Environment & In-use Vehicles

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Sr. Deputy Director
The Automotive Research Association of India
Contents of the presentation

- Air Quality
- Motor Vehicle Emission Control in India
- New Vehicle Emission Norms
- Emission Control From In-use vehicles
- In use vehicle testing roadmap for India
- Summary
The Air Quality Improvement Challenge

- Air Pollution has serious effects
  - health
  - economic well-being
  - visibility
- But controlling air pollution can be a challenge
  - economic growth can appear to conflict with improved air quality
  - change can raise fears in communities, companies
- What will drive smart air quality change?
Contribution to the Clean Air

In-use vehicle emission Control
Oil Companies
Judiciary
Traffic Management/Policies
Vehicle Manufacturers
Land Use Planning

Air Quality Management
Government Departments
Vehicle Users
NGOs
Clean Vehicle Technology
Clean Fuels
Alternative Fuels/Drivetrains
Other Sources
Regulating Air Pollution: One-Atmosphere Approach

Mobile Sources
- NOx, VOC, Toxics
  (Cars, trucks, airplanes, boats, etc.)

Industrial Sources
- NOx, VOC, SOx, Toxics
  (Power plants, factories, refineries/chemical plants, etc.)

Area Sources
- NOx, VOC, Toxics
  (Homes, small business, farming equipment, etc.)

Chemistry
- Ozone
- PM
- Acid Rain
- Visibility
- Air Toxics

Meteorology
- Atmospheric Deposition

(AIRAI - Progress through Research)
Emission Control Reduction Requires a Systems Approach

- Advanced Engine Designs
- Advanced Emission Controls
- High Quality Fuel and Lubricants

New cars

In-use cars

Low (er) Emissions

- Retrofits
- I & M
- High Quality Fuel and Lubricants

Low (er) Emissions
Motor Vehicle Emission Control in India
Emission Control Program in India
On- and Off-Road Applications

- **New Vehicles**
  - Ensure appropriate emission control technologies through vehicle design – Type Approval.
  - Compliance at production level quality – Conformity of Production (COP)

- **In-use vehicles emission control.**
  - On road checks (PUC)
  - Retrofitment – CNG / LPG
  - Inspection & Certification
New Vehicle Emission Norms
Vehicle Emission Road Map In India

- **Emission norms for catalytic vehicles**
  - **1st set norms notified**
    - 1990
  - **2nd set norms notified**
    - 1996
  - **1995**

- **Euro-I equivalent (Country)**
  - **Euro-II eqv. For cars (4 metros)**
  - **1995**

- **Sulphur 2500ppm**
  - Delhi & Taj
  - April 1998

- **Entire Country**
  - April 2000

- **Sulphur 500ppm**
  - 11 cities
  - April 2005

- **Euro-II (Country)**
  - **Euro-III (11 cities)**
  - 2000/01

- **2005**

- **August 1997**

- **April 1998**

- **Sulphur 2500ppm**
  - Delhi & Taj

- **Sulphur 500ppm**
  - Metro cities

- **April 2000-04**

- **Sulphur 500ppm**
  - 11 cities

- **April 2005**

- **Sulphur 50ppm (11 cities)**

- **April 2010**

- **Sulphur 50ppm (11 cities) & 350ppm (11 cities)**

- **Entire Country**

- **April 96**

- **April 1996**

- **Sulphur 2500ppm**
  - 4 metros & Taj

- **April-2000**

- **April-2010**

- **Sulphur 500ppm**
  - Entire Country & 350ppm (11 cities)

Diesel Sulphur Reduction Programme
# Emission Norms - 2W/ 3W

## Category of Vehicles and Exhaust Emissions

<table>
<thead>
<tr>
<th></th>
<th>BS-I Emission Norms (effective from year 2000)</th>
<th>BS-II Emission Norms (effective from year 2005)</th>
<th>BS-III Emission Norms (effective from year 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two-Wheelers (Petrol)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>HC+Nox</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Three wheelers (petrol)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>4.0</td>
<td>2.25</td>
<td>1.25</td>
</tr>
<tr>
<td>HC+Nox</td>
<td>2.0</td>
<td>2.0</td>
<td>1.25</td>
</tr>
<tr>
<td><strong>Two and Three Wheelers (Diesel)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>2.72</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>HC+Nox</td>
<td>0.97</td>
<td>0.85</td>
<td>0.5</td>
</tr>
<tr>
<td>PM</td>
<td>0.14</td>
<td>0.1</td>
<td>0.05</td>
</tr>
</tbody>
</table>

## Deterioration Factor (DF)

<table>
<thead>
<tr>
<th>Deterioration Factor (DF)</th>
<th>Petrol 2W</th>
<th>Petrol 3W</th>
<th>Diesel 2W/3W</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>1.2</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>HC+Nox</td>
<td>1.2</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>PM</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Note:** The values for CO, HC+Nox, PM, and the Deterioration Factor (DF) are in terms of grams per kilometer.
<table>
<thead>
<tr>
<th>Engine Category</th>
<th>Deterioration Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>HC</td>
</tr>
<tr>
<td>Spark Ignition BS-II</td>
<td>1.2</td>
</tr>
<tr>
<td>Spark Ignition BS-III</td>
<td>1.2</td>
</tr>
<tr>
<td>Compression Ignition</td>
<td>1.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BS I Norms</th>
<th>Cold Start</th>
<th>(Limits in g/km) w.e.f. 1st Apr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Pass. Cars</td>
<td>CO</td>
<td>2.72</td>
</tr>
<tr>
<td>Pass. Cars</td>
<td>4 Wheeler (Gasoline)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BS II Norms</th>
<th>Cold Start</th>
<th>(Limits in g/km) w.e.f. 1st Apr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 2500 kg / 6 Seats</td>
<td>RM Kg</td>
<td>CO</td>
</tr>
<tr>
<td>Upto 1250 kg</td>
<td>2.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Above 2500 kg, Below 3500 kg, &amp; Above 6 Seats</td>
<td>1250 - 1700</td>
<td>4.0</td>
</tr>
<tr>
<td>Above 1700 kg</td>
<td>5.0</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BS III Norms</th>
<th>Cold Start</th>
<th>(Limits in g/km) w.e.f. 1st Apr 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 2500 kg / 6 Seats</td>
<td>RM Kg</td>
<td>CO</td>
</tr>
<tr>
<td>Upto 1305 kg</td>
<td>2.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Above 2500 kg, Below 3500 kg, &amp; Above 6 Seats</td>
<td>1305&lt;RM&lt;=1760</td>
<td>4.17</td>
</tr>
<tr>
<td>Above 1760 kg</td>
<td>5.22</td>
<td>0.29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BS IV Norms</th>
<th>Cold Start</th>
<th>(Limits in g/km) w.e.f. 1st Apr 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 2500 kg / 6 Seats</td>
<td>RM Kg</td>
<td>CO</td>
</tr>
<tr>
<td>Upto 1305 kg</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Above 2500 kg, Below 3500 kg, &amp; Above 6 Seats</td>
<td>1305&lt;RM&lt;=1760</td>
<td>1.81</td>
</tr>
<tr>
<td>Above 1760 kg</td>
<td>2.27</td>
<td>0.16</td>
</tr>
</tbody>
</table>
## Emission Regulations – Pass. Cars-Diesel

### 4 Wheeler (Diesel)

#### BS I Norms

<table>
<thead>
<tr>
<th>Engine Category</th>
<th>Deterioration Factors</th>
<th>BS I Norms (Limits in g/km) w.e.f. 1st Apr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO</td>
<td>HC+NOx</td>
</tr>
<tr>
<td>Upto 1250</td>
<td>2.72</td>
<td>0.97</td>
</tr>
<tr>
<td>1251 – 1700</td>
<td>5.17</td>
<td>1.40</td>
</tr>
<tr>
<td>Above 1700</td>
<td>6.90</td>
<td>1.70</td>
</tr>
</tbody>
</table>

#### BS II Norms

<table>
<thead>
<tr>
<th>Engine Category</th>
<th>Deterioration Factors</th>
<th>BS II Norms (Limits in g/km) w.e.f. 1st Apr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO</td>
<td>HC+NOx</td>
</tr>
<tr>
<td>2500/ 6 seat</td>
<td>1.00</td>
<td>0.70</td>
</tr>
<tr>
<td>Upto 1250</td>
<td>1.25</td>
<td>1.00</td>
</tr>
<tr>
<td>1251 – 1700</td>
<td>1.50</td>
<td>1.20</td>
</tr>
</tbody>
</table>

#### BS III Norms

<table>
<thead>
<tr>
<th>Engine Category</th>
<th>Deterioration Factors</th>
<th>BS III Norms (Limits in g/km) w.e.f. 1st Apr 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO</td>
<td>NOX</td>
</tr>
<tr>
<td>Upto 2500 kg / 6 Seats</td>
<td>0.64</td>
<td>0.5</td>
</tr>
<tr>
<td>&gt;2500 kg, &lt;3500 kg, &amp; Above 6 Seats</td>
<td>0.8</td>
<td>0.65</td>
</tr>
<tr>
<td>1305&lt;RM&lt;=1760</td>
<td>0.95</td>
<td>0.78</td>
</tr>
<tr>
<td>Above 1760</td>
<td>0.95</td>
<td>0.78</td>
</tr>
</tbody>
</table>

#### BS IV Norms

<table>
<thead>
<tr>
<th>Engine Category</th>
<th>Deterioration Factors</th>
<th>BS IV Norms (Limits in g/km) w.e.f. 1st Apr 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO</td>
<td>NOX</td>
</tr>
<tr>
<td>Upto 2500 kg / 6 Seats</td>
<td>0.5</td>
<td>0.25</td>
</tr>
<tr>
<td>Above 2500 kg, Below 3500 kg, &amp; Above 6 Seats</td>
<td>0.63</td>
<td>0.33</td>
</tr>
<tr>
<td>1305&lt;RM&lt;=1760</td>
<td>0.74</td>
<td>0.39</td>
</tr>
<tr>
<td>Above 1760</td>
<td>0.74</td>
<td>0.39</td>
</tr>
</tbody>
</table>
## Emission Norms for HCV Engines

<table>
<thead>
<tr>
<th>Category of Vehicles and Exhaust Emissions</th>
<th>BS-I Emission Norms (g/kWh) 2000-01 (11 cities) (DF=1.0)</th>
<th>BS-II Emission Norms (g/kWh) 2003 (11 cities) (DF=1.0)</th>
<th>BS-III Emission Norms (g/kWh) 2005 (11 cities) (DF=1.0)</th>
<th>BS-IV Emission Norms (g/kWh) 2010 (For DF please refer table below)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(13-mode cycle)</td>
<td>(13-mode cycle)</td>
<td>(13 mode ESC cycle)</td>
<td>(13 mode ESC cycle)</td>
</tr>
<tr>
<td>CO</td>
<td>4.5</td>
<td>4.0</td>
<td>2.1</td>
<td>1.5</td>
</tr>
<tr>
<td>NMHC</td>
<td>--</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HC</td>
<td>1.1</td>
<td>1.1</td>
<td>0.66</td>
<td>0.46</td>
</tr>
<tr>
<td>NOx</td>
<td>8.0</td>
<td>7.0</td>
<td>5.0</td>
<td>3.5</td>
</tr>
<tr>
<td>PM</td>
<td>0.36</td>
<td>0.15</td>
<td>0.10/0.13</td>
<td>0.02</td>
</tr>
<tr>
<td>ELR Smoke (1/m)</td>
<td>--</td>
<td>--</td>
<td>0.8</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Engine Category

<table>
<thead>
<tr>
<th>Test Cycle</th>
<th>Deterioration Factors (only for BS-IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO</td>
</tr>
<tr>
<td>Diesel</td>
<td>ESC 1.1</td>
</tr>
<tr>
<td></td>
<td>ETC 1.1</td>
</tr>
<tr>
<td>CNG/LPG/Gaseous Fuel Engine</td>
<td>ETC 1.1</td>
</tr>
</tbody>
</table>
How Fuel contributes to the Air Pollution?

- **Use of gasoline contributes to:**
  - HC+NOx = Ozone formation
  - PM10 & PM2.5, NOx, SO2, CO
  - Toxic Pollutants (Benzene, 1,3-butadiene, others)

- **Use of diesel contributes to:**
  - PM10& PM2.5, NOx, SO2, HC, CO
  - Toxic Pollutants (PM, Benzene, PAHs, others)
Different Automotive Fuels

Blending

Different Crude Oils and Refineries

ÖL

Gasoline

Formulation ?

~200 types of HC + Additives

Oxygenates
Olefins
Paraff./Napht.
Aromatics

+ Air

Different Combustion

~300 types of HC + Additives

Diesel

Formulation ?

Olefins
Aromatics
Naphtens
Paraffins

Different Exhaust Constituents

Different Automotive Fuels

+ Additives

~300 types of HC

* Source: www.awma.org/ACE2002/Forum/Topic3/walsh.ppt
Emission Control From In-use vehicles
Why In use Vehicle Emissions are high ???

Higher in use vehicle emissions are due to:

- Poor Maintenance
- Deliberate tampering of fuel system in a attempt (usually futile) to improve performance or fuel economy
- Poor vehicle durability
- Use of spurious vehicle / engine components
- No vehicle scrap mechanism
- Higher lube oil addition than specified
- Fuel Adulteration
Why In use Vehicle Emissions are high ???
Contd…

- Large proportion of old vehicles are still in use
- Studies in US show that approx. 10% of vehicles are responsible for over 50% of CO and HC emissions from warm running vehicles
- The higher in use vehicle emissions will offset the emission benefits derived by the introduction of new stringent emission standards
ARAI Study on In use Vehicle emissions

- Benefits due to Proper Maintenance

% Improvement

<table>
<thead>
<tr>
<th>4 W</th>
<th>3 W</th>
<th>2 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>29</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

CO | HC | FC

CO: Carbon Monoxide
HC: Hydrocarbons
FC: Fine Carbon
ARAI Study on In use vehicle emissions - Conclusions derived

- There is definite improvement in mass emission due to maintenance
- Fuel consumption improvement is a complimentary benefit
- Higher in-use vehicle emissions are mainly contributed due to improper tuning of carburetor and spark plug settings
- Even older vehicles if properly maintained produce lower emissions
- New technology vehicles if not maintained properly could give higher emissions
Effect of Traffic Speed on Emissions

Source: JARI
In-Use Vehicle Testing

- Generally for Exhaust emission performance
  - Idle Emission measurement on Gasoline / CNG / LPG vehicles
  - Free acceleration smoke test for diesel vehicles
- Different countries follow different test methodologies
- The different systems adopted are
  - Low idle, High idle, SS, ASM, IM240
- Remote sensing for on-road testing
- The system is selected based on
  - Local pollution problem
  - Type of pollutant and optimum cost
I & M Program

– *A tool to reduce In use vehicle emissions*

- Different countries follow different I and M Programs.
- The different programs adopted are:
  - No load short test
    - Idle / High idle
  - Steady State Loaded Test
    - ASM 5015, ASM 2525
  - Loaded Transient Test
    - IM 240
- Recent developments
  - VMAS and Remote sensing for on-road testing
- The program is selected based on the local pollution problem, severity as well as the type of pollutant and optimum cost.
## Worldwide In Use Vehicle Evaluation

<table>
<thead>
<tr>
<th>Region</th>
<th>Checks</th>
</tr>
</thead>
</table>
| Asia   | • Idle check for Petrol Vehicles  
          • Free Acceleration Smoke (Smoke) for Diesel vehicles |
| Europe | • Idle check for old vehicles  
          • High Idle check for new cat fitted closed loop vehicles  
          • FAS for Diesel |
| USA    | • 12-15 states use Idle or 2 speed idle (idle + high idle) check  
          • 8 states use ASM (New Jersey, Pennsylvania, Washington etc)  
          • 12 states use IM 240 (Arizona, Colorado, Washington DC, NY)  
          • Idle test being used for old vehicles  
          • CA, NY, Washington DC.. All use mass measurement techniques  
          • Additional checks : For Evaporative emissions, OBD II  
          • Road side Checks / Physical presence of components |
In use vehicle Testing

- The in use vehicle testing should be at a centralized high throughput test centers only
- Perform emission and safety in I&M Centres
- Network the I&M Centers with the motor vehicle registration authorities for effective implementation
- Identify high polluting vehicles by
  - Remote sensing device
  - Past test data
- Subject the High polluting vehicles to loaded test at centralized, vehicle inspection and certification lanes
- Separate the Repair / Maintenance and certification
- Increase the Public awareness through campaigns
Retrofitment Technologies

- Addition of new/improved Exhaust after-treatment devices
- Conversion of any engine to run on a cleaner fuel like CNG/LPG/Bio diesel
- Upgrade the engine with new technology engine
- Early replacement of older engines with newer/cleaner engines
- Combination of above
In use vehicle testing roadmap for India
Existing Inspection system

Motor vehicles

- Transport vehicles
  - Fitness certificate
    - New Vehicles: 2 years
    - Old vehicles: 1 year

- Private vehicles
  - Re-registration after 15 years
  - No fitness certificate required

PUC checking
Existing Institutional structure

Central Government
- Enacting Law
- Setting standards
- Policy guidelines

State Government
- Administering law
- Creating necessary infrastructure

R.T.O
- Granting fitness certificate
- Enforcement
Issues to be addressed

- Coverage and contents
- Phasing of regime
- Frequency of tests
- Institutional structure
- Test Centers: Numbers and Location
- Auditing and enforcement
- Financing and management
- Legislative and administrative issues
Coverage and contents

- Coverage & contents based on desired results
  - All categories can be polluting
  - All criteria pollutants: CO, HC, NOX (?)
  - Safety is equally important

- Proposed scope
  - All modes / vehicles
  - Emissions: All pollutants
  - Safety: Roadworthiness tests

- Need for uniform national approach
Proposed tests

- **Visual safety tests**
  - Steering
  - Chassis
  - Fuel tank & piping
  - Engine mountings
  - Battery terminals etc
  - Seatbelts
  - Lighting
  - Oil leakages
  - Leaf springs…

- **Automated safety tests**
  - Headlamp beam
  - Brakes
  - Sideslip

- **Emissions**
  - Volumetric concentration for gasoline
  - Opacity for diesel
Phasing of regime

- Need for phasing
  - Resource and capability constraints

- Selection of cities
  - Based on air quality, not just size
  - Where transport emissions are a concern

- Modes and vehicles
  - Utilization: Commercial Vehicles
  - Vintage: Old personal vehicles
<table>
<thead>
<tr>
<th>Cities to be covered in Phase I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi / NCR</td>
</tr>
<tr>
<td>Kolkata</td>
</tr>
<tr>
<td>Bangalore</td>
</tr>
<tr>
<td>Ahmedabad</td>
</tr>
<tr>
<td>Pune</td>
</tr>
<tr>
<td>Kanpur</td>
</tr>
</tbody>
</table>
**Frequency of tests**

- Implications of frequency
  - Costs
  - Convenience

- Basis
  - Utilization: Higher for commercial vehicles
  - Vintage: Higher for older vehicles

### Proposed frequency

<table>
<thead>
<tr>
<th>Vehicle Types</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;3 years</td>
</tr>
<tr>
<td>Private vehicles</td>
<td>NA</td>
</tr>
<tr>
<td>Commercial vehicles</td>
<td>Annually</td>
</tr>
<tr>
<td>Motorcycles &amp; scooters</td>
<td>NA</td>
</tr>
</tbody>
</table>
Test Centers: Numbers and Location

- Depends on:
  - No of vehicles
  - Frequency of tests
  - Duration of tests

- Based on:
  - Demand
  - Convenience

- Institutional responsibility: State Governments
Financing and management

- Cost of a center depends on
  - Land and building cost, No of testing lanes, Equipment cost, Manpower cost, Operating cost

- Factors affecting capacity
  - No of testing lanes
  - Time taken for testing each category
  - Working hours
  - Availability of skilled manpower
Mode of Public Sector Participation

- **Role of the private sector**
  - Operator of inspection centers
  - Preferably independent from automobile and oil industry

- **Tendering process**
  - Draft tender documents
  - Invite technical and financial bids
  - Selection of bidder
    - Technical competence
    - License fee based on a pre-determined inspection charges
  - Award contract

- **Differential fee structure**
Institutional structure

- Union Government: Legislative framework, policy
- National Technical Committee
  - Development of effective test procedure
  - Design of inspection centers
  - Development of documentation on test procedures and audit principles
  - Training and capacity building
- State Government: Implementation
- Vehicle Inspectorate
  - Independent agency, outside of the department
- Audit teams
  - False certificates
  - Equipment
  - Procedure & protocols
  - Qualifications of personnel
- Penalty system
  - Award penalty points for each violation
  - Cancel permit after points add up to a limit
Supporting Measures

- Maintenance program
  - Set up vehicle repair centers
  - Component replacement schedule
  - Check essential components for BIS standards
  - Guidelines to owners on maintaining vehicles road-worthy

- Training and capacity building

- Consumer awareness campaigns
Supporting measures

- Stringent enforcement of In use vehicle safety and emission standards is required
- Networking of the in use vehicle testing centres with the motor vehicle registration authorities for effective implementation
- Identify high polluting and unsafe vehicles by
  - Remote sensing device
  - Past test data
- Subject the High polluting vehicles tests at centralized, vehicle inspection and certification lanes
Supporting measures

- Have a centralized, high throughput test only centers
- Separate the Repair / Maintenance and certification
- Increase the Public awareness through campaigns
- Active Participation by All Interested Parties Will Be A Key Element in a Successful Program
Control Strategies to reduce Emissions from In-Use vehicles

- Implementation of stricter norms
- Introduction of Oxygenated fuel blends:
  - Ethanol
  - Bio Diesel
  - Hydrogen –CNG
- Retro fitment of DOC and DPF for public transport Vehicles
- Stricter I &M practices for all categories of vehicles throughout India
Control Strategies to reduce Emissions from In-Use Vehicles

- Phasing out of older vehicles
- Better Public Transportation system
- Traffic Management:
  - Synchronization of traffic signals.
  - Ear-marking/Availability of parking lots and enforcement for smooth traffic flow.
  - Construction of fly-overs for vehicles, subways/escalators for pedestrians.
  - Efficient Mass transport system.
  - Discourage use of private vehicles within city limits
  - By-pass of heavy vehicles from city traffic areas.
Way Forward

- Integrated Air quality management system
  - Effective I & M regime
  - Policy framework:
    - Infrastructure for roads, parking and mass transportation system
    - Phasing out of older vehicles
    - Monitoring of Air Quality Monitoring on continuous basis in all major cities
  - Dissemination of information in a public domain
  - Cost benefit analysis
  - Health effect study
  - Infrastructure, availability of CNG/LPG/HCNG/H2-FCV/Hybrid vehicles
THANK YOU