4.1 Introduction

The air quality in many of the Indian cities has been declining. In fact, the air quality in some of the cities has reached a critical level. The reason for this has primarily been the increase in vehicular population. The Government, too, on its part turned a blind eye to this problem until recently. In this chapter, we discuss the vehicular pollution control measures taken by the Centre and the State, their drawbacks and finally the experiences of other countries.

This chapter is divided into four sections. Section 4.2 discusses the measures taken by the Government so far to control the problem of vehicular pollution. This section also discusses the measures specifically taken with respect to the State and a critical analysis of the measures taken by the Government. Section 4.3 discusses the measures taken in other developed and developing countries. Section 4.4 concludes.

4.2. Vehicular Pollution Control in India

The legislation and the regulations in our country relating to pollution are based on command and control policy. The Government of India formulated a comprehensive policy for abatement of pollution in 1991. The policy aims at:

- Prevention of pollution at source.
- Encourage development and application of the best available practicable technologies.
- Focus on the “critical” or the heavily polluted areas.

In the policy statement of 1992, the Government paid specific attention to transport related pollution and the highlights were:
- Control of pollution from automobiles.
- Encourage use of the public transport system.
- Encourage the use of bicycles for short distances.
- Development of rapid mass transit system.
- Discourage the plying of vehicles in heavily polluted areas.
- Earmarking of natural gas for the transport sector.

Apart from this, the Government has enacted a number of legislation for control of pollution. They include Environment (Protection) Act, 1986, Motor Vehicles Act (as amended in 1988 and 1994), Air (Prevention and control of Pollution) Act, 1981 (as amended in 1987).

The Government has also formulated a National Program for Control of Vehicular Pollution, which involves the following components:

- Vehicle manufacturers.
- Oil Industry.
- User level.
- Suitable legislation and regulatory mechanism.
- Fiscal Incentives.

Let us look at these components in detail.

1. Vehicle manufacturers
   - Emission control regulations suitable for India need to be formulated and enforced in a phased manner.
   - Phased upgradation of technologies needs to be undertaken.
   - R&D laboratories need to be set-up for the testing and certification of new vehicles.
2. Fiscal measures such as exemption/reduction in import duties, incentives on cleaner vehicle can be stipulated.

2. Oil industry

- Fuel quality to be specified and adhered to. This is because fuel quality is a very important parameter for meeting certain emission norms, as the present state of the art technologies can work only if good quality fuels are used.
- A phased program of fuel reformulation to be prepared in consonance with the automobile Industry.
- Fuel adulteration, which can seriously hamper the performance of the engines and of tailpipe devices vigorous control such as catalytic converters and other exhaust treatment devices, requires rigorous control.
- Incentives on cleaner fuels, promotion of alternative fuels like methanol, ethanol etc. are some of the other measures.

3. User level (in-use emission reduction)

- Formulate and implement a comprehensive inspection and maintenance (I & M) program tailored to the different categories of vehicles.
- I & M program to be supported by enforcement and initiatives.
- Awareness campaign on maintenance measures, health effects of vehicular pollution and punitive measures for violations of pollution check at the in-use stage.
- Other measures such as restriction of movement of vehicles, plying of ecofriendly vehicles in congested areas etc.

Let us discuss about the **Inspection and Maintenance** Programme.

Inspection and Maintenance programme is meant to reduce pollution by requiring regular inspection and maintenance of motor vehicles already plying on roads. It identifies
those in-use vehicles that need maintenance and repair because they pollute more than the new vehicles. The program helps in reducing air pollution. I&M program is widely used in other countries and it has been able to reduce about 30-40% of pollution loads. Such facilities for thorough inspection and maintenance of vehicles are required in different parts of the country.

4.2.1 Inspection and maintenance in India

Commercial vehicles and public transport vehicles are checked once a year. However, the Fitness Certification for non-commercial vehicles is required for renewal of registration, but only after 15 years from the date of first registration.

As regards Pollution checking, PUC needs to be obtained once in every 3 months. However, the fitness checks are very basic as per the current rules and are restricted to brakes, rusting of body, light and horns.

Let us now discuss some of the measures already implemented by the Government.

Formulation of the national emission control standard was set up in India in 1985 when the Ministry of Environment and Forests set up an Expert Committee in the Central Pollution Control Board. In order to focus specifically on the increasing trend of vehicular pollution in the major metropolitan cities in India, tightened national vehicular standards have been notified in early February 1998 for vehicles fitted with catalytic converters in the four metros (Delhi, Bombay, Calcutta and Madras), all state capitals and all Union Territories as well. These standards are stricter by 50% over national standards for petrol driven vehicles fitted with catalytic converters.

The progressive tightening of national standards for emission is depicted in the Table 4.1
TABLE 4.1: PROGRESSIVE TIGHTENING OF EMISSION STANDARDS

<table>
<thead>
<tr>
<th>Type of Vehicle and Pollutants</th>
<th>April 1991</th>
<th>April 1996</th>
<th>April 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Petrol: 2-wheelers (g/km)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>15-35</td>
<td>4.5</td>
<td>2.4</td>
</tr>
<tr>
<td>HC</td>
<td>10-12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO+HC</td>
<td>-</td>
<td>3.6</td>
<td>2.4</td>
</tr>
<tr>
<td><em>Petrol: 3-wheelers (g/km)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>40</td>
<td>6.8</td>
<td>4.8</td>
</tr>
<tr>
<td>HC</td>
<td>15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO+HC</td>
<td>-</td>
<td>3.4</td>
<td>2.4</td>
</tr>
<tr>
<td><em>Petrol: Cars (g/km)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>14.3-27.1</td>
<td>8.68-12.4</td>
<td>3.16</td>
</tr>
<tr>
<td>HC</td>
<td>2.0-2.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO+HC</td>
<td></td>
<td>3-4.36</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Source: CPCB (1997) Parivseh Newsletter

From the above table, there is a progressive tightening of emission standards for the vehicles. As for petrol vehicles, the government has also progressively tightened the emission norms for diesel vehicles. The emission norms for diesel vehicles are based on the weight of the vehicles and are different for light duty diesel vehicles and heavy-duty diesel vehicles.

The Government is also implementing a major program for improvement of automotive fuels in India in a phased manner to harmonise with the introduction of tighter emission norms. The program for introduction of low-leaded petrol and unleaded petrol is summarised in Table 4.2

TABLE 4.2: PROGRAM FOR INTRODUCTION OF LOW-LEAD AND UNLEADED PETROL IN INDIA

<table>
<thead>
<tr>
<th>Type of Fuel/City</th>
<th>Date of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-lead petrol/ Delhi, Bombay, Calcutta, Madras</td>
<td>June, 1994</td>
</tr>
<tr>
<td>Low-lead petrol/ In the entire country</td>
<td>December, 1996</td>
</tr>
<tr>
<td>Unleaded petrol/ Delhi, Bombay, Calcutta, Madras</td>
<td>April, 1995</td>
</tr>
</tbody>
</table>

A similar program at the National level for the introduction of low-sulphur diesel has been launched and is summarized in Table 4.3.

**TABLE 4.3: PROGRAM FOR INTRODUCTION OF LOW SULPHUR DIESEL IN INDIA**

<table>
<thead>
<tr>
<th>Type of Fuel/City</th>
<th>Date of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>.5% Sulphur diesel/ Delhi, Bombay, Calcutta, Madras</td>
<td>April, 1996</td>
</tr>
<tr>
<td>.25% Sulphur diesel/ Taj Trapezium</td>
<td>September, 1996</td>
</tr>
<tr>
<td>.25% Sulphur diesel/ In the entire country</td>
<td>April, 1999</td>
</tr>
</tbody>
</table>

*Source: Ministry of Petroleum and Natural Gas (1997) Annual Report*

The Ministry of Environment and Forests of India is in the process of notifying the standards for two stroke engine oils of the low smoke quality. Simultaneously, they are also involved in a time bound program for the supply of premixed petrol engine oil in all the major cities of India for the use of 2 stroke engines.

The Government has also taken up the use of compressed natural gas (CNG), an ecofriendly fuel, for the use of petrol driven vehicles. By fixing a CNG kit, gasoline vehicles can be converted to CNG Vehicles. Inadequate supply of CNG has affected its acceptance among consumers. Supply of CNG on a large scale implies large expenditures. Owing to the gaseous nature of CNG and being a non-renewable source, doubts have been raised regarding its worth in terms of the expenditure involved in procuring adequate supplies of the same. However, the Ministry of Environment and Forests is preparing an action plan for conversion of all 3-wheelers plying in Delhi to use CNG. In addition, replacement of old buses with new ones (which have CNG engines) is also planned. The use of other alternative fuels like Liquefied Petroleum Gas (LPG) is also under consideration of the Government of India.
Emission norms for all categories of petrol and diesel vehicles at the manufacturing stage have been introduced. The mass emission standards for the vehicle manufacturers came into force in April 1991. These were further revised for enforcement in 1996 and subsequently in the year 2000. It is contended that the targets set for 1996 are so low that over 60% of the vehicles in India are already within these standards and that these standards will not provide sufficient inducement for improvement in technology, more so in view of the fact that 10 to 20 percent relaxation in standards is allowed during the conformity of production costs. This necessitates the need to lay down appropriate norms keeping in view the problem.

4.2.2 Vehicular Pollution Control Measures in Tamil Nadu

In this section, we discuss the measures taken by the Government of Tamil Nadu in order to control the problem of pollution from vehicles. The major measures taken by the Government of Tamil Nadu with respect to vehicular pollution control are: a) Emission check and pollution under check certificates; b) Phasing out of leaded Gasoline; c) LPG as an alternative fuel. These are discussed below.

a) Emission check and pollution under control certificates

The Tamil Nadu government passed a resolution in 1994, which requires all motor vehicles to comply with the laid emission standards. It is mandatory for every motor vehicle to obtain a certificate of pollution under control. The validity of this certificate has been reduced from 6 months to 3 months. Only a sub-inspector of police, inspector of transport or gas stations authorized by the transport department are empowered to carry out these checks. The table below gives the monthwise report of vehicles checked from May 1997 to September 1999 by the Automobile Association of Southern India centres.
### TABLE 4.4: MONTH WISE REPORT OF VEHICLES CHECKED FROM MAY 1997 TO SEPTEMBER 1999

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of Two-Wheelers Checked</th>
<th>Number of Four Wheelers Checked</th>
<th>Number of Vehicles that Exceeded Limit</th>
<th>Total Vehicles Checked</th>
</tr>
</thead>
<tbody>
<tr>
<td>May’97</td>
<td>315</td>
<td>207</td>
<td>17</td>
<td>522</td>
</tr>
<tr>
<td>June’97</td>
<td>126</td>
<td>88</td>
<td>25</td>
<td>214</td>
</tr>
<tr>
<td>July’97</td>
<td>96</td>
<td>9</td>
<td>55</td>
<td>187</td>
</tr>
<tr>
<td>August’97</td>
<td>27</td>
<td>35</td>
<td>13</td>
<td>62</td>
</tr>
<tr>
<td>September’97</td>
<td>204</td>
<td>158</td>
<td>36</td>
<td>362</td>
</tr>
<tr>
<td>October’97</td>
<td>2041</td>
<td>545</td>
<td>89</td>
<td>2586</td>
</tr>
<tr>
<td>November’97</td>
<td>3006</td>
<td>729</td>
<td>145</td>
<td>3735</td>
</tr>
<tr>
<td>December’97</td>
<td>4630</td>
<td>1145</td>
<td>507</td>
<td>5775</td>
</tr>
<tr>
<td>January’98</td>
<td>140</td>
<td>56</td>
<td>19</td>
<td>196</td>
</tr>
<tr>
<td>February’98</td>
<td>90</td>
<td>29</td>
<td>8</td>
<td>119</td>
</tr>
<tr>
<td>March’98</td>
<td>239</td>
<td>74</td>
<td>15</td>
<td>313</td>
</tr>
<tr>
<td>April’98</td>
<td>145</td>
<td>85</td>
<td>8</td>
<td>230</td>
</tr>
<tr>
<td>May’98</td>
<td>146</td>
<td>77</td>
<td>7</td>
<td>223</td>
</tr>
<tr>
<td>June’98</td>
<td>1132</td>
<td>398</td>
<td>64</td>
<td>1530</td>
</tr>
<tr>
<td>July’98</td>
<td>1291</td>
<td>366</td>
<td>49</td>
<td>1657</td>
</tr>
<tr>
<td>August’98</td>
<td>86</td>
<td>36</td>
<td>3</td>
<td>121</td>
</tr>
<tr>
<td>September’98</td>
<td>68</td>
<td>27</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>October’98</td>
<td>52</td>
<td>40</td>
<td>3</td>
<td>92</td>
</tr>
<tr>
<td>November’98</td>
<td>85</td>
<td>48</td>
<td>2</td>
<td>133</td>
</tr>
<tr>
<td>December’98</td>
<td>131</td>
<td>85</td>
<td>3</td>
<td>216</td>
</tr>
<tr>
<td>January’99</td>
<td>201</td>
<td>113</td>
<td>11</td>
<td>314</td>
</tr>
<tr>
<td>February’99</td>
<td>167</td>
<td>85</td>
<td>10</td>
<td>252</td>
</tr>
<tr>
<td>March’99</td>
<td>188</td>
<td>188</td>
<td>24</td>
<td>376</td>
</tr>
<tr>
<td>April’99</td>
<td>122</td>
<td>133</td>
<td>12</td>
<td>255</td>
</tr>
<tr>
<td>May’99</td>
<td>116</td>
<td>37</td>
<td>2</td>
<td>153</td>
</tr>
<tr>
<td>June’99</td>
<td>129</td>
<td>49</td>
<td>4</td>
<td>178</td>
</tr>
<tr>
<td>July’99</td>
<td>127</td>
<td>64</td>
<td>6</td>
<td>191</td>
</tr>
<tr>
<td>August’99</td>
<td>108</td>
<td>49</td>
<td>4</td>
<td>157</td>
</tr>
<tr>
<td>September’99</td>
<td>66</td>
<td>36</td>
<td>4</td>
<td>102</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15273</strong></td>
<td><strong>5073</strong></td>
<td><strong>1150</strong></td>
<td><strong>20346</strong></td>
</tr>
</tbody>
</table>

Source: Through personal interaction with Automobile Association of Southern India officials

From the above table, we can see that the numbers of vehicles, which exceed the emission standards, are about 5%. It is to be noted that, Automobile Association of Southern India is responsible for the checking of only the light duty vehicles, while the Tamil Nadu Pollution Control Board is responsible for the checking of heavy-duty vehicles.
b) Phasing out of leaded gasoline

The unleaded petrol was introduced in Chennai in 1998. However, unleaded gasoline was available at the same price as leaded gasoline, and no differential fuel pricing policy was followed. However, in a significant development, leaded gasoline has been completely phased out in Chennai since May 2000. According to Madras Refineries Limited, Chennai went unleaded in December 1999 itself, but the official announcement was made in May 2000 due to administrative procedures. Therefore, Chennai became the third metropolitan city in the country after Delhi and Mumbai to go completely unleaded.

c) LPG as an alternative fuel

In yet another significant development, the Tamil Nadu government in an order passed in April 2000 has approved the use of LPG as an automotive fuel. However, this has been possible only for four wheelers.

Let us now look into the drawbacks of the vehicular pollution control management.

4.2.3 Drawbacks of the pollution control measures

The pollution control measures have not been very successful in combating the problem of vehicular pollution. This has been due to the fact that there are a lot of loopholes in the pollution control management by the Government. Based on the study by Anil Agrawal (Centre of Science and Environment), the drawbacks of the pollution control management are classified into two major categories. a) Legal aspects and b) Planning aspects. These are discussed below:

a) Legal aspects

There were very little legal policy issues to deal with the pollution problem. Whatever little legal development took place up to the 1990s was myopically focussed on stationary sources of pollution like industries and thermal power plants - and remained
almost blind to the looming air pollution crisis from mobile sources like vehicles. Regulations to deal with vehicular emissions came into force in 1990.

Laws to control vehicular pollution need periodic revisions of emissions regulations dealing with vehicle and fuel quality. The Central Motor Vehicles of 1939 was amended in 1989 to regulate vehicular emissions. Although the Air act and the EPA provide the prescription of the automobile emission standard by the Central Pollution Control Board or the Ministry of Environment and Forests, implementation and enforcement of these standards is the responsibility of the Ministry of Surface Transport at the state level (MOST). Therefore, the vehicular emission norms are notified under the EPA of Ministry of Environment and Forests and included in the Motor Vehicles Act, 1989, by MOST to enforce the laws.

Following this amendment, the exhaust emission rules for the owners of the vehicle were notified in 1990, and the mass emission standards for vehicle manufacturers were enforced in 1991 for the first time.

Fuel quality, which is a major determinant of the pollution emanating from vehicles, was hardly ever thought to be responsible for the vehicular pollution in the Indian cities, by the authorities and therefore, it was never regulated keeping the environmental fallout in mind until recently. Fuel standards with respect to parameters, which have a bearing on the emission levels, have become fully operational in this country only in late 2000. Ministry of Environment and Forests had notified binding fuel standards under the EPA for the first time in 1997. Prior to that, the Bureau of Indian Standards governed fuel quality in the country and these were not even mandatory for the refineries to meet.

Despite the recent improvements in the legal reforms, the air quality goal remained elusive, which has steadily worsened in the last decade. This is due to the fundamental
flaws in the planning aspect. A concerted planning on the part of the authorities is needed to make any meaningful impact on the pollution because a few fragmented policies are not going to have any effect on the pollution level in the country.

b) Planning aspects

In the last decade, two major aspects of air pollution control have become most pronounced. While weak enforcement of laws has allowed industrial air pollution to grow uncontrollably, efforts to deal with vehicular pollution have encountered even more serious problems at the planning stage resulting in almost no action. The institutional arrangements for coordination among different government agencies are not demarcated clearly, leading to bureaucratic indifference and conflict of interest. For example, while Ministry of Environment and Forests is responsible for setting air quality standards and other environmental regulations, other ministries are also responsible for the enforcement of these regulations. For instance, Ministry of Surface Transport is responsible for the enforcement of emission regulations for vehicles, and the Ministry of Petroleum and Natural Gas (MPNG) for enforcement of fuel standards and so on, thus making it virtually impossible to get all the ministries to function together.

Weak regulations

Regulations have been very weak, and there is no mechanism to ensure its enforcement in the case of vehicular emissions and fuel quality, which have to be periodically revised to make the products cleaner, to cut emissions at source. Since the pollution due to vehicles is basically a non-point source, this makes devising a scheme and implementing very difficult. As the Government has not been proactive in neither setting stringent emission standards to push the automobile industry to improve technology nor setting standards for the fuel, the vehicles manufactured emit high levels of pollutants.
Emission regulations for vehicles

At one level, emission standards for vehicles in India are weak, at another level, technical parameters for measuring mass emissions, which have a significant bearing on actual emissions level, are not properly specified which make them even weaker. Since 1991, parameters such as cold and warm start emissions and urban driving cycles for laboratory testing of vehicular emission, have been modified to reduce the severity of emission standards. The driving cycle simulates the real road driving conditions, such as acceleration, cruising and deceleration. The aim of the cycle is to gauge emissions of a vehicle driven at an average speed over a specified period of time for a particular distance in laboratory conditions, simulating real road driving conditions.

The most serious criticism of the Indian mass emission regulation is that even in year 2000 India will only meet the outdated European Emission regulations. India will adopt in 2000 the Euro I standards which Europe had enforced way back in 1992-93. The emission norms introduced by the Government of India called “Bharat Emission norms” and “India 2000 norms” are also much more lax in comparison to emission norms worldwide. Secondly, the most controversial aspect of the 2000 emission regulations is that the norms for the durability of the catalytic converters have been specified without creating an authority to certify their durability. It only specifies the deterioration factor for type approval for catalytic converters. The deterioration factor is the factor by which the efficiency of the catalytic converter in reducing emissions is going to deteriorate over a period of time. The efficiency level of catalytic converter has to be higher than the specified standards so that, even after deterioration over time, it would still meet the emission standards. The notification does not specify the certification authority and CPCB officials say that neither the certification procedures nor the authority for certifying the catalytic converters have been established in India. The Ministry of Environment and Forests had initially specified the durability of catalytic converter to be 80,000 km, but it
was later watered down to mere fitness certificate as it is felt that there is no sure way of determining the actual life of catalytic converter.

Fuel quality regulations

It is not just that there has been poor planning for improving the engine quality; there has been equally poor planning for improving the fuel quality. The outdated and the inefficient refining process in India is largely responsible for the poor quality of fuel. Despite the evidence about the ill effects of the poor quality of fuel, the oil refinery has shown only limited interests in improving the quality of fuel. The fuel quality standards are extremely lax as compared to the world standards. This is primarily due to the fact that the very agency that manufactures oil is responsible for setting standards for it. Let us, for instance, look at the standards for diesel. The standards, which are being discussed for 2005, are ridiculously low compared to the world standards. It is proposed to bring down the sulphur content in the diesel to .05% by 2005. This is extremely high as compared to the standard of .001 % sulphur enforced in Sweden. Under Supreme Court orders, the Ministry of Petroleum and Natural Gas has introduced diesel with .25% sulphur content in Delhi and Agra. This is being imported, as the Indian refineries cannot produce even this quality diesel. The irony is that even .2% sulphur content diesel is 250 times dirtier than the world’s best diesel. The problem of meeting the stricter standards for diesel is that it might lead to production loss. Ironically, the government has paid little attention to any of these apprehensions and has carried on encouraging the usage of dirty diesel, with a flawed pricing policy, which has as a result put even more pressure on the refineries to increase production of diesel at the cost of quality.

Despite the deadly profile of the diesel particulates, the government has not yet rationalised the fuel pricing policy by keeping the diesel prices (although the diesel prices have shot up in the recent years) much cheaper than the petrol prices, which is promoting
the use of the former. The main reason for this policy has been ostensibly to help agricultural production and public transport. However, this is a myth. The biggest benefactors of cheap diesel and subsidized kerosene are urban consumers. While the transport sector uses 70% diesel, the urban consumers account for 70% kerosene meant for the rural poor. Even the argument that diesel should be kept cheaper to keep freight costs low does not auger well for environment; freight movement is more energy consuming and polluting than road transport.

Though the process of dismantling the administered pricing began in 1997, the subsequent strategy of taxing petrol to subsidize diesel has started the rather dangerous trend of dieselisation in the Indian cars and autos.

The data on the diesel and the petrol consumption in the transport sector available from CPCB show that the diesel consumption in 1980 was 4.8 times higher than that of petrol. By 1994-95, the diesel consumption was nearly 7 times higher. Till 1997, the prices of petrol and diesel were centrally administered. Further, diesel was cross-subsidized by petrol. This led to increasing use of diesel by the transport sector. The immediate fallout of this policy of fuel pricing is that a diesel mania has hit the automobile Industry. Many auto majors, in fact, most of them have come out with their diesel versions. While the government has failed to look into this issue, the Environment Control Authority set up under the direction of Supreme Court to control pollution in the National Capital Territory of Delhi, is considering the possibility of banning the registration of diesel cars in Delhi. However this proposal is facing serious opposition from the automobile industry, which has charted its future growth path keeping cheap diesel in mind.

Another serious drawback of the planning is that the fuel policies are often implemented without considering their environmental implications. The most glaring example is that of changing the fuel composition to tackle the threat posed by the high
level of airborne lead. Unleaded petrol was introduced in India in 1995 to cut lead emissions and enable new vehicles fitted with catalytic converters to scavenge the overall emissions. Lead has been traditionally added to petrol to raise its octane level. Removing the lead would actually eliminate the largest source of lead in cities. In unleaded petrol, the octane boosting is done by raising the level of aromatic hydrocarbons. Combustion of aromatic hydrocarbon produces benzene—a potent carcinogen linked with leukemia. While the refineries in the developed countries have dealt with the problem by further modifying the refining processes by adding the octane enhancing lead substitutes such as oxygenates so as to keep the benzene and aromatic levels low, Indian refineries are yet to meet this challenge. India’s lead-phase out program has brought to the forefront the alarming prospect of high benzene emissions. Indian fuel standards mandate benzene level in unleaded petrol is at 5%, whereas the world standard is 1%. India cannot afford to take the high benzene route, as the evidence on benzene levels in the air of Indian metros is alarming.

4.3 Experiences of Other Countries

For effective vehicular pollution control management, it is imperative that the Government also draws from experiences of other countries. It is true, that success of a measure in one country might not guarantee a similar result in another country, as the success of the measures are dependent on the characteristics peculiar to each country. However, the experiences of other countries do provide a rough guideline for other countries to follow. Therefore, in this section, we discuss the various measures which are categorized as a) Command and control regulation and b) Economic Instruments- Direct and Indirect, that have been implemented by different countries and also provide an evaluation for the measures implemented for which there is information available.
a) Command and control regulations

Here, we document the experiences of various countries with respect to command and control regulation, which can be categorized as: i) Vehicle Based ii) Fuel Based and iii) Transport Management based.

i) Vehicle based measures

In Mexico, since 1975, the new cars sold in Mexico have been subject to new emission standards that include CO, HC, NOx. In general, these emission standards have been based on the U. S Standards. Before model – year 1991, Mexican standards were lenient enough to be met without use of a catalytic converter or other advanced emission technologies. The standards for 1991-93 represented a transition period because they were sufficiently stringent to require use of catalytic converter but did not include the full range of emission control required in the United States. Beginning with 1994, model – year all new cars were subject to exhaust emission standards equivalent to those of United States. These standards necessitated the installation of three-way catalytic converters and computerized engine control systems but lacked requirements for evaporative emission controls, emission warranties, or recall of vehicle parts that did not comply with emission standards. Installation of catalytic converters has enabled a 90 to 95% reduction in CO and HC emissions from gasoline fuelled cars, taxis, vans and microbuses. Exhaust emission standards for new urban transport microbuses for polluted areas have been laid down but have not been enacted.

In Sao Paulo, the national legislation established a solution to cope with Brazil’s worsening vehicular air pollution in 1986. It sought to reduce pollutant emissions from vehicles to comply with different air quality standards, especially in urban centres; promote and develop technology for sampling and analysing pollutants; create inspection and maintenance program for in-use vehicles; promote public awareness of the vehicular
air pollution problem; establish evaluation criteria for results obtained and improve fuel characteristics to reduce vehicular pollution. The program, based on the experiences of industrial countries which enforce emission standards for motor vehicles using standardized testing procedures and reference fuel types, defines phased and increasing rigorous emission testing procedures for all new gasoline-alcohol and dieselfuelled engine cars used in cars, trucks and buses. This has resulted in 83 percent exhaust emission reduction in CO, 75% reduction in HC, and 62% reduction in NO, for 1995 model gasohol vehicles as compared to 1985 model vehicles.

Vehicular Pollution Control Program has been started in Honk Kong in 1995 with an aim to curtail the emissions of lead. In order to achieve this, new tighter emission standards were formulated and this has resulted in cleaner emissions from fuel. A similar initiative was launched in Teheran in 1995 in order to reduce emissions per unit of fuel and to reduce fuel use per passenger kilometre. The impact of this measure is unknown since the plan has not yet been implemented.

ii) Fuel based measures

Most cars in Belo Horizonte use either ethanol or gasohol. The average lead content of gasoline was reduced from .25g/litre in 1977 to 0.15 g/litre in 1979 to .09g/litre in 1987. Since 1991 gasohol has been lead free. Most heavy-duty vehicles use diesel fuel. Two grades of diesel fuel, with different sulphur contents are available. Diesel-fuelled vehicles circulating in the Belo Horizonte area use the low sulphur grade. In October 1996 the sulphur content of this diesel fuel was reduced from 0.5 to 0.3 percent by weight. The high-sulphur content is allowed for vehicles operating outside Belo Horizonte. The sulphur content of this diesel fuel was reduced from .9 to .5 percent by weight. Both grades of diesel fuel are sold at the same price.
In Sao Paulo, Gasoline, diesel, fuel and CNG are the transport fuels available in Argentina. In 1996 motor vehicles in Federal capital consumed about 14% of gasoline, 8% of diesel fuel and 26% of CNG consumed in Argentina. Use of these alternative fuels rather than gasoline in light duty vehicles has resulted in lower CO and HC exhaust emissions. According to the test conducted on pre-91 model vehicles, greater reductions in CO and HC exhaust emissions can be obtained by increasing the ethanol content in the blend. It is estimated that 12% ethanol blend gasohol reduces CO consumption by 25 to 67 percent, and a 22% blend reduces CO emissions by 50 to 78%. For HC emissions, the reductions are 21 and 29 percent respectively.

In Rio de Janeiro, gasoline has been increasingly replaced by the use of methanol, ethanol and gasohol. This has consequently reduced CO, HC, PM and SO₂ emissions but has increased the aldehyde emissions in the case of light duty vehicles that are not equipped with catalytic converters. Evaporative HC emissions have been decreased for ethanol-fuelled vehicles. The shift from leaded to unleaded gasoline has undoubtedly reduced the lead emissions. Similarly, the use of CNG as a fuel for taxis and buses has also reduced the emissions in PM, sulphur oxides and nitrogen oxides. However, due to lack of reliable ambient air quality data these measures have not been quantified.

Unleaded gasoline was introduced in Santiago in 1992. Since its introduction in 1992, the share of unleaded gasoline in domestic gasoline consumption grew from 17% in July 1994 to 40% in July 1996 and is expected to cross 65% by the year 2000. Leaded gasoline is subject to complete elimination by 2006. It is estimated that the introduction of high-octane gasoline would reduce CO emissions by 17%, HC emissions by 12% and NOₓ emissions by 9 percent. The use of CNG as an alternative fuel to diesel for heavy-duty vehicles was estimated to result in 79% reduction of PM emissions, 62% reduction for NOₓ emissions and 17% reduction for CO.
The vehicular pollution control program of Honk Kong also prescribed reformulation of diesel to reduce the sulphur content, in order to reduce emissions of PM, and this measure has greatly reduced the emissions of PM. The Transport Air Quality Management Project of Mexico, which was launched in 1992 suggested supply side measures such as Fuel Reformulation, CNG retrofitting in order to reduce vehicle emissions and this has had a definite impact on emissions.

iii) Transport based

Transport Management measures are very effective in controlling pollution. The role of transport management measures in controlling pollution is rather indirect. Primarily, these measures help in controlling congestion and therefore in controlling pollution as well. Here, we discuss the transport based command and control regulation.

Improved reliability, regularity of service and journey speed is of vital importance in attracting car drivers to public transport. In many cities, the buses and trams are given exclusive street space where practicable, and priority at traffic signals which in turn works as a deterrent to car use. In the 1970s, Zurich opted for a modernised tram system, expanding and upgrading the old tram systems and its buses. Buses and trams were given priority at traffic lights. In the 1980s, the city continued its investments in public transportation, and A-Bahn was fully developed and co-ordinated with other public transport services. In Zurich, the introduction of bus lanes, exclusive bus access in pedestrian zones, segregated tram and trolley routes, computerised operational control systems and selective vehicle detection at 80% of the traffic signals on bus and tram routes have kept public transport patronage high. Transit use has seen a particular increase in Zurich over the last few decades.

The second urban transport project of Kuala Lumpur, which was started in 1975, implemented measures such as new road construction and phase out of seat taxes in buses
in order to restrain car use, and improvement of public transport. The impact of this measure however has been indeterminate. Bus priority has also become an essential component of traffic management in Seoul. The Bus lane Priority Project (1995-) suggested measures to improve the bus service by having separate bus lanes. To manage the flow of the buses, some streets have as many as four dedicated lanes. This measure has resulted in lesser congestion and lower emissions since high ridership of bus reduces fuel use per passenger kilometre. In Curitiba, The Brazil Urban Transport Project of Curitiba, which was in operation from 1979-85 implemented measures such as, synchronization of bus system, reduction in commuting time, establishing branch bus line and pavement of feeder roads. This has resulted in lower emissions, which could be attributed to measures such as road paving and high bus use. In order to increase bus use, measures like development of bi-articulated bus lanes and a rapid bus system using boarding tubes were adopted. The Urban Street and Transport Project (1989-95), implemented measures like paving and retiring dirt roads, computerization of traffic signals, weekly ban on cars without catalytic converters, and the ban of empty taxis in CBD (Central Business District). Despite these measures, the air quality deteriorated in the post project period. The Bangkok Traffic Management Project (1979-1985) implemented measures like cutting down the number of parking spaces, establishing road lanes, and modernizing traffic lanes. These measures resulted in initial declines in congestion and pollution, but poor public transport lead to greater use of private vehicles thus negating the positive impact of the project. Mexico implemented bans on driving car on one day of a week. This measure, however, did not have any impact, as the households bought additional cars to circumvent the ban. This measure resulted in an increase in the circulation of vehicles thus negating the impact on reduced gasoline consumption.
b) Economic instruments

We document the experiences of other countries with respect to economic instruments, which can be classified as: 1) Vehicle Based ii) Fuel Based and iii) Transport Management based. The economic instruments are of two types-direct and indirect. Indirect economic instruments have been in greater use in combating the problem of vehicular pollution, as can be seen below:

i) Vehicle based measures

The Vehicle based direct economic instruments are mainly two types, viz., emission fees and tradable permits. The experiences of the countries with these instruments have been very limited, if none at all. As explained earlier, most of the countries rely more on indirect economic instruments. In Australia, there is a tax on sale or initial registration of vehicles. The rate of tax varies on the basis of the value of the vehicles. There is a higher annual registration fee on commercial vehicles compared to private vehicles. In Austria, an environmental tax on car registration was introduced in 1992. While, the base is the selling price of cars, the tax rate depends upon the standard petrol consumption. Further since May 1, 1993 the annual vehicle tax on passenger cars is assessed on the basis of the engine power and is no longer based on cylinder volume as it was assessed earlier. From January 1, 1995, the cars without catalytic converters are imposed a surtax of 20 percent. At the same time value added tax (VAT) on new vehicles was reduced from 32 percent to 20 percent and the VAT rate on electric cars was cut by half to 10 percent. In Belgium, an annual tax on registration was introduced for new motorcars on June 1, 1992, and it has been extended to the in-use cars since June 1, 1993. This tax is based on the engine power of the cars. A higher excise duty is also levied on petrol in Belgium. In Brazil, there is a penalty system for violation of air pollution since 1981. Fines are arbitrary as the level of emissions from trucks is generally visually assessed. Fines are related to frequency of violation rather than intensity or toxicity of pollution. In Britain, a

Note: Sales tax is also imposed in many other countries like Britain, India, USA apart from Australia.

It is to be noted that Value Added Tax (VAT)
sales tax on new cars of 17.5% is levied in addition to the annual vehicle excise duty. In addition, there are higher taxes on commercial vehicle sales, ownership (excise duty based on axle and weight) and use than on private cars. In Canada, British Columbia introduced permit fees on pollutant emissions in 1992. The fees are reduced if the actual emissions are less than the permitted emissions. There is a tax on purchase of fuel-efficient passenger and sport utility vehicles. A subsidy of 100$ is provided to cars with a highway of fuel efficiency rating of less than 6 litres per 100 kilometre. In Chile, the city allocated bus transit rights and auctioned routes based on fares and types of buses. In Denmark, there is a fuel tax, which is based on the CO₂ content at combustion, which is being levied since 1992.

In Finland, an annual tax on diesel vehicles and passengers cars of 150 FIM or 100 kg of weight, and on delivery vans of 1000 kg of weight is levied. Further, the environmental taxes on cars are differentiated on the basis of whether or not they are equipped with catalytic converters. In Germany, there is an annual tax on motor vehicles for not meeting the European Union emission standards to accelerate the introduction of cleaner vehicles. The rates of environmental tax are differentiated by the age of the car. In Greece, there is an exemption from the road surtax and initial lumpsum tax for a period of 5 years for new cars fitted with a catalytic convertor, subject to scrapping of old car by the buyers of new car. A total of about 3 lakh cars are being scrapped. In Hungary, new cars with catalytic converters get a discount of Forint 50000 from consumption tax. In 1992, a tax at the rate of 0.7% of the price was introduced on motor vehicles fuels. The revenue is earmarked for environmental expenditure relating to vehicular traffic. In Iceland, an excise duty is based on the cylinder capacity of vehicles. Further, an Ikr of 330 is charged for a mandatory annual emission test. There is also an inspection fee, which is charged for the annual inspection of vehicles over 2 years old. The rate of charge is on the basis of the weight of the vehicles. In Ireland, a sales tax is levied on the retail price of private vehicles.
based on the cylinder capacity. In Italy, a one-off registration tax is levied on the purchase of new and used vehicles depending on the type and the size of vehicles. In Japan, there are tax deductions for cars with low emissions, electric cars and cars on alternative fuels. A one-off consumption tax on new or old car registration is levied at 3 percent. Further, there is an annual tax in relation to power and load of vehicles. In Korea, environmental quality improvement charges were levied in 1991. It also covers vehicles (including bus and trucks using diesel). The charge is computed by the price of the catalytic converter.

In Netherlands, there is a lower sales tax on cars that complies with the future European Union Standards. Consequently, the share of the future European cars rose from 37% to 70%. In Norway, system of differentiated tax on car prices, with a tax advantage given to cars fitted with catalytic converters and cars powered by electricity or gas is followed. In Singapore, an additional registration charge at 150 percent of the cost of the car has been levied since 1983 to discourage car ownership. A rebate on tax is also given if an old vehicle is scrapped simultaneously. In Sweden, vehicle tax is levied based on the basis of the weight and the environmental characteristics. Subsidy is also given to cars, which are fitted with catalytic converters, and a special tax is levied on cars without catalytic converters. In the United States, there is an higher excise tax (of 12 percent) on trucks, there is an annual use tax on "heavy vehicles", excise tax on tyres weighing over forty pounds, a "Gas Guzzler" tax on automobiles with unsatisfactory fuel economy ratings. The Gas Guzzler excise tax is imposed on the sale of the autos whose fuel efficiency is less than 22.5 miles per gallon. The tax varies from $1000 to $7700 depending on the fuel efficiency. Further, there is also non-conformance charge on heavy vehicles, which are levied on the basis of the degree of the non-compliance.
ii) Fuel based measures

Britain follows a policy of differential fuel pricing for leaded and unleaded petrol. Tax differential has been gradually increased and now stands at 4.8 pence per litre. The proportion of unleaded petrol in total petrol sales rose to 50% in 1993 from a negligible share in 1986. In Denmark, there is a fuel tax, which is based on the CO₂ content at combustion, which is being levied since 1992. The policy of differential fuel pricing for leaded and unleaded petrol is being followed since the mid-1980s, as a result, the market share of unleaded petrol rose to nearly 100%. There is also a lower tax on lead free petrol than on leaded petrol since 1986. In Finland, a lower excise duty on sulphur free diesel since 1993 and a carbon tax on fuel have been levied since 1994. Further, a higher tax has been imposed on the diesel cars as compared to the petrol cars since 1994. There is also a duty differential between leaded and unleaded petrol at the rate of DM 0.10 per litre. Further, a higher tax has been imposed on the diesel cars as compared to the petrol cars since 1994. In Ireland too, the policy of differential fuel pricing is followed, with a higher excise duty on leaded petrol than on the unleaded petrol. In the United States, there is an higher excise tax (of 12 percent) on trucks, there is an annual use tax on “heavy vehicles”, excise tax on tyres weighing over forty pounds, a “Gas Guzzler” tax on automobiles with unsatisfactory fuel economy ratings. The Gas Guzzler excise tax is imposed on the sale of the autos whose fuel efficiency is less than 22.5 miles per gallon. In Luxembourg, a higher excise duty and VAT rates on leaded petrol by 2-3% is levied than on unleaded petrol. In Mexico, again, a policy of differential fuel pricing is levied with higher excise tax on leaded petrol than on unleaded variety. The policy of differential fuel pricing is being followed with unleaded petrol being cheaper than leaded petrol in Netherlands. In New Zealand, a policy of tax treatment in favour of unleaded petrol vis-à-vis leaded petrol is being followed, that is, a US $ 0.039 per gram was levied on lead added to gasoline. In Norway, gasoline tax difference has been introduced for leaded petrol based on emissions
per litre. Further, fuel tax based on sulphur, carbon and lead content is also levied. In Sweden, high gasoline taxes are levied. The policy of differential tax in favour of unleaded petrol is also pursued. A carbon tax has been imposed on motor and other fossil fuels since 1991. The part of the tax levied on motor fuels amounted to SKr 0.58 per litre for petrol and 0.92 for diesel. The system of tax rebate for producers of cleaner diesel fuel is also being followed since 1991. In Switzerland, the market share of unleaded petrol increased to 65% in 1992 due to a tax differentiation of ECU 0.041 per litre in favour of unleaded petrol. This leads to a steep fall in the lead emissions. In Taiwan, differential policy in favour of unleaded petrol is also being followed. This led to an increase in the market share of unleaded petrol from 18.7 % in 1990 to 51.84 % in 1993, which resulted in an improvement in the urban air quality. In Thailand, surtax on leaded gasoline is levied to finance the subsidy on unleaded gasoline.

iii) Transport management type of measures

In Chile, the metropolitan transport authorities allocated bus transit rights and auctioned routes based on fares and types of buses. This had a definite impact on reducing congestion in the more congested areas and thus also had a positive impact on the pollution reduction. In Norway, the city of Bergen introduced toll for motorists entering the city between 6.a.m to 10 p.m. on the weekdays. The rate is differentiated on the basis of the loading capacity of the vehicles. The revenue so collected is used to finance the construction of bypasses. This measure too reduced the congestion and therefore the pollution level to some extent. In Singapore, the electronic road pricing system was introduced in 1998. It is an automated version of the earlier area licensing scheme, which was introduced in 1976 to reduce traffic congestion in the busy areas of the district. Under area licensing scheme, the areas covered by the scheme were called restricted zones. All vehicles except the exempted ones were required to display valid license coupons (daily or monthly) on their windscreens to gain entry to restricted zones. The area licensing scheme
was very successful in reducing the traffic volume during the rush hours in the Central Business District by spreading traffic to other times and alternative routes. Since ERP is relatively a new measure, the effects have not yet been quantified. However, ERP is more efficient vis-à-vis the area-licensing scheme because in this system each trip is charged unlike in area licensing scheme (ALS), which charged a fixed fee for any number of trips in a day/month. Another scheme, which is implemented in Singapore, is the off-peak car scheme, which was introduced in 1994 in place of the weekend car scheme. Under this scheme, vehicles, which opt for OPC (off-peak car) scheme, are allowed to ply on Sundays, public holidays and Saturdays between 3 p.m. to 7 a.m. and on weekdays between 7 p.m. to 7 a.m. For running the OPC scheme vehicles during restricted hours, one can get a license fee for 20$ a day. This measure has also had a definite impact on curtailing the congestion and hence the pollution level. A similar area-licensing scheme was introduced in Kuala Lumpur as a part of the second urban transport project in order to reduce the car usage. Since this measure was introduced in combination with a few other projects, it is difficult to quantify the effect of this measure alone, more so since the overall impact of the project is indeterminate.

4.4 Conclusion

It can be seen that the vehicular pollution control measures taken by the Central Government and by the State Government have been by and large command and control regulations. The main drawback of these measures is that they lack in the planning aspect and the problem is exacerbated by poor enforcement. In order to enhance the pollution control program, it is imperative that economic instruments are introduced so that the desired reduction can be achieved at a lesser cost. It can be seen from the experiences of other countries that indirect instruments can be effectively used for combating vehicular pollution. This does not mean, that command and control regulations should be totally
abandoned. Instead, these measures could be supplemented by the economic instruments, for an effective solution to the problem of vehicular pollution.