The Future of Vehicle Emissions Regulation in the EU and Internationally

June 5, 2013

Michael P. Walsh
International Consultant

Founding Chairman
Board of Directors,
International Council on Clean Transportation
Key Points

- Urban, Regional and Global Air Pollution Challenges Remain Daunting
- Vehicles Remain Major Contributor
- EU Standards Have Been Much Less Effective Than Intended – Well Known For Long Time
- Euro 6 Still Not Sufficient – Diesel NOx; GDI PN; No Improvement in Gasoline Cars, Euro 6B?
- Non Road PN
- 400 PPM CO2; Need Real Reductions and Strong 2025 Target
Over 3.2 Million Premature Deaths Worldwide And Over 74 Million Years Of Healthy Lives Lost

The Global Burden of Disease 2010

- Systematic Comparison of Air Pollution and Other Risks Globally and Regionally
- Outdoor Air Pollution analysis by >20 worldwide experts, led by Health Effects Institute and St. Georges, University of London
- Published in the Lancet 15 December 2015 (Lim, et al)
Health effects of fine particles (PM$_{2.5}$)

Breathing fine particles (PM$_{2.5}$) causes adverse effects on the cardiovascular and respiratory systems.

**Ambient** (outdoor) PM$_{2.5}$ exposures linked to:

- Premature death
- Heart attacks
- Strokes
- Hospital and emergency room visits
- Acute and chronic bronchitis
- Asthma-related effects
- PM$_{2.5}$ may also be associated with infant mortality, low birth weight, and cancer


New: June 2012 - WHO Classifies Diesel Engine Exhaust As Group 1 Known Carcinogen
We’ve Come a Long Way!

EU Passenger Car Exhaust Emissions Standards

- NOx Emissions Standards
  - Grams/Kilometer

- PM Emissions Standards
  - Grams/Kilometer

- EU Gasoline NOx
- EU Diesel NOx
- EU Diesel PM

Year:
- 1982
- 1986
- 1990
- 1994
- 1998
- 2002
- 2006
- 2010

Levels:
- 6
- 5
- 4
- 3
- 2
- 1
- 0

- 0.3
- 0.25
- 0.2
- 0.15
- 0.1
- 0.05
- 0
European Union Light-Duty Vehicle Emission Standards

Euro 5+ (2011) and 6 include $6 \times 10^{11}$/km particle number limit
Euro 6 PM mass limit uses revised PMP mass protocol
European Union Heavy-Duty Engine Transient Cycle Emission Standards

Euro III | Euro IV | Euro V | Euro VI
---|---|---|---
Diesel NOx | 5.00 | 3.50 | 2.00 | 0.40
Diesel PM X 100 | 16.0 | 3.0 | 3.0 | 1.0
Diesel NMHC X 10 | 7.8 | 5.5 | 5.5 | 1.6
Diesel CO | 4.0 | 4.0 | 4.0 | 4.0

Euro VI includes particle number limit
Note: Euro VI uses THC rather than NMHC
But Air Quality in Europe Remains Very Polluted

- % Urban Population in EU Exposed to Air Pollution Above WHO Reference Levels (2008-2010)
  - PM2.5: 90-95%
  - PM10: 80-81%
  - O3: Over 97%
  - NO2: 6-12%

Source: EEA Air Quality in Europe 2012
Results Are Alarming

- Air Pollution Causes 350,000 premature Deaths/Year
- Transport Air Pollution Costs €100 billion/Year
- Heavy Goods Vehicles alone Cause € 43-46 billion/Year in Health Damage
Non Compliance with The NOx Emissions Ceiling Remains Serious

- Many Member States Over Ceiling
- Road transport approximately 40% of EU-27 NO$_x$
- Reductions of NO$_x$ from this sector not as large as anticipated partly because real-world emissions higher than anticipated with vehicle emission standards.
This Problem Was Known in 2006 When This Data Was Presented At An EU Workshop

How have specific NOx emissions of diesel passenger cars evolved in the past?
European Union Light-Duty Vehicle Emission Standards

But it was Not Addressed
In Euro 5 and is
Implicitly “allowed” At
The Start of Euro 6

Are Manufacturers Not
Responsible For The
In Use Performance of
Their Cars in Real Driving
Or Only in the
Laboratory?

Euro 5+ (2011) and 6 include $6 \times 10^{11}$/km particle number limit
Euro 6 PM mass limit uses revised PMP mass protocol
What About Trucks?
The problem: High off-cycle NOx emissions in urban applications

In-use PEMS testing of Euro IV and Euro V trucks in The Netherlands found emission well above standard in urban driving in 2008!

Source: Kleinebrahm 2008
We Now Face A New Global Challenge: Climate Change

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base.

Source: Roger Braithwaite, University of Manchester (UK)
GHG Concentrations Are Reaching New Peaks

CO2 Reached 400 PPM in the Last Few Weeks!

Source: WMO GHG Bulletin Number 8
The EU Is To Be Commended For Making Significant Progress Toward Its 20% Reduction Target

- EU-27 total GHG emissions:
  - 14.9% reduction KP base-year/2011 = 635 million tonnes CO2-eq.
  - 4.2% decrease 2010/2011 = 160 million tonnes CO2-eq.

- EU-15 total GHG emissions:
  - (17.0% = 958 mill. tonnes CO2-eq., incl. CO2 from int. aviation)
  - 3.3% decrease 2010/2011 = 155 million tonnes CO2-eq.

EU-15: -8% Kyoto target over the period 2008-2012

EU-27: -20% unilateral target by 2020 (incl. international aviation)
And The Auto Industry Is Contributing Its Share
Or Is It? - ‘Gap’ between type-approval and on-road CO₂ emissions for cars increases

- 25% gap in 2011
- Data for 0.5 million vehicles
- Private and company cars
- All datasets confirm trend

[Graph showing the gap between type-approval and on-road CO₂ emissions over time]

http://www.theicct.org/laboratory-road
Or Is It? Only half the CO₂ reduction achieved on-road compared to type-approval

• 20% CO₂ reduction according to type-approval values (2001-2011)
• On-road most likely only about 10% CO₂ reduction

• Need to introduce new test procedure (WLTP) soon
• Need to introduce additional correction factors
• Need to introduce compliance testing

http://www.theicct.org/laboratory-road
Emerging Standards

• Non Road Vehicles
  • Without a PN Standard will lose Ultrafine and BC Control

• GDI Technology
  • Why should PN be 10x Diesels for next several years when control technology exists now
Fleet Average Emission Standards

150,000-mile New Vehicle Fleet Average Emissions

Model Year

NMOG+NOx (g/mi)

PC, LDT1
LDT2, MDPV

75% Lower

LEV III Particulate Matter Standards

PM Emissions (mg/mi)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions (mg/mi)</td>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Evaporative Emissions

• Extend zero-evaporative emission requirements currently in place for PZEVs to the entire light-duty vehicle fleet by MY 2022

• Extend Onboard Refueling Vapor Recovery (ORVR) requirements to all complete vehicles less than 14,000 pounds GVWR
Conclusions

• In Spite of Great Progress, Air Pollution and Climate Problems Remain at Crisis Levels with Millions of Premature Deaths and CO2 Crossing 400PPM

• Vehicles Have Made Substantial Progress But Much More in the Laboratory than in the Real World

• Manufacturers Should Be Responsible For Real World Performance and Compliance Procedures Must Be Strengthened To Assure This

• NonRoad and GDI PN Standards Needed Quickly

• It Is Premature To Stop – Euro 7/VII and Next (2025) Stage of CO2 Control Should Be Adopted Soon
Thank You