Air pollution study: Victim of bad science and industry folklore
Need answers. Need action…

Centre for Science and Environment

New Delhi
8, February, 2011
Why are we here today?

• First check out these teasers from the oil companies and auto industry.....
A presentation slide from the IOC…….Says LPG is the biggest polluter in Delhi.

**Distribution of source contribution of PM\textsubscript{2.5} as per CMB**

**Res. Delhi: PM\textsubscript{2.5}**
- LPG Combustn: 40.8%
- Kerosene Combustn: 17.4%
- Wood Combustn: 2.0%
- Road Dust: 4.9%
- Transport: 22.4%
- Industries: 2.8%

**Kerb Delhi: PM\textsubscript{2.5}**
- LPG Combustn: 40.5%
- Kerosene Combustn: 14.2%
- Wood Combustn: 2.4%
- Garbage Burning: 14.0%
- Road Dust: 5.4%
- Transport: 7.0%
- DG Set: 9.5%

**Industries Delhi: PM\textsubscript{2.5}**
- LPG Combustn: 61.2%
- Kerosene Combustn: 21.5%
- Wood Combustn: 3.6%
- Road Dust: 6.4%
- DG Set: 1.1%
- Transport: 6.0%
- Industries: 0.3%

**Dominated by domestic sector combustion**

Other sectors are transport, garbage, DG sets
Automobile industry -- SIAM released this a few days ago -- “Diesel: Some Perceptions - Some Realities……”

Perception – Diesel vehicles are polluting

Reality says SIAM-

Diesel Cars Contribute Just 0.1% to PM Emissions in Delhi

SIAM released this on 1st Feb 2011
Another recent study by ICAT-CPCB says CNG is the worst fuel and Euro II and III diesel are the best.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Vehicle Category</th>
<th>Best Fuel</th>
<th>Worst Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two wheeler</td>
<td>BS III Petro +E5</td>
<td>BS III Petrol</td>
</tr>
<tr>
<td>2</td>
<td>Three wheeler</td>
<td>BS II Diesel</td>
<td>BS III Petrol</td>
</tr>
<tr>
<td>3</td>
<td>Four wheeler</td>
<td>BS III Petrol</td>
<td>CNG</td>
</tr>
<tr>
<td>4</td>
<td>Light Commercial Vehicle</td>
<td>BS II Diesel</td>
<td>CNG</td>
</tr>
<tr>
<td>5</td>
<td>Heavy Commercial Vehicle</td>
<td>BS II Diesel</td>
<td>CNG</td>
</tr>
</tbody>
</table>
What are industry and oil companies quoting now and why?

• Both are citing a recently released National Summary Report from the Union Ministry of Environment and Forests based on emissions inventory and source apportionment studies in six cities—Delhi, Mumbai, Kanpur, Chennai, Bangalore and Pune.
What are these studies?

In six cities the following studies have been carried out to assess the contribution of different sources to air pollution……

-- Emission Inventory of PM10, NOx and SO2: This is a bottom-up approach of assessing emission load from major contributing sources in an area. This surveys sources and activities in the area.

-- Source Apportionment of particulates which is a top down approach where ambient particulates have been studied for the presence of specific chemical species or markers to help characterise different pollution sources in a area.

Why are these studies?

The Auto Fuel Policy of 2003 had mandated these studies to decide the 2010 emissions standards roadmap for vehicles and fuels. The government will now use them to decide the post-2010 emissions standards roadmap.

There is a lot at stake

India has implemented Bharat Stage IV norms in 13 cities (5 years behind Europe) and Bharat Stage III in the rest of the country (10 years behind Europe). As of now there is no roadmap for the post 2010 for the automobile industry.

This therefore is not just another study….. This will decide the technology roadmap of our automobile Industry. Industry is cagey…….
• CSE investigates this issue............
Who have conducted these studies in six cities?

<table>
<thead>
<tr>
<th>Cities</th>
<th>Type of studies</th>
<th>Agencies</th>
</tr>
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<tbody>
<tr>
<td>Delhi</td>
<td>Source apportionment, Emissions inventory</td>
<td>NEERI</td>
</tr>
<tr>
<td>Bangalore</td>
<td>Source Apportionment, Emissions inventory</td>
<td>TERI</td>
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<tr>
<td>Pune</td>
<td>Source apportionment, Emissions inventory</td>
<td>ARAI</td>
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<tr>
<td>Mumbai</td>
<td>Source apportionment, Emissions inventory</td>
<td>NEERI</td>
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<tr>
<td>Chennai</td>
<td>Source apportionment, Emissions inventory</td>
<td>IITM</td>
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<td>Kanpur</td>
<td>Source apportionment, Emissions inventory</td>
<td>IITK</td>
</tr>
<tr>
<td>Emissions factors for vehicles</td>
<td></td>
<td>ARAI</td>
</tr>
</tbody>
</table>

Why industry is citing only NEERI study in exclusion of all else?
• Naturally... Except the NEERI study all other studies bring out the problem of vehicles......But how?
What are these studies showing?

Emission Inventory Results on sources of PM10 and NOx in six cities

- The NEERI studies of Delhi and Mumbai show vehicles’ contribution to be the lowest for both PM and NOx.
- Other studies show higher vehicular contribution – particularly to NOx.
But industry says particles are mostly dust..... The same old trick

Environment Ministry says – set up a road dust committee
Is that the priority from public health standpoint?

Figure 4.3: Prominence of Sources of PM$_{10}$
Take out the road dust and consider only combustion sources in the emission inventory results.....

**Vehicles become a significant source of pollution**

If road dust is taken out from the PM10 inventory results – vehicles share increase to 83% in Chennai, 63% in Bangalore and 53% in Pune. Vehicles become the second major contributor in Kanpur and third in Delhi.

Mumbai and Delhi in any case have a very low rank for vehicles in NEERI study.

**Why is industry ignoring this message?**

(Source: CSE analysis of National summary report)
• How could the NEERI study pass the technical scrutiny of the Environment Ministry?
NEERI’s source apportionment study for PM2.5 says ---
Domestic LPG contributes 50% of the PM2.5 in Delhi

The report does not explain the reason or the science.

There is no information on the indicators and the chemical markers they have used to track LPG contribution to PM2.5
NEERI study says LPG combustion contributes 49% of PM2.5 in residential areas, 61% in industrial areas and 40% in traffic areas of Delhi.

If LPG’s contribution to PM2.5 is about 50% in Delhi then how can it be 0% in other cities? Is this possible?

What’s so special about Delhi’s LPG use?
More gaffes! -- If LPG’s contribution to PM2.5 is 50% then how can it be zero in PM10? Unbelievable!

Table 5.5 Percent contribution of various sources at residential, kerbside, industrial locations in all the six cities in respect of PM10 and PM2.5

<table>
<thead>
<tr>
<th></th>
<th>LP G</th>
<th>Garbage</th>
<th>Social</th>
<th>Road Dust</th>
<th>Secondary Aerosol</th>
<th>Construction</th>
<th>Transport</th>
<th>D G</th>
<th>Domestic/wood combustion</th>
<th>Coal</th>
<th>Kerosene</th>
<th>Bakery</th>
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<td>Bengaluru</td>
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<td>49</td>
<td>9</td>
<td>0</td>
<td>19</td>
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<td>22</td>
<td>0</td>
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<td>7</td>
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<td>0</td>
<td>17</td>
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<td>46</td>
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<td>34</td>
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<tr>
<td>Pune</td>
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<td>57</td>
<td>0</td>
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<tr>
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<td>PM 25</td>
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<td>0</td>
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<td>46</td>
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<td>34</td>
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<td>16</td>
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<td>0</td>
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</table>

Source: Anon 2010, Air quality monitoring, emission inventory and source apportionment study for Indian cities, CPCB, p100
What is the secret behind the missing report on Mumbai source apportionment study on PM2.5?

Yet again NEERI study shows high contribution of LPG to PM2.5 in Mumbai.

In residential areas it shows maximum PM2.5 from CNG and LPG—No mention of diesel.

Presented in international conference. But removed from the Summary Report with no explanation. Why?
After thought? Why?

Figure 5.8: Contribution of Sources in PM$_{2.5}$ in Residential Locations
Check out other source apportionment studies in India and Asia. There is no evidence of LPG fouling up ambient air.

**Asia PM 2.5 Source Apportionment: Vehicles ~20% - 35%**

Source: Chowdhury, HEI 2010
Discrepancies in the studies …..

• Monitoring time and seasons are not harmonised across cities making comparisons difficult
• Source profiles used for the studies in six cities are not common
• Chemical markers used for identification of the sources are not consistent across the cities (Eg Figure 3.31 – p 44)
• No information on the indicators and markers used for assessing LPG contribution to PM. Also not clear if they are referring to LPG burning in engine or stoves
• There is no information on the emissions sources and rates of emissions for locations studied in cities in the summary
• No explanation on how PM from diesel DG sets have been differentiated from diesel vehicles, or construction dust from fugitive dust and road dust etc etc etc……

But there is still a lot of evidences from the individual studies in six cities that can drive strong action
All is not lost….
The six cities have still given us enough clinching evidences to prove that vehicles need strong and urgent action….

Some examples....

- **Contribution of vehicles to pollution load is significantly high**: Vehicles are a dominant contributor of NOx – in most cities it varies between 45 per cent to upto 94 percent.

- **Scary when particles from only combustion sources are considered**: Share of vehicles increase dramatically.

- **The report states** “......PM2.5 has much higher component of toxic elemental carbon and organic carbon that mostly come from combustion sources like vehicles and others....” (Page 196)

- **Chemical markers indicate importance of vehicles**: Says study “...the presence of hopanes and steranes (chemical markers) at all the sites in much higher quantities compared to background location indicates that effect of vehicles is prevalent at all the sites of Delhi.” (Page 43) etc

- **The study acknowledges the health problem associated with particles**— “PM2.5 is of specific concern because it contains a high proportion of toxins, and ... penetrate deeper into the lungs. ...greater emphasis is to be given on reduction of PM2.5 and toxic constitutes of particulates”. (P 197). Etc etc....
The report also acknowledges:

“It is important to note that though in some cases a source indicates high load within the city boundary, … as in the case of power plants …, the exposure impacts due to this source could be lower.” (Page 64)

In Mumbai -- “The model results are dominated by few industrial sources, however, they are located in a very limited area of the city.” (Page 118)

Illustratively an example of a typical polluted day in Delhi
(Source: Sim Air)
• **Clearly industry does not like this…… Why?**

  – In the near term -- it is time for budget. Public outcry is shrill this year about the misuse of subsidised diesel for luxury consumption in cars and SUVs. Even the Environment Minister has condemned this as “criminal”….. Demand for disincentive for diesel cars growing stronger.....

  – In the medium term – The government has to finalise the post-2010 emissions standards roadmap. This study is expected to set the terms of action for the industry. ....

• **What must be done?**
The European diesel standards becomes comparable with the global best standards only at Euro 6 stage.

Need Auto Fuel Policy
Roadmap to reduce and eliminate the time lag with the best European norms.
Check dieselisation of car segment
Diesel’s increased market share is a reality and health effects are not ‘perceptions’

Number of cars (by fuel type) in different weight categories

---

Lower taxes and distorted small car definition will further skew dieselisation—

Small petrol car is legally defined as one with length not exceeding 4,000 mm and with an engine capacity not exceeding 1,200 cc.

For diesel small car this has been relaxed to 1,500 cc for diesel cars.

Source: CSE
Diesel: Objections
License to pollute more...
More toxic emissions....

<table>
<thead>
<tr>
<th>Toxic Air Contaminant</th>
<th>Unit Risk/Million People</th>
<th>Detection limit (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>2.7</td>
<td>0.10</td>
</tr>
<tr>
<td>Benzene</td>
<td>29</td>
<td>0.05</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>170</td>
<td>0.04</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>42</td>
<td>0.02</td>
</tr>
<tr>
<td>Chromium, Hexavalent</td>
<td>150,000</td>
<td>0.06 (in nanogram)</td>
</tr>
<tr>
<td>Para-Dichlorobenzene</td>
<td>11</td>
<td>0.30</td>
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<tr>
<td>Formaldehyde</td>
<td>6</td>
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<tr>
<td>Methylene Chloride</td>
<td>1</td>
<td>0.10</td>
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<tr>
<td>Perchloroethylene</td>
<td>5.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Diesel particulate matter</td>
<td>300</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Unit Risk represents the number of excess cancer cases per million people per microgramme per cubic meter TAC concentration over a 70 year lifetime exposure.

A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the "Risk Reduction Plan to reduce Particulate Matter Emissions from Diesel Fuelled Engines an vehicles (ARB, October 2000)"

Source: California Air Resource Board

NOx norms for cars

PM norms for cars

Toxic Air contaminant (Unit Risk Factors)
Ironic: Rich use diesel subsidy to spew toxic emissions
But regulations do not force diesel to meet the clean benchmark

Emissions vs efficiency remains unresolved……..

Source ARAI
It is possible to clean up diesel and meet the clean benchmark….But we do not have a roadmap

• **Cleaner fuels** are necessary for the introduction of cleaner, more efficient vehicles with functioning emission control devices

  - When sulfur content falls below certain levels, emissions control devices can be used
  - 500ppm permits the use of oxidation catalysts, which can achieve up to a 30% reduction in emissions of particulate matter
  - Sulfur levels no greater than 50ppm permit a reduction of up to 75% of particulate matter
  - And around 10 to 15ppm permit reductions of particulate matter up to 95%

Source: ICCT
Indian style socialism
Subsidy for rich car owners to pollute more

• Gross misuse of diesel subsidy has already made the cars the second biggest beneficiaries of the official tax policy after trucks. Cars use up 15 percent of diesel in the country where as buses and agriculture 12 percent each, industry 10 percent, railways 6 percent, power generation 8 percent. (Kirit Parikh Report)

• The on-road small diesel car fleet is misleading. The rate of increase is more worrying. Diesel cars are already 36% of the new car sales will be half soon.

• This budget will have to put fiscal brake on increased use of diesel in cars and prevent the shift towards bigger cars and SUVs. Cheap fuel creates incentive for bigger cars….Market is already shifting towards big and diesel..

• The estimates from the India assessment of the International Council on Clean Transportation show that these trends can lead to a cumulative loss of 6.5 mtoe of energy between 2010 and 2020. This equals fuel use of all four wheeled passenger vehicles in 2006 that was around 6.6 mtoe. This defeats the energy security objective.

• Auto industry’s claim of greater fuel efficiency and lesser carbon emissions from diesel cars is unacceptable as diesel fuel has higher carbon content than petrol. If more cheap diesel is burnt more heat trapping CO2 will escape.

• At the same time the black carbon emissions from diesel cars can trap several times more heat and cause warming.
Remove incentive for dieselisation

- Freeing of petrol prices and controls on diesel prices further adds to subsidy.
- **Since 2008 petrol price in Delhi has increased by Rs 12.75 but diesel price by only Rs 4.89 a litre. The price gap has increased from 28 percent in 2008 to 35 percent now.**
- The under-recovery -- the revenue that the oil companies are losing on diesel today, stands at Rs. 7-9 per litre.
- Price of fuel is higher for two-wheeler driver than diesel SUV
- If only diesel sold in Delhi is considered then the total loss in revenue from central excise and retail is estimated to be close to Rs 300 crore. This can compound to a massive amount on a nation-wide basis.
- Who will bear the economic and health burden?

<table>
<thead>
<tr>
<th></th>
<th>Delhi</th>
<th>Mumbai</th>
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<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2011</td>
</tr>
<tr>
<td>Petrol price (Rs/litre)</td>
<td>45.62</td>
<td>58.37</td>
</tr>
<tr>
<td>Diesel price (Rs/litre)</td>
<td>32.86</td>
<td>37.75</td>
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<tr>
<td>Diesel prices lower than petrol prices</td>
<td>1.4 times</td>
<td>1.5 times</td>
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</table>
Lifetime emission cost of Euro IV diesel is higher than petrol cars: Example from Europe

Some benefit in CO2 but completely lost in NOx and PM...in fact the total emission costs is higher for a diesel car than a petrol car.

Source: 2009, European Commission, Directorate General Energy and Transport
Other governments are taking active fiscal measures

• Fiscal measures to discourage conventional diesel.
  – In Brazil diesel cars are actively discouraged because of the policy to keep taxes lower on diesel.
  – In Denmark, diesel cars are taxed higher to offset the lower prices of diesel fuel.
  – In China, taxes do not differentiate between petrol and diesel.
  – European Commission has calculated the difference in lifetime pollution costs of Euro IV compliant diesel car and petrol car. The total pollution cost of a Euro IV diesel car is 1195 Euros vis a vis 846 Euros for a petrol car. This nullifies the marginal greenhouse gas reduction benefit of diesel car and costs higher to the society.
Vehicular emissions contribute to significant human exposure. Pollution concentration in our breathe is 3-4 times higher than the ambient air concentration.

In densely-populated cities more than 50 – 60% of the population lives or works near roadside where levels are much higher.

In three cities World Bank review found vehicles contributing an average 50% of the direct PM emissions and 70% of PM exposure.

Some of the deadliest air toxics, also carcinogens, are related to vehicular emissions. Blamed even for killing foetus.

Central Road research Institute survey in 2007 shows traffic volume has exceeded the designed capacity of 51 arterial roads in Delhi. This increases roadside exposure -- majority of people live within 50 m, 500 m to 1500 m from roads.
We now have evidence for Delhi
New Study shows very high exposure to vehicular pollution in Delhi

The Traffic Impact Area in Delhi:
New HEI Analysis: 55% of the Population within 500 meters of a Freeway; 50 meters of a Major Road

Given the large number of people living within 300-500 meters of a major road, the Panel concluded that exposures to primary traffic generated pollutants are likely to be of public health concern and deserve attention.

Source HEI
What about our health?

Polluted air kills: Evidences mounting in Delhi

National Chittaranjan Cancer Research Institute/CPCB: 33% of Delhiites have one or more respiratory symptoms; lung function impaired in 40% of residents.

Centre for Atmospheric Sciences, Delhi IIT: Increase in respiratory ailments and hospital admissions due to PM, ozone and NO2 pollution.

Dr Rajendra Prasad Centre for Ophthalmic sciences, Venu Eye Institute: Significantly high incidence of eye symptoms and disorders in areas with high pollution levels.

AIIMS study of 2002: Strong correlation between high pollution levels and hospital visits related to cardio respiratory events,

Vallabhbhai Patel Chest Institute found high respiratory symptoms in high pollution areas. Now studying the ozone link..

Pattern of PM10 distribution in Delhi (2000-05)

Source: Epidemiological Study On Effect Of Air Pollution On Human Health (Adults) In Delhi, CPCB
The most recent evidence in Delhi.
It is our health that must matter

• The new Health Effect Institute estimates are scary for Delhi
  – It estimates approximately 0.15% to 0.17%
    *increase in mortality per 10 μg/m3 PM10* (~0.3%/20 μg/m3).
  – In Delhi where overall deaths are 100,000 annually even this increase can translate into 3000 additional premature deaths annually due to air pollution related diseases..... (HEI 2010)

Our health is not negotiable
Solutions have emerged from the six city study. Act on them. Build on them.

- The weight of the evidences from six cities have helped to get some robust recommendations from the ministry of environment and forests.........Focus and build on them and not the industry folklore....
- The six city study has recommended control strategies for the 2015-17 timeframe: Expedite this with greater stringency and urgency
  - Progressive incremental introduction of BS IV from 2010 onwards
  - Progressive incremental introduction of BS V/VI from 2015 onwards
  - Electric vehicle to be 2 per cent of the city fleet
  - Hybrid to be 2 per cent of the fleet
  - All commercial three and four wheelers should be on CNG/LPG
  - 75% of solid fuel and kerosene should be shifted to LPG/NG
  - 20 per cent shift in vehicle miles traveled to public transport

The forthcoming Union Budget must introduce additional excise tax on diesel cars and SUVs to neutralise the fuel cost advantage.
  Rationalise the definition of small cars to remove the lenient definition of small diesel cars

Need more robust and credible technical process for scientific studies for policy action
Need real, hard and effective solutions....

Not ‘Auto Fool Policy’