Effects of Diesel Sulfur Content on PM2.5

Source: ICCT Roadmap model 1-K. 2013
Cleaner, More Efficient Vehicles: The Role of Partnerships in Transformational Change
www.unep.org/transport
Partnerships: “Voluntary and collaborative relationships between various parties, both public and nonpublic, in which all participants agree to work together to achieve a common purpose or undertake a specific task and, as mutually agreed, to share risks and responsibilities, resources and benefits.”

Avoid
Shift
Improve

©Elisa Dumitrescu/UNEP
+ Improve

- Fuel quality: 50 ppm or less sulfur in petrol and diesel

- Vehicle emission standards: Euro 4-6/IV – VI

- Transport black carbon, PM$_{2.5}$ reductions

- Doubling Auto Fuel Economy by 2050: “50by50”
Growth in light-duty vehicles
2005 - 2050

90%+ of growth in developing countries

Source: IEA Energy Technology Perspectives, 2012
BAU vs. Stabilization:

fuel consumption, CO2 from cars to double 2000-2050 (IEA)

World LDV CO2 emissions, business as usual vs GFEI, million tonnes (Mt) CO2, GFEI intervention (IEA 2009)
• Heavy-duty trucks and buses currently account 80% + of PM2.5 emissions from on-road vehicles (ICCT 2013)

• 25% of BC from transport, diesel (both on and off-road)
Black Carbon

Methane
\( \text{N}_2\text{O} \)
HFCs

Climate Change

CO2

Air Quality

PM
NOx
VOC
SOx
HC
CO
Metals

Ozone
Main challenges to cleaner fuels and vehicles

- Awareness of policy and technology – demanding good technology
- Prioritization of cleaner fuel and vehicle solutions vis-a-vis other health, environment, economic issues
- Finance and investment in refineries
- Import costs of cleaner fuels
- Fuel subsidies and distortionary vehicle taxation
- Economics of vehicle ownership – measures taxing older carts are unpopular, as are import restrictions on older vehicles
Partnership for Clean Fuels and Vehicles

www.unep.org/pcf

• Founded 2002 as leading global partnership for cleaner fuels and vehicles worldwide, 100+ members from gov’t. industry, NGOs and academia
• Lead-free, low sulfur (50 ppm or less) petrol and diesel, complementary vehicle standards
2002: leaded petrol use

Leaded Petrol Phase-Out: Global Status October 2002

Unleaded
Dual
Leaded
Unknown
2015: leaded petrol use
UNEP’s independent Evaluation Office evaluated PCFV Lead Campaign in Sub-Saharan Africa entitled *Outcome and Influence Evaluation of the UNEP Based Partnership for Clean Fuels and Vehicles*, published in 2010. The evaluation found that, as a very conservative estimate, it would have taken **ten years rather than five** to achieve the elimination of lead from fuel in Sub-Saharan Africa in the absence of PCFV.

A 2010 study by California State University assessed the global benefits of phasing out leaded fuel: **over one million deaths avoided each year** and **over US $2 trillion (or 4% of global GDP)** is saved by eliminating lead from fuel.

Tsai, Peter L. and Thomas H. Hatfield, “Global Benefits from the Phase out of Leaded Fuel” *Journal of Environmental Health*, Volume 74, No. 5 December 2011
Global Diesel Fuel Sulfur Levels
2015

Diesel Fuel Sulphur Levels: Global Status
February 2015

* Information in parts per million (ppm)
For additional details and comments per country, visit www.unep.org/transport/pcfsv/
What makes an effective partnership?

*Design Principles*

- **Develop clear goals**: focus on a few highly ambitious targets and campaigns
- **Neutral Clearing-House/ Secretariat**: trust (and fundraising)
- **Design for buy-in and trust**: Governance Rules, Chatham House Rule, no contribution requirement or onerous membership – *but* partners are expected to contribute (in-kind or financial)
- **Build a strong core membership**: Advisory Group representing sectors

2011 EPA Evaluation of the Partnership for Clean Fuels and Vehicles (PCFV) Lead Campaign: Summary of Findings on Design Principles for Successful Voluntary Global Partnerships
Initial focus is on SLCP’s methane, black carbon, and HFCs. Action on short-lived climate pollutants must complement and supplement, not replace, global action to reduce CO2.

• Raising awareness of SLCP impacts and mitigation strategies
• National and regional action
• Improving scientific understanding of impacts and mitigation

45 Country + 50 non-state partners
Heavy Duty Diesel Initiative

“...substantial reductions of fine particulate matter and black carbon emissions from heavy duty diesel vehicles...through adoption of clean fuel and vehicle regulations and supporting policies.”

Through the adoption of clean vehicle and fuel standards globally reduce 2.7 million metric tons of fine particles, 1.9 million metric tons of black carbon emissions from heavy-duty vehicles = 1.4 million cases of premature mortality by 2030.
HDDI Leads: Canada, U.S., UNEP, ICCT

• **Global fuel sulfur strategy**: financing and sub-regional fuel hubs

• **National programs and policies**: low sulfur diesel, emission standards in
  – **Latin America**: Mexico adopts Euro VI, Peru black carbon reduction strategy, DPF pilots in Montevideo and Lima
  – **Africa**: East Africa adoption of 50 ppm
  – **Asia**: Emissions inventory and clean ports strategy Jakarta

• A **high-level coalition** of industry, country and NGO leaders on Green Freight Call to Action to improve the energy efficiency and environmental performance of freight operations worldwide
2015 - 2016:

- HDV standards to match fuels: East, West, Southern Africa
- Marine vessels (coast, in-land and Arctic)
- Ports of Chittagong, Valparaiso, Aqaba, Tema
- Cities: Soot-Free Urban Buses
Facilitate large reductions of greenhouse gas emissions and oil use through improvements in automotive fuel economy in the face of rapidly growing car use worldwide, as per IPCC and G8 recommendations.

GFEI at G20
Brisbane

Chile announces LDV FE label 2012

www.globalfueleconomy.org
Auto fuel economy improvement plays largest role, particularly through 2030, in cutting transport energy-related CO2 emissions by more than half in 2050 (compared with 2009).

Source: Lewis Fulton, UC Davis & IEA Energy Technology Perspectives 2012
### ‘50by50’ or 8 Lge/100km to 4 Lge/100km

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
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<tbody>
<tr>
<td><strong>New Cars</strong></td>
<td><strong>30%</strong> reduction in L/100km in OECD:</td>
<td><strong>50%</strong> average improvement globally:</td>
<td><strong>50% + (PHEV, EV, FC required)</strong></td>
</tr>
<tr>
<td></td>
<td>**engines, drive trains, weights,</td>
<td><strong>full hybridisation of most models;</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>**aerodynamics; PHEV, EV, FC not</td>
<td><strong>PHEV, EV and FC not required</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>required</strong></td>
<td></td>
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<tr>
<td><strong>All Cars - Global</strong></td>
<td><strong>20%</strong> reductions with lag time for</td>
<td></td>
<td><strong>50by50</strong></td>
</tr>
<tr>
<td></td>
<td><strong>stock turnover</strong>; eco-</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>driving, maintenance</strong></td>
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BAU vs. Stabilization:

fuel consumption, CO2 from cars to double 2000-2050 (IEA)

World LDV CO2 emissions, business as usual vs GFEI, million tonnes (Mt) CO2, GFEI intervention (IEA 2009)

double auto fuel economy by 2050 + flanking measures
<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2008</th>
<th>2011</th>
<th>2013</th>
<th>2030</th>
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<tr>
<td><strong>OECD average</strong></td>
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<tr>
<td>average fuel economy (Lge/100km)</td>
<td>8.6</td>
<td>7.9</td>
<td>7.3</td>
<td>6.9</td>
<td></td>
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<tr>
<td>annual improvement rate (% per year)</td>
<td>-2.7%</td>
<td>-2.6%</td>
<td>-2.6%</td>
<td></td>
<td>-2.6%</td>
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<tr>
<td><strong>Non-OECD average</strong></td>
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</tr>
<tr>
<td>average fuel economy (Lge/100km)</td>
<td>7.3</td>
<td>7.4</td>
<td>7.3</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>annual improvement rate (% per year)</td>
<td>0.5%</td>
<td>-0.4%</td>
<td>-0.9%</td>
<td></td>
<td>-0.2%</td>
</tr>
<tr>
<td><strong>Global average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average fuel economy (Lge/100km)</td>
<td>8.3</td>
<td>7.7</td>
<td>7.3</td>
<td>7.1</td>
<td></td>
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<tr>
<td>annual improvement rate (% per year)</td>
<td>-2.3%</td>
<td>-1.9%</td>
<td>-1.8%</td>
<td></td>
<td>-2.0%</td>
</tr>
</tbody>
</table>

| **GFEI target**         |      |      |      |      |      |
| average fuel economy (Lge/100km) | 8.3  |      |      |      | 4.2  |
| required annual improvement rate (% per year) | 2005 base year | 2005 base year | 2014 base year |      | -2.7% |
|                        |      |      |      |      | -3.1% |

GFEI Approach

1. **Analysis**: Data, modeling, baseline, projections
2. **Options**: feebate, labeling, standard?
3. **National strategy development**, dialogues
4. Awareness, communication

- Financial Support
- Technical Expertise
- Global Network
Global Fuel Economy Policies

(2014)

Global Fuel Economy Initiative (GFEI)
Elisa Dumitrescu
elisa.dumitrescu[at]unep.org
unep.org/transport
globalfueleconomy.org
www.ccacoalition.org/
Fuel and Vehicle Technology

**A Systems Approach:** clean fuels open the door to technology, technology drives fuel quality

**Fuel quality:** 50 ppm or below sulfur in fuels

**Vehicle emission standards:** Euro 4/IV and above
Only 20% of the energy is converted into movement

- Most energy lost as heat

**Engine losses:** 67% to 72%
- thermal such as radiator, exhaust heat, etc. (57% to 62%)
- combustion (3%)
- pumping (4%)
- friction (3%)

**Parasitic losses:** 4% to 6%
- (e.g., water pump, alternator, etc.)

**Power to wheels:** 5% to 21%
- dissipated as:
  - wind resistance (7% to 10%)
  - rolling resistance (4% to 6%)
  - braking (4% to 5%)

IEA 2012