COMPREHENSIVE ACTION PLAN FOR CLEAN AIR FOR NON-ATTAINMENT CITIES OF ODISHA

AIR QUALITY MONITORING COMMITTEE, GOVERNMENT OF ODISHA

DECEMBER 2018

ROURKELA

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Abbreviations

AAQ: Ambient air quality
AAQMS: Ambient air quality monitoring stations
AQI: Air Quality Index
AQMC: Air Quality Monitoring Committee
BMC: Bhubaneswar Municipal Corporation
C&D: Construction and demolition
CAGR: Compound annual growth rate
CAP: Comprehensive Action Plan
CDP: City Development Plan
CNCI: Chittaranjan National Cancer Research Institute
CNG: Compressed natural gas
COPD: Chronic obstructive pulmonary disease
CPCB: Central Pollution Control Board
CRUT: Capital Region Urban Transport
GRAP: Graded Responsive Action Plan
GSDP: Gross State Domestic Product
ICMR: Indian Council of Medical Research
IHME: Institute for Health Metrics and Evaluation
IPT: Intermediate public transport
MoEF&CC: Ministry of Environment, Forest and Climate Change
MoEF: Ministry of Environment and Forestry
NAAQS: National Ambient Air Quality Standards
NAQI: National Air Quality Index
NCAP: National Comprehensive Action Plan
NGT: National Green Tribunal
NMT: Non-motorized transport
OIDP: Odisha Industrial Development Plan
OSPCB: Odisha State Pollution Control Board
PHFI: Public Health Foundation of India
PUC: Pollution Under Control
SEZ: Special Economic Zone
TTPS: Talcher Thermal Power Station
WHO: World Health Organization

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OVERVIEW

1 Mandate for framing of Action Plan for Clean Air

In pursuance of the directions of the Hon'ble National Green Tribunal (NGT), Principal Bench, New Delhi, dated 8 October 2018, the Government of Odisha vide Notification dated 15 November 2018, has set up a six-member Air Quality Monitoring Committee with representation from the State Transport Authority of Bhubaneswar, Housing and Urban Development Department, Directorate of Industries, Directorate of Agriculture and Food Production, and State Pollution Control Board. This Committee is to be supervised by the Additional Chief Secretary, Forest and Environment Department, and further supervised by the Chief Secretary for intra-sectoral coordination.

The Committee will prepare appropriate action plan within two months aiming to bring the air quality to meet the prescribed norm within six months from the date of finalization of the action plan for six non-attainment cities, including Angul, Balasore, Bhubaneswar, Cuttack, Rourkela and Talcher.

This is in accordance with the NGT order dated 8 October 2018, that has directed, 'Once the standards have been laid down in the statutory provisions of the Air Act, 1981, all the authorities as well as citizens are statutorily bound to follow the said standards.' The NGT direction among others has stated that the Action Plans may take into account the GRAP (Graded Response Action Plan), and the CAP (Comprehensive Action Plan) and the action plan prepared by the Central Pollution Control Board (CPCB) as well as all other relevant actors. The Action Plans may be forwarded to the CPCB by 31 December 2018. The same may be placed before the Committee as directed in direction no. vi. The Action Plan will include components like identification of sources and its apportionment considering sectors like vehicular pollution, industrial pollution, dust pollution, construction activities, garbage burning, agricultural pollution, residential and indoor pollution etc. The action plan shall also consider measures for strengthening of Ambient Air Quality (AAQ) monitoring and steps for public awareness including issuing of advisory to public for prevention and control of air pollution and involvement of schools, colleges and other academic institutions and awareness programmes. The Action Plan will indicate steps to be taken to check different sources of pollution having speedy, definite and specific timelines for execution.1

According to this order the Action Plan should be consistent with the carrying capacity assessment of the non-attainment cities in terms of vehicular pollution, industrial emissions and population density, extent of construction and construction activities etc. The carrying capacity assessment shall also lay emphasis on agricultural and indoor pollution in rural areas. Depending upon assessed carrying capacity and source apportionment, the authorities may consider the need for regulating number of vehicles and their parking and plying, population density, extent of construction and construction activities etc. Guidelines may accordingly be framed to regulate vehicles and industries in non-attainment cities in terms of carrying capacity assessment and source apportionment.

The Hon'ble NGT order has further directed that the action plan once submitted will be reviewed by a three member committee that shall examine the Action Plans and on the recommendations of the said Committee, the Chairman, CPCB shall approve the same by 31 January 2019. NGT has made the Chief Secretaries of the State and Administrators/Advisors to Administrators of the Union Territories personally accountable for failure to formulate Action Plans.

Further, it directed that the CPCB, SPCBs and State Pollution Control Committees to develop a public grievance redressal portal for redressal of public complaints on air pollution along with a supervisory mechanism for its disposal in a time bound manner. Any visible air pollution can be reported at such portal by email/SMS. Further, central ministries including MoEF&CC in consultation with other ministries to lay down such guidelines as maybe considered necessary for improvement of air quality in the country. The CPCB need to compile the action plans and furnish the same on or before 15 February 2019 to NGT and this matter will be heard in the last week of February 2019.

The Government of Odisha has thus formed a high-powered committee to frame the action plans for the six non-attainment cities.

This report is divided in two parts. Part 1 presents the overview that outlines the mandate of the committee, analysis of air quality trends and public health evidences, and challenges in each sector that needs addressing through the action planning process in each city. The sectors include industry, power plant, vehicles and mobility, and area sources including construction activities, waste burning, road dust, use of solid fuels in domestic cooking and road side eateries among others. This has reviewed the available information from existing studies and reports, official data bases, and information available from the implementing agencies. The direction of the Hon'ble NGT that plans be linked with the carrying capacity assessment and source apportionment studies have been included in this plan itself. These studies that will require a longer time frame to include multiple seasons and spatial assessment cannot be completed within the current timeframe. However, this base action plan is based on the best available information from the existing databases and reports, and field assessment. This helps to identify the major sources of pollution that require mitigation measures.

Part 2 lays out the proposed GRAP and CAP for each of the six cities in tabular form that identifies specific measures in each sector, lists agencies responsible for implementation of measures and the timeline for action. While substantial part of the proposed measures are common and uniform for all the six cities, further customisation has been done depending on the nature of the local issues and problems. This has been done city-wise. The proposed action plans can be further refined and tightened based on newer evidences and air quality assessment and source apportionment studies to be undertaken in the future. This exercise is expected to be a dynamic process.

Moreover, the framing of the action plans—GRAP and CAP—has taken into account the several ongoing initiatives of the State Government of Odisha to implement strategies in each sector that have bearing on the air quality. A range of policy measures has been implemented in different sectors of pollution control over time. This has drawn upon the existing plans as well as the baseline policy measures already implemented and further refined based on the proposed roadmap to have one unified and integrated plan with required customization to guide action in each of the six cities.

2 Air quality concern and public health imperative

Air-quality monitoring

Both GRAP and CAP need to be supported by strong air quality monitoring grid to track change in pollution level over time and also daily variations. The Odisha State Pollution Control Board (OSPCB) monitors criteria pollutants on a regular basis. Currently, air quality monitoring in all six cities is based entirely on manual monitors except one real time monitor in Talcher *(see Table 1: State of air quality monitoring in six non-attainment cities)*. There are six manual stations in Bhubaneswar, three manual stations in Cuttack and Balasore each and four manual stations in Rourkela. Angul has two manual stations and Talcher has two manual and one real-time monitoring stations. The manual stations monitor PM10, PM2.5, SO2 and NOx. Only in Bhubaneswar the manual station additionally monitors ammonia (NH3), ozone (O3) and lead (Pb). The data from these manual stations is reported on the OSPCB website. Data from one continuous station is available on the CPCB website.

OSPCB has shared the long-term data from the manual monitoring stations with the Committee. Data for Bhubaneswar is available from 2011, for Balasore, Angul and Talcher from 2012, for Rourkela from 2013 and for Cuttack from 2014. Manual stations provide data for two days in a week. As a result it is not possible to assess the real time daily trend that is needed for GRAP implementation. Implementation of GRAP—which is an emergency response to daily air quality—requires continuous online reporting of air quality data of all criteria pollutants monitored in real-time. Manual monitors normally report data twice a week and there is time lag, which is not suitable for GRAP implementation. Criteria pollutants, which include PM10, PM2.5, NO2, SO2, ozone and CO are considered for GRAP implementation as these have serious short-term health impacts (in addition to longer-term health impacts) on those suffering from cardiac and respiratory conditions and asthma. These pollutants have immediate trigger effect during smog episodes.

In view of the Hon'ble NGT order regarding the air quality monitoring stations the proposed action plan has recommended a plan for further strengthening of the monitoring grid. The NGT has directed that the scope of monitoring should be expanded to include all twelve notified parameters as per Notification No B-29016/20/90/PCI-L dated 18 November 2009 of CPCB. It further said that continuous Ambient Air Quality Monitoring Stations (AAQMS) should be preferred to manual monitoring stations. And, all such ambient air quality monitoring stations shall be connected to central server of CPCB for reporting analysis of results in a form of Air Quality Bulletin for general public at regular intervals at least on weekly basis and ambient air quality on continuous basis on e-portal. MoEF&CC will provide requisite funds for the purpose.

Table 1: State of air-quality monitoring in six non-attainment cities

A. Bhubaneswar—Locations of the ambient air quality monitoring stations and parameters monitored

S. no.	Station name and location	Parameters monitored	Category
1	SPCB office building, Nayapalli	PM10,PM2.5, SO_2, NOx, NH_3, O_3 and Pb	Residential
2	IRC Village, Nayapalli	PM10, PM2.5, SO2, NOx, NH3, O_3 and Pb	Residential
3	Capital Police Station, Unit-1	PM10, PM2.5, SO_2, NOx, NH3, O_3 and Pb	Residential
4	Palasuni Water Works	PM10, PM2.5, SO_2, NOx, NH3, O_3 and Pb	Residential
5	Patrapada	PM10, PM2.5, SO_2, NOx, NH3, O_3 and Pb	Residential
6	Chandrasekhapur	PM10, PM2.5, SO_2, NOx, NH3, O_3 and Pb	Residential

B: Angul and Talcher—Locations of the ambient air quality monitoring stations and the parameters monitored

S. no.	Station name and location	Parameters monitored	Category
1	R.O., SPCB Building, Angul	PM10, PM2.5, SO_2 and NOx	Industrial
2	NALCO Nagar, Angul	PM10, PM2.5, SO_2 and NOx	Residential
3	TTPS, Talcher	PM10, PM2.5, SO_2 and NOx	Industrial
4	MCL, Talcher	PM10, PM2.5, SO_2 and NOx	Kerbside
5	Dera square of Talcher (Continuous ambient monitoring station)	SO_2,NO-NO2 NO_X,NH_3, CO, O_3, PM10,PM2.5 and BXT Meteorological parameters like wind speed and direction, temperature, RH, solar radiation and rainfall	Residential

C: Balasore—Locations of ambient air quality monitoring stations and parameters monitored

S. no.	Station name and location	Parameters monitored	Category
1	R.O, SPCB Sahadevkhunta	PM10, PM2.5, SO_2 and NOx	Residential
2	DIC Office, Angaragadia	PM10, PM2.5, SO_2 and NOx	Residential
3	Rasalpur Industrial Estate	PM10, PM2.5, SO2 and NOx	Industrial

D: Cuttack—Locations of ambient air quality monitoring stations and parameters monitored

S. no.	Station name and location	Parameters monitored	Category
1	RO Building, SPC Board	PM10, PM2.5, SO_2 and NOx	Residential
2	Traffic Tower, Badambadi	PM10, PM2.5, SO_2 and NOx	Residential
3	PHD Office, Barabati	PM10, PM2.5, SO_2 and NOx	Residential

E: Rourkela—Locations of ambient air quality monitoring stations and parameters monitored

S. no.	Station name and location	Parameters monitored	Category
1	RO SPCB Building, Sector-5	PM10, PM2.5, SO_2 and NOx	Residential
2	IDL Outpost, Sonaparbat	PM10, PM2.5, SO_2 and NOx	Residential
3	Kuarmunda Govt. hospital	PM10, PM2.5, SO_2 and NOx	Residential
4	Kalunga Industrial Estate	PM10, PM2.5, SO_2 and NOx	Industrial

Source: Based on data provided by OSPCB

An assessment of the current monitoring framework in the non-attainment cities of Odisha indicates that the state could certainly benefit from expansion of the monitoring grid and the number of monitors especially the real time monitors. To estimate the number of additional real-time monitors that will be needed in each city the CPCB criteria have been adopted. The required number of stations has been estimated based on the CPCB's monitoring network distribution guidelines, 2011. The formula for calculating the number of stations required by a city takes into account the city's population. Given the absence of more recent data, Census 2011 data has been used *(see Table 2: Requisite expansion of air-quality monitoring network based on CPCB guidelines).* This indicates the minimum number of monitoring stations that are required in each city. Currently, almost all the stations in Odisha are manual and do not provide daily air-quality data. Future expansion will require real-time stations.

It is also possible for these cities to further explore the possibility of low cost sensor based monitoring to develop local area hotspot action plans. In fact, the concept note of the Ministry of Environment and Forest and Climate Change, Government of India (MoEF&CC) on the National Clean Air Programme has recommended to assess this possibility. This can help to assess a much larger area that are not yet covered by the regulatory monitors to generate baseline data for local action.

Table 2: Requisite expansion of air-quality monitoring network based on CPCB guidelines

City	Population	Minimum number of monitors required	Existing number of monitors	Additional number of monitors required
Angul	43,795	4	2	2
Balasore	144,373	5	3	2
Bhubaneswar	843,402	9	6	3
Cuttack	610,189	8	3	5
Rourkela	320,040	6	4	2
Talcher	40,841	4	3	1

Note: This table lists the minimum number of monitoring stations required.

Source: Census 2011 and Guidelines for Ambient Air Quality Monitoring, CPCB, 2003.

Air quality trends in six non-attainment cities

Non-attainment status of cities implies consistent high level of air pollutants above the national ambient air quality standards. In the six non-attainment cities of Odisha, PM10 and PM2.5 are the major concerns. The respirable particles come from a variety of sources; they consist of finer particles too that are largely contributed by fossil and other combustion sources. While a predominant pollutant is taken as a reason for non-attainment, in reality air in urban areas is laced with numerous pollutants (of these 12 are regulated under NAAQS). As cities are setting up more monitoring stations new areas of high exposure/ high air pollution can be identified.

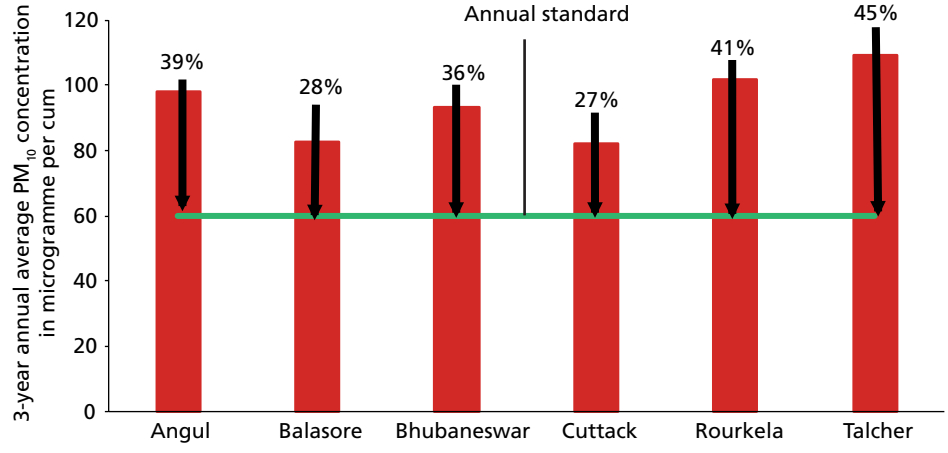
The NGT order has directed that the action plans should enable compliance with the National Ambient Air Quality Standards (NAAQS). In the longer- term, emissions must be permanently reduced so that the National Ambient Air Quality standards are maintained at least for 98 percentile of the days in a year (as per the Air Act, 1981) and peak pollution episodes are prevented. This requires a more

comprehensive action plan with short- and long-term measures and targeted reduction over time to attain the national ambient air quality standards and to address the non-attainment status. Air quality monitoring allows assessment of the level of non-compliance from the national ambient air quality standards.

To meet the NAAQS it may help to assess the target reduction required. Longer-term trend analysis helps to understand impact of action on longer-term ambient concentration as well as helps to assess the current baseline of the pollution concentration and the target reduction needed to meet the national ambient air quality standards. As per the international best practice such as the method used by the US Environmental Protection Agency (USEPA), an annual average of immediate past three years is taken to define the base pollution level and, accordingly, the target reduction is set. This helps to assess the level of reduction that is needed to meet the clean air standards. Accordingly, target for pollution reductions are set to guide action and prepare action plans. Setting such targets helps to determine the level of reduction that is needed and, accordingly, work out the detailed measures for all sources of pollution.

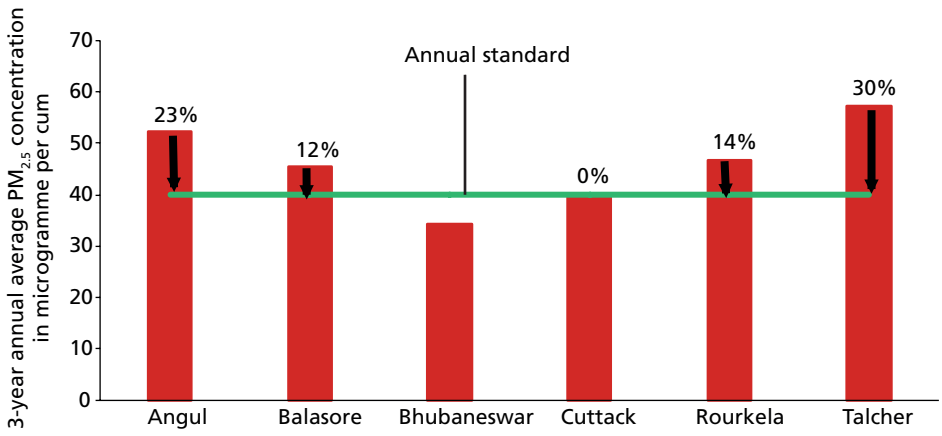
If a similar method is applied to the air quality of all the six cities of Odisha based on the annual data provided by the OSPCB, the indicative reduction targets for each cities can be worked out *(see Graph 1: Reduction targets of PM10 concentration in six cities and Graph 2: Reduction targets of PM2.5 concentration in six cities)*. The baseline year for the reduction target is considered as 2015–17 These reduction targets to meet the annual average ambient air quality standards and to sustain this over time are significant. This is expected to define the level of detail and stringency needed in action to achieve clean air. For instance, Bhubaneswar will have to reduce the annual average level of PM10 by 36 per cent to meet the NAAQS standard. But annual average PM2.5 is within the limit now but real-time monitoring may help to identify hotspots. Similarly, Angul will have to reduce PM10 by 39 per cent and PM2.5 23 per cent. In Cuttack the three-year annual average is just meeting the standard, it implies that in future if the emissions are not controlled now, the levels of smaller particles will increase in these cities. The highest PM2.5 reduction is for Rourkela city whic is at 30 per cent. However, it is important to emphasize that more effective air quality profile will emerge once the real-time monitoring is established in all cities. It is evident that manual monitoring under estimates pollution compared to real time monitoring.

Graph 1: Reduction targets of PM10 concentration in six cities



Source: Based on the annual average station wise data provided by OSPCB.

Graph 2: Reduction targets of PM2.5 concentration in six cities



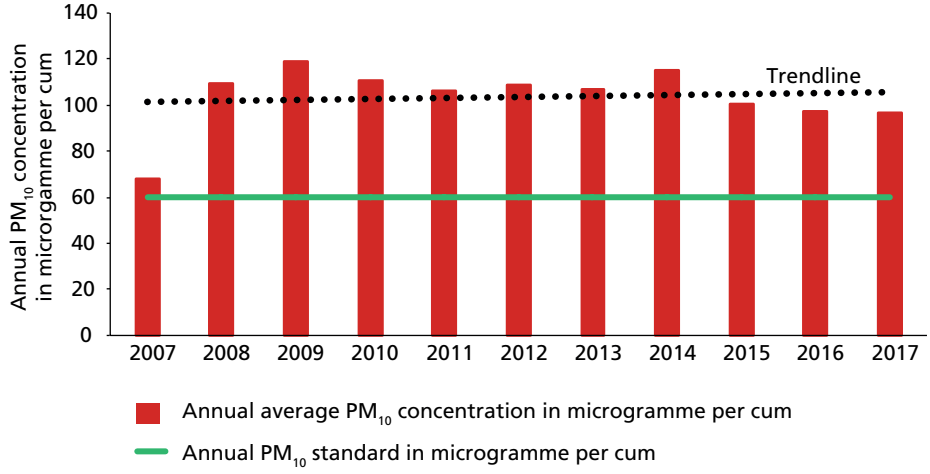
Source: Based on the annual average station wise data provided by OSPCB.

Long-term annual average trend in PM10

To understand the longer-term trends in annual average levels, available PM10 data has been analysed for all the six cities. The long-term annual average PM2.5 data is not available. The trend was analysed based on the data provided by the OSPCB *(see Graphs 3A–3F: PM10 trends in six non-attainment cities).* Almost all cities are showing a rising trend in annual average PM10 levels. In Rourkela, the PM10 levels started to decline after 2012, but turned upwards in 2017.

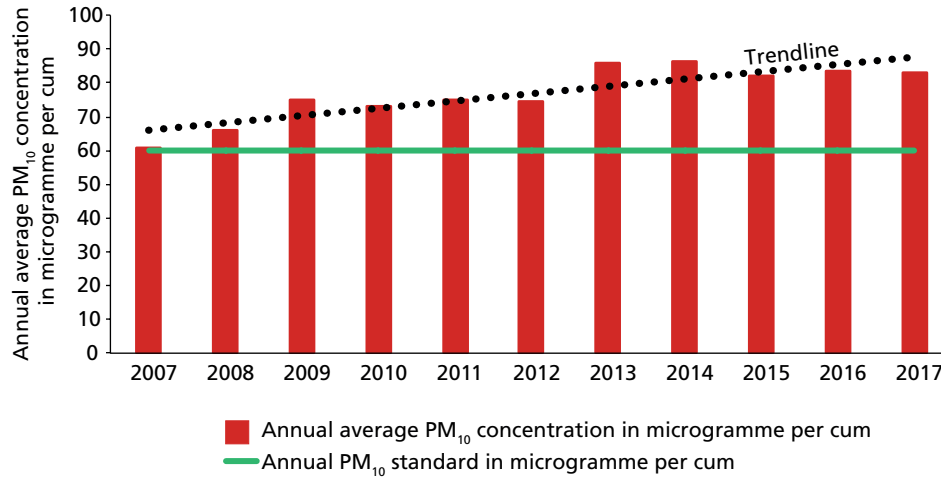
Graph 3: PM10 trends in six non-attainment cities

Graph 3A. Angul—long-term trend in annual average level of PM10 concentration



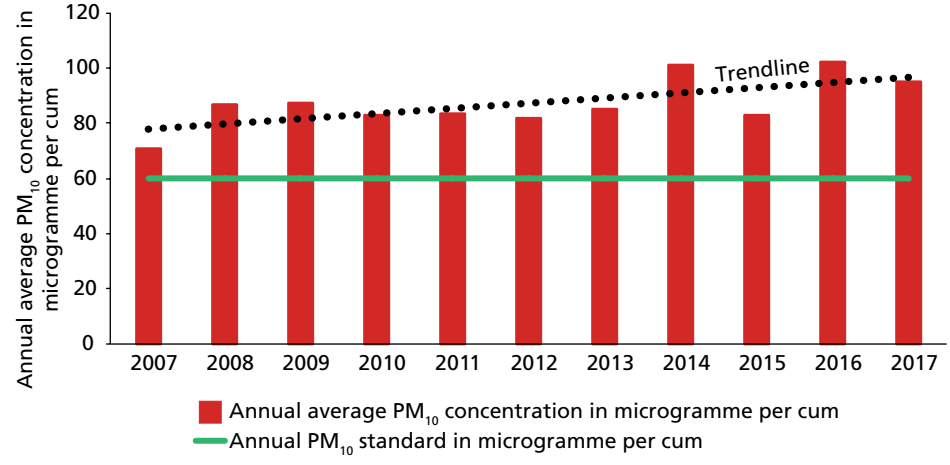
Source: Based on the annual data provided by OSPCB.

Graph 3B: Balasore—long-term trend in annual average level of PM10 concentration



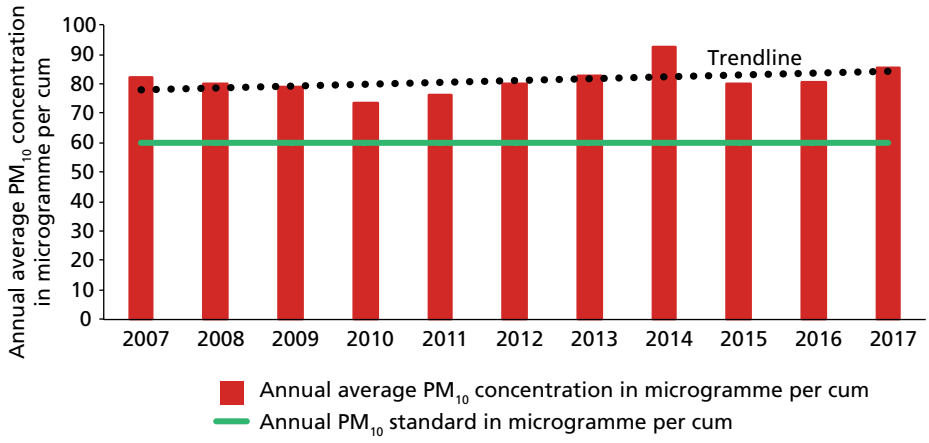
Source: Based on the annual data provided by OSPCB.

Graph 3C: Bhubaneswar—long-term trend in annual average level of PM10 concentration



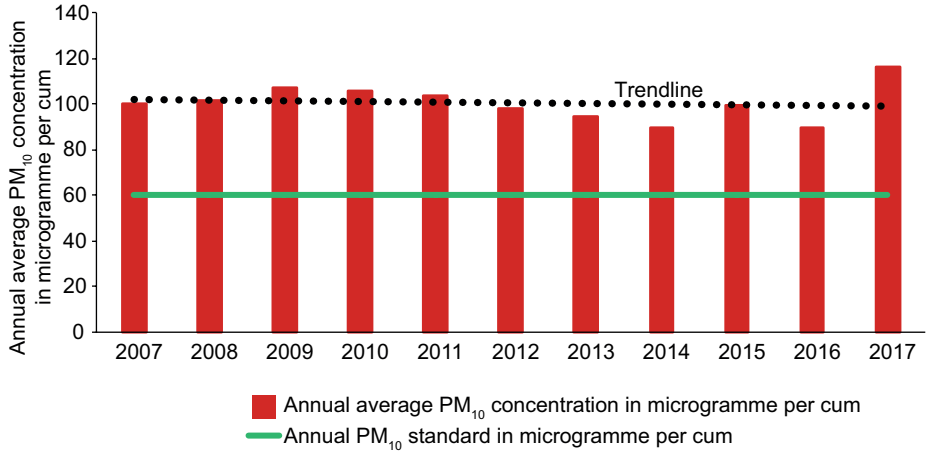
Source: Based on the annual data provided by OSPCB.

Graph 3D: Cuttack—long-term trend in annual average level of PM10 concentration



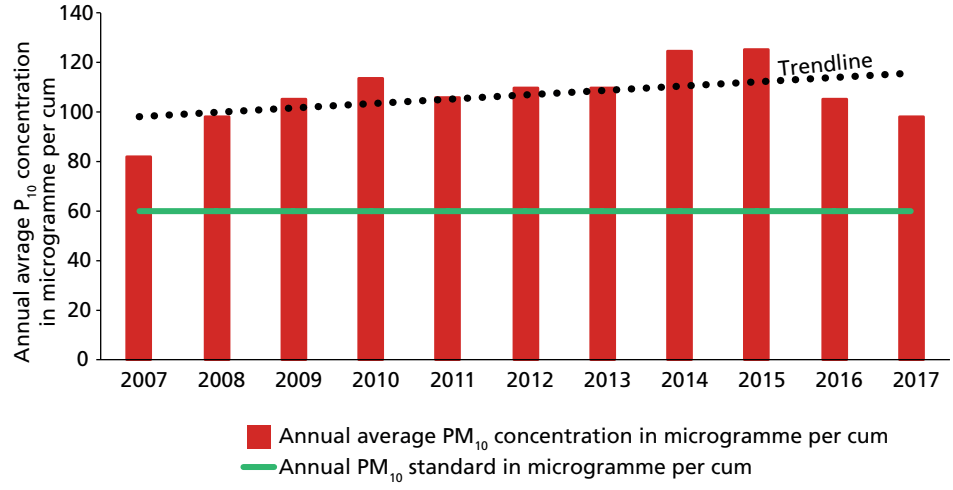
Source: Based on the annual data provided by OSPCB.

Graph 3E: Rourkela—long-term trend in annual average level of PM10 concentration



Source: Based on the annual data provided by OSPCB.

Graph 3F: Talcher—long-term trend in annual average level of PM10 concentration



Source: Based on the annual data provided by OSPCB.

City-wise and station-wise distribution of annual PM10 levels over the years

Air quality management also requires identification of pollution hotspots and trends. This helps to define more targeted action for the effective impact on air quality. The CPCB defines cities as critically polluted if the annual average levels of criteria pollutants are more than 1.5 times the standards. Levels up to 1.5 times the standard are labelled high; levels dipping till 50 per cent of the standards are considered moderate. Below this they are low. For instance, for PM10 annual average standard or safe level is 60 microgramme per cubic metre. And as per the classification cities with annual average level more than 50 per cent of the standard is termed as (1) 'critical pollution level', i.e. annual average levels more than 90 microgramme per cubic metre. (2) Up to 50 per cent above the standard is termed 'high pollution level', i.e. 60–90 microgramme per cubic metre. (3) From 50 per cent of the standard to the standard limit is termed 'moderate pollution level', i.e. 30–60 microgramme per cubic metre (4) Below 50 per cent is termed 'low pollution level', i.e. 0–30 microgramme per cubic metre.

Based on the data available from OSPCB, it is possible to see the trend in air quality status of cities and the monitoring locations in each city based on the CPCB classification since 2007. This shows that all locations in cities where monitoring is done are either highly or critically polluted with respect to PM10 and with very little change in the status since 2007 *(see Table 3: PM10 status in monitoring locations in each city based on CPCB classification of air quality)*. For instance, both the monitoring stations in Angul have worsened from high to critically polluted status since 2007. Monitoring locations in Balasore have largely remained highly polluted except Rasalpur, which is critically polluted. Bhubaneshwar shows several pollution hotspots that are critically polluted. These include Capital Police station, Palasuni, Patrapada and Chandrashekharpur. In Cuttack, all locations are either highly polluted or critically polluted. The location Traffic Tower has emerged as critically polluted. In Rourkela nearly all monitoring locations are critically polluted. Only IDL Outpost has shown some improvement over time. The RO Building has remained critically polluted over the last decade. Talcher shows no improvement in last one decade. Both the monitoring locations are critically polluted.

Table 3: PM10 status in monitoring locations in each city based on CPCB classification of air quality

A. Angul

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
RO office	H	C	C	C	C	C	C	C	C	C	C
Nalco	H	H	H	H	H	C	C	C	C	C	C

B: Balasore

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
RO building	H	H	H	H	H	H	H	H	H	H	H
DIC office	-	-	-	-	-	H	H	H	H	H	H
Rasalpur	-	-	-	-	-	-	C	C	H	C	H

C: Bhubaneswar

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SPCB building	H	H	H	H	H	H	H	C	H	C	C
IRC village	H	H	H	H	H	H	H	H	H	C	H
Capital police station	H	C	C	C	C	C	C	C	H	C	C
Palasuni	-	-	-	-	-	H	H	C	C	C	H
Patrapada	-	-	-	-	-	H	H	H	H	C	C
Chandrasekharpur	-	-	-	-	-	-	-	-	-	C	C

D: Cuttack

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Traffic tower	H	H	H	H	H	H	H	C	C	C	C
RO building	H	H	H	H	H	H	H	H	H	H	H
PHD office	-	-	-	-	-	-	H	C	H	H	H

E: Rourkela

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
RO building	C	C	C	C	C	C	C	H	C	C	C
IDL outpost	C	C	C	C	C	C	C	H	H	H	H
DISR Rajgangpur	-	-	-	-	-	-	C	C	C	-	H
Kalunga	-	-	-	-	-	-	C	-	-	-	C

F: Talcher

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TTPS	H	C	C	C	C	C	C	C	C	C	C
Coalfield	H	C	C	C	-	-	C	C	C	C	C

Note: C is critical; H is high

Source: Based on air-quality data provided by OSPCB.

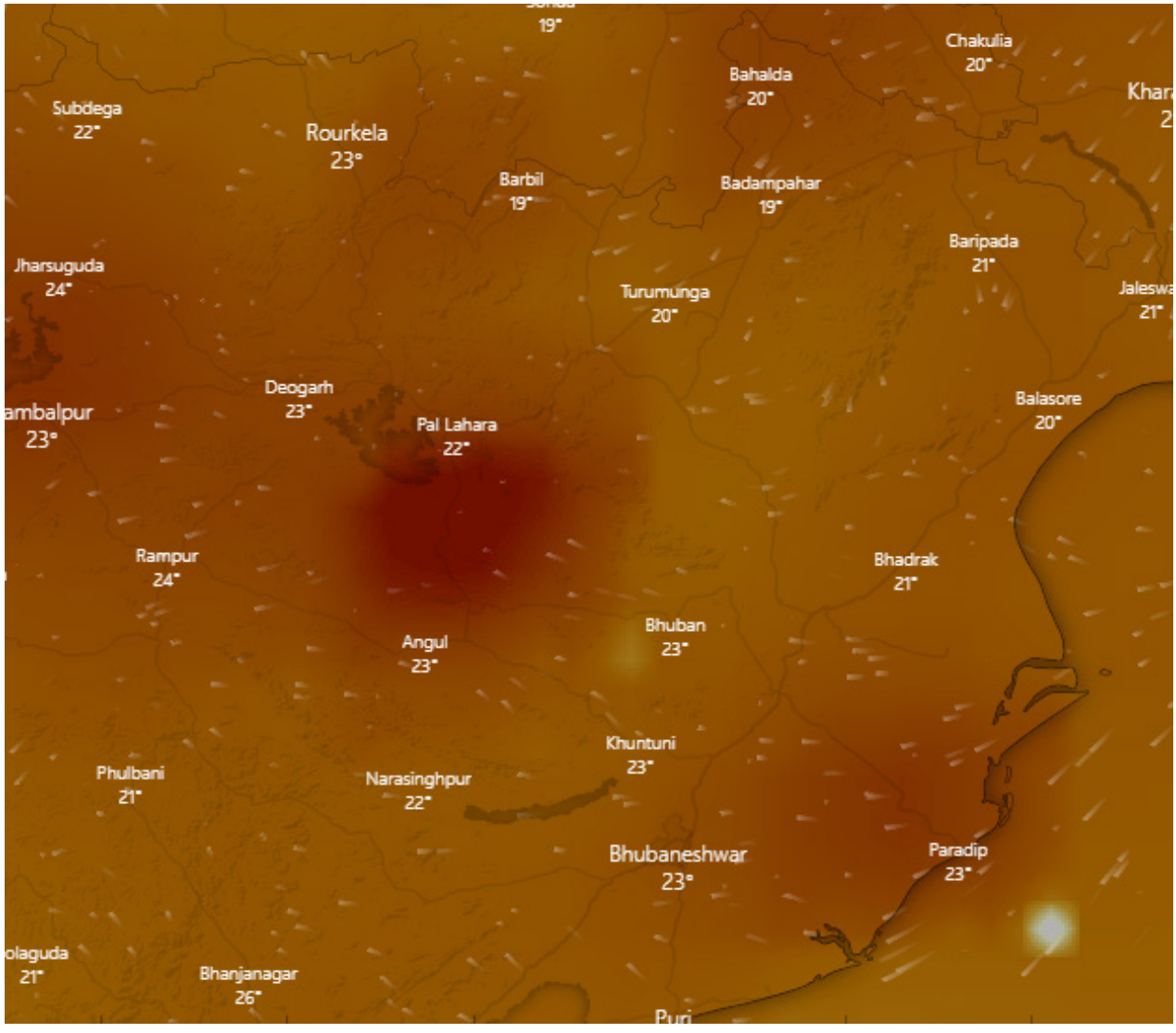
Trend in NO_2 and SO_2 levels

The concentration of both the pollutants in all the six cities have remained well below the standard throughout the period. There is however a small increase in NO_2 levels in some cities like Angul, Talcher and Bhubaneswar where the nitrogen dioxide levels will require special attention as these are strongly

correlated with motorization and industrialization. NO_2 also contributes towards ozone formation which is yet another very harmful gas.

However, given the high usage of coal in the area SO_2 build up will require greater scrutiny as studies in India and also that by the CPCB has shown that SO_2 may also contribute to the formation of secondary particulate and increase the particulate concentration in the air. The satellite imagery of the state of Odisha shows build-up of SO_2 (see Map: Sulphur dioxide mass cover over Odisha). The dark-coloured patches over the Odisha state show high SO_2 mass. The main sources of SO_2 in the air is the industrial activities that processes materials that contain sulphur, example generation of electricity from coal. Some mineral ores also contain sulphur, and sulphur dioxide is released when they are processed. In addition, industrial activities that burn fossil fuels containing can be an important source of SO_2. It is also release as a result of fuel combustion in vehicles but then the motor vehicles are not the main source of SO_2 in the air.

Map 1: Sulphur dioxide mass cover over Odisha



Source: As per windy.com, as accessed on 10 December 2018.

Trend in daily air pollution levels and GRAP implementation

As air quality monitoring in six cities are based on manual monitors it is not possible to classify the days according to the severity of daily air pollution levels (24 hours) that is needed for emergency action like GRAP when smog builds up. However, the State Pollution Control Board has analysed daily pollution data from the manual monitors to indicate the proportion of days in a year that have exceeded the national ambient air quality standards for PM10 between 2008 and 2017. This shows that in all the cities the percentage of days violating the standards have increased over time *(see Table 4: Percentage of days violating the 24-hour PM10 standard in a year [2008–17])*.

The data shows that industrial cities such as Angul, Talcher and Rourkela have the maximum violations of the 24-hourly PM10 concentration. However, there is a varying trend over time. In Bhubaneswar the percentage of days violating the daily standards has increased from 26 per cent in 2008 to 45 per cent in 2017; in Angul it has increased from 29 per cent in 2008 to 34 per cent in 2017; in Talcher from 9.65 per cent in 2008 to 45 per cent in 2017; in Balasore from 3 per cent in 2008 to 6.25 per cent in 2017. However, in Cuttack it has reduced from 28 per cent in 2008 to 25.95 per cent in 2017; and in Rourkela from 54 per cent in 2008 to 45 per cent in 2017.

Table 4: Percentage of days violating the 24-hour PM10 standard in year (2008–17)

	Angul	Talcher	Balasore	Bhubaneswar	Cuttack	Rourkela
2008	28.95%	9.65%	3%	25.9%	28%	54%
2009	27.25%	58.65%	9.8%	25%	30.85%	65.75%
2010	47.5%	60.5%	6%	27.3%	22%	69%
2011	49.9%	60.1%	1%	32.5%	29.4%	60.05%
2012	55.75%	69.9%	4.7%	31.36%	24.25%	53.25%
2013	52.4%	57.65%	13.1%	36.14%	37.4%	35.7%
2014	62.95%	62.6%	5%	33.4%	31%	25.9%
2015	50.5%	70.2%	6.7%	24.16%	14.4%	43%
2016	50%	60.4%	13.7%	45.3%	20.5%	16.3%
2017	34.16%	45.1%	6.25%	37.06%	25.95%	45%

Source: Based on data provided by OSPCB.

High violation of daily or 24-hour average standard indicates that this requires daily emergency responses or graded response action plan (GRAP) especially if the levels go very high. GRAP is designed for short-term emergency response to control daily pollution peaks and reduce exposure and associated health risk. Smog episodes largely occur when weather is adverse with calm atmosphere or no wind, cold temperature, and lower mixing height of air that traps air and pollution very close to the ground. This increases exposure drastically. While nothing can be done to control weather, or to remove trapped emissions already present in the atmosphere, short-term policy action can control further loading of emissions and prevent higher smog peaks. This is needed to reduce exposure and protect public health.

For this purpose, MOEF&CC has notified the National Air Quality Index (NAQI) and a corresponding health advisory in 2015. Based on this index, daily pollutant concentrations are classified and graded as good, satisfactory, moderate, poor, very poor and severe and colour-coded so that the general public can understand the

gravity of the problem. The health advisory has also been framed to indicate the expected health outcomes at varying severity of daily air pollution *(see Table 5: National Air Quality Index of India and Table 6: Health Advisory at different AQI levels in India).*

GRAP implementation requires automatic real-time air quality monitoring and daily real-time data gathering and online reporting system to enable decision-making on a day-to-day basis. Whichever pollutant is shown to be leading by the index will determine the nature of interventions as predefined in the GRAP. Thus, GRAP needs to be supported by real-time automatic and online air quality monitoring and continuous reporting of daily air quality data to assess the rolling daily average to help decision-making.

Table 5: National Air Quality Index of India

AQI category (range)	PM10 24-hour	PM2.5 24-hour	NO_2 24-hour	O_3 eight-hour	CO eight-hour (mg/m^3)	SO_2 24-hour	NH_3 24-hour	Pb 24-hour
Good (0–50)	0–50	0–30	0-40	0-50	0–1.0	0–40	0–200	0–0.5
Satisfactory (51–100)	51–100	31–60	41–80	51–100	1.1–2.0	41–80	201–400	0.5–1.0
Moderately polluted (101–200)	101–250	61–90	81–180	100–168	2.1–10	81–380	401–800	1.1–2.0
Poor (201–300)	251–350	91–120	181–280	169–208	10–17	381–800	801–1,200	2.1–3.0
Very poor (301–400)	351-430	121–250	281–400	209–748*	17–34	801–1,600	1,200–1,800	3.1–3.5
Severe (401–500)	430+	250+	400+	748+*	34+	1,600+	1,800+	3.5+

Note: Ambient concentration values of all regulated pollutants are compared with corresponding standards, and an exceedance factor is used for qualitative assessment of air quality.

Source: Ministry of Environment and Forest and Climate Change

Table 6: Health advisory at different AQI levels in India

AQI	Associated health impacts
Good (0–50)	Minimal impact
Satisfactory (51–100)	Minor breathing discomfort to sensitive people
Moderately polluted (101–200)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults
Poor (201–300)	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease
Very poor (301–400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases
Severe (401–500)	May cause respiratory effects even on healthy people and serious health impact on people with lung or heart diseases. The health impacts may be experienced even during light physical activity

Source: Ministry of Environment and Forest and Climate Change

3 Public-health imperatives of CAP and GRAP

Significant health impact evidence has emerged nationally and globally to establish immediate trigger effect of air pollution on cardiac and respiratory conditions that increase health risks especially for elderly and children. This is relevant for the GRAP strategy. Moreover, large-scale studies have confirmed long-term impact of air pollution on metabolic diseases and cancers even at annual average levels of pollution that are much lower than what is observed during short duration smog episodes. This requires a CAP strategy. Therefore, GRAP and CAP are needed to reduce both short- and longer-term health risks.

A 2018 Lancet report on the impact of air pollution on deaths, disease burden, and life expectancy across the states of India has estimated that in 2017, the number of deaths attributed to air pollution in Odisha was 31,118. Death rate per 100,000 population attributable to air pollution in Odisha is 65·3, which is almost same as that of Delhi. Life expectancy at birth in Odisha is 68·5 years, which is less than the average for India, i.e. 69 years. If air pollution concentration could be lowered, the life expectancy in Odisha could increase by 1.2 years. The number of deaths due to household air pollution (17,633) is greater than the number of deaths due to ambient air pollution (11,985) in Odisha.1 It is important that use of solid fuels for cooking in the state has continued to remain high risk factor. The 2015 Air Pollution and health Impact report of the Ministry of Health and Family Welfare has stated that indoor pollution is responsible for about 25 per cent of the outdoor air pollution in the country. This therefore indicates clean energy access even for domestic cooking will have to be part of the mitigation strategy.

In 2017, the first ever state-level disease burden estimates released by IHME, ICMR and PHFI showed that air pollution ranks as the second-largest risk factor responsible for the premature deaths in Odisha. In the disease profile of the state, ischaemic heart disease and lower respiratory infections have been identified as the leading cause of productive life year's loss in Odisha. These diseases are greatly influenced by air pollution. Air pollution is a serious short-term trigger factor for causing early deaths due to heart diseases.

This risk can be worse if a range of modifiers, including poverty, high levels of pollution etc. that can enhance the health effect due to pollution and increase the burden on the health care system of the cities. If the number of days in the cities starts to remain in poor to severe category then the increase in evidences on burden of illness and emergency hospital admissions will increase. These evidences bring out the merit of adopting emergency responsive measures approach for daily protection and prevention strategies to lower risk for illness, hospital admissions and premature deaths.

The health risk of air pollution has already been borne out by the studies in other regions of the world. Studies conducted at a massive scale, such as those carried out in the US, show that an increase of only 10 microgramme/cum of PM2.5 is enough for significant increase in health risks. High exposure to PM2.5 is known to lead to increased hospitalization for asthma, lung diseases, chronic bronchitis and heart damage. Long-term exposure can cause lung

cancer. Rising levels of nitrogen oxides can also have serious implications for respiratory diseases.

Widely available national and global health evidence shows that when criteria pollutants, including PM10, PM2.5, NOx, SO2, and ozone—exceed the standards or breach higher levels, it can have immediate trigger effect on health conditions related to cardiac and respiratory ailments and strokes. Even short duration exposure to high levels can increase rate of illness among vulnerable and emergency hospital admissions and cause early deaths. Therefore, the health advisory attached to the National AQI states the potential effect of pollution on different groups of population, especially the vulnerable sections, including children, elderly and those suffering from cardiac, respiratory ailments and asthma.

High daily pollution levels can have serious short term impacts. The health advisory of the national AQI and Delhi-NCR's GRAP state that those suffering from heart diseases, asthma, and other respiratory disease may consider avoiding undue and prolonged exposure, minimize unnecessary travel, use public transport and avoid using private vehicles among others. Similar advisories in other countries are more elaborate and are widely disseminated. They advise children to discontinue vigorous outdoor activities regardless of duration. Outdoor physical education classes, sports practices, and athletic competitions are re-scheduled or cancelled. Those with heart or lung disease need to avoid outdoor activity. Advisories encourage public to reduce unnecessary driving and promote ride share. Encourage employers to limit the amount of time their employees work outdoors. Thus, emergency measures are designed globally to advise people to take precaution and reduce exposure. Additionally, governments take short-term emergency action like GRAP to prevent pollution from worsening.

Simultaneously, longer-term systemic strategies need to be put in place to reduce pollution levels over time and reduce long-term risks of developing and worsening respiratory diseases, metabolic diseases, and cancer. Widely investigated link between air pollution and a range of disease profiles have demonstrated an insidious link between air pollution and COPD, ischaemic heart diseases, hypertension, diabetes, effect on brain and a range of cancers. Air pollution is a serious risk factor. In fact, in 2012 the WHO classified a group of air pollutants as Class I carcinogens and has specially classified diesel emissions as Class I carcinogen for its strong links with lung cancer. Air pollution is a serious contributory risk factor.

Most metabolic diseases and cancers develop over time and are triggered by longer-term exposures. Studies show that these effects occur at an annual average level that is much lower than the levels recorded in the city. This requires reduction in annual average levels not to the level of national air quality standards but further down to the level of WHO guidelines for public health protection.

As part of this action planning process health impact studies will be carried out to understand the unique factors and other local modifiers that influence health impact of air pollution to further help refine mitigation strategies. Therefore both emergency response measures like GRAP and a comprehensive action plan (CAP) needs to be designed to reduce short term as well as long- term health risks.

4 Pollution-source profile and baseline policy action in non-attainment cities of Odisha

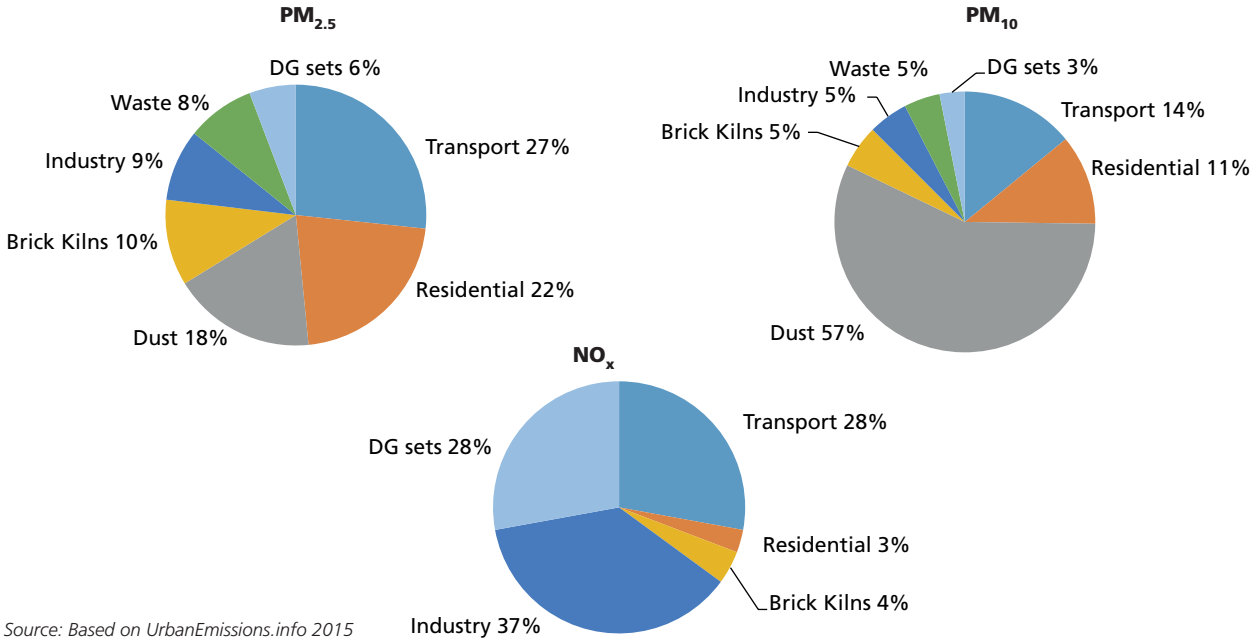
Any air pollution control strategy will need baseline information on the sources of air pollution and their relative contribution to ambient air pollution concentration as well as population exposure. There is currently no official study on source apportionment and source inventory to bring greater precision in the assessment of the pollution profile of the six cities. Once these studies are carried out in the non-attainment cities, the action plans can be further modified/ refined. The action plan therefore proposes detailed source apportionment and source inventory studies for the six cities.

However, for the purpose of the preparation of this base plan broad range of information on the gamut of sources in six cities are available from the OSPCB. It is also possible to piece together the fragmented estimates that exist on pollution sources from different studies done over time.

To inform the current action planning process the available information on the assessment of pollution sources been taken into consideration. The latest emission inventory for Bhubaneswar is available from an independent think tank called UrbanEmissions.info as of 2015. This study shows that the contribution of the transport sector to PM2.5 is highest at 27 per cent which is followed by the residential sector at 22 per cent, dust at 18 per cent, brick kilns (10 per cent) and industry (9 per cent).

The vehicles are the dominant source as shown by this study *(see Graph 4: Emission inventory for Bhubaneswar based on PM2.5, PM10 and NOx).*

Graph 4: Bhubaneswar: Emission inventory based on PM2.5, PM10 and NO_x



Source: Based on UrbanEmissions.info 2015

For the purpose of this report, field visits were organized to identify the key pollution sources in the six cities. Also feedback was received from concerned regional offices of SPCB. This has helped to map out the key big sources of air pollution *(see Table 7: Major sources of air pollution in six cities).* Even though the exact quantification is not possible without the detailed source apportionment and inventory studies that will be carried out in the future—it is possible to define the key measures based on the best practices and also keeping in view the desired reduction target that requires deep cuts in emissions from all sources. However, the emphasis has changed depending on the difference in the dominance of pollution sources across six cities.

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Table 7: Major sources of air pollution in six cities

S. no.	City	Major sources of pollution
1	Angul-Talcher	Industries, coal mines, road dust, thermal power plants
2	Balasore	Industry, vehicles, road dust
3	Bhubaneswar	Vehicles, road dust, construction
4	Cuttack	Road dust, vehicles, industries in peri-urban areas
5	Rourkela	Industries, vehicles

Source: Based on the field visit and feedback received from concerned regional offices of SPCB.

5 Air-pollution challenges and baseline action in key sectors

The comprehensive clean air action plan for the six non-attainment cities has been developed based on the review of the current challenges in each sector in six cities, and existing and emerging policy action. Review of the baseline policy action in each sector is important to align all ongoing and emerging policy initiatives across all sectors with the objective of meeting the clean air targets and identify additional measures that are needed for an effective roadmap. Several pollution control measures and also infrastructure development are underway in different sectors that have bearing on air quality. Recognizing this inter-relationship between different sectoral action is important to maximize impacts and air quality benefits.

Industrial pollution

Odisha is a rapidly industrializing state and has well defined industrial belts and clusters that will require locally appropriate action. At district level Angul-Talcher, Rourkela, Balasore and even areas around Cuttack have large number of red and orange category industry that influence the urban air quality *(see Table 8: Number of the industries category-wise in different districts of Odisha).* Given the profile and nature of industry in the state industrial pollution control and stringent compliance will require special as these have significant impact on the densely populated habitats and urban air quality (see Box: Industrial belt and non-compliant cities).

A large number of industries are registered with the Odisha Pollution Control Board (OSPCB). OSPCB maintains a record of all regulatory orders, including closure and guidance on its website. A review of the regulatory orders passed between 2015 and 2017 shows that most industrial set-ups that have boilers or furnaces are equipped with air pollution control system like electrostatic precipitators (ESPs), cyclones and scrubbers etc. However, there are concerns around enforcement and proper operations of pollution control systems. This will require more rigorous on-site continuous emissions monitoring system (CEMS) for compliance.

There is however no clear estimate of the number of informal industrial units across these cities. Since these units are unregulated, there might not be any emission controls in place. These units are known to have high fugitive emissions and are not amenable to stack monitoring. The state pollution control board would need to maintain an inventory of these units. In fact, comprehensive strategies are needed for overall control of fugitive emissions in the industrial sector.

Table 8: Number of the industries category-wise in different districts of Odisha

S. no.	City	Red category	Orange category	Green category
1	Angul (includes Talcher)	69	94	17
2	Balasore	93	179	27
3	Bhubaneswar	1	20	1
4	Cuttack	75	623	319
5	Rourkela	137	275	61

Source: Based on data from OSPCB

Industrial pollution control plan and schemes in the state and especially around the targeted non-attainment industrial cities have been framed around the requirements of the designated Critically Polluted areas. Angul Talcher is such a designated Critically Polluted Area. The MoEF&CC through its Office Memorandum dated 13 January 2010 had directed respective SPCBs to prepare Action Plans for each of the Critically Polluted Area for abatement of pollution. Odisha State Pollution Control Board has prepared two separate Action Plans, one for Angul-Talcher area and the other for combine IB Valley-Jharsuguda area. Based on 'Implementation status and action plan in critically polluted areas (Angul-Talcher)'1 (prepared as of March 2016) several action points have been identified and initiated for air pollution control. This may not be an exhaustive list, however, more action points can be assessed for implementation after an evaluation of current status of implementation. Since Angul-Talcher is a Critically Polluted Area due to Industrial pollution it remains a reason for its non-attainment status of NAAQS.

Individual industries and industrial units will require mapping of the status and operation of the pollution control equipment and their severity for further action. Such efforts are underway. For instance, the action plan states that the NALCO Smelter is the only aluminium smelter in the critically polluted area. During implementation of action plan NALCO has augmented capacity of air pollution control devices in Bake Ovens and also installed online monitoring facilities for round the clock emission monitoring. In the iron, steel and ferro alloy plants operational status of ESP/GCP in sponge iron plants needs to be checked. As per OSPCB report, the ferro alloy plants have installed gas cleaning plants in ferro alloy furnaces for control of particulate matter emission. These industries have also been directed to install pneumatic dust handling system at the hoppers of ESPs and bag filters for mechanized handling of dust.

In Rourkela, another industrial town, as per the information available from the OSPCB, cement industries have moved out of the city periphery. The main sources now are the steel plant in the middle of the city. Industries such as sponge iron and chemical industries are located in the declared industrial estate of Kuarmunda and these are within the 10 km periphery of the city. The guidelines as prescribed by CPCB should be followed for these industrial estates. If these industries cannot be shifted then they need to be fitted with best available technology and emission control devices and be brought under rigorous continuous emission monitoring and compliance. Existing pollution control devices such as ESP bag filters etc. should be revamped for effective reduction.

Bhubaneswar, which is a state capital, is not an industrialised city. Available information shows that it is affected by the brick kilns and stone crushers in its vicinity. Some brick kilns have been shut down in the recent times. Cuttack is not an industrial city but Cuttack district is quite industrialised. Overall, Bhubaneswar and Cuttack will require stronger focus on transport, waste, and construction activities.

Emissions standards and siting policy: Industrial pollution management is governed by the emissions standards fixed by the Central Pollution Control Board. Both existing and new standards will have to be implemented with strong compliance and penal requirement. While the ongoing effort will be strengthened further, the new set of emissions standards that have been framed recently will require immediate implementation. The case in point are the new SOx and NOx standards that have been notified by the MoEF&CC for 34 groups of industries following the direction of the Supreme Court on 29 January 2018.

Further strengthening of siting policy for industrial units will help to reduce exposure and public health risk in populated areas.

Star rating system: In order to bring more compliance with pollution standards and transparency in air pollution control efforts in industries and also incentivize quicker uptake of improved emissions control system, Odisha government on September 2018 has launched a 'Star Rating' system for industries, the first-of- its-kind initiative in the state. The programme, will rate industries from 1 to 5 based on their efforts to meet the standards set by Odisha's pollution control board and is expected to strengthen the pollution board's regulatory efforts.

This system is expected to encourage industries to adopt clean technologies. Also 'Star Rating' programme will help public to know if the industries in their vicinity are complying with environmental requirements. It will also recognize the efforts of industries that take responsibility to maintain clean environment. A website has been launched where citizens can access information in this regard.

Clean fuel strategy: In addition to improving and advancing the emission control systems in industry, ensuring use of cleaner fuels will provide more systemic solution. Often due to wide difference in pricing of industrial fuels dirty bottom of the barrel fuels like petroleum coke and fuel oil etc. are widely used. In smaller units unregulated fuels like tyre oil etc. are used. The OSPCB is considering change over to cleaner fuels like oil or gas to reduce particulate emission load from industrial operations. This is a step in right direction and in line with the action being taken in other states to control and discourage dirty fuels.

Clean fuel strategy along with stringent emissions control systems will require incentive policy to make a supply plan and infrastructure for cleaner fuels, adopt favourable taxation and pricing policy to make cleaner fuels competitive vis a vis the dirty fuels and help to phase in clean fuels for industries (such as natural gas, electricity, and low sulphur fuels). Access to natural gas and oil is improving in the state and may leveraged to promote their usage in the industrial sector as much as possible with a proper pricing and regulatory policy. Industries that will be using coal will require stringent emission control system and monitoring.

Dirty fuels are also used in small and unauthorized units without pollution control systems. There are also risks of several unregulated oil like recycled oil, tyre oil etc. filtering in causing enormous toxic pollution. Therefore notified approved fuels list can help to counter such risks in all sectors. Some cities like Delhi have issued notification on the list of approved fuels that can be used in different sectors.

In view of the growing use of heavy furnace oil in the sector it is important to take on board the national level development in this regard for future reference and roadmap. In response to the concerns over the growing use of pet coke and furnace oil (FO) in industry that have very high sulphur and heavy metal content have led to the notification on the emissions standards for SOx and NOx following the direction of the Hon'ble Supreme Court. This is needed to enable effective uptake of improved emissions control systems to control these gases. Testing of Petroleum Coke and Fuel Oil used for combustion was found to contain as high as 75,000 ppm and 20,000 ppm sulphur respectively.

But current transport fuels have 50 ppm sulphur that will be further lowered to 10 ppm sulphur in 2020. Fuels containing high levels of Sulphur lead to high emission of particulates; gaseous emissions like SOx and contribute to 'secondary' particulate load. High sulphur fuels also contain heavy metals, which adds to the toxicity and contamination of the environment. The Supreme Court of India vide order of 24 October 2017 has banned use and sale of petroleum, coke and fuel oil, in Haryana, Rajasthan and Uttar Pradesh. Delhi had banned these fuels in 1998. Only those like cement industry are allowed to use this as feedstock but not fuel. Further the order dated 13 July 2018, the Supreme Court has asked for a ban on import of pet coke into India, with specific exemptions given to four categories of Industries. The Ministry of Commerce, GOI has issued order dated 17 August 2018 to this effect. Further, under India's commitments to the WTO, the country's laws are bound to treat imported and domestic pet coke equally. As of November 2018, the Ministry of Commerce & MOE&FCC are considering restricting the usage of all pet coke in India—domestic and imported.

Industrial belt and non-compliant cities: Status of action

As on March 2017, the State of Odisha had 252 large and medium industries (213 large industries and 39 medium industries) operating in 22 districts. Mining is also an important industrial activity in the state. The State is the largest producer of stainless steel in the country, and has more than 20 percent of the total steel production capacity of the country. The major industrially active zones include Talcher-Angul (thermal power, aluminium, coal washeries, ferro alloys, coal mines) and Balasore (pulp and paper, ferro alloys, rubber industries). Rourkela Steel Plant (RSP) and Nilachal Ispat Nigam Limited (NINL) are the two PSUs in Odisha. These industrial units are in the larger air shed of the six non-attainment cities and have strong bearing on the regional and urban air quality.

Angul-Talcher: The industrial cluster of Angul-Talcher comes under the 24 critically polluted areas specified by CPCB and houses many large scale industrial units of aluminum, steel and thermal power such as National Aluminum Company Limited (NALCO), Smelter and Captive Power Plant, Talcher Super Thermal Power Station (or NTPC Talcher Kaniha), Jindal Steel & Power Ltd., Nava Bharat Ventures Ltd., Bhushan Steel Ltd., GMR Kamalanga Energy Ltd, Monnet Ispat & Energy Ltd, Jindal India Thermal Power Ltd, BRG Iron and Steel Pvt. Ltd, MGM Minerals Limited etc. Several of these large units have in-house captive thermal power (TPP).2

The captive TPP of NALCO aluminium plant has 477 acre of fly ash pond, with a volume of 36 million tonnes. The fly ash utilization during 2018-19 is estimated to be 70 per cent. Ash is being utilized in construction, cement industries, asbestos industries, brick production, civil construction and rehabilitation of used sites.

This plant uses coal, LDO and HFO—heavy fuel/furnace oil. An analysis of the annual trends in fuel utilization indicates that the usage of coal has increased from 4.83 million tonnes in 2013–14, to 6.04 million tonnes in 2017–18. Although this is accompanied with a drop in the consumption of furnace oil (from 5.05 million litres in 2013–14 to 1.07 million litres in 2017–18), the specific coal consumption has increased marginally. The PLF remained at around 70 per cent in 2017–18, up from 54 per cent.

Various measures have been taken to control pollution from captive thermal power plant. According to the OSPCB all the units have retrofitted and revamped the old electrostatic precipitators to reduce the stack emissions. Ammonia dozing system has been installed in all the units to reduce stack emission. There are four continuous ambient air quality monitoring system and the data is transmitted to OSPCB and CPCB through GPRS. Several steps have been taken to enhance ash utilization. Ash pond-I Dyke raising work from 110 mrl to 113 mrl has been completed. Construction of third phase Ash mound work over ash pond-II is in progress. Second phase work of Ash mound over Ash pond –II from 111 mRL to 115 mRL

Power generation

There are seven thermal power plants in Odisha, with over 24 units running collectively in the district of Jharsuguda, Angul and Dhenkanal. Angul has 14 power units. Three of the bigger power projects, consisting of 7 units, are situated in Jharsuguda, an industrial hub, consisting mainly of metallurgical industries. While Dhenekal, a centrally located town has three power units in

operation. Angul and Dhenkanal districts are neighbouring districts centrally located in odisha, while Jharsuguda is located north of Odisha *(see Table 9: Thermal power plants in Odisha and Box: Power plants in Odisha).* A review of Central Electricity Authority's recent monthly reports shows high plant load factors (PLFs) for all the state and central thermal power plants in Odisha which indicates greater plant utilization. A lower PLFs was observed for private sector plants since they are captive thermal plant and is only used for supplying electricity to its own industry.

The action plan that was prepared by the OSPCB for the Angul Talcher critically polluted belt states that all the thermal power plants have installed Electro

was completed in February 2018. Wheel washing system has been installed recently in the ash silo areas to control dust nuisance due to plying of vehicles.

In NALCO smelter the smelter plant has been expanded and is being monitored. Integrated Automatic Mixing System for mixing crushed bath with alumina has been commissioned. Procurement, installation and commissioning of three new Continuous Ambient Air Monitoring Stations in and around Smelter plant have been done. Online monitoring system at the FTP stacks, online effluent monitoring system at the ETP has been completed to control air pollution with latest dry scrubbing technology erection and fume treatment centre at Bake oven-I. The major fuel consumed is HFO—heavy furnace oil. Other fuels include LDO, HSD, LPG, CP coke. The consumption of HFO fuel has increased by approximately 58 per cent.

Further, there are many medium and small-scale industries related to metals, hot mix plants, brick kilns, rice mills and food processing, coal, power and chemicals. The region also has rich reserves of coal. Some of the major open cast mines that are in operation include Jagannath OCP, Bharatpur OCP, Lingaraj OCP, South Balanda and others of Mahanadi Coal Fields Ltd.

Balasore: The main industrial estate in the city is at Ganeswarpur where five red category industries are present out of which four are polluting. These are LPG cylinder, aluminium extrusion, captive thermal power plant and rice mill. Boilers and furnaces are air polluting. Majority of industries are using ESPs, dust settling chambers and cyclone to control the pollution. There are 13 orange category and 18 green category industries in this area.

Rourkela: The entire Industrial Complex is divided by a hill range and the hill is virtually a separation boundary between the localities of the steel township and the 'Old Rourkela'. Steel Township contains residential sectors segregated from the pollution zone. On the other side of the hill range lies Bondamunda area, Civil township, the Giant Steel Plant, several medium industries, like cement, refractories, sponge iron plant, explosive and chemicals and many more small scale industries. For the steel plant, raw materials like coal, haematite, limestone, dolomite etc. are available within a short radius of the plant itself. Besides these, bulk of raw materials comes from its own captive mines.

There are 75 red category, 175 orange and 47 green category industries within the city and up to 10 km of the proximity. There are 28 industries, which are directly air polluting. This includes the Rourkela Steel Plant, sponge iron industry, NTPC SAIL Power Company limited. Generally, coal is the dominant fuel used by the industries.

A survey from the regional transport office reveals that more than 1.5 lakh registered small and heavy vehicles are in the industrial complex that also contribute to dust pollution and emissions.

Table 9: Thermal power plants in Odisha

Company name	Plant name	District	Commissioning year	Capacity in MW
Odisha Power Generation Corporation Ltd (OPGCL)	I B Valley	Jharsuguda (2 units)	1994	210
			1994	210
NTPC Ltd	Taicher (OLD) TPS (6 units)	Angul (6 units)	1967	60
			1968	60
			1968	60
			1969	60
			1982	110
			1983	110
Ind-Barath Energy (Utkal) Ltd	Jharsuguda Ind-Barath Power station	Jharsuguda	2015	350
GMR Energy Ltd	Kamalanga	Dhenkanal (3 units)	2013	350
			2013	350
			2013	350
NTPC Ltd	Talcher Kaniha	Angul (6 units)	1995	500
			1995	500
			1995	500
			1995	500
			1995	500
			1995	500
Vedanta	Sterlite Energy Ltd	Jharsuguda (4 units)	2010	600
			2010	600
			2010	600
			2010	600
Jindal India Thermal Power Ltd	DERANG	Angul (2 units)	2014	600
			2014	600

Source: 2017, Ministry of Power

Static Precipitators (ESPs) as basic air pollution control device for control of particulate matter emission from stacks. The standard for emission of particulate matter from stacks of TPPs is 150 mg/Nm3. However in order to reduce the concentration of particulate matter in the ambient air, a tighter standard of 50 mg/Nm3 for particulate matter emission has been planned through the action plan. All plants were instructed to augment the capacity of ESPs to achieve stricter emission standard. The TPPs have also installed bag filters and other dust suppression measures at coal circuits for control of air pollution during coal handling. As per the status report it was proposed to upgrade/install 32 ESPs to meet a PM emission standard of 50 mg/Nm3, out of which as of 2016, 13 ESPs have achieved desired result. Therefore the achievement till 2016 was 40 per cent. The current status and compliance to norms will have to be assessed.

New emissions standards that were notified by the MOEF&CC in 2015 are yet to be implemented. The proposed date for its implementation is 2022 though a quicker roadmap to phase in the new standards will be hugely beneficial. The new standards need to be implemented by an early date. A transition plan can for each plant need to be drawn up to enable that process and ensure compliance. This will allow tighter regulations of emissions of particulate matter, nitrogen oxides, sulphur dioxide and mercury. The standards are designed to enable

Power plants in Odisha

Angul: Angul is home to Taicher TPS (NTPC), Talcher Kaniha, Derang and Jindal Thermal Power Plant. The Taicher TPS, a centrally run power plant was commissioned in 1967, now running a total of six units, the last unit being added in 1983. It operates a combined 460 mw capacity generating 3781 million units during 2017-18. The Talcher Kaniha, owned by NTPC, in Angul has two units at a combined installed capacity of 3000 mw. From the data available, it is evident that Talcher TPS has exceeded the permissible SOx level, emitting upto 272 mg/N.cu.m.

Derang TPS has an installed capacity of 1200 MW. The National Thermal Power Corporation has two units in Talcher, a subdistrict in Angul. One unit of this power plant, located 7 km from Talcher on the way to Bhubaneswar, is of 460 MW and the other one, NTPC Kaniha is of 3000 MW. Coal for power generation is sourced from the Talcher Coalfield and water from Samal Barrage Reservoir. The location of NTPC, Talcher is at Kaniha which is 45 km from Talcher. The Talcher Coalfield is the prime supply of coal to most of the power plants in Angul district.

Jharsuguda has three of the major power plants in the region: the IB Valley power plant, Sterlite Energy Ltd plant and Ind-Barath Power Station. The IB valley has a combined installed capacity of 420 MW, Ind-Barath has installed capacity of 350 mw and Sterlite Energy has an installed capacity of 2,400 MW.

Dhenkanal has Kamalanga power plant with an installed capacity of 1050 MW. A major power project under the Lanco has been announced in Dhenkanal with two units, with installed capacity of 660 MW The Babandh Power project has two station Phase I and Phase II, each with two units of 660 MW installed capacity. The construction for the Phase I is already underway. Smaller capacity units (less than 80 mw) can also be found near Cuttack which houses 11 large-scale industries, Sambalpur which is home to the Mahanadi Coalfield and Hindalco Aluminium Smelter, in the coastal district of Balasore and Bhadrak.3

Balasore: There is just one power plant of Birla which is located at a distance of approximately 8kms from the city. The height of the stack is around 65 metres. It has ESP to reduce particulate matter emissions from the stack. The plant load factor is 70–90 per cent. There is no fly ash pond as whatever is generated is utilized by fly ash brick manufacturers. The power is supplied through NESCO with a power cut of an hour on a daily basis in the city.

Talcher: Talcher thermal power station of NTPC, established in 1967, supplies power to the state with four units of 60MW capacity and two unit of 110MW. There are three stacks in total out of which two is of 60.05 metres height and the third one is 125m from the ground. The hourly coal consumption by the units I and II and units III and IV is 98 tonnes/hour whereas the consumption by units V and VI is 179 tonnes/hour. TTPS has installed ESP and PLC based ammonia dosing systems for control of PM emissions from Stage I (4x60MW) units ESPs have been installed in Stage II (2x110) units for control of PM emissions with 99.981 percent pollution control efficiency. Earlier only ESP was installed. But in 2010 when the plant was found to be violating the standard and there was no scope of retrofitting it, ammonia dozing system was introduced. While some part of the fly ash is being utilized by fly ash brick manufacturers, remaining fly ash is being disposed of in a abandoned mine void (South Balanda mine void). Two more units of 660MW are to be installed. The fuel used by the plant is majorly coal. In 2017–18, there is a slight reduction of 0.7 per cent in the coal consumption from 2013–14.

The Talcher Kaniha, owned by NTPC, in Angul has two units at a combined installed capacity of 3,000 megawatt. From the data available, it is evident that Talcher TPS has exceeded the permissible SOx level, emitting upto 272 mg/N.cu.m.

Jindal Thermal power plant is four year old with two stacks and hourly coal consumption of 664 MT at full load. In 2017, 100 per cent fly ash was utilized in brick making industry, low lying area filling, ash pond dyke raising and in plantation. The efficiency of ESP is 99.95 per cent. The size of the fly ash pond is 135 acres with volume of 52 lakh m^3. The plant load factor is 75 per cent. The pollutants concentration is as SOx—1068 mg/NM^3, NOx—286 mg/NM^3, PM—46 mg/NM^3. The SO_2 standard for this plant of 600MW is 200mg/NM3 which clearly indicates that how this plant is violating the emission standards for SO_2.

quicker uptake of much cleaner super critical technology. Currently, sub-critical technology dominate that are more polluting. As there are plans to set up new power plants in the state and some are under implementation progressive step is needed to design them based on the new standards so that high pollution and carbon are not locked in the new infrastructure for many more years— especially when industrialization is growing in the state.

Policy incentive to enable cleaner plants to operate in the state need to be assessed so that necessary changes can be met in merit dispatch policy.

Among all the units eight units have come up post 2010 whereas a sizeable numbers are quite old. About six units are more than 30 years old and the rest are also fairly old. These meet the older emissions standards. A phase out plan will be needed to progressively close the older and more polluting thermal power plants and to move to cleaner fuels like natural gas.

Some of the plants have been found to be emitting high. This will require more stringent stack monitoring with the help of continuous emissions monitoring (CEMS). Fly ash utilization will have to be further scaled up.

Brick kilns

In the state of Odisha, the number of brick kiln units (ones which produce about 25 lac bricks) is 500 and number of brick kiln units (ones which produce about 5 lac bricks) is 5,000. Brick kilns are largely located at the periphery or outside the city. But these units have trans-boundary effect on the urban air quality of the non-attainment cities. Units that use conventional kilns are highly polluting.

Among the six non-attainment cities brick kilns are present in Balasore and Rourkela. In Rourkela there are brick kilns in the periphery *(see Table 10: Rourkela: Brick kilns in the periphery)*. Some are present in Angul, Bhubaneswar and Cuttack. The number of kilns in Balasore is 150, Rourkela—86, Angul—14, Bhubaneswar—55 and Cuttack—68. As these are operating within the air shed of the cities transition to improved zigzag technology is needed to reduce their pollution impact.

Angul district sources most of its bricks from other districts, as its soil is not suitable for brick making. According to the 2012 report on Odisha brick industry, Angul district has lowest brick production which stands at 4.5 crore per annum. There is opportunity for production of fly ash brick in Angul district and also in Cuttack district.

An order was issued by the CPCB in 2017 under the directions of section 18 (1) (b) of the Air (Prevention and Control of Pollution) Act, 1981 for prevention and control of air pollution, for different types of brick kilns. The CPCB issued orders stating that all SPCBs: (i) Must provide consent, failing which brick kilns are to be shut; brick kilns must meet the prescribed norm and siting guideline with immediate effect, (ii) Provide the status on the conversion of natural draft to induced draft brick kilns, (iii) Strictly enforce siting guidelines, (iv) Ensure that all the moving area around brick kilns should be paved, and (v) Ensure that fine dust does not accumulate around the brick kilns. This requires regular inspection and stringent compliance.

Table 10: Rourkela: Brick kilns in the periphery

Name and location of brick kiln	Coal consumption/ unit of production	Technology used by different brick kilns
B.P. Enterprises	10 T/month	Bull tranch and fixed chimney
MAA DURGA ENTERPRISES	60 T/month	Bull tranch and fixed chimney
S P Bricks	20 T/month	Bull tranch and fixed chimney
VIP BRICKS	07 T/month	Bull tranch and fixed chimney
Z Z Bricks	20.8 T/month	Bull tranch and fixed chimney

Source: Based on data provided by the SPCB Regional Office, Rourkela.

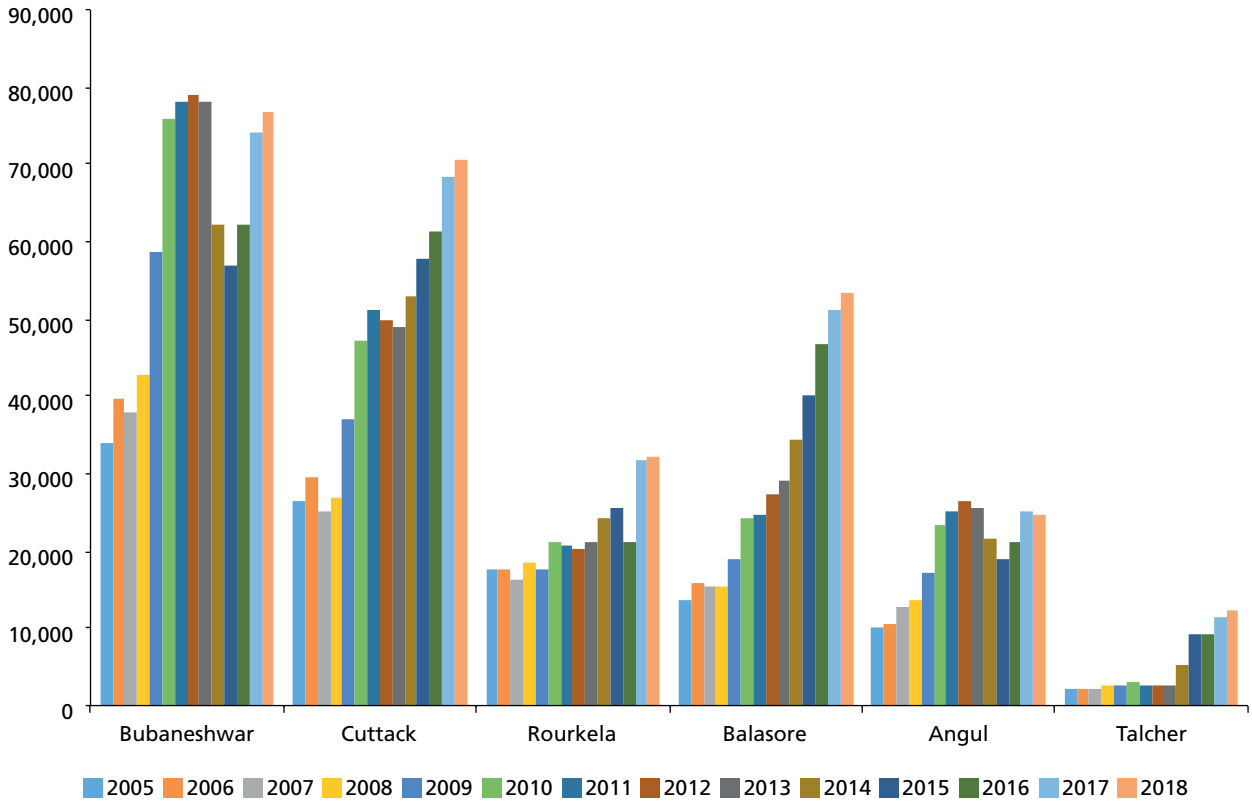
During severe smog episodes or when pollution levels exceed standards, the conventional kilns with old technologies need to be shut down while ramping up the process of complete transition to improved kiln technologies and fuels.

Vehicles

Vehicle numbers are growing rapidly in cities of Odisha. Bhubaneswar, Cuttack, Balasore, Angul, Talcher and Rourkela are experiencing rapid increase in registration of motor vehicles. Among all the non-compliant cities Bhubaneswar has the highest vehicle stock. Two-wheelers dominate the fleet in all. There is a spike in registration of two-wheelers in Cuttack, Rourkela and Balasore. Bhubaneswar has the highest number of private cars *(see Graph 5: Annual registration of vehicles in cities of Odisha in 2005–18; Graph 6: Growth of two-wheelers in cities of Odisha and Graph 7: Growth of cars in cities of Odisha).*

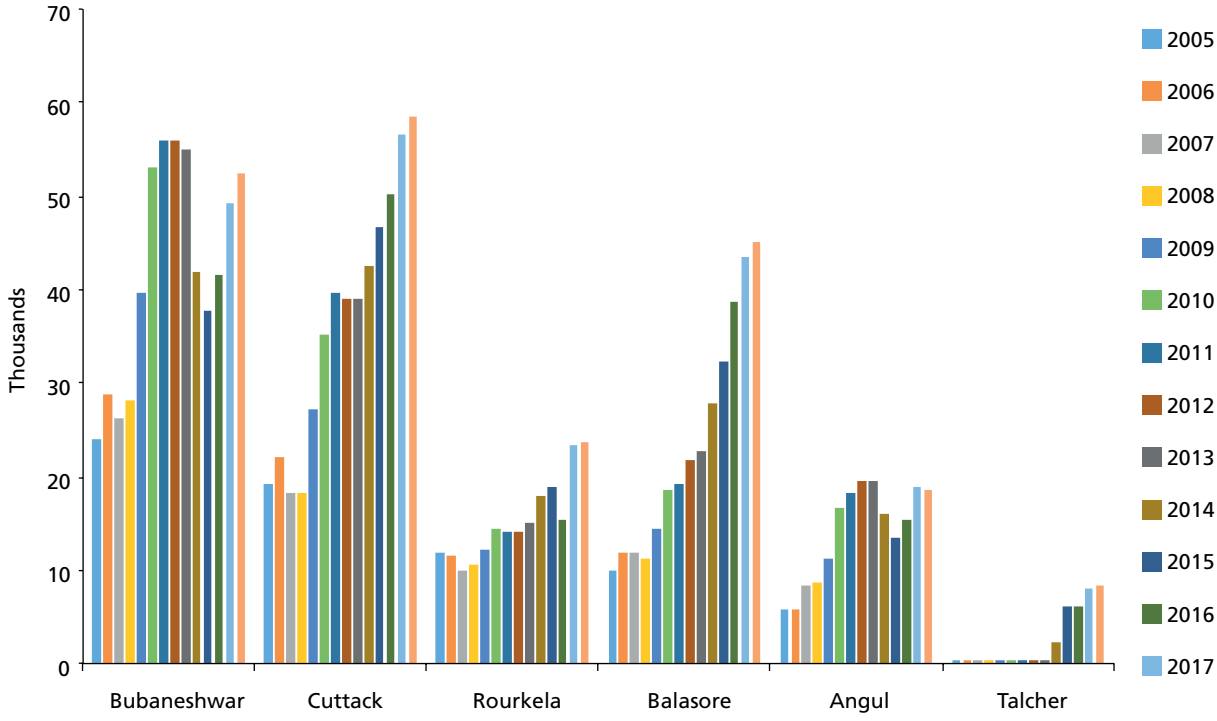
Vehicular pollution control requires action at two levels: i) reduction in tailpipe emissions through improvement in emissions standards and robust emissions inspection and phase out of older vehicles; and ii) Reduction in total vehicle miles travelled in cities by improving public transport and non-motorized transport system, restraint measures to reduce demand for personal vehicle usage, and compact urban planning to reduce distances travelled. All these measures are important and need to align to reduce vehicular emissions. Some of these actions are already underway. These will have to be integrated and aligned for the and further improved for the maximum impact.

Graph 5: Annual registration of vehicles (all categories) in cities of Odisha from 2005–18



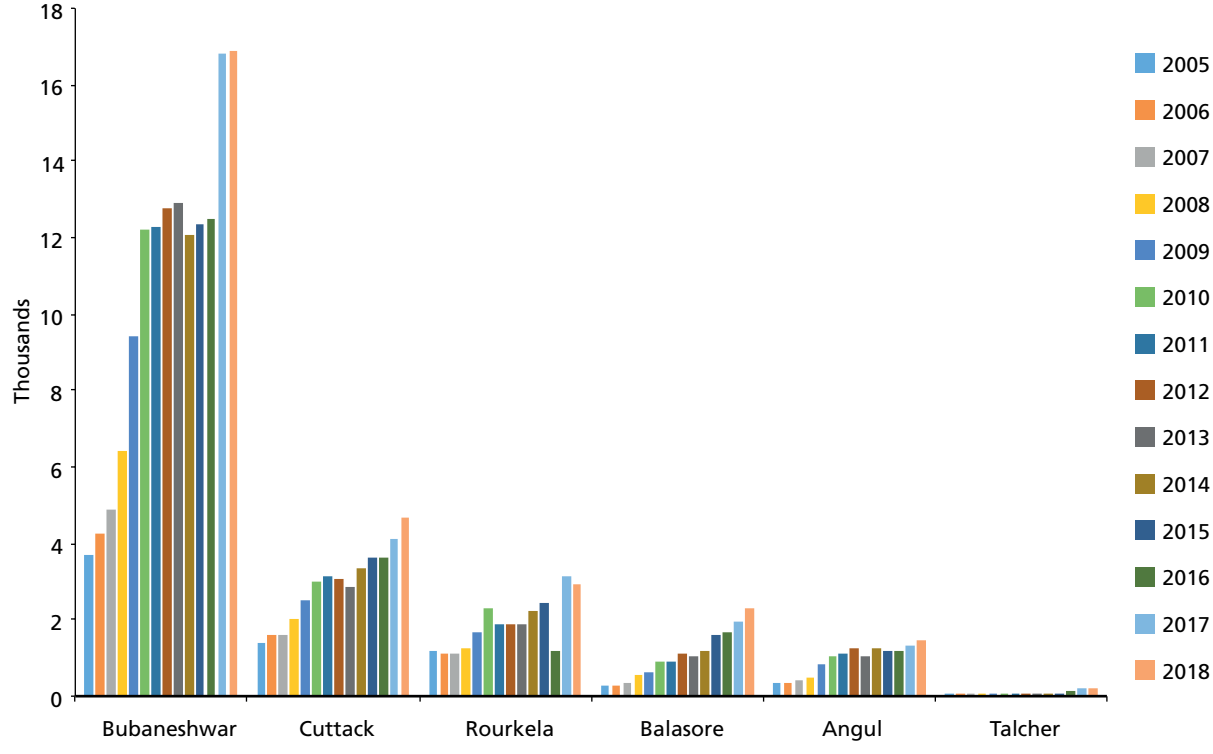
Source: Based on the data provided by RTOs.

Graph 6: Growth of two-wheelers in cities of Odisha (2005–18)



Source: Based on the data provided by RTOs.

Graph 7: Growth of cars in cities of Odisha (2005–18)



Source: Based on the data provided by RTOs.

Strategies to reduce tailpipe emissions

Emissions standards for new vehicles: As per the national roadmap, Odisha has implemented the Bharat Stage IV (BSIV) emission norms for new vehicles in April 2017. It is scheduled to introduce Bharat Stage (BS) VI (BSVI) norms and fuels in April 2020. The BS VI norms are slated to reduce emissions from new vehicles by 80–90 per cent. On road fleet will also benefit from the introduction of clean BS VI compliant 10 ppm sulphur fuels by April 2020. These emissions standards will come with stronger real-world emissions requirements and management to ensure that vehicles remain low emitting on road. As these new generation vehicles will be equipped with more advanced emissions control system, commensurate improvement in emissions inspection and maintenance will be needed at the city level.

Emission management of on-road fleet

With continuous ageing of vehicles, keeping vehicles low emitting through out their lifetime on road will require multiple strategies including in-use emissions inspection, monitoring of real world emissions, phase out of old vehicles and scrappage, clean fuel substitution and control of heavy duty traffic.

PUC programme: The current in-use emissions inspection programme is the Pollution under Control Certificate (PUC) system. Currently, under this programme idling carbon monoxide (CO) and hydrocarbon (HC) concentrations are measured in petrol vehicles and smoke density is measured in diesel vehicles. The status of implementation of lambda tests as per the 2004 notification of the Ministry of Road Transport and Highways—that is needed to maintain the optimum air to fuel ratio for proper functioning of catalytic converters in petrol cars—is not yet available. Ground assessment shows that there are quality control challenges with regard to the testing methods, calibration of equipment and overall compliance with the programme. Detailed data on the PUC programme for each city is not available.

At the national level under the direction of the Supreme Court order the Ministry of Road Transport and Highways (MORTH) is setting up the system to link PUC certificate with the annual vehicle insurance to ensure full compliance with the programme. Such methods and more are needed at the state level to ensure that everyone turns up for the PUC tests.

As the PUC centres are decentralized and numerous they need frequent inspection, robust audit programme to ensure that credible and authentic tests are being done. Such steps have been initiated by the Department of Transport. Steps are needed to further reform the system and also expand the online networking of PUC centres to link with centralised data server for proper audit. The detailed data on number of PUC centres in each non-compliant city, number of vehicles tested each centre, pass and fail status of the vehicles, networking status of the PUC centres with central server, etc are not available. Such a data base as indicated in the *Table 11: Status of PUC programme in non-attainment cities in Odisha,* is needed for proper scrutiny and monitoring of the programme.

Centralized vehicle inspection and fitness centres: The government is establishing vehicle inspection and maintenance centres for commercial vehicles in the state. As per the plan, six automated vehicle testing centres are to come up in Odisha. The state government has decided to set up automated vehicle inspection and certification centres and driving testing tracks. The I&C

Table 11: Status of PUC programme in non-attainment cities in Odisha

	Number of PUC checking centres	Number of vehicles tested in 2017–18	Number of vehicles failed PUC tests in 2017–18	Failure Rate	Do all the PUC centres monitor lambda from petrol cars	Networking status of PUC centres with central server location at transport department of each city	Is PUC testing made compulsory to avail vehicular insurance in compliance to Supreme Court order?
Angul	NA	NA	NA	NA	NA	NA	NA
Balasore	4	NA	NA	NA	NA	NA	NA
Bhubneshwar	NA	NA	NA	NA	NA	NA	NA
Cuttack	NA	NA	NA	NA	NA	NA	NA
Rourkela	NA	NA	NA	NA	NA	NA	NA
Talcher	NA	NA	NA	NA	NA	NA	NA

NA: Information not available

Source: CSE, compiled from data provided by pollution control board, and transport departments

testing in the automated centres needs to replace or complement and revamp the current visual fitness tests to bring robustness and reliability in the tests. Once the commercial vehicle testing facilities are set up to meet the requirements more information will be available on the compliance with fitness tests. This is an important step forward to improve overall safety and emissions from on- road vehicles. In 2016 it was reported that there are high number of unfit vehicles on roads. According to the State Transport Department, 17,322 such vehicles were detected in Bhubaneswar and Bhubaneswar-II regions and a total 51,426 vehicles were found without any requisite fitness certificates have been traced in the State.4 These vehicles can gross polluters.

On-road smoky vehicle inspection: Cities need strong on road smoky vehicle inspection to identify visibly polluting vehicles and remove them from roads for inspection and repair. A small number of grossly polluting vehicles contribute significantly to the pollution load from on-road vehicles. If these can be identified and addressed substantial emissions reduction is possible.

Advancement in on-road emissions monitoring: Introduction of BSIV and BSVI vehicles with more advanced emissions control systems will require advancement in emissions monitoring of on-road vehicles. The current PUC programme will not be adequate for that. The Ministry of Road Transport and Highways has already sent out an advisory to the State Transport Departments that all vehicles manufactured after 2013 that are equipped with On-board Diagnostic System (OBD) should be checked for malfunctioning light on the dashboard of the vehicle when they come for PUC check. If the light is on the vehicle should be returned for proper check in workshop and repair. This needs to be implemented across all PUC centres immediately. In addition, this system can be further upgraded in PUC centre to check if the OBD itself is functioning properly or have been tampered with. The OBD in vehicles have capacity to sense and record the emissions performance of the vehicles to alert the driver if there is any anomaly. While full scanning of the OBD for such diagnostic exercise can be done in the designated workshops to be identified, PUC centres can do simple tests to ensure if the OBD is functional. This kind of upgradation has become important after the introduction of BSIV and upcoming BSVI emissions standards that will bring more advanced and sophisticated

emissions control technologies that cannot be adequately monitored through PUC programme that was designed for older generation of vehicles.

Similarly, as being discussed in Delhi, the on-road fleet will require more rigorous monitoring for real world emissions to ensure that vehicles do not emit more than they are designed to emit. This may require selective and pilot introduction of on-road remote sensing monitoring to check the emissions as the vehicles are passing by to catch the most grossly polluting vehicles and characterise the fleet emissions. Cities of Odisha especially Bhubaneswar can take the lead in this matter to demonstrate for other cities.

Regulating movement of heavy duty vehicles: Yet another area of intervention is the heavy duty truck movement through cities that can contribute hugely to the urban pollution. Usually, cities restrict truck movement during the day and allow them to pass through or do loading and unloading during night. In Bhubaneswar the trucks are allowed to ply from 8 p.m. to 8 a.m. and in coal-mining areas from 6 p.m. to 6 a.m. But explicit intervention is needed to design highway alignment in a way that they bypass the highly populated cities and do not cut across. Truck movement and dust control from loading and unloading will be of special concern in industrial cities and mining areas and will require spatial planning to reduce exposure. In non-industrial cities strong siting policy is needed to place truck terminals and container depots away from the city centre and densely populated areas.

Heavy duty vehicle movement and operations in industrial and mining areas will require special attention. In the plan for critically polluted industrial area of Angul-Talcher it has been stated that enclosures be provided for all unloading operations. Water shall be sprayed on the material prior and during unloading, and pathways in coal yard for vehicles should be paved.

Phasing out of old vehicles: As of now cities in Odisha do not have age restriction on vehicles. Vehicles of and more than 15 years age are not prohibited from plying within cities. After crossing the 15 years registration time frame, these vehicles are not removed instead they are re-registered for a span of another five years. The non-attainment cities require a phase out plan either through age restrictions or tax policy or restrictions on their movement in city centres. The phase out plan will need to be supported by a scrappage policy especially for the old commercial vehicles and buses. Currently, Union Ministry of Road Transport and Highways (MORTH) is also working in a national scrappage as policy. But state level policies are also important for scrappage infrastructure. Recently, Delhi has framed a similar policy. Regulatory and fiscal measures are needed to discourage use of old vehicle vintage meeting very old emissions standards.

Sticker system for vehicles: It may be noted that on 26 July 2018, the Supreme Court has approved the MoRTH's Colour Coded High Security Registration Plates (HSRP) Hologram Stickers programme to come into effect across the country from 1 April 2019. Under this programme, each vehicle, both old and new will be provided colour coded non-tamperable High Security Stickers, along with the number plates. These stickers, affixed on the windshield of a vehicle, will be Orange in colour for all Diesel vehicles and Light blue in colour for all Petrol/CNG vehicles. On December 6, 2018, the MORTH has notified the Motor Vehicles (High Security Registration Plates) Order, 2018. This will be implemented for all new vehicles from 1 April 2019, and can subsequently also be enforced for older vehicles. This sticker based identification programme

can help to identify the most polluting vehicles during high pollution episodes. This policy measure, once implemented, will also mean that Low Emission Zones (LEZs), as seen in Paris, London, Berlin, Amsterdam and Chinese cities etc. can be formed in pollution hotspots in urban areas. This can help to regulate movement of very old and polluting vehicles inside the city. If polluting vehicles using polluting fuels and older vehicles can be identified through a sticker system their movement can be regulated and restricted when pollution levels increase in the city or congestion needs to be managed.

Clean fuel initiative: CNG

Substitution of mainstream fuels especially diesel with cleaner fuels like compressed natural gas (CNG), liquefied natural gas (LNG) and liquefied petroleum gas (LPG) can help to improve emissions substantially. Natural gas vehicle programme has become a possibility in Bhubaneswar and Cuttack. The Union Ministry for Petroleum and Natural Gas has inaugurated two Compressed Natural Gas (CNG) stations in Cuttack. As per plans 20 CNG stations will be commissioned in the twin cities of Bhubaneswar and Cuttack. Currently, natural gas is being supplied in special containers by road from Kakinada in Andhra Pradesh. Provision has been made for transportation of Liquefied CNG in cryogenic tankers from Dahej in Gujarat to Bhubaneswar and Cuttack. Necessary infrastructure is under construction at Bhubaneswar for the facility. After commissioning of 2,655-km-long Jagdishpur-Haldia and Bokaro- Dhamra Natural Gas Pipeline (JHBDPL) under Urja Ganga project, natural gas will be supplied through pipeline.

As on June 2018 Odisha State Government has set a target to convert 30,000 diesel-run auto-rickshaws in Bhubaneswar and Cuttack to CNG. The number has gone up to 800 auto-rickshaws, 40 cars and 20 scooters on CNG. Bhubaneshwar has two CNG-filling stations at Patia and Chandrasekharpur. Two more stations are likely to come up at Khandagiri and Tamando. Cuttack city has two stations. GAIL has plans to build 15 CNG stations in Bhubaneswar and 10 others in Cuttack in a phase wise manner.

City gas distribution project is being implemented. Three companies—Gas Authority of India Limited (GAIL), Bharat Gas Resources and Adani Gas Limited—will invest in 17 districts of the state to provide piped natural gas to households, commercial and industrial segments and vehicles. This programme needs to be scaled up on a priority basis for the non-compliant cities.

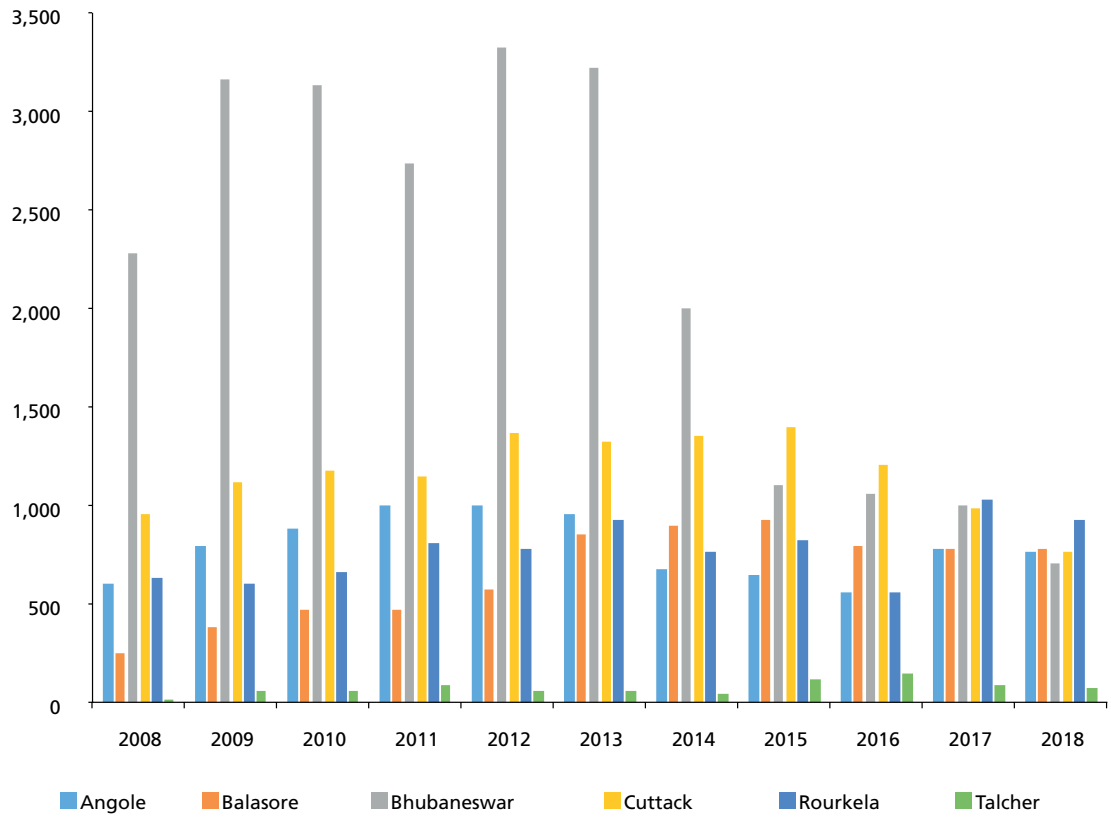
Natural gas vehicle programme will require to set targets for different vehicle segments. All auto-rickshaws, taxis that do point-to-point service inside the city, light and medium duty freight vehicles on local permits and a part of bus transport can move to CNG and help to reduce toxic diesel emissions. Creating such a mandate can help to do better infrastructure planning.

Share of diesel cars and auto rickshaws in Bhubaneswar is high. In the three-wheeler sector, diesel autos dominate. High rate of use of diesel in transport sector is a matter of concern, as diesel emissions are extremely toxic and according to the WHO are classified as Class I carcinogen for strong link with lung cancer. Diesel vehicles also contribute more to particulate matter and nitrogen oxides that are a matter of concern in cities. High mileage public transport system inside the city including buses, taxes and auto rickshaws can be targeted for phased introduction of CNG programme.

Fuel-wise breakup of fleet shows that use of diesel cars have grown in all cities and is particularly high in Bhubaneswar. It is also a matter of concern that auto-rickshaws in all cities are predominantly on diesel *(see Graph 8: Number of autos running on diesel and Graph 9: Diesel and petrol vehicles in the six cities).* Bhubaneswar has the highest number of diesel autos followed by Cuttack, Rourkela, Angul, Balasore and Talcher. Phase out diesel autos is important as these are designed to emit higher emissions than even diesel cars. Under the current emissions standards of BSIV, a diesel auto is legally allowed to emit 1.7 times higher particulate matter and 1.3 times higher NOx+HC than a BSIV diesel car. This gap with diesel cars will further widen under BSVI regulations that will be enforced within two years. Even after meeting BSVI emissions standards, a diesel three-wheeler will emit close to 6 times higher particulate matter and two times more nitrogen oxide compared to a BSVI diesel car. The big concern is the very high on-road and in-vehicle toxic exposure from these vehicles. These small engines with unstable emissions and high exhaust temperatures limit the scope of application of advanced and effective after-treatment systems that are otherwise used in other diesel vehicles.

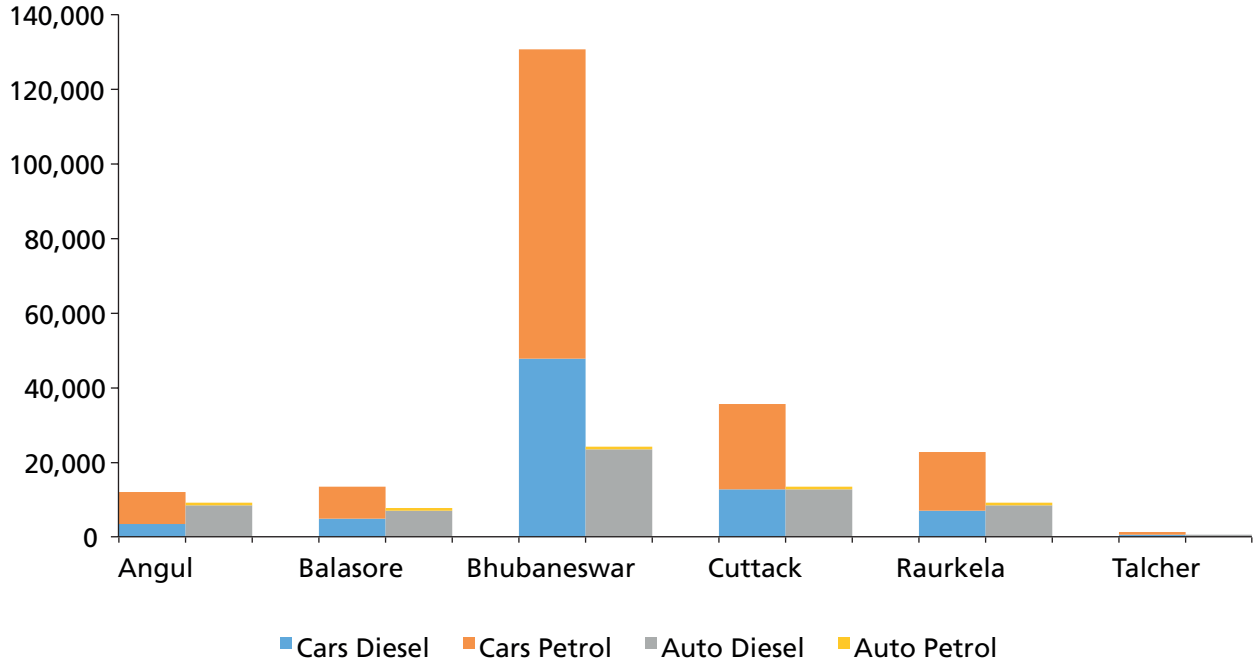
Bhubaneswar has now started to phase out of diesel autos. This will be accelerated and expanded to other vehicle segment with requisite expansion of CNG refuelling stations. Other cities, need an early phase-out plan for diesel autos.

Graph 8: Number of autos running on diesel



Source: Based on the data provided by RTOs.

Graph 9: Diesel and petrol vehicles in the six cities



Source: Based on the data provided by RTOs.

Transportation and mobility

Control of vehicular pollution will also require transportation and mobility strategies to reduce traffic volumes and total vehicle kilometres travelled in the city. Such action has already started in Bhubaneswar that include bus sector reform, infrastructure for non-motorized transport (NMT), bike sharing programme, street design guidelines, transit oriented urban planning, parking management, electric mobility among others. This needs to be scaled up to create a template for other non-compliant cities as well. For the clean air action plan it will be useful and necessary to set a target of achieving an improvement of modal share of public transport to at least 85–90 per cent by a target date. This will help to plan the requisite infrastructure for the desired shift.

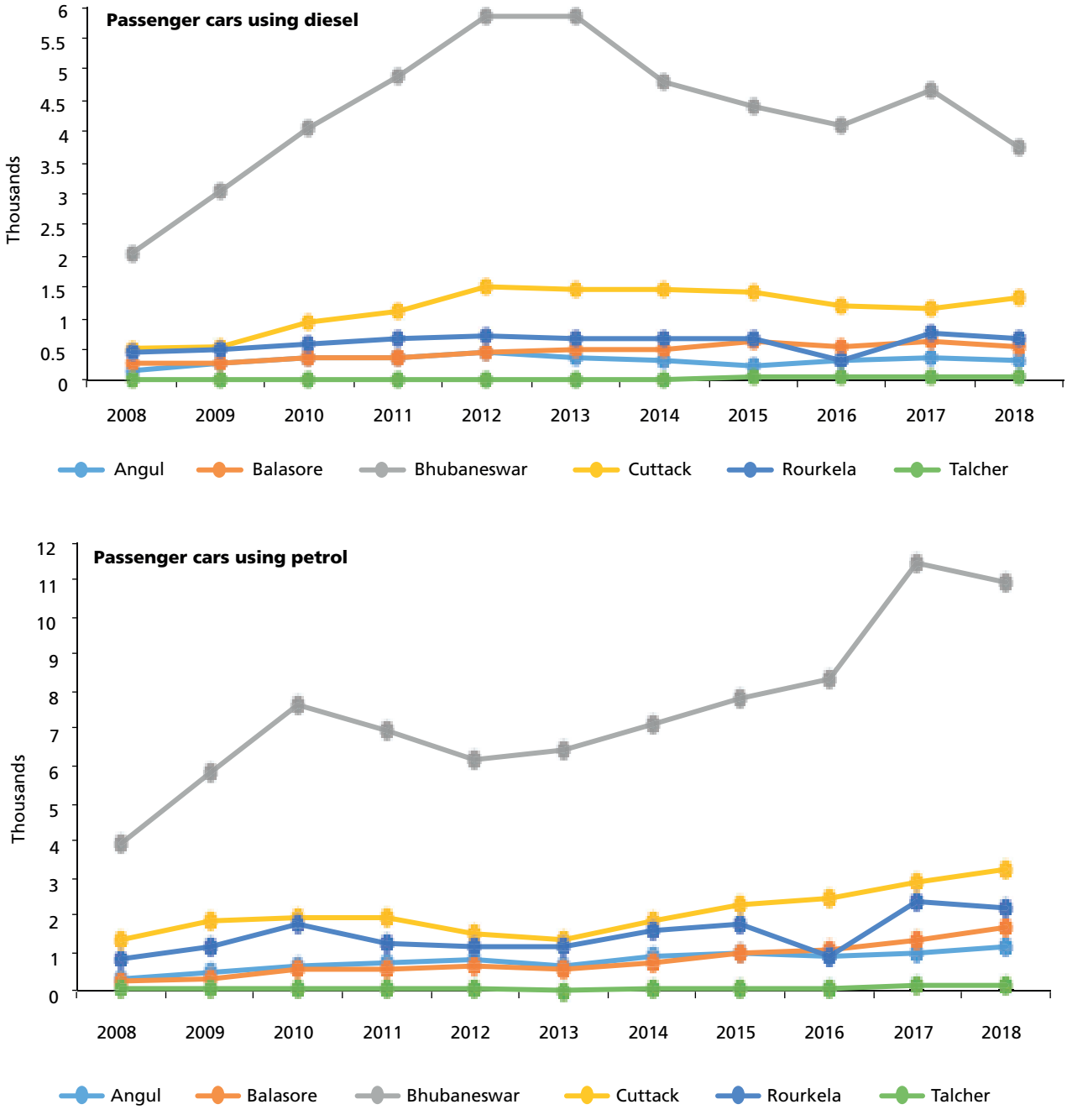
Travel demand is increasing with growing population in cities. The population in Bhubaneswar and Cuttack has increased from 1.05 lakh and 1.94 lakh in 1971 to 8.43 lakh and 6.10 lakh in 2011 as per census data, with a decadal growth rate of 29.42 per cent for Bhubaneswar and 13.24 per cent for Cuttack. The population in Rourkela and Balasore has increased from 35,000 in 1961 to 3.2 lakh in 2011 and from 33,931 in 1961 to 1.44 lakh in 2011. Angul and Talcher are small industrial towns with a lot of floating population. The population of these cities has increased from 24,000 in 1961 to only 43,000 in 2011 and from 26,000 in 1991 to 41,000 in 2011. System for movement and transport will have to be designed to cater to the growing demand. Motorization is highest in Bhubaneswar followed by Cuttack while the trend in other cities are upward *(see Graph 10: Trend in motorization in six non-attainment cities during 2008– 18).*

While proposing mobility strategies for mitigation of air pollution this plan has adopted distinct strategies for a comparatively bigger city like Bhubaneswar and smaller cities. Both the categories of cities require distinct strategies. Smaller cities like Talcher, Angul, Balasore etc, have predominantly lower volume of travel demand and short distance travel. This will require more

locally appropriate transportation systems. These cities are mostly dependent on smaller and often informal systems like inter-mediate public transportation, walking and cycling to meet most of their travel demand. They cannot support high volume mass transport. These cities would need to reform these smaller systems for more efficient deployment, last mile connectivity and pedestrian and cycling infrastructure.

The bigger cities like Bhubaneswar with higher travel demand will require larger network of formal and organized and bigger systems but supported by walking and cycling infrastructure. Bhubaneswar will therefore require

Graph 10: Trend in motorization in six non-attainment cities during 2008–18



Source: Based on data from RTOs

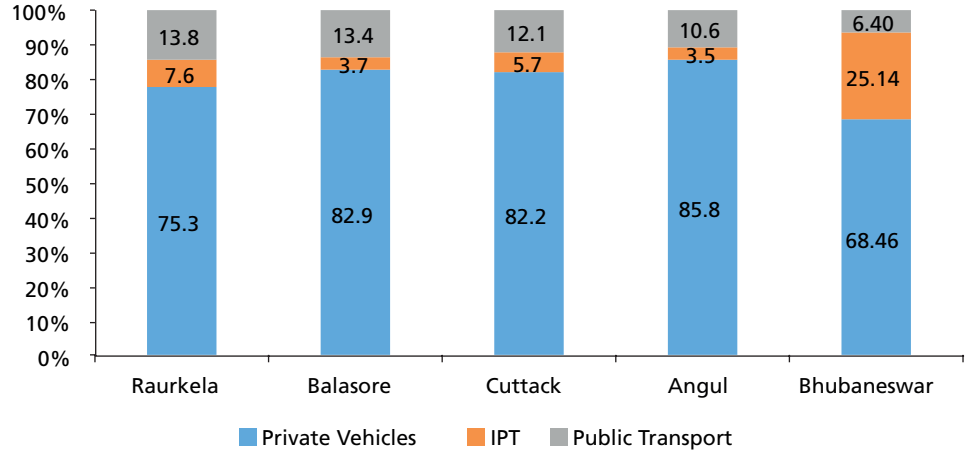
different strategy that include diverse but integrated public transport systems with more organized bigger bus system, walking and cycling infrastructure, compact city norm including mixed land-use requirements to prevent sprawl and reduce distances among others.

Even though the absolute number of vehicles is higher in Bhubaneswar as compared to the smaller cities such as Balasore, Rourkela etc., the number of motor vehicles per thousand people can be higher in smaller cities than even in the big metros. Bigger cities or state capital like Bhubaneswar have invested in formal bus based public transportation system to some extent. But most smaller and industrial towns do not have well organized public transport services. This leads to higher dependence on personal vehicles in the smaller cities. Bus based formal public transportation is introduced only when a city has attained a particular size and population. This leaves the smaller cities to rely on either personal means of travel or informal intermediate public transport modes like auto-rickshaws, shuttle services etc. But more innovative approaches based on efficient smaller systems supported by safe pedestrian and cycling access and pedestrianisation can help significantly to reduce emissions.

The modal share of private vehicles among all motorized trips is very high in all cities: at almost 70 per cent in Bhubaneshwar, 89 per cent in Balasore, 80 per cent in Rourkela and 55 per cent in Cuttack. If the motorization continues based on this kind of modal share then non-compliant cities will find it increasingly difficult to meet the clean air standards and reduce exposure. Growing population and travel trips will lead to exponential increase in personal vehicles and toxic exposure. This will require more options for well-integrated and affordable mass transport system and walking and cycling to improve the carrying capacity of the existing road network and to reduce congestion and pollution.

State of public transport: The provision of public transport in all the cities is minimal. In Rourkela share of public transport accounts for 5.6 per cent, Balasore 6.6 per cent, Cuttack 5.3 per cent, Angul 5 per cent and Bhubaneswar 5.6 per cent *(see Graph 11: Modal Share of daily travel trips in different cities [motorized trips only]).* This is due to unavailability of organized city bus

Graph 11: Modal share of daily travel in different cities (motorized trips only)



Source: Census Data 2011.

services to cater to the commuting needs of people. Apart from Bhubaneswar that has recently revived its city bus services, other cities do not possess any form of formal public transport system within the city limits. There are few private agencies plying but lack reliable operations. There are gaps that need to be addressed in order to have a safe, comfortable and reliable public transportation network and services. In order to reinforce the bus systems as the backbone of urban mobility it is imperative to create a focus towards higher modal share of public transport.

In Bhubaneswar, city bus operation commenced in 2009 between Bhubaneswar-Puri-Cuttack-Khurda with nine routes, which increased to 23 by 2015. However, due to lack of ridership a few of the routes had to be terminated. Currently, 17 routes are operational and maximum routes are crossing through master canteen. In terms of ridership the available data presents a significant reduction in the ridership since 2014. The data shows a daily ridership of 42,000 achieved in 2012– 13, which has now fallen to a little over 23,000 daily passengers. The pax/bus/ day has also dropped since 2013–14 *(see Table 12: Bus usage in Bhubaneswar). Strategies are needed to improve public transport ridership.*

Table 12: Bus usage in Bhubaneswar

Year	Passenger/bus/day	daily (lakh pass)
2011–12	317.12	0.3
2012–13	427.98	0.42
2013–14	409.31	0.38

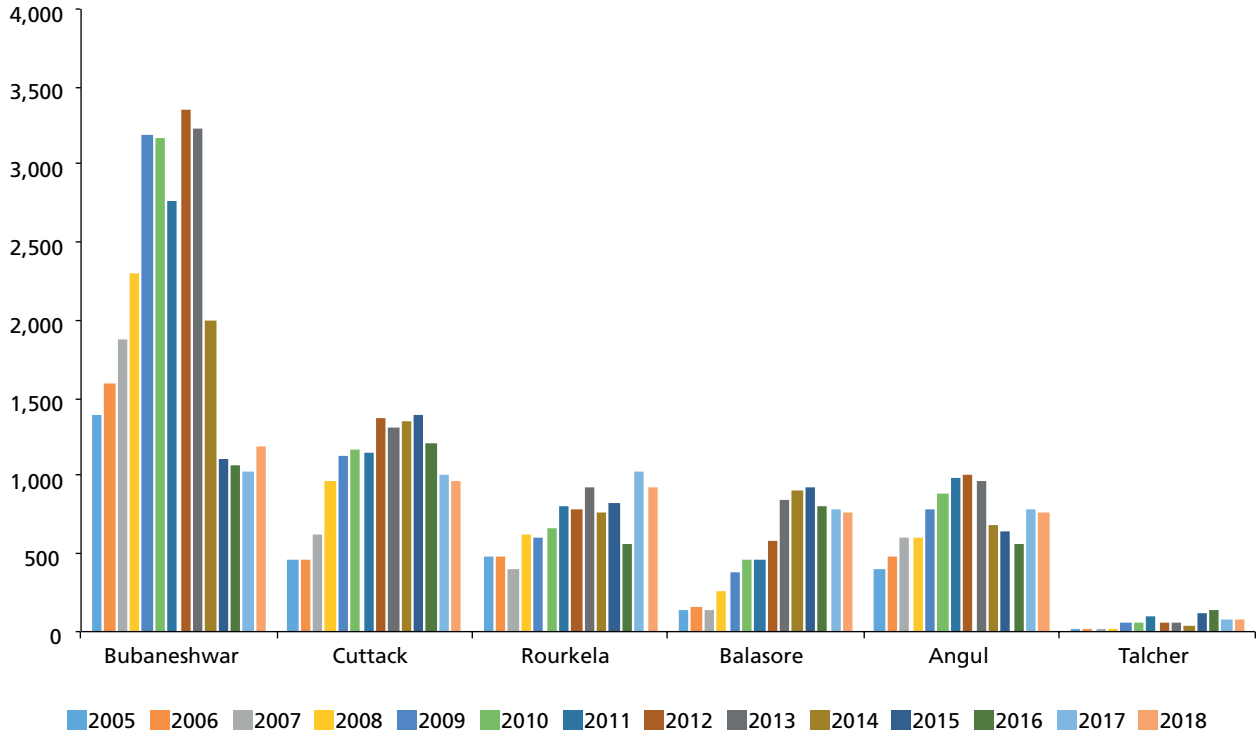
Source: Bhubaneswar City Bus Modernization Plan, DPR-May 2018.

Recently Bhubaneswar started MO Bus services housed within Capital Region Urban Transport (CRUT). The objective of this service is to provide reliable, safe, accessible, user-friendly and sustainable public transport. Currently under this scheme 200 buses are plying on the roads, and all these buses are equipped with GPS tracking, on board public information systems, on board surveillance and free Wifi facilities. Modern bus queue shelters fitted with all the basic amenities (seating, dustbins, signane) have been constructed for the convenience of the passengers. GPS-based public information system (PIS) mounted on the BQS shows real-time information on MO BUS plying on the routes. The PIS is linked to the Bhubaneswar Operations Centre (BOC) for better coordination amongst passengers and operators. However, the system will have to be operated with accountability for reliable services.

Other non-compliant cities will need assessment in terms of introducing organized buses services based on the travel demand. Even for critically polluted industrial cities like Angul-Talcher, the OSPCB plan has stated that these cities need to procure and deploy buses in a phased manner as a form of formal public transport system. Given the relatively low population, appropriate bus sizes could be considered so they could be run at a good frequency. The buses may be introduced in high demand routes (trunk routes) whereby existing intermediate public transport services could be rationalized to act as feeder to the bus system. It would be pertinent to work out a full deployment plan and create the system in phases accordingly to have a full-fledged ITS-integrated city bus system in five years. This may be implemented.

Intermediate public transport: Assessment of travel pattern in almost cities show very high demand and usage of intermediate public transport (IPT) modes, i.e. cycle rickshaws, auto rickshaw, e-rickshaws and taxis. They play

Graph 12: Growth in the number of auto-rickshaws registered in the six cities



Source: Based on the data provided by RTOs.

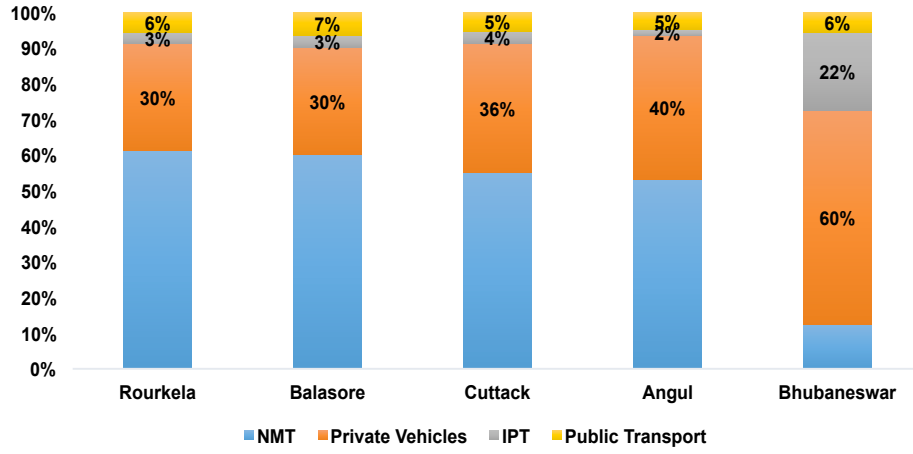
a paramount role to meet the travel demand. Particularly in smaller cities they are the predominant mode of transport. The services provided by IPT modes are usually fairly flexible and are dependent on the requirements of the passengers. These are low volume, affordable and high frequency services that are very suitable for catering to the small distance travel needs in the cities. In most cities the average travel distances are very low—even shorter than 5 km. This makes IPTs very important.

As per the data provided by the RTOs the total number of registered three-wheeled passenger vehicles in 2018 are 30,000 in Bhubaneswar, 15,000 in Cuttack, 10,000 in Rourkela, 7,600 in Balasore, 10,200 in Angul and 900 in Talcher. There has been an exponential increase in the growth rate of auto-rickshaws in almost all cities, other than Bhubaneswar, when compared to the total numbers registered a decade back *(see Graph 12: Growth in the number of auto-rickshaws registered in the six cities).*

The para-transit sector is not recognized by government and is considered a part of informal sector, hence there are very limited initiatives proposed for the development of this mode of transport. There are plans to introduce E-rickshaws to act as a last and first mile substitute. This plan will be initiated first in Bhubaneswar and then Cuttack. So far the plans to introduce these vehicles are confined to these two cities. With an aim to promote eco-friendly transport in Bhubaneswar and Cuttack, electric vehicles will hit the city roads by next year.

As is evident from the initiatives from other parts of India it is possible to reorganise this segment for proper deployment, efficient services, and

Graph 13: Modal share of different cities (non-motorized trips included)



Source: Census Data 2011.

neighbourhood connectivity. This mode is suitable for rapid electrification.

Non-motorized transport: The available census data on work trips show that in cities of Odisha maximum numbers of trips are by walking and non-motorised transport (NMT), the only exception being Bhubaneswar, where number of trips by private vehicles are very high. Maximum number of trips generated in Angul, Talcher, Rourkela, Balasore and Cuttack are by non-motorized modes (walk and cycle). Even with such high share of NMT in these cities there is no infrastructure available for NMT services and walking hence pedestrians and NMT users are exposed to higher risks of accidents and exposure as they share the same right of way with the motorized vehicles *(see Graph 13: Modal share of different cities [non-motorized trips included]).*

As per the smart city plan, Bhubaneswar Smart City Ltd has launched several schemes to advocate and implement NMT plan and policies. One such project is the Smart Janpath. It is conceptualized as complete streets that are based on the principle of equal roads for all. Bhubaneswar has recently launched cycle sharing with 1500 cycles under Mo Cycle. The public bicycle-sharing programme is one of the ambitious project under smart city programme. The city has 11 km of existing cycle tracks, which were painted red by the urban development authority to segregate the bicycle lanes within the right of way.

As part of the clean air action plan comprehensive street design guidelines and non-motorized transport policy will help to promote zero emissions mode and leverage the high share of walking and cycling practice in most non-attainment cities. Most of the strategies that are needed to improve sustainable mobility and transportation system are being piloted in Bhubaneswar already. This provides the learning curve for other cities. These initiatives need to be integrated with the clean air action plan for an integrated approach.

Non-motorised transport intervention will be critical in other non-attainment cities that are also smaller cities.

Compact city development to reduce vehicles miles travelled: Clean air action plan will require strategies to reduce vehicles miles travelled and automobile

dependence in cities. All non-attainment cities have the advantage of short travel distances and short average trip length. For instance, in Bhubaneswar average daily travel trips are below 5.5 km. This means well organized intermediate transport, walking and cycling infrastructure can meet most of the travel demand in the city and reduce use of personal vehicles.

However, with new urban development cities have also started to sprawl and low-density development is taking place at the city's periphery as is evident in Bhubaneswar. This increases travel distances and dependence on personal vehicles due to poor connectivity. This will have to be contained by adopting compact city guidelines and regulations and integrate that with the Master Plan. Clean air action plan requires urban planning to promote high density, mixed land use and mixed income use development and compact urban form to make the city more accessible and walkable. The Union Ministry of Housing and Urban development has framed guidelines for compact city development. Also those bigger cities like Bhubaneswar that are expected to have transit systems like BRT and improved bus system , transit oriented development policy can be framed to ensure compact and accessible urban form near transit nodes.

In both big and smaller cities—even without transit line—it is important to adopt an urban form code to keep the design of the city compact and accessible. For that purpose adopt urban form based codes to help reduce travel distances and improve accessibility to allow comfortable use of public transport, para transit and walking and cycling.

Travel demand management and parking policy: Along with increasing the options for sustainable travel modes like public transport, walking and cycling, there is need to have travel demand management measures to encourage people to reduce dependence on personal vehicles and use other modes. As is evident from the global best practices, parking policy, congestion pricing, low emissions zone etc. are some of the established methods to reduce demand for travel and usage of personal vehicles that help to reduce emissions and congestion. In Indian cities the first step towards travel demand management is parking policy and rules. Detailed indicators for such a parking policy has already been included in the comprehensive clean air action plan of Delhi and National Capital Region. Even globally, parking policy and strategies have emerged as an important air pollution control measure. This is used to reduce travel demand and parking demand.

Presently, parking is largely unorganized in all non-attainment cities. Government of Odisha had earlier issued a parking policy in 2013 indicating the issues and proposals to solve the massive parking problems arising in the city. The document deliberates on an emergent need to come up with a parking policy and a set of operational standards/ guidelines to encourage private initiative, in addition to the government initiatives, in creation of adequate parking spaces through appropriate incentives and enforcement systems. However, the policy is currently focused on parking supply and not on demand management. It is assumed that parking demand will continue to grow and therefore plans are made to provide and supply more parking spaces by building stand alone multilevel parking structures and allowing infinite and free use of public spaces and roads for parking. This further increases demand for parking and becomes insatiable and unsustainable.

As part of the clean air action plan therefore, parking policy and rules will be framed as a demand management tool. This principle has already been

provided in the National Urban Transport Policy 2014 and the deliberation of the Hon'ble Supreme Court interventions on air pollution in Delhi and the Capital region. Parking policy to be framed for all non-compliant cities will promote city-wide parking area management plans to identify legal parking areas in the delineated zones without encroaching on green areas, parks, footpaths and cycle tracks and that will be demarcated on ground. On-street and off-street legal parking will be demarcated and managed in integrated way. Priced and shared public parking will be promoted for optimum utilization of legal parking lots. Multilevel parking will be planned as part of the larger area plan instead of as a stand-alone measure. This will be combined with variable parking pricing and residential parking permits among others.

Electric mobility programme

There is considerable opportunity in non-attainment cities to adopt electric mobility policy and zero emissions mandate to reduce the emissions impact of motorization. The compact city design of the six cities and small distances and dominant use of para transit are favourable for quicker adoption of the zero emissions mandate. On a priority basis a sizeable part of the buses, auto rickshaws, taxis, large delivery fleet can be targeted for electric mobility programme. In addition, given the very large usage of two-wheelers that are very polluting, can also be targeted for this programme for substantial air quality benefits.

Odisha does not have a state-wide comprehensive Electric Vehicle policy yet. However, it has announced policy measures for electric vehicles. Under the Smart City Programme, Bhubaneswar has developed an E-mobility Plan in December 2017. Key features of the plan include deployment of 148 e-buses, 500 e-rickshaws, 100 EV sedans and 1,000 e-cycles by 2021. This also includes installation of 522 AC slow chargers and 85 fast chargers; a target of 20 per cent trips on electric vehicles by 2021 and 30 per cent by 2030. There is a provision to reserve a minimum of 30 per cent of the parking spaces for electric vehicles, with charging facilities. Use of electric sedans for internal usage of municipal and regulatory agencies such as Bhubaneswar Municipal Corporation, Bhubaneswar Development Authority etc. has been provided for. Detailed route planning and rationalization for e-buses, e-rickshaws and e-cycles has been done. Bhubaneswar has not been allocated any electric bus under FAME 1. However, VAHAN database shows 1,235 EV's registered in Odisha in 2018 (till 12 December), up from 218 in 2017 and 31 in 2016.

This initiation of electric vehicle programme in Bhubaneswar can create the template for replication in other non-attainment cities especially targeting the city centres. This initiative can be promoted with a legal zero emissions mandate for targeted phase in and timeline.

Construction and demolition waste

Construction and demolition waste (C&D) is not only the source of dust but these also get dumped in ecologically fragile zones and water bodies that cause environmental degradation. But most of this inert waste is reusable and recyclable and can be brought back to the construction itself. According to the guidelines on environmental management of construction and demolition (C&D) wastes 2017, Bhubaneswar generates approximately 196.8 tonnes per day (TPD). The civic body, Bhubaneswar Municipal Corporation (BMC) proposes to set up a C&D waste processing plant on public-private-partnership mode. The civic body has identified two sites for dumping of waste—Patia and Kargil Basti.

The C&D charges have been fixed for construction. These are as follow: For a structure > 80 sq. m area Rs 50 per month; Rs 100 charged for 120 sq. metre. Beyond 120 sq. metre, Rs 200; stacking of construction/demolition debris Rs 1,500 per tractor trip Rs 3,000 per truck trip. The disposal of this waste is done on regional Landfill of non-biodegradable and inert material site at Brajrajnagar/ Jharsuguda.

The three respective zonal divisional commissioners of the Bhubaneswar Municipal Corporation (BMC) will ensure that a fine of Rs 6,500 per tractor load of construction and demolition waste is collected from the violators. Of this, Rs 1,500 will be transportation charges, while the remaining Rs 5,000 will be administrative charges.5

In Balasore the total municipal solid waste generated from households and commercial establishments is 42.5 MT/day. The C&D waste generated is approximately 2 MT/day. There is one dumping site in Balasore at Chunbhati where without any treatment all the waste is being dumped.

In Talcher the quantity of solid waste generated by the city is 18 MT/day and construction waste generated is 2-3 MT/day. Both kind of waste follows the SWM rules and C & D waste management rule. Most of the waste generated especially the municipal solid waste is directly dumped into the landfill site as informed by the officials of the municipality in Talcher.

In Angul the executive officer with the municipality informed that 20 MT/day of municipal waste is generated within the city and the waste management rules is not implemented in the city. The amount of C&D waste generated is 50 cum and there are 23 active sites where construction is going on. The C&D guidelines are yet to be implemented in the city.

Solid waste management

Municipal solid waste management based on household based segregation, recycling and reuse and composting of vegetative waste need accelerated roadmap and infrastructure to address the problem. Solid Waste Management Rules and Regulations need implementation across all cities to address this concern. Clean air action plan will also require a roadmap for zero landfill policy. Across other cities landfill sites are becoming source of pollution due to spontaneous fires caused by methane emissions. This is possible only through decentralized waste management and recycling. Adequate and appropriate infrastructure will have to be created to enable this process. In the meantime landfill management will be needed to prevent fires.

Household and domestic emissions

Use of solid fuels for domestic cooking has significant impact not only on indoor air quality but also on outdoor air quality with serious public health consequences. This is one of the reasons why the advisory on the National Clean Air Programme (NCAP) of the MOEF&CC has recommended installation of rural air quality monitoring as well. The new Lancet study has shown that death rate due to solid fuel use for domestic cooking is among the highest in Odisha. According to the Department of Health and Family Welfare, Government of Odisha, incidence of Acute Respiratory Infection and Pneumonia have increased by 32.3 per cent between 2014 and 2015, - from 1.64 million to 2.17 million incidences.6 As per the 2017 report India: Health of the Nation's States, Air Pollution is the second largest risk factor driving death and disability in Odisha in 2016, up from being the third largest risk factor in 1990.

Use of solid fuels remains quite dominant. The rate in growth of use of clean fuels for domestic cooking is rather slow, at 1.15 per cent CAGR across Odisha. Although in urban areas, the growth is faster, even here, more than one in three households continue to use solid fuel for domestic energy requirements *(see Table 13: State of solid fuel usage in rural and urban areas of Odisha).*

Table 13: State of solid fuel usage in rural and urban areas of Odisha (in per cent)

% of Households	2005-06 (NFHS-III)	2011 (Census)	2015-16 (NFHS-IV)	Reduction per year in solid fuel usage (2005-16)
Total	89.3	86.2	80.5	**1.15**
Urban	51.7	45.3	34.4	**4.43**
Rural	96.1	93.8	88.8	**0.87**

Source: CSE analysis based on data from National Family Health Survey (NFHS—Rounds III and IV) and Census 2011.

As per the Census 2011, 8.33 million households (86.2 per cent of Odisha's total households) currently use solid fuels (Firewood, Crop Residue, Cow dung Cake, Coal, Lignite or Charcoal) for cooking. For urban and rural areas, this figure is 0.69 million and 7.64 million households (45.3 per cent and 93.8 per cent of total households) respectively. This is to be compared against the national average of 67.2 per cent, 26.2 per cent and 86.5 per cent of total, urban and rural households respectively. Coal consumption in massive amounts by households has also led to the increase in the pollution levels. This will have to be strongly curtailed. In Cuttack, the majority of the households use firewood as a household fuel according to the District handbook of Cuttack, 2011. More granular city-wise consumption and usage is available. But this will require serious attention as this has serious adverse impact on maternal and child health.

As on 13 December 2018, Odisha had released more than 3.52 million LPG connections under the Ujjwala Yojana. This represents one of the fastest growth rates in the sale of LPG (23.8 per cent in 2016–17) as well as in the number of customers (32.5 per cent between 2016 and 2017).

Several other initiatives have been taken to promote cleaner energy options like biogas plants. About 2.41 lakh family-type biogas plants for domestic cooking and lighting have been developed by the Odisha Renewable Energy Development Agency (OREDA), Department of Science and Technology, Odisha, under the National Biogas and Manure Management Programme (NBMMP).

Under the clean cook stoves initiatives, 247 clean cookstoves (Unnat Chulhas) have been provided by OREDA in 2016–17. About 9,800 clean cookstoves (Parishad Chulhas) have been provided in schools for Mid-Day Meals by OREDA till date, of which 2,500 have been installed in 2016–17. An analysis by the Centre for Science and Environment shows that in Odisha, the growth in customers outstrips the growth in LPG sales, indicating the lack of sustained use of cleaner fuels after the initial connection under LPG. There are 0.79 million inactive LPG connections, as on April 2018.

Availability of cheap solid fuel such as coal, firewood and crop residues must be countered with fiscal incentives to make clean fuels economically viable for domestic use. The six non-compliant cities require 100 per cent LPG coverage of households and reliable supply. This will have to be supported by strong public awareness programme.

Diesel generator sets and roof-top solar programme

Given the state of electricity supply dependence on diesel generator sets is quite significant that causes high local exposure to toxic diesel fume. There is no estimate of the total number of generator sets in the non-compliant cities—residential and institutional—and their installed capacity. Implementation of the emission standards for all diesel generator sets is essential. The ultimate solution to this problem is assured and reliable supply of electricity. This will require full utilization of the installed power generation capacity, revamping of grid and connectivity.

Yet another important solution to this problem is to promote roof top solar power generation. A study by the Centre for Science and Environment has shown that on a lifecycle basis cost of roof-top solar works out to be cheaper than diesel generator sets especially keeping in view the diesel prices. This creates incentive for the consumers—both domestic as well as institutional and industry—to install roof solar systems. This programme may be further strengthened with stronger incentive policy to encourage quicker adoption of rooftop solar systems especially by the industrial and commercial users, and residential blocks.

In accordance with 'Odisha Solar Policy—2013' of Science and Technology Department of Government of Odisha, Odisha receives an average solar radiation of 5.5 kWh/sq. m area with around 300 clear sunny days every year. Odisha's gross renewable energy potential is 53,820 MW. The feasible potential for power generation in the Solar Photovoltaic and the solar thermal routes have been roughly estimated as 8000 MW and 2000 MW respectively. Odisha has set a target of 2,378 MW of power to be generated from solar power plants. In addition to this, solar rooftop power has also been targeted to accomplish the 'power for all' objective. Solar power production in Odisha has been divided into four categories, with 328 MW coming from utility-scale projects, 50 MW from solar panels on waterbodies and 1 GW capacity from large-scale solar parks and 1 GW from rooftop (both on and off grid) projects in the commercial and domestic segment.

By 2017–18, Odisha has set a target of achieving 297 MW of total solar installed capacity, with 125 MW coming from rooftops. In Bhubaneswar city bus modernization plan, 2018, there are proposals of all street lighting to be powered by solar energy, roof top solar panels should be fixed and use of low power consuming LED bulbs should be done. Rooftop solar programme needs to leveraged to reduce dependence on diesel generator sets. This will require city wise plan.

Road dust

Road dust and windblown dust can accumulate and carry toxic substances that come from other combustion sources and can be a health hazard. Most cities and especially the Angul-Talcher belt is heavily polluted due to the unpaved roads present in the coal mining area. With expansion of infrastructure—both institutional, transport and basic services—road digging has become common cause of road dust and wind blown dust. Also in several cities roads and pavements are not well paved and are devoid of vegetative cover.

While road sweeping—both manual and mechanical sweeping—can help, greater benefit will come from improvement in streets and footpath paving— both hard and soft. Street design guidelines need to be adopted to ensure proper paving and creation of vegetative barrier to douse dust. All infrastructure agencies need to

be made liable for adoption of dust control measures during construction phase and also for restoration of the dug up places after completion of the construction.

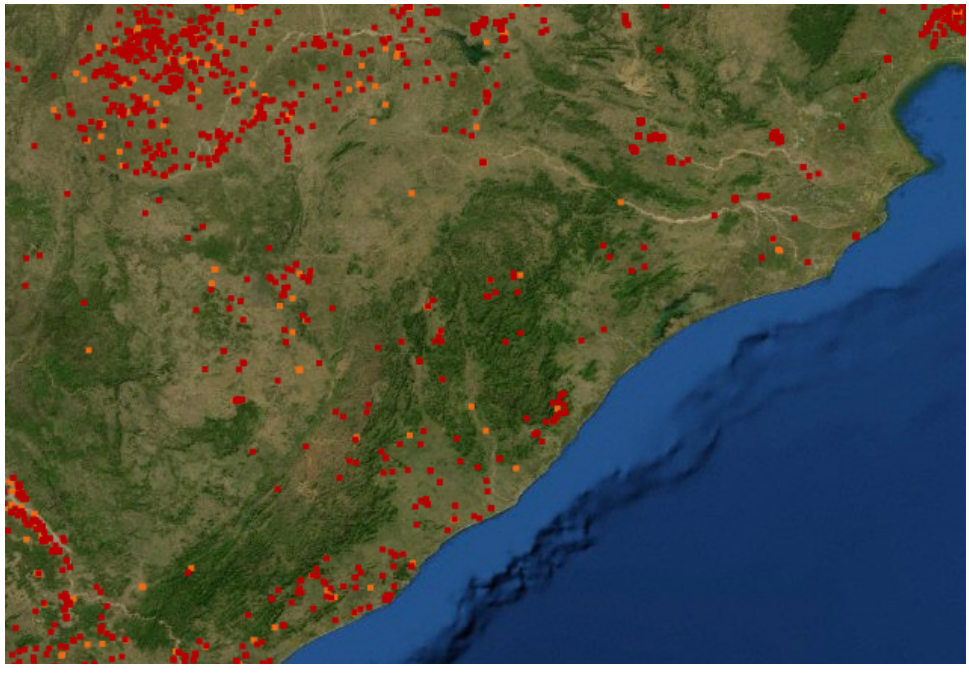
Crop and forest fires

Urban air quality of cities is also impacted by the pollution at the regional level due to trans-boundary movement of pollution. From that perspective any large-scale open fire in the region can have serious impacts. While the impact of the problem of agricultural stubble burning or crop residues is well known in northern India, it has not been properly evaluated in eastern India. There is also the aspect of forest fire in the region that requires scrutiny. Pollution from such fires is seasonal and episodic.

The satellite imagery from NASA shows large expanse of fires in Odisha and surrounding regions especially during March-April-May, which is a rabi harvesting season and dry summer. Some marginal burning occurs in other seasons also (see Maps: Open fires). The fires look very extensive and are likely to impact on the urban air quality of the six non-attainment cities as well. In northern India special policy package has been drawn up to incentivize the farmers to adopt technologies that help to mix and mulch the stubble in the soil instead of burning. It is also possible to develop business model to re-utilize the straw to generate power and make other material from them. Such initiatives at the early stages can prevent the problem from growing. Incidence of forest fires will require assessment.

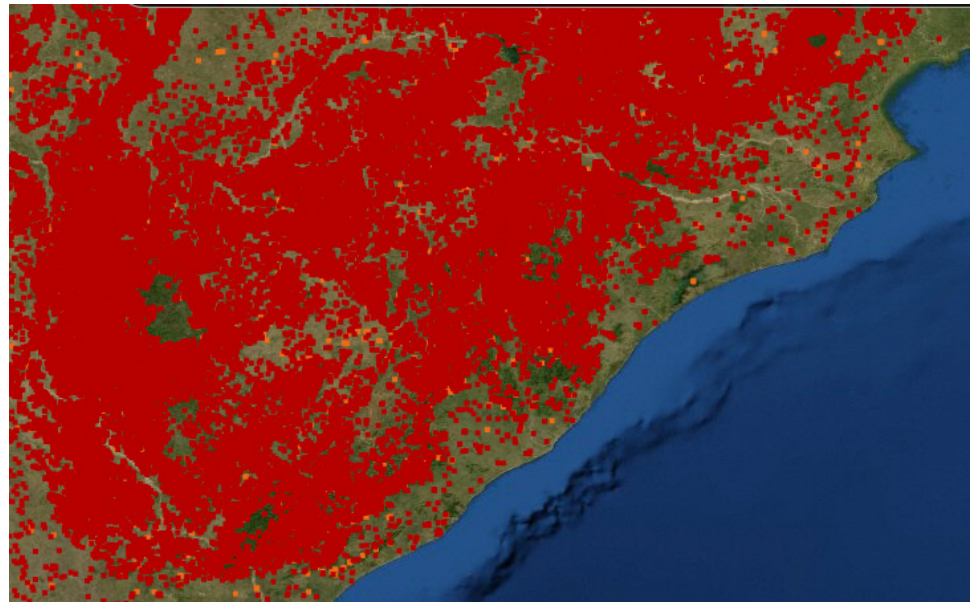
Map 2: Open fires

i. Cumulative fires mapped—12 November–12 December 2018



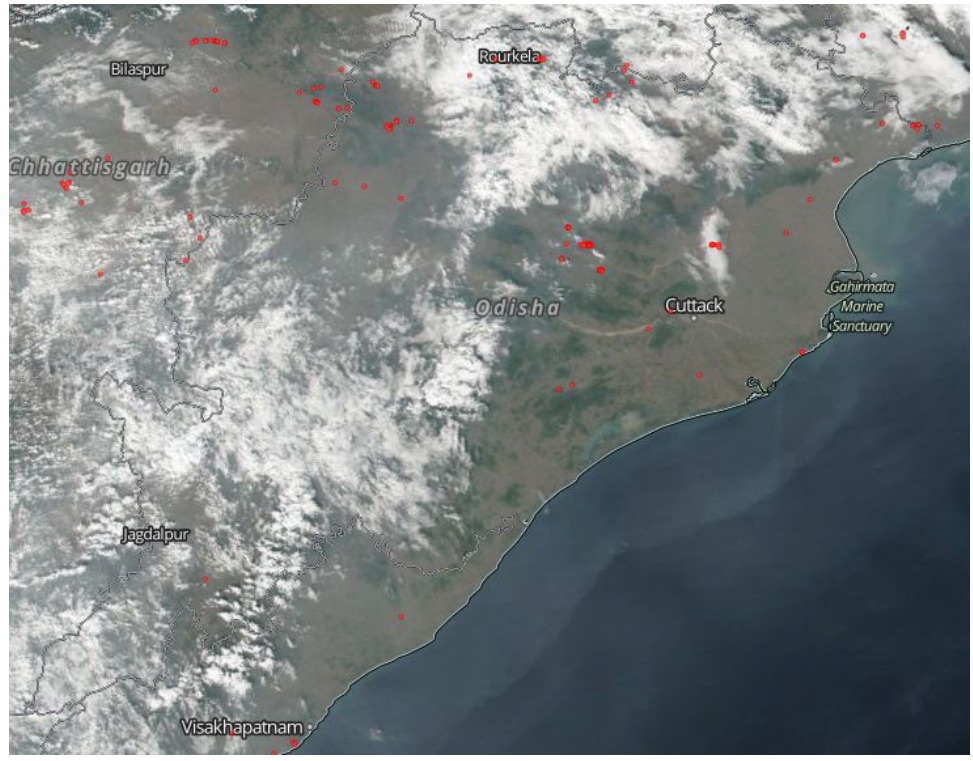
Source: NASA Fire Information for Resource Management System, as accessed on 12 December

ii. Cumulative fires mapped—March 2018 (peak fires)



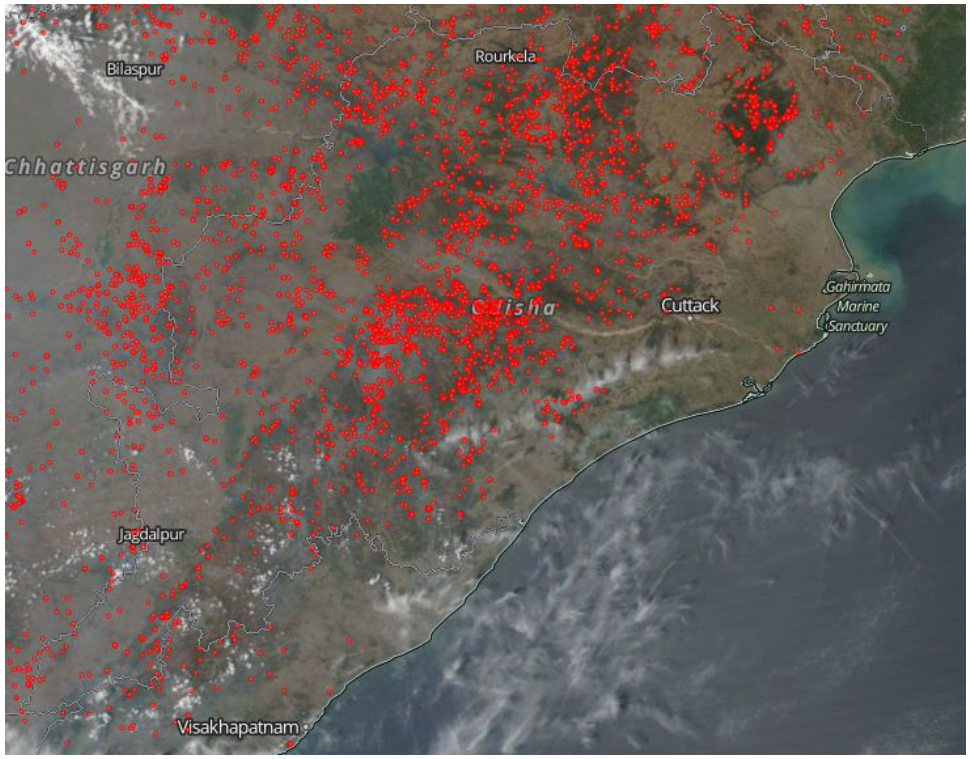
Source: NASA Fire Information for Resource Management System, as accessed on 12 December

iii. Satellite Image—11 December 2018



Source: NASA MODIS and VIIRS data, as accessed on 12 December

iv. Satellite image—20 March 2018



Source: NASA MODIS and VIIRS data, as accessed on 12 December

Urban greens and forests

Urban planning needs to integrate urban greens (parks, district forests etc.) and urban forests in the Master Plans of the cities as well as integrate their requirement in all infrastructure development and urban redevelopment projects. At least 15–20 per cent of the new urban redevelopment projects should be set aside for urban green and tree cover. Urban planning should also provide for green roofs and vertical greens linked to infrastructure development. Green walling with plantations around dust generators and also to be dust barriers are important interventions that should be integrated with the urban forestry and forest policy

Mining areas

Mining areas have substantial impact on the air shed of the region and needs addressing. Among all the six non-attainment cities, Talcher is most affected by the mining in the surrounding areas and is a unique challenge of this urban area.. Local pollution in these areas can be high. For instance, in Jagannath Colliery the air quality monthly report shows that the PM10 concentration level is higher during summer. The annual PM10 concentration level increased by 67 per cent in 2017–18 compared to 2014–15. All mining areas will therefore will require stringent monitoring especially in view of the fact that Odisha has 28 percent of India's iron ore, 24 percent of coal, 59 percent of bauxite, and 98 percent of chromite. Mines also have special standards that need to be met.

The plans for critically polluted areas and Odisha Climate Change Action Plan (for the period of 2018- 23) have stated that many advanced technologies are now available for sustainable mining of coal and needs to be adopted. The plan for critically polluted areas—Angul-Talcher—for instance has recommended

measures for the mining and industrial areas. These include windbreak walls or greenbelt on three sides of open stock piles; prevention of emissions by installing appropriate dust extraction system; and except for gypsum and clinker, all storage piles should be kept in moist condition by spraying water at regular intervals for controlling fugitive emission, wherever possible. Dousing of coal dust is a serious challenge.

Some good practices have emerged that needs stringent implementation and monitoring. Some of the current practices are as follow.

Talcher coalfield mines: Baratpur OCP: The capacity of this mine is 20MTPA having G-13 grade of coal whose ash content is 40-44 per cent. For dust suppression, more than 95 per cent of coal is produced by using surface miners with water inject system. Thus, dust level is drastically minimized. Blasting is avoided. In all siding water sprinkling is done through fixed water sprinklers. Two instant water shower systems are arranged at exit of quarry to sprinkle water on coal-loaded trucks. SILO and MGR with conveyor belt (20 MT capacity) is arranged which enables dispatch through rail mode and reduces the share of road transportation of coal. The coal corridor having length of 2.3 km in the project is arranged for coal transportation by trucks For Haul road and internal coal transportation road. Five 28 KL departmental water tankers and seven 12 KL contractual mobile water tankers have been deployed for dust suppression over haul road and internal CT road. Along with these mobile water tankers have been provided for dust suppression at stockyards and siding. The maintenance of haul roads is regularly followed up for avoiding potholes and thus, suppressing the dust caused by transporting vehicles. Plantation around the stockyard arrests propagation of dust.

Jagannath colliery: The capacity is of 7.5 MTY and the coal is of G-12 grade. Pollution control measures for dust suppression include Dust Extractor in drills with wet drilling arrangement. Mist sprinklers and fixed sprinklers are provided at CHP. Five of 28KL mobile tankers spray water on haul roads and other dust generating points round the clock. Coal production is done through eco-friendly surface miner with dust suppression arrangements. ETP is provided for effluent treatment at mine workshop.

Kaniha OCP, Kaniha area: With 14 MTY capacity, the coal is of G-14 grade. For pollution control, they are using 14 fixed sprinklers installed along with 13 mobile water tankers of 12kl capacity at railway siding.

Hingula: with 15 MTY capacity, the grade of the coal is G-13 and ash content is 41–46 per cent. Suppression of dust is done through Mobile water tankers; misters are deployed in the mines. Coal production is done through surface miner to minimize dust. Blasting and drilling procedures are discouraged.

The public sector Mahanadi Coal Fields Limited (MCL) has already adopted some of the best practices.

Such interventions will have to be scaled up and implemented with utmost stringency to mitigate pollution impacts of mining on local and urban air quality and reduce public health risk.

2

COMPREHENSIVE ACTION PLAN (CAP) AND GRADED RESPONSE ACTION PLAN (GRAP)

COMPREHENSIVE CLEAN AIR ACTION PLAN (CAP) AND GRADED RESPONSE ACTION PLAN (GRAP)

Comprehensive Clean Air Action Plan Against the backdrop of the challenges outlined in each sector, this pollution source-wise comprehensive action plan has been developed for all noncompliant cities in Odisha. While some aspects of this base plan are common for all cities, additional special measures have also been identified for individual cities wherever appropriate. Keeping in view the air pollution reduction targets in each city detailed strategies have been identified to indicate the nature, scale, scope and depth of action needed for effective reduction to make an impact overtime. In view of this instead of listing only broad action points, detailed indicators and action points have been included for all sectors to guide implementation.

This plan has integrated and built on the on-going action and action plans of the state government in each sector that are already underway. Action plan has also been improved further based on emerging good practices. In several sectors good practices have emerged that need to be leveraged and aligned to meet the clean air objective. This creates a good template for upscaling and replication in other cities. For instance, as part of the Smart City initiative Bhubaneswar has adopted several progressive measures in the area of urban planning, transport, non-motorized infrastructure, electric mobility among others that create the opportunity to cut emissions at source. This can be taken forward and integrated with the larger planning process across all cities. Similarly, as part of the critically polluted area planning for industrial cities of Angul-Talcher, Rourkela etc. have initiated various industrial pollution control measures that can be further strengthened and be taken forward. This action plan has integrated all these ongoing efforts to chart the roadmap.

Special care has been taken to ensure that sufficient indicators are included in the plan itself to indicate the nature and scope of the strategies outlined for each sector that are needed for implementation to make an effective impact. For instance, often it is not clear how different aspects of transportation and urban planning are linked with air pollution control. It is important to ensure that clean air action plan ensures convergence of planning for road building, public transport infrastructure and non-motorized transport planning to guarantee that people-oriented design are integrated all across to prevent lock in of pollution in the infrastructure itself. Similarly, action in renewable energy sector, urban forestry and a plethora of clean energy and industrial emissions management strategies have been integrated.

The action plan has also been developed keeping in view the needs of the small and big cities as well as special characteristics of cities such as industrial cities. While a common minimum programme has been developed for all six cities, special measures have also been identified depending on the dominant economic and polluting activities of the cities. Alignment of inter-sectoral action will be critical to leverage the available resources of funding for maximum impact. In all sectors—transport, industry, power plants, construction industry, municipal solid waste management, air quality monitoring, road building and traffic management—budgetary resources have been earmarked for investment, or, investments from other private or bilateral sources are coming in. If these investments are better informed and aligned with this clean air action planning process and objective, significant change at a scale is possible.

This plan also opens up the opportunity for developing fiscal strategies based on polluter pay principle to generate additional resources for funding of the plan. For instance, in other cities such as Delhi, fiscal measures such as environment compensation charge on trucks, big diesel cars and diesel fuel have helped to create dedicated funds that are now available for pollution control efforts. Such measures can be adopted to top up the resource needs in addition to the state and central government funding. In areas where the action depends on private sector participation and investments the detailed guidelines under this plan can guide such investment. This plan has identified the agencies responsible for implementation of each action point and has also indicated the timeline for implementation. This can be monitored for reporting and compliance.

Graded response action plan

Based on the National Air Quality Index Graded Response Action Plan has been framed for daily response to air quality changes. This has predefined the set of measures to be taken for different air quality categories—satisfactory, moderate, poor, very poor, severe and emergency. Once notified these measures will come into force automatically. Available data shows that in most non-compliant cities, barring hotspot areas in industrial cities, the daily levels vary between moderate to poor; sometime touching the very poor level. The GRAP measures will be implemented accordingly. GRAP is also includes the advisory for people to take precaution for self protection.

Institutional arrangement for implementation of the clean air action plan

It is proposed that a high-powered committee is set up with representation from all key departments for oversight and monitoring for compliance with both Comprehensive Clean Air Action plan and Graded Response Action Plan. This high-powered committee may be advised by a scientific Task Force to be set under the aegis of the Department of Environment and Forests/State Pollution Control Board with other expert bodies including meteorological department to report on the daily and annual trends in air quality, pollution forecasting and weather data, emission trend from different sources and assessment.

For proper implementation and oversight the high-powered committee will coordinate with the city level authorities in each six non-compliant city for direction, compliance monitoring and reporting. Each concerned department in a city will appoint a high level officer as a nodal official for coordination, implementation and periodic reporting.

A. Comprehensive Action Plan (CAP): Short-, medium- and long-term measures

Source-wise clean air action plan and compliance strategy for Rourkela to meet clean air standards The following table indicates short, medium and long term action points along with the agencies responsible.

COMPREHENSIVE CLEAN AIR ACTION PLAN (CAP)

(1) AIR QUALITY MONITORING AND ASSESSMENT

S. no.	Action Points	Agency responsible	Timeline
	Short-term priority action		
1.1	**To set up adequate number of real time automatic monitoring stations: Rourkela should set up 3 real-time monitoring stations within 6 months and rest of the stations follows in a year.** The grid plan should be representative of population distribution and land use including residential, commercial, industrial, roadside and sensitive areas. Also include hotspots such as near mines, landfill sites etc. Refer to the CPCB's thumb rule as prescribed in IS:5182 (Part 14), 2000 on *Recommended minimum number of stations, population-wise* (Also mentioned in Guidelines for Ambient Air Quality Monitoring, CPCB, 2003). Among all twelve pollutants to be monitored, special focus is needed on PM2.5 and ozone monitoring.	Odisha State Pollution Control Board (OSPCB), Central Pollution Control Board (CPCB)	6 months
1.2	Use air quality information provided by satellite-based monitoring to complement ground based air quality monitoring and also to monitor those areas that remain unmonitored. This is also useful to identify agricultural burning/ forest fires etc, that have bearing on urban air quality.	CPCB, IMD, State remote sensing centre, (DST), OSPCB	6 months
	Medium-term action		
1.3	Develop capacity for pollution forecasting for implementation of graded response action plan. This will also require monitoring of weather data.	CPCB, IMD, State remote sensing centre, (DST), OSPCB	1 year
1.4	Do one pollution inventory and source apportionment study. Capture the seasonal variation.	OSPCB CPCB	
1.5	Set up daily air quality public information dissemination system based on National Air Quality Index and health advisory. Further develop online reporting of daily and annual data for all pollutants and pollution forecasting on SPCB website.	OSPCB	6 months
1.6	Set up rural and peri-urban air quality monitoring to assess the airshed/influence area. The advisory on National Clean Air Programme (NCAP) from the Union Ministry of Environment and Forest and Climate Change has recommended rural air quality monitoring. Install low cost sensor based monitors for local area baseline and local area action	CPCB, SPCB	1 year to 2 year
	Long-term action		
1.7	Research studies including emission inventories, source apportionment, health impact studies, exposure impacts, carrying capacity assessment of air shed, regional impacts, hotspot studies and other relevant studies may be undertaken to further refine inform the action plan: Government to support research works / scientific studies by academic / research institutions. Expertise will be sought from various institutions to develop protocols for assessment of the research proposals.	DoFE, OSPCB	2 years

(2) INDUSTRIES

S.no.	Action Points	Agency responsible	Timeline
	Short-term priority action		
2.1	**Implement of SOx and NOx standards** notified by MOEF&CC on January 29, 2018 for 35 categories of industries.	OSPCB	6 months
2.2	**To strengthen the star rating programme to include full compliance to standards and switchover to low sulfur fuels/ natural gas**	OSPCB	6 months
2.3	**Prepare a clean fuel policy and provide incentives for clean fuels for the state:** for this identify approved and non-approved fuels. Promote relatively cleaner fuels like oil, gas and electricity. Discourage industrial fuels with very high sulphur and heavy metals like furnace oil, pet coke, tyre oil etc – (except where it is used as feedstock like cement). Need favourable taxation and pricing policy.	OSPCB	6 months

2.4	**Implement Continuous Emission Monitoring System (CEMS) in all air polluting industries:** Ensure calibration and working of CEMS in all industries in the urban airshed or area of influence and provide information to monitoring agencies to take appropriate action. Ensure quality control and quality assurance of CEMS data and ensure that data is available online and the reported data is compared with applicable prescribed limits and not the older standards. Compliance checkingto be enforced routinely to check the tampering with the CEMS.	OSPCB	6 months
2.5	Identification of cumulative impact and prescribe more stringent action for industries as Rourkela has high concentration of industries (steel plant, sponge iron, induction furnace, fire brick and chemical units). All action related to critically polluted areas should apply.	OSPCB	6 months
2.6	Identification and control of fugitive emission control measures in ancillary units, material transfer and handling and during industrial processes in Rourkela Steel Plant and other plants. Need stringent monitoring mechanism for informal industrial units.	OSPCB	6 months
2.7	Enforce restrictions on operations of intensively polluting industries within urban airshed zones during high pollution periods. Identification of air-polluting industries in Kalunga Industrial Estate and other such industries located within a radius of Rourkela Development Area and stricter emission control measures	OSPCB	6 months
Medium-term action			
2.8	**Prepare and implement local area action plan for pollution hotspots and strict enforcement of air pollution control measures in all industries**, including those located in unauthorized areas. Build schedule for inspection of areas of concern.	OSPCB	1 year
2.9	Strengthen current siting policy for industries to be set up in future	MoEF&CC, OSPCB, Department of Industries	1 year
2.10	**Use CEMS data for enforcement and compliance checking:** Use this for compliance in addition to the ongoing manual sampling of emissions. There should be provision to use CEMS data as legal evidence and a policy be framed in consultation with Central Pollution Control Board.	DoFE, OSPCB	1 year

(3) POWER PLANTS

S. no.	Action Points	Agency responsible	Timeline
Long-term priority action			
3.1	**Implementation of new thermal power plant standards** in all power plants by an early date. The power plants need to comply with the new emission standards by the outer date of 2022. Check status of compliance and prepare a transition plan for each plant to meet the new standards. This should apply to all state owned, private and captive power plants: • Plants found not meeting set emission reduction targets to be penalized • Prepare plan for full utilization of flyash, and also carry out monitoring, sprinkling of water (recycled water) especially during summer months to curtail wind-blown ash.	OSPCB, Ministry and Department of Energy	2 years
3.2	**Progressively close the older and more polluting thermal power plants and to move to cleaner natural gas.**	OSPCB, Department of Energy, DoFE	2 years
3.3	**Chart a roadmap for cleaner plants and Incentivize them to operate in the region** for this assess and make necessary changes in the merit order dispatch policy	OSPCB, DoFE, Department of Energy, power generating companies	2 years

(4) Brick kilns

S. No.	Action points	Agency responsible	Time Line
Short-term action			
4.1	**Enforce restrictions on operations of brick kilns within urban airshed zones** during high pollution periods, allow Brick kilns that comply with zig-zag or improved technology.	OSPCB	6 months

Medium-term action			
4.2	**Convert all brick kilns to zigzag technology** – from natural draft kilns to induced--draft kilns (zigzag technology).	OSPCB	
4.3	**Prescribe design specifications for ki9lns and ensure compliance checking** to know that conversion has actually taken place.	OSPCB, Department of revenue	

(5) Action to reduce vehicular emissions

S. No.	Action points	Agency responsible	
Medium-term action			
Long-term action			
5.1	**Emission And Fuel Quality For New Vehicles** Ensure on-schedule implementation of BS VI fuel and emission standards on April 1, 2020. Ensure that only BS VI compliant vehicles are registered from this date. Supreme Court order of October 24, 2018 has directed that no vehicle that is not BSVI compliant can be registered from April 1, 2020.	Transport department	2 years
5.2	**ALTERNATIVE CLEAN FUEL POLICY FOR VEHICLES**		
Short-term priority action			
5.2.1	**Gaseous fuel programme:** Expand natural gas programme for industry and transport. Expand CNG refuelling infrastructure for delivery and use. Move all auto rickshaws and sizeable share of taxis and buses to run on CNG. Replace diesel three wheeler & taxi fleets with CNG/LPG fleet.	Transport department, Department of Energy	6 months
Medium-term action			
5.2.2	**Electric vehicle programme: Need zero emissions mandate for targeted vehicle segment-wise phase in of electric vehicles --** two-wheelers, three-wheelers/para transit, buses and large delivery fleet. – Development of electric-mobility plan – Mandate registration policy for electric buses, auto-rickshaws, taxis, delivery fleet, two wheelers and cars to target 25 per cent of all registration by 2025 on electric mode. – Plan infrastructure for charging and battery disposal. – This can be incentivised by lower road tax, motor vehicle taxes and registration charges, preferential licensing and permit system, allowing them in low emissions zones etc. – Identify and notify commercial areas with high footfalls and good public transport and goods transport connectivity to pedestrianise supported by zero emission battery-operated vehicles: Priority may be accorded to battery-operated para-transit as feeders and for last mile connectivity. Ensure organized deployment to reduce congestion.	Transport department, Urban Local body	1 year
5.2.3	There is potential of generating biogas from waste and sewage to run buses in cities.	Department of Energy, Oil marketing companies	1 year
5.2.4	**Need favorable tax measures to promote clean fuels and vehicles and zero emissions vehicles.**	Department of, Energy and Finance	1 year
5.3	**EMISSION CONTROL MEASURES FROM ON-ROAD VEHICLES**		
Short-term action			
5.3.1	Set up requisite number of PUC centres. Strengthen periodic auditing and oversight of PUC centres and calibration of equipment and third party checks.	Transport Department	6 months
Medium-term action			
5.3.2	**Improve and strengthen PUC programme:** Ensure universal linking of PUC centres with remote server and eliminate manual intervention in PUC testing. Implement all notified emissions parameters including Lambda testing for petrol cars as notified by MORTH in 2004.	Transport Department	1 year

5.3.4	Integrate on-board diagnostic (OBD) system fitted in new vehicles with vehicle inspection. As per the MORTH advisory PUC centres have to check malfunctioning indicator light on dash boards of vehicles. If the light is found on vehicles to be sent back for testing in authorized workshops; Additionally, PUC centres need to check if the OBD is functioning properly	Transport Department	1 year
5.3.5	Link PUC certificates with annual vehicle insurance to ensure 100 per cent compliance as per the Directive of the Hon'ble Supreme Court. Need strong penalty for non-compliance with PUC. Prohibit vehicles without valid PUC certificate to ply in the city.	Transport Department	1 year
5.3.6	**Enforcement of law against visibly polluting vehicles**: remove them from road, impose penalty, and launch extensive awareness drive against polluting vehicles.	Transport Department, Traffic Police	1 year
5.3.7	**Set up modern centralized vehicle inspection centres** for upgraded emissions and fitness tests for commercial vehicles and diesel vehicles.	Transport Department	1 year
5.4	**Phase out old vehicles and vehicle scrappage policy:** Phase out old vehicles with the help of age cap and age linked road tax policy. Set up scrapping infrastructure for scientific dismantling and disposal of old vehicles. Set up recycling units that are authorised with proper guidelines.	Transport Department,	1 year
5.5	**Vehicle labelling or sticker programme:** The July 26, 2018 directive of the Supreme Court has approved the MoRTH'sColour Coded HSRP Hologram Stickers. This programme to come into effect on April 1, 2019, across the country will require, each vehicle, both old and new to be provided with colour coded non-tamperable High Security Stickers, along with the number plates. At a later date, older and polluting vehicles may be discouraged in city centres or earmarked low emissions zonesby using these stickers for identification of vehicles.	Transport Department, Traffic Police	1 year
5.6	**FREIGHT TRANSPORTATION**		
Short, Medium and long-term action			
5.6.1	**Use of off-peak passenger travel times to move freight** and restrict the entry of heavy vehicles into cities during the day to continue	Municipal Corporation,	Within 6 month
5.6.2	Provide truck rest areas/parks along national and state highways to prevent entry of trucks into cities during peak hours.	Transport department PWD, NHAI	Within 6 months
5.6.3	I**nstall weigh-in-motion bridges and monitoring equipment** Ensure better quality and more efficient vehicles Promote high capacity trucks for freight transport of mining material instead of smaller trucks	Transport department NHAI	Within 6 months
5.6.4	**Diversion of truck traffic:** Check feasibility of diversion of non-destined trucks into the city. Alternate routes need to be identified and improved to ensure that non destined commercial traffic does not enter the city. Also fix entry and exit timings of trucks and a management plan for warehousing, loading unloading.	Transport department Traffic Police	Within 6 months
5.6.5	**Check overloading:** Use weigh-in-motion bridges/machines (WIM) and Weigh bridges at entry points to the city to check the payload of commercial vehicles. As per the CMVR, a penalty of 10 times the applicable rate for overloaded vehicles is applicable.	Transport department Traffic Police	Within 6 months
5.6.6	**Develop urban freight consolidation centres** in relation to location of warehouses relative to suburban areas.	Transport department	1 year
5.6.7	**Create management systems for loading and unloading of goods in city areas.**	Transport department	6 month
5.6.8	**Develop a Safe-to-Load programme to ensure fitness of trucks and compliance to set standards would be adopted and enforce**. Important for industrial cities.	Transport Department,	6 month
5.6.9	**Intra-state freight transport plan**: Prepare plan for inter- and intra- state freight transport plan to improve rail-based freight traffic to reduce dependence on trucks.	Transport Department, Railways	1 year

5.7	**FUEL QUALITY TESTING TO CHECK ADULTERATION** Prepare an action plan to check fuel adulteration and random monitoring of fuel quality data. To ensure that periodic routine and surprise fuel testing is done for all transport and non-transport fuels. For this an action plan need to be prepared in consultation with oil companies and ministry of petroleum and natural gas.	OSPCB, Oil marketing companies	6 month
5.8	**Emission Control at Refueling Stations** Install vapour recovery systems in fuel refueling outlets to reduce benzene and VOC emissions in cities. CPCB has issued direction for installation of stage I and Stage II vapor recovery system in all retail outlets with capacity 3000 kilolitre and more in 46 million plus cities by December 2017. Retail outlets across the city should comply with this.	Department of Energy Oil companies OSPCB	1 year

(6) PUBLIC TRANSPORT SYSTEM

S. no.	Action points	Agency responsible	Timeline
6.1	**City bus system**		
	Medium to long-term action		
6.1.1	Introduce a city bus system of appropriate fleet size and desirable bus type replete with GPS tracking, ETVMs for fare collection and Passenger Information Systems.	Urban local body	1-3 years
6.1.2	Define routes, permits, fares, vehicle design and safety standards, and vehicle technology standards for para-transit vehicles. Strengthen para-transit driver training and licensing procedures. This strategy is very important for smaller cities.	Transport Department	1-2 years
6.1.3	Enforce through IT-based systems that track traffic violations, with repeat violations leading to increased penalties including fines, increased insurance, and cancellation of licenses	Transport Department	1-2 years
6.1.4	Ban and phase out diesel auto-rickshaws. Introduce CNG/electric auto-rickshaws. Provide appropriate fiscal or regulatory incentives	Transport Department	1-2 yers
6.1.5	Regulate the taxi industry in as integrated a manner as possible— as a feeder service or otherwise—to complement and promote NMT and public transport	Transport Department	1-2 years
6.2	**Non-motorized transport and safe access**		
	Short-term action		
6.2.1	**Develop Ring Road, Panposh Road and Rourkela Road as a pedestrian and cycling friendly corridor along with targeted street clusters.** To do so, adopt urban street design guidelines that will prioritize design for public transport access, walking and cycling infrastructure, safe and universal access, street furniture, facilities for parking, inter- modal transfer hubs, road markings, signage and traffic signals, pick up and drop off points for taxi, auto, three-wheelers stands, spaces for street vending and service lanes. Design drainage to provide co- benefit of capturing run-off and prevent flooding.	Urban local body	6 months

6.2.2	**Prepare and implement zonal plans for developing an NMT network. This should include the following action:** • Implement network plan for footpaths on all roads • Target specific lengths of footpaths and cycle tracks to be completed in a phased manner and cover the entire city • Implement a network plan for more secondary street networks and un-gated streets to provide direct shortest routes for pedestrians and cyclists. Vehicular traffic can also be redistributed from major junctions through multiple routes to decongest. Signal-free corridors should be avoided as more road-space only attracts more traffic and impedes people's movement • Plan and upgrade pedestrian/NMT crossings atleast every 250 m, with pedestrian signals and signages. These should preferably be at-grade. Reduce block sizes to reduce walking and cycling distances • Implement synchronization of signals on a priority basis with an integrated IT-based traffic management system so that despite having frequent at-grade pedestrian crossings, traffic can move swiftly across signals. Introduce cycle sharing systems and expand as feeders to public transport. • Identify and notify key commercial areas with high footfalls and good public transport connectivity to create pedestrian plazas • Make safety and walkability audits of walking and cycling infrastructure mandatory • Make encroachment of NMT lanes punishable offence under the current provision of law • Need dedicated funding	Urban local body	1-3 years
6.3	**Compact city development to reduce distances and improve access**		
	Medium- to long-term action		
6.3.1	Adopt compact urban form code to create high density, mixed-use, mixed-income development and high-density accessible streets to reduce travel distances and emissions	Urban local body	1-3 years
6.3.2	In low density areas as well as new development and urban sprawl maximize densities with good transport connectivity, in order to facilitate maximum number of people walking or cycling or use NMT or feeder services easily to access public transport.	Urban local body	1-3 years
6.3.3	Enable a balanced mix of jobs and housing close to public transport nodes coupled with caps on parking supply, higher housing affordability through design and technology options, and improved efficiency and equity in the resulting developments. Design these spaces with adequate green spaces and high-density street network	Municipal Agencies/ Development Authorities	1-3 years
	Medium-to-long-term action		
6.5	**Travel demand management and restraint measure: Parking Management**		
	Implement Parking Area Management Plan (PAMP) for all delineated neighborhoods and land uses for demarcation of all types of legal parking spaces for all modes as well as essential street amenities – on-street, off-street and multi-level parking facilities, vending zones, multi-modal integration facilities, green open spaces along with the allied traffic and pedestrian/ NMT circulation plans, signage plans and pricing strategy. PAMPs to be prepared in consultation with local stakeholders, planning bodies/ departments. This should include among others:		
	Short-term action		
6.5.1	Demarcate the emergency vehicle route on all public roads within the neighbourhood	Municipal Agencies/ Development Authorities	6 months
6.5.2	Ensure no parks and green areas are converted to parking	Municipal Agencies/ Development Authorities	6 months
6.5.3	Where shared Multilevel Parking facility is provided demarcate ingress-egress plan and ensure that no major disruption occurs on main thoroughfare traffic. Also indicate pedestrian circulation plan.	Municipal Agencies/ Development Authorities	6 months
6.5.4	Eliminate free parking and introduce effective variable parking charges based on duration of parking and 'user pay' principle as per the National Urban Transport Policy.	Municipal Agencies/ Development Authorities	6 months
6.5.5	Do not allow annual or monthly lump sum payment for parking in commercial areas. Annual passes allow unlimited use and do not reduce demand.	Municipal Agencies/ Development Authorities	6 months

Medium-to-long-term action			
6.5.6	Physically demarcate legal parking areas. Equip them with metering systems, proper signage, IT for information on parking availability to reduce cruising time and on-street management	Municipal Agencies/ Development Authorities	1-3 years
6.5.7	Penalty for illegal/wrong parking esp. parking within the emergency lanes and non-designated areas to be prohibitive.	Municipal Agencies/ Development Authorities	1-3 years
6.5.8	Bundle existing / planned public parking facilities and on-street and off-street parking (including multi-level) facilities for management by a single agency/ operator. New stand-alone parking only sites are mostly not required since parking is permitted in all use zones.	Municipal Agencies/ Development Authorities	1-3 years
6.5.9	Earmark a part of parking revenue for local area improvement that includes footpaths, public amenities and parking facilities within the PAMP area	Municipal Agencies/ Development Authorities	1-3 years
6.5.10	Introduce residential parking permit for regular parkers for use of public parking space and these may be monitored	Municipal Agencies/ Development Authorities	1-3 years
6.5.11	In order to optimize utilization of land, ensure that in all new projects (e.g. commercial, institutional, housing, etc.), at least 50% of the available parking spaces is made available for shared parking facility.	Municipal Agencies/ Development Authorities	1-3 years
6.5.12	Ensure in the parking contractual agreement that the revenue sharing model is dynamic and flexible, allowing for flexibility in charging and varied usage and rates of the parking spaces; specify the investment that Contractor will have to make for upgradation of the PAMP area including metering, ITS application for commuter information, signage	Municipal Agencies/ Development Authorities	1-3 years
6.5.13	Plan and implement parking provision for buses, commercial vehicles and IPT-NMT modes, and for the differently abled.	Municipal Agencies/ Development Authorities	1-3 years
6.5.14	Parking charges should be optimal and ensure that at least 85 per cent of the available parking spaces are occupied during peak time. About 15% of parking spaces can be vacant and available at any time to encourage short term parkers.	Municipal Agencies/ Development Authorities	1-3 years
6.5.15	Introduce and further upgrade variable time-based pricing, as per market demand. Coordinated off-street and on-street / surface pricing in commercial and residential areas, and parking permits in residential areas. Parking should be charged as per duration, location in city and size of the vehicle. Parking rates (even if differential) should be applied to the entire PMAP area and not to a few streets.	Municipal Agencies/ Development Authorities	1-3 years
6.6	**Traffic management**		
Short-term action			
6.6.1	Create electronic monitoring of traffic violations	Traffic Police	6 months
6.6.2	Conduct audit of traffic intersections and install functional traffic signals at all major intersections	Traffic Police	6 months
6.6.3	Enforce lane driving through heavy fining	Traffic Police	6 months
Medium- to long-term action			
6.6.4	Prepare traffic management plan for the city and continuously update it and monitor its performance.	Traffic Police/ Development Authorities	1-2 years
6.6.5	Introduce early alarm system during traffic congestion for the benefit of commuters on major routes, to facilitate route diversion	Traffic Police/ Development Authorities	1-2 years
6.6.6	Consider introducing plan for flexi/staggered timings to minimize peak movement of vehicles on roads	Traffic Police/ Development Authorities	1-2 years
6.6.7	Formulate action plan for controlling decongestion of fuel stations including increasing the number of dispensing machines	Traffic Police/ Development Authorities	1-2 years
6.6.8	Examine existing framework for removing broken down buses / trucks from roads and create a system for speedy removal and ensuring minimal disruption to traffic from such buses / trucks	Traffic Police/ Development Authorities	1-2 years

7. Generator sets

S. no.	Action points	Agency responsible	Timeline
Short-term priority action			
7.1	Ensure that only those DG sets that meet the standards in terms of emission or design of chimneys/ exhaust and acoustic enclosures, also verify and check whether design specifications are followed or not thereafter the genset to be allowed to operate.	CPCB, OSPCB, District and local administration	6 months
7.2	Curtail use of DG sets in social events by providing temporary electric connections	OSPCB, Distribution companies	6 months
Medium-term action			
7.4	Alternate power systems should be promoted in cell towers, and use of DG sets discouraged	OSPCB, Department of Energy, Distribution Companies	1 year
7.5	Leverage roof top solar programme to reduce dependence on DG sets		1 year
7.6	Ensure access to quality electricity supply		1 year

8. Open burning (including solid waste and agricultural residues)

S. no.	Action points	Agency Responsible	Timeline
Short-term priority action			
8.1	Enforce a complete ban on garbage burning in the entire region. Evolve a monitoring mechanism for this. Take stringent action against open burning of biomass / leaves / tyres etc to control such activities	Municipal corporations, Regional Development Authority, OSPCB	6 months
8.2	Ensure proper collection of horticulture waste (biomass) and composting-cum-gardening approach; municipal zonal offices should be responsible for controlling burning of leaves and garbage on roads / parks. All horticulture agencies should have compost pits in parks. Implement public outreach programme for household and community based composting programme (compost pits, shredders etc) to prevent burning of waste.		6 months
8.3	Implement decentralized waste management for hotels, apartments, institutions as per Solid Waste Management Rules 2016. Implement provisions of Solid Waste Management Rules 2016 to implement penal provisions to spot fine on waste burning. Strictly ban open burning of hazardous industrial waste		6 months
8.4	Use of satellite based monitoring as well as mobile spot check squads for enforcement	Municipal corporations, Regional Development Authority, State Police Department, PCB GIS cell	6 months
8.5	Proper management of landfill sites to prevent spontaneous fire		
8.6	Adopt roadmap for zero landfill policy to promote decentralized waste segregation, reuse and recycling		
8.7	Good decentralised waste management and segregation will not require waste-to-energy plants. In case such plants are needed in any location implement very stringent siting policy to keep it away from habitation and neigbourhoods of the low income groups. Need stringent implementatin of emissions standards and reporting of realtime emissions data to SPCB.	Municipal corporations, Regional Development Authority, State Police Department, PCB GIS cell	

9. Common biomedical treatment facility

Sr. No.	Action Points	Agency Responsible	Timeline
Short-term priority action			
9.1	**Implement emission norms for incinerators** and examine the feasibility of less polluting alternatives in compliance to Biomedical waste treatment rules.	OSPCB, municipal corporation, regional development authority, incinerator facility operators	6 months
9.2	**Implement CEMS for incinerators** and provide data on emissions on an open platform progressively.		6 months
Medium-term action			
9.3	**Develop a siting policy for biomedical incinerators.**	OSPCB, municipal corporation,	1 year

10. COOKING FUELS AND OPEN EATERIES

Sr. No.	Action Points	Agency Responsible	Timeline
	Medium to long term action		
10.1	A targeted programme to be implemented for 100 per cent coverage of households by distribution of LPG/PNG in all non compliant cities. Leverage existing programmes like Ujwala and State Government Schemes	DoFE, Department of Energy,	1-2 years
10.2	In low-income neighborhoods, as well as roadside eateries/dhabas/ restaurants etc. promote and give access to LPG and electricity. Mandate and link commercial license to clean fuels.	DoFE, Dept. of energy, power and Natural gas, municipal corporation, urban local bodies	1-2 years
10.3	Prohibit use of coal in hotels and restaurants, phase out and eliminate use of kerosene for cooking in the city and incentivize move to LPG also check feasibility of natural gas pipeline for residential and commercial use	DoFE, Department of energy, power and Natural gas, civil supplies department	1-2 years

11. ROAD DUST

Sr. No.	Action Points	Agency Responsible	Timeline
	Short-term priority action		
11.1	Sprinkling of recycled water (without compromising other uses); introduce water fountains at major traffic intersections, wherever feasible. Adopt dust control measures for all construction projects.	PWD, Road owning agencies	6 months
11.2	Phase-in mechanical / vacuum-based street sweeping wherever feasible; introduce wet / mechanized vacuum sweeping of roads		6 months
	Medium to long term actions		
11.3	Implement truck loading guidelines; use of appropriate enclosures for haul trucks; gravel paving for all haul routes.	Department of Transport, Traffic Police,	1-2 years
11.4	Maintain pot hole-free roads for free flow of traffic to reduce emissions and dust.	Municipal corporation,	1-2 years
11.5	Increase green cover in the region. Undertake greening of open areas, gardens, community places, schools and housing societies.	DoFE, Municipal corporation,	1-2 years
11.6	Enforcement of air pollution control in concrete batching (use of water spray and wind breakers, bag filter at silos and enclosures, hoods, curtains etc).	OSPCB, Department of industries	1-2 years
11.7	Adopt street design guidelines for paving of roads and footpaths (hard and soft paving) with vegetative barriers. All construction agencies to restore dug up areas according to these guidelines.		1-2 years

12. Construction Dust

Sr. No.	Action Points	Agency Responsible	Timeline
	Short-term action		
12.1	Adopt and implement dust control measures in all construction -- buildings and infrastructure. The preventive measures should be strictly enforced. Regulators can refer the check list for inspection of construction sites prepared under directions of NGT and EPCA.	Municipal corporation,	6 months
12.2	Undertake control measures for fugitive emissions from material handling, conveying and screening operations through water sprinkling, curtains, barriers and dust suppression units. Introduce steeper penalties for non-compliance. Needs enforcement.	Municipal corporation	6 months
12.3	Enforce restrictions on construction activities within urban airshed zones during high pollution period	Municipal corporation	6 months
	Medium to Long term action		
12.4	Frame and implement policy for segregatin of construction and demolistion waste and provide a network of decentralized C&D waste segregation and collection sites across the city. Set up facilities for recycling of this waste.	Municipal corporation,	1-2 years

12.5	For material handling, construction and demolition, it should be obligatory on part of the developers to provide evidence of debris on-site recycling and/or disposal at designated sites.	Municipal corporation	1-2 years
12.6	Mandate that a certain percentage of new construction should be recycled C&D waste. Promote recycling of construction and demolition waste. Implement provision of Central regulations for construction and demolition waste management rules 2016. Set up facilities for recycling of C&D waste	Municipal corporation,	1-2 years

13. EPISODIC EVENTS

Sr. No.	Action Points	Agency Responsible	Timeline
13.1	**Measures to control biomass/ crop residue / forest burning:** Use satellite based monitoring and on-ground enforcement to control biomass burning episodes.	OSPCB, GIS cell, Department of Agriculture, Department of Science and Technology,	Ongoing
13.2	**Firecrackers:** regulate and control its usage including restrictions on timing as per the Supreme Court and CPCB and PESO guidelines.	Police Department, OSPCB	Ongoing

14. Renewable energy

S. no.	Action Points	Agency Responsible	Timeline
	Medium to long term		
14.1	Solar rooftop policy should be implemented and should be linked with transition from diesel genset to solar power, also the electric public transport can be linked with solar power plans to shift to zero emission target. Identify and target institutional, industrial and residential consumers for adoption of rooftop solar programme. Identify open areas for installation of solar power generation systems.	Department of renewable energy, Department of power/energy, Odisha Renewable Energy Development Agency, District and local administration	1-2 years

15. URBAN GREENS AND FORESTS

S. no.	Action Points	Agency Responsible	Timeline
	Medium-term action		
15.1	Carry out avenue plantation along roads with more traffic. Urban planning to integrate urban greens (parks, district forests etc) and urban forests in the Master Plans of the cities and all infrastructure development and urban redevelopment projects. At least 15-20 per cent of the new urban redevelopment projects should be set aside for urban green and tree cover. Urban planning to provide for green roofs and vertical greens linked to infrastructure development. Green walling with plantations around dust generators and also to be dust barriers to be integrated with the urban forestry and forest policy.	DoFE, Department of Forest	1 year

16. IMPROVE TRAINING &CAPACITY

S. no.	Action Points	Agency responsible	Timeline
16.1	Training and skill development will be required of public officials and other public functionaries for planning and management and execution of the plan. This will also require extensive capacity building in all sectors and infrastructure planning.	DoFE, Department of Personnel and Training,	Ongoing

17. NEED FOR PUBLIC AWARENESS AND COOPERATION

Sr. No.	Action Points	Agency Responsible	Timeline
17.1	Organizing deeper public engagement and forums for pubic consultation for public understanding of the nature of solutions needed to address the complex problem of sustainable industrial development and urban mobility.	DoFE, OSPCB,	Ongoing

B. Graded Response Action Plan (GRAP) for reducing air pollution in non-attainment cities of Odisha

The proposed graded measure approach for each pollution source according to the Air Quality Index (AQI) categories includes appropriate measures for each level of pollution (PM10 / PM2.5). While the comprehensive clean air action plan must be implemented round the year, the GRAP measures are meant to be temporary measures for duration of smog episodes and are implemented according to the severity of the air pollution levels. Once the levels come down and stabilize, measures are withdrawn. The objective of the GRAP is to prevent pollution from getting worse when adverse weather conditions trap and spike pollution.

The proposed GRAP includes set of measures to be implemented with greater vigour and stringency to prevent and avoid high level of air pollution in cities. This is linked to the national air quality index that categorises daily air quality as good, satisfactory, moderate, poor, very poor, severe, and emergency. All actions suggested for each category are cumulative and add up to the level of emergency as air quality worsens.

For GRAP implementation the scientific Task Force under OSPCB will advise the High-powered committee on the daily pollution levels and forecasting based on real time monitoring. Accordingly the High-powered Committee may issue notices to the city authorities to implement the pre-defined action. Each implementing department will appoint a nodal officer to facilitate implementation. The action notified for moderate and poor that are largely about stringent enforcement in different sectors, can become default action for continuous implementation throughout the year. Additional measures meant for very poor and severe may be notified which such situation develops especially during calm and inversion conditions.

This will require daily air quality data reporting on the SPCB website and public dissemination system on air quality and health alert. The GRAP measures can be customized based on the special needs and the unique pollution profile of the city.

Severe + or Emergency **When PM2.5 levels cross 300 microgramme per cum or PM10 levels cross 500 microgramme per cum (or 5 times above the standard) or persist for 48 hrs or more.**	
Action to be taken	**Agency responsible**
Stop entry of diesel truck traffic into city (except essential commodities)	Traffic Police Municipal Corporations
Stop construction activities	Pollution Control Board Municipal Corporations
Introduce odd and even scheme for private vehicles based on license plate numbers Or introduce low emissions zones in the city to stop entry of polluting vehicles (old and ageing and polluting diesel vehicles etc). For this purpose introduce sticker system as per MORTH guidelines to indicate fuel and date of manufacture of vehicles.	Transport Department Traffic Police
State Pollution Control Board Task Force to take decision on any additional steps including shutting of schools	

Severe **When PM2.5 levels are above 250 microgramme per cum or PM10 levels are above 430 microgramme per cum**	
Action to be taken	**Agency responsible**
Close brick kilns, Hot Mix plants, Stone Crushers and other highly polluting units or as applicable locally	State Pollution Control Board District Administration Police
Shut down / minimize operation of polluting coal based power plant and incentivize power generation from existing natural gas based plants or as needed locally	State Pollution Control Boards
Intensify public transport services. Introduce differential rates to encourage off-peak travel.	Transport Department State Transport Corporations
Increase frequency of mechanized cleaning of road and sprinkling of water on roads. Identify road stretches with high dust generation.	All road owning agencies including Municipal Corporations, Public Works Department and National Highway Authority of India
Restrict movement of trucks inside the coal field mine areas	State pollution control board, Department of Steel and mines
Very Poor **When PM2.5 levels are between 121-250 microgramme per cum or PM10 levels are between 351-430 microgramme per cum**	
Action to be taken	**Agency responsible**
Stop use of diesel generator sets	State Pollution Control Boards
Enhance parking fee by 3-4 times	Municipal Corporations
Augment public transport services by increasing frequency	Department of Transport State Transport Corporation
Stop use of coal/firewood in hotels and open eateries	Municipal Corporations
Residential societies and individual house owners to provide electric heaters during winter to security staff to avoid open burning	Municipal Corporations Resident Welfare Associations
Alert in newspapers/TV to advise people with respiratory and cardiac patients to avoid polluted areas and restrict outdoor movement.	State Pollution Control Board
Moderate to poor **Poor - When PM2.5 levels are between 91-120 microgramme per cum or PM10 levels are between 251-350 microgramme per cum; Moderate - When PM2.5 is between 61-90 microgramme per cum or PM10 is between 101-250 microgramme per cum**	
Action to be taken	**Agency responsible**
Stringently enforce/stop garbage burning in landfills and other places and impose heavy fines on person responsible	Municipal Corporations
Close/stringently enforce all pollution control regulations in brick kilns and industries	State Pollution Control Board
Stringently enforce pollution control in thermal power plants through Pollution Control Board monitoring	State Pollution Control Board
Do periodic mechanized sweeping on roads particularly in roads with heavy traffic and water sprinkling every two days	Municipal Corporations Traffic Police PWD

Strict vigilance and no tolerance for visible emissions – stop plying of visibly polluting vehicles by impounding or heavy fine	Department of Transport Traffic Police
Stringently enforce rules for dust control in construction activities and close non-compliant sites	District Administration, Police
Deploy traffic police for smooth traffic flow at identified vulnerable areas	Traffic Police
Divert non-destined truck traffic	Municipal Corporations Traffic Police
Strictly enforce Supreme Court orders on firecrackers	SPCB, District Administration in consultation with Chief Controller of Explosives, Petroleum and Explosive Safety Organization (PESO); Police
Ensure fly ash ponds are watered every alternate day during summer months (March-May)	Plant in charge of Power Plants
Information dissemination, social media, mobile Apps should be used to inform people about the pollution levels, contact details of control room, enable them to report polluting activities/sources to the concerned authorities, and actions that will be taken by government based on the level of pollution.	State Pollution Control Board District Administration

Action to be taken by public

While the National Air Quality Index (AQI) and health advisory will inform people about the dangers of exposure, people are also expected to take precautionary measures to protect themselves. Suggested actions by public are listed below:

Level according to AQI	Action
Very poor, severe and emergency	Those suffering from heart diseases, asthma, and other respiratory disease may consider avoiding undue and prolonged exposure
	Schools to suspend all outdoor activities and sport events
	Report visible emissions from vehicles, industries, power plants, garbage burning, and other non compliances to the respective control rooms
	Do not use diesel and kerosene generators
	Maintain vehicles properly (PUC certificate, replace car air filter, maintain right tyre pressure)
	Minimize unnecessary travel, use public transport & avoid using private vehicles

Annexure 1

GOVERNMENT OF ODISHA
FOREST & ENVIRONMENT DEPARTMENT

NOTIFICATION
Bhubaneswar, dated 9-Nov-18

ENV-I-68/2018 24823 /F&E, In pursuance of the directions of the Hon'ble National Green Tribunal, Principal Bench, New Delhi dated 08th October, 2018 contained in Para 15(ii) of the said direction in O.A. No. 681 of 2018, the Government of Odisha in Forest & Environment Department is pleased to constitute a six member committee called the "**Air Quality Monitoring Committee**" (AQMC) with the following members.

1. Transport Commissioner-cum-Chairman, State Transport Authority, Bhubaneswar ..... Member
2. Director, Env-cum-Spl. Secy. to Govt., Forest & Environment Department ..... Member
3. Director, Municipal Administration, H & U.D. Department (Urban Development) ..... Member
4. Director of Industries, Killa Maidan, Buxi Bazar, Cuttack ..... Member
5. The Director Agriculture, Directorate of Agriculture and Food Production, Odisha ..... Member
6. Member Secretary, State Pollution Control Board, Odisha, Bhubaneswar .... Member Convener

The Committee shall prepare appropriate Action Plans within two months, aiming to bring the standards of air quality within the prescribed norms within six months from the date of finalization of the action plans.

The AQMC shall function under the overall supervision and coordination of the Addl. Chief Secretary to Government, Forest & Environment Department. This may be further supervised by the Chief Secretary or their counterparts by ensuring intra-sectoral co-ordination.

By order of the Governor

(S.C.Mahapatra)
(Addl. Chief Secretary to Government)

Memo No. 24824 /F&E, dt. 15.11.18

Copy with soft coy of the notification forwarded to the Director, Printing, Stationery & publication, Odisha, Cuttack with a request to kindly publish this notification in the next issue of Extraordinary Gazette of Odisha and supply 100 copies to this Department.

Director, Env.-cum-Spl. Secy. to Government

Memo No. 24825 /F&E, dt. 15.11.18

Copy forwarded to all members of the Committee for information and necessary action.

Director, Env.-cum-Spl. Secy. to Government

Memo No. 24826 /F&E, dt. 15.11.18

Copy forwarded to all departments of Government for information and necessary action.

Director, Env.-cum-Spl. Secy. to Government

Stakeholders' Workshop on

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(Angul, Balasore, Bhubaneswar, Cuttack, Rourkela & Talcher)

Date: 22.12.2018 :: Hotel Crown, Bhubaneswar :: Organised by State Pollution Control Board, Odisha, Bhubaneswar & Centre Science & Environment, Delhi

ATTENDANCE SHEET

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