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Invite you
to
Roundtable Deliberation
on

Pseudo Stifling: Mumbai & Mumbaikars:

Championing for Cleaner Air and Clearer Skies

Following are the themes of discussion which are the major contributors to the compromised ambient air quality

- Public & Private infrastructure construction in Mumbai
- Vehicular emissions in Mumbai
- Informal garbage disposal methods in Mumbai

In the distinguished presence of:

D. K. Jain (tbc)
Chief Secretary, Maharashtra

R. A. Rajeev (tbc)
Commissioner MMRDA

Ajoy Mehta (tbc)
Commissioner, MCGM

5th November 2018

11.00 am to 5.00 pm

Venue:
Cricket Club of India (CCI)
C. K. Naydu Hall

RSVP:
✉ info@mumbaifirst.org
✆ 22810070

Pseudo Stifling: Mumbai & Mumbaikars

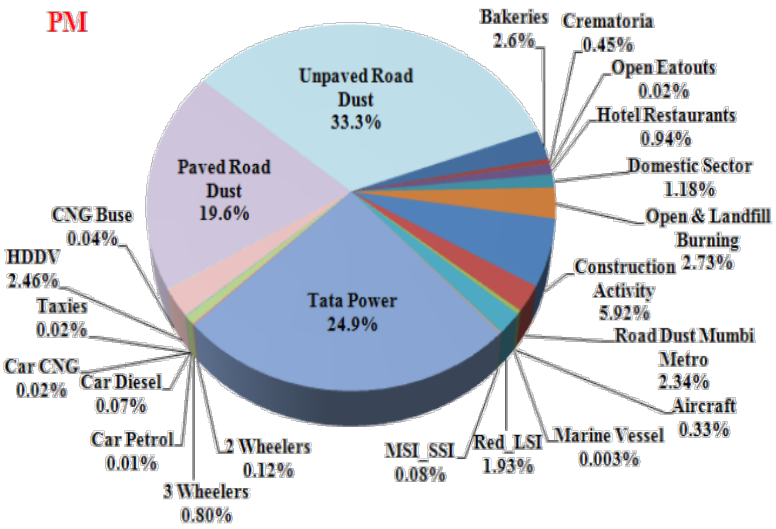
CHAMPIONING FOR CLEANER AIR AND CLEARER SKIES

5th November 2018,
Venue : Cricket Club of India (CCI), C.K.Naydu Hall

BRIEF NOTE

Mumbai is an Urban Agglomeration coming under category of Mega City with estimated city population of 12.44 million according to 2011 census, which is projected upto 13.18 million in 2020. Over the years, urbanization and industrialization in Mumbai have led to emergence of air quality issues as one of the major concerns impacting quality of life. To understand the current scenario of air quality and adopt remedial measures, Mumbai's ambient air quality is being monitored under National Ambient Air Monitoring Program (NAMP), coordinated by Central Pollution Control Board (CPCB) or SAMP (State Ambient Air Monitoring Program) stations. From the air quality data generated during the period from 2005 to 2015, it is observed that Particulate matter concentration is higher than the prescribed limits throughout the monitoring period.

In view of this, CPCB has directed SPCBs to develop action plans and implement these to control air pollution in Mumbai. Thus, an Emission inventory and Source apportionment study has been undertaken by NEERI in collaboration with IIT Bombay. The study has covered Point sources, Area sources and Line sources contributing to Particulate matter emission.



Percent Contribution of Sources to Particulate Matter Emission

As per the study, there are many sources of particulate matter emission impacting the ambient air quality of the city of Mumbai; however, the major ones are resuspended dusts and industries. The impact of the industrial sector is reducing due to various reasons such as closure of industries, shift to clean fuel, better compliances and discharge of emission at higher elevations.

The emission inventory indicates that though point sources contribution is reasonably high particularly due to power plant in terms of total load; however its impact on the ambient air quality is low due to emissions at a higher elevation, providing high dilution and dispersion.

Vehicle activity in the city has shown tremendous increase over a period of last 10 years. The mobile (line) source emissions are not only dependent upon the number of vehicles registered but also on the actual number plying on the roads, speed of movement and the conditions of vehicles besides many other factors. Increased levels of vehicular activity and resulting high levels of air pollution have led to active anti air pollution campaign by the nongovernmental organization (NGO) and judiciary.

The area sources also have significant impact on the PM levels in the atmosphere; however it could be more localized, particularly from the sources such as bakeries, crematories, construction, garbage burning etc. Some of these sources can have significant local impact on the ambient air quality for a shorter duration. Overall a city growth pattern indicates that domestic fuel has become cleaner, bakeries /crematoria situation have not changed so much. Construction/ demolition related emission has gone up, refuse burning has increased and road dust related emissions have also shown increase due to increased construction activities.

In view of these observations on Mumbai's air quality and pollution contributing sources, Mumbai First in association with NEERI, is organizing a half – day roundtable discussion on Pseudo Stifling: Mumbai & Mumbaikars"Championing for Cleaner Air and Clearer Skies" on 5th November 2018.Based on the study carried out by NEERI and IITBombay, the themes would include the major contributors to the compromised ambient air quality i.e.Public & Private infrastructure construction in Mumbai, Vehicular emissions in Mumbai and Informal garbage disposal methods in Mumbai.

The need of this discussion is due to the fact that the cause of air pollution mitigation must move from citizen's charter and bring the focus back to all stakeholders. With partnerships of concerned agencies and citizens, it would be possible to keep air quality as pristine as possible.

Report On

AIR QUALITY, EMISSION INVENTORY AND ACTION PLAN FOR MUMBAI CITY

Prepared by

Council of Scientific & Industrial Research - National Environmental Engineering Research Institute (CSIR –NEERI)

Indian Institute of Technology Bombay (IITB)

Maharashtra Pollution Control Board (MPCB)

Workshop on

Psuedo Stifling : Mumbai & Mumbaikars –
"Championing for Cleaner Air and Clearer Skies"

Date : 5th November 2018,
Venue : Cricket Club of India (CCI), C.K.Naydu Hall

Mumbai Air Quality, Emission Inventory & Action Plan

1. Preamble

Mumbai is an Urban Agglomeration coming under category of Mega City. Greater Mumbai, city covers an area of 603 Sq. Km. Of this, the island city spans 67.79 Sq,Km, while the suburban district spans 370 Sq. Km, under the administration of Municipal Corporation of Greater Mumbai (MCGM). Mumbai the capital city of Maharashtra is second most populous metropolitan city in India and fifth most populous city in the World, with an estimated city population of 12.44 million according to 2011 census. The population density of Mumbai is 27461 person per Sq. Km (excluding no development area). The living space is 4.5 square meters per person. The estimated projected population of 2016, 2020, and 2030 is around 12.91, 13.18 and 13.42 respectively. During the last decade, 2001-2011, Island City has shown a population decline of 262,620 whereas the Western and eastern have shown an increase of 321,841 and 394,702 respectively. Ward P/N in the Western Suburbs has the highest population of nearly one million among all 24 wards, holding 7.5% of the total population. Whereas, ward B in the island City has the lowest population of 140,633 among 24 wards.

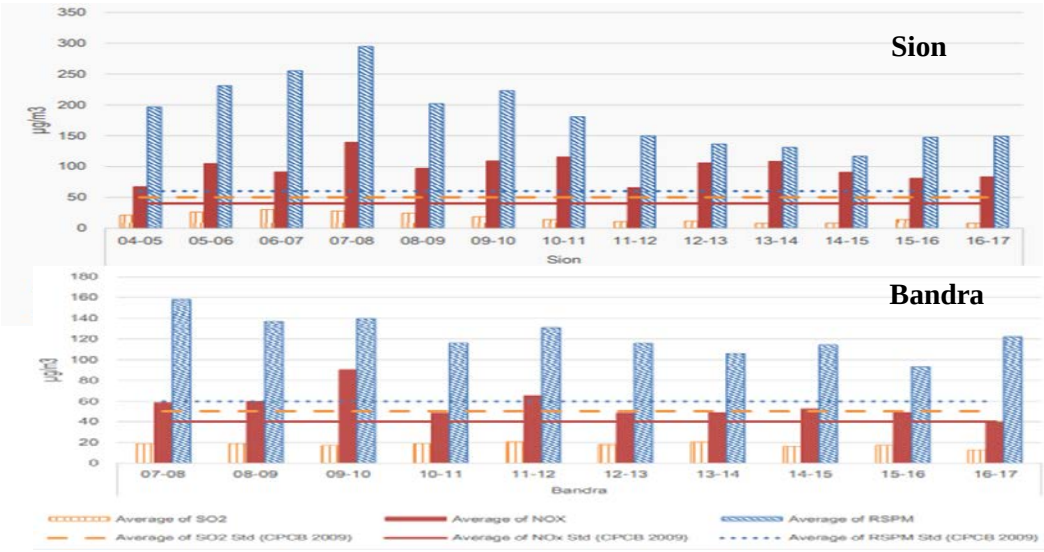
Of the total population within MCGM jurisdiction in 2011, 41.85% live in slums including the notified areas under Special Planning Authorities (SPA) SPAs. 51.91% of the total population in the Eastern Suburbs resides in slums as compared to 42.69% of the total population in the Western Suburbs and 27.88% in Island City *(MCGM, City Development Plan, 2034).*

Greater Mumbai region is along the seacoast that experiences a tropical wet and dry climate. The region experiences three seasons, Summer (March to May), Monsoon (June to September) and Winter (October to February). The mean minimum temperature is 16.3°C and the mean maximum temperature is 32.2°C. The normal annual rainfall over the region varies from about 1800 mm to about 2400 mm. Majority of the rainfall is received in the South-West monsoon i.e., during the months of June to September. Rest of year remains dry with average relative humidity around 75%.

The average wind speed in the region is in the order of 25 kmph and gusts upto 45 kmph. The maximum wind speeds exceed 150 kmph during tropical storms in the region *(NEERI, NAAQM, 2016).*

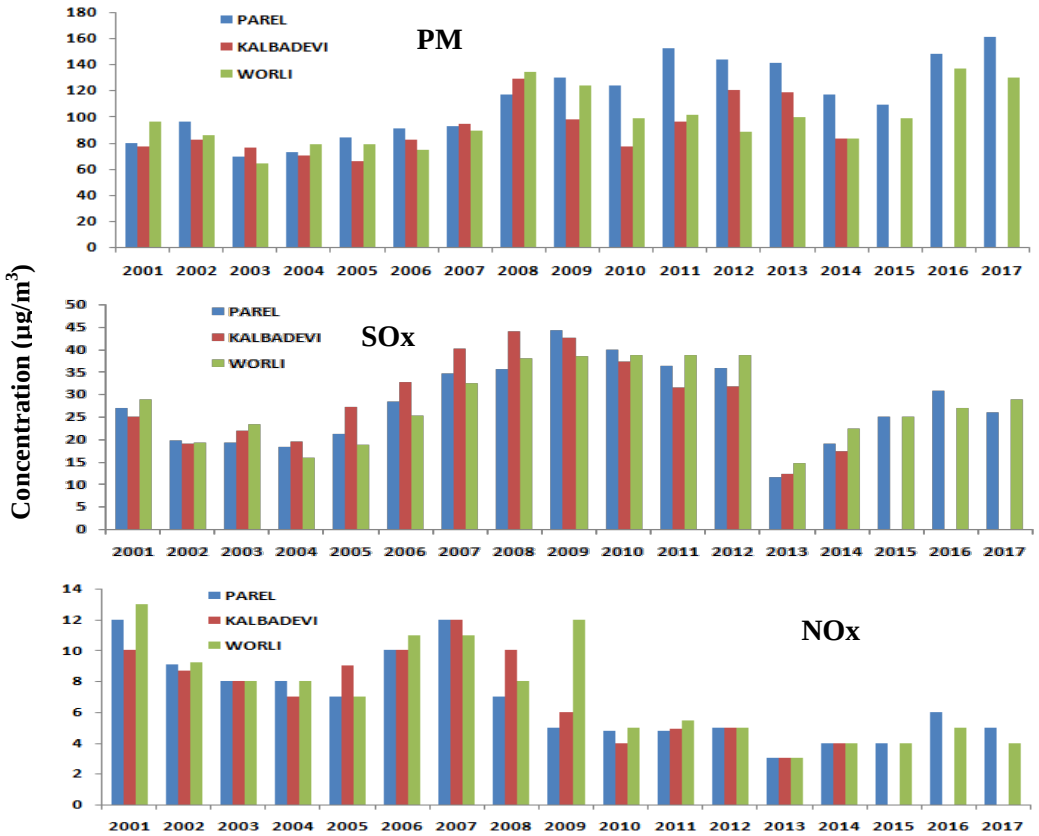
2. Air Quality

Mumbai's ambient air quality is being monitored under National Ambient Air Monitoring Program (NAMP), coordinated by Central Pollution Control Board (CPCB) with NEERI at Worli and SAMP (State Ambient Air Monitoring Program) with MPCB at Sion an Bandra stations.



Annual Averages for PM, NOx and SOx Over Period 2005 - 2017 in Mumbai *(SAMP Station Operated by MPCB)*

CPCB Std. Annual Avg. : PM- 60 µg/m^3, SO_2- 50 µg/m^3, NO_x- 40 µg/m^3



Annual Average of PM, NOx and SOx Over Period 2001 - 2017 in Mumbai *(NAMP Station operated by NEERI)*

The annual average concentration of PM_{10} at Bandra is 124 µg/m^3 and 152 µg/m^3 at Sion during 2016-2017. Whereas, 13 µg/m^3 and 8 µg/m^3 for SOx and 40 µg/m^3 and 83 µg/m^3 for NOx, concentration were observed at Bandra and Sion respectively. The percentage exceedance of PM is around 50% at Bandra and 25% at Sion, similarly NOx concentration were also exceeding around 4% and 48% respectively. As per Air Quality Status Maharashtra report prepared by TERI for MPCB during 2016-17 shows that air quality index category wise distribution is as : Good (0-50) [42 (Bandra), 6 (Sion)], Satisfactory (51-100) [99 (Bandra), 50 (Sion)], Moderate (101-200) [94 (Bandra), 112 (Sion)], Poor (201-300) [63 (Bandra), 68 (Sion)], Very Poor (301-400) [3 (Bandra), 5 (Sion)].

The annual averages of pollutants monitored under NAMP Station operated by NEERI shows that the concentrations of PM_{10} at all the stations are above the standard limit throughout the period. PM and NOx are above the NAAQS and SOx is in compliance throughout the period. Over the years trends shows criteria pollutant decline from 2010. During monsoon period the concentrations are reducing drastically.

3. Objective of the Study

CPCB has listed cities in India in which the RSPM levels are non-complaint with the NAAQS and has directed SPCBs to develop action plans and implement these to control air pollution in these cities. Seventeen such cities have been identified for the state of Maharashtra - Akola, Amaravati, Aurangabad, Badlapur, Chandrapur, Kolhapur, Mumbai, Nagpur, Nashik, Navi Mumbai, Pune, Sangli, Solapur and Ulhasnagar.

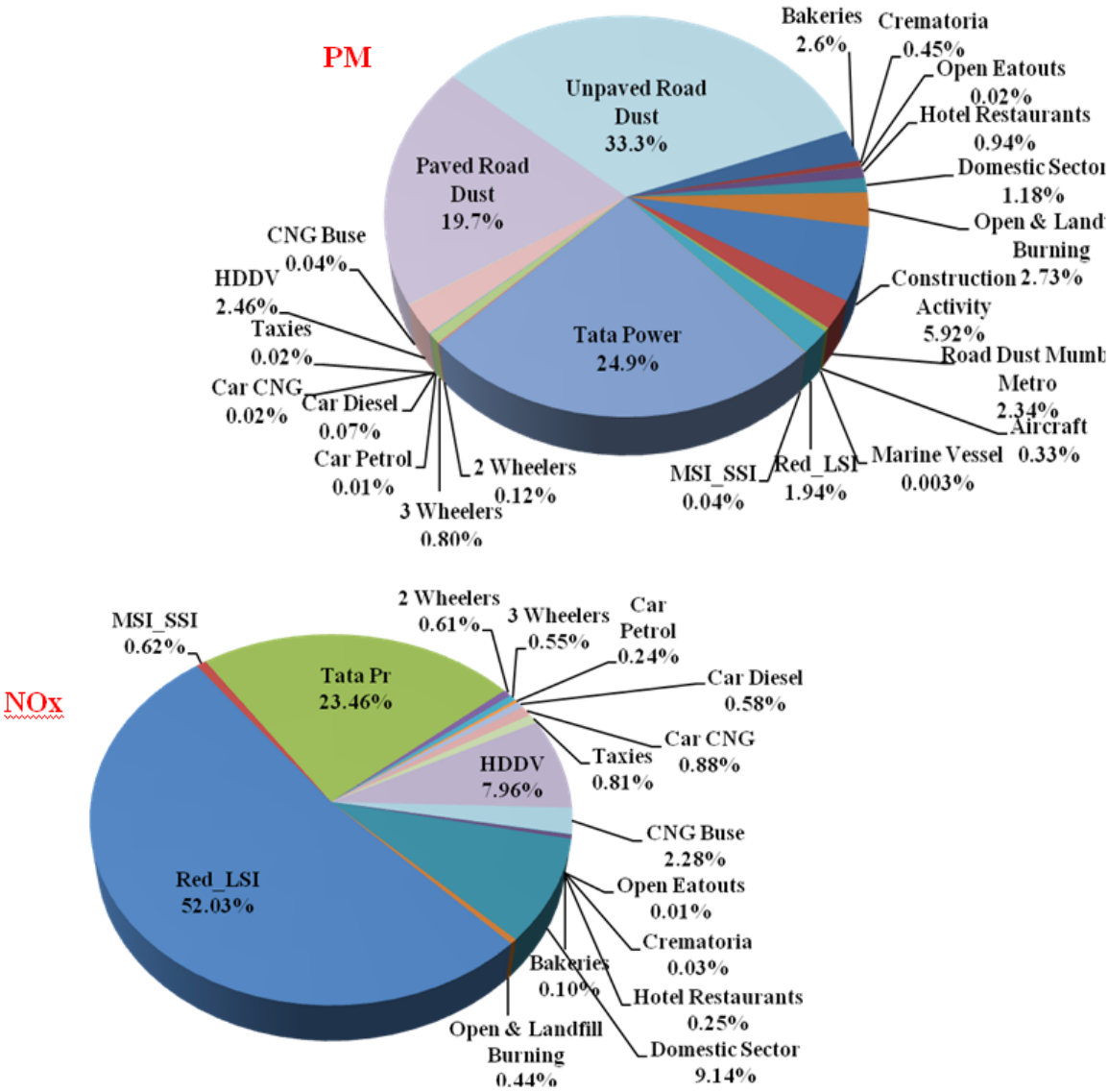
The main objectives of the projects are :

- To measure baseline air pollutants (Particulate Matter) in different parts of the city which include “hot spots” and kerbside locations.
- To develop emissions inventory various pollutants in the city.
- To conduct source apportionment study of PM.
- Suggest action plan based on various options delineated in the Six City Study of MoEFCC or any relevant workable options. To prioritize the source categories for evolving city-specific air pollution management strategies/plan.
- To assess the impact of sources on ambient air quality under different management/ interventions/control options and draw a roadmap of short and long term measures as a part of action plan suggested.

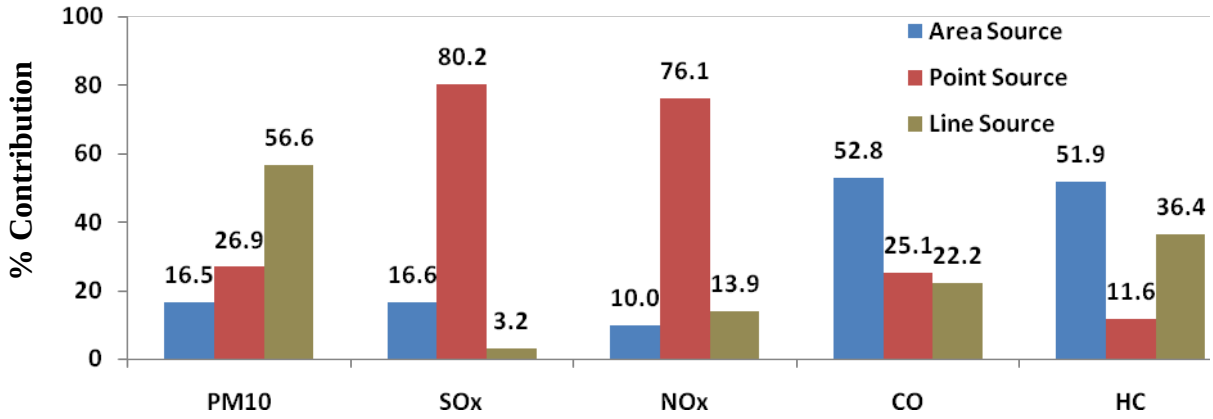
4. Emission Inventory

An emissions inventory estimates the emissions from various pollution sources in a geographical area. As the city is overwhelmingly expanding in terms of population, infrastructure and vehicular growth; as also CPCB has listed the non attainment of PM standards in Mumbai city. The identification of pollutant loads with specific focus to PM emission and to prepare the strategic action for plan for controlling them is the need of the hour.

Different type of sources and activities were accounted for their operation, fuel consumption, operating hours etc, in the study for the estimation of pollutants emission load across whole city Percent contribution of pollutant due to different source categories is and all sources from whole of Mumbai city is presented below :



Percent Contribution of PM and NOx in Mumbai City



Percent Contribution from All Sources for Whole of Mumbai

In Mumbai city, PM is mainly contributed from road dust (53.04%) followed by industrial sources (26.9%) and area sources (16.5%), while tailpipe emissions of vehicular sources contribute 3.53%. Among the total area source construction activities contribute 5.9% followed by open burning and bakeries (2.7 to 2.6%), very negligible sources i.e. 0.3 to 1.2% is shares from crematoria, hotels & restaurants and domestic sectors, aircrafts etc. out of the total emission load. Among the industries, Tata Power fuel share is highest i.e. Coal -8400 (TPD), LSHS -3300 (TPD) and NG -3000000 (m^3/day) (MPCB Consent, 2017), which contribute PM emission load around 24.9%. The Red LSI i.e. refineries, chemical and fertilizers companies are emits PM shares the 1.9% of the total PM and all MSI, LSI & SSI (Red, Orange and Green industries) share 0.04% percent of PM. The vehicular sources percent contribution from heavy duty is 2.46%, while, 3 wheelers shares 0.80%. The overall line source contributes 3.53% but if we considered vehicular dust the percentages goes upto 53.03%.

The NOx contribution is mainly shared by industries i.e 76.1%. Among industries Red LSI contributes 52.0%, MSI & SSI (All Categories R,O,G) shares 0.7% and alone Tata Power gives 23.4% to the total. The area source and line source gives 10% and 13.9% NOx contribution respectively. The domestic sector (LPG consumption) alone gives 9.13% of the total NOx and other area source share only 0.83%. The HDDV and CNG Buses shares 7.95% and 2.28% respectively and vehicles categories contributes around 13.9%.

The SOx emission is mainly from industries i.e. around 80.2%. Out of this 8.5% and 48.6% comes from MSI & SSI and Red LSI industries respectively. Only 16.6% shares come from area source among them domestic sector is higher 12.5%. For vehicles SOx emissions are calculated based on sulphur content (Diesel 300 ppm and Gasoline 30 ppm) which reflect 1.72% from HDDV, 1.22% from Car Diesel.

It is important to note that high load contribution does not necessarily lead to high ambient contribution of a particular source at the receptor site. This is due to the fact that emission distribution in atmosphere depends upon multitude of factors such as local meteorology, location, height of release, atmospheric removal processes and diurnal variation. Further, it is equally important that fine particles which constitute higher fractions of toxics are mostly released at ground level sources such as vehicles, refuse burning, bakeries-crematoria, road side eateries, airport and railways ground operations etc. Since mass based emission inventories do not provide the complete picture of real contributions at the levels of exposure, it is pertinent to use chemical analysis data with appropriate dispersion and receptor models.

There are many sources of particulate matter emission impacting the ambient air quality of the city of Mumbai; however the major ones are resuspended dusts and industries. The impact of the industrial sector is reducing due to various reasons such as closure of industries, shift to clean fuel, better compliances and discharge of emission at higher elevations. Even small-scale industrial units are changing into commercial offices. The emission inventory contribution of PM projected above indicates that though point sources contribution is reasonably high particularly due to power plant in terms of total load; however its impact on the ambient air quality is low due to emissions at a higher elevation, providing high dilution and dispersion.

Vehicle activity in the city has shown tremendous increase over a period of last 10 years. The mobile (line) source emissions are not only dependent upon the number of vehicles registered but also on the actual number plying on the roads, speed of movement and the conditions of vehicles besides many other factors. Vehicle kilometer travelled for the city has been showing consistent increase; however, at some junctions the traffic congestion is so high that VKT rise is ironically not so high but emission is high. Saturation traffic situation where average speed goes on decreasing, the VKT may not increase as vehicles are not crossing a point for a long time. Increased levels of vehicular activity and resulting high levels of air pollution have led to active anti air pollution campaign by the nongovernmental organization (NGO) and judiciary.

The area sources which emit at ground level also have significant impact on the PM levels in the atmosphere; however it could be more localized, particularly from the sources such as bakeries, crematories, construction, garbage burning etc. Some of these sources can have significant local impact on the ambient air quality for a shorter duration. Overall a city growth pattern indicates that domestic fuel has become cleaner, bakeries /crematoria situation have not changed so much.

Construction/ demolition related emission has gone up; refuse burning has increase and road dust related emissions have also shown increase.

To derive Air Quality Management framework in a Cities, regulator should have define measures in relation with the activities and demographic of the region, while taking socio economic factor into consideration for its viability, such as follows:

- Monitoring of air pollutants *f*
- Preparation of source-wise air pollutant emission inventories *f*
- Source apportionment studies
- Future air quality projections using dispersion models *f*
- Assessment of potential of different strategies for control of pollution
- Cost benefit analysis for short, medium, and longer timeframes *f*
- Preparation of air quality management plans for short, medium, and longer timeframes *f* Implementation of selected strategies *f*
- Assessments of impact of strategies through monitoring and repeat previous steps till air quality standards are achieved.
- Other than local air quality management plans, there are interventions that are relevant at the national scale and are proven worldwide to provide significant air quality benefits. These measures should be adopted for long-term air quality control in India.

The action plan presented later therefore, makes an attempt to delineate strategies on the basis of understanding sources and their possible contribution to the ambient and kerb side air quality. Each of the strategies will have to be looked at from the point of view of its impact level in terms of reduction in emissions (low, medium, high); its feasibility from implementation and administrative point of view (easy, moderately difficult and difficult); financial viability (low, medium and high costs) besides issues relating to their long and short term impacts.

4.1 Area Source

As per emission inventory percent contribution from area source emissions are high particularly for PM when compared with emissions from vehicular emissions. Other area sources though called area sources, are limited to small regions (viz. open eatouts, bakeries, crematoria and hotels) and therefore, their impact does not seem to be wide ranging and across the city. For example, open burning can be common all through the city with some variation based on locality; however landfill open burning is limited to Mulund and Kanjurmarg. During study period recent work going for Metro line development is also a time bound activity for at least 5 years, so as the dust emission.

Measures Required

- Bakeries and crematoria emissions can be reduced through implementation of fuel shift combined with awareness programmes
- Open refuse burning and landfill site burning are the most important issues for the degradation of ambient air quality. This needs very quick and credible solution to stop these emissions.
- Road dust from paved and unpaved roads in the city is largely responsible for high PM. The code for road and pavement constructed should be written well and implemented.
- Large scale construction and demolition of buildings in the city give high local dust contribution leading to health impacts. These practices need adequate rules and compliance to reduce emissions.

Resuspension from the building and construction activity is one of the prominent sources of PM emission load. As there are various infrastructural and development project going vide across Mumbai region, the resuspension attributed to these activities within their construction phase is severe but time being.

Emission Reduction Action Plan for Area Source

Area Sources	Short Term- 2019	Long Term- 2022	Action Required
Domestic	25% of slums to use LPG/ PNG 50% of non slum to use LPG/PNG	50% of slum to use LPG/ PNG 100% same	Proper dispensing and easy availability of cylinder to the consumer of slum population should be made. Increase the infrastructure and availability of LPG/PNG to whole of Mumbai region. Ensure proper ventilation reforms to be implemented in kitchen to improve the indoor air quality. Awareness about the same should be disseminated
Hotel & Restaurants	50% of coal to replace by LPG	75% of coal to replace by LPG	Wood is mainly used in tandoors in restaurant, LPG/ electrically operated tandoors may be used. Hotels & Restaurants should be regulated for their operation and maintenance of chimneys. Designated areas should be designed for the coal and wood based operations within the premises. Options of fuel shift should be implanted in phase wise.
Open Eatouts	Since these operation is illegal, difficult to quantify		If we restrict the activities with proper rehabilitation or their conversion from traditional fuels to clean fuels, then per unit /day reduction of PM- 0.12, and NOx – 0.039 kg/day can be achieved, considering the large number of vendors and eat outs.
Bakeries	25% LPG /NG 25% Electric	50% LPG /NG 75% Electric	Clean fuels like LPG/NG or electricity can be attempted for bakery operations. Initial incentives and rebate should be provided for the conversion from traditional fuel. There are illegal and unaccounted small and mid-scale bakeries that have significant contribution to final emission load. They should be taken in confident by the regulatory bodies for their accountability, inventeriozation of their fuel consumption and conversion of their existing facilities. This will require change in current baking practices for which a separate study involving techno-economic feasibility is recommended.
If consumption of wood in a bakery is considered to be 500 kg/day, then emission load of pollutants are PM - 8.65 kg/d, CO - 63.15 kg/d, NOx -0.65 kg/d, HC-57.25 kg/d and if we manage to replace the wood quantity by other fuel i.e only 100 kg/days of wood is being used, there will be 80% reduction in load, with final emission per 100 kg will be PM -1.73 kg/d, CO -12.6 kg/day, NOx- 0.13 kg/d and HC - 11.4 kg/d. This conversion can be towards natural gas, as emissions from them are relatively much less than solid fuels.			

Emission Reduction Action Plan for Area Source (Contd..)

Area Sources	Short Term-2019	Long Term-2022	Action Required
Crematoria	50% Electric	75% Electric	There are sentiments involved in the activities that are carried out in crematorium. Still all crematoria should be provided with efficient pyres and chimneys with bag filters for release of emissions through stacks at appropriate height. Further, a study involving usage of NG burners in a closed furnace like electrical crematoria may be explored as substitute to existing practices. This will require participation of social organizations for increasing the awareness about need to change from the traditional methods. Concept like Green Crematoria should be explored.
Similarly, for wood consumption of 300 kg/body cremation at crematoria is replaced by electric or gas cremation, an overall PM-5.19, CO- 37.89, NOx -0.39, HC -34.35 and CO2 – 510 kg/yr of emission load reduction can be achieved per unit cremation			
Open & Landfill Burning	50% control on open burning 100% control of Landfill burning	100% control of Landfill burning 100% control on open burning	It has been observed that the unaccounted or mismanaged waste from SWM system, often are reported into road side open burning cases. As city is receiving 8,400 solid waste per day, proper collection and disposal practices should be adopted on daily basis so that opening burning cases are not reported. Fast track steps for scientific SW management. Refuse of all types are burning from certain localities like Dharavi, Kurla where auxiliary and small scale industries are located should restricted. This practice needs to be stopped by planning of dumping till sanitary landfills are made. Treated water from Ghatkopar STP can be used effectively for any accidental fire for landfill sites. Strict vigilance by sensor base monitoring of the incidences and immediate attention is required for frequent fire movement at landfills.
If we restrict the activities of open and landfill burning we can reduce pollutant load per Tonne by PM -8, CO- 42, HC -21.5 kg/t			
Bldg. & Road Construction	50% control on dust emission	50% control on dust emission	Building construction/demolition codes need to be used with specific reference to PM control. UTTIPEC design manual has been recently created by Delhi Development authority for uniform roadside, drains, footpath and related design. The same should be adopted for all future design for roads and pathways. Road construction/repair uses wood for melting tar, this technology needs to be abolished as over a large period of time, emissions are high. During study period placing Metro Line is a temporary activity, but proper attention for dust control measures and muck disposal is required as an immediate action, because the activity is spreading across Mumbai.

Emission Reduction Action Plan for Area Source (Contd..)

Area Sources	Short Term-2019	Long Term-2022	Action Required
Paved & Unpaved Road Dust	Paving : 15% control on dust Unpaving: 15% of remaining road if any	Paving : 25% control on dust Unpaved : 100% of remaining road if any	99% of roads were considered to be paved. Pavement of road should be made wall to wall, especially the shoulders. The silt on partially paved shoulders of road are re-entrained, or resuspended, into air through vehicle-induced turbulence and shearing stress of the tires. A Road dust suspension is an increasing concern in terms of being a source of atmospheric PM. Better sweeping management system should be implemented. Major concreting works of road are already worked out in Mumbai, but if any 1% roads remain then it should be immediately deal with. Resupension of road due to vehicular movement is a cause of concern, a study should be done and viable solution should be identified. Use of mechanical sweepers should be initiated for large coverage.
Ports	Awareness and Management	Clean diesel programme should be initiated along with better engine I & M for small boats/ships. Bigger ships are controlled under MARPOL. Navy and BPT should be sensitized about use of clean fuel and emissions.	
Airports	Awareness and Better Inventory	As the traffic of Mumbai airport is day by day increases the proper inventorisation of landing and takeoff studies with respect to emission load. High HC and VOCs emissions due to aircraft movement need assessment and documentation with a view to adopt international guidelines (IATA/ UFTAA) to reduce emissions and also green house gases. Diesel and petrol consumption could not be computed for airport related vehicles such as loaders, buses, jeeps, food carts etc. Many of these remain operational throughout. These vehicles should be converted to run either on CNG or electric. Flight idling emissions should be reduced within time frame.	
Railways	100% on electric	100% on electric	The activities of shunting locomotives which was working on diesel should be replaced with electricity for all loco shades in Mumbai

4.2 Point Source

The major industrial units are located in Chembur- Trombay area. As per emission inventory the percent emission contribution is around 26.9% form industrial sector to the whole of Mumbai. Among the industries Tata Power fuel contribution of PM is about 24.9%. The Red LSI i.e. refineries, chemical and fertilizers companies are shares 1.9% and all MSI & SSI (All Categories R,O,G) adds 0.04% percent of PM to the city. Tata Power Plant uses huge quantity of Coal, LSHS and NG, though the PM and NOx emissions from the power plant is within the city limit, as the impact is not felt due to its dispersal at the far end of the city through stacks Predominant meteorology of the city also favours its negligible impact on urban PM and NOx concentrations as established through modeling results. Other MSI & SSI industries use wide ranging fuels such as FO, LSHS, LDO, Coal and HSD, the quantities used are not very large; however, their local impact could be high. The short and long term reduction strategy is given below :

Measures Required

- Industries decline in the city has led to large decrease in air pollution; however, fuel shift in existing industries will further improve the ambient air quality. With fuel change, it will be decisive to study the feasibility of adopting the new technology. The MSI and SSI also need to get larger share of the natural gas for combustion processes to shift from FO and LSHS.
- The only power plant within the city, if it shifts to Natural Gas, major reduction in emission shall be achievable.
- Industries should adopt stack emission norms beyond those prescribed by CPCB Industries with QA/QC, the increase of most of the stack by large emitters can affect the air quality substantially as the prominent wind direction of the city to eastern part of Mumbai will disperse the pollution load.
- The data for small scale and unauthorized industries is scanty and at this stage to suggest the levels of contribution from these are difficult. The source apportionment study and the data indicate large part of the PM from other sources, which also need further investigations. These investigations of sources should be undertaken by MPCB/ GoM.
- Normally big industries monitored their air emission frequently. This resource should be well distributed with centralized data linkage with MPCB, which will provide very useful data base for city air quality management

Point Source Strategies for Short and Long Term

Point Sources	Short Term- 2019	Long Term- 2022	Action Plan
Power Plant	Shift to cleaner fuels i.e 50% LSHS to LDO Coal to NG Combustion technology up gradation for fuel change.	Shift in cleaner fuels i.e. 100% LDO & Coal to NG Feasibility of conversion of thermal power production to gas based system	For power plant the fuel change leads to technology change as well. However, newer technologies are more efficient and long term cost effective. The high quantity of fuel consumption is not much reflect in emission load from Tata Power as the stack heights are more and control options implemented.
Red (LSI)	Shift to cleaner fuels – 50% FO, LSHS, HSD to LDO Coal & Others to NG	Shift to cleaner fuels - 100% Low Fuel i.e LDO Nearly all to NG	• Shift to cleaner fuels from FO and Coal to Natural Gas (NG) as per the availability from M/s. Mahanagar Gas P.Ltd. • Feasibility of changing combustion technology to facilitate usage of gaseous fuels may be undertaken with financial incentives. • Use of continuous air pollution monitoring devices. • Identification of low cost and advanced cleaner technology for air pollution control with policy intervention at specific zones. • Industries should adopt stack emission norms beyond those prescribed by CPCB Industries with QA/QC • Inventorisation of prominent industries with technological gaps and detailed feasibility study is required as dispersion pollution with modeling and formulate land use based policy. • Industries should take lead for plantation around industrial zone and premises and green belt development. • One tree will offset on average about 10 kg CO_2 each year. According to this we will need 500 million additional trees in 2020 and 1200 million trees in 2051.

Point Source Strategies for Short and Long Term (Contd..)

Point Sources	Short Term- 2019	Long Term- 2022	Action Plan
MSI & SSI (All Categories Red, Orange and Green)	Shift to cleaner fuels – 50% FO, LSHS, HSD to LDO Coal & Others to NG	Shift to cleaner fuels – 100% Low Fuel i.e LDO Nearly all to NG .	• Shift to cleaner fuels from FO and Coal to Natural Gas (NG) as per the availability from M/s. Mahanagar Gas P.Ltd. • Inventorisation of prominent industries with technological gaps and make them available to change combustion technology to facilitate usage of gaseous fuels may be undertaken with financial incentives. • Reduction in use of DG sets by ensuring adequate power supply, and have stricter norms for DG set emissions. • Hazardous Air Pollutant emitting units. They have been directed to install Leak detection & repair system (LDAR) within months. • All the bulk drug and pesticides manufacturing units are being proposed to improve efficiency of their VOC scrubbers. • Energy Conservation Scheme should be encouraged in the industries that are not economically capable towards shifting to eco friendly fuel use or advanced clean technology. • Identification of Illegal SSI, MPCB should survey their levels of operation and their contribution of emission in each of the city grid.

4.3 Line Source

One of the major contributors to Particulate Matter (PM) and NOx emissions in Mumbai region is vehicular exhaust. Particulates present in vehicular emissions are especially harmful due to their small size (under PM_{10}) and even larger number below $PM_{2.5}$. The fine particles are also important due to their harmful chemical composition. The most prominent sources of vehicle particulate emissions are diesel driven and two-stroke petrol driven vehicles. Reduction strategies addressing both technical and non-technical issues presented here take into consideration the current ambient air quality standards; exhaust emission standards, emission inventory, vehicular population composition, infrastructure availability and the techno-economic feasibility in Greater Mumbai Region.

The discussion has been presented in following order:

- Improvement in fuel quality and alternate fuels
- Improvement in vehicle related components/technologies (After-exhaust treatment techniques and retrofitment)
- Synchronization of traffic signals
- Inspection & Maintenance programme
- Transport planning and traffic management
- Other options including phasing out old vehicles, revision of emission standards
- Encourage public transport, encourage non motorized transport and
- Reduce dust resuspension

Line Source Strategies for Short and Long Term

Area Sources	Short Term-19	Mid Term-22	Long Term-24	Action required
Reduction Emission per Unit of Fuel				
Sulphur reduction	S Reduction - 10%	S Reduction -30%	S Reduction -50%	▪ Low S level in the metro cities (Mumbai at <350 ppm) used as diesel in HDDV and LDDV. Delineating tighter diesel fuel standards. ▪ Phasing out fuel subsidies, uniform pricing all over the state ▪ Measures which can dissuade truck operators from buying high S fuel should be stricter, reliable and reproducible inspection for smoke levels.
Fuel Adulteration	Strict Banning of Fuel Adulteration-50%	Strict Banning of Fuel Adulteration-80%	Strict Banning of Fuel Adulteration-100%	▪ At petrol pumps facility should be provided for identification of fuel adulteration by way of marker ▪ Oil companies should used colour codes on the tanker transporting the fuel, regular testing of the fuel before it is filled in the bunks and after. Show pro-activeness in promoting the better lubricants. ▪ Oil companies should also put their own manpower and machineries in checking effectively their products being sold from their outlets. (e.g. BPCL's Pure for Sure; HPCL's Club HP and IOC's Q & Q etc., which are being carried out in, limited way. ▪ Economic measures such as removing the disparity in petrol, diesel and kerosene prices will be required to remove incentives for such large scale malpractices, Fines and cancellation of license are the tools ▪ Ministry of petroleum has constituted anti adulteration cell for preventing the malpractices of fuel adulteration
CNG/ LPG	Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted - 30%	Privately operated Vehicles viz. OLA, Uber and other contract buses, public trans. should be converted - 50%	Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted - 75%	▪ Taxies, 3 Wheeler and BEST Buses had already converted. ▪ Nearly 5000 cabs operated by Ola and Uber in Mumbai city which can be converted for clean fuel. The contract buses and intra city buses should promote for shifting of fuel through administrative orders and tax exemption. ▪ Incentive for new owners to buy CNG/LPG vehicles. ▪ Developed infrastructure for easy availability of fuel station for CNG refueling and availability of kits for such conversion to the older vehicles

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-19	Mid Term-22	Long Term-24	Action required
Reduction Emission per Unit of Fuel				
Banning of 15 year Old Commercial Vehicle	50% banning Encouragement by provision of incentives in form of scrap value.	70% banning	100% banning	▪ All vehicles should go through inspection and certification every two years. Incentive for an owner to phase out his vehicle after 15 years given in the form of low registration cost or direct subsidy ▪ Corporation and metropolitan authority should demark designated places for scrapped vehicles as such there is no provision in the city
Synchronization of traffic signals Sensor Based - Real time tracking	Major & minor roads, excluding feeder roads (or about 35% of the all arterial roads)	Major & minor roads, excluding feeder roads (or about 65% of the all arterial roads)	Major & minor roads, excluding feeder roads (or about 80% of the all arterial roads)	▪ Pre feasibility study should undertake for some hotspots. Detail study should be worked out on signaling network with sensor based monitoring and apply fuzzy logic, mathematical model gives the real time picture.
New Vehicle Standards	Currently BS-IV standards are in operation	Implement BS- VI from 2020 -50% (adopt progressive increment)	Implement BS- VI from 2020 -75% (adopt progressive increment)	▪ The government of India is planning to implement BS VI norm across all country in 2020, but due to recent events it has been implemented in some regions like Delhi. ▪ Regulatory bodies can undertake prior feasibility studies for its successful implementation across region. This is major measure considering 90% reduction in fuel sulphur.
In-Use vehicle	Marginal improvement from newer vehicles except when implementation is for Euro V & VI. -25%	Newer vehicles implementation of standards - 50%	Newer vehicles implementation of standards - 75%	▪ Improvement and compliance system in existing PUC ▪ In-use vehicles emission reduction can be substantial ▪ Inspection and identification of highly polluting vehicles ▪ Augmentation of manpower and related infrastructure for Inspection and Certification ▪ Vehicle manufacturer should be asked to get the emission warranty for the complete period of the operation of the vehicle. The same may also be included in the MoRTH guidelines to be developed asking manufacturer to be proactive even when vehicles have been sold

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reducing Fuel Consumption Per Unit Distance				
Share of Electric vehicles in Total City Fleet	Two wheeler: 5%, 3 wheeler and Taxi: 5% Public transport buses -5%	Two wheeler: 10%, 3 wheeler and Taxi: 10% Public transport buses -10%	Two wheeler: 10%, 3 wheeler and Taxi: 10% Public transport buses -20%	▪ Encouragement to public participation for taking share of electric vehicles. ▪ Easily availability of engine testing and repairs workshop. Incentive for buying and providing exchange offers mostly young generation and women.
Share of Hybrid vehicles in Total City Fleet	(Gasoline powered four-wheelers only) – 10%	(Gasoline powered four-wheelers only) – 20%	Gasoline powered four-wheelers only) – 30%	▪ Hybrid vehicle particularly efficient for city traffic where there are frequent stops and idling periods also reduce noise emissions in comparison to conventional engine vehicles. ▪ Hybrid vehicles can reduce air emissions of smog-forming pollutants by up to 90% and cut carbon dioxide emissions in half
Retrofitment of Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter in HDDV	Retrofitting devices- 50% conversion for HDDV in city registered vehicles	Retrofitting devices- 75% conversion for HDDV in city registered vehicles	Retrofitting devices- 1000% (Excluding the heavy duty city outside vehicles)	▪ A pilot study is required to test the need and efficacy of emission control device and retrofitting it in the older vehicles ▪ As retrofitment of emission control devices also needs a certain levels of fitness of the vehicle, it would be desirable to follow the norm after developing the same through the inspection and certification procedures ▪ It will be helpful to Maharashtra State Transport Corporation, Old BEST buses, Contract carriers ▪ Impose restriction of truck movement in the city for plying without retrofitment to HDDV vehicles (base on age and engine type). ▪ Tighter diesel fuel standards particularly for Sulphur to bring down its level up to 50 ppm. Differential taxation to those with and without after treatment devices.

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reducing Fuel Consumption Per Unit Distance				
Inspection and Maintenance	New I&M regulations (30% population of vehicles of a RTO region)	New I&M regulations (50% population of vehicles of a RTO region)	Full compliance - 100%	▪ The test design should have the basis of engine and overall vehicles fitness (roadworthiness). ▪ The Vahan-nagari area should be developed for I&M which is equipped with state-of-the-art testing set-up for all the types of emission as well as fitness testing ▪ Strict compliance for I&M programs that are difficult to cheat; computerized data capture of control of tests, strict enforcement with socially acceptable failure rates and penalties
Ban of odd /even vehicles	It is feasible to take trail for commercial / office areas – 20%	Identified the interlinking roads and traffic hotspots and implement for trail road - 20%	Identified the interlinking roads and traffic hotspots and implement for trail road -50%	▪ Add and even numbered vehicles will run on alternate days. Alternate arrangements should be made to bolster public transport. ▪ All private vehicles even having registration numbers issued by neighboring states will have to follow the odd-even number formula
Reduce Vehicle Distance Travelled				
Regulating Road Site Parking	Road site parking to be reduced by 50% (On street parking spaces as per IRC: SP: 12:2015.)	Road site parking to be reduced by 75%	Road site parking to be reduced by 100%	▪ Parking on roads should be regulated along with a rule to allow purchase of vehicles only if parking place is available. ▪ All road side shop, commercial premises, busy lanes are parking their vehicles indiscriminately near the approach movement. Municipal corporation should define designated space in the localities and develop elevated pay and park zones. Higher parking fee for longer period of time. ▪ The commercial vehicles for good transport should not be allowed in peak hours

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reduce Vehicle Distance Travelled				
Encourage Public Transport	Increase Public Transport - 20% Which reflect 10% VKT reduction from private vehicles.	Increase Public Transport - 50% Which reflect 40% VKT reduction from private vehicles	Increase Public Transport - 75% Which reflect 60% VKT reduction from private vehicles	▪ Refer Comprehensive Mobility Plan for Mumbai City prepared by Lee Associate. Incorporate city specific proposals on public transport with respect to Metro/mono rail, BRT, large buses contingent etc with integration of sustainable development and management. ▪ It can be achieved by way of providing better frequency to reduce congestion during peak period, better bus quality in terms of sitting as well as standing space ▪ The public transport should be cross-supported directly from the personalized vehicles either being purchased newly or older one running on the road. Funds generated from measures such as higher car user charges, higher parking charges, high registration fees, higher taxes on private mode of transport etc. should be directly transferred to them to achieve the low cost, better comfort, better frequency and faster travel. ▪ Diesel or any fuel used for public transport should be sold at lower price to keep the bus fare lower. ▪ Exclusive bus lanes should be identified. There is a need to undertake a project to demonstrate effectiveness of such system in Mumbai at one or two road stretches

For example, for one km of travel, a car consumes nearly five times more energy than a 52-seater bus with an average load factor of 82 percent. The corresponding consumption factor for two-wheeler is 2.6. The comparative fuel costs of a car and two-wheeler are 11.8 and 6.8 times respectively for the same distance. Besides, the major issue is that a car occupies 38 times more road space compared to a bus for a kilometer of a travel. Two wheelers space requirement is even higher at 54 times that of a bus*.

Further, the emission from a two-wheeler equivalent to a bus could add 27 percent higher, whereas the cars would cause 17 percent more pollution. The age of the bus can be of no major concern, when we compare the benefits that it could give in terms of fuel savings, emission and safety.

* Report on the Expert Committee on Auto Fuel Policy, Chapter 15, Government of India, 2002.
Every stakeholders consulted during the process, have agreed the major focus of any future transport initiative should be based on low cost public transport.

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reduce Vehicle Distance Travelled				
Road and Traffic Control	Interlink age & accessibility of road to Station, Residential Blocks & Offices. Identify 10% area	Identify 50% area covering feeder and service roads	Identify 75% area covering service roads and arterial roads highways	▪ MUTP component for Station Area Improvement (SATIS) shall be able to provide the necessary augmentation of current conditions. Prepare plan for widening of road and improvement of infrastructure for decongestion zones. ▪ Interlink age of Western and Eastern Express Highways, City linkage node like Airoli, Mulund Dahisar and Sion Panvel Highway of Road need to address as per traffic flow in peak hours. New development of Metro lines will reduce the load of private vehicles to public mode of transport. ▪ Encourage car pooling resulting reduction in private occupancy of vehicles and generate open space, less congestion with easy traffic flow.
Encourage non motorized Transport	Define in every ward at least 2% are for walking and cycling track	Define in every ward at least 10% are for walking and cycling track	Every road should at least 3 m road for walking - 100% removal of road encroachment	▪ Pedestrian friendly walkways /Subways ▪ Introduce and define walking and cycle tracks during city development plan. Cycling should be promoted with safety, free parking lots for users, and free bicycle ride facilities stops outside all railway stations

Line Source Strategies for Short and Long Term (Contd..)

Area Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reduce Vehicle Distance Travelled				
Reduce Dust Resuspension	Only some minor road are unpaved in Mumbai city, but due to resupension of vehicles dust is the major issue. Paving of all road 75%	Paving of all road 75%	Paving of all road 100%	▪ Need for better construction practices and codes for roads and pavement construction. UTTIPEC design manual has been recently created by Delhi Development authority for uniform roadside, drains, footpath and related design. The same should be adopted for all future design for roads and pathways. ▪ Vehicle speed and volume and road condition should frequently monitor by Traffic department, potholes and repair digging activities should be properly managed. ▪ Dug-up pavements have shown that fine particles keep getting resuspended in the atmosphere as the pavements are either not maintained or after the digging, those are not brought back to their original conditions ▪ Encroachment of roads space by slums are one of the major reasons for slow down of traffic and leading to higher per unit emission due to congestion ▪ Coordination with all institution working in the area of road and pavement maintenance, digging for utilities etc. ▪ Standards for road construction specified in terms of guaranteed life of the road. Financial incentives to contractors using better technology for road construction. ▪ Treated water from Ghatkopar STP can be used for road washing where resuspension is high during road maintenance and in summer season.

5. Management

There is a lack of collaborative policy initiative among the administrations and organization with regard to air quality improvement. These policy initiatives can be sustained and kept up-to-date only if there is an apex body, which from time to time gets feedback from various sources. These sources could be State Pollution Control Board, Regional Transport Office, Mumbai Municipal Corporation, Truck & Taxi Association of Mumbai, Baker Associations, Building Construction Association, MMRDA, MSRDC, Oil Companies, Anti-Adulteration Cell, and representative from ULB and NGOs, school and colleges. As and when, it is felt by the apex body that particular information desired is either site specific or city specific it can commission studies/ investigate on its own. Monitoring and regulatory agencies will provide all the information on monitoring to this body for data assimilation and dissemination. Regulatory framework, if needs can be communicated to the apex body for starting the initiative for policy formation. Hierarchical and structured managerial system for efficient implementation should be introduced with data linkage to SPCB/CPCB (of monitoring devices).

It is not just sufficient to measure air pollutant concentrations and assess their sources and their apportionment. It is equally important to disseminate that information to the public through various channels such as web / mobile application, information boards in public spaces as well sharing important studies conducted on air pollution with the public. This ensures public awareness of the issues and can help build ground up pressure on the concerned agents to address the problem.

MPCB and corresponding industrial stakeholders should take initiative in creating awareness program at various schools, colleges, public places, etc. through road shows, posters, banners, hand bills and various programs etc.

Most of the actions can be done by adapting and reinforcing existing actions for a more integrated, comprehensive and effective approach to combat Air pollution. Other actions focus on identified gaps in our study response so far that requires new activities, the discovery of new knowledge and the creation of new partnerships. The action plan will strengthen collaboration and surveillance, will reduce data gaps and allow for the sharing of best practices within the city jurisdiction. It will create more synergies and coherence between different policies according to our study. The action plan will thus support the stakeholders in delivering innovative, effective and sustainable responses to Air Pollution.