ACTION PLAN FOR CONTROL OF AIR POLLUTION

IN NON-ATTAINMENT CITY OF BIHAR

(PATNA)

BY

BIHAR STATE POLLUTION CONTROL BOARD
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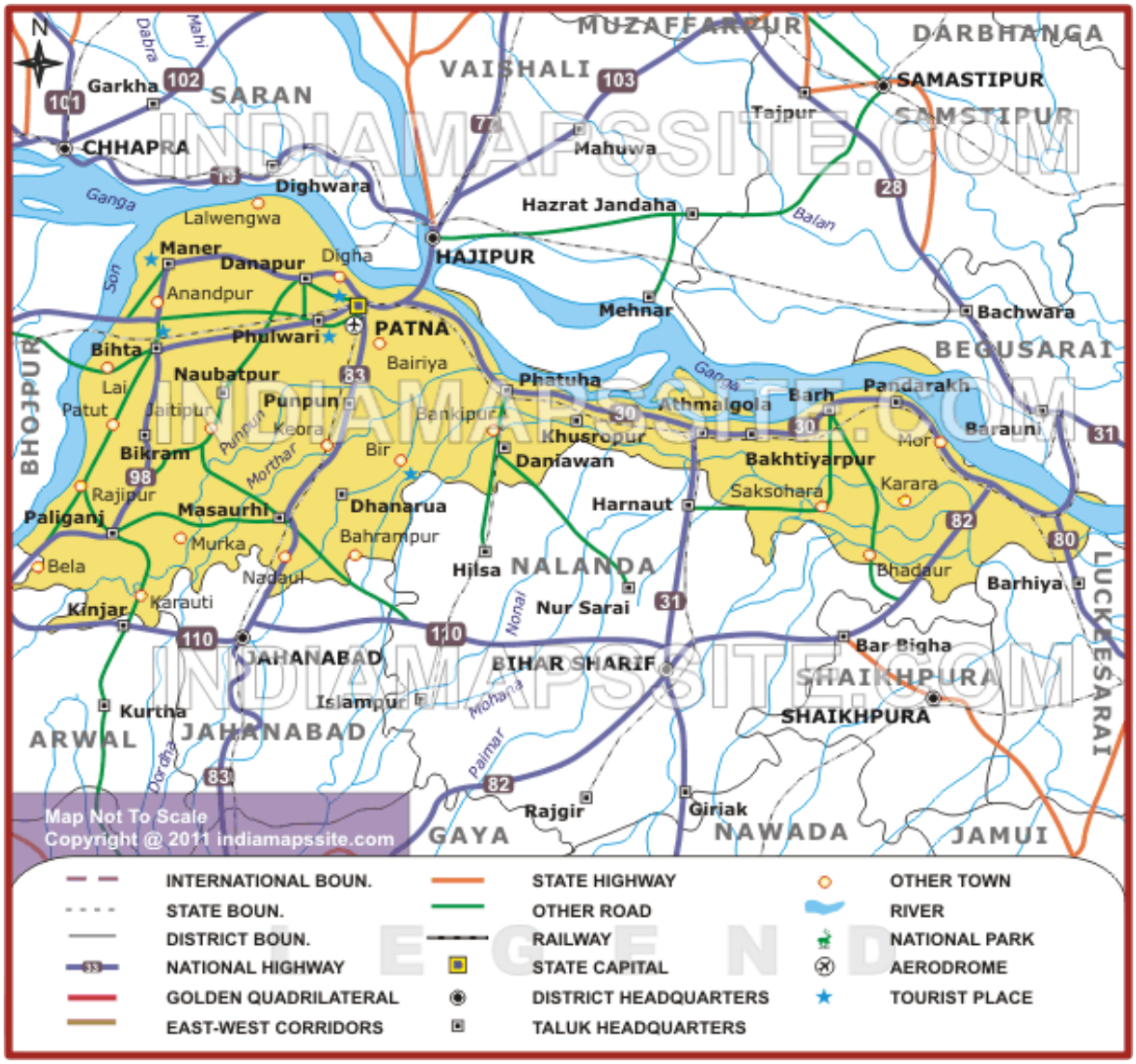
Action Plan for Control of Air Pollution in Non-Attainment City of Bihar (Patna)

Preamble:

Patna, the capital of Bihar is situated on southern bank of holy river Ganga at $25^0$30' - $25^0$40'N latitude & $85^0$10' - $85^0$20'E longitude and about 53m above sea level. It is spread over an area of 110 Sq km and has a population of 16.84 Lakh (City)/20.49 Lakh (Urban Agglomerations) as per census 2011. The Patna agglomeration includes Patna Municipal Corporation Area, Patliputra Housing Colony, Phulwarisharif, Danapur Nizamat, Danapur Cantonment, Khagaul etc. Total no. of vehicles registered as on July 2018 in Patna District with Transport Department is 14,37,562 (Truck: 50171, Bus: 8637, Car: 190865, Taxi: 18460, Jeep: 40627, Three Wheeler: 70200, Two Wheeler: 1009397, Tractor: 27270, Trailer: 16115 and others: 5820).



The major sources of air pollution in Patna are road dust, vehicular emission, domestic fuel burning, open waste burning, construction activities, industrial emissions etc. Bihar State Pollution Control is regularly monitoring the ambient air quality at Patna through Continuous Ambient Air Quality Monitoring Station (CAAQMS) installed at Indira Gandhi Science Complex; Planetarium premises and Beltron Bhawan, Shastrinagar & Gandhi Maidan, Bankipur Bus Depot under NAMP.

Particulate Matter (PM_{10} & $PM_{2.5}$) has been identified as main air pollutant as it is found above the prescribed national standards. This is mainly due to re-suspension of road dust, emission from vehicles, D.G. sets, construction activities, burning of domestic fossil fuels, open burning of solid wastes, transportation of construction materials such as sand, soil etc. without covering and emission from brick kilns located around Patna. NO_2 also has been observed an alarming level. This is mainly due to vehicular emissions. Plying of old vehicles and traffic congestion causes higher level of NO_2. It has been observed that air quality of Patna during winter season becomes very poor & severe due to condensation of fine particulate matter in the lower portions of the atmosphere.

Action Plan for Control of Air Pollution in Non-Attainment city of Bihar

1.	Name of the city	:	**Patna**
2.	Air Pollution concerns	:	PM_{10}, $PM_{2.5}$, NO_2
3.	Air pollution levels: (provide range of 24-houly average concentration values; annual average for past five years; No. days in various AQI categories)	:	Annexed as Annexure-1
4.	Months with high air pollution levels	:	January, February, November & December.

Sl. No	SECTOR	ACTION POINTS	Technology/Infrastructure requirement (TR/IR)/ Methods (M)/ Outcome (OC)	Implementation period (Short – 6 months, Med-<2 yrs.), long – (>2 yrs.)	Implementation agency	Time Target for Implementation
1	**Transportation**	Addition of new buses to public transport system – Electric buses, Hybrid diesel buses, CNG buses	Introduction of Electric buses with proper support infrastructure (charging stations) OC—Public transportation in play will reduce the number of private vehicles plying in the city. This will reduce the total emission load form tail-pipe emissions	Long	Bihar State Road Transport Corporation (BSRTC), Private Bus Owners Transport Department Industry Department	December-2024
			TR—Introduction of CNG buses	Long		

			OC—Public transportation in play will reduce the number of private vehicles plying in the city. This will reduce the total emission load form tail-pipe emissions			
		Check on more than 15 years diesel commercial vehicles		Short		December 2018
		Restriction on plying and phasing out of 15 years old commercial diesel driven vehicles.	OC- Reduction In black carbon emissions M- Policy reforms	Medium	Transport Dept. Govt. of Bihar	December 2019
		Ban on registration of diesel driven auto rickshaw's and tempo.	OC- Reduction In black carbon emissions M- Policy reforms	Medium		December 2019
		Complete ban on 2-stroke autos and replacing them with CNG based vehicle or EV	TR—E-rickshaws OC—Reduction of emission load from autos TR—CNG based autos OC—Reduction of emission load from autos	Medium - Long		December-2022
		1) PUC check (every 6 months) and 2) Better PUC check infrastructure and management (Hon'ble Supreme court of India in W.P.(C) no 13029/1985 that pollution testing centres should be set up with in premises of all petrol pumps)	OC—With better PUC infrastructure and strict pollution norms emission from private and public vehicle will decrease	Medium		December-2020
		Incentivising the use of cleaner fuels - electric vehicle and (CNG/LPG) for private vehicles	TR—Proper infrastructure to increase the adoption rate of cleaner fuels OC—Reduction of emission load from private vehicles which switched to Electric/CNG/LPG based vehicle from Petrol/Diesel based vehicles	Medium		December-2021

		Installation of Diesel Particulate Filter (DPF) in all the diesel vehicles	M—Installing DPF filters to existing diesel vehicles OC—Reduction of emission load from diesel vehicles	Medium	Transport Dept. Govt. of Bihar	December-2020
		Good traffic management including re-direction of traffic movement to avoid congestion.	OC- Reduction in Emission due non congestion TR- Policy intervention	Medium	Traffic police	December 2020
		Demarcated lanes for E rickshaw's plying for public commuting	OC- Reduction in Emission due non congestion TR- Policy Intervention	Short	Traffic police	Immediate
		Development of Multi level parking	OC- Traffic congestion & road encroachment reduction, emission reduction M- Land space demarcation around public transportation hotspots	Long	PMC	December 2023
		Monitoring of Vehicle fitness	OC- Reduction in emission M- Audit systems	Short-Medium	Transport & Traffic dept.	December 2019
		Checking on fuel adulteration	OC- Reduction in emission M- Audit systems	Short	District Administration & Oil companies	April 2019
		Periodic calibration test of vehicular emission monitoring instrument.	OC- Reduction in emission M- Audit systems	Short	BSPCB & Transport	April 2019
		Complete ban of carriage transport, heavy vehicles, during peak hours (8:00 -11:00 am & 5:00 - 8 pm). (Arranging alternate routes to all carriage transports between)	OC—Reduction in peak hour traffic will facilitate faster vehicle movement and reduce tail- pipe emission	Short	Traffic police	April 2019
		Launch drive against any vehicle with visible smoke coming out of it and ensure strict compliances		Short	Traffic police	April 2019

2	**Industry**	Adapting new technologies for Brick kilns	Adapting Cleaner technology	Medium	Bihar State Pollution Control Board (BSPCB) Dept. of Industries (Bihar)	December 2019
		Random auditing for 1) Air pollution measures 2) Online reporting systems in the industries	Setting up of policies and Institutions that 1) Conduct Random auditing for air pollution control measures 2) Prevents opening up of new industries that fall under Red Category and Orange Category.	Medium		December 2019
		Introduction and shifting towards cleaner fuels in Induction and casting industries	M- Regulatory requirements	Medium		December 2019
		Shifting of Polluting Industries	M- Regulatory requirements	Long		December 2021
		Ban on Polluting Industries	M- Regulatory requirements	Short		June 2019
	Biomass & Garbage Burning	Check Stubble burning	OC- Reduction in emission from stubble burnings M- Regulatory as well as Awareness Sensitization	Medium	Dept. Of Agriculture	December 2020
3		Identify Garbage burning locations and strict enforcement of NGT (2016) rules regarding prohibition of garbage burning.	OC—Reduction in emission load from garbage burning	Short	PMC	Immediate
		Promoting waste composting plants at city level				
		Recycling plants for dry waste.				
		Establishing waste to energy plants (WTE)				
4	**Domestic**	Increasing the LPG connections in low income strata. To mandate LPG/Bio gas in commercial eateries.	M—Increase in LPG connection OC—Reduction in emission load	Medium	Food And Civil Supplies Department	December 2020

		Ensuring uninterrupted electric supply with in the city.	OC—Reduction in total emission load from kerosene lamps (as power cut backup will not be required)	Medium	South Bihar Power Distribution Company Limited	December 2019
		Ensure easy availability of affordable cleaner cooking fuels (LPG in urban areas & biogas in rural areas)	M—Improvement in LPG/Bio gas infrastructure	Medium	Food & Civil supplies Dept.	December 2020
5	**Construction & Demolition**	Construction materials should be transported in covered vehicles	OC—Reduction in emission load from dust	Short	Traffic Police	Immediate
		To mandate facility of tar road inside the construction site for movement of vehicles carrying construction material	OC—Reduction in emission load from dust	Medium	PMC	December 2019
		Promotion of the use of prefabricated blocks for building construction	OC—Reduction in emission load from dust	Long		December 2020
		Strict enforcement of CPCB guidelines for construction (use of green screens, side covering of digging sites, etc.)	OC—Reduction in emission load from dust	Short	BSPCB	Immediate
		Demolition & Construction Sites should be covered from all sides	OC- Reduction in Road Dust	Short	PMC	Immediate
		Restriction on storage of construction materials along the road.	OC- reduction in road dust	Short	PMC	Immediate
6	**Road Dust**	To take appropriate action to remove road dust/silt regularly by using mechanical sweepers	Mechanical sweeping 1) Identifying the road stretch with high silt content 2) Procuring the mechanical sweepers	Medium	PMC & Urban Development Dept.	December 2019
		End to end road pavement	OC—Reduction in resuspension of dust M—Improvement in Infrastructure	Medium	PMC & Urban Development Dept.	
		Creating green buffer along the roads.				

		Urban Greening including vertical garden				
7	**Strengthening of AAQ monitoring**	Installation of four CAAQMS at Patna. a. Two CAAQM stations under CSR funds of CPSU through CPCB at Eco-Park. b. Two CAAQM stations under State Govt. financial assistance.	OC- Proper Evidence on sectorial contributions with primary baseline surveys to update the emissions inventory. OC- Efficient Monitoring	Short	BSPCB	June 2019
		Source apportionment study (Dispersion +Receptor) Modelling	OC- identification of pollutants	Medium	BSPCB	December 2019
8	**Public Awareness**	Issue of advisory to public for prevention and control of air pollution	OC- Awareness and better implementation of policy	Short	BSPCB & Dept. of Environment, forest & Climate Change	Immediate
		Launch public awareness programme campaign to control air pollution	OC—Through awareness, public participation for air pollution reduction will increase	Short	BSPCB PMC & Dept. of Environment, forest & Climate Change	Immediate
9	**Others**	Compliance of guidelines on D.G. sets and action against violation	OC- Reduction in Black carbon TR- DPF (Diesel Particulate Filters installation)	Short	BSPCB & PMC	Immediate
		Help line to oversee non compliances on aforesaid issues.	OC- Awareness and better implementation of policy	Short	BSPCB & PMC	Immediate
		Hospital incinerators for bio-medical incineration	OC—Reduction in bio-hazardous materials being dumped in to the landfill	Short	BSPCB GMC Dept. of Health (Govt. of Bihar)	Immediate
		City wise cap on coal use	OC—Reduction in coal consumption will reduce the emission load	Medium	BSPCB Food And Civil Supplies Department	December 2019
		Polluter pay principle	OC—Will act as a deterrent against polluters	Medium	BSPCB	December 2019

		Transportation of municipal solid wastes, construction materials and debris in covered system.	OC- Minimization in road dust M- Monitoring of Implementation	Short	PMC	Immediate
		Immediate lifting of solid wastes generated from de-silting and cleaning of municipal drains for its disposal.	OC- Minimization of Road dust M- Monitoring of Implementation	Short	PMC	April 2019

1. **Monitoring mechanism for implementation:** The aforesaid action plan shall be implemented by Bihar State Pollution Control Board with co-ordination of Department of Environment and Forest, Govt. of Bihar, Urban Development & Housing Department, Govt. of Bihar, Transport Department, Patna Municipal Corporation, Traffic Police and District Administration. Bihar State Pollution Control Board shall regularly review the implementation of aforesaid action plan.

2. **Public Awareness and Grievance Redressal**: A multifaceted awareness campaign is scheduled where in not just to create sensitization but create some agents of change among all sections of society. Set up an anti-Pollution Help-Line in Patna region to register complaints of specific violations. A pollution app at crowd sourcing platform is in the phase to be prepared wherein citizens can take a picture of the violation and upload it for quick remedial action. In addition, efforts are also being made through various camps, trainings and workshops, apart from campaigns through various print media, televised shows and radio jingles, in informing the air pollution as a hazard and adhering to the standard measures as a citizen. Gathering information to build an Emissions Inventory is an essential input for forecasting air quality in a given area. While static emission sources like industries, brick kilns etc. are captured easily, the challenge lies in capturing information such as waste-burning, accidental fires, other events that throw up clouds of dust and any such type of events. One possible solution to this problem is to use crowd-sourced information where unknown individuals will be able to report as well as verify air pollution events that are random in nature. The challenge is to make sure that complete information about the event is captured as well as establish the veracity of the information being received. This will act as source of public awareness and simultaneously social media can used as a potential tool for the same.

3. Public Advisory:

BSPCB along with other stakeholders like BSDMA, Dept. Of Health will be sending out advisory for citizen's preparedness. Use of media and social media for creating wide dissemination will be catered through these advisory. A statutory advisory is attached in the annexure II.

4. Source Apportionment Study

To monitor the air pollution, Patna has 1 Continuous Air Monitoring Station (CAMS) reporting data for all the criteria pollutants, 2 manual stations reporting data on PM2.5, PM10, SO_2, and NO_2 and (Fig 01). However the data acquired by CAMS installed at IGSC, Planetarium is insufficient to find the sectorial and per capita emission load. There should be at least 12 CAMS in the city for efficient reporting. However, emission inventory survey can be used to supplement the data to calculate the emission load[1]. The current average ambient air pollution for Patna is around 156 µg/m^3 and under BAU scenario it is expected to be around 276 in 30 years' time.

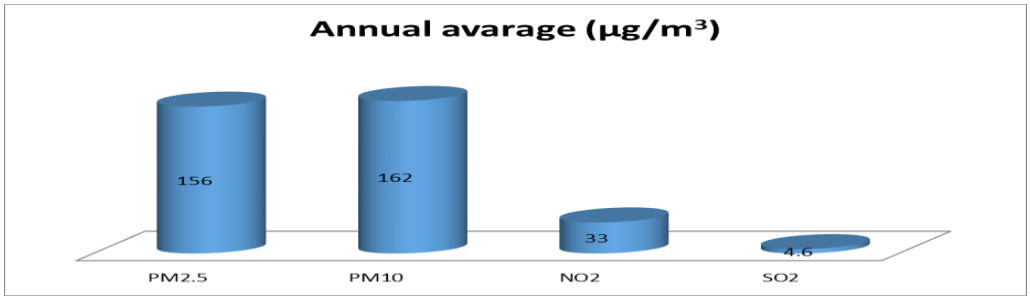


Fig 01: Annual averages from the national ambient monitoring program (2011-2015) µg/m3. Source: (Central Pollution Control Board, 2018)

The modelled source contributions present an even share of transport (including on-road dust), domestic cooking and heating, industries, open waste-burning, and influence of outside sources. An estimated 19% of the ambient annual PM2.5 pollution (in 2015) originated outside the urban air-shed. It came from coal-fired power plants, large (metal and non-metal processing) industries and brick kilns located outside the urban air-shed (Fig 02). Some regional interventions could reduce the pollution loads. By 2030, increase in LPG consumption, residential electrification and urbanisation will decrease emissions from residential cooking and lighting (Fig 03). However, use of biomass and coal for warmth in the winter will still be an issue. The city needs to aggressively promote public and non-motorized transport and improve road infrastructure to reduce on-road dust re-suspension. Vehicle exhaust emissions are expected to remain constant by 2030, if and only if, Bharat 6 fuel standards are introduced nationally in 2020, as recommended by the Auto Fuel Policy. The 300 brick kilns in the urban air-shed can benefit from a technology upgrade from the current fixed-chimney and clamp-style baking to (for example) zig-zag, in order to improve their overall energy efficiency[2].

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[1] Central Pollution Control Board, 2018. Central Control Room, CAAQMS, IGSC Planetarium, Patna: http://app.cpcbcrr.com/AQI/. accessed on December 02, 2018 at 1530hrs.

[2] Guttikunda SK, J. P., 2014. *Characterizing Patna's Ambient Air Quality and Assessing Opportunities for Policy Intervention,* New Delhi: Urbanemission.Infor.SK, G., 2015. *APnA City - Patna,* Patna: UrbanEmission.

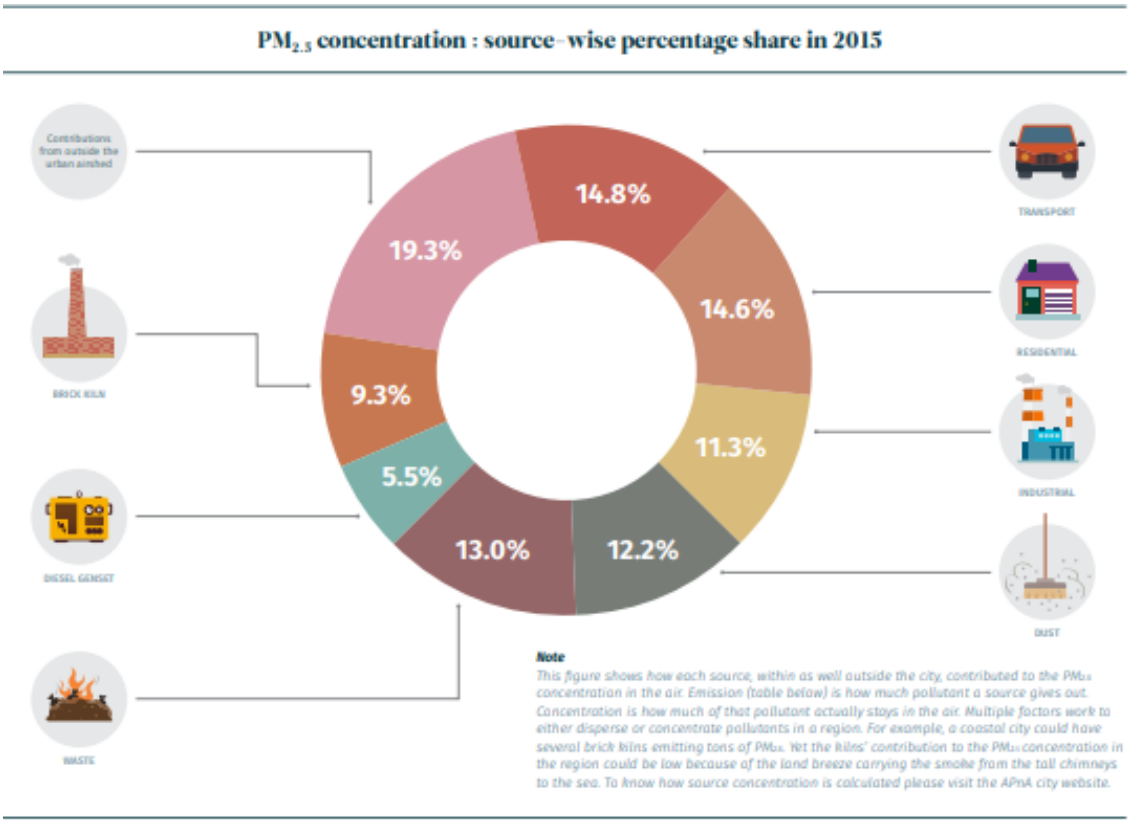


Fig 02: Share of sectorial emission 2015 in Patna. Source: (SK, 2015)

5. **Convergence with Graded Response Action Plan :**

In pursuant to the order of the Hon'ble Supreme Court dated December 02, 2016 in the matter of M. C. Mehta Vs. Union of India regarding air quality in National Capital Region of Delhi and approval of Ministry of Environment, Forests and Climate Change, Govt. of India vide its notification S.O. 118 (E), dated-January 12, 2017 CPCB has formulated Graded Response Action Plan for Delhi & NCR based on Air Quality Index and concentration of particulate matter. In consistent with the same, a Graded Response Action Plan has been formulated for Patna as hereunder:-

Severe + or Emergency (ambient PM2.5or PM10concentration values of 300µg/m3or 500µg/m3 respectively persist for 48 hours or more)	**Implementing Agency**
Stop construction activities.	Patna Municipal Corporation, Building Construction Department, Govt. of Bihar, Road Construction Department, Govt. of Bihar, Bihar Rajya Pul Nirman Nigam(BRPNN) and Bihar State Pollution Control Board.
Introduce odd and even scheme for private vehicles based on license plate numbers and minimize exemptions.	Transport Commissioner, Transport Department, Gov. of Bihar, District Transport Officer, Patna and District Magistrate, Patna.
Task Force to take decision on any additional steps including shutting of schools	District Magistrate, Patna
Severe (ambient PM2.5 or PM10 concentration value is more than 250 µg/m³ or 430µg/m³ respectively)	**Implementing Agency**
Intensify public transport services. Introduce differential rates to encourage off-peak travel.	Transport Commissioner, Transport Department, Gov. of Bihar, District Transport Officer, Patna and District Magistrate, Patna.
Close brick kilns, hot mix plants.	Bihar State Pollution Control Board, Mining Department, Govt. of Bihar.
Increase frequency of mechanized cleaning of road and sprinkling of water on roads. Identify road stretches with high dust generation.	Patna Municipal Corporation, Public Works Department, Govt. of Bihar, Road Construction Department, Govt. of Bihar and National Highway Authority of India.
Very Poor (ambient PM2.5 or PM10 concentration value is between 121-250µg/m³ or 351-430 µg/m³ respectively)	**Implementing Agency**
Stop entry of truck traffic into Patna (except essential commodities).	Patna Municipal Corporation (PMC) and Traffic Police, Patna Town.
Stop use of diesel generator sets.	Bihar State Pollution Control Board, District Administration, Patna, Patna Municipal Corporation, Patna.
Enhance parking fee by 3-4 times.	Patna Municipal Corporation, Patna.
Increase public transport bus services by augmenting contract buses and increasing frequency of service.	Transport Department, Gov. of Bihar, District Transport Officer, Patna, District Administration, Patna.
Stop use of coal/fire wood in hotels and open eateries.	Patna Municipal Corporation, Patna.
Residential Welfare Associations and individual house owners, Security Staff to provide electric heaters during winter to avoid open burning by them.	Resident Welfare Associations, Apartment Committee, Security Organizations
Alert in newspapers/TV/radio to advice people with respiratory and cardiac patients to avoid polluted areas and restrict outdoor movement.	Bihar State Pollution Control Board.
Moderate to poor(ambient PM2.5 or PM10 concentration value is between 61-120 µg/m³ or 101-350 µg/m³ respectively)	**Implementing Agency**
Stringently enforce/stop garbage burning in	Patna Municipal corporation, Patna.

landfills and other places and impose heavy fines on person responsible.	
Close/stringently enforce all pollution control regulations in brick kilns and industries.	Bihar State Pollution Control Board.
Do periodic mechanized sweeping on roads with heavy traffic and water sprinkling also on unpaved roads every two days.	Patna Municipal corporations, Patna
	Traffic Police, Patna to identify roads with heavy traffic and provide information to Municipal Commissioner, Patna.
	In-charge, PWD, Govt. of Bihar, Patna region to identify unpaved roads with heavy traffic and provide information to Municipal Commissioner, Patna.
Strict vigilance and no tolerance for visible emissions–stop plying of visibly polluting vehicles by impounding or heavy fine.	District Transport Officer and Traffic Police, Patna.
Strict vigilance and enforcement of PUC norms.	
Stringently enforce rules for dust control in construction activities and close non-compliant sites.	Patna Municipal Corporation, Patna, Building Construction Department, Govt. of Bihar and Road Construction Department, Govt. of Bihar.
Deploy traffic police for smooth traffic flow at identified vulnerable areas.	Traffic Police, Patna
Strictly enforce Supreme Court ban on firecrackers.	Chief Controller of Explosives, Petroleum and Explosive Safety Organizations (PESO) and District Administration, Patna.
Information dissemination through Social media, mobile Apps 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 be taken by government based on the level of pollution.	Bihar State Pollution Control Board, Department of Environment and Forest, Govt. of Bihar.

Annexure-1

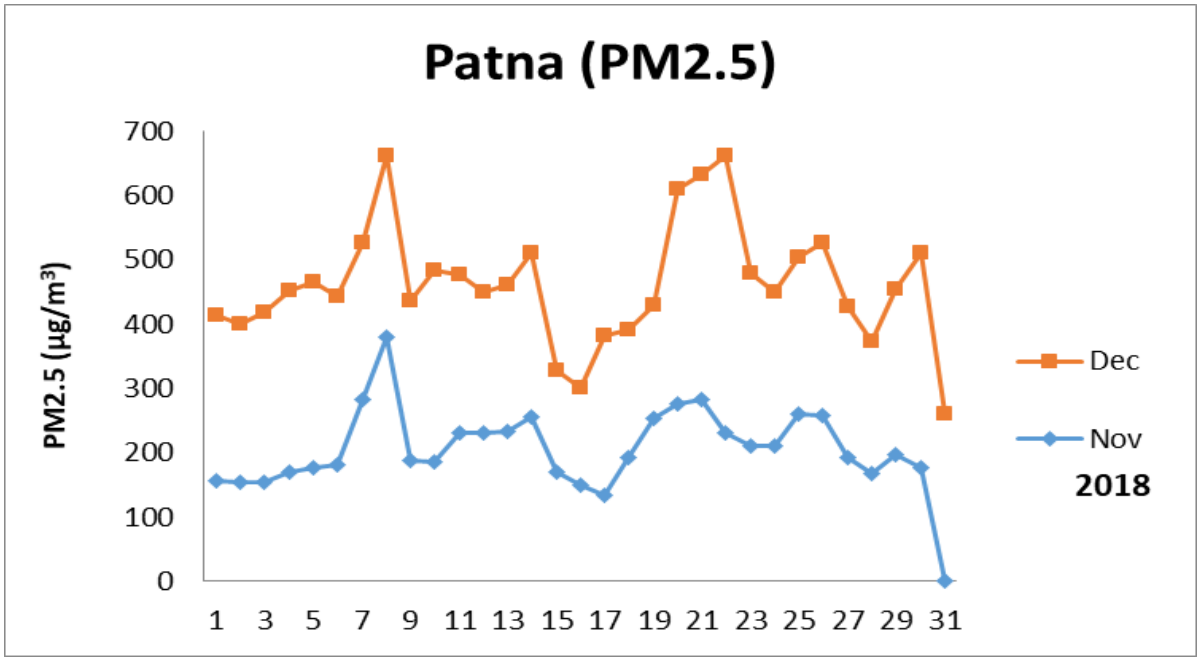
Status of Ambient Air Quality at IGSC-Planetarium Patna

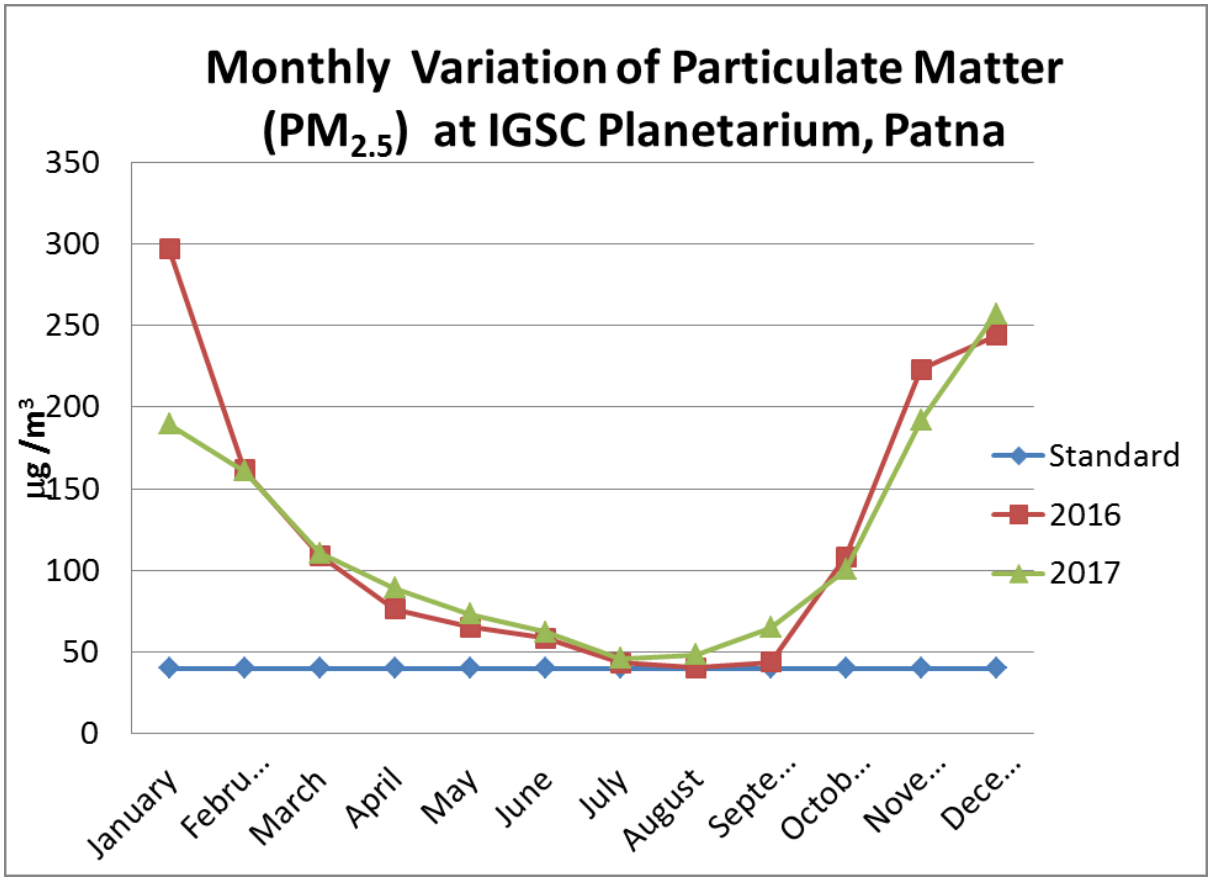
Sl. No	PARAMETERS	Annual Average Concentration							Standards for residential, Rural and other Areas
		2011	2012	2013	2014	2015	2016	2017	
1.	PM_{10}	186.09 µg/m^3	194.88 µg/m^3	225.78 µg/m^3	211.60 µg/m^3	199.23 µg/m^3	--	--	60 µg/m^3 Annual
2.	$PM_{2.5}$	----	112.86 µg/m^3	121.90 µg/m^3	-----	203.83 µg/m^3	122.51 µg/m^3	116.15 µg/m^3	40 µg/m^3 Annual
3.	CO	2.35 mg/m^3	2.02 mg/m^3	1.98 mg/m^3	1.87 mg/m^3	1.67 mg/m^3	1.55 mg/m^3	1.49 mg/m^3	02 mg/m^3 8 hours 04 mg/m^3 1 hour
4.	O_3	47.89 µg/m^3	37.07 µg/m^3	27.50 µg/m^3	34.64 µg/m^3	21.86 µg/m^3	34.33 µg/m^3	24.63 µg/m^3	100 µg/m^3 8 hours 180 µg/m^3 1 hour
5.	SO_2	8.66 µg/m^3	14.17 µg/m^3	8.97 µg/m^3	22.65 µg/m^3	13.11 µg/m^3	6.80 µg/m^3	12.08 µg/m^3	50 µg/m^3 Annual
6.	NO_2	60.10 µg/m^3	71.69 µg/m^3	56.08 µg/m^3	29.00 µg/m^3	57.54 µg/m^3	45.10 µg/m^3	37.01 µg/m^3	40 µg/m^3 Annual
7.	Benzene	4.04 µg/m^3	2.33 µg/m^3	0.99 µg/m^3	0.09 µg/m^3	1.65 µg/m^3	1.24 µg/m^3	0.46 µg/m^3	05 µg/m^3 Annual

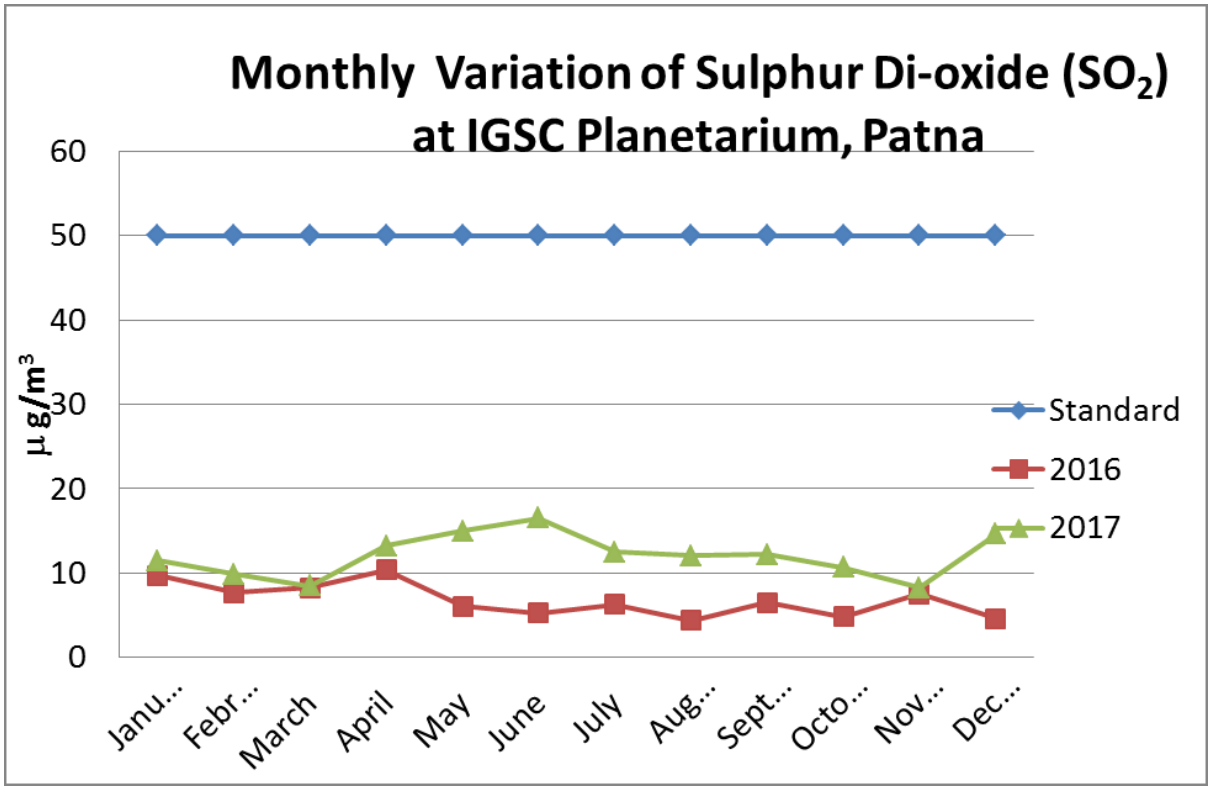
Status of Ambient Air Quality of IGSC Planetarium, Patna															
Sl No.	**Month**	**Main pollutants & BTX Parameters 2016 & 2017**													
		CO in mg/m³		**SO2 in µg/m³**		**NO2 in µg/m³**		**O_3 in µg/m³**		**PM 2.5 in µg/m³**		**Benzene in µg/m³**			
		Avg		**Avg**		**Avg**		**Avg**		**Avg**		**Avg**			
		2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**		
1	January	2.79	2.13	9.7	11.5	76.6	80.6	31.7	18.4	296.7	189.3	2.65	1.09		
2	February	1.43	1.96	7.7	9.9	63.6	94.0	28.1	35.8	161.7	160.7	1.88	0.92		
3	March	1.37	1.48	8.3	8.5	49.6	13.2	47.8	33.2	109.0	110.6	1.36	0.76		
4	April	1.25	1.14	10.4	13.2	21.4	8.0	53.2	32.3	76.1	89.1	1.13	0.41		
5	May	1.23	0.99	6.1	15.0	33.4	8.3	54.2	32.7	65.5	73.3	1.04	0.38		
6	June	1.18	0.93	5.3	16.5	44.2	8.3	36.7	20.7	58.4	62.4	0.91	0.31		
7	July	1.09	0.86	6.3	12.5	41.0	14.5	20.0	10.6	43.5	45.9	0.75	0.26		
8	August	1.09	0.93	4.4	12.1	35.1	19.1	20.3	9.5	40.3	48.3	0.76	0.20		
9	September	1.16	1.37	6.5	12.2	37.9	47.8	23.4	21.4	43.8	65.1	0.82	0.24		
10	October	1.26	1.26	4.8	10.7	48.2	50.4	37.0	26.6	108.3	100.3	0.93	0.25		
11	November	2.02	2.01	7.5	8.3	69.8	65.0	42.7	33.9	223.0	191.8	1.26	0.35		
12	December	2.70	2.79	4.6	14.6	57.9	34.9	16.8	20.4	243.8	257.0	1.42	0.36		
	Avg	**1.**55	**1.49**	**6.80**	**12.08**	**48.23**	**37.01**	**34.33**	**24.63**	**122.51**	**116.15**	**1.24**	**0.46**		
Standards		02 **mg/m³** 8hours 04 **mg/m³** 1 hours		50 **µg/m³** Annual		40 **µg/m³** Annual		100 **µg/m³** 8hours 180**µg/m³** 1 hours		40 **µg/m³** Annual		05 **µg/m³** Annual			

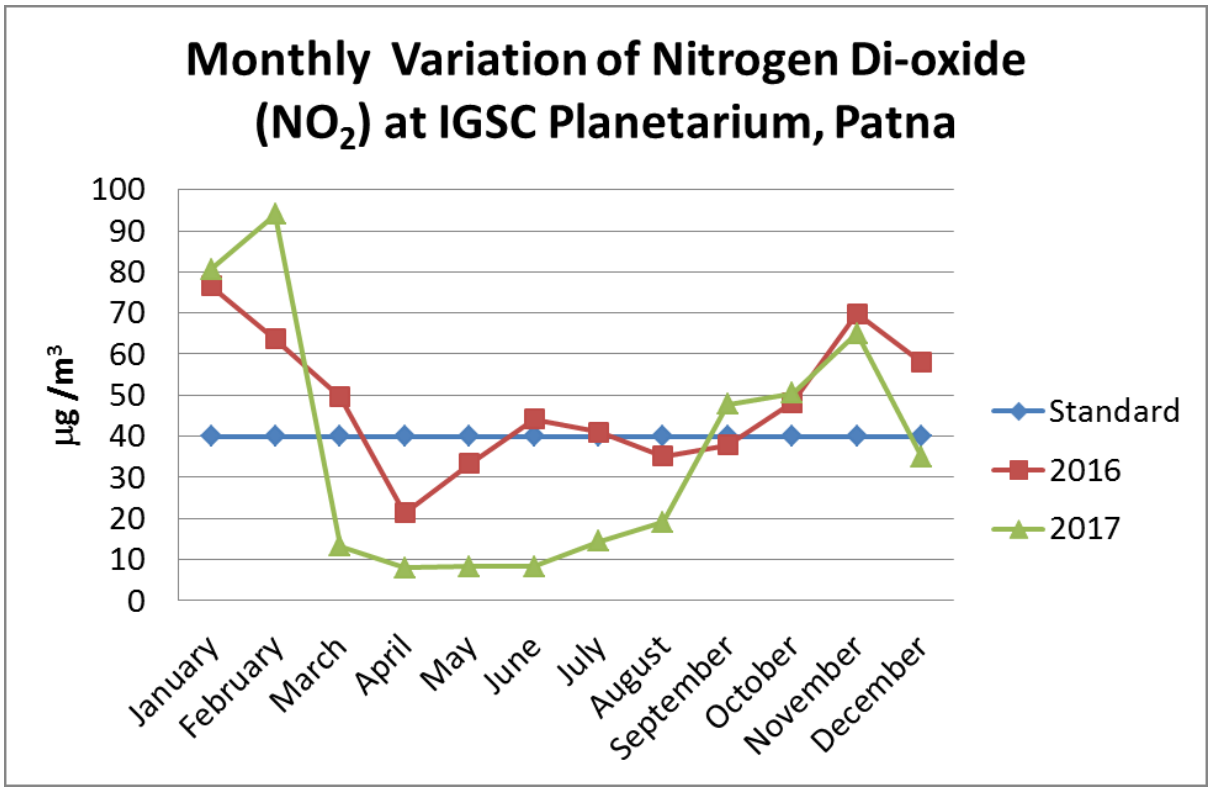
Meteorological Parameters at IGSC Planetarium, Patna during 2016 & 2017															
Sl. No.	**Month**	**WS in m/s**		**WD in Degree**		**AT in ^{0}C**		**RH in %**		**BP in mmHg**		**SR in w/m²**		**VWS in m/s**	
		Avg		**Avg**		**Avg**		**Avg**		**Avg**		**Avg**		**Avg**	
		2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
1	January	0.3	0.3	182	195.7	15.6	18.4	73.4	74.9	755.5	755.5	467.7	109.8	-0.05	-0.09
2	February	0.5	0.3	183.2	202.8	21.9	21.0	62.6	66.7	754.6	754.5	397.3	172.2	-0.05	-0.09
3	March	0.4	0.3	196.6	173.6	28.3	24.6	50.6	58.5	753	752.3	450.3	166.5	-0.07	-0.09
4	April	0.4	0.4	196.9	139.1	35.3	30.8	34.4	56.1	749.7	750.4	209	155.5	-0.09	-0.09
5	May	0.4	0.4	126.8	127.2	27.6	32.0	65.4	63.8	749.4	749.5	180.4	95.5	-0.09	-0.09
6	June	0.4	0.4	124.3	132.3	29.5	32.4	70.3	71.5	748.5	747.7	311.4	89.5	-0.09	-0.09
7	July	0.4	0.4	131.7	134.8	26.1	29.5	83.9	83.6	747.8	747.7	353.2	79.7	-0.09	-0.09
8	August	0.4	0.3	132.9	166.8	27.4	28.9	78.9	87.7	748.1	748.3	307.2	103.1	-0.09	-0.12
9	September	0.3	0.3	146.1	158.6	25.2	30.9	86.5	78.9	**749.9**	750.1	349	97.8	-0.09	-0.15
10	October	0.3	0.3	174.9	157	24.7	28.5	74.3	76	**751.7**	751.7	201.1	81.5	-0.09	-0.15
11	November	0.3	0.3	186.1	174	18.5	22.7	68.1	66.8	**753.9**	754.1	438.7	61.5	-0.09	-0.15
12	December	0.3	0.3	195.4	192	15.7	17.3	87.8	75.3	**755.2**	755.3	483.2	37.6	-0.09	-0.15
	Avg	0.4	**0.3**	164.7	**162.9**	24.7	**26.4**	69.7	**71.7**	**751.4**	**751.4**	345.7	**104.2**	-0.08	**-0.11**

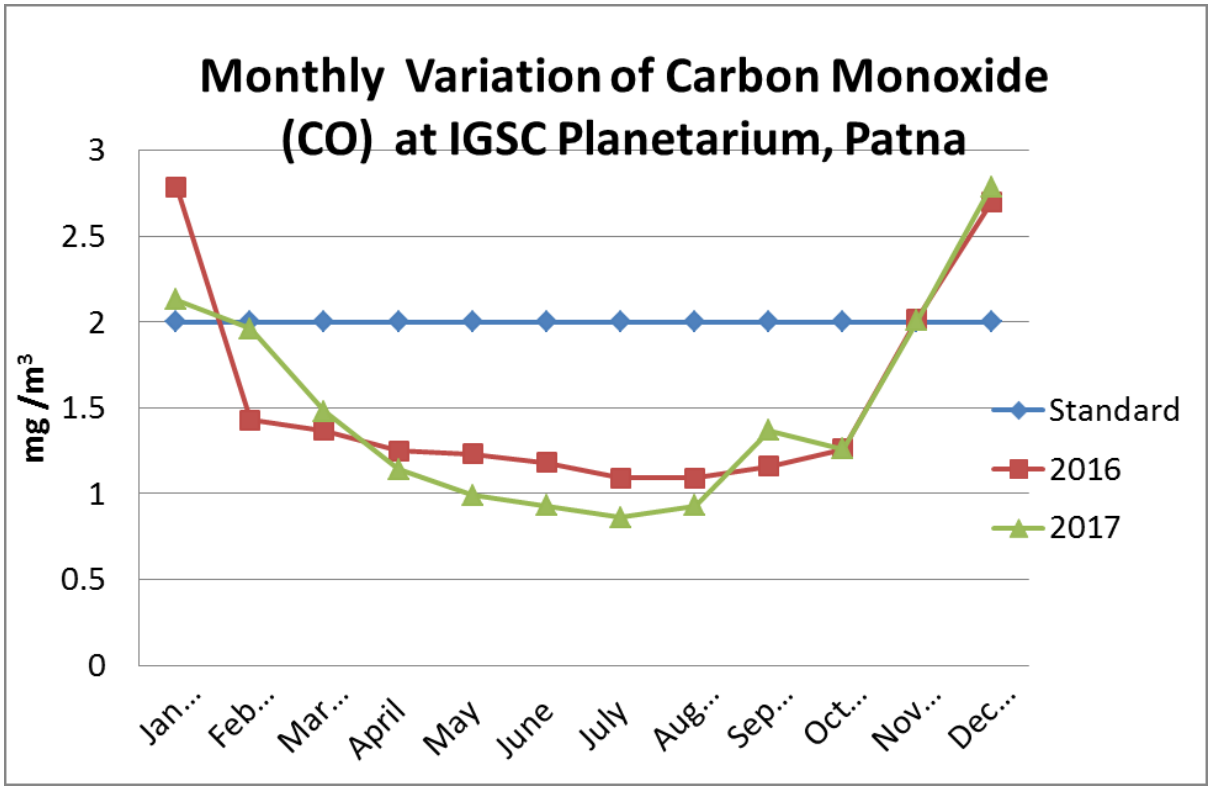
Air Quality Index of Patna in days during 2016 & 2017													
Sl.No.	**Month**	**Good**		**Satisfactory**		**Moderate**		**Poor**		**Very Poor**			**Severe**
		2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
1.	January	-	-	-	-	-	01	-	02	13	22	18	06
2.	February	-	-	-	-	02	03	07	07	18	15	01	03
3.	March	-	-	02	-	12	09	04	11	13	10	-	-
4.	April	-	-	04	03	20	11	05	13	01	02	-	-
5.	May	-	-	07	08	23	16	01	07	-	-	-	-
6.	June	-	-	14	11	16	19	-	-	-	-	-	-
7.	July	01	02	25	25	05	04	-	-	-	-	-	-
8.	August	01	-	26	14	04	03	-	-	-	-	-	-
9.	September	-	-	23	08	07	16	-	02	-	-	-	-
10	October	01	-	02	08	10	09	07	02	10	12	-	-
11.	November	-	-	-	-	-	01	03	9	16	11	11	09
12	December	-	-	-	-	-	-	-	-	21	13	10	18
Total		**3**	**02**	**103**	**77**	**99**	**92**	**27**	**53**	**92**	**85**	**40**	**36**

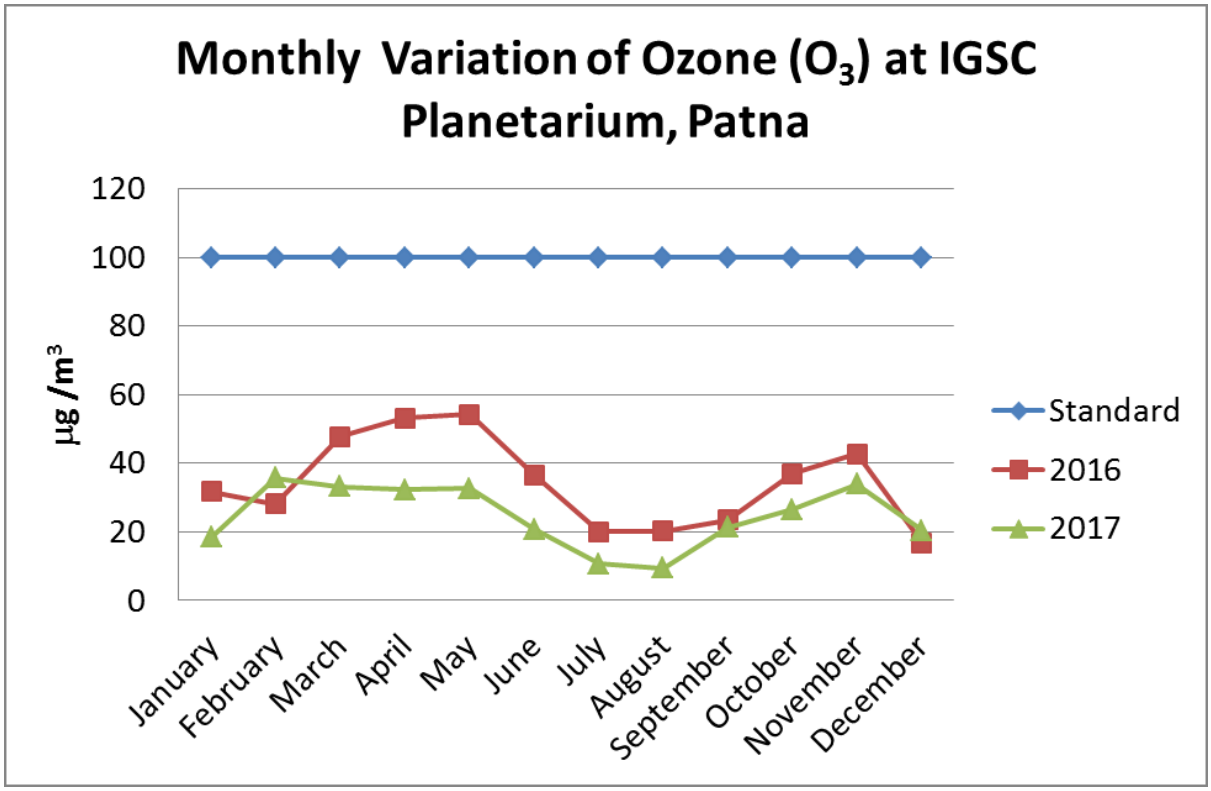

Patna (PM2.5)
PM2.5 (µg/m³)
700
600
500
400
300
200
100
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
Dec
Nov
2018

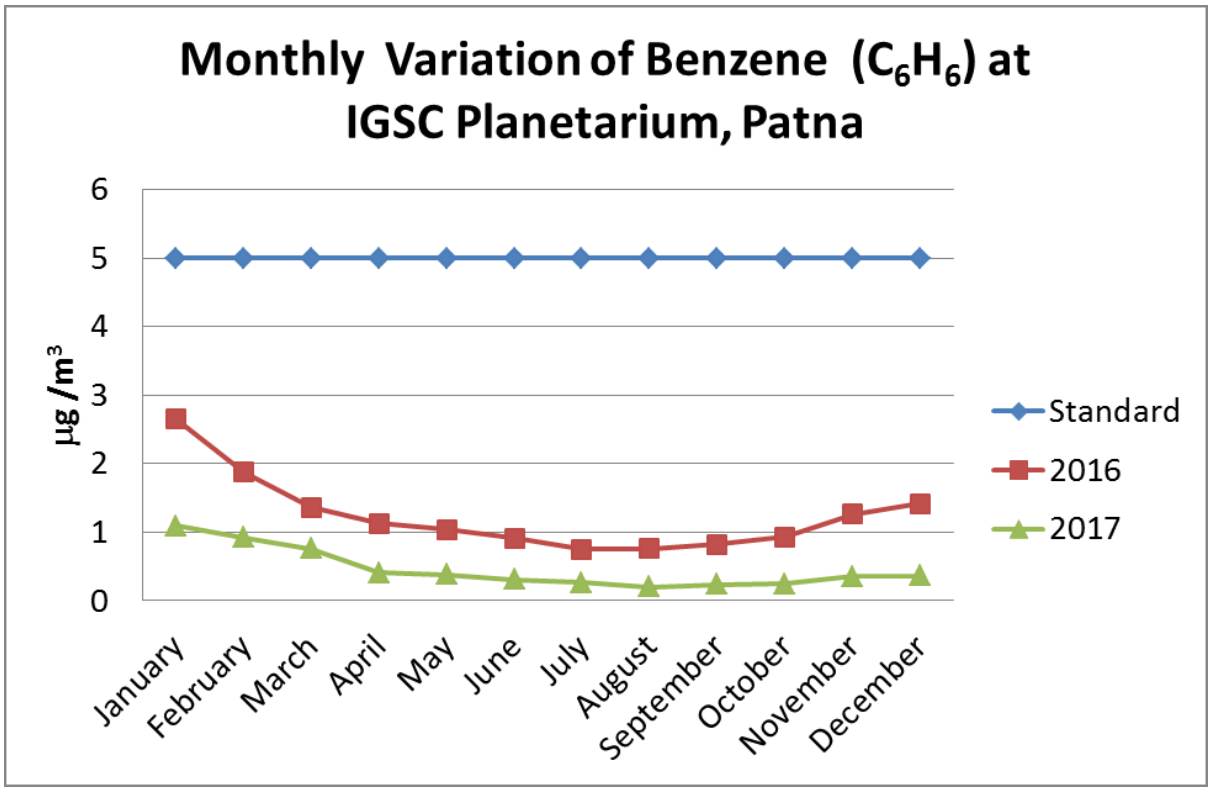

Monthly Variation of Particulate Matter (PM2.5) at IGSC Planetarium, Patna
µg /m³
350
300
250
200
150
100
50
0
January
Febru...
March
April
May
June
July
August
Septe...
Octob...
Nove...
Dece...
Standard
2016
2017


Monthly Variation of Sulphur Di-oxide (SO_2) at IGSC Planetarium, Patna
60
50
40
30
20
10
0
µg/m³
Janu...
Febr...
March
April
May
June
July
Aug...
Sept...
Octo...
Nov...
Dec...
Standard
2016
2017


Monthly Variation of Nitrogen Di-oxide (NO_2) at IGSC Planetarium, Patna
100
90
80
70
60
50
40
30
20
10
0
µg /m³
January
February
March
April
May
June
July
August
September
October
November
December
Standard
2016
2017


Monthly Variation of Carbon Monoxide (CO) at IGSC Planetarium, Patna
mg /m³
3
2.5
2
1.5
1
0.5
0
Jan...
Feb...
Mar...
April
May
June
July
Aug...
Sep...
Oct...
Nov...
Dec...
Standard
2016
2017


Monthly Variation of Ozone (O_3) at IGSC Planetarium, Patna
µg /m³
120
100
80
60
40
20
0
January
February
March
April
May
June
July
August
September
October
November
December
Standard
2016
2017


Monthly Variation of Benzene (C_6H_6) at IGSC Planetarium, Patna
µg /m³
6
5
4
3
2
1
0
January
February
March
April
May
June
July
August
September
October
November
December
Standard
2016
2017

Annexure-II

Advisory

- Not to burn dry leaves, crops residue, wood, coal, Gobar Upla etc.plant more trees to make your city green. Trees like Neem, Sheesham, Peepal, Keekar , Gulmohar etc. make the air clean and healthy , create green belt in and around the capital
- Use carpooling and public transport, as much as possible. Walk or use non-polluting mode of transport for short distance
- Avoid going outdoor during early morning and late evening for walk or outdoor physical activity as the pollution levels are maximum during this time
- Avoid going to high pollution areas during peak hours. Stay indoor as much as possible
- Schools may avoid outdoor assembly, sports activities and other physical activities in the early morning
- Take extra precautions for high risk group as mentioned above, use N95 mask if going outdoor during the peak pollution hours
- Do not smoke, as it harms not only you but others also.
- If you feel irritation in the throat and nose, take steam and do salt water gargles. Drink plenty of warm water and maintain good hydration.
- If any time you are feeling breathless or palpitation, immediately go to nearest medical facility. Treatment is absolutely free in all the government Health facilities.

Annexure-III

Schedule of the Source Apportionment Study

Major theme	Activity	Months																	
		1-2		3-4		5-6		7-8		9-10		11-12		13-14		15-16		17-18	
Air quality monitoring	Establishment of network, Source profile monitoring																		
	I^{st} season monitoring																		
	II^{nd} season monitoring																		
	Analysis of I^{st} season results																		
	Analysis of II^{nd} season results																		
Receptor modelling	CMB modeling																		
Emission Inventory	Reconnaissance survey																		
	Secondary data collection																		
	Primary surveys																		
	Emission inventorization																		
	Scenario analysis																		
Dispersion modeling	Baseline dispersion modeling																		
	Future dispersion modeling																		
Air quality management plan	Based on both receptor and dispersion models																		