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ISSUE BRIEF

CLEARING THE AIR: A REVIEW OF 10 CITY PLANS TO FIGHT AIR POLLUTION IN INDIA

Executive Summary

Air pollution is a major global public health risk in cities across the world. It is one of the highest-ranking environmental health challenges in the world, especially in developing countries like India.[1] While New Delhi is often featured on the news for its dangerous air pollution, poor air quality extends far beyond the capital city.[2]

To improve long-term air quality, the Indian Government launched the National Clean Air Programme (NCAP) in early 2019.[3] The NCAP provides a roadmap to prevent, control, and abate air pollution with specific targets.[4] It requires states and cities to take urgent action to reduce outdoor (ambient) concentrations of harmful particulate matter (PM). Under the NCAP, India's cities that do not meet its National Ambient Air Quality Standards (NAAQS)[5] have created city-level Clean Air Plans (CAPs) to plan and implement mitigation measures aimed to reduce ambient PM concentrations. For example, city actions include expanding electric mobility, solid waste controls, enhanced air pollution monitoring, and regulating industries. These city-level plans aim to work in close consultation with broader national interventions that have crucial implications for the sources of emissions in cities.

More than 100 cities across India have developed CAPs. The CAPs vary dramatically in terms of proposed mitigation actions and much can be learned from city-to-city experiences. To strengthen city efforts, this issue brief provides analysis of the 10 CAPs for major cities under the NCAP and presents findings for three key emissions sectors: transportation; stationary sources; and waste, construction, and diesel generator use. The second part of the issue brief highlights learnings from international experiences aimed at reducing air pollution.

Credit - NRDC

AIR POLLUTION IS A MAJOR HEALTH CHALLENGE FOR INDIA'S CITIES.

I. OVERVIEW OF NATIONAL CLEAN AIR PROGRAMME (NCAP)

In many Indian cities, air pollution levels regularly exceed "very poor" and "severe" on the Air Quality Index (AQI)[6]. A 2018 Lancet Commission study found that outdoor (ambient) air pollution causes a staggering 670,000 deaths each year in India.[7] Air pollution has serious implications on health and morbidity of exposed populations, including both chronic and acute implications.

In January 2019, the Indian Government launched the National Clean Air Programme (NCAP). The plan aims to reduce national levels of particle air pollution ($PM_{2.5}$, PM_{10}) by 20-30% by 2024 compared to 2017 levels. NCAP targets 122 non-attainment cities, as identified by the Central Pollution Control Board (CPCB).

NCAP is a mid-term, five-year action plan with a funding of INR 300 crore/USD 42.6 million for the first two years.[8] The program underlines need for close collaboration and cross-sectoral coordination among central ministries, state governments and local bodies. NCAP builds upon India's international commitments for climate change, and integrates with five existing missions of the Indian Central Government: National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Mission for a Green India, and National Mission for Sustainable Agriculture.

II. PRIORITIZED CITIES FOR ANALYSIS

To determine the 10 cities for analysis, more than 90 of the publicly available CAPs for non-attainment cities under the NCAP were reviewed.[9] From these, ten large metropolitan cities were analyzed in detail. *The ten cities are Ahmedabad, Hyderabad, Kanpur, Kolkata, Mumbai, Nagpur, New Delhi, Patna, Pune, and Surat.*

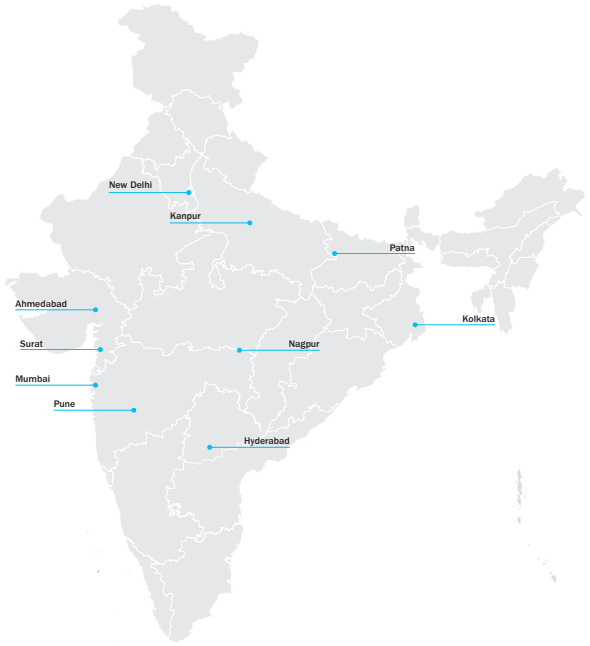
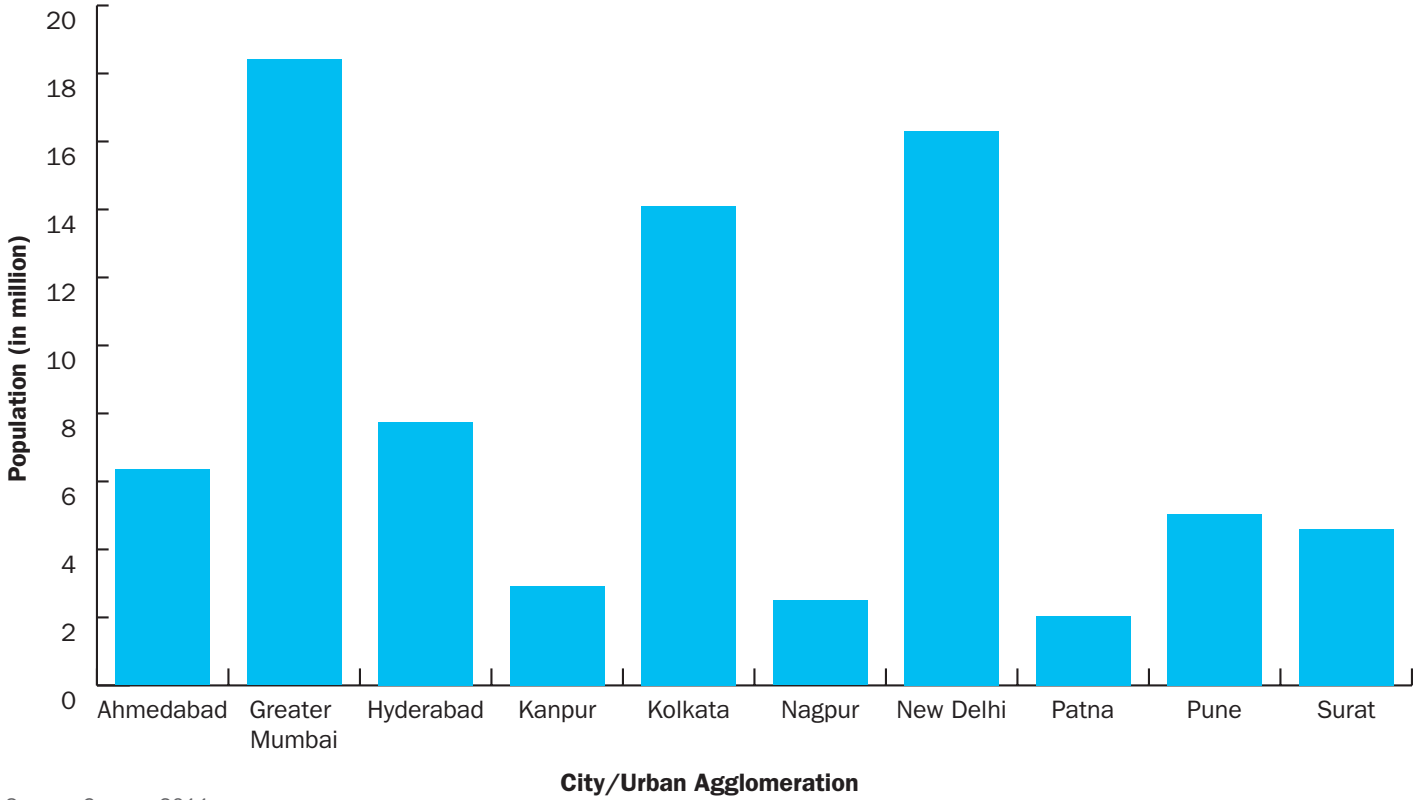


FIGURE 1: CITIES INCLUDED IN NRDC'S ANALYSIS

FIGURE 2: POPULATION OF CITIES INCLUDED IN NRDC ANALYSIS



Source: Census 2011

Selection criteria for the 10 cities included: city inclusion in the NCAP, an approved CAP, large population (above 2 million) as per census information, geographic and climatic conditions representative of India's varied geography, and representative work done by key civil society organizations.

Air Information and Response (AIR) Plans in Ahmedabad and Pune

2018 LAUNCH OF AHMEDABAD AIR PLAN HEALTH RISK COMMUNICATION MATERIALS (CREDIT: NRDC, 2018)

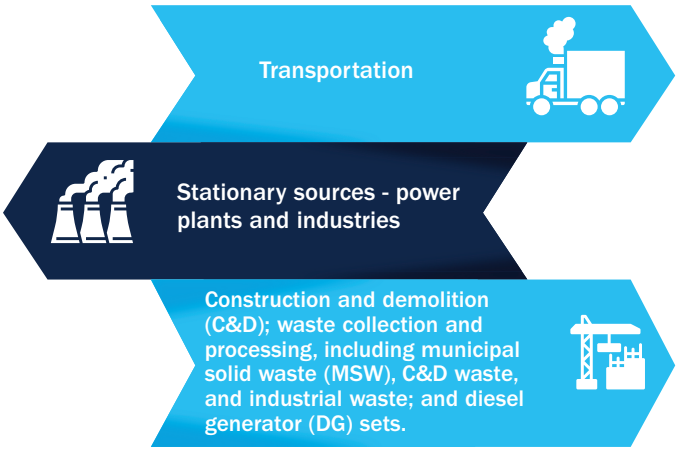
In 2017, Ahmedabad launched an air pollution monitoring and risk communication project, the Air Information and Response (AIR) Plan. The centerpiece of the plan is the AQI developed by IITM-SAFAR relaying information from 10 continuous air monitoring stations. This data helps people avoid harmful exposures, in tandem with city-led health risk communications and longer-term policy strategies achieve cleaner air. Ahmedabad is among the first cities in India where city leaders, state government, and civil society worked proactively together to address the country's air pollution challenge with a focus on public health.

Since 2019, Pune is also working on developing a health risk communication-focused AIR Plan and broader strategies, including a mitigation-focused Clean Air Programme (CAP). In terms of guiding principles for the recommendations, strong partnerships and community stakeholder engagement are critical to successful implementation. Through the AIR Plans in Ahmedabad and Pune, NRDC and its partners continue to work on creating a sustained movement towards reducing health risks from air pollution, and improving air quality in these cities

OCTOBER 2019 ROUNDTABLE IN PUNE TO LAUNCH AN ISSUE BRIEF ON PUNE'S AIR PLAN (CREDIT: IITM, 2019)

METHODOLOGY

The methodology included analysis of CAP documents for ongoing and planned sector-specific mitigation actions for each of the 10 cities, with a specific focus on three key emissions sectors. Key sectors include:



As a common minimum, national level actions uniformly implemented have been discounted from each city's action plan. For example, India is implementing stringent fuel and vehicular emission standards nationally, leapfrogging from the existing Bharat Stage (BS) IV to BS VI by April 1, 2020. The introduction of improved vehicular emission standards and low Sulphur fuel standards will reduce emissions from all new vehicles. Additionally, while there are nationally established emission standards for power plants and industries, compliance and installation of emission control technology depends on state and city-level authorities, thus determining the rate of emissions reduction from local sources.

The analysis helped to identify a common set of mitigation measures aimed at reducing emissions from key emission sources, highlight common strategies for achieving pollution reduction goals, and present ways to further strengthen city efforts. Based on our preliminary review of international air management plans, sector-specific intervention details should include: the sector of intervention, specific air pollution control plan or planned intervention, expected air quality impact, degree of technical feasibility, costs and expected benefits, implementation period, proposed deadline for implementation, and identification of responsible agencies for implementation, as well as capacity building within these agencies to implement successful strategies.

It should be noted that the CAPs were analyzed as standalone, self-contained plans. The plans were taken to be comprehensive and representative of the city's efforts to improve its air quality. Any steps taken by the city outside of the stated plans have not been considered

in this analysis. In several cities, there are ongoing and proposed air pollution control actions that are outside the scope of the CAPs. However, given the need for interagency coordination, as well as the monitoring and enforcement of regulatory compliance, such standalone efforts have had limited impact in the past. It must also be noted that the NCAP requires that review committees be set up in each city, which could help in improvement of the effectiveness of CAPs, but that whether or not such committees have been effectively functioning in the selected cities is outside the scope of this paper.

The preliminary analysis discussed in this report was discussed during stakeholder workshops and meetings in New Delhi, Ahmedabad, Pune, and elsewhere.

III. AIR QUALITY MONITORING IN INDIA – AN OVERVIEW

The Government of India has been rapidly increasing its network of air quality monitoring stations to be able to more accurately assess the levels of air pollution across states. The NCAP includes increasing the number of monitoring stations in the country, including rural monitoring stations, technology support, emphasis on awareness and capacity building initiatives, setting up of certification agencies for monitoring equipment, and source apportionment studies.[10]

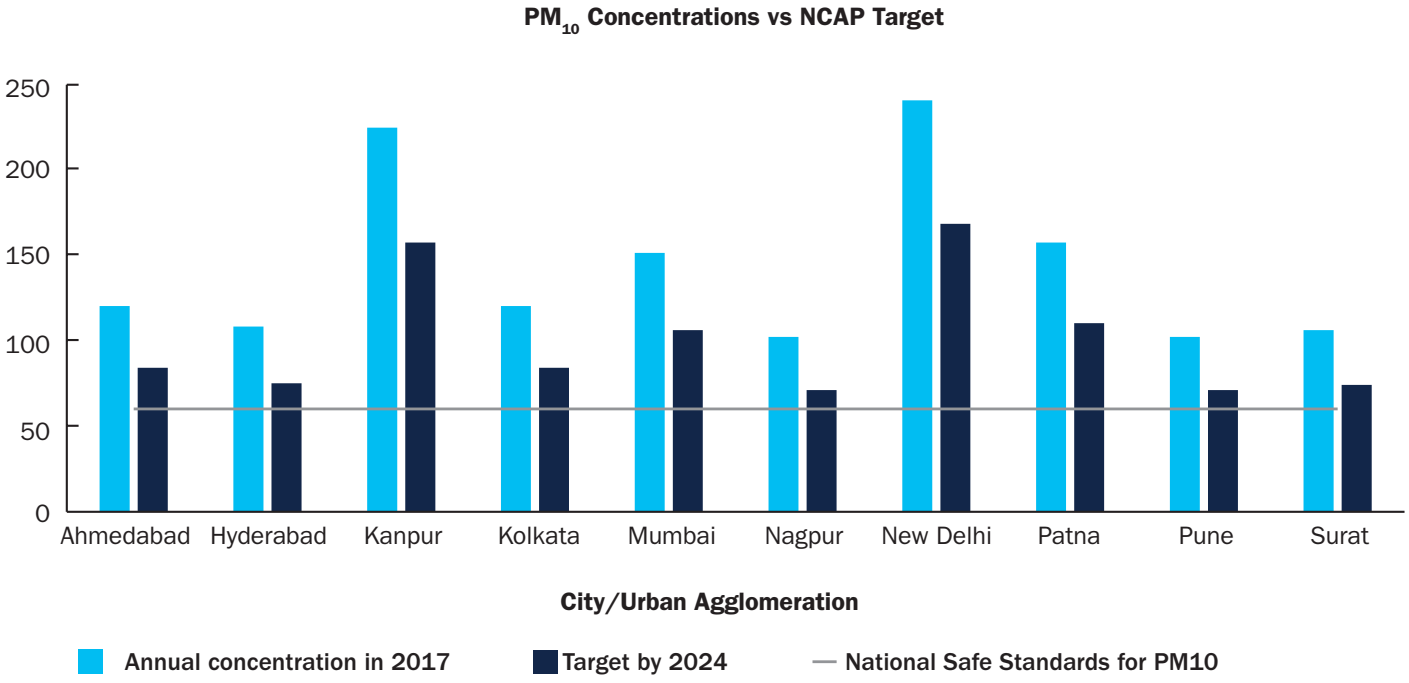
India has approximately 800 total monitoring stations, 200 of which are continuous real time monitoring stations (CAAQMS)[11]. A mere five percent of cities and towns (339 out of 6,166) are monitored, and less than one percent (only 60 out of 6,166) of cities have CAAQMS.[12] Additionally, almost 25% of CAAQMS are concentrated within the National Capital Region (NCR). The other (non-CAAQMS) monitoring stations are manual, and do not allow for daily reporting of real time air quality data. As many rural areas have not yet been covered under the National Air Quality Monitoring Programme (NAMP) it is proposed to expand the monitoring network.

Under the NCAP, there is a process of identifying and developing/validating alternative cost-effective technology for source and ambient air quality monitoring. Parallel efforts are ongoing at the central level to develop a protocol for the integration of a network of sensor-based monitors to maximize granularity of air quality data. Satellite-based monitoring, when combined with verification from ground-based monitoring stations, has the potential to be the most cost-effective method.

IV. TRANSPORTATION SECTOR

In 2018, India was the fourth-largest market in the world for vehicle sales by volume.[13] Automobile sales in India between April 2018 and March 2019, including passenger and commercial vehicles, three-wheelers, and two-wheelers, totaled around 26.3 million. At the national level, transportation contributes four percent of $PM_{2.5}$ emissions, however, emissions are concentrated in urban centers.[14] For example, in Delhi, vehicle exhaust contributes up to 40% of the ambient $PM_{2.5}$ pollution.[15]

FIGURE 3: PM10 CONCENTRATIONS (ANNUAL AVERAGE, IN µg/M³) VS NCAP TARGET



Source: CarbonCopy analysis of NCAP Targets (https://ncap.carboncopy.info/)

City-level actions highlighted in the CAPs to mitigate pollution from the transportation sector include (presented by city in Table 1):

- Restrictions on older vehicles
- Increased infrastructure for compressed natural gas (CNG) and electric mobility
- Cleaner fleets for public transport, transportation network company (TNC's), and 1st/last mile connectivity using electric vehicles (EVs) or cleaner fuel, such as CNG
- In-use vehicles emissions control, including installation of remote sensor-based system pollution under check (PUC)
- Implementing intelligent traffic management systems
- Increased vehicle demand management, including parking policies, walking and non-motorized transport (NMT), and fiscal measures

FINDINGS FOR THE TRANSPORTATION SECTOR

The CAPs analyzed cover an extensive list of actions for mitigation of air pollution from the transport sector; there are however, certain gaps observed which need to be strengthened. These include:

1. PHASING OUT OLDER VEHICLES

a. While all CAPs include action points to remove older vehicles which adhere to older, less stringent emission standards, there is a lack of uniformity in criteria for defining "older" vehicles. For example, while Delhi has restrictions on 10-year-old petrol vehicles and 15-year-old diesel vehicles, Kolkata includes the restriction only for commercial vehicles older than 15 years. There is also a lack of effective monitoring and enforcement mechanisms to ensure that older vehicles are identified and removed from the roads.

Table 1: Mitigation actions identified in city CAPs for the transport sector

Transportation										
Action	Ahmedabad	Pune	Delhi	Hyderabad	Kanpur	Nagpur	Patna	Surat	Kolkata	Mumbai
Restriction on older vehicles	Yes (Partial)	Yes (Partial)	Yes	Yes (Partial)	No	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)
Infrastructure for CNG and e-mobility	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cleaner Fleets for public transport, TNC's and 1st/last mile connectivity using clean fuel – CNG and EVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In-use emission control, including installation of remote sensor-based PUC system	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Intelligent traffic management systems	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Vehicle demand management - parking policy, walking & NMT, and fiscal measures	Yes	Yes	Yes	No	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes	Yes	Yes

Table source: NRDC analysis (2020)

Credit: NRDC, 2017

VEHICULAR EMISSIONS CONTINUE TO BE ONE OF THE LARGEST SOURCES OF PARTICULATE MATTER

b. The large inventory of more polluting BSIII and older vehicles in most cities need to be not just removed from the cities, but from operation all together. For instance, many older vehicles in Delhi have been re-sold and continue to operate in surrounding rural areas. There is thus a need for policies and mechanisms to ensure these are taken off the road. The proposed End-of-Life Vehicle (ELV) Policy is an example of one such mechanism.

2. PRIORITIZING PUBLIC TRANSPORT

a. Although all CAPs include action points to prioritize public transport, the focus is on developing greenfield capital-intensive public transport infrastructure such as MRTS – Metro, Monorail and/or BRTS, which require significant financial outlay that is often lacking.

b. Action points for improving service provision of existing public transport modes, i.e. buses and intermediate para transit (taxis, autorickshaws) is limited to augmenting fleet sizes, and most CAPs do not have a roadmap for prioritizing road based public infrastructure to support public transportation.

c. Most CAPs include action points to augment the size of public transport fleets, investments for vehicles and infrastructure are in many cases, split between diesel, natural gas and electricity. This diversion of public funds between different fuel types also affects the operations of public transport fleets. However, it must be noted that many of the analyzed cities have announced plans to augment their electric vehicle fleets, especially buses, taxis and e-rickshaws, alongside other fuel modes, and efforts are underway outside of the CAPs to electrify vehicles.

d. CAP action points for public transport treat each mode independently, without ensuring seamless transition between metro, buses and other modes. The absence of a central regulator that coordinates public transport across various modes is a barrier to a better performing public transit network.

3. CITY AND TOWN PLANNING

a. Very few cities have addressed the need for integration of transit lines into city planning, and the role of land-use regulation in controlling vehicular emissions. This includes planning for a network of pavements and cycle tracks to promote non-motorized transportation.

4. CLEANER VEHICLES

a. While Bharat Emission Standards regulate emissions from new vehicles, for reducing emissions from

existing vehicles operating on the roads, most CAPs include action points to augment the PUC network to strengthen the check on vehicle fitness and maintenance. However, the PUC system currently suffers from serious shortcomings[16], and stringent monitoring & enforcement mechanisms are needed, such as the 2018 Ministry of Road Transport and Highways (MoRTH) notifications for PUC reform, which include linking to centralized servers, linking PUCs to insurance, and up-linking with the VAHAN database. Implementation of these can potentially identify the worst polluting vehicles and reduce emissions.

b. Most CAPs include action points for installation of remote sensor-based PUC checks, which was aimed at eliminating manual checks for vehicle emissions (PUC tests), which are prone to manipulation. However, there is a need for a unified approach in the potential use cases and benefits of remote sensing technology. A clear roadmap for this is needed, along with a stringent monitoring mechanism.

c. While multiple states in India either already have operational EV policies, or have announced draft policies, individual cities have yet to include electrification of vehicles, especially those that are privately owned, as part of their CAPs. For rapid adoption of cleaner electric vehicle technology, conducive policies are needed at the National, State and Local (city) level simultaneously.

5. DISINCENTIVIZING PRIVATE VEHICLES

a. While all CAPs contain action points to ease vehicular congestion, there are little to no restrictions on the growth of the city's vehicular fleet. Private vehicular ownership and parking constraints require a demand regulation approach, as opposed to demand management. For example, many cities discuss additional parking spaces to meet the demand, rather than recognizing parking as a major cause of congestion.

b. Apart from Delhi, no other city's CAP contains action points which use fiscal instruments to restrict the operation of polluting and inefficient vehicles. For instance, The Environmental Compensatory Charge (ECC) in Delhi is a "feebate" mechanism, which also generates funds for pollution control. Similarly, congestion pricing can be used to reduce vehicular emissions in pollution hotspots.

V. STATIONARY SOURCES – POWER PLANTS AND INDUSTRIES

Coal-fired power plants account for about 60% of India's total electricity production.[17]

Many of India's coal-fired power plants are aging, inefficient, and thus, highly polluting. In the past, state utilities, which own many of India's aging coal power plants, have failed to comply with strict emissions standards.[18] As per a 2016 inventory, the share in national $PM_{2.5}$ emissions are dominated by the industrial and residential combustion sectors, 36% and 39%, respectively.[19] Power plants contribute 4% of $PM_{2.5}$ emissions; however, these may contribute significantly to the pollution levels in the specific zones of influence of the power plants. In Delhi, power plants and industries contribute up to 5% and 15% of the ambient $PM_{2.5}$ pollution, respectively. [20]

City-level actions highlighted in the CAPs to mitigate pollution from the stationary sources include (presented by city in Table 2):

- The regulation and closure of older power plants within 300 km radius of the non-attainment city
- Implementation of the 2015 emission standards for PM, NOX and SOX for thermal power plants (TPPs)
- Mandates, incentives, and siting restrictions for clean fuels
- Conversion of brick kilns to induced draft zig-zag technology
- Implementation of fiscal measures, including an emissions trading scheme (ETS).

Credit: NRDC, 2017

STATIONARY SOURCES, SUCH AS POWER PLANTS AND INDUSTRIAL STACK EMISSIONS WITHIN THE CITY LIMITS CONTRIBUTE HEAVILY TO AIR POLLUTION

Table 2: Mitigation actions identified in city CAPs for the stationary sources

Stationary Sources – Power Plants and Industries										
Action	Ahmedabad	Pune	Delhi	Hyderabad	Kanpur	Nagpur	Patna	Surat	Kolkata	Mumbai
Regulation and closure of power plants within 300 km radius	No	No	Yes (Partial)	No	No	No	No	No	No	Yes (Partial)
Implementation of 2015 emission standards for PM, NOX and SOX for TPPs	No	No	No	No	No	No	No	No	No	Yes (Partial)
Clean Fuels - mandates, incentives and siting restrictions	No	No	Yes	Yes (Partial)	No	Yes (Partial)	Yes (Partial)	No	Yes (Partial)	Yes (Partial)
Conversion of brick kilns to induced draft zig-zag technology	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No
Fiscal measures, including ETS schemes	No	No	No	No	No	No	No	Yes	No	No

Table source: NRDC analysis (2020)

FINDINGS FOR STATIONARY SOURCES

1. POWER PLANT EMISSIONS

a. Most CAPs do not contain any action points to address emissions from power plants located in in the city limits/local airsheds. Only two cities, Mumbai and Delhi, directly address emissions from power plants.

b. There is a need to develop a stringent monitoring & enforcement mechanism for implementation of the 2015 emission standards for power plants, which are required to be met by law but are currently unimplemented.

2. BRICK KILN EMISSIONS

a. Most CAPs include action points for controlling emissions from brick kilns. However, given the under-regulated and informal nature of most kilns, there is a need for a robust mechanism to monitor the implementation and compliance across cities. For example, in the NCR region, conversion to cleaner Zig-Zag kiln designs are mandatory and need to be approved by the state pollution control boards for the kilns to be allowed to operate.

3. INDUSTRIAL EMISSIONS

a. Most CAPs do not contain any action points to actively reduce industrial emissions from units situated within the city limits/local airsheds. A uniform policy is needed for industrial siting, based on the prevalent pollution levels in a city and on meteorological conditions. For example, Delhi has disallowed all industries classified as potentially most polluting (Red Category[21]) from operating within the city limits.

b. There is a need to develop a stringent monitoring & enforcement mechanism for implementation of the 2018 emission standards for SOx and NOx from industries. These are currently not included in any of the analyzed CAPs.

c. None of the CAPs apart from Delhi contain action points to regulate the fuels used in industrial and commercial activities. In all 10 cities, a large number of small and under-regulated industrial and commercial units exist, which require supply-side regulations, such as restrictions on permissible fuels for residential, commercial, and industrial use. Delhi has issued notification for a list of approved fuels[22], which would eliminate the availability of many dirty and polluting fuels from the city.

VI. SOLID WASTE, CONSTRUCTION & DEMOLITION (C&D), AND DIESEL GENERATOR (DG) SETS

In Delhi, soil and road dust contributes up to 20% of the ambient $PM_{2.5}$ pollution, and diesel generators contribute up to 10%[23]. IIT Kanpur reports that for Delhi, dust is a major contributor of air pollution specifically in the summer, contributing up to 50% for PM_{10}.[24]

Overall, DG sets contribute to 7-18% to the ambient air pollution in non-attainment cities.

City-level actions highlighted in the CAPs to mitigate pollution from the solid waste, C&D and DG sets sources include (presented by city in Table 3):

- Scientific management of landfill sites and complete implementation of the MSW Rules, 2016, to comprehensively address emissions from domestic waste.
- Limiting the use of DG sets to restrict emissions
- Recycling of C&D waste
- Control of C&D dust from construction hotspots.

Table 3: Mitigation actions identified in city CAPS for solid waste, C&D and DG sets

Solid Waste, Construction & Demolition, and Diesel Generator Sets										
Action	Ahmedabad	Pune	Delhi	Hyderabad	Kanpur	Nagpur	Patna	Surat	Kolkata	Mumbai
Scientific management of landfill sites and complete implementation of MSW Rules, 2016	Yes (Partial)	No	Yes (Partial)	No	Yes (Partial)	No	No	Yes (Partial)	Yes (Partial)	Yes (Partial)
Limits on use of DG sets	No	No	Yes	No	No	Yes (Partial)	No	No	Yes (Partial)	No
C&D waste recycling	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)	Yes (Partial)
C&D dust control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table source: NRDC analysis (2020)

FINDINGS FOR SOLID WASTE, CONSTRUCTION & DEMOLITION, AND DG SETS

1. EMISSIONS FROM GARBAGE AND MUNICIPAL SOLID WASTE (MSW)

All the analyzed CAPs contain action points that address emissions arising from garbage burning in landfill sites. However, the inherent flaws of dumping unsegregated waste in landfill sites is not addressed by most CAPs. There is a need to overhaul city level solid waste management practices to ensure source segregation for maximized recycling and processing.

a. Nationally, the government has notified the MSW Management Rules in 2016, which have been implemented in part. There is a need to develop a stringent monitoring & enforcement mechanism for its implementation.

b. Almost all CAPs have included action points for investing in waste to energy (WTE) plants. However, the existing WTE plants in Mumbai, Delhi and elsewhere in the country remain heavily underutilized, and have not been very successful given the unavailability of segregated waste for combustion as fuel. WTEs are not recommended as they divert resources from recycling to combustion, and often have inadequate pollution control equipment, apart from not being appropriate for the typical composition of Indian municipal waste.

c. CAPs don't address biomass emissions from the burning of garden waste, grasses and leaf litter which are generally burnt and there is no mechanism set for its collection and disposal in cities and peri-urban areas. This can also include seasonal sources such as crop residue burning.

2. EMISSIONS FROM DG SETS

a. Only a few of the analyzed CAPs included action points for limiting the emissions from DG sets. Given that electricity supply may be erratic in some cities, there is a need to develop a mechanism to regulate the operation of DG sets, which is a major source of local emissions. For instance, Delhi disallows DG sets during the winter months, when air pollution reaches very poor levels.

3. EMISSIONS FROM CONSTRUCTION AND DEMOLITION ACTIVITIES

a. All the analyzed CAPs contain action points to limit emissions from C&D activities. These include site management, as well as provisions during transport of materials. However, there is a need to develop stringent monitoring & enforcement mechanisms for its implementation, which currently relies on self-reporting and manual monitoring by understaffed regulatory agencies.

b. Nationally, the government has notified the C&D Waste Management Rules in 2016, which have mostly been unimplemented. There is a need to develop a stringent monitoring & enforcement mechanism for its implementation, including the development of recycling facilities.

EMISSIONS FROM GARBAGE LANDFILL SITES AS WELL AS CONSTRUCTION AND DEMOLITION ACTIVITIES CONTRIBUTE SIGNIFICANTLY TO OVERALL PM EMISSIONS

PART 2: RECOMMENDATIONS FROM INTERNATIONAL EXPERIENCE

Based on experiences in international environmental policy, this section outlines policy strategies to consider for reducing air pollution in India.

STRENGTHEN REGULATORY FRAMEWORKS FOR AIR POLLUTION MANAGEMENT:

- Although India's CPCB administers the country's air quality standards, national systems for documenting and reporting air quality data need to be strengthened to adequately protect the public from the health risks posed by air pollution. Access to limited real-time and forecast air quality information is not available in most cities and most directly-monitored air quality data is difficult to obtain or interpret, which stifles efforts to protect residents and inhibits research that could quantify harmful exposures.

STRENGTHEN LEGAL ENFORCEMENT:

- Compliance and enforcement are strengthened through a central responsible party for enforcement implementation and clear and transparent compliance guidelines for private industry.
- To support this effort, additional resources could be dedicated to the Central Pollution Control Board and State Pollution Control Boards to provide adequate staffing, training, and capacity building for state and city air management agencies.

IMPROVE THE SYSTEMATIC COLLECTION OF AIR POLLUTION AND HEALTH DATA:

- Meteorological data from IITM or IMD could be made available online and preferably with air pollution data to enhance impact and understanding among public.
- Small-scale industries are numerous and can represent major local sources of air pollution (e.g., brick kilns, diesel generator sets, etc.). Therefore, it is recommended that emissions from these sources are measured and/or estimated periodically and tracked either through periodic fence-line monitoring or through ambient monitors in industrial zones that are representative of these source emissions impacts.
- Enable more useful research through the creation of national/regional databases and repositories for exposure and biological data. Expand access to technologies for chemical speciation data on emissions to identify emission signatures in more extended urban areas as well as rural areas. These efforts could integrate satellite data and low-cost sensors for unmonitored areas, in order to guide the siting of additional air quality monitors in rural and urban areas.

ROAD, CONGESTION, AND CARBON PRICING AND OTHER ECONOMIC DISINCENTIVES:

- In cases where impediments to promoting the use of public and alternate forms of transport exist, taxes and user road pricing are seen as useful short-term interventions. Disincentives to reduce traffic on congested roads have been shown to be effective in places such as in London, where congestion pricing led to a reduction in CO_2 emissions by 16% and generated over $120 million in revenue.[25]

LOWER SPEED LIMITS:

- Many of the emissions from heavy-duty road freight transport are associated with operational problems related to overloading and exceeding the speed limit.[26] Additionally, more PM is resuspended as road dust at higher speeds for gravel and unpaved roads. Lower speed limits may mitigate both vehicle exhaust and road dust issues, while at the same time improving pedestrian safety. More research needs to be done to consider this as a potential strategy.

ANTI-IDLING AND IDLE REDUCTION POLICIES:

- Idling can produce large amounts of PM and other air pollutants. Some schools in the U.S. have instituted anti-idling or idle reduction policies to reduce the impact of pollution from buses and passenger vehicles near schools.[27] Anti-idling policies can result in large decreases in particle concentrations, particularly at schools operating multiple diesel school buses.

FUEL SWITCHING AND UPGRADING BUS FLEETS:

- Encouraging the switch to a certain type of vehicle is not recommended on a city level, as enforcement would only be confined to city jurisdictions.[28] However, in Delhi, benefits on air quality accrued from switching buses from diesel to compressed natural gas (CNG), though they were later negated by increase in

vehicle population over time, ultimately leading to an increase in particulate matter concentrations.

- In the US, EPA suggests upgrading bus fleets to reduce children's exposure to emissions near schools. Fleet turnover for diesel school buses is low, with buses typically operating for 20 to 30 years. Older buses emit high levels of PM and other air pollutants. Emissions can be reduced by retrofitting older school buses with PM filters or oxidation catalysts or by replacing older buses with newer models, which are 60 times cleaner than buses produced prior to 1990. Emissions may be reduced by using certain alternative fuels, including biodiesel blends, CNG, liquid petroleum gas (LPG), and liquefied natural gas (LNG).

VEHICLE OPERATING AND ACCESS RESTRICTIONS:

Odd-even rules are not recommended in the long run. While at first these rules may lower emissions, they have perverse incentives that increase pollution in the long-term. In Sao Paolo, Brazil, for example, a similar rule banning certain plates during 20% of the week resulted in reductions in peak congestion initially, but then prompted residents to purchase cheap, older vehicles following lower emissions standards to circumvent the rule. In other cases, it led to the increased reliance of taxis instead of public transport. Low-emissions zones and economic disincentives, such as congestion pricing, may be a better option.

Beijing's Battle Against Air Pollution

To improve air quality, Beijing implemented the Clean Air Action Plan between 2013-2017, with the target of reducing $PM_{2.5}$ concentrations by 25% in 2017 from 2012 levels.[29]

The Clean Air Action Plan consisted of eight projects, six safeguard measures, and three public initiatives. The eight pollution reduction projects included source control, energy restructuring, automobile restructuring, industrial structure optimization, end treatment of pollution, urban refined management, ecological environment construction, and heavy air pollution emissions.

Key elements of the Clean Air Action Plan were divided into 84 quantified tasks, involving 42 commissions, offices and bureaus as well as 23 enterprises in Beijing. Beijing continued the Clean Air Action Plan by launching the Blue-Sky Action Plan.

Blue Sky Action Plan measures are:

- Optimize transportation structure, lower mobile source emission
- Stop both pollution and root cause, more meticulous dust control
- Optimize industry structure, promote green production
- Optimize energy structure, clean energy consumption
- Surface pollution control on municipal and agriculture emission
- Fall-winter seasonal pollution control and emergency actions
- Strengthen the leadership of governments
- Build effective regulations, and monitoring and enforcement system, and improve scientific understanding of pollution

ABOUT THE PARTNERS

CENTRE FOR ENVIRONMENT EDUCATION

The Centre for Environment Education (CEE) was established in 1984 as a Centre of Excellence of the Ministry of Environment and Forests, Government of India. As a national institution, CEE's mandate is to promote environmental awareness nationwide. CEE develops innovative programmes and educational material and builds capacity in the field of Education for Sustainable Development. It is committed to ensure that Environmental Education leads to action for sustainable development. It undertakes field projects that demonstrate and validate the role education can play in sustainable development. CEE works with local, state, national and international agencies, organizations and governments in India and in various other countries to help create a sustainable future. ceeindia.org

INDIAN INSTITUTE OF PUBLIC HEALTH-GANDHINAGAR

The Indian Institute of Public Health Gandhinagar (IIPH-G) is India's first Public Health University. IIPHG aims to strengthen the overall health system in the country through education, training, research, and advocacy/policy initiatives. The institute started its operations in July 2008 from with the commencement of its first batch of Post Graduate Diploma in Public Health Management (PGDPHM). IIPHG is India's largest public health university and is the hub for excellence in public health teaching, public health innovation, research and practice. iiphg.edu.in

NATURAL RESOURCES DEFENSE COUNCIL

The Natural Resources Defense Council (NRDC) is an international environmental organization with more than 3 million members and online supporters. Since 1970, our scientists, lawyers and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC works in the United States, China, India, Canada, Latin America, as well as on global initiatives to address climate change, protect nature, and promote healthy people and thriving communities. In India, NRDC works with local partners on transformative solutions to advance clean energy and climate resilience. nrdc.org

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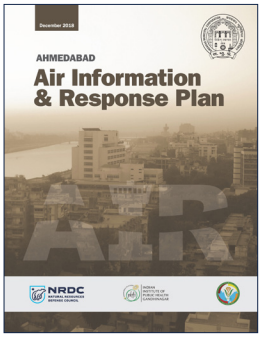

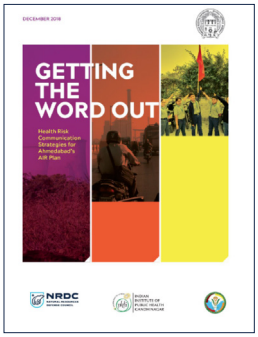

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