Kolhapur

Kolhapur City Air Pollution Control Action Plan

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

KOLHAPUR

MAHARASHTRA POLLUTION CONTROL BOARD

KALPATARU POINT, 3rd Floor,

Sion-Matunga Scheme Rd. No.8,

Opp. Sion Circle, Sion (East),

Mumbai-400 022.

Emission Inventory and Emission Reduction Action Plan for Kolhapur City

1. Preamble

Kolhapur is the historical city located on the bank of Panchganga River, Maharashtra, India. It is the district headquarters of Kolhapur district. Kolhapur is an inland city located in south-west Maharashtra state, 228 km south of Pune. At an average temperature of 29°C, April is the hottest month of the year (Max. Temp. 35°C and Min Temp. 24°C). In December, the average temperature is 22.6 °C. It is the lowest average temperature of the whole year. Yearly average rainfall is around 996 mm with most wet season (June to September) having average rainfall of 761 mm.

(Source:https://cultural.maharashtra.gov.in/english/gazetteer/KOLHAPUR/phy_climate.html)

Kolhapur city is growing with its population and consequently other urban activities are growing too. According to the last census (2011), it has a population of 5,61,840 which was 0.045% of total Indian population. Last decadal (2001-2011) growth rate was 1.06% (source: http://www.census2011.co.in/census/city/386-kolapur.html). **Fig 1**. The Kolhapur Municipal Corporation is the causative administration and has the managing authority for planned development in Kolhapur city. The Annual average concentration of RSPM and SPM over Kolhapur for last four years is analysed and it is observed that the levels of both the pollutants are increasing in last three years as shown in **Fig 2**.

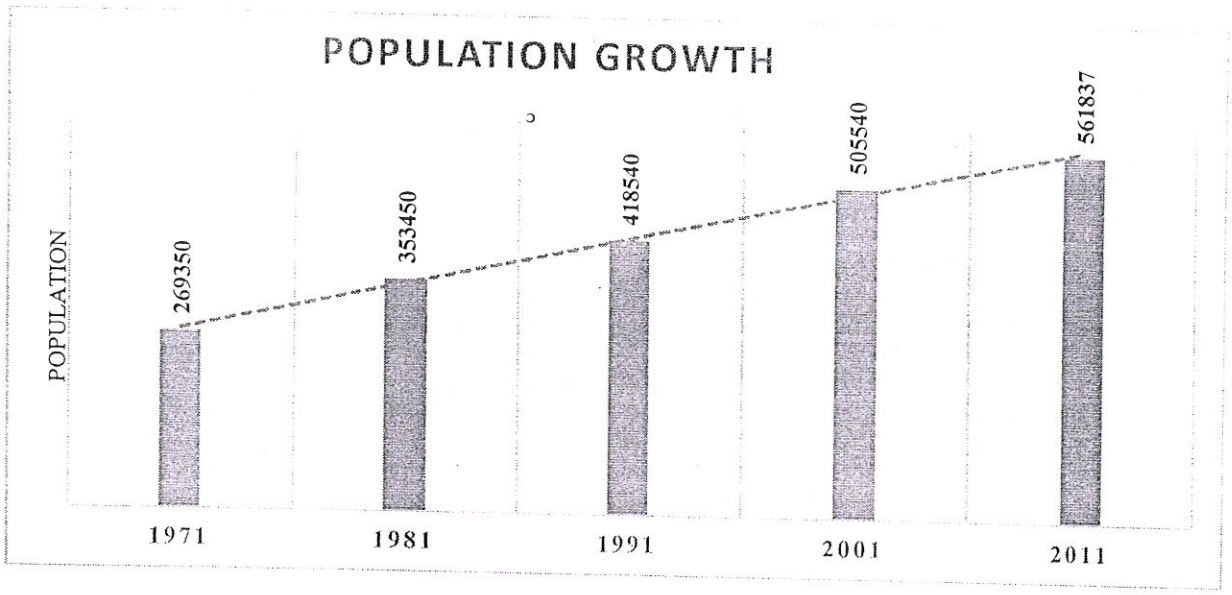

Fig : 1 Population Growth of Kolhapur City.

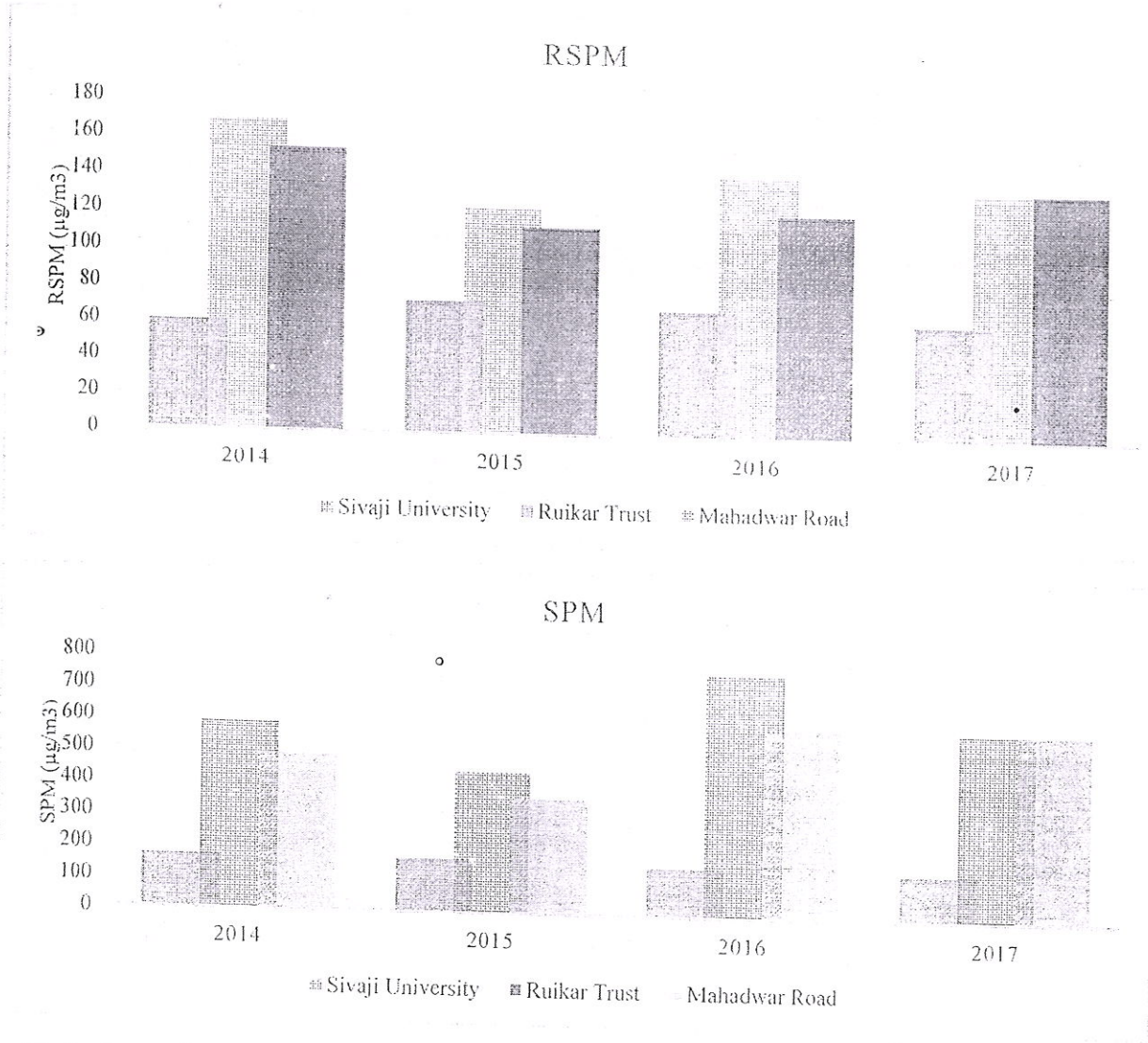

Fig 2: Annual average concentration of RSPM and SPM over Kolhapur for last four years.

Emission Inventory of Kolhapur City

Methodology

Gross Emission inventory of different sources of air pollution has been prepared for 10-15kms radial distance from centre of Kolhapur city . The base year 2018 is taken for most of the source data collection. This emission inventory is used to estimate/extrapolate total emissions for the whole of the city for next 5 years. Emission inventory has been prepared in terms Particulate matter (PM10, PM2.5,). Source categories and types of sources of air pollution in Delhi are presented in **Table.1**.

Table .1: Source Categories and Types of Sources of Air Pollution

Source Category	Types of Sources
Area Sources	• Domestic cooking • Bakeries • Crematoria • Hotels & Restaurants • Open eat outs • Open burning (refuse/biomass/tyre etc. burning) • Paved & unpaved roads • Construction/Demolition/Alteration activities for buildings, • roads, flyovers • Waste Incinerators • DG Sets
Point Sources	• Large scale industries Foundry, distilleries etc • Medium scale industries • Small scale industries (36 industrial estates)
Line Sources	• 2 Wheelers (Scooters, Motor Cycles, Mopeds) • 4 Wheelers (Gasoline, Diesel,) • LCVs (Light Commercial Vehicles) • Trucks (Trucks, min-trucks, multi-axle trucks) • Buses (Diesel)

For emission inventory, 2017-18 has been considered to be the base year. Reported information and statistics within ±2 years have been considered for the purpose of this study except for Census data where 2011 data was used as last available statistics. Data on residential sector obtained from: Census 2011, Statistical handbook of Maharashtra, Indian oil corporation, District Census Reports, survey. Number and other details of registered medium and large restaurants (division based on capital invested) are collected from Municipal Corporation, Distt. Collectorate, MPCB and other small roadside stalls are being surveyed for relevant information like number, type of fuel, monthly fuel usage etc. The electricity supplied (in terms of annual sale) by MSEB. Number of vehicles of different category (cars, buses, trucks, three wheelers) registered in KMC area are collected from RTO/other published report and Public Vehicles Department . **Table 2** represents primary data collection plan while **Table 3** shows the plan for secondary data collection.

Table 2 Primary survey plan

Sector	Data type	Survey type
Registered Restaurants	Type of Fuel, Fuel usage per day	Questionnaire survey of sample population
Roadside eateries/Bakeries/DG sets (unregistered)	Type of Fuel, Fuel usage per day	Questionnaire survey of sample population

Vehicular	Vehicular fleet age, miles travelled per day etc.	Petrol pump/parking lot survey
Domestic	Type of Fuel, Fuel usage per day	Questionnaire survey of sample population
Crematories	Type of Fuel, Fuel usage per day, no. of bodies burnt per day etc.	Questionnaire survey of select crematories
SSIs	Type of Fuel, Fuel usage per day	Questionnaire survey of sample population
Construction/Demolition/Roads Paved/Unpaved	Length of Road, Construction type time period etc	Questionnaire survey of sample population

Table 3 Plan for secondary data collection

Sector	Data type	Concerned Dept.
Population	Slum population	Municipal Corporation
Registered Restaurant	List and address	Municipal Corporation MPCB
Construction (Road, bridge, other civil)	Type of Fuel, Fuel usage per day, Base Area of construction, earth dug per day, number and operating hours of non-road vehicles (earth diggers, cranes, mixers)	Municipal Corporation
Small foundries , distilleries, sugar units etc	Numbers in city, Operating hrs/day and days/y, Type of Fuel, Fuel usage per day	MPCB
Registered Restaurants	List, address and number	Municipal Corporation
Vehicular	No. of registered vehicles in city and their type (small, medium, heavy and sub categories) with emission compliance category (Bharat/Euro etc.)	RTO offices
	No. of vehicles on read per day (Metro reports)	
Industry and industrial activities	Type of industry, Production capacity, Operating hrs/day and days/y, Type of Fuel, Fuel usage per day and where used, control equipment's with efficiency	MPCB
Stone Crushers	Production capacity, Operating hrs/day and days/y, Type of Fuel, Fuel usage per day or year, control equipment's with efficiency	MPCB
DG sets (industrial, commercial, residential)	Operating hrs/day and days/y, Type of Fuel, Fuel usage per day	MPCB/ Municipal Corporation

The Source Activity data sheets for various points, area and line sources for the city is prepared as given in **(Table 4).**

Table 4 Activity Source Types in the Project Cities

Source Category	Types of Sources
Area Sources (residential and commercial)	• Domestic cooking • Hotels & Restaurants, Bakeries • Crematoria • Waste Incinerators • DG Sets • Open burning (refuse/biomass etc. burning) • Construction Activities • Agriculture Tractors
Point Sources	• Large scale industries • Medium scale industries • Small scale industries – foundry, sugar/distillery, stone crusher etc.
Vehicular Sources	• 2 Wheelers (Scooters, Motor Cycles, Mopeds) • 3 Wheelers (Petrol/Diesel) • 4 Wheelers (Gasoline, Diesel,) • LCVs (Light Commercial Vehicles) • Trucks (Trucks, min-trucks, multi-axle trucks) • Buses (Diesel,) • Tractors/Trailers • Railway, Airways

Emission factors used for estimating Inventory

The source wise emissions are estimated based on activity data and source wise emission factor for particulate matter (PM10 and PM2.5). These emission factors are obtained from published documents of CPCB, ARAI and AP-42 USEPA as per the link given below:

- *http://cpcb.nic.in/NGT/Annexure_3.1_27.02.2018.pdf*
- *http://cpcb.nic.in/displaypdf.php?id=RW1pc3Npb25fRmFjdG9yc19WZWhpY2xlcy5wZGY=*
- *http://cpcb.nic.in/displaypdf.php?id=RmluYWxOYXRpb25hbFN1bW1hcnkucGRm....**page No 258 Annexure VIII***
- *https://www.epa.gov/air-emissions-factors.../ap-42-compilation-air-emissions-factors*

Point Source:

Various technological options are available for Air Pollution & air pollution control from point sources. The control technologies recommended for the industries within city impact zone, include fuel substitution, changes in production process, and pollution abatement through flue gas treatment etc. to reduce the ambient concentrations of pollutants. The Indusrtrial emissions are estimated based on the activity data received from MPCB on industry wise fuel use, type, etc as per the questionnaire and from MPCB's CTE and CTO files. The emission load is estimated based on these factors as per CPCB methodology. The estimated emissions from point sources for the year 2018 and its growth keeping Industrial Growth (air Polluting type) as constant upto year 2022 is given in **Table 5.** The control option like fuel change, implementation of APC Systems with greater efficiency, strict compliance and maximizing use of renewable energy source are suggested and the reduction in emissions are estimated as improved Emission Scenarios for point sources The proposed type of fuel used in industries with time to achieve intended targets of emission reduction from strategic action plan is shown in **(Table 6).** The generalised action plan is delineated for emission reduction in short and long term and are given in **Table 7**

Table 5: Estimated emissions from point sources for the year 2018 and its reduction upto year 2022 keeping growth constant

Year	Industry Emission PM (TPD)	Control Strategy to be adopted
2018	7.63	Improved APC system installation, Strict compliance of CEPI action plan
2019	6.556	Use of NG and other renewable energy source Strict compliance of CEPI action plan
2020	5.356	Implementation of APC systems, Use of LPG/NG. Relocation of polluting industry outside city area Strict compliance of CEPI action plan
2021	4.91	Strict compliance, improved APC system, clean fuel Strict compliance of CEPI action plan
2022	3.58	Strict compliance, Renewable energy sources

Table 6: Improved Emissions Reduction Scenario from point sources for the year 2018 and its growth upto year 2022 – Due to shift in cleaner fuel use

Fuel used in Industries	In 2018 (%)	Target 2019 (%)	Target 2020 (%)	Target 2021 (%)
Coal/Coke	5	4	3	1
Biomass	30	26	35	35
FO/ Diesel	25	20	10	5
LPG/CNG/electricity	40	50	52	59

Area Sources:

Busy urban areas with commercial activities, which give rise to pollution from area sources, surround city. Unpaved roads re-suspension dust due to vehicle movements, domestic/residential burning, crematorias, soild waste burning etc form the major contributors of area sources.

Road Resuspension

The emissions°from road resuspension from paved/unpaved roads are estimated based on road length and emission factors. The proposed length of roads of each type with time to achieve intended targets is also used for arriving at the emission reduction from strategic plan (Table 8 and 9). The Action Plan to curb Resuspension is given in Table 10

Table 8 Kms to be paved in the city during next 5 years

Type	Target Km to be paved				
	2018	2019	2020	2021	2022
Paved Road	772	799	825	851	877
Unpaved	105	78	52	26	0

Table 9 Emission reduction strategies for Road dust resuspension

Type	PM Emission (TPD) in control scenario				
	2018	2019	2020	2021	2022
Paved Road	4.3	4	3.8	3.5	3.2
Unpaved	0.9	0.7	0.5	0.2	0
Total	**5.2**	**4.7**	**4.3**	**3.7**	**3.2**

Construction and Demolition (C&D) waste

Unpaved roads, pot holes, construction and demolition (C&D) activities in residential /commercial areas along with narrow roads and vehicle parking/movements leading to generation of air pollution. Proper paving of roads enforcement of C&D rules may be followed with strict enforcement by the regulators.

Fugitive dust from mismanaged construction and demolition (C&D) waste contribute to particulate air pollution. On 29 March, 2016 MoEFCC has notified India's first ever rules construction and demolition waste management. The challenge now is to have these rules implemented and reduce generation of this waste to reduce fugitive dust in cities. The emission projection and reduction from Construction and Demolition (C&D) waste is shown in **Table 10**

Table 11. Emission Projection and reduction from Construction and Demolition (C&D) waste

Year	2018	2019	2020	2021	2022
PM Emission (TPD) with 3% annual growth rate*	3.19	3.28	3.37	3.47	3.57
PM Emission (TPD) with control measures To strictly follow MOEF guidelines for 4-5% reduction in growth scenarios	3.19	3.15	3.20	3.29	3.38

* Growth rate source: http://www.census2011.co.in/census/district/368-kolhapur.html

Cooking Fuel (Domestic & Commercial)

The domestic fuel and commercial eat outs/ hotels and restaurants are spread in the city area. Therefore, a policy of restricted permits for new installations (which could use cleaner fuels and proper pollution control measures) is suggested. Hotels and restaurants around city should be directed to use cleaner fuels such as LPG, improved cook stove etc. Use of open chullah on pavements and burning of dry leaves around CITY should be strictly prohibited. The Distribution of cooking fuels in household, emission estimation, its reduction and action plan is given in **Table 12, 13 and 14** respectively.

Table 12 Distribution of cooking fuels in commercial/residential areas

No. of Household	Firewood	Crop Residue	Cow-dung cake	Coal	Kerosene	LPG	Electricity	Biogas	Any Other	No Cooking
277966	45267	3657	39167	170	7480	153165	65	26550	321	2124
Percentage (%)	16.3	1.31	14.0	0.061	2.7	55.1	0.023	9.5	0.11	0.76

Table 13 Consumption and emission Load from cooking fuels in commercial/residential areas

	Consumption (kg/day)	PM Emission (kg/Day)
Firewood	67900	1175
Crop Residue	10971	60
Cow dung cake	58750	1016
Coal/Charcoal	850	17
Kerosene	561	0.34
LPG	125595	264
TOTAL	264627	2532.34

Table 14 Proposed Emission distribution to achieve intended target in commercial/residential areas

	2018	2019	2020	2021	2022
Emission in TPD LPG & Biogas facility provision is to be increased from current 65% scenario to 70% by 2019, to 75% by 2020 and to 80% by 2021 to achieve the targets proposed in strategic plan.	2.532	2.1	1.9	1.7	1.5

Therefore, LPG & Biogas facility provision is to be increased from current 65% scenario to 70% by 2019, to 75% by 2020 and to 80% by 2021 to achieve the targets proposed in strategic plan.

Crematoria, Open Burning from Dump-sites and slum areas

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.

It has been observed that the unaccounted or mismanaged waste from SWM system, often are reported into road side/ slum areas open burning cases. As city is receiving 60MT of 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 slum areas 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. The emission estimation from Crematoria, management practice of MSW waste and emissions from dumpsites and open burning from slum areas is given in **Table 15, 16 and 17** respectively. The action plan to curb pollution from these sources is gin in **Table 21.** The city authorities have provided common dust bins at different location in city premises for collection of wet and dry solid waste. It is recommended that separate dust bins with color code may be provided (for differentiating solid wastes) in order to ensure proper waste collection and disposal.

Table 15 Emissions from Crematoria's

Crematoria	
Emission Type	**Emission (T/day)**
PM10	0.01395
PM2.5	0.02051
Total	0.03446

Table 16 : Management statistics of MSW

Year	Solid Waste Created Tonnes	Treated per anum	Unmanaged
2018	60225	43800	16425
2019	62809	49275	13534
2020	63474.8	51100	12374.8
2021	64147.6	54750	9397.6
2022	64827.6	60225	4602.6

Table 17 Emissions from Dumpsites burning

Source	Emission (T/D)
Total Dumpsites	**0.000121479**

Table 18 Emissions from slum area Open Burning

Source	Emission PM_{10} (kg/day)	Emission PM 2.5 (Kg/day)
LPG	0.01688	
Wood	**0.8057**	0.5478

Line Sources:

Since city has large network of roads and busy urban areas, with roads running all around its periphery, a synchronized auto traffic signal system to be provided at all the intersection around the monument, for better and smooth flow of vehicles with minimum halt period.

The pollution from auto exhaust is the most important causative factor in busy congested roads Therefore, the traffic on the roads around the city should be minimal with complete ban on heavy traffic. Commercial vehicles, particularly autos, school/other buses, taxis and buses were found quite old. Adoption of regular inspection and maintenance program for these vehicles are suggested in order to meet emission norms. Ban of old commercial vehicles may be promulgated.

Implementation of the expert committee recommendations on Auto Fuel policy (August 2002) with respect to different categories of vehicles should be ensured.

The continued growth in future demographic profile of the automobile is inevitable. Thus it becomes imperative to control the auto emissions at source. The best strategy is proper maintenance and tuning of the carburetor of the gasoline powered vehicles which can ensure low CO and HC levels. PUC system to be upgraded/strengthened with latest state of art technology, Various options for mitigating emissions from sources are given below: the registered vehicle data from RTO and its projection is given in **Table 19. Table 20** provides Proposed emission scenario with time to achieve intended targets of emission reduction from strategic plan.

Table 19 Registered vehicle at Kolhapur and their projected values

	R.T.O Provided Data				Projected Data*			
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Two Wheeler	833588	912168	983725	1023948	1095948	1167948	1239948	1311948
LMV	84163	92858	103485	109365	118365	127365	136365	145365
Jeeps & Omni	21173	21255	21265	21267	21367	21477	21597	21727
Taxi	1100	1193	1301	1336	1396	1456	1526	1606
Auto rickshaws	15518	15947	16451	16786	17286	17886	18536	19286
Buses	1434	1642	1836	1951	2101	2301	2521	2721
Truck & Lorries	15635	16180	16556	16723	17073	17448	17848	18298
Delivery Van 4W	14671	15885	17219	18086	19286	20486	21736	23036
Delivery Van 3W	10227	10475	10673	10841	11041	11261	11481	11731
Tractor	33534	36880	38174	38810	41310	44090	47290	50590
Trailers	27340	29776	31247	31261	32761	34361	36011	37711

*** Projected values are calculated 6-8% increment factor from previous years (2014-2017) actual R.T.O data.**

Table 20 Proposed emission scenario with time to achieve intended targets of emission reduction from strategic plan

	PM Emission (TPD)					*Control Strategies suggested for 15-20% emission reduction*
Type of Vehicle	*2018*	*2019*	*2020*	*2021*	*2022*	
2 Wheeler	1.3	1.1	1	0.8	0.7	• Good public transport/ Cycle lane/ promoting usage of cycle • Launch public awareness campaigns/ Sulphur reduction in diesel • Widening of Road/ Synchronize traffic movement • Strict PUC system • Phase out of old vehicles • E-vehicles & Ethanol blending fuel.
3 Wheeler	0.5	0.4	0.3	0.3	0.25	
4 Wheeler	0.33	0.3	0.25	0.2	0.15	
Truck/Buses	0.8	0.6	0.5	0.4	0.35	
Total	**2.93**	**2.4**	**2.05**	**1.7**	**1.45**	

Month-wise and Annual Emission data for varicus Kolhapur locations are as follows,

Table No. 21: Data for Monthly average reading recorded at various locations in Kolhapur

Station Name	year	Month	Average of SO_2	Average of NOx	Average of RSPM
			50	*40*	*60*
Shivaji University Campus	2017	Apr	14	28	78
		May	13	24	63
		Jun	13	23	52
		Jul	11	21	43
		Aug	11	17	40
		Sep	10	13	43
		Oct	12	18	57
		Nov	11	16	57
		Dec	11	21	62
	2018	Jan	17	33	81
		Feb	15	27	70
		Mar	14	24	70
Ruikar Trust	2017	Apr	33	65	151
		May	30	56	120
		Jun	24	43	104
		Jul	19	33	72
		Sep	20	28	102
		Oct	26	36	106

		Nov	27	40	110
		Dec	33	59	134
	2018	Jan	37	71	146
		Feb	32	54	122
		Mar	24	48	117
Mahadwar Road	2017	Apr	25	47	110
		May	20	36	90
		Jun	18	31	76
		Jul	15	27	59
		Aug	19	30	72
		Sep	14	19	74
		Oct	19	25	89
		Nov	20	30	96
		Dec	26	45	111
	2018	Jan	31	62	128
		Feb	25	46	107
		Mar	20	38	98

Table No. 22: Data for Annual average trend of SO_2, NOx, and RSPM at various locations in Kolhapur

Station Name	year	Average of SO_2	Average of NOx	Average of RSPM
		50	***40***	***60***
Shivaji University Campus	05-06	4	7	40
	06-07	5	7	44
	07-08	5	3	46
	08-09	8	10	62
	09-10	8	4	55
	10-11	9	9	56
	11-12	10	13	60
	12-13	12	18	61
	13-14	14	20	64
	14-15	12	22	60
	15-16	13	23	63
	16-17	11	21	61
	17-18	13	22	60
Ruikar Trust	05-06	12	45	108
	06-07	11	39	96
	07-08	10	27	95
	08-09	16	27	100
	09-10	16	20	99
	10-11	21	27	105
	11-12	24	33	116
	12-13	27	42	159
	13-14	27	48	141

	14-15	28	50	118
	15-16	25	52	120
	16-17	29	53	120
	17-18	28	48	117
Mahadwar Road	05-06	8	28	69
	06-07	8	21	64
	07-08	8	11	75
	08-09	12	17	84
	09-10	13	15	86
	10-11	17	21	92
	11-12	20	26	102
	12-13	25	35	136
	13-14	23	37	113
	14-15	24	38	104
	15-16	21	40	106
	16-17	23	39	99
	17-18	21	36	90

3. Action Plan for Control of Air Pollution for Kolhapur

Area Source - Action plan is delineated for emission reduction in short and long term

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
Action against non-complying industrial units	reduction of Air Pollution Load from casting, foundries, stone crusher SSIs-Medium, Strict compliance of CEPI action plan	Implementation/feasibility studies	MPCB/MIDC
Sulphur reduction in fuel	reduction of Air Pollution Load from industries-Medium	Implementation/feasibility studies	MPCB/MIDC
Improved Combustion technology	reduction of Air Pollution Load from industries-Medium	Implementation/feasibility studies	MPCB/MIDC

Alternate fuel	reduction of Air Pollution Load from industries-Medium	Implementation/feasibility studies	MPCB/MIDC
Promoting cleaner industries	reduction of Air Pollution Load from industries-High	Implementation/feasibility/policy studies	MPCB/MIDC
Location specific Emission reduction	Inputs/suggestions from Source Apportionment studies	Implementation/feasibility/policy studies	MPCB/MIDC
Fugitive emission control	reduction of Air Pollution Load from industries-High	Implementation/feasibility/policy studies	MPCB/MIDC
Banning of new industries in existing city limit	reduction of Air Pollution Load from industries-High	Implementation/feasibility/policy studies	MPCB/MIDC
Installation /upgradation of air pollution control systems, Strict compliance of CEPI action plan	reduction of Air Pollution Load from industries-High, Strict compliance of CEPI action plan	Implementation/feasibility/policy studies, Strict compliance of CEPI action plan	MPCB/MIDC
Use of high grade coal	reduction of Air Pollution Load from industries-High	Implementation/feasibility/policy studies	MPCB/MIDC
Regular audit of stack emissions for QA/QC	reduction of Air Pollution Load from industries-High, Strict compliance of CEPI action plan	Implementation/feasibility	MPCB/MIDC

Action Plan to curb Resuspension of road dust

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
Prepare plan for creation of green buffers along the Traffic corridors	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation
Maintain Pothole Free Roads for Free flow Traffic	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation, Traffic Dept.
Introduce water fountains at Major Traffic intersection, wherever feasible.	Reduction of Air Pollution Load from resuspended dust- low	Implementation or feasibility/probing study for use of dry scrubbing system at traffic corridiors	Municipal Corporation
Greening of open areas, garden, community places, schools and housing societies.	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation
Blacktopping of metaled Roads including pavement of Road shoulders	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation
Wall to Wall paving (brick)	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation
Road design improvement	Reduction of Air Pollution Load from resuspended dust- low	Implementation	Municipal Corporation

Action Plan to curb pollution from Construction & Demolition

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
Enforcement of construction & demolition rules.	Reduction of Air Pollution Load from C&D projects- High	Implementation	Town Planning Authority, KMC

Control measures for fugitive emissions from material handling, conveying and screening operations through water sprinking, curtains, barriers and suppression units.	Reduction of Air Pollution Load from C&D projects-High	Implementation/feasibility of wet/dry scrubbing to be tested	Town Planning Authority, KMC
Better construction practices with PM reduction of 50%	Reduction of Air Pollution Load from C&D projects-High	Implementation/feasibility	Town Planning Authority, KMC
Ensure carriage of construction material in closed/covered Vessels	Reduction of Air Pollution Load from C&D projects-Medium	Implementation/feasibility	Town Planning Authority, KMC

Action Plan to curb pollution from Cooking Fuel

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
Shift to LPG from solid fuel & kerosene for domestic applications	reduction of Air Pollution Load from commercial/Residential cooking- Medium	Implementation/feasibility	Maharashtra Govt./ KMC
Better cook-stove designs	reduction of Air Pollution Load from commercial/Residential cooking- Medium	Implementation/feasibility	MNRE/ KMC
Use of LPG in Hotels and "Dhabas" and renewable fuel/oil/Electricity/gas etc in Crematoria	reduction of Air Pollution Load from C&D projects- Medium	Implementation/feasibility of use of solar power to be probed	Maharashtra Govt./ KMC
The crematoria present in the city limits	These should have green belt alongside or control systems attached to it else they could be shifted away from the residential areas. Shifting to use of briquettes rather than wood and use of electric crematoria should be promoted.	Implementation/feasibility	MNRE/ KMC

Action Plan to curb pollution from Crematoria's and open burning

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
The crematoria present in the city limits	These should have green belt alongside or control systems attached to it else they could be shifted away from the residential areas. Shifting to use of briquettes rather than wood and use of electric crematoria should be promoted. The crematoria's open pyre type to use cow dung/bricketes/and pollution control system for reducing the emissions. Use of Gas fired/electric fired crematoria may be promulgated	Implementation/feasibility	KMC
Open burning in solid waste dumping sites, etc to be banned	Banning of open burning	Implementation/feasibility	KMC
MSW Management through proper	Banning of open burning. Solid waste management to be	Implementation/feasibility	KMC

segregation and Magagement	undertaken to reduce emissions (Bio gas generation, Waste to energy plant) etc may be practiced		

Action Plan to curb Vehicle Emission

Control Option	Expected reduction and impacts	Technical Feasibility	Responsible/ Implementing agency
Launch extensive drives against polluting vehicles for ensuring strict compliance	pollution from existing vehicle to get reduced - Low	Surveys/Identification and maintenance/better combustion/ Emission reduction steps Introduction of Bharat Stage VI Vehicles	RTO
Launch public awareness campaigns for air pollution control, vehicle maintenance, minimising use of personal vehicles, lane discipline etc.	pollution from existing vehicle to get reduced - Low	Maintenance /Strict compliance	Traffic Dept./ RTO
Prevent parking of vehicles at Non designated areas.	Designated parking will reduce the Traffic congestion and thereby reduction in pollution - Low	Parking Plan of city to reduce congestion and easy driving of vehicles	KMC/RTO
Prepare action plan for widening of road and improvement of Infrastructure for decongestion of Roads.	reduction of Air Pollution Load from existing vehicles- low	Implementation	KMC
Prepare Plan for the construction of expressways/bypass to avoid congestion	Reduction of Air Pollution Load from existing vehicles- low	Implementation/policy	KMC
Steps for Promoting Battery operated vehicles.	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation/policy	RTO

Install weigh in Motion bridges at the borders of the cities/Towns and states to prevent overloading of vehicles.	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation/policy	KMC/RTO
Synchronize Traffic movements/Introduce Intelligent Traffic systems for Lane Driving	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation	RTO/ Traffic Dept.
Installation of Remote Sensor based PUC systems	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation	RTO
Sulphur reduction in diesel	Reduction of Air Pollution Load from existing vehicles- High	Implementation Policy Decision	
Introduction of new technology vehicles	Reduction of Air Pollution Load from new vehicles- Medium	Implementation Policy Decision	
Provide good public transport system	Improved Bus/Metro/etc- Medium	Implementation Policy Decision	MSRTC, KMC, RTO
Standards for new and in-use vehicles	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation/ Policy Decision	RTO
Alternative fuels	Reduction of Air Pollution Load from existing/new vehicles- Medium	Implementation/ Policy Decision	RTO
Implementation of BS-VI norms	reduction of Air Pollution Load from existing/new vehicles- Medium	Implementation/ Policy Decision	RTO
Electric/Hybrid Vehicles	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation/ Policy Decision/ Feasibility study	RTO
OE-CNG for new public transport buses	Reduction of Air Pollution Load from existing vehicles- Medium	Implementation/ Policy Decision/ Feasibility study	RTO, KMC

Ethanol blending (E10-10% blend)	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation/ Policy Decision/ Feasibility study	RTO
Bio-diesel (B5/B10:5-10% blend)	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation/ Policy Decision/ Feasibility study	
Retro-fitment of Diesel Oxidation Catalyst (DOC) in 4-Wheeler public transport (BS-II and BS-III)	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation/ Policy Decision/ Feasibility study	RTO, KMC
Banning of 10 year old commercial vehicles	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation/ Policy Decision/Alternative option	RTO
Inspection/maintenance to all BSII & BSIII commercial vehicles	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation	RTO, KMC
Restrict commercial vehicle entering city by having ring roads.	Reduction of Air Pollution Load from existing vehicles-Medium	Implementation	RTO, KMC

Overall Emission Management Plan

The overall PM emission inventory of Kolhapur is given in **Fig 3.**

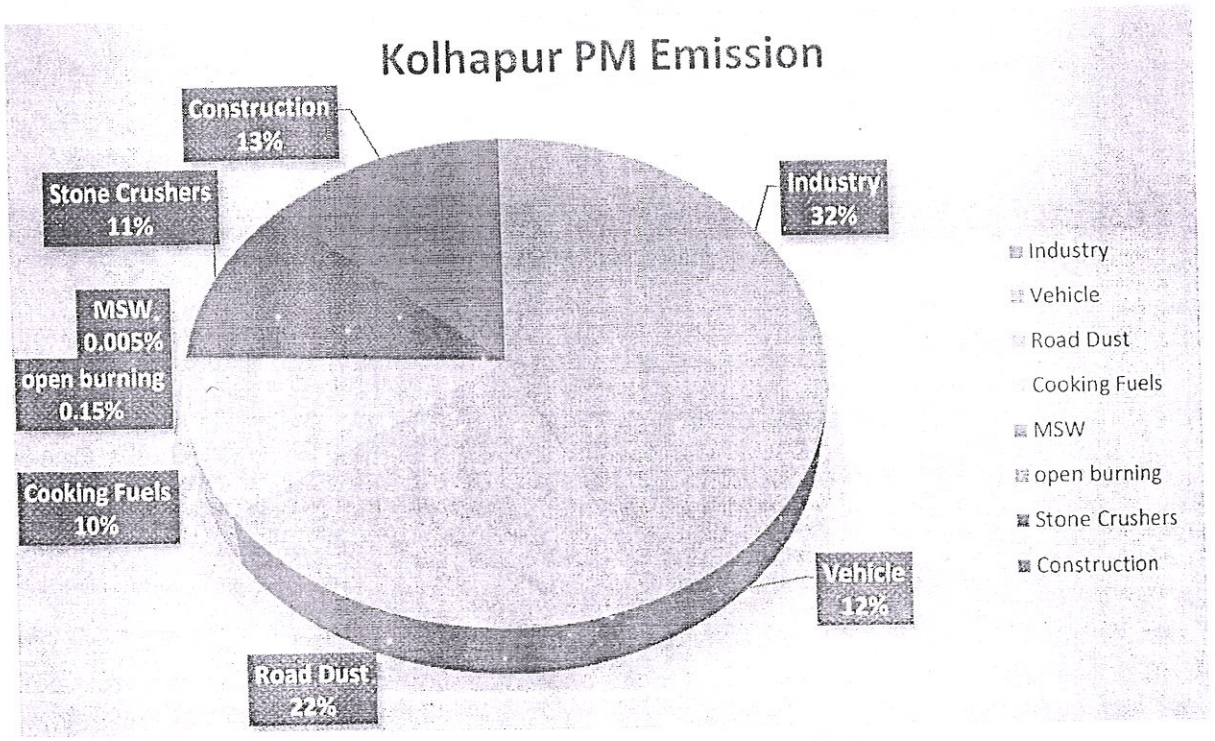

Fig 3. Overall PM Emission Inventory of Kolhapur

The overall PM emission management is as follows

- The dominant parameter are Particulate matter, ascribed to growing industrial activity in foundry, vehicular traffic, stone crushing units and construction projects as well as commercial and infrastructure development including road construction etc.
- There is a deficiency of collective policy enterprise among the administrations and organisation with regard to air quality improvement. These contract enterprises can be affirmed and kept up-to-date only if there is an apex body, which will monitor and mentor the involving departments time to time from various sources. These sources could be State Pollution Control Board, Regional transport office, Municipal Corporation, MIDC, Oil Companies, Anti-Adulteration cell, and representative from ULB and NGOs, school and colleges. Regulatory framework, if needs can be communicated to the apex body for starting the initiative for policy formation.
- Provision of cycle lanes in city roads and promotion from Government to use cycles by the citizen will help decongestion of traffic and resuspension issues.
- As per the provisions of 73 (3), Central Govt. can restrict and limit number of contract carriers in the cities / towns were heavy population is not less than 5 lakhs. Accordingly,

Maharashtra Govt. has issued notification restricting number of contract carriers in the city of Mumbai, Thane, Pune, Nagpur, Solapur, Nashik, Aurangabad etc., the provision of Act & Rules need to be reviewed and amended suitably in the light of increasing population & urbanization of these cities. Traffic of heavy goods vehicles may be routed outside city area by creating by-passes & ring roads before entry and exit of the city.

- Industries should adopt stack emission norms beyond those prescribed by CPCB Industries/power plants, which should be followed by regular QA/QC & performance audit.
- Fuel consumption in DG set operation in industrial should be regulated with stringent surveillance and made to follow stack emission standards with installation of efficient air control equipment. The dependency on DG set on power cut should be replaced by conventional source of energy.
- It is not just adequate to assess air pollutant concentrations and evaluate their origins and. It is every bit important to propagate that message to the public through various mediums such as web / mobile application, information boards in public spaces as well apportioning crucial studies carried on air pollution with the public. This ascertains public consciousness of the issues and can assist developing pressure on the concerned authorities to address the question.

3. Monitoring Mechanism for Implementation

The aforesaid action plan shall be implemented by Maharashtra State Pollution Control Board with co-ordination of concerned departments. Maharashtra State Pollution Control Board shall regularly review the implementation of aforesaid action plan.

4. 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.

Kolhapur Minicipal Corporation

Evaluation of Emission Control Option as per CPCB Templates

Sr. No.	Sr. No.	(A) Source Group	(B) Control Option	(C) Expected reduction and impacts	(D) Technical Feasibility	(E) Requiremen: financial resources	(F) Implementation period (Short/mid/long-term)	(G) Time target for implementation	(H) Responsible agency (ies)	Any Other Information
	(i)	**Vehicle emission**								Major source: 2W followed by Heavy duty diesel vehicles
1	1		Launch extensive drives against polluting vehicles for ensuring strict compliance, inspection of commercial vehicles	Low	Surveys/Identification and maintanence/better combustion/ Emission reduction stepsIntroduction of Bharat VI Vehicles	Survey work-Rs. 5-10 lakhs,, Ref http://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/nuidp/Downloads/BSR/RUIDP%20ISOR-%202017.pdf	Short/Long Term term	2018-2019	RTO / Smart city KMC	
	2		Synchronize Traffic movements/Introduce Intelligent Traffic systems for Lane Driving	Medium		Rs. 100 lakhs per traffic intersection Ref. https://parade.com/19072/marilynvossavant/what-would-traffic-light-synchronization-cost/	Mid term	2019-2020	Electrical Department, KMC, RTO, Traffic Police, Smart city	
	3		Launch public awareness campaigns for air pollution control, vehicle maintanence, minimising use of personal vehicles, lane discipline etc. NGOs need to be involved for this purpose.	Low	Maintanence/Strict compliance	Survey work-Rs. 5-10 lakhs,, Ref http://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/nuidp/Downloads/BSR/RUIDP%20ISOR-%202017.pdf	Short term	2018-2022	Traffic Engineer, KMC/Smart city Advertise Deptt. KMC MSRTC	
	4		Retrofitment of Diesel Particulate Filter in 4-wheeler public transport	Medium	RTO department taking strict action regarding implementation of these new norms	Rs. 0.5-0.7 lakhs per unit https://dir.indiamart.com/impcat/diesel-particulate-filters.html		2018-2021	NEERI / IIT, City Traffic Police, RTO	Enforcement of smoke emission standards for containing vehicular exhaust at the manufacturer and user level.
	5		Immediate launch of extensive fuel adulteration drive and random monitoring of fuel quality data	Medium	Maintanence/Strict compliance. Refer page no 9 PUC statement from 1.4.2016 to 31.3.2017, Mechanism to check with time requirement of each check to be identified	Survey work-Rs. 5-10 lakhs,, Ref http://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/nuidp/Downloads/BSR/RUIDP%20ISOR-%202017.pdf	Long term	2018-2022	Residence Deputy Collecter(RDC) , Distrcit supply officer & Tahsildar, KMC, RTO	Policy adapt us measure to ensure that all vehicle come for tests, On road inspection if vehicles planned and periodicity and coverage

Sr. No.	Sr. No.	(A) Source Group	(B) Control Option	(C) Expected reduction and impacts	(D) Technical Feasibility	(E) Requirement financial resources	(F) Implementation period (Short/mid/long-term)	(G) Time target for implementation	(H) Responsible agency (ies)	Any Other Information
	6		Reads need to be identified for widening.Maintain potholes free roads for free flow of traffic.	Low	Maintanence/ Road Construction/ Traffic management	Survey work-Rs. 5-10 lakhs, pothol maintanence-Rs. 10000 approx. based on the size	Mid term	2018-2020	KMC, PWD, NHAI, RTO	
	7		Introduce bi-cycle tracks/paths and encourage the use of bi-cycles.	Low		Rs. 30-50 Lakhs	Short term	2018-2020	KMC	
	8		Restriet commercial vehicle entering city by having ring roads.	Medium		As per sanctioned budget	Mid term	2018-2021	PWD, NHAI	
	9		Steps for promoting Battery operated vehicles, new technology vehicles	Medium	Implementation / Policy Decision	Rs. 10-15 lakhs per vehicle Ref. https://dir.indiamart.com/	Mid term	2020-2022	KMC, RTO	
	10		Public transport system: the current status of public transport in terms of number of buses, load factor etc. and proposed plant to augment the fleet	Medium	Implementation Policy Decision	Rs. 20000-50000 per filter Ref https://dir.indiamart.com/impcat/particulate-filter.html	Long term	2018-2022	Transport Department, KMC	
	11		Ethanol blending (E10-10% blend)-bus	Medium	Implementation/ Policy Decision/ Feasibility study	Rs. 1.20 cr. per bus Ref https://timesofindia.indiatimes.com/city/nagpur/Ethanol-bus-eco-friendly-not-pocket-friendly/articleshow/4666224.cms, http://moi.gov.in/writereaddata/files/document_publication/TaskForceReportOnCleanFuel.pdf	Long term	2018-2022		
	12		Banning of 10 year old commercial vehicles	Medium	Implementation/ Policy Decision/Alternative option	-	Long term	2018-2022	RTO	
	(ii)	Resuspension								
2	1		Creation of green buffers along the traffic corridors	Low	Implementation/ Policy Decision/Alternative option	Rs. 1000 per sq. ft Ref. www.sanjaynursery.com/vertical-garden	Task Completed	2018-2019	Building and Contruction Department, KMC, PWD	
	2		Plantation drive along the road side, Greening of open areas, garden, community places, schools and housing societies.	Low	Implementation/ Policy Decision/Alternative option	PPP basis, Rs. 1 cr. For 10 km (approx.) Ref https://economictimes.indiatimes.com/news/politics-and-nation/rs-1000cr-fund-to-plant-trees-along-highways-in-the-works/articleshow/51592606.cms	Mid term	Task completed. Further plantation drive will be conducted in July 1st of each year.	Garden deptt. KMC / Garden Deptt. Building and Contruction Deptt., Environment Deptt. KMC	
	3		Wall to Wall paving (brick)	Low	Implementation	Rs. 100 per sq. ft Ref. https://www.indiamart.com/proddetail/natural-stone-wall-bricks-16478046533.html	Long term	2018-2020	KMC	

Sr. No.	Sr. No.	(A) Source Group	(B) Control Option	(C) Expected reduction and impacts	(D) Technical Feasibility	(E) Requirement financial resources	(F) Implementation period (Short/mid/long-term)	(G) Time target for implementation	(H) Responsible agency (ies)	Any Other Information
	(iii)	**Biomass/trash burning, landfill waste burning**								
3	1		Launch extensive drives against open burning of biomass, crop residue, garbage, leaves etc. Strict compliance of ban on open burning in municipal area.	Medium	Implementation	Survey work Rs. 5-15 lakhs for Solid waste handling Ref http://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/mudp/Downloads/BSR/RUIDF%20ISOR-%202017.pdf Green Belt development extra	Mid term	2018-2022	Health Department, KMC, Environmental Department,	Solid waste generated - 60225 tons /Y, and dumped in three dump yards.
	4		Increase in segregation, collection and proper disposal with increased Green Belt	Medium		Rs. 5000 per ton of waste Ref http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Manual%20on%20municipal%20solid%20waste%20management_%20MoUD_GOI_2000.pdf.	Short term	2018-2022	Health Department, KMC, Environmental Department, KMC	
	5		Biomethanation and biogas plant need to be installed.	Medium		Rs. 17.0 Lakhs. For 250 kg/day plant Cap and Operating extra Ref: http://niti.gov.in/writereaddata/files/document_publication/TaskForceReportOnCleanFuel.pdf	Mid term	2020-2022	Health Department, KMC, Environmental Department, KMC	Plastic bituminous roads option to be excercised, option of decentralized small scale plant unit may be excercised
	(iv)	**Industry**								
	1		Action against non-complying industrial units	Medium	Implementation/feasibility studies	MPCB	Short term	2018-2020	MPCB	
	2		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 efficientcy. For the other industries, the aged boilers need to be replaced, if any.	Medium	Implementation/feasibility studies	By WCL	Short term	2019-2021	(Policy matter) MPCB, RDC	
	3		Efficacy of use of solar power in Industries and other control measures needs to be studied	Medium	Implementation/feasibility studies	to be done individually by Ind ---- 100 kW rooftop solar plant costs Rs 60 Lakhs Read more at: http://www.solarmango.com/faq/2	Short te.m	2018-2021	Revenue Deptt. RDC	
	4		Location specific Emission reduction	Medium	Implementation/feasibility/policy studies, clean fuels to be used	replacement cost to be provided by industry	Short term	2019-2020	MPCB	Coal and Wood are the major sources
	5		Banning of new industries in existing city limit	High	Implementation/feasibility/policy studies		Short term	2018	MPCB	
	6		Installation /upgradation of air pollution control systems. Technological improvement option as given in Ma et al., Aerosol and Air Quality Research, , 17: 636–643, 2017can be studied	High	Implementation/feasibility/policy studies	Rs. 50-100 lakhs by industry for APC systems & house keeping	Short term	2018-2020	MPCB, KMC, industries	Visit observations: water sprinkling after the arrival of the officials, needs to be a regular practice in fugitive dust areas
	7		Regular audit of stack emissions for QA/QC	High	Implementation/feasibility	Rs. 5-10 lakhs per industry	Short term	2018	MPCB (55 industries are situated in Municipal Corporation area)	

Sr. No.	Sr. No.	(A) Source Group	(B) Control Option	(C) Expected reduction and Impacts	(D) Technical Feasibility	(E) Requirement financial resources	(F) Implementation period (Short/mid/long-term)	(G) Time target for implementation	(H) Responsible agency (ies)	Any Other Information
	(v)	**Construction and Demolition Activities**								
5	1		Enforcement of construction & demolition rules.	High	Implementation/feasibility		Short term	2018	KMC and MPCB	
	2		Ensure carriage of construction material in closed/covered Vessels	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 regionalization seems promising, the corporation can then plan and implement the program.	Rs. 1 lakhs per vehicles	Short term	2018-2019	KMC and MPCB	
	3		Control measures for fugitive emissions from material handling, conveying and screening operations through water sprinking, curtains, barriers and suppression units.	High	The provision made to control meaures for fugitive emissions from material handling, conveying and screening operations through water sprinkling, curtains, barriers and dust suppression units.	No additional cost. It will be added in maintenance part in each contract work to the contractor.	Short term	2018-19	Building and Construction Department, KMC, PWD, Notice will be issued by Environmental Department	
	4		Banning of operation of Brick kilns in city area	Medium	Implementation/feasibility	Not required	Short term	2018-19	Revenue RDC	
	5		Reduction in unpaved roads by paving	Medium	Implementation/feasibility	Rs. 15 cr. for 100 km of cement road	Short term	2018-2020	PWD	
	(vi)	**Domestic fuel burning**								
6	1		Shift to LPG from solid fuel & kerosene for domestic applications. Making clean sources available. Making ubiquitously available sources (i.e. biomass) clean.	Medium	Implementation/feasibility	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 distriction systems designed to make clean energy affordable and accessible to the poor	
	2		Better cook-stove designs	Medium	Implementation/feasibility	Rs. 20000 per stove (for residential purpose)	Short term	2018-2020	MNRE stoves	
	(vii)	**Stone Crushers**								
			Each stone crusher unit shall install	Medium	Implementation/feasibility	Rs. 10-20 lakhs per unit	Short term	2018-2020	MPCB	
			APC measures, sheet covers and							
			sprinklers during operation							
			All approach road must be melted							
	(viii)	DG sets								
8	1		Strict action against old DG sets which are not complying standard emission norms. Public awareness about effects of DG set pollution	Medium	The old DG set replaced by new one as per CPCB norms 2014	Rs. 2 lakhs - survey work	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		Reduction in DG set operation /Un-interrupted power supply. Pollution control as well as clean fuel use	Medium	Implementation/feasibility studies	15 KVA (NG based)-3.7 lakhs, 100 KVA (NG based)- 14 lakhs Ref https://dir.indiamart.com/impcat/natural-gas-generators.html	Short term	2018-2019	Director, MSEDCL (Electrical Inspector)	
	(viii)	**Bakeries /Crematoria**								
9	1		Use of LPG in Hotels and "Dhabas" and renewable fuel/oil/Electricity/gas etc in Crematoria	Medium	Implementation	Cyl. (commercial) cost per unit-Rs 1000 approx	Mid term	2019	KMC, Disetriet Supply	