ACTION PLAN FOR CONTROL OF AIR POLLUTION IN NON-ATTAINMENT CITIES OF MAHARASHTRA

AMARAVATI



MAHARASHTRA POLLUTION CONTROL BOARD

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(AMARAVTI)

1. Preamble

Amravati District constitutes 3.96% of the total area of the Maharashtra state and is located in the Vidharbha region on the north eastern side. It is divided into 14 Tahsils and 14 Panchayat Samities. According to the 2001 census, there was 843 Gram Panchayats for the purpose of Rural Development. 75% of the district is covered by Deccan trap while 25% area is covered by Purna alluvium. Amravati city (21.30'-21.50'N; 76.35'-78.27'E) which includes the municipal boundaries has total area of about 121.65 Sq. Km. The population as per 2011 census is 647057. The city is located on the National Highway NH-6 leading to Mumbai in the west and Kolkata in the east. Amravati has good road and rail connectivity with almost all important cities in India. Fig. 1 shows the location map of Amravati city. The summary of demographic structure of the city is given in Table 1a. The ward wise population is given in Table 1b and slum population is given in Table 1c.





S. No.	Demographic Parameters	Amravati Municipal Corporation
1	State/District	Maharashtra/Amravati
2	No. of Prabhags	22
3	Total No. of Households	136796
4	Total Population	647057
5	Density of Population (Km ²)	5319
6	Sex Ratio (Females/100 males)	961
7	Scheduled Castes	111435 (17.22%)
8	Scheduled Tribes	15955 (2.47%)
9	Literate	535594 (82.77%)
10	Main Worker	189628 (29.31%)
11	Marginal Worker	18908 (2.92%)
12	Non Worker	438521 (67.77%)

 Table 1a. Summary of Demographic Structure in Study Area

Source : Primary Census Abstract, 2011 (Amravati District, Maharashtra state)

Ward no.	Ward name	Total population
1	Shegaon – Rahatgaon	27457
2	Shri Sant Gadgebbaba P.D.M.C	26952
3	Navasari	30705
4	Navasari colony	31005
5	Mahendra Colony-New Cotton market	29268
6	Vilas Nagar-Morbag	29597
7	Jawahar Stadium	27135
8	Jog Stadium – Chaparashi pura	26829
9	S.R.P.F. – Wadali	20452
10	Benoda – Bhimtekadi – Dastur Naga	32235
11	Frejarpura	28585
12	Rukhmini Nagar – Swami Vivekanand	26930
13	Ambapeth – Gaurakshan	27848
14	Jawahar Gate – Budhwara	29870
15	Chhaya Nagar – Gavalipura	32705
16	Alim Ngar – Rahmat Nagar	32004
17	Gadgadeshwar	31860
18	Rajapeth – Shri Sant Kanwarram	32501
19	Sai Nagar	30452
20	Sutgirni	32518
21	Juni Wasti Badnera	32442
22	Navi Wasti Badnera	27707
Total		647057

Table 1b. Ward wise population of Amravati city

Source: Census, 2011

Table 1c.	Urban	and	Slum	Po	pulation	in	the	City
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Population	Total		
Details			
City Population	647,057		
Slum Population	238,883		
Source: Census, 2011			

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1.1 Climate and Meteorology

Amravati has a tropical wet and dry climate with hot and dry summers and mild to cool winters. Summer lasts from March to June, monsoon from July to October and winter from November to March. The maximum temperature in summer is recorded as 44^oC and minimum as 29^oC. In winter, maximum temperature is usually around 28^oC and minimum is around 19^oC (AccuWeather, 2018). Wind speed is around 10 mph (16.9 km/hr) from North West and humidity is 12% (World weather online, 2018). The windrose diagram is shown in Fig. 2. It can be seen that the predominant wind direction is from West, NE and NW direction.



Fig.2. Windrose diagram for Amravati city – based on 2017 data

1.2 Ambient Air Quality – Secondary data

Based on last 5 year data obtained from the MPCB website, RSPM concentration is plotted in Fig. 3 Since MPCB provides the AAQ data on SPM, RSPM only and PM2.5 concentration is not provided by them or any other agency, it was not possible to give the historical picture of PM2.5 concentration. The data is plotted for three sites, Terrace of Govt. College of Engineering, Electronic & Computer Building (Residential), Building of Apurva Oil Industries (Industrial) and Vanita Samaj Building (Commercial). It can be seen that RSPM concentration is lower at residential site, whereas at commercial and industrial sites, it is mostly higher than CPCB standard of 100 ug/m³.



Fig. 3 RSPM concentration at three sites in Amravati during 2013-2017

1.3 Emission Inventory

For the effective emission reduction plan in advance, the knowledge of sources prevailing in the area along with their contribution is the preliminary step to envisage further steps. In order to facilitate the preparation of emission inventory, the general sources based on Point, Area and Line source category are considered. Data requirement for preparation of emission inventory along with its probable sources is presented in Table 2. For area sources, the emissions from domestic fuel consumption, bakeries, hotels, dhabas and open eat outs are considered. The details of the respective sources are given in the appropriate sections. In order to estimate emission load, CPCB and USEPA based emission factors are used. ARAI/CPCB has provided the emission factors for various types of vehicles. Emission factors for various types of vehicles being developed by ARAI/CPCB and other organizations will be utilized to estimate the vehicular emission load.

Table 2. Data Requirement and Probable Sources for Preparation of Emission Inventory

No.	Task	Data Required	Probable Source
			5 P a g e

<u> </u>			
1.	Mapping of road	Base maps, road network details,	Traffic Commissioner, RTO,
	network and other	population density, industrial	Municipal ward office
	details for delineation	activities	
	of zones / sector		
2.	Emission inventory for vehicular sources	 Secondary data on vehicle counts and locations, in-use vehicle population Registered data on vehicles (year-wise) and growth rate for past 15 years Vehicle usage characteristics Number of garages/service centers. Number of PUC centres Planned technological interventions Sale of Petrol/Diesel/ LPG per month Emission factors for emission 	Transport commissioner's office, RTOs, Reports, SIAM etc. Primary data through questionnaire Petrol pumps/Local Agencies/Marketing Terminal/PUC centres/Parking lot/ Vehicle service centres/Individual vehicle owner
3.	Emission Inventory for Industrial Sector	load estimation Major types of air polluting industries - Fuel usage (quantity), fuel type (quality) and	PCB, CPCB, Industrial Development Corporation, Industries Association, Fuel
		pollutant load from various industries	supply agencies
4.	Emission Inventory for Area Sources (residential and commercial sector)	 Population and demography Data on domestic fuel Number of registered hotels, Restaurants, bakeries etc., Number of Crematoria Data on refuse burning Data on Incinerators Sale of LPG/kerosene/coal/ wood 	Census office, Municipal Corporation. District Collector's office, District fuel supply office, Rationing office, Fuel supply dealers, Development Authority, Associations of Hotels, Restaurants, Bakeries, Health department of Municipal Corporation. Primary data through questionnaire Residential/Hotels and restaurant owners/bakery owners /commercial establishments/ crematoria

1.3.1. Area Source

Emission load calculated for area sources is given in Table 3. The details of the major area sources in short are given below. The details on the solid waste generation and construction activities are given in the respective sections.

A.1 Bakery

It was found that most of the bakeries are operating as coal based unit (63.64% - 590 kg/d) and wood based unit (36.36% - 845 kg/d).

A.2. Open eat-outs

Most of the open eat-outs are operating as LPG based (82.4%) with kerosene (12.8%), coal (12%), diesel (1.2%) and wood (2.4) based units.

A.3. Hotels and Restaurants

Hotels and restaurants are mostly LPG based (91.1%) with presence of kerosene (3.81%), coal (1.6%) and wood (3.38%) units.

A.4. Crematoria

Crematoria are operating as kerosene based unit (91.6%).

A.5. House Hold Fuel Consumption

There are 10 LPG distributors in the area. Number of LPG consumers are 3.83 lacs with 10.37 TMT quantity sold in 2018 as per the data given by Indian Oil Corporation Limited, Bandar, Mumbai. The emission load is however calculated based on the data from the report of Census of India, 2011.

A.6. Fuel Consumption in Slum Population

A survey of 36 households was conducted, spread over 7 areas within the city which were known to have significant slum population. It was seen that majority of the slum houses used a combination of fuels such as LPG (6.06%), wood (77.79%) and kerosene (16.13%). The kerosene consumption based on ration shops survey was found to be 7179 L/M.

As per emission inventory, PM percent contribution from area sources is very high particularly when compared with emissions from vehicular emissions. Based on the % share contribution, surveys and assessment, few recommendations are suggested to reduce the emissions from area sources as given in Table 4.

Source	Fuel/Type	PM2.5 (TPY)
Bakery	Wood	1.7
	Coal	1.2
Crematoria	Wood	10.8
	Kerosene	0.0
Open burning	196.1	196.1
Construction	New	407.8
	Ongoing	383.3
	Road dust	24.1
Domestic	Kerosene	5.7
	LPG	270.8
	Wood	654.3

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	Coal	20.7
	Crop residue	297.6
	Cow-dung	11.5
Open eatout	LPG	0.5
	Keorsene	0.0
	Coal	0.0
	Wood	0.3
	Diesel	0.0
Hotel	LPG	515.3
	Kerosene	0.0
	Wood	0.4
	Coal	0.3
Brick Kilns	Wood	148.3
	Coal	225.5
Paved Road dust	291.5	291.5
Unpaved Road dust	241.8	241.8

B. Solid Waste emissions

In Amravati, there are 5 zones within which 22 Prabhags are located. For the sake of convenience of management of municipal solid waste; the waste generated, resources available etc. are referred to each prabhags and respective zonal office. The ward wise MSW generation is given in Table 5. The corporation performs its function as per the provisions of the act governing the municipal corporation in the state. Table 6 shows the facilities for collection and transportation of MSW. Based on the survey data, 362 tonnes per day solid waste generation is considered for estimation of PM emission load.

Out of the total waste generated, 35.53% is biodegradable, 15.95% is recyclable and 48.52% is debris and silt (Khandve. P. V, Rai.R. K., 2011. Municipal Solid Waste Management at Amravati City - Present practice and future challenges, I. J. Environmental Sciences 2(2). 625-635). As such only dumping facility at Sukoli depo is available for the whole city. The transportation of waste up to compost depot at Sukhli road is done through open trucks and dumpers. The disposal of solid waste is done at the landfill site, which is approx. 160-170 MT.

Ward No.	Name of wards Cover Door to Door Colletion	Name of Plant waste to energy / Composting, Recycling / Biomethanation	Waste Collection (Ton/Day)	Waste Treated (Ton/ Day)	Remaining Waste (Ton/Day)
1	Shegaon- Rahatgaon	Rathi nagar Garden	18	4.3	13.7
2	PDMC	Rathi nagar Garden	17	4.1	12.9

Table 4. Ward-wise Population and Total Solid Waste Generated

3	Navsari	Sukali Compost Depot	16	3.8	12.2
4	Jamil Colony	Sukali Compost Depot	17	4.1	12.9
5	Mahendra Colony	Sukali Compost Depot	16	3.8	12.2
6	Vilas Nagar	Sukali Compost Depot	16	3.8	12.2
7	Jawahar Stadium	Sukali Compost Depot	16	3.8	12.2
8	Jog Stadium	Sukali Compost Depot	16	3.8	12.2
9	SRPF	Wadali Garden / Bambu Garden	16	3.8	12.2
10	Benoda	Chhatri Talav	17	4.1	12.9
11	Frezarpura	Sukali Compost Depot	17	4.1	12.9
12	Rukhmini Nagar	Sukali Compost Depot	16	3.8	12.2
13	Ambapeth	Sukali Compost Depot	16	3.8	12.2
14	Budhwara	Sukali Compost Depot	16	3.8	12.2
15	Gawalipura	Sukali Compost Depot	16	3.8	12.2
16	Alim Nagar	Sukali Compost Depot	16	3.8	12.2
17	Gadgadeshwar	Sukali Compost Depot	16	3.8	12.2
18	Rajapeth	Sukali Compost Depot	16	3.8	12.2
19	Sai Nagar	Sukali Compost Depot	16	3.8	12.2
20	Sutgirani	Sukali Compost Depot	16	3.8	12.2
21	Old Town Badnera	Sukali Compost Depot	18	4.3	13.7
22	New Town Badnera	Sukali Compost Depot	18	4.3	13.7
Total			362	86.3	275.7

Source: Survey by Green Health Foundation, 2018

Table 5 Infrastructure for MSW Collection and Transportation

S. No.	Facility/Infrastructure	No.
1	Handcarts	90
2	Ganti Katla (Mechanized)	350
3	Ganti Katla (Organized)	90
4	Hydraulic Auto	43
5	M.O.H	1
6	Medical Officer	1
7	Doctor Incharge	1
8	Sanitary Superintendent	1
9	Sanitary Inspector	48
10	Mukadam deployed	86

Source: Khandve. P. V, Rai.R. K. (2011)

Note: the data is old and many changes may have taken place.

The resolution No. **368 dated 25-11-2016** has been passed by the standing committee for the total 500 TPD plant proposed for the scientific disposal of the 200 TPD daily waste and 300 TPD for old dumping waste

C. Point Source

As per emission inventory, the percent emission contribution to PM2.5 is around 28.8% from industrial sector (coal, brick kiln and wood). Based on the report on industrial profile (Brief Industrial Profile of Amravati District, 2015-16, MSME Development Institute, Govt. of India, Ministry of MSME), it is observed that the number of registered industrial units have declined from 1051 to 261 during 2014-15 to 2015-16. There are approximately 57 industrial units in and around the 5km radius of the city that have been considered as air polluting and accounted for in the present study. Fuel based contribution is given in Table 8. There are in all 9 brick kilns in the area. The fuel consumption pattern of the brick kilns is 23.82% wood, 60.25% coal and 15.91% asha. The emission from coal based power plant is 3465 TPY and from other industries, emission load is estimated to be 719 TPY. From brick kilns, the total emission load is 373.8 TPY. Fig. 4 shows the % share of brick kilns, coal based power plant.

Fuel	PM2.5 load (TPY)
Coal	2788.7
Furnace oil	4.0
Wood	110.1
Diesel	51.8
HSD	13.2
Methane gas	0.0
Biomass Briquettes	5.0
Bagasse	2.3
LDO	1.1
Total	2976.1

 Table 6. Point Source Emission Inventory



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Fig. 7 PM2.5 emissions from industries and brick kilns

D. Line Source

There are about 258925 lakhs registered vehicles in Amravati District. The distribution of vehicles based on RTO data is given in Table 10a. Based on the traffic count data it is observed that overall 569652 vehicles ply on the roads of the city. The distribution of different vehicles is given in Table 10b. There are 5 parking sites in the city, namely, Badnera cycle stand, central railway (pay and park), city hospital, railway station parking, ST bus stand. The numbers of registered vehicles are growing 7% per annum in Amravati (based on RTO data). Public transport in Amravati city is a road based bus, operated by AMC. Currently the city buses operated by AMC are privatized with the operation & maintenance done by the contractors. A royalty of 1.10 Paisa per Km is given to the AMC. A total of 27 buses run throughout the city covering a daily run of 3963 Kms. The frequency of these buses is 15 minutes. Apart from the city bus services ST bus service facilities is provided by the ST Mahamandal, Amravati. Considering the number of vehicles in the city, the corresponding infrastructure in terms of parking facilities is not adequate. There are 100 buses that operate in and out of the city. The public transport infrastructure needs to be justifiable in terms of the number of commuters. Action plan for line source emission reduction is given in Table 11.

S. No.	Type of vehicles	No of Vehicles
1	2W	213538
2	Cars_Diesel	10054
3	Cars_Petrol	6771
4	Jeeps_Diesel	2116
5	Jeeps_Petrol	95.2
6	Station Wagons	145
7	Taxi_Diesel	418
8	Taxi_Petrol	248
9	Auto Rickshaws_Diesel	516
10	Auto Rickshaws_Petrol	5886
11	Stage Carriages	222
12	Contract Carriages/Mini bus/ School van	163
13	School Buses_Diesel	105
14	School Buses_Petrol	95
15	Pvt. Service Vehicles	56
16	Ambulance_Diesel	102

Table 8a. Number of Vehicles in the City

17	Ambulance_Petrol	21
18	Trucks & Lorries	3400
19	Tankers	96
20	Delivery Van (4 Wheelers)	3360
21	Delivery Van (3 Wheelers)_Diesel	1254
22	Delivery Van (3 Wheelers)_Petrol	557
23	Tractors	5974
24	Trailers	3490
25	Others	243
r	Fotal	258925

Source: RTO, 2017

Vehicle	No. of
Туре	Vehicles
2W	341394
3W	107270
Car	93454
4W	27534
Total	569652

Source: Green Health Foundation, 2018



Fig. 5 % contribution of PM2.5 from different type

Overall PM2.5 contribution by various sources

Table 12 shows the PM2.5 emission load contribution by various sources in tonnes per year (TPY). It can be observed from Fig. 6 that Industries contribution is highest followed by

domestic and commercial fuel burning (D&C burn). Vehicles and Road dust also contributes significantly to total PM2.5 load.



Fig. 6. % contribution to PM2.5 by various sources

Source	PM2.5 load (TPY)
Vehicle	1620.5
Industry	2004.6
Road dust	1348.6
D&C burn	1791.2
Open Burning	196.1
Total	6960.9

Table 9. Emission load contribution by various sources

2. AMBIENT AIR QUALITY DATA

2.1 Month and Annual average data for SO2. NOx and RSPM are provided below

Station Name	year	Month	Average of SO ₂	Average of NOx	Average of RSPM
			50	40	60
		Apr	15	16	147
		May	13	14	138
		Jun	13	15	119
		Jul	10	16	110
	2017	Aug	11	14	108
Dei Kamal Chawk		Sep	13	14	119
Kaj Kamai Chowk		Oct	12	13	122
		Nov	12	13	107
		Dec	14	15	115
		Jan	14	15	121
	2018	Feb	13	14	116
		Mar	13	117	122
		Apr	13	15	79
		May	13	14	82
		Jun	10	11	62
		Jul	9	10	52
	2017	Aug	9	14	65
Govt. College of Engineering		Sep	11	12	64
		Oct	11	14	75
		Nov	12	13	70
	2018	Dec	12	13	71
		Jan	12	13	75
		Feb	11	13	70
		Mar	12	61	73
		Apr	12	13	120
		May	11	12	105
2017 Godhadiwala Private Limited	Jun	9	11	85	
		Jul	10	11	82
	Aug	10	14	87	
		Sep	10	11	98
		Oct	11	12	103
		Nov	12	13	105
		Dec	12	13	100
		Jan	13	14	101
	2018		12	13	89
	Mar	12	100	101	

Data for Monthly average reading recorded at Amravati

Station Name	year	Average of SO2	Average of NOX	Average of RSPM
		50	40	60
	06-07	13	19	79
	07-08	11	16	78
	08-09	12	15	100
	09-10	14	16	125
	10-11	13	15	146
Pai Kamal Chawk	11-12	15	18	108
Kaj Kamai Chowk	12-13	12	13	109
	13-14	12	13	128
	14-15	12	14	133
	15-16	12	14	135
	16-17	13	14	141
	17-18	13	23	120
	06-07	10	12	50
	07-08	8	8	40
	08-09	8	10	47
	09-10	10	12	78
	10-11	10	13	79
Cout College of Engineering	11-12	10	12	79
Govt. College of Engineering	12-13	11	12	80
	13-14	10	12	80
	14-15	11	12	75
	15-16	11	12	73
	16-17	11	13	73
	17-18	11	16	69
	06-07	12	16	67
Godhadiwala Private Limited	07-08	9	12	58
	08-09	10	13	71
	09-10	12	14	102
	10-11	12	14	125
	11-12	11	13	100
	12-13	12	13	101
	13-14	11	12	94
	14-15	12	14	108
	15-16	11	13	110
	16-17	12	13	108
	17-18	11	21	97

Data for Annual average trend of SO₂, NOx, and RSPM at Amravati

3. Action Plan

Table 10. Action Plan for Area Source Emission Mitigation

Area Sources	Short Term- 2019	Long Term- 2022	Action required
Fuel burnt Res and commercial Cooking	5% reduction in emissions	20% reduction in emissions	As given below for individual sources
Domestic combustion			Household wood and cow-dung burning is to be reduced. Increase in LPG usage through Ujjwala scheme. Alternate fuel options e.g. solar needs to be assessed and exercised.
Hotels, dhaba and open eat- outs			Use of LPG in Hotels and eateries.
Bakery			In bakeries, reduction in wood usage is to be emphasized through replacement with other options such as electric- ovens.
Crematoria			Total 10 crematorias. Renewable fuel/biomass briquette etc. to be encouraged.
Solid waste/open burning	5% reduction in emissions	7% reduction in emissions	 Increase in segregation, collection and proper disposal with increased Green Belt. Launch extensive drives against open burning. Decrease in waste burning. Public awareness drives. Proper collection of Horticulture waste and its disposal following composting-cum-gardening approach. Bio-methanation and biogas plant need to be installed.
Road dust and C&D	2% reduction in emissions	8% reduction in emissions	 Reduction in unpaved roads by paving. Enforcement of construction & demolition rules. AMC has proposed plan for creation of green buffers along the traffic corridors (AMC has passed the order Vide letter no AMC/ENV/MC/817/2017 dated 07/02/2016 forwarded to GM BSNL, PWD, for proper action). Plantation drive along the road side, Greening of open areas, garden, community places, schools and housing societies. Wall to Wall paving (brick).

Point Sources	Short Term-	Long Term-	Ensure carriage of construction material in closed/covered Vessels. Control measures for fugitive emissions from material handling, conveying and screening operations through water sprinkling, curtains, barriers and suppression units. Action Plan
Industry	2019 To get the 10% reduction in emissions till 2019	2022 To get the 25% reduction in emissions till 2022	 Change in coal quality with less ash content. The need is to focus on the less ash content and high calorific value of the coal to increase the plant efficiency. For the other industries, the aged boilers need to be replaced, if any. Conversion of natural draft brick kilns to induced draft, Banning of operation of Brick kilns in city area. Banning of new air polluting industries in existing city limit. Visit observations: water sprinkling after the arrival of the officials, needs to be a regular practice in fugitive dust areas. Regular audit of stack emissions for QA/QC. Efficacy of Use of solar power in Industries and other control measures needs to be studied. Technological improvement option as given in Ma et al., Aerosol and Air Quality Research, 17: 636–643, 2017 can be studied.
Line Sources	Short Term- 2019	Long Term- 2022	Action required
Vehicles	15% reduction in emissions	37% reduction in emissions	 Heavy duty vehicles are the major contributors to PM load: Although the number is less, high emissions are observed due to high emission factor and VKT. High number of heavy duty 4W are observed at Shegaon Sq., Dastur Nagar Sq., Old bypass, Welcome gate. Bypass exists for nondestined vehicles. Retro fitment of Diesel Oxidation Catalyst (DOC) in 4-wheeler public transport. Retro-fitment of Diesel Particulate Filter in 4- wheeler public transport.

 Inspection/maintenance to all commercial vehicles. Restrict commercial vehicle entering city by having ring roads. 2W are significant contributor to PM load. With proper maintenance, the emissions are assumed to be same in spite of increase in number of vehicles. High number of 2W are observed at Railway stn bridge, Pachwati Sq. Shegaon nak, Kathora naka sq. and Tapovan Sq. For reducing the traffic congestion, no parking zones at the traffic areas need to be delineated. Roads hindering the smooth traffic movement need to be identified and either may be closed and traffic may be diverted or some other suitable option may be exercised. Roads need to be identified for widening. Maintain potholes free roads for free flow of traffic. Introduce bi-cycle tracks/paths and encourage the use of bi-cycles Launch public awareness campaigns for air pollution control, vehicle
• Launch public awareness campaigns for air pollution control, vehicle
maintenance, minimizing use of
NGOs need to be involved for this
purpose.
Immediate launch of extensive fuel adulteration drive and random monitoring of fuel quality data.

3.1 Recommendations

A. Fuel burnt in hotels, dhabas, open eat-outs, bakeries and domestic combustion Recommendations

• Bakeries, hotels, restaurants and open eat-out emissions can be reduced through implementation of fuel shift combined with awareness programmes.

- The emissions from the stacks of bakeries should be regulated and emission control devices such as bag filter, scrubbers etc. should be installed. These bakeries can be made to operate on electric or LPG.
- Consumption of wood and cow dung burning is high in Amravati. Shift to LPG usage through Ujjwala schemes is envisaged to reduce the emissions from wood burning. Better cook-stove designs can also reduce emissions from LPG combustion which is also the higher contributor to PM2.5 emissions.
- Crematories need installation with efficient pyres and chimneys for release of emissions. Bodies related emissions from the pyre can be reduced by installing efficient PM control measures such as bag filters or cyclones. Wood consumption is higher in all the crematories. Option of shift of fuel to biomass briquettes and electricity needs to be exercised.

B. Solid waste

1. On site segregation of solid waste to separate dry solid waste and wet solid waste needs to be improved to minimize the load on compost depot.

2. Collection and transportation facilities required to be strengthened by providing different category of extra collection vehicles as well as workers.

3. Existing compost depot and proposed Landfill site should be well planned and equipped with new technologies for disposal of municipal solid waste.

4. Utilization of compost manure, recovery of possible materials for recycling, and landfill gas utilization for energy recovery.

C. Construction

There are 109 numbers of building constructions and 7 road constructions. The recommendations are:

- Follow-up of Building construction and demolition rules considering the emission control of PM. Strict norms to be followed if the violations are observed.
- There is poor pedestrian infrastructure in Amrawati. RUBs / ROBs / Footpaths, Pedestrian crossing etc. are necessary for proper transport system. Provision should be made from Corporation with appropriate fiscal measures. Special provision for bi-cycle pathways need to made to reduce PM emissions.
- Regular maintenance of road, sweeping at regular intervals can reduce resuspension of dust contribution to PM in the city.
- To control of resuspension from construction sites, appropriate covering or barricading should

be done to avoid dispersion of the dust. Constructing a water pit at the entry/exit points of the construction site to avoid dispersion of particulate matter through movement of trucks while entering and exiting the site.

D. Road dust

Road length data is given in Table 7, which shows that unpaved road length is higher than paved road length. PM2.5 contribution from paved road dust is 291.5 TPY and unpaved road dust contribution is 241.8 TPY

Road Type	Length (Km)
Bitumen (Dambar)	366.78
Concrete Road/Paver block	226.49
WBM (Khadikaran)	522.4
Un surface Road	420.14
Total	1535.81

Table 11. Road Length in the City

Source: Amravati Municipal Corporation

E. Industry

- Although based on the report by MSME, industries have declined in the city but the overall emission contribution is highest. Some suggestions have been given in Table 9 regarding the fuel shift and inclusion of air pollution control technologies in the existing industries
- Change in coal quality with less ash content will reduce the PM emission to a larger extent.
- It is further to note that information on small scale and medium scale industries is fully not available and accounting for those industries contribution is difficult.

F. Amravati Smart City Vision (Source: Smart City Challenge- AMC, 2015)

- G. "Make Amravati city the Agro-Tech Business District (ATBD) especially in textile Industry and in the process improves economic and social well-being of the citizens; Make Amravati the city with the highest quality of life index" Amravati has huge industrial potential and the new textile park will further boost its industrial profile
- H. The City is rapidly expanding towards Badnera, 10 km to the south
- I. Growing as an industrial centre, with cotton mills leading the way. Home to Vidharbha Sugar Mills.
- J. At Nandgaon Peth/Saward: 2,700 MW Thermal Power Plant is coming up. Bharat Dynamics Limited (BDL) plans to make air defence missiles.

- K. Significant warehousing potential with CWC presence and APMC godowns
- L. Amravati Airport to be developed by AAI
- M. Upcoming Railway Walgaon Factory will boost the scope of developing a lorry unit for wagons.

4.0 Monitoring Mechanism for Implementation

The aforesaid action plan shall be implemented by Maharashtra State Pollution Control Board with coordination of concern departments/stakeholders.

5. Implementation status

The Chief Secretary, Govt. of Maharashtra to convene the meetings with different concerned departments and direct for compliance of directions for implementation of air quality of Amravati. The Principal Secretary, Environment and Forest, Govt. of Maharashtra to also convene the meeting for follow up of the aforesaid directions. The Maharashtra Pollution control Board continuously conducted the meetings with all stakeholders for preparation of comprehensive action plan for city and its implementation.

					Amravati Municipal Corpora	ition			
				Evaluation of	Emission Control Option as p	er CPCB Template	25		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	
Sr. No.	Source Group	Control Option	Expected reduction and impacts	Technical Feasibility	Requirement financial resources	Implementati on period (Short/mid/I ong-term)	Time target for implementati on	Responsibl e agency (ies)	Any Other Information
(i)	Vehicle emissi on								Major source: 2W followed by Heavy duty diesel vehicles
1		Launch extensi ve drives against pollutin g vehicle s for ensurin g strict compli ance, inspecti on of comme rcial vehicle s	Medium	Surveys/Ide ntification and maintanenc e/better combustion / Emission reduction stepsIntrod uction of Bharat VI Vehicles	Survey work-Rs. 5-10 lakhs,, Ref: http://urban.rajasthan.go v.in/content/dam/raj/udh /organizations/ruidp/Dow nloads/BSR/RUIDP%20ISO R-%202017.pdf	Short/Long Term term	2018-2019	RTO / Smart city AMC	See Annexure D1-D8
2		Synchr onize Traffic movem ents/In troduc e Intellig ent Traffic system s for Lane Driving	Low		Rs. 100 lakhs per traffic intersection Ref. https://parade.com/1907 2/marilynvossavant/what- would-traffic-light- synchronization-cost/	Mid term	2019-2020	Electrical Departmen t, AMC, RTO, Traffic Police, Smart city	
3		For reducin g the traffic congest ion, no parking zones at the traffic areas need to be delinea ted.	Medium	Unathorize d contruction of total 348 Private Parking belonging to Hotels, Function Halls, Commercia I Complexes was removed	Rs. 10 lakhs	Short term	2018-2019	Electrical Departmen t, AMC, RTO, City Traffic Police	Continuous efforts have been taker to remove the road side encrochme nt for smooth flow of traffic. Amravati Public Works Department

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	Roads hinderi ng the smooth traffic movem ent needs to be identifi ed and either may be closed and traffic may be diverte d or some other suitabl e option may be excerci sed.		and bind them to use only for parking purposes to minimize the traffic congestion, modern traffic signalling system at major junctions have been initialized, re- designing traffic structure to encourage lane- driving.					has already contracted the new bypass in addition to the existing bypass (old bypass) constructed already as per city developme nt within the time frame
4	Launch public awaren ess campai gns for air pollutio n control, vehicle mainta nence, minimi sing use of person al vehicle s, lane discipli ne etc. NGOs need to be involve d for this purpos e.	Low	Maintanen ce/Strict compliance	Survey work-Rs. 5-10 lakhs,, Ref: http://urban.rajasthan.go v.in/content/dam/raj/udh /organizations/ruidp/Dow nloads/BSR/RUIDP%20ISO R-%202017.pdf	Short term	2018-2022	Traffic Engineer, AMC/Smart city Advertise Deptt. AMC MSRTC	
5	Retrofit ment of Diesel Particul ate Filter in 4- wheele r public transpo rt	Medium	RTO departmen t taking strict action regarding implement ation of these new norms	Rs. 0.5-0.7 lakhs per unit		2018-2021	NEERI / IIT, City Traffic Polic, RTO	Enforcemen t of smoke emission standards for containing vehicular exhaust at the manufactur er and user level.

6 Immedia Mediam Maintanen alte launch extensi of extensi exte									
7 Roads Low AMC prepared lakkin, pothol 2018-2020 AMC, PVD. Construction 1 identifi epared lakkin, pothol maintanence-Rs. 10000 NHAI n of over 1 identifi been in implement implement implement implement 1 ation such as widening as widening as widening as widening as widening 1 of for free of road and infrastructu refor as widening as widening <td>6</td> <td>Immedi ate launch of extensi ve fuel adulter ation drive and rando m monito ring of fuel quality data</td> <td>Medium</td> <td>Maintanen ce/Strict compliance . Refer page no 9 PUC statement from 1.4.2016 to 31.3.2017, Mechanism to check with time requiremen t of each check to be identified</td> <td>Survey work-Rs. 50-70 lakhs</td> <td>Long term</td> <td>2018-2022</td> <td>Residence Deputy Collector(R DC) , Distrcit supply officer & Tahsildar, AMC, RTO</td> <td>Policy adapt as measure to ensure that all vehicle come for tests, On road inspection if vehicles planned and periodicity and coverage</td>	6	Immedi ate launch of extensi ve fuel adulter ation drive and rando m monito ring of fuel quality data	Medium	Maintanen ce/Strict compliance . Refer page no 9 PUC statement from 1.4.2016 to 31.3.2017, Mechanism to check with time requiremen t of each check to be identified	Survey work-Rs. 50-70 lakhs	Long term	2018-2022	Residence Deputy Collector(R DC) , Distrcit supply officer & Tahsildar, AMC, RTO	Policy adapt as measure to ensure that all vehicle come for tests, On road inspection if vehicles planned and periodicity and coverage
		Roads need to be identifi ed for wideni ng.Mai ntain pothole s free roads for free flow of traffic.	Low	AMC prepared the action plan which is already been in implement ation such as widening of road and improveme nt of infrastructu re for decongesti on of roads. In future also, the work shall be continued as per the directions issued by Hon'ble Board. AMC has developed an extensive network of traffic facilities. These facilities should continue to be implement ed, connected and expanded. Roads and footpaths "properly leveled, surfaced and maintained free of patholes or ditches" Alonp	Survey work-Rs. 10-50 lakhs, pothol maintanence-Rs. 10000 approx. based on the size	Mid term	2018-2020	AMC, PWD, NHAI	Construction n of over bridge to minimize traffic congestion on Amravati Badnera Road near Dhamman Garden Area now it has been opened for vehicle movement Similarly AMC planned to construct Railway over bridge at Rajapeth which is under process and soon completed which will ease the traffic congestion in the area Improvement similarly AMC planned to construct Railway over bridge at Rajapeth which is under process and soon completed which will ease the traffic regulation and strict enforcement t of prescribed standards. To promote the publc transport system, AMC

			traffic corridors, maintain pathhole- free roads for free flow of traffic, introduce water fountains at traffic intersectio ns and conduct plantation drives in open areas, gardens, community places, schools and housing societies.					new buses and in addition to that 15 new buses proposed within the city .
8	Introdu ce bi- cycle tracks/ paths and encour age the use of bi- cycles.	Low		See (v)5	Short term	2018-2020	AMC	
9	Restrict comme rcial vehicle enterin g city by having ring roads.	Medium		As per sanctioned budget	Task completed	Task completed	PWD, NHAI	
10	Steps for promot ing Battery operat ed vehicle s, new technol ogy vehicle s	Medium	As per the directions, action plan have been prepared for promoting battery operated vehicles. In smart city action plan, this activity has already been proposed and will be put up for approval in Amravati Smart City Developme nt Board	Rs. 10-15 lakhs per vehicle Ref. https://dir.indiamart.com /	Mid term	2020-2022	AMC, RTO	

				meeting. Regional Transport Authority informed about this action point and they will take appropriate action					
11		Public transpo rt system: the current status of public transpo rt in terms of numbe r of buses, load factor etc. and propos ed plant to augme nt the fleet	Medium	Implement ation Policy Decision	Rs. 20000-50000 per filter Ref. https://dir.indiamart.com /impcat/particulate- filter.html	Long term	2018-2022	Transport Departmen t, AMC	
12		Ethanol blendin g (E10- 10% blend)- bus	Medium	Implement ation/ Policy Decision/ Feasibility study	Rs. 1.20 cr. per bus Ref.https://timesofindia.i ndiatimes.com/city/nagpu r/Ethanol-bus-eco- friendly-not-pocket- friendly/articleshow/4660 2245.cms	Long term	2018-2022		
13		Bannin g of 10 year old comme rical vehicle s	Medium	Implement ation/ Policy Decision/Al ternative option	-	Long term	2018-2022	RTO	
(ii)	Resusp ension								
L			i		1	1	E		<u> </u>

2	Creatio n of green buffers along the traffic corrido rs Plantati on	Low	The buffer zone has been created to following road; Irwin to Biyani square, Police petro pump to Rathi High School, At welcome points, Hamalpura to Science Score Ground ((AMC has passed the order Vide letter no AMC/ENV/ MC/817/20 17 dated 07/02/2016 forwarded to GM BSNL, PWD, for proper action) Total 3100 plantation	Rs. 1000 per sq. ft Ref. www.sanjaynursery.com/ vertical-garden	Task Completed Mid term	2018-2019 Task completed.	Building and Contruction Deparment , AMC, PWD Garden deptt. AMC	See Annexure C2-C6 Amravati city has 69 action
	drive along the road side, Greeni ng of open areas, garden, commu nity places, schools and housin g societie s.		plantation has been carried out last year along the opn areas, gardens, community places, schools and housing societies. The city has a tree cover distributed throughout the urban- scope. A tree census is being conducted by AMC. 3700 trees were planted in the year 2014-15 & 300 trees are planted int he year 2015-16. For creation of green buffer zone, total	https://economictimes.in diatimes.com/news/politi cs-and-nation/rs-1000cr- fund-to-plant-trees-along- highways-in-the- works/articleshow/51592 606.cms		Further plantation drive will be conducted in July 1st of each year.	/ Garden Deptt. Building and Contruction Deptt., Environme nt Deptt. AMC	gardens. 6 new gardens ar proposed t be supplemer ed within the city. The school curriculum is an effective way to deliver messages household Greenery development of Shiv Tekadi which locates in the centre of the city to tackle carbon footprints. Development of ecotourisn spot withir AOC jurisdictior such as Wadali Lakes and

				plantation in yera 2016-17 with 100% survival rate along the roadside. This activity will continue to implement to cover maximum area to minimize the pollution.					Chhatri Lake.
3		Wall to Wall paving (brick)	Low	Implement ation	Rs. 100 per sq. ft Ref. https://www.indiamart.co m/proddetail/natural- stone-wall-bricks- 16478046533.html	Long term	2018-2020	AMC	
(iii)	Biomas s/trash burnin g, landfill waste burnin g								No segregation of waste is done at present. Dumping Site-Sukali (landfilling' dumping). Biomedica Waste managmen ent 1TPD
1		Launch extensi ve drives against open burning of biomas s, crop residue , garbag e, leaves etc. Strict compli ance of	Medium	Resolution has been passed to ban the burning impose fine of Rs. 5000 -25000 as per NGT order. Statuary body legal compliance s by APC and its action plan: Air Environme nt: Air	Survey work-Rs. 5-10 lakhs	Already implemented	2018-2022	Health Departmen t, AMC, Environme ntal Departmen t, AMC	Solid waste generated - 132130 tons /Y, 31500 is treated and remaining unmanaged . This emits about 365 TPY of PM Recovered the fine 9.21 lakh from burning and plastic banned

	ban on open burning in munici pal area.		Pollution direction u/s 18(1) (b) and 31 (A) of the Air (Prevention and Control of Pollution Act, 1981).						
2	Regular check and control of burning of Munici pal Solid waste. Public awaren ess about the effect of burning and current law	Medium	Sanitary inspector at each zone has monitored the situation. Daily announcem ent on waste collection vehicles by hordings, programme organizing in the school.	Survey & monitoring	Already implemented	2018-2022	Health Departmen t, AMC, Environme ntal Departmen t, AMC, Police, Agricultural Office	See Annexure A1-A4	
3	Proper collecti on of Horticu Iture waste and its disposa I followi ng compo sting- cum- gardeni ng approa ch, installa tion of recyclin g machin e	Medium	Implement ation studies	Rs. 20 lakhs per machine Ref. https://www.indiamart.co m/proddetail/horticulture -waste-recycling-machine- 10677170191.html	Short term	2018-2019	Health Officer (S) / Garden Suptd., AMC		

4		Increas e in segrega tion, collecti on and proper disposa I with increas ed Green Belt	Medium		Rs. 5000/ tonne of SW handled http://www.indiawaterpo rtal.org/sites/indiawaterp ortal.org/files/Manual%2 0on%20municipal%20soli d%20waste%20managem ent_%20MoUD_GOI_200 0.pdf.	Short term	2018-2022	Health Departmen t, AMC, Environme ntal Departmen t, AMC	
5		Biomet hanatio n and biogas plant need to be installe d.	Medium		Rs. 17 lakhs capital for 250 kg/day SW processing NITI Aayog Repoort on clean fuels	Mid term	2020-2022	Health Departmen t, AMC, Environme ntal Departmen t, AMC	Plastic bituminous roads option to te excercised option of decentralize d small scale plant unit may be excercised
(iv)	Industr y								Majore source: coal
1		Identifi cation of Brick Kiln and their regular monito ring includi ng use of designa ted fuel and closure /contro I of unauth orized units.	Medium	Rs. 5 lakhs fine imposed on Brick Kiln industries	Rs. 10-15 lakhs per unit	Short-term	2018-2019	AMC, MPCB	wood and coal are major contributor S
2		Conver sion of natural draft brick kikns to induce d draft	Medium	Implement ation/feasi bility studies	Rs. 10 lakhs by industry	Long term	2018-2022	Revenue Deptt. RDC	See Annexure E1-E7

3	Action against non- comply ing industri al units	Medium	Implement ation/feasi bility studies	МРСВ	Short term	2018-2020	МРСВ	
5	Change in coal quality with less ash content . The need is to focus on the less ash content and high calorifi c value of the coal to increas e the plant efficien tcy. For the other industri es, the aged boilers need to be replace d, if any. Efficacy	Medium	Implement ation/feasi bility studies	By WCL	Short term	2019-2021	(Policy matter) MPCB, RDC	
	of use of solar power in Industri es and other control measur es needs to be studied		ation/feasi bility studies	Ind100 kW rooftop solar plant costs Rs 60 LakhsRef: http://www.solarmango.c om/faq/2			Deptt. RDC	
6	Locatio n specific Emissio n reducti on	Medium	Implement ation/feasi bility/policy studies, clean fuels to be used	replacement cost to be provided by industry	Short term	2019-2020	МРСВ	Coal and wood are the major sources
7	Bannin g of new industri es in	High	Implement ation/feasi bility/policy studies	Not required	Short term	2018	МРСВ	

		existing city limit							
8		Installa tion /upgra dation of air pollutio n control system s. Techno logical improv ement option as given in Ma et al., Aerosol and Air Quality Resear ch,, 17: 636– 643, 2017ca n be studied	High	Implement ation/feasi bility/policy studies	Rs. 50-100 lakhs by industry for APC systems & house keeping	Short term	2018-2020	MPCB, AMC, industries	Visit observation s: water sprinkling after the arrival of the officials, needs to be a regular practice in fugitive dust areas
9		Regular audit of stack emissio ns for QA/QC	High	Implement ation/feasi bility	Rs. 5-10 lakhs per industry	Short term	2018	MPCB (55 industries are situated in Municipal Corporatio n area)	
(v)	Constr uction and Demoli tion Activiti es								
1		Enforce ment of constru ction & demolit ion rules.	High	According to the direction AMC has passed the order Vide letter no AMC/ENV/ MC/817/20 17 dated 07/02/201 6 forwarded to GM BSNL, Superinten dent Engineer PWD, Chief Engineer MSED and as per letter no	to be included in contract	Short term	2018	AMC and MPCB	See Annexure C1-C6, CPCB report to be followed

			AMC/ENV/ MC/818/20 17 dated 07/02/201 6 to ADTP, Medical Officer of Health Departmen t respectivel y for the futher action.					
2	Ensure carriag e of constru ction materia l in closed/ covere d Vessels (as well as in the site)	High	Depending on state or local by- laws, member of corporation can organize regional co- operations according to their specific needs. Through the corporation , public and private decision makers can be brought together to consider a regional strategy in the direction of MPCB. If regionalizat ion seems promising, the corporation can then plan and implement the	to be included in contract	Short term	2018-2019	AMC and MPCB	CPCB repo t to be followed
3	Control measur es for fugitive emissio ns from materia l handlin g, conveyi ng and screeni ng operati ons throug	High	The provision made to control meaures for fugitive emissions from material handling, conveying and screening operations through water sprinkling,	No additional cost. It will be added in maintenance part in each contract work to the contractor.	Short term	2018-19	Building and Constructio n Departmen t, AMC, PWD, Notice will be issued by Environme ntal Departmen t	As per CPCB report

		h water sprinki ng, curtain s, barriers and suppre ssion units.		curtains, barriers and dust suppressio n units.					
4		Bannin g of operati on of Brick kilns in city area	Medium	Implement ation/feasi bility	Not required	Short term	2018-19	Revenue RDC	
5		Reducti on in unpave d roads by paving	Medium	Implement ation/feasi bility	Rs. 15 cr. for 100 km of cement road	Short term	2018-2020	PWD	
(vi)	Domes tic fuel burnin g								Major source: Wood burning followed by LPG
1		Shift to LPG from solid fuel & kerose ne for domest ic applica tions. Making clean sources availabl e. Making ubiquit ously availabl e sources (i.e. biomas s) clean.	Medium	Implement ation/feasi bility	Ujjawala scheme in operation (Rs. 500 per cyl. Refilling)	Short term	2018-2020	Ujjawala scheme in operation, RDC, In the case of former, issues such as fiscal policies and districution systems designed to make clean energy affordable and accessible to the poor	See Aneexure B1
2		Better cook- stove designs	Medium	Implement ation/feasi bility	Rs. 20000 per stove (for residential purpose)	Short term	2018-2020	MNRE stoves	
(vii)	DG								

1		Strict action against old DG sets which are not comply ing standar d emissio n norms. Public awaren ess about effects of DG set pollutio n	Medium	The old DG set replaced by new one as per CPCB norms 2014	Survey work-Rs. 5-10 lakhs	Short term	2018-2019	DCP Traffic , MPCB (Diesel generator sets, primarily located in residential areas or in commercial buildings, are significant contributor to pollution load in city)	
2		Reducti on in DG set operati on /Un- interru pted power supply. Pollutio n control as well as clean fuel use	Medium	Implement ation/feasi bility	15 KVA (NG based)-Rs. 3.7 lakhs, 100 KVA (NG based)- Rs. 14 lakhs Ref. https://dir.indiamart.com /impcat/natural-gas- generators.html	Short term	2018-2019	Director, MSEDCL (Electrical Inspector)	
(viii)	Bakeri es /Crema								
1	toria	Use of LPG in Hotels and "Dhaba s" and renewa ble fuel/oil /Electri city/gas etc in Cremat oria	Medium	Total 10 Cremetoria, at one cremetoria 1.Amba Devi Area 2.Badnera Area -2no 3.Shankar Nagar 4.Vilas Nagar 5.Navsari 6.Faisalpur a 7.Lalkhedi 8.Rahatgao n -Furnace has been installed to minimize the impact, on emore proposed at Vilas Nagar	Cyl. (commercial) cost per unit-Rs. 1000 approx.	Mid term	2019	AMC, Disctrict Supply Occifer	See Annexure B2-B4