

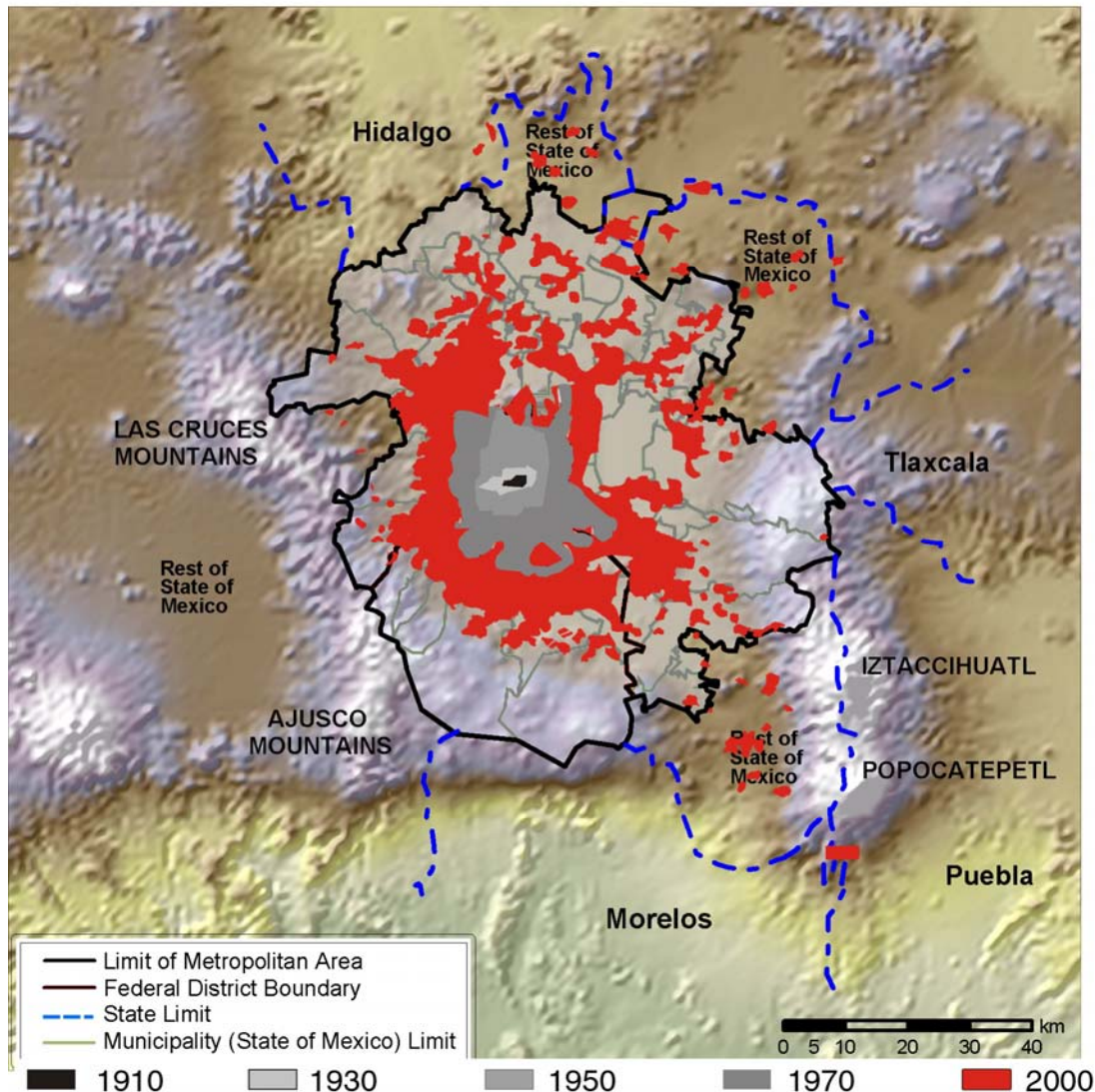
# History of Mexico Air Quality Management and Some Recent Development

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# Topographical map of Mexico City Metropolitan Area showing the urban expansion



- Population Growth

- >18 million (2000):  
20-fold increase since 1900

- Growth projection to >25 million (2010)

- Urban Sprawl

- >1500 km<sup>2</sup> (2000):  
10-fold increase since 1960

- >Expansion to peripheral areas

- Geographic and Topographical Conditions

- >High altitude (2240m): less efficient combustion processes

- >Mountains are a physical barrier for winds

- >2nd largest megacity in the world

- >Temperature inversions in the dry season

- Increases in Emissions Sources

# Mexico City Population at Risk

- **20 million inhabitants, including:**
  - 2.2 million children**
  - 250,000 street vendors**
  - 250,000 taxi, microbus and bus drivers**
- **More than 30 million trips-person are made every day**
- **People spend on average 3 hr commuting per day;**
  - 20% of commuters spend 4 or more hours**
- **CO, PM, VOCs and NOx exposure levels are 3-4 times higher in commuting microenvironments than at fixed site monitoring stations**

# History of Mexico City Air Quality Management (1)

- 1972:** - Under-Ministry of “Environmental Improvement”
  - First Federal Law for Pollution Control
- 1988:** - First General Environmental Law (LGEEPA)
  - I/M becomes mandatory / First Contingency Plan
- 1988:** - “One day without a car program” (*Hoy no circula*)
- 1990:** - First Air Pollution Plan for Mexico City (PICCA)
  - Unleaded petrol is introduced
- 1992:** - Metropolitan Environmental Commission (CAM) was created
- 1993:** - Diesel with 500 ppm of sulfur; 3-w catalysts

# History of Mexico City Air Quality Management (2)

**1994:** - Federal Environment Ministry (SEMARNAP) was created

**1995:** - Air quality plan 1995-2000 (PROAIRE) was released  
- Environmental Trust Fund (gasoline surcharge)

**1997:** - Leaded gasoline was completely phased out  
- Installation of vapor recovery systems begin  
- “One Day Without the Car” Program is modified  
- Changes to General Environmental Law  
(public participation and access to information)

**1999:** -TIER I standards are introduced for new vehicles

**2001:** - Air quality management plan (PROAIRE 2002-2010)

# **Air Quality Monitoring Network in Mexico City**

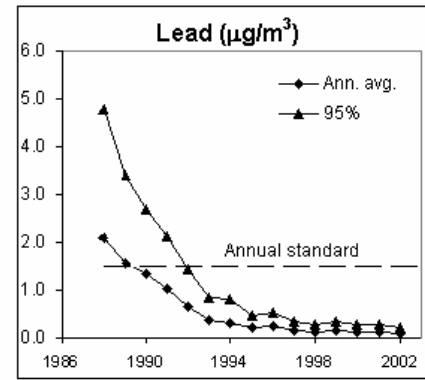
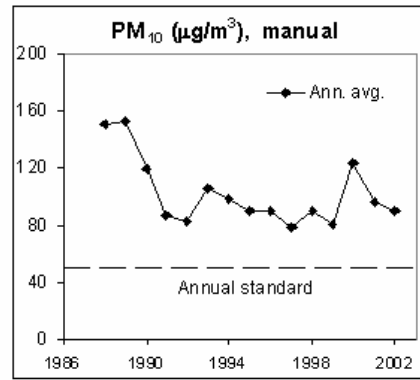
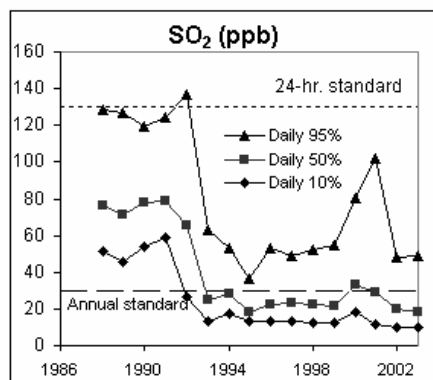
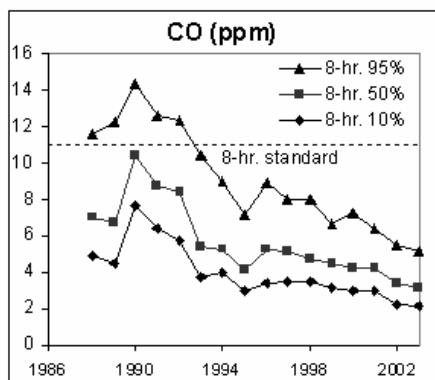
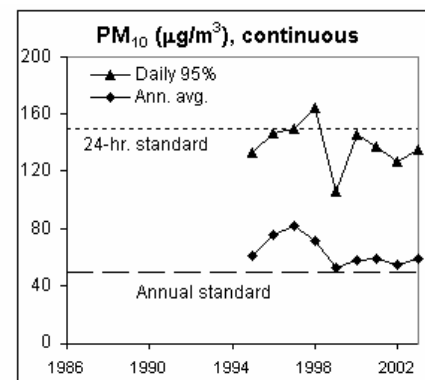
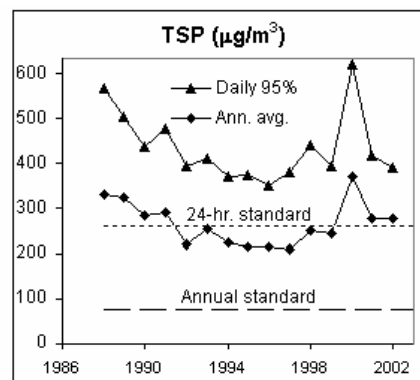
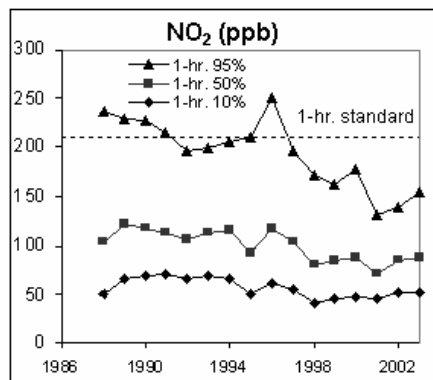
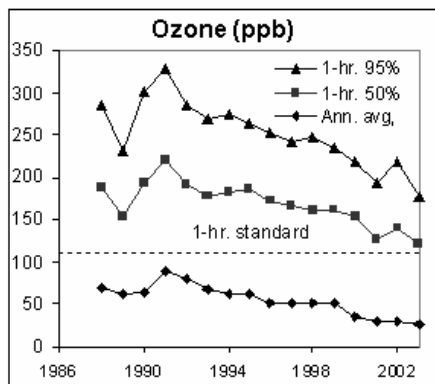
- **The Automatic Air Quality Monitoring Network (RAMA) was established in 1986 with 25 stations.**
- **Currently the Network consists of 36 stations located in strategic areas and measure ozone, NO<sub>2</sub>, SO<sub>2</sub>, CO, PM<sub>10</sub>, meteorological parameters. PM<sub>2.5</sub> monitoring was added to 8 stations in 2003.**
- **Additionally, there are several manual stations for PM, lead, nitrates, sulfates and formaldehyde.**
- **Air quality measurements are reported daily to the public in the form of Metropolitan Air Quality Index (IMECA).**

# Mexico City air pollution situation

- **In the early 1990s:**
  - Air Quality Standards for **ALL CRITERIA POLLUTANTS** frequently exceeded
  - Ozone standard exceeded 90% of the days
  - Peaks above 300 ppb 40-50 days a year
- **In the late 1990s:**
  - Pb, SO<sub>2</sub> levels always within standard
  - CO and NO<sub>2</sub> standards rarely exceeded
  - Ozone peaks above 300 ppb only 3-4 days a year
  - Ozone still above standard 85% of days
  - PM10 exceeds standard on 20-30 % of days

# Trends in criteria pollutant concentrations for the MCMA

(averages of data at five RAMA sites: TLA, XAL, MER, PED, and CES)





# Main reasons for air quality improvement in the MCMA (1990-1999)

## Lead

- Unleaded gasoline introduced in 1990
- Leaded gasoline completely phased out in 1997
- Average blood lead levels dropped from 20 ug/dl in the late 1980s to less than 10 ug/dl in the late 1990s

## Sulfur Dioxide

- Industrial heavy fuel oil was phased out in mid 1990s
- Sulfur content of diesel was reduced to 0.05% in 1995
- Power plants and other industry shifted to natural gas in the early 1990s

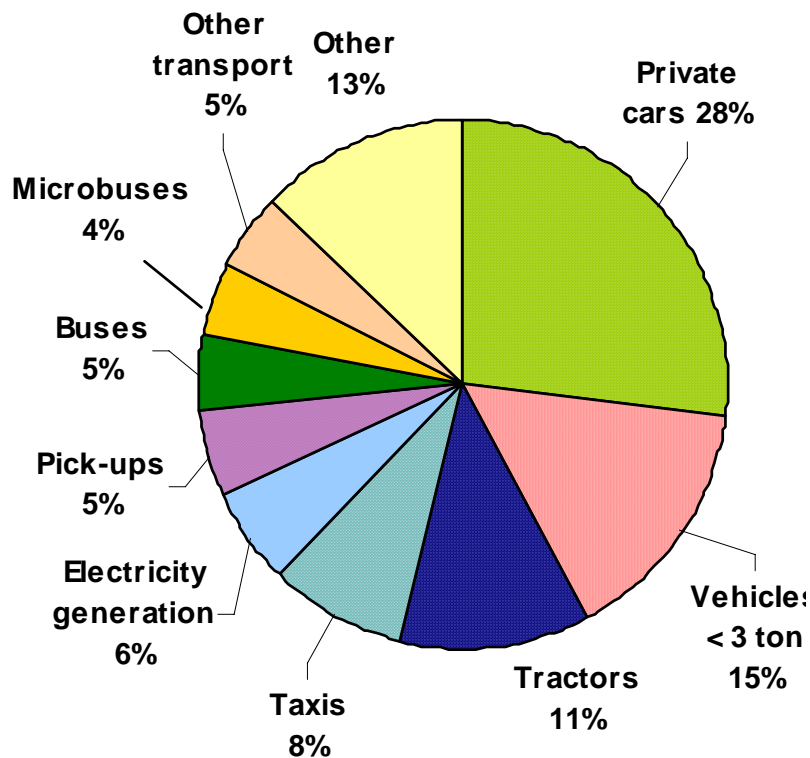
# **Main reasons for air quality improvement in the MCMA (1990-1999)**

## **Ozone peaks and CO levels**

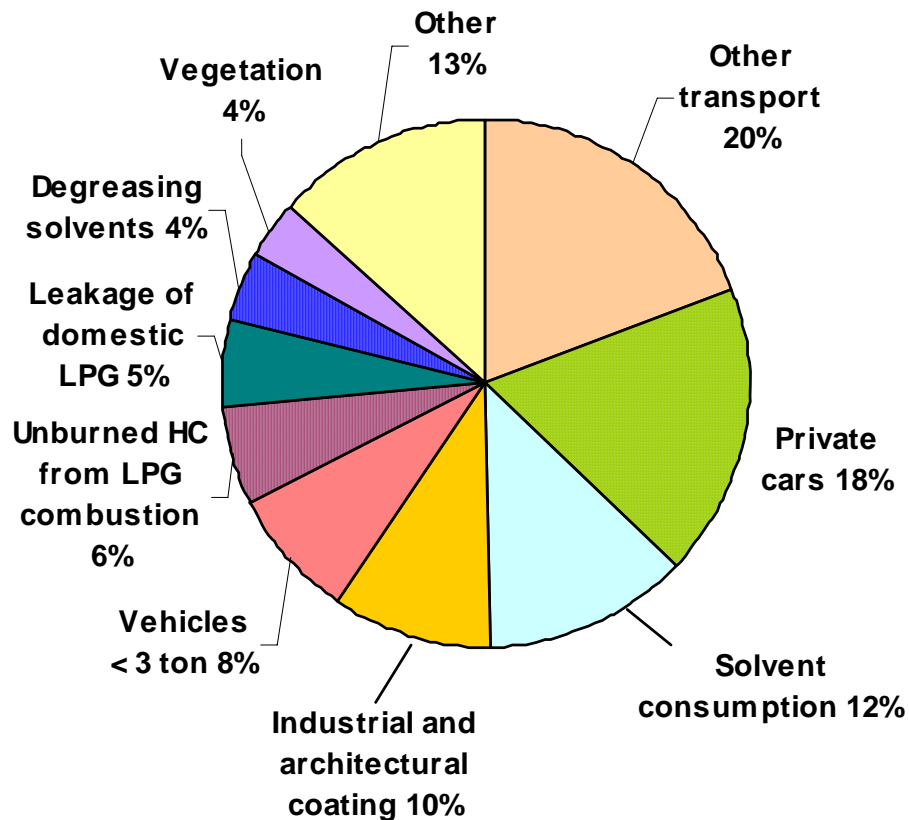
- **Oxygenated gasoline introduced in early 1990s**
- **Vehicle Inspection Program upgraded in 1993**
- **3 way catalysts introduced in 1993**
- **Vapor recovery systems installed in gasoline storage tanks and service stations**

# Percentage of emissions from the MCMA in 2000 by source category

## NO<sub>x</sub>

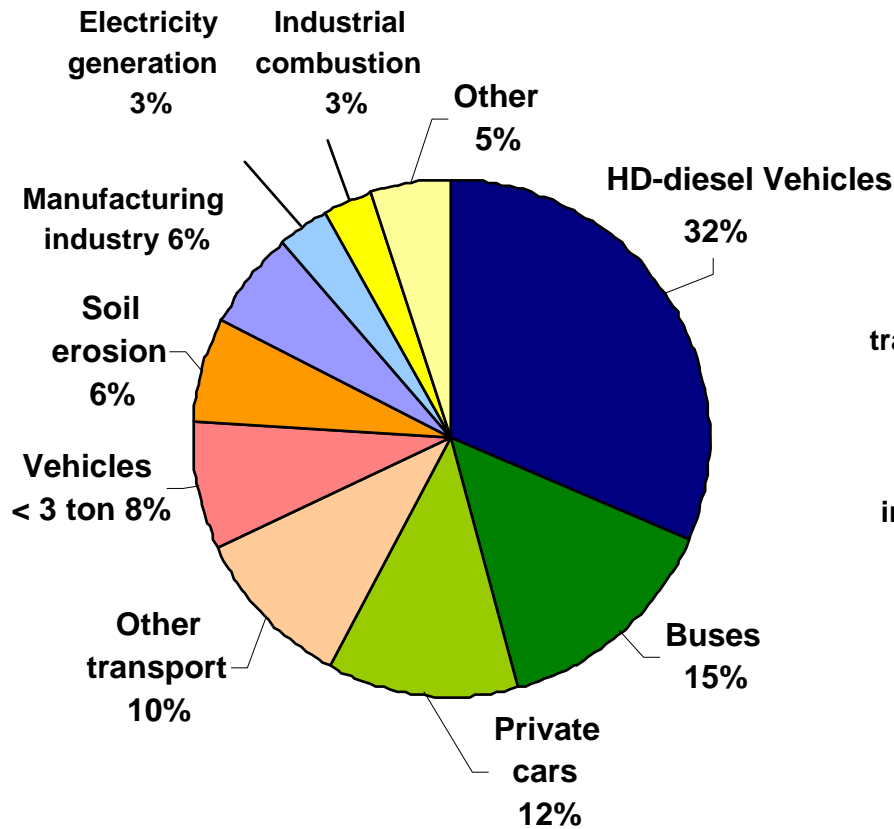


## VOC

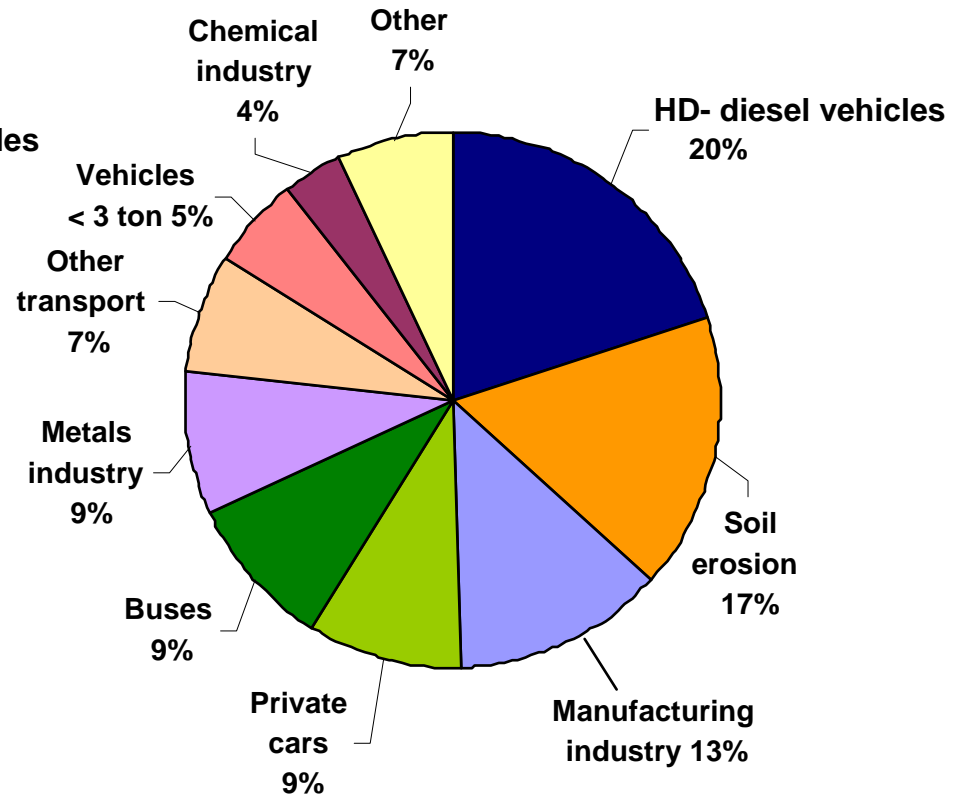


# Percentage of emissions from the MCMA in 2000 by source category

## PM<sub>2.5</sub>

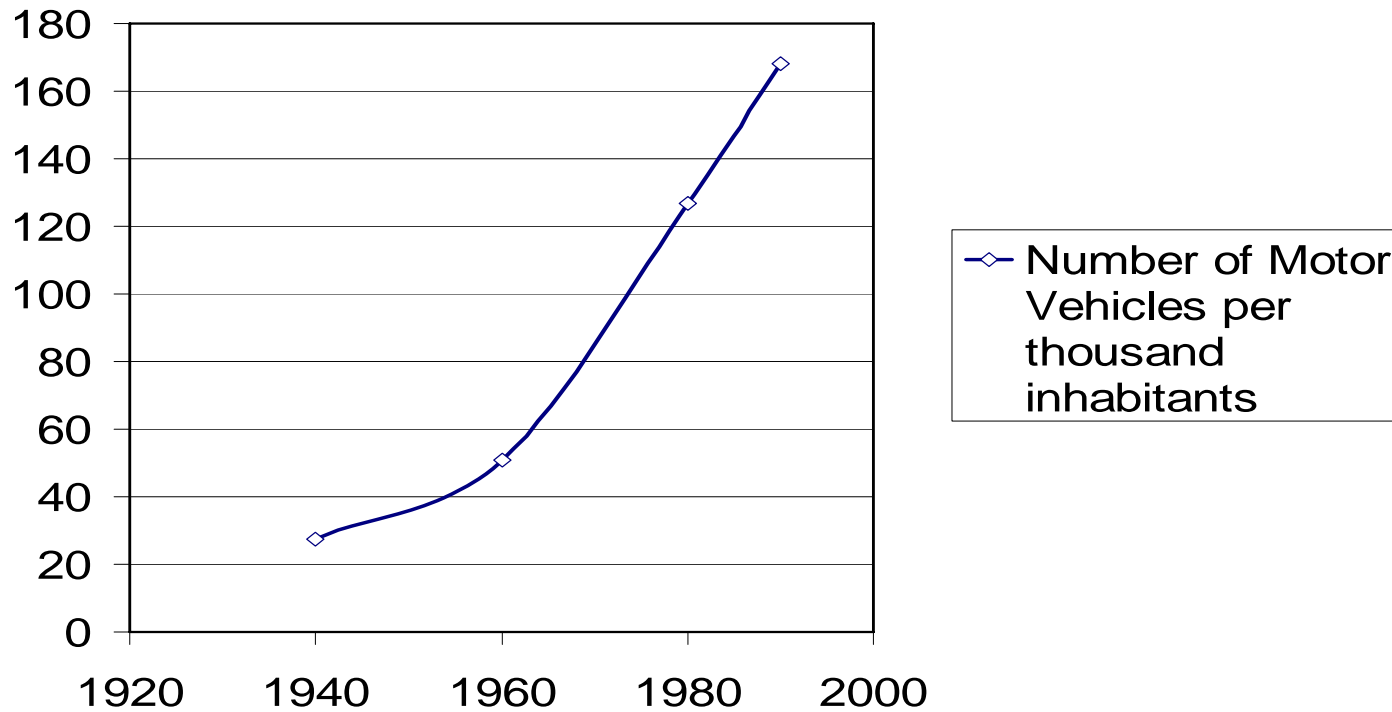


## PM<sub>10</sub>

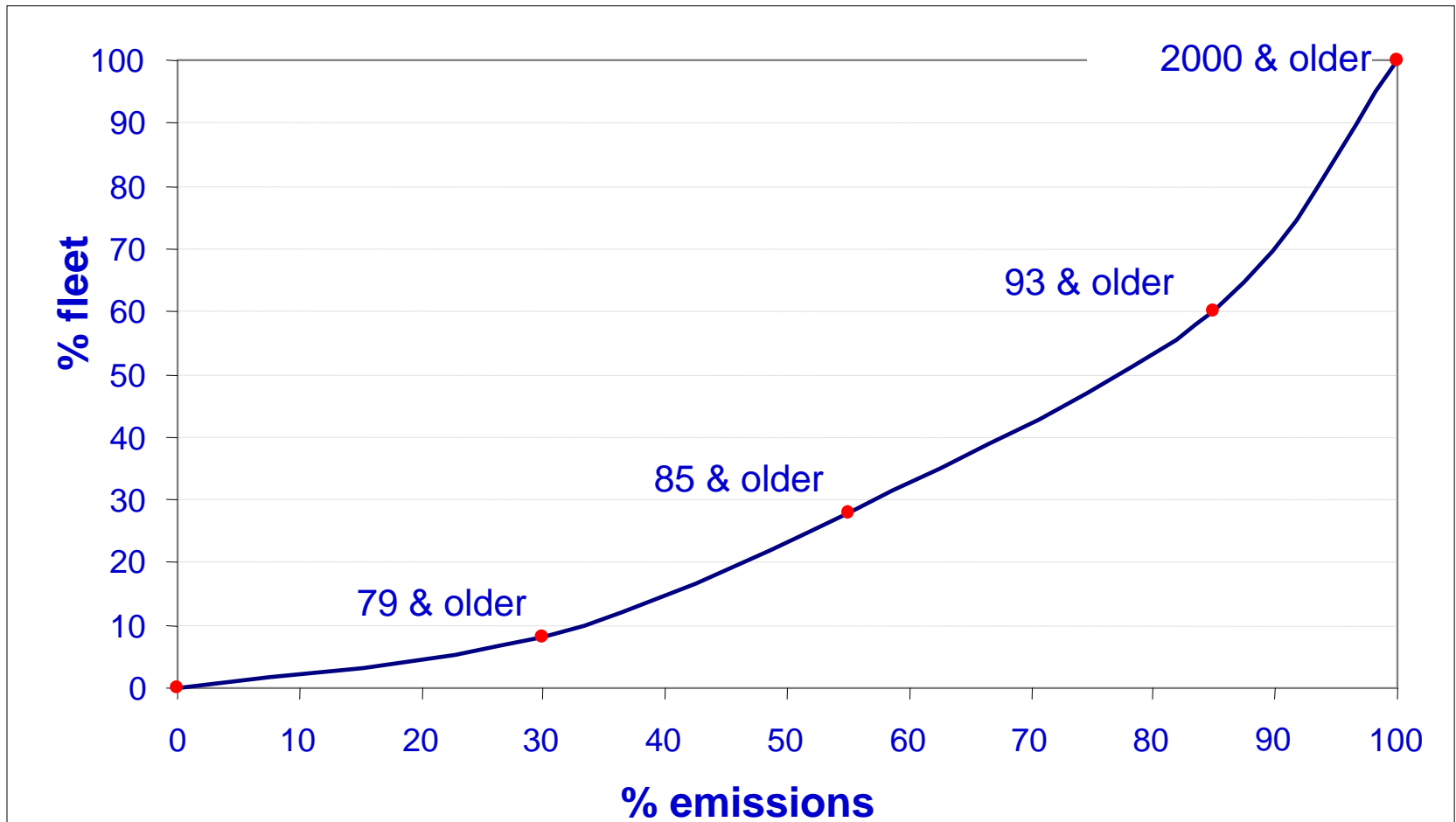


# Increase in Automobiles per Capita in the MCMA

Motorization Index in the MCMA

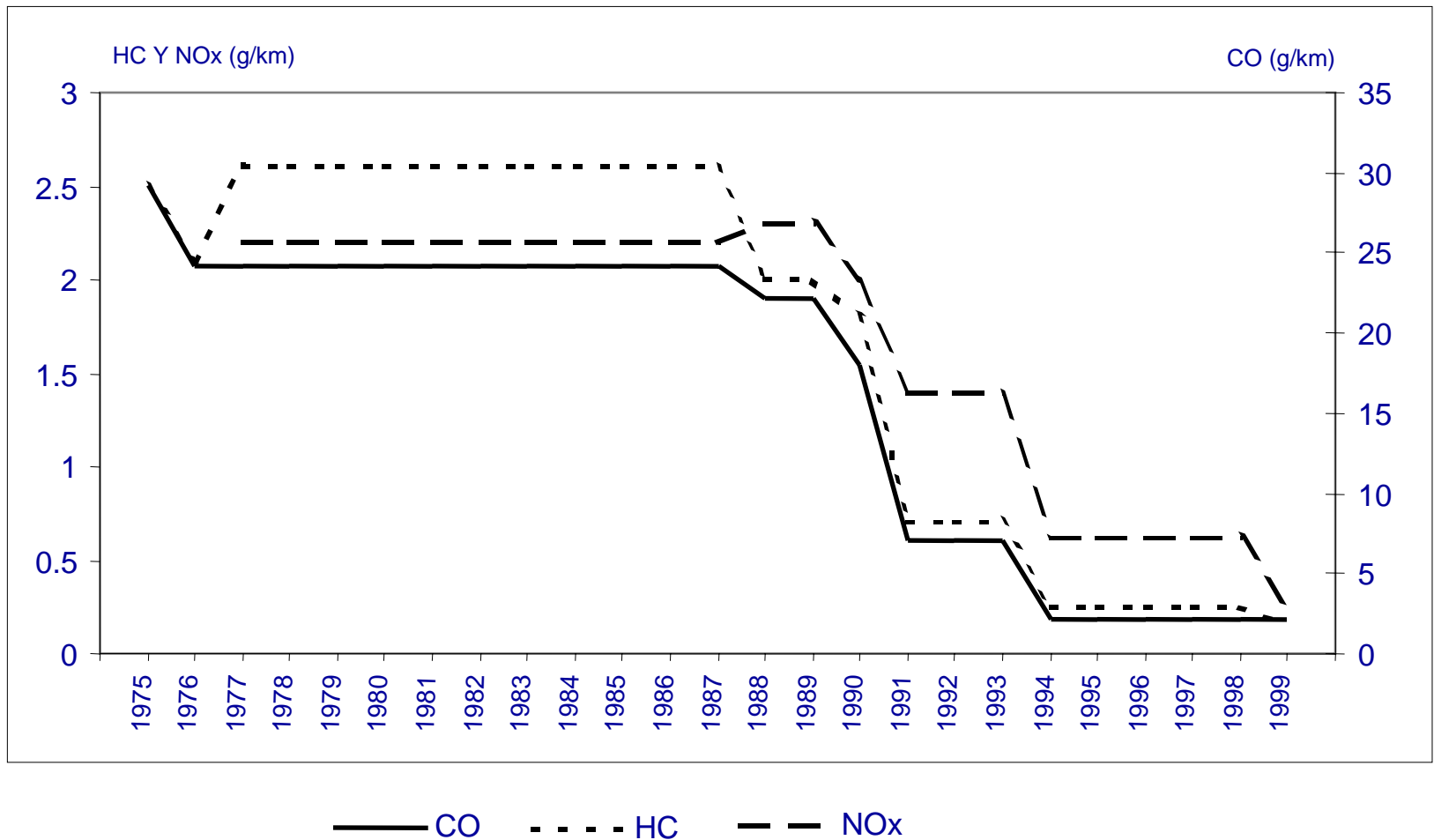


# Emissions contribution of different categories of vehicles in Mexico City



(Source: A. Fernandez, INE)

# Evolution of emission standards for new vehicles in Mexico



(Source: A. Fernandez, INE).

# Third Air Quality Management of the MCMA (PROAIRE 2002-2010)

The Third AQM Program contains a series of 89 measures --- drawn from the science-based findings and recommendations of MIT

## **Integrated Program on Urban, Regional and Global Air Pollution**

- To design an integral strategy for air quality management in the MCMA, for supporting the development of PROAIRE 2001 - 2010. This strategy is divided into seven specific actions
  - Integrated assessment of air quality in the MCMA
  - Air quality and pollution exposure modeling for MCMA
  - Assessment of health effects of pollution in MCMA
  - Design and evaluation of control strategies
  - Economic analysis of strategies
  - Integrated analysis
  - Training and education for air quality management personnel

### **Reference:**

Air Quality in the Mexico Megacity: An Integrated Assessment, L.T. Molina and M.J. Molina, eds., Kluwer Academic Publishers, 2002.



# Strategies to reduce Transport-related Emissions

- **Increase the turnover rate of the trucks, taxis, minibuses, and private auto fleets**
- **Encourage retrofitting of trucks with emission control devices**
- **Tighten the “tailpipe standards” on all new vehicles sold in Mexico to conform to world class standards.**
- **Introduce ultra-low-sulfur fuels (gasoline and diesel) to enable the use of state-of-the-art vehicle technologies**
- **Improve public transportation**
  - **Build strategic corridors and other roadway infrastructure to reduce congestion and improve air quality**
  - **Substitute low-capacity buses with Bus Rapid Transit (Metrobus)**

# MCMA Field Measurement Campaign

## Objectives

To update and improve the MCMA emissions inventory and to improve the current knowledge of the chemistry, dispersion and transport processes of the pollutants emitted to the MCMA atmosphere.

## February 2002 Exploratory Mission

Two-week period

Mobile laboratories

## April 2003 Intensive Measurement Campaign

Five-week period

Mobile laboratories; Supersite; Boundary Sites Mobile Units

## Participants

30 institutions from Mexico, US and Europe

## Sponsors

Comisión Ambiental Metropolitana (Mexico), MIT, NSF, PEMEX, others



# MILAGRO Campaign

## (1-30 March 2006)

### **MILAGRO (Megacity Initiative: Local And Global Research Observations)**

- First international effort to study the impact of a megacity on air quality and climate,
- More than 150 institutions from Mexico, US and Europe collaborated in the project.
- Over 450 investigators and technicians from 30 different nationalities participated in the initial phase of the measurement campaign in Mexico City.

### **MILAGRO is organized under four coordinated simultaneous campaigns:**

**MCMA-2006** (Mexico City Metropolitan Area – 2006) - led by the Molina Center on Energy and the Environment (MCE2) with funding from US and Mexican agencies - to examine emissions within the Mexico City Basin, their dispersal, transport and transformation in the atmosphere, the exposure patterns and effects on human health.

**MAX-Mex** (Megacity Aerosol Experiment – Mexico) - led by DOE Atmospheric Science Program - to examine the evolution of aerosols and gas-aerosols interactions in the immediate urban outflow.

**MIRAGE-Mex** (Megacity Impacts on Regional and Global Environments – Mexico) - led by National Center for Atmospheric Research with funding from NSF - to examine the evolution of the Mexico City plume on larger regional scales.

**INTEX-B** (Intercontinental Chemical Transport Experiment –Phase B) - led by NASA - to study the evolution and transport of pollution on global scales.

More information available at <http://www.mce2.org>

# MILAGRO Campaign: Geographic Coverage



**INTEX-B**  
NASA DC-8  
J-31, Satellites

**MIRAGE-Mex**  
NSF C-130,  
King Air, Supersite

**MAX-Mex**  
DOE G-1,  
KingAir, Supersite

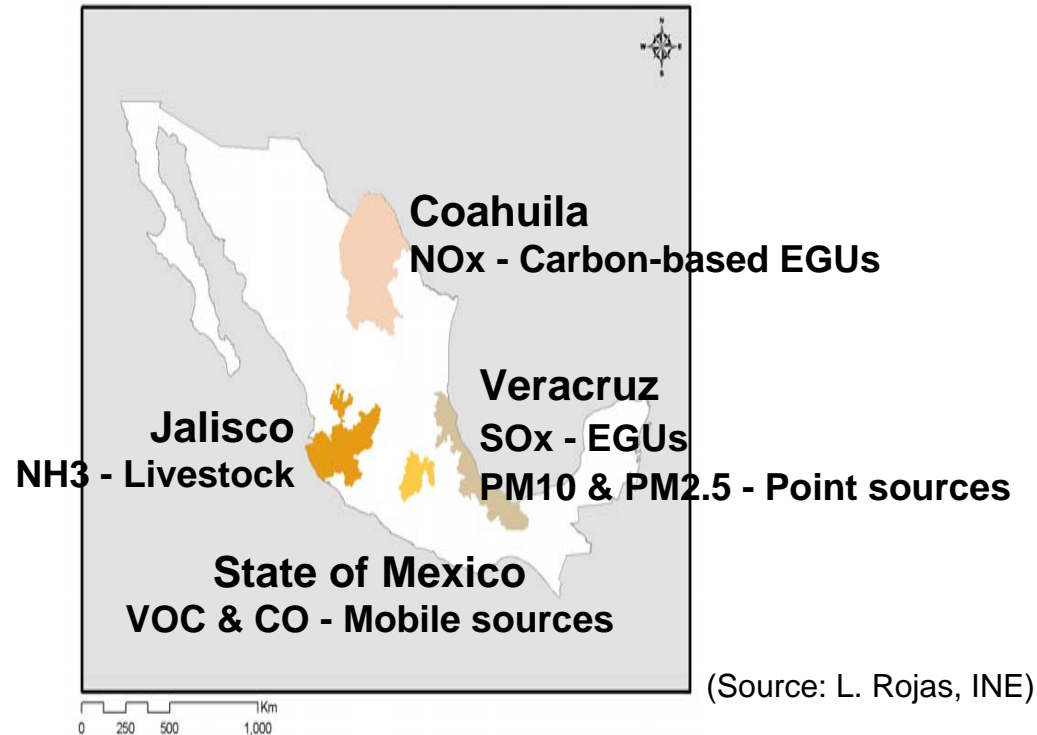
**MCMA-2006**  
Supersites,  
Mobile Laboratories

# First Mexico Release of Toxic Chemicals (August 2006)

- Preliminary data on releases of toxic chemicals from over 1,000 industrial facilities in Mexico
- Collected for 2004 under the new *Registro de Emisiones y Transferencia de Contaminantes* (RETC)
- The RETC is a mandatory reporting system known as a pollutant release and transfer register (PRTR). It is similar to the Toxics Release Inventory in the United States.
- Information available at <http://app1.semarnat.gob.mx/retc/index.php>

# First Mexico National Emissions Inventory (released in September 2006)

- **Base Year** 1999
- **Pollutants** NO<sub>x</sub>, SO<sub>x</sub>, VOC, CO, PM<sub>10</sub>, PM<sub>2.5</sub>, NH<sub>3</sub>
- Group by state, municipality and emission source
- Consistent methodology for the whole country



- English and Spanish reports available

<http://www.ine.gob.mx> and

<http://www.epa.gov/ttn/chief/net/mexico.html>

Spatial distribution

**Note:** Mexico City has its own emissions inventory and is not included in the national report. The 2004 emissions inventory data is available at:

[http://www.sma.df.gob.mx/sma/modules.php?name=Biblioteca&d\\_op=search&query=aire](http://www.sma.df.gob.mx/sma/modules.php?name=Biblioteca&d_op=search&query=aire)