

ENHANCED CAPABILITIES TO ADOPT INNOVATIVE TECHNOLOGIES FOR CITY AIR POLLUTION CONTROL IN SELECT COUNTRIES OF THE ASIA-PACIFIC

Gurugram, India

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Gurugram

- A major city located next to New Delhi, in State of Haryana
- Major industrial and residential townshiop, high growth area
- City population more than 1.2 million, significant industrial and residential development along the city limits
- Is part of National Capital Territory (NCR) of Delhi, which has been experiencing air pollution since last many years
- An air action plan for NCR is already in place, though seperate city action plan for Gurugram is now under preparation
- India has more than 132 non-attainment cities for which a national level program (NCAP) with financial support from National Goverment is in place since 2017.

National Air Quality Index

Central Pollution Control Board,
Ministry of Environment, Forests and Climate Change

State: Haryana City: Gurugram Station: Vikas Sadan, Gurugram - HSPCB Date: 24/05/2023 Time: 16:00

Insufficient data for computing AQI

Vikas Sadan, Gurugram - HSPCB
Prominent Pollutant is **OZONE**
On **Wednesday, 24 May 2023 04:00 PM**

Pollutant	Timeline	Avg	Min	Max
PM2.5		-	-	-
NO2		51	36	74
SO2		-	-	-
CO		63	5	151
OZONE		188	9	188

AQI	Remark	Color Code	Possible Health Impacts
0-50	Good	 	Minimal impact

[List of AQI Stations with Data of above selected Date & Time](#)

National Air Quality Index

Central Pollution Control Board,
Ministry of Environment, Forests and Climate Change

State: Haryana City: Gurugram Station: Vikas Sadan, Gurugram - HSPCB Date: 24/05/2023 Time: 15:00

Poor

254

Vikas Sadan, Gurugram - HSPCB
Prominent Pollutant is **PM2.5**
On **Wednesday, 24 May 2023 12:00 PM**

Pollutant	Timeline	Avg	Min	Max
PM2.5		254	72	471
NO2		51	36	74
SO2		22	15	34
CO		98	7	151
OZONE		38	9	151

Poor

259

Vikas Sadan, Gurugram - HSPCB
Prominent Pollutant is **PM2.5**
On **Wednesday, 24 May 2023 01:00 PM**

AQI	Remark	Color Code	Possible Health Impacts
0-50	Good	 	Minimal impact

[List of AQI Stations with Data of above selected Date & Time](#)

Scope of Study

1. Study the technological interventions and gaps/needs for air pollution control
2. Examine city level action plans of Gurugram (and their alignment with national plans), and assess the strengths and challenges related to the strategies for adopting air pollution control technologies
3. Multi-stakeholder consultations at the city level to discuss the outcomes of 1 and 2, and develop recommendations for strengthening their city action plans for adoption of enabling mechanism for innovative technologies

Proposed Methodology

- Gurugram being in NCR area, significant information like GRAP is available.
- Reference Framework: Desk Research
- Technical Consultations: focussed group discussions with experts in the field
- Stakeholders consultation: major stakeholders would be identified and the draft outcomes would be presented before them

Reference Framework

- City specific action plan for Gurugram (not available)
- GRAP and NCAP
- EPCA and CPCB documents, reports and statutory orders
- Area air quality actions plans, international experience from World Bank and ADB
- HSPCB documents including directions and studies
- Research papers, mainly from IITs, NEERI and DST

General Structure of Action Plan

- Particulate is pollutant of concern
- Actions are broadly at three levels
 - National Level mainly policy initiatives like;
 - monitoring programs,
 - overall action plan design,
 - policy formulation like fuel, e-vehicle, scrapping,
 - emission standards, industry, automobiles
 - State level;
 - coordination with national and local levels
 - enforcement and compliance
 - Local Level: mainly execution, monitoring and evaluation including;
 - Regional plans,
 - parking policy,
 - public transport,
 - awareness and participation (AOR)

5/25/2023 Funds are coming from National Level and regular budgets of cities

Summary of the action points mentioned in the NCAP clean air plans.

Sector	Action Points
Transport	1. Plying of electric vehicles for public transport and establishment of charging stations for all vehicles 2. Construction of expressways/bypasses/peripheral roads 3. Arrangement of multi-level parking facilities 4. Development of cycle zone 5. Retrofitting of particulate filters in diesel vehicles 6. Use of bio-ethanol 7. Widening of Roads 8. Remote sensor based PUC system
Industry	1. Adoption of zig zag technology in brick kilns 2. Monitoring of Industrial emissions through Online Continuous Emission Monitoring System (OCEMS) 3. Shifting of air pollution industries to conforming zones 4. Installation of web cams and OCEMS in gross polluting
Waste burning	1. Extensive drive against open burning 2. Proper collection of horticultural wasteburning 3. Door to door collection of segregated waste 4. Establishment of compost pits
Construction	1. Control measure for fugitive emissions 2. All construction areas must be covered to avoid dispersion of particulate matter 3. Ensure carriage of construction material in closed/covered vessels.
Residential	1. Engage with concerned authorities on continual basis for maximizing coverage of LPG/PNG for domestic and commercial cooking with target of 100 per cent coverage
Dust	1. Maintaining 33% forest cover 2. Creation of green buffers 3. Maintain potholes free roads 4. Introduce water fountains 5. Wall to Wall pavement 6. Blacktopping of metallic roads

Present Status of Use of Technologies in NCAP India

- The source specific control Measures are mandated under regulatory regime; through emission standards
- The individual sources like bakeries, food joints, crematoriums, etc are considered as area sources, and dealt through policy initiatives like supply of clean fuels
- Area sources like road dust resuspension are dealt through mitigation measures like water spraying, mechanical dust collection systems
- Till now focus on mitigation rather than control at source as area sources dominate and the major sectors like industries, transport are dealt through policies at National level
- Good practices for Solid waste management and Construction-demolition waste management

Source-wise Contribution in NCR Area (including Gurugram)

Sr. No	Sector Source	% Contribution estimated by dispersion modelling		%Contribution estimated by receptor modelling	
		Summer	Winter	Summer	Winter
1	vehicle	14	23	19	16
2	road dust	52	30	32	23
3	biomass	13	14	19	20
4	industries	13	26	24	26
5	others	8	7	6	15

Source: Source Apportionment studies TERI/ARAI 2026

Opportunity for Technology Intervention

- Local sources like bakeries, DG sets,
- Solid waste management- landfills and burning of biomass
- Resuspension of road dust
- Traffic congestion
- Vehicle fleet modernisation: e-vehicles
- Construction works
- demolition waste management

Mechanisms for Particulate Removal

- Sedimentation. Particles settle under gravity to the floor of the chamber.
- Migration of charged particle in an electric field. The particles are charged and then subjected to an electric field. The resulting electrostatic force on the particles causes them to migrate to one of the surfaces of the device, where they are held and collected.
- Inertial deposition. When a gas stream changes direction as it flows around an object in its path, suspended particles tend to keep moving in their original direction due to their inertia.
- Brownian diffusion. Particles suspended in a gas are always in Brownian motion. When the gas stream flows around obstacles, the natural random motion of the particles will bring them into contact with the obstacles, where they adhere and are collected. Brownian motion is more pronounced the smaller the particle, the devices based on diffusion as the separation mechanism will be most effective for small particles.

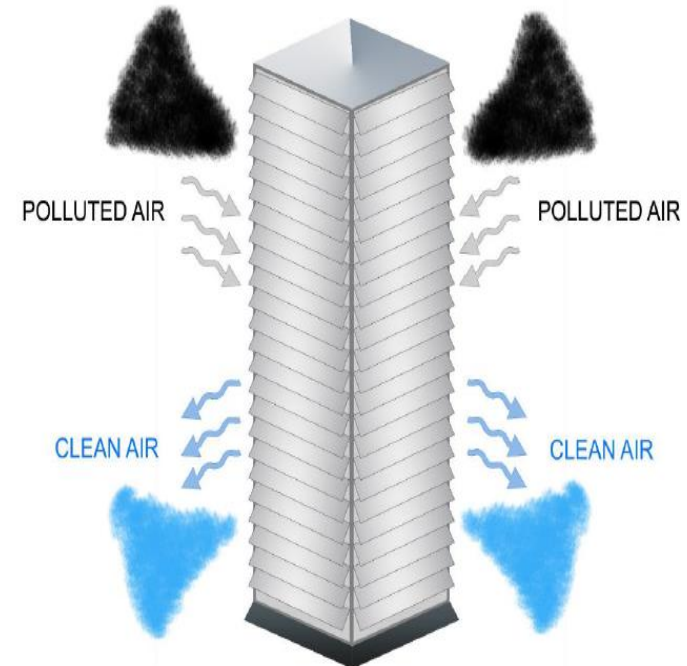
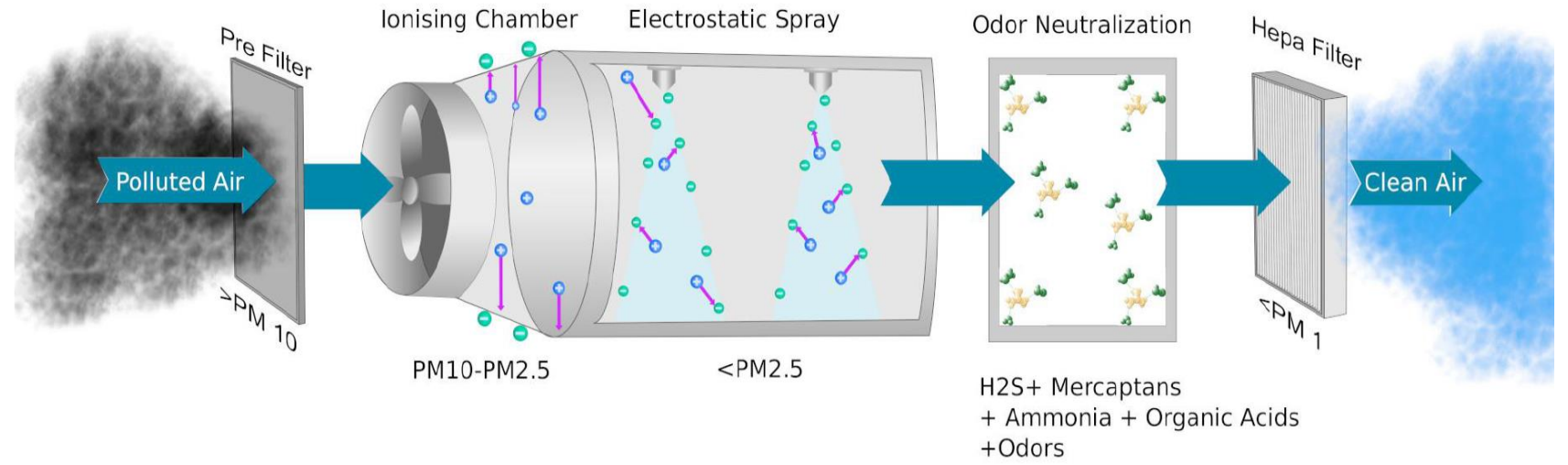
Technology Application in City Air Plan in India

- Road dust resuspension:
 - mechanical road cleaning machines,
 - water spraying machines,
 - Greenery and carpeting
 - fountains
- Construction:
 - Covering of construction and demolition sites,
 - water fogging machines (guidelines notified)

Some Technologies being Tried In Field

Sr. No.	Technology/Product Name
1	Pulsed Wi-Fi based Air Purification system – Lucknow Case Study
2	Positive Ionization based Smog Tower – Delhi Case Study
3	Building Construction Dust Mitigation using Low-Powered Air Filters Road Dust Control using Backpack Mechanized Street Sweepers
4	Filter Based Automatic Air Purification system / Smog Tower
5	Combination of Technology: Street Side Filter based Air Filtration Unit Vehicle Mounted Filter based Air Filtration Unit Ionization based Smog Free Tower
6	Utpavitra - a filter less Anti-Smog Air Purifying Tower
7	Pure-Skies - Pulsed Wi-Fi based Air Purification system
8	Wind Augmentation Purifying Unit -WAYU
9	Combination of Technology: 6 stage ACE+ Air Purification Technology.
10	Truck Mounted Road Washer & Sprinkler System Vehicle Mounted Misting Machine (Mist Cannon) Vehicle mounted detachable Air Purification Unit
11	Chakr Shield - DG Set End Pipe Solution
12	Carbon Cutter Machine - ESP/ catalytic Based
13	Virtual Chimney for traffic junction

Examples





Present Status of Study: Gurugram

- Initial discussions with Nodal agency held
- Literature review completed
- Draft Report of city level action plans of Gurugram (and their alignment with national plans), in 1st week of June
- Draft Report on technologies would also be submitted in 1st week of June
- Need to finalise the local multi-stakeholder consultation soon thereafter for presenting the findings there
- Final report with ppts can be submitted within 15 days thereafter.

Challenges

- Evaluation of the technologies for their efficiency, economy and suitability for local condition
- Technologies can be categorised as source specific and ambient air based (receptor level)
- Identification of hotspots- may be through sensors and then adopt site specific solution
- Assessment of efficiency is a critical aspect; mass of dust removed per unit time
- Its effect on air quality need to be estimated
- Sources outside city limit: need of air shed approach

Literature

- National Clean Air Program of Government of India https://moef.gov.in/wp-content/uploads/2019/05/NCAP_Report.pdf
- A brief Issue Paper prepared by NRDC with CEE in 2020 titled 'Clearing The Air: A Review Of 10 City Plans To Fight Air Pollution In India'
- Ganguly, Tanushree, Kurinj L. Selvaraj, Sarath K. Guttikunda. 2020. "National Clean Air Programme (NCAP) for Indian cities: Review and outlook of clean air action plans." Atmospheric Environment: X, Vol 8 . <https://doi.org/10.1016/j.aeaoa.2020.100096>
- CPCB draft guidelines on Conceptual Guidelines And Common Methodology For Air Quality Monitoring, Emission Inventory & Source Apportionment Studies For Indian Cities <https://cpcb.nic.in/displaypdf.php?id=c291cmNIYXBwb3J0aW9ubWVudHN0dWRpZXMucGRm>
- Catalogue: Indian Emission Inventory Reports, January 2022, The Energy And Resources Institute and Environmental Defense Fund, <https://www.teriin.org/sites/default/files/files/Indian-Emission-Inventory-Report.pdf>
- Source Apportionment of PM2.5 & PM10 of Delhi NCR for Identification of Major Sources' report prepared by ARAI and TERI, Report No. ARAI/16-17/DHI-SA-NCR/Final Report