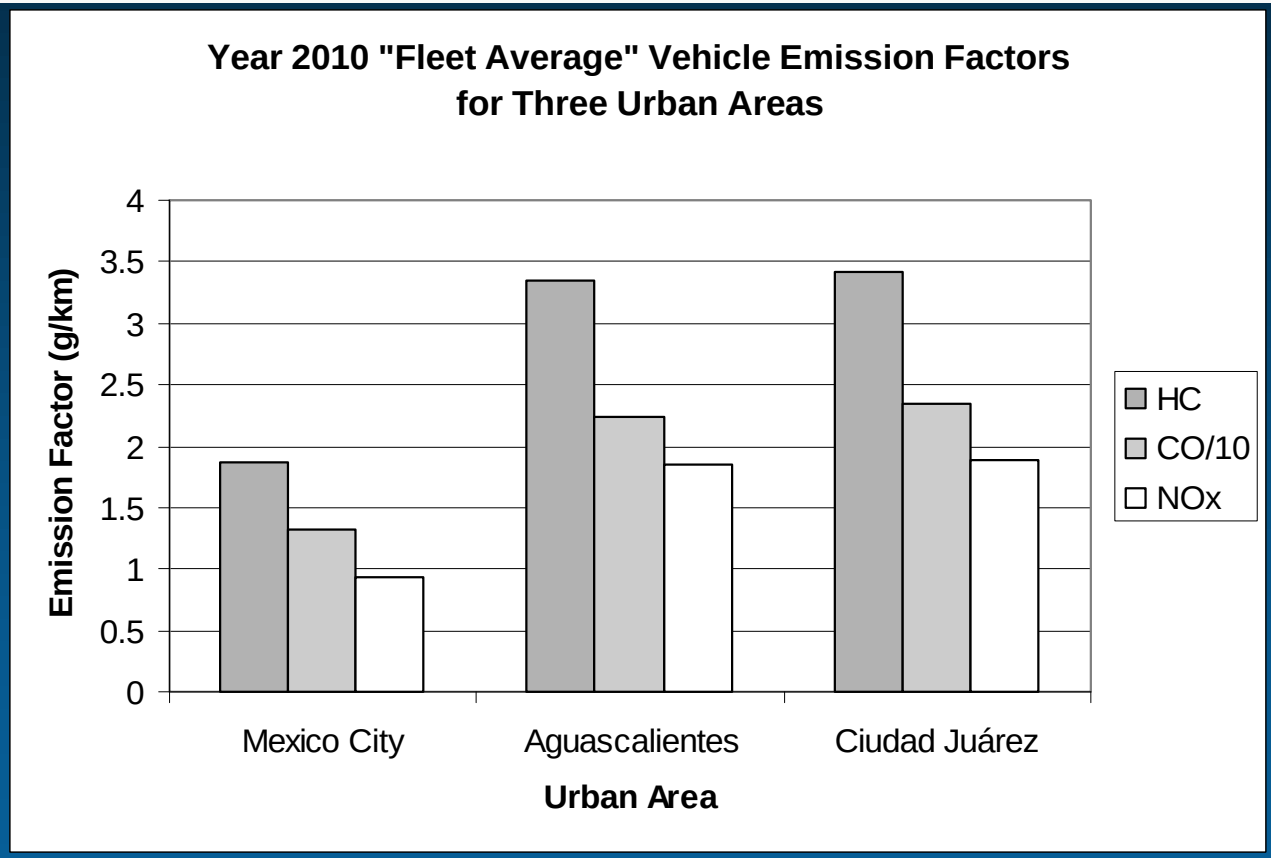
# Interior Urban Module - $NO_x$ Results



# Different Modules - Scenarios

| Parameter | Value | Comment |
|---|---|---|
| **Mexico City, Distrito Federal** | | |
| Region | High altitude | Higher than 5500 feet |
| Reformulated gasoline | No | No oxygenates added |
| Reid Vapor Pressure | 9.0 psi | Fuel volatility |
| Average Speed | 25.9 km/hr | All vehicle types |
| First I/M Year | 1996 | IM240 (annual TSI program before 1996) |
| Model Years Covered | 1968 – 2010 | |
| Cutpoints | HC = 0.8 g/mi (0.50 g/km)<br>CO = 20 g/mi (12.4 g/km)<br>$NO_x$ = 2.0 g/mi (1.24 g/km) | Annual test |
| Vehicle Types Covered | All gasoline-powered vehicles | |
| Anti-Tampering Program | Yes | Catalyst, evaporative system, gas cap |
| VKT Fractions | LDGV = 0.772, LDGT1 = 0.182, LDGT2 = 0.026, HDGV = 0.002, LDDV = 0.001, LDDT = 0.002, HDDV = 0.007, MC = 0.009 | |
| **Ciudad Juárez, Chihuahua (Border Urban)** | | |
| Region | Low altitude | 500 feet |
| Reformulated gasoline | No | No oxygenates added |
| Reid Vapor Pressure | 7.7 psi | Fuel volatility |
| Average Speed | 31.5 km/hr | All vehicle types |
| First I/M Year | 1996 | |
| Model Years Covered | 1968 – 2010 | |
| Cutpoints | HC = 220 ppm<br>CO = 1.2% | Annual test |
| Vehicle Types Covered | All gasoline-powered vehicles | 10% gasoline-powered vehicles and 5% diesel-powered vehicles registered in USA. |
| Anti-Tampering Program | Yes | Catalyst, evaporative system, gas cap |
| VKT Fractions | LDGV = 0.611, LDGT1 = 0.242, LDGT2 = 0.066, HDGV = 0.056, LDDV = 0, LDDT = 0, HDDV = 0.019, MC = 0.006 | |

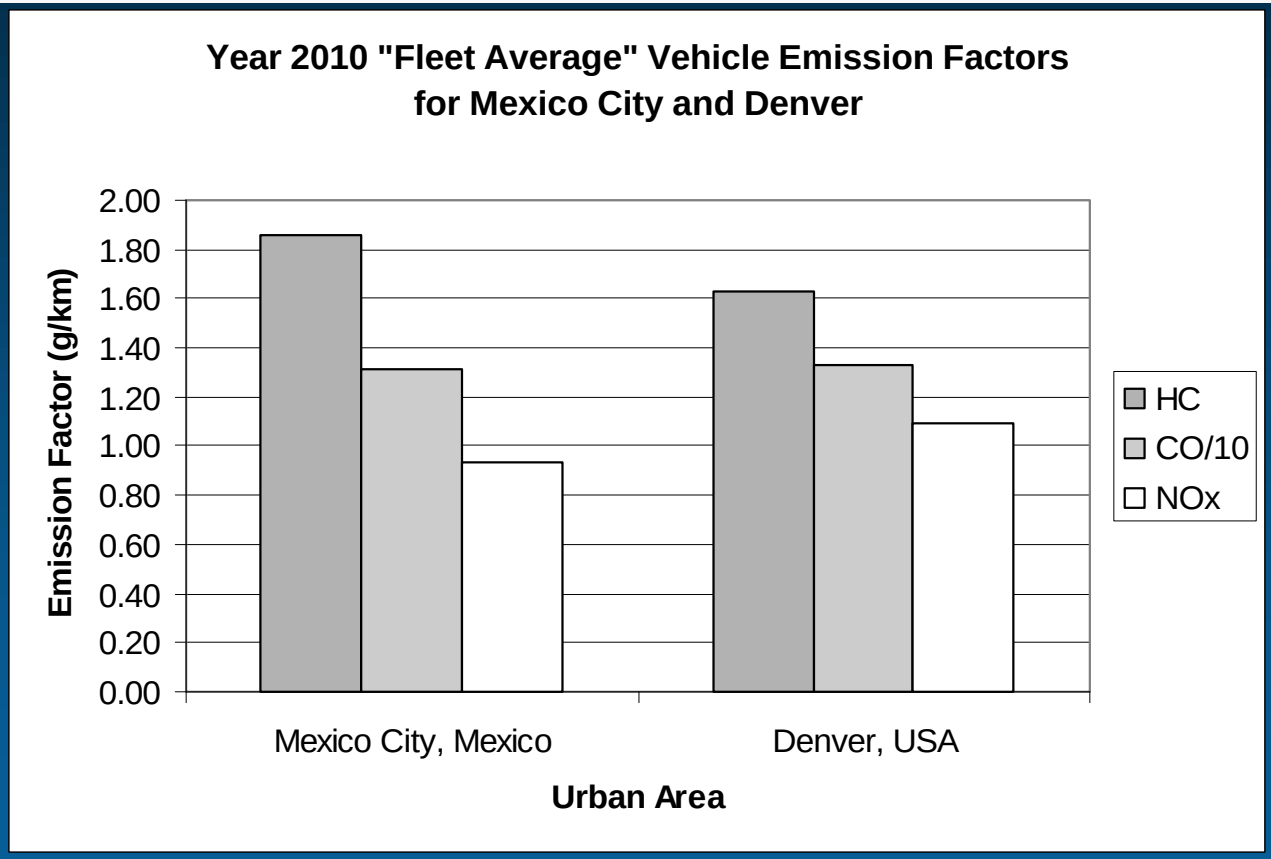
# Different Modules - Results



# Mexico-U.S. Scenarios

| Parameter | Value | Comment |
|---|---|---|
| **Denver, Colorado (MOBILE5b)** | | |
| Region | High altitude | 5500 feet |
| Reformulated gasoline | No | No oxygenates added |
| Reid Vapor Pressure | 13.6 psi | Fuel volatility |
| Average Speed | 19.6 mi/hr | All vehicle types |
| First I/M Year | 1983 | |
| Model Years Covered | 1981 – 2010 (IM240)<br>1967 – 2010 (TSI) | |
| IM240 Cutpoints | HC = 0.8 g/mi (0.50 g/km)<br>CO = 15 g/mi (9.3 g/km)<br>$NO_x$ = 2.0 g/mi (1.24 g/km) | Biennial test |
| TSI Cutpoints | HC = 220 ppm<br>CO = 1.2% | Annual test |
| Vehicle Types Covered | All gasoline-powered vehicles | |
| Anti-Tampering Program | Yes | Catalyst, air pump, fuel inlet |
| VKT Fractions | LDGV = 0.395, LDGT1 = 0.383, LDGT2 = 0.127, HDGV = 0.023,<br>LDDV = 0, LDDT = 0.002, HDDV = 0.065, MC = 0.005 | |

# Mexico-U.S. Results



# Areas for Improvement

- Additional light-duty emissions testing (especially Mexico City)
- Incorporate new testing data sets (second set of Ciudad Juárez data from TNRCC and Tijuana data from ARB)
- Heavy-duty emissions testing (would require equivalent of heavy-duty chassis dynamometer)
- Examine differences in Mexico driving behavior (initial work conducted in Aguascalientes)