Status of Worldwide Environmental Regulations

20th Annual Mobile Sources
Clean Air Conference
October 7, 2004
Global Trends In Motor Vehicle (Cars, Trucks & Buses) Production

R-square = 0.951  # pts = 53
y = -1.8e+009 + 9.28e+005x
The Global Market For New Motorcycles and Mopeds

Total: 29792139

- Asia: 84.4%
- North America: 3.1%
- Latin America: 3.5%
- Europe: 7.9%
- Middle East: 0.4%
- Oceania: 0.3%
- Africa: 0.4%

Source: Honda Facts & Figures
Global Trends in the Total Vehicle Population (Excluding Motorcycles)

Number (000)

- Oceania
- Other Asia
- Japan
- S & E Asia
- Africa
- C & S America
- N America
- C & E Europe
- W Europe

Year:
- 2000
- 2010
- 2020
- 2030

Vehicle Population (000):
- 0
- 200,000
- 400,000
- 600,000
- 800,000
- 1,000,000
- 1,200,000
- 1,400,000

Decades:
- 2000
- 2010
- 2020
- 2030
Share of worldwide CO2 emissions from the combustion of fuel, by sector

- Production of Energy: 41%
- Transport: 26%
- Manufacturing and Construction: 19%
- Residential: 8%
- Commercial and other: 6%

Source: IEA 2000a.
Recent and Projected World Transportation Fuel Demand

Transportation is the Fastest Growing CO₂ Emissions Source

Source: EIA/DOE (2001)
Light Duty Vehicle NOx Standards (g/km)
Light Duty Vehicle PM Standards (g/km)
Nitrogen oxides (NOx)

Particulate matter (PM)

International Emission Regulations:
- Heavy-duty vehicles (GVW>3.5t)

Low-sulfur diesel needed to meet 2005 regulations
Ultra Low Sulfur Diesel Fuel Is Spreading

PPM

US 2006
EU 2000
EU 2005
Denmark
Sweden Class 1
Germany
Japan 2003
Japan 2004
Hong Kong
South Korea 2006
Taipei, China
Australia 2009
Australia 2006
Thailand 2010

0 50 100 150 200 250 300 350 400 450 500
A view outside the Moscow Ministry of Transport
September 30, 2004
Health Impacts of Air Pollution

Premature Deaths

Cancer

Developmental Effects

Hospitalization

Asthma Attacks and Bronchitis
### Gasoline Car Regulations

<table>
<thead>
<tr>
<th>Standard</th>
<th>Limit (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro I</td>
<td>500 ppm</td>
</tr>
<tr>
<td>Euro II</td>
<td>500 ppm</td>
</tr>
<tr>
<td>Euro III</td>
<td>150 ppm</td>
</tr>
<tr>
<td>Euro IV</td>
<td>50 ppm</td>
</tr>
<tr>
<td>Japan ’00</td>
<td>100 ppm</td>
</tr>
<tr>
<td>Japan ’05</td>
<td>10 ppm</td>
</tr>
<tr>
<td>CA SULEV</td>
<td>30 ppm</td>
</tr>
</tbody>
</table>
Ultra Low Sulfur Diesel Fuel Is Spreading
Developing Countries Which Have Adopted US Or EU Standards For New Vehicles

Population

- Adopted: 65.0%
- Not Adopted: 35.0%

Vehicle Population

- Adopted: 71.0%
- Not Adopted: 29.0%
Europe

European New Vehicle Sales

Europe 32.0%
ROW 68.0%
Euro 5/6 Developments

- Germany, France, Denmark & Sweden Pushing Hard for Traps
- Standards Process Could Be Very Slow
  - DG XI Wants Part of CAFE Process – 2005 Proposals
  - 10 Accession Countries
  - New Constitution
  - New Parliament
  - New Commission
  - Likely 2-3 Years
- There Will Very Likely Be Tight Euro 5/6

- Looking For Incentives Approach in the Interim
  - German Environment Ministry Pushing Tax Incentives
  - Similar push in several other countries e.g., France, Denmark, Netherlands
- UBA Jawboning Effectively
Would You Rather Put A Filter on Your Kid Or Your Car?

Diesel New Car Sales in EU
Euro 5 Scenarios Proposed By Commission For Diesel Cars

% Reduction From Euro 4

<table>
<thead>
<tr>
<th></th>
<th>NOx</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-70%</td>
<td>-90%</td>
</tr>
<tr>
<td>2</td>
<td>-70%</td>
<td>-90%</td>
</tr>
<tr>
<td>3</td>
<td>-66%</td>
<td>-70%</td>
</tr>
<tr>
<td>4</td>
<td>-66%</td>
<td>-70%</td>
</tr>
<tr>
<td>5</td>
<td>-50%</td>
<td>-50%</td>
</tr>
<tr>
<td>6</td>
<td>-50%</td>
<td>-50%</td>
</tr>
<tr>
<td>7</td>
<td>-66%</td>
<td>-66%</td>
</tr>
</tbody>
</table>
European Agreement (g CO$_2$/km)

- Some 120 g/km Cars in 2000
- Target Range of 165-170 g/km in 2003
- Review Feasibility of 120 g/km for Average car by 2012 in 2003

Kyoto Agreement Now Appears Likely
Average specific CO$_2$ emissions:
Relative to 1995 value
US and Canada New Vehicle Sales

- US & Canada: 25.2%
- ROW: 74.8%
US Air Quality: Ozone and PM$_{2.5}$ Present Significant Challenges


- Yellow: Counties Exceeding 8-hour Ozone NAAQS Only
- Orange: Counties Exceeding PM2.5 NAAQS Only
- Red: Counties Exceeding Both NAAQS
- Green: Federal Class I Areas (Visibility)
US EPA’s Triple Crown

- Tier 2 Low Sulfur Gasoline
- 2007/10 HDE ULSD
- 2008/14 Nonroad ULSD
Status of US EPA's Voluntary Diesel Retrofit Program

Total: 129906

- PM Filter, Low Sulfur Fuel: 49.9%
- Engine Mods: 19.3%
- Engine Repower: 0.4%
- Early Retirement: 5.7%
- Biodiesel: 10.2%
- Fuels, Additives, SCR: 3.7%
- Idling Controls: 8.1%
- Catalyst: 2.8%

6/3/2003
New Vehicle Fuel Economy

Improved Rapidly Until mid 1980s But...

CAFÉ Standard

New Cars

Combined

New Trucks

California
Asia Could Surpass Europe by 2010
New Standards For Japanese Vehicles (October 2005)

Will Likely Be A Next Step in 2010
Desulfurizing Fuels in Japan

- 1953: 1.2%
- 1976: 0.5%
- 1992: 0.2%
- 1997: 500 ppm
- 2003: 50 ppm
- 2005-2007: 10 ppm

Diesel Fuel

- Gasoline
  - 100 ppm
  - 50 ppm
  - 10 ppm
  - 2005-2008
Environmental performance target for next-generation EFVs – 2010 Target

<Passenger cars, small trucks>

Fuel-efficiency target
CO₂ emissions per vehicle:
   ➔ Half of the present level
Exhaust emissions target
Exhaust emissions:
   ➔ Nearly Zero

<Heavy-duty Vehicles>

Fuel-efficiency target:
To maintain present level of diesel vehicles
Exhaust emissions target:
NOx: 1/10 of 2005 target
PM: Nearly zero

Japan Development target (2005)
NOx 2.0 (g/kWh) 1/10
PM 0.027 (g/kWh) Nearly zero
China

China New Vehicle Sales

Cars, Trucks & Buses
- China: 9.4%
- ROW: 90.6%

Motorcycles & Scooters
- China: 43.0%
- ROW: 57.0%
Chinese Vehicle Population Has Been Exploding (million)

- **Total Vehicle**: Annual Growth Rate 11.6%
- **Private Vehicle**: Annual Growth Rate 23.0%

Plus Approximately 50 Million Motorcycles And Over 20 Million Agricultural Vehicles
By The End of 2003, China Has Become The 4th Largest Producer In The World
# Control Measures on Motor Vehicle Pollution

## Emission Standards For New Vehicles

<table>
<thead>
<tr>
<th>Category</th>
<th>Before 2000</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>ECE 1503</td>
<td>EURO I</td>
<td>←</td>
<td>←</td>
<td>←</td>
<td>EURO II</td>
<td>←</td>
</tr>
<tr>
<td>LDV&amp;LDT</td>
<td>ECE 1503</td>
<td>←</td>
<td>EURO I</td>
<td>←</td>
<td>←</td>
<td>←</td>
<td>EURO II</td>
</tr>
<tr>
<td>HDDV</td>
<td>None</td>
<td>←</td>
<td>EURO I</td>
<td>←</td>
<td>←</td>
<td>EURO II</td>
<td>←</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>ECE R 40</td>
<td>←</td>
<td>EURO I</td>
<td>←</td>
<td>←</td>
<td>←</td>
<td>EURO II</td>
</tr>
</tbody>
</table>

Beijing, Shanghai already introduced Euro 2 in 2003
What’s In Play in China

- Nationally-SEPA
  - Mobile Sources
    - Developing 11th Five Year Plan Document
    - Will Put Strongest Environmental Case Together For Euro4 Stds & Fuels

- Beijing EPB
  - Pushing For Euro 3 Gasoline, Euro 4 Diesel
  - Cleaner Fuels Adopted For July 1, 2005
  - Interested in Accelerating Euro 4
  - MMT Concern

- Shanghai EPB
  - Also Interested in Leapfrogging to Euro 4
MMT Becoming Major Challenge

- **Canada**
  - Expert Panel Under Royal Society Soon
  - Most Oil Companies Suspending Use

- **EU**
  - Accession Members Forcing Issue
  - Will Likely Set Up Testing Protocol

- **US**
  - Health Studies Underway
  - EPA Being Very Cautious

- **CARB** – Ban in Effect

- **HEI Health Effects Study A Red Flag**
Fuel Consumption Standards – MT Cars

Phase I will be effective in July 2005
Phase II will be effective in July 2008

<table>
<thead>
<tr>
<th>Curb Mass (Kg)</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Existing Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>11</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Fuel Consumption Standards – MT Cars

Phase I will be effective in July 2005
Phase II will be effective in July 2008
For both Phases, the upper dot line is for Manual transmissions and the lower solid line is for Automatic transmissions.
China vs. U.S. — Loose for Light Models But Stringent for Heavy Models (SUVs)

Red Line -- Phase II Minimum (2009)
New Vehicle Standards in India

- **Entire Country**
  - Euro 2 – April 2005
  - Euro 3 – April 2010

- **Major Cities**
  - Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad & Ahmedabad, Pune Surat, Kanpur & Agra Already Euro 2
  - Tighter emission norms for all private vehicles, city public service vehicles and city commercial vehicles
    - Euro 3 From April 2005
    - Euro 4 From April 2010

- Through CSE (and ARAI), pushing to accelerate Time Schedule
India Diesel Fuels Road Map

Current

2005

2010

National

Metros

0
500
1000
1500
2000
2500

India Diesel Fuels Road Map

Current

2005

2010

National

Metros

0
500
1000
1500
2000
2500
Brazil New Vehicle Sales

Brazil
3.4%
ROW
96.6%
Brazil

- **Passenger Cars & Light Commercial Vehicles**
  - Tier 1 Phased in 2005-2007 (40/70/100%)
  - Tier 2 in 2009
  - No Diesel Cars Allowed

- **Heavy Duty Trucks & Buses**
  - Euro 3 Phased in 2004-2006
  - Euro 4 in 2009

- **Fuels**
  - Diesel Fuel S in City from 2000 to 500 in 2005 & to 50 in 2009; in rural areas from 3500 to 2000 in 2005 & to 500 in 2009
  - Gasoline S from 1000 to 400 in 2004 & to 80 in 2008

- A Diesel Strategy Paper That Will Call For Tighter Standards, More Quickly, & Retrofits To Be Released Soon!
Mexico New Vehicle Sales

Mexico
2.0%
ROW
98.0%
Mobile Sources Program In Mexico

Tighten emission limits for new gasoline and diesel vehicles.

- **Gasoline:**
  - Tier I first introduced in 1999 (US-EPA-94).
  - Tier II to be introduced in 2006, under discussion.

- **Diesel:**
  - EPA-98 currently in place.
  - Standards for new diesel vehicles under discussion.

- **Key Issue Is Fuel Quality - Sulfur**

Two Workshops Have Been Held & Major Press Event in June
### Average/Maximum Sulfur content in fuel, parts per million weight

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pemex Premium</td>
<td>500 Máx.</td>
<td></td>
<td>250/300(^{(1)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30/80(^{(2)})</td>
</tr>
<tr>
<td>Pemex Magna MCMA</td>
<td>500 Máx.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30/80(^{(3)})</td>
</tr>
<tr>
<td>Pemex Magna R.C.</td>
<td>1000 Máx.</td>
<td></td>
<td>300/500 (^{(4)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30/80(^{(3)})</td>
</tr>
<tr>
<td>Pemex Diesel</td>
<td>500 Máx.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15 Máx.(^{(3)})</td>
</tr>
</tbody>
</table>

**Notas:**

1. January, 2004
2. January, 2006
3. September, 2008
4. January, 2005
5. January, 2006
Africa

- 50% of Gasoline Now Lead Free
- Most Countries Committed by 2005/6
- Sulfur Discussion Beginning
South Korea

- Vehicle Standards
  - Gasoline Vehicles – ULEV by 2006
  - Diesel Vehicles – Euro 4 by 2006
  - 50% Tighter by 2010

- Fuels
  - Diesel S from 430 to 30 by 2006
  - Gasoline S from 130 to 50 by 2006

- “Clean” Vehicle Incentives – (50-75% Lower)
  - Mandatory For Public Agencies
  - Economic Incentives For Others
Starting January 2004, EU Diesel Car Standards Will Be Deemed Equivalent To Taiwan Light Duty Standards


Gasoline S From 180 to 50 & Diesel S from 350 to 50 From January 1, 2007
What About I/M in Developing Countries?

- Mexico City
- India
- China
- Brazil
Summary and Conclusions

- While technologies are advancing rapidly, no country or region has yet adopted the state of the art requirements for both conventional and greenhouse gases.
- The EU, Japan and perhaps California could be on track for both groups of pollutants by the end of this decade.
- Developing Countries Accelerating Adoption of State of the Art Controls – Low Sulfur Fuels.
- I/M Efforts Underway in Several Countries.
- Sustained Efforts Are Needed To Reduce Conventional & GHG Emissions In Absolute Terms.
- Aircraft and Marine Emissions Are Not Being Adequately Addressed Anywhere and Appear Increasingly Significant.