

# Transport Sector: Improved Fuel Quality- Indian Perspective and Future Strategies



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# Growth of road transport sector

India had about 115 million registered motor vehicles at the end of fiscal year 2008-09.

Personalized mode (constituting mainly two wheelers and passenger cars) accounted for more than four-fifth of the motor vehicle population in the country compared to their share of little over three-fifth in 1951 :increased 60 to 80%

Result of rapid economic growth (an average growth rate of more than 7% in the decade since 1997), population growth, expansion of metropolitan areas increasing dependence on motor vehicles because of change in land use

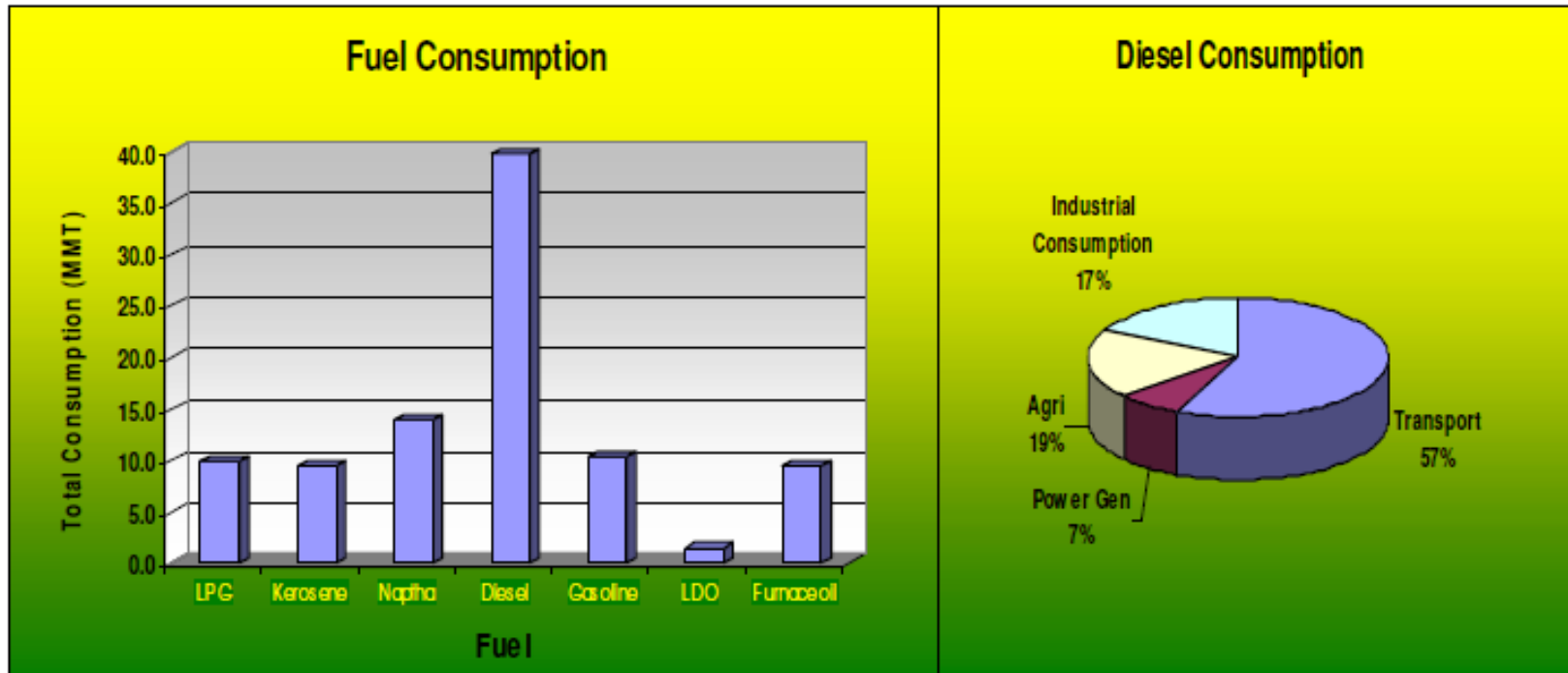
Sales of motor vehicles in India have nearly tripled between 2001 and 2010.

# Forecast

Automobile segments	2011-12 growth over 2010-11 (per cent)
Passenger cars	16-18%
Utility vehicles	12-14%
LCV (goods)	18-21%
MHCV (goods)	10-12%
Commercial vehicles (buses)	8-10%
Motorcycles	11-13%
Scooters	15-17%
Three wheelers (Cargo)	4-6%
Three wheelers (passengers)	10-12%
Automobile Industry	12-15%

During the fiscal year 2010-11 the sales of new vehicles rose by 26%, compared to the previous year and double-digit sales growth is expected across the board in 2011-2012

# Sectoral consumption of hydrocarbon fuels



In the transport sector ~98.5% of the energy consumption is met by petroleum products

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# Transport Sector-Indian Current Scenario

## **Main issues of concern for increased energy consumption are:**

- Rapid increase in travel demand
  - Increased use of personalised transport
  - Vehicular technology
  - Fuel quality
  - Fuel Adulteration
  - Road quality
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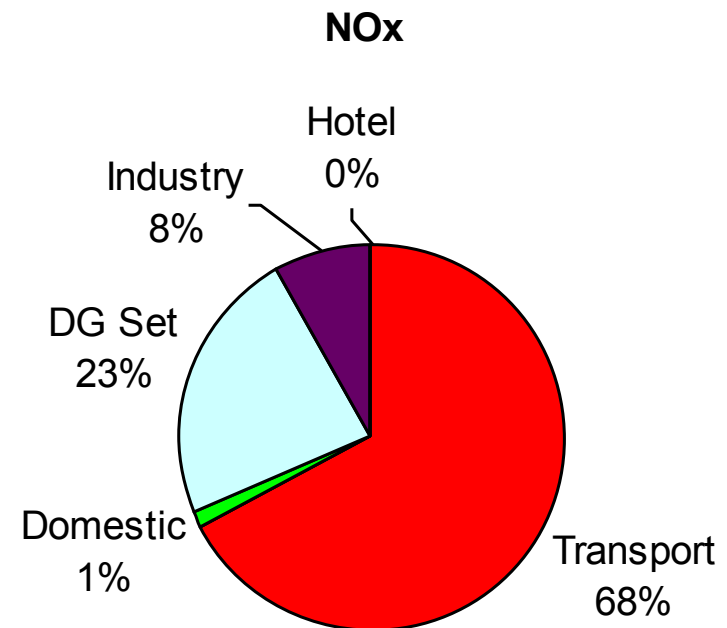
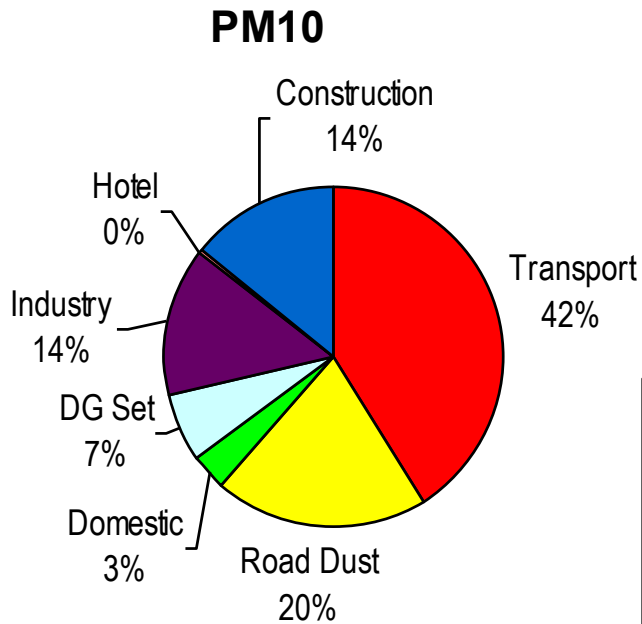
# Vehicular pollution

Pollutants	Sources	Effects
Nitrogen oxides (NO <sub>x</sub> )	Combustion processes (heating, power generation, and vehicles)	Bronchitis in asthmatic children. Reduced lung function growth
Particulate Matter (PM <sub>2.5</sub> , PM <sub>10</sub> )	Major sources are vehicles, industrial sources, domestic fuel burning, road dust re-suspension, construction activities	Cardiovascular and respiratory diseases, lung cancer, acute lower respiratory infections, chronic obstructive pulmonary disease.
Carbon monoxide (CO)	Incomplete fuel combustion (as in motor vehicles)	Reduces the oxygen carrying capacity of blood, causes headaches, nausea, dizziness. Can lead to death at high levels
Sulphur dioxide (SO <sub>2</sub> )	Burning of sulfur-containing fossil fuels for domestic heating, power generation and motor vehicles.	Affects respiratory system and lung functioning. Coughing, mucus secretion, aggravation of asthma and chronic bronchitis. SO <sub>2</sub> with water forms sulfuric acid and causes acid rain.
Benzene	Combustion and distribution of petrol.	Exposure over a long time can lead to cancer
1, 3 Butadiene	Petrol and diesel combustion Production of rubber for tires.	Exposure over a long time can lead to cancer.
Ozone	formed by the reaction of NO <sub>x</sub> and volatile organic compounds (VOCs) in presence of sunlight (photochemical reaction)	Breathing problems, can trigger asthma, reduce lung function and cause lung diseases. Ozone is one of the most damaging pollutants for plants.
VOC's (volatile organic carbons)	Some cleansers, disinfectants, waxes, glues, cosmetics, dry cleaning products, paints, varnishes, gasoline, kerosene and other fuel also contains VOCs.	Irritation to eyes, nose and throat, headache, nausea, nerve problem and exposure over a long period of time can increase the risk of getting cancer.

## Actions taken.....

- Revised AAQ standards: Introduction of PM<sub>2.5</sub> and others (O<sub>3</sub>, Benzene, Benzo (a) Pyrene-BaP). Standards for particulate matter (PM<sub>10</sub>) and carbon monoxide (CO) are now uniformly applied, and more stringent limits for lead, SO<sub>2</sub>, and NO<sub>2</sub> are set for residential areas
- Need for improvements across sectors include **Transport-**
- Indian clean air program (ICAP) has demonstrated, vehicular emissions continue to be one of the main sources of urban air pollution in India
- Also, Source apportionment studies conducted recently in 6 Indian cities have revealed that transport is a major source of emissions in some cities
- Euro 4 equivalent standards have been introduced in 13 major cities, no date has so far been set for introducing these standards all over the country
- Continued growth in vehicle population will negate the gains of the past decade in the absence of further policy action

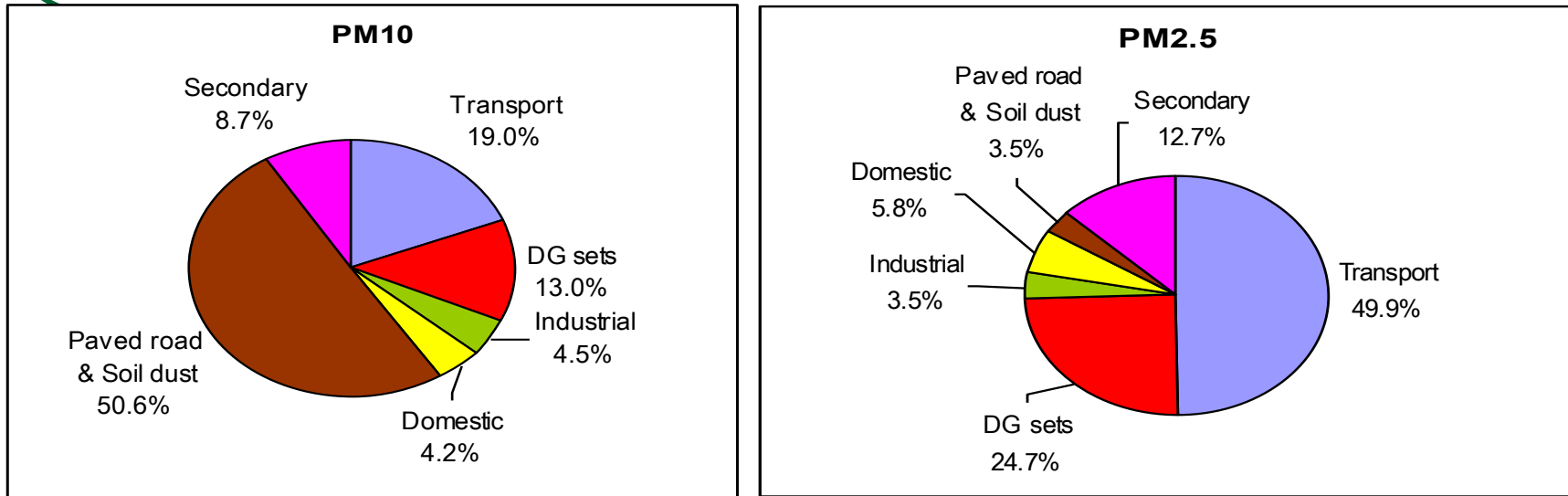
# Contribution of sources in PM<sub>10</sub> and NO<sub>x</sub>



Percentage share of different sources in total PM<sub>10</sub> and Nox emission loads



# Quantification of sources in PM



PM<sub>10</sub> and PM<sub>2.5</sub> source contribution in Bangalore

The contribution of diesel and gasoline-fueled vehicles varies widely within cities and between cities. –

Estimates of the contribution of motor-vehicle exhaust to PM<sub>2.5</sub> range from 6% in Beijing, to 53% in Barcelona.

Estimates of the contribution of motor-vehicle exhaust to PM<sub>10</sub> range from 4% in northern Chinese cities to 48% in Madrid, Spain

**Differences in the models and quality and extent of the input data also affected these results. (HEI 2010)**

# Health impacts of emission

- Recent studies by Pope et al. (2002), Scoggins et al. (2004), the review by Pope & Dockery (2006) and G. Fisher et al. (2007), it can be concluded that annual non-external mortality increase could be in the range 4–8% for each 10  $\mu\text{g}/\text{m}^3$ , in the age group above age 30
- An evaluation of traffic-related air pollution by the Health Effects Institute (HEI) concluded that there is sufficient evidence that exposure to traffic can cause exacerbation of asthma, especially in children, and suggestive evidence for other health effects such as premature mortality, lung function, and respiratory symptoms (HEI 2010)

Concerns about the health effects of motor-vehicle combustion emissions led to the introduction of regulations and innovative pollution-control approaches: resulted in a considerable reduction of exhaust emissions, particularly in developed countries and few developing countries as well e.g., India

# Road map for controlling vehicular pollution from New vehicles (all vehicle except 2/3 wheelers)

<b>Norms</b>	<b>Cities of Implementation</b>	<b>Effective date</b>
<b>1991 emission norms</b>	<b>Throughout the country</b>	<b>1.4.1991/92</b>
<b>1996 emission norms</b>	<b>Throughout the country</b>	<b>1.4.1996</b>
<b>Cat converter norms ( for passenger cars)</b>	<b>45 cities</b>	<b>1.10.1998</b>
<b>India stage 2000 norms</b>	<b>Throughout the country</b>	<b>1.4.2000</b>
<b>Bharat stage-II norms</b>	<b>11 cities Throughout the country</b>	<b>2000-2003 1.4.2005</b>
<b>Bharat stage-III norms</b>	<b>11 cities Throughout the country</b>	<b>1.4.2005 1.4.2010</b>
<b>Bharat stage-IV norms</b>	<b>11 cities* Throughout the country</b>	<b>1.4.2010 ?????</b>

\*13 cities

This roadmap on vehicular emission standards and fuel quality has been largely implemented. Starting year 2010, Bharat IV standards have been implemented in 13 major cities, while Bharat III standards are in effect in the rest of the country.

# Road map for controlling vehicular pollution from New 2/3 wheelers

Norms	Cities of implementation	Effective date
1991 emission norms	Throughout the country	1.4.1991
1996 emission norms	Throughout the country	1.4.1996
India stage 2000 norms	Throughout the country	1.4.2000
Bharat stage-II norms	Throughout the country	1.4.2005
Bharat stage-III norms	Throughout the country	1.4.2008/10

From the point of view of vehicle emission standards and fuel quality,

A time lag between the European and Indian schedules;

2/3-W in India and the European Union is currently three years

4-wheelers and heavy-duty vehicles the time gap varies, with **major metropolitan** areas in India about **five years** behind the latest Euro standards and the **rest of the country** almost a **decade back**

Therefore, harmonizing emissions standards nationwide and moving to standards that use the best available emission control technologies would enable India to catch up to advanced countries and yield significant environmental and public health benefits.

# Fuel Quality Specifications for Diesel

<b>For meeting norms</b>	<b>Sulphur content</b>	<b>Cetane number</b>	<b>Density</b>
<b>1991 norms</b>	<b>1.0</b>	<b>42</b>	<b>-</b>
<b>1996 norms</b>	<b>0.50</b>	<b>45</b>	<b>820-880</b>
<b>India stage 2000 norms</b>	<b>0.25</b>	<b>48</b>	<b>820-860</b>
<b>Bharat Stage-II norms</b>	<b>0.05</b>	<b>48</b>	<b>820-860</b>
<b>Bharat stage-III norms</b>	<b>0.035</b>	<b>51</b>	<b>820-845</b>
<b>Bharat stage-IV norms</b>	<b>0.005</b>	<b>51</b>	<b>820-845</b>

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# Refinery capacity

- India is not only self-sufficient in refining capacity for its domestic consumption but also exports petroleum products substantially.
  - As of April 2010 there were a total of 20 refineries in India comprising 17 in the public sector and 3 in the private sector. The total officially reported refining capacity stands at 184.4 million metric tonnes per annum (MMTPA), with a utilization capacity close to 100%, while the consumption of petroleum is 140 MMTPA, of which 56 MMTPA is diesel and 13 MMTPA is gasoline (MoPNG, 2010)
  - India's refiners are expected to achieve 256 million tons per year crude processing capacity by 2012 due to about 6% per year expansion over the next two years.
  - Refineries in India are currently refining fuels at sulfur levels corresponding to Euro III and Euro IV specifications, i.e., at 350 ppm and 50 ppm respectively for diesel and 150 ppm and 50 ppm respectively for gasoline.
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# Policy intervention and impact

- Daily ambient air quality data from June 1999 to September 2003 from the busiest crossing in Delhi do not indicate an all-round improvement in ambient quality. The NO<sub>x</sub> has risen after the conversion whereas SPM and PM<sub>10</sub> have shown only marginal fall; CO has shown a significant decline.
- The assertion that the conversion to CNG reduces the particulates levels has not been established.
- Article, however, shows that after every significant policy event the pollution levels do fall but not in a sustained manner (e.g. relates to SO<sub>2</sub> and NO<sub>2</sub>). One of the reasons for this transitory impact could be that more than 200,000 vehicles join the existing fleet **annually**.

Converting bus fleet to CNG did not solve all the problems because (i) even though retrofitted CNG buses had lower PM emissions (less than PM<sub>2.5</sub>??), they did not have a very good NO<sub>x</sub> performance. (ii) Any conversion to CNG has largely been offset by increases in (a) total number of vehicles, and (b) fraction of diesel vehicles (iii) there is no silver bullet, and simply converting bus and auto fleet to CNG is not adequate since there are still more issues to deal with in terms of cars and commercial vehicles

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# Key Issues -Future Strategies

## Status of Fuel Policy

- Europe Road Map
- India situation (Euro IV no date for whole India)
- Need to set a date for Euro IV or advance to Euro V/VI

## Vehicles

- Preparedness of India (Euro IV/V/VI) –should not limited to few models

## Fuel

- Refinery preparedness
- Time frame/investments
- Fiscal regimes model

## Way forward

- Govt. of India set ULSD fuel= one fuel quality, one emission standard: ONE country
  - CNG where infrastructure is available or planned
  - Refineries to make the necessary arrangements for fulfillment the demand of ULSD, if not possible need to import??
  - Auto sectors plans accordingly??
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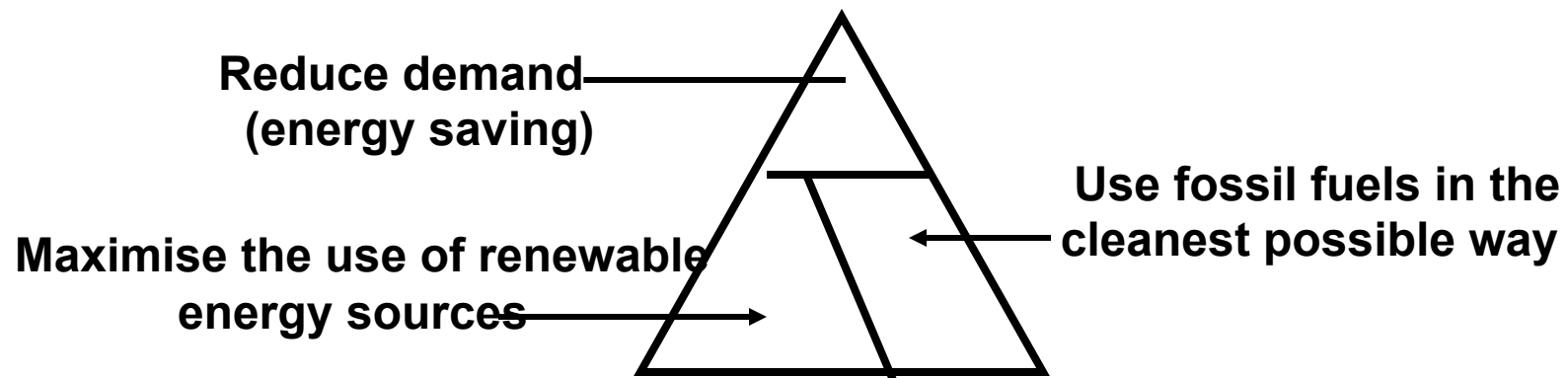
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## contd.. Key Issues -Future Strategies

- Therefore, the next phase of the auto fuel policy or similar institutional framework in India will have to decide a roadmap for implementation of Bharat IV in entire country or Bharat V/VI standards similar to those implemented in Europe and elsewhere in the world
  - It is imperative for the policymakers to start stakeholder consultations and formulate a plan to draw up the next phase of Auto Fuel Policy in India and establishment of an auto-oil forum
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# Three-way approach to clean environment



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Thank you

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