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Air Pollution and Mobility: Choking and Grounded

Media Conclave on State of India's Environment

Anil Agarwal Environment Training Centre
February 11-13, 2019

CENTRE FOR SCIENCE AND ENVIRONMENT

ANIL AGARWAL DIALOGUE 2019

ANNUAL MEDIA CONCLAVE
ON THE STATE OF INDIA'S ENVIRONMENT

FEBRUARY 11-13, 2019

Anil Agarwal Environment Training Institute (AAETI)
Nimli, Alwar, Rajasthan

Do we know enough about national air quality?

-- There are 6,166 Census cities and towns. Only 312 cities are monitored – 5%!

-- About 57 cities have continuous real time monitoring stations.

-- Manual stations do not allow daily reporting of real time air quality data and emergency action.

-- Explore sensor based monitoring and satellite monitoring techniques for baseline assessment
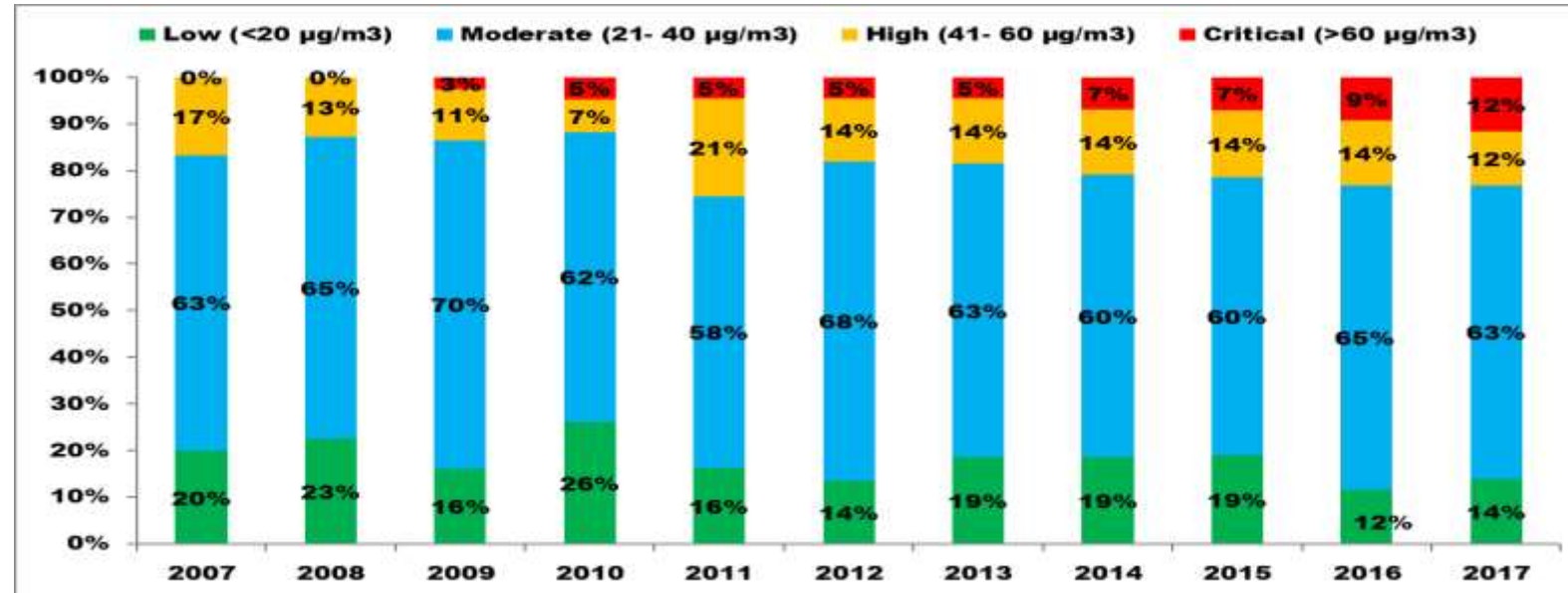
More cities in grip of critical level of PM10
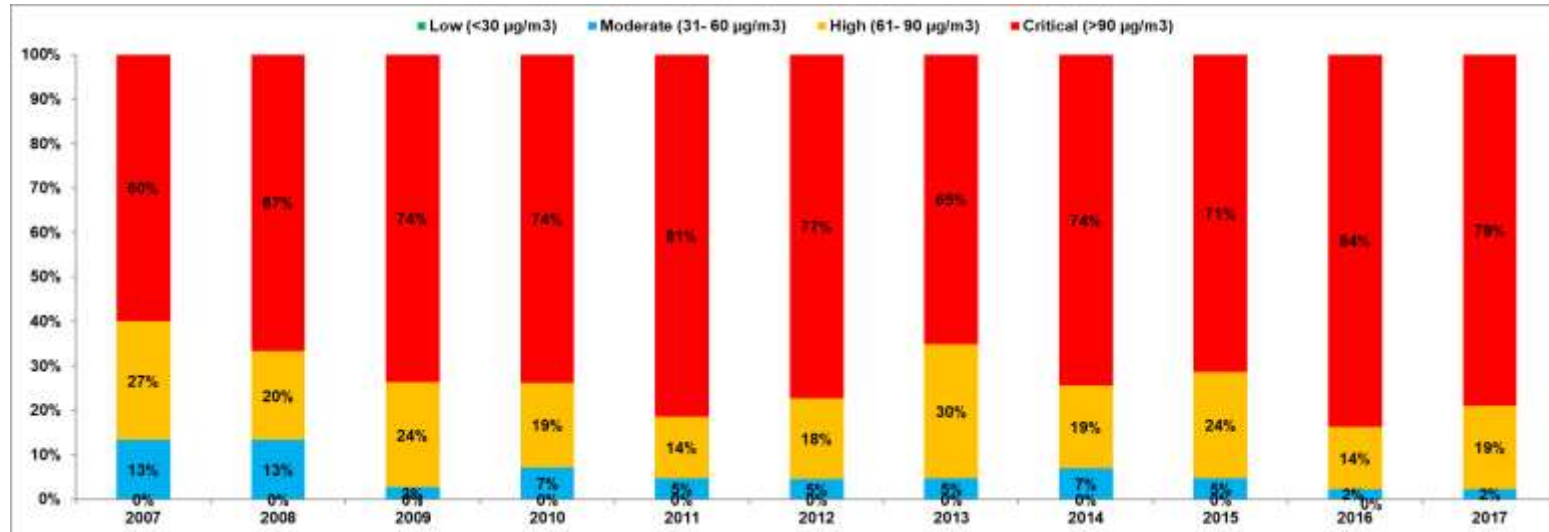
Source: CSE's analysis of CPCB air quality data present on ENVIS centre

- **2007**: Cities with critical level of PM10 (more than 1.5 times the standards) 60%
- **201**7: 79%
- **2007**: 13% cities complying with standard
- **2017**: 2%
- There are no cities in the low pollution category (50% below the standard)

NO2 – an emerging problem

Source: CSE's analysis of CPCB air quality data present on ENVIS centre

- 2007: 17% cities exceeding annual average standards
- 2017: 24% exceeding standards.
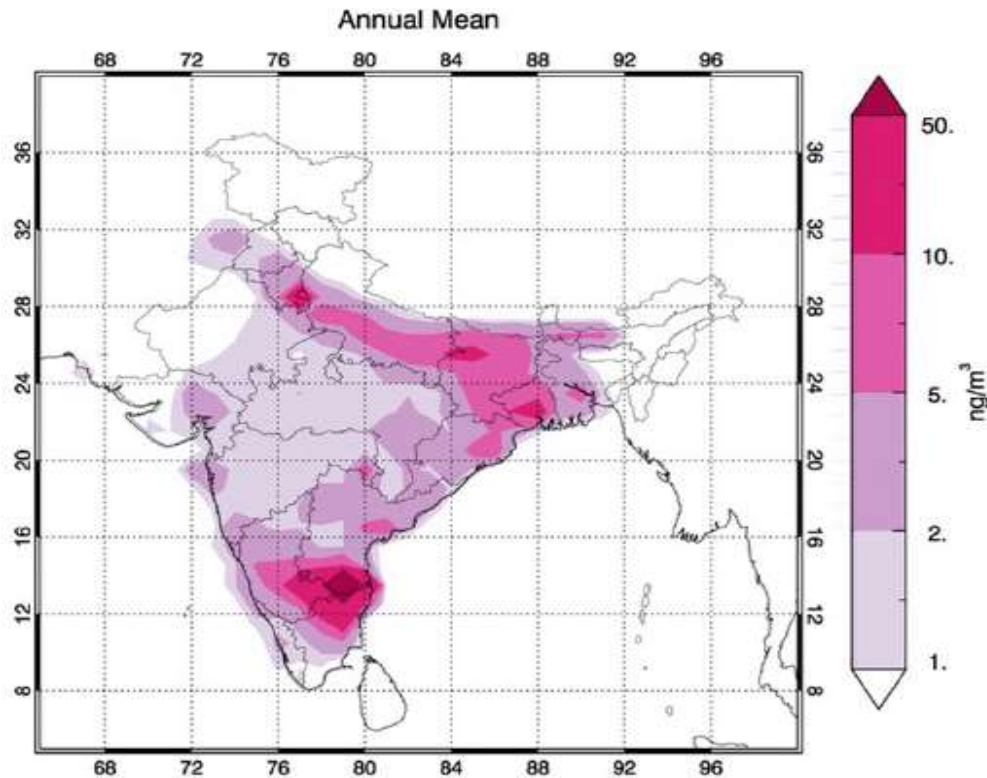- NO2 hotspots – Howrah, KalyanDombivali, Thane, Pune, Pimpri Chinchwad, Navi Mumbai, Meerut, Kolkata, Kanpur, Delhi

Land locked Indo-Gangetic plains most vulnerable
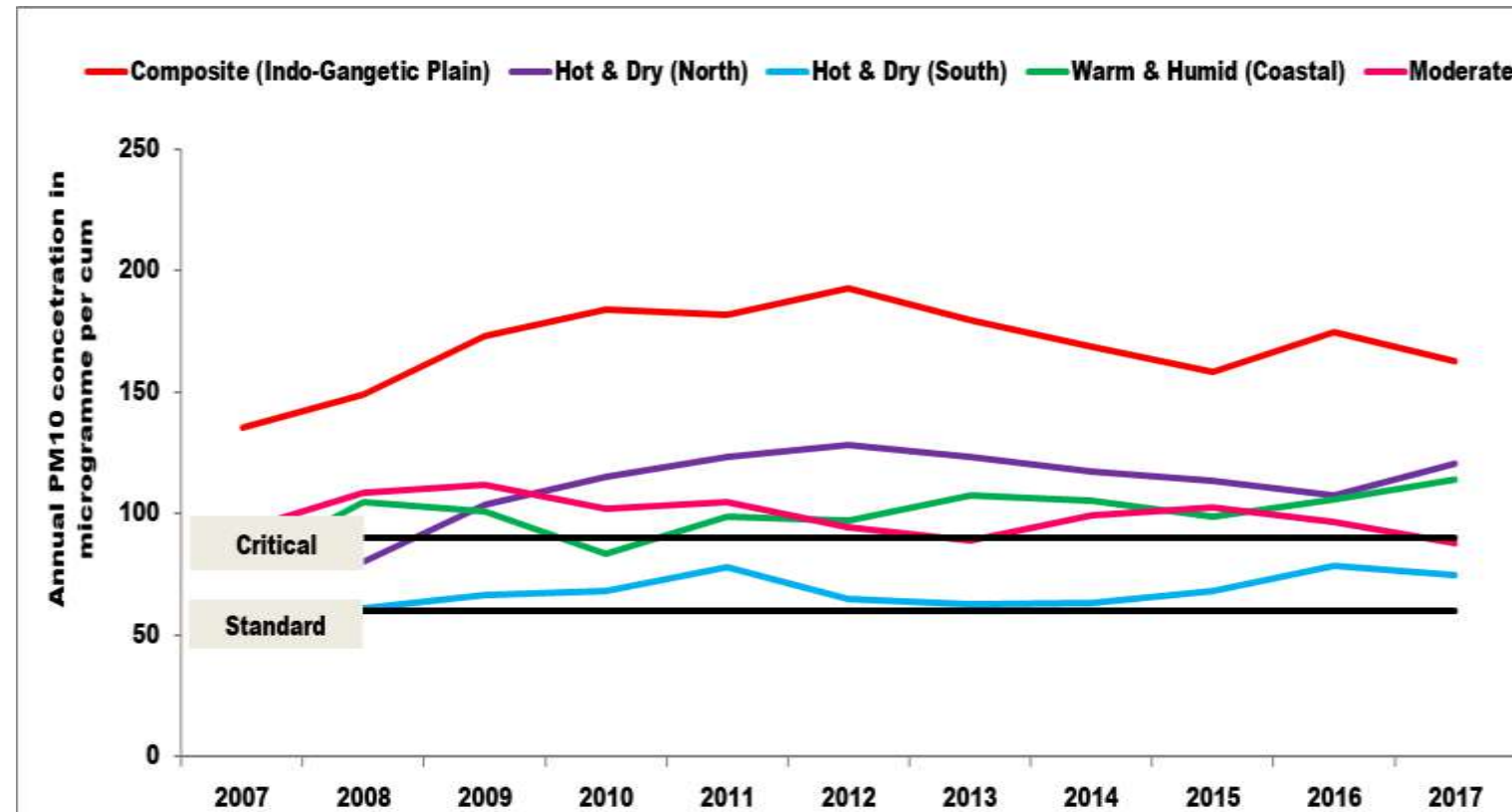
Source: CSE's analysis of CPCB air quality data present on ENVIS centre

Regional Challenge

Annual PM2.5 mean

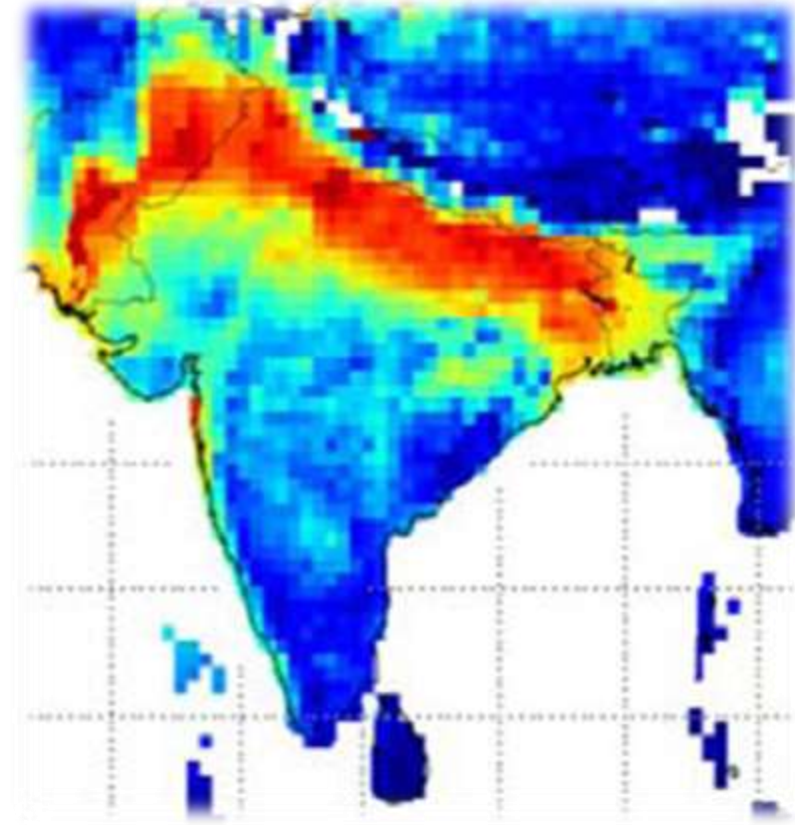**Daily PM2.5 mean**

Source2015, Norwegian Institute for Air Research, International Institute for Applied Systems Analysis, IITM
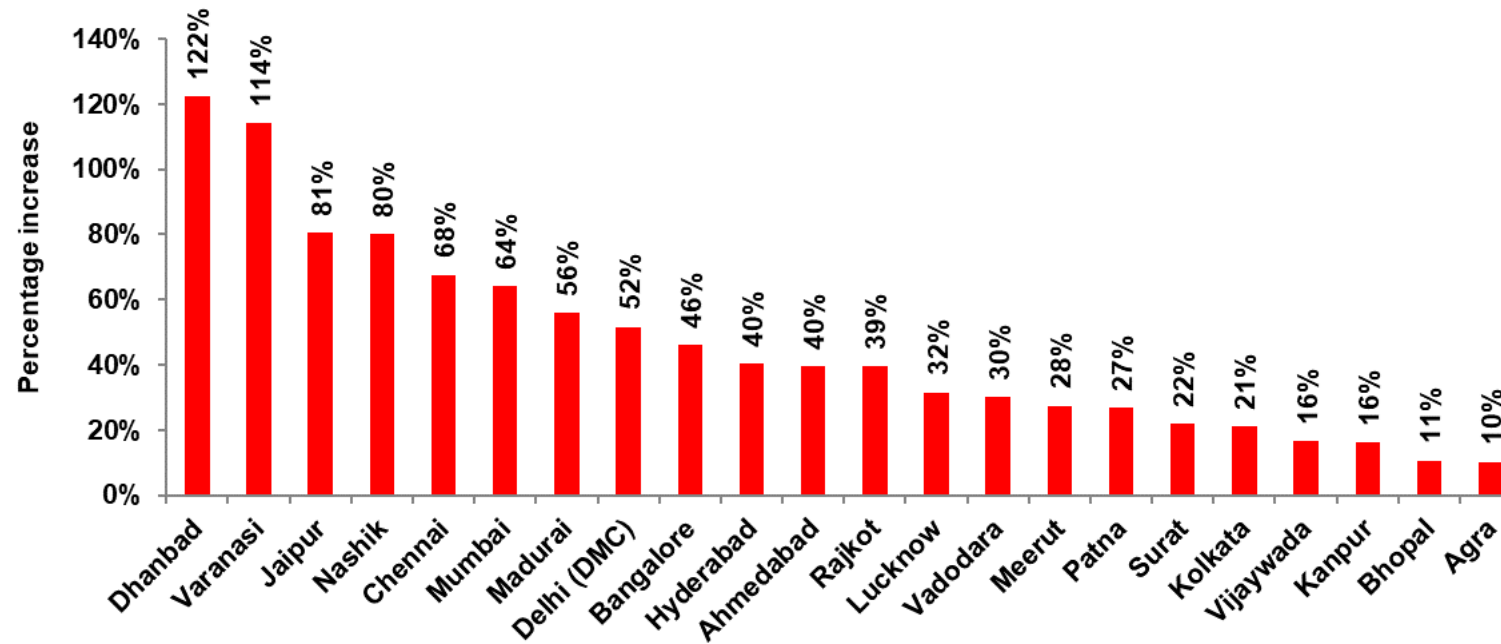
Source: Sagnik Dey 2016, Indian Institute of Technology Delhi,

Cities with rising PM10 trend

Percentage increase in the PM10 concentration levels between 2007 and 2017

Source: CSE's analysis of CPCB air quality data present on ENVIS centre

Stable and Declining Annual Average PM10 trend

Cities with mixed trend:
- Delhi, Chennai, Hyderabad, Bengaluru and smaller cities like Surat, Pune, Thane etc

Cities with stable but high trends:
- Mumbai, Nagpur, Ahmedabad, Faridabad, Kanpur, Kolkata and Jodhpur.

Cities with declining trend:
- Amritsar, Coimbatore, Gwalior, Howrah, Indore, Jabalpur, Ludhiana, Raipur and Vishakhapatnam.

- Need riders. Often a reflection of changes in location of monitoring stations. Also monitors being used for reporting data.

Difficult to explain trends in most cities

Reduction target to meet PM10 standard

NCAP target: 20-30% by 2024
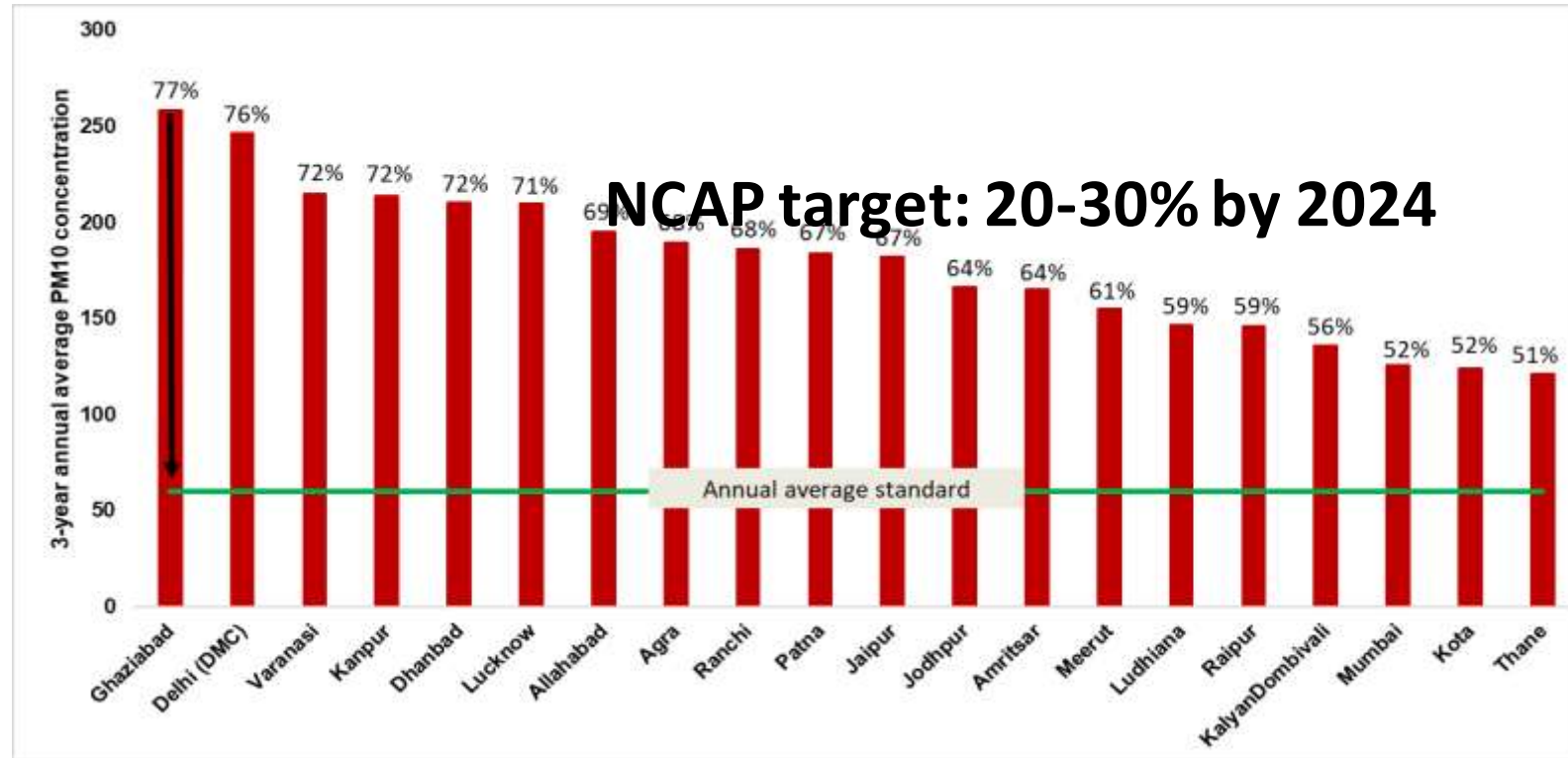
Source: CSE's analysis of CPCB air quality data present on ENVIS centre

Reduction target to meet PM10 standards

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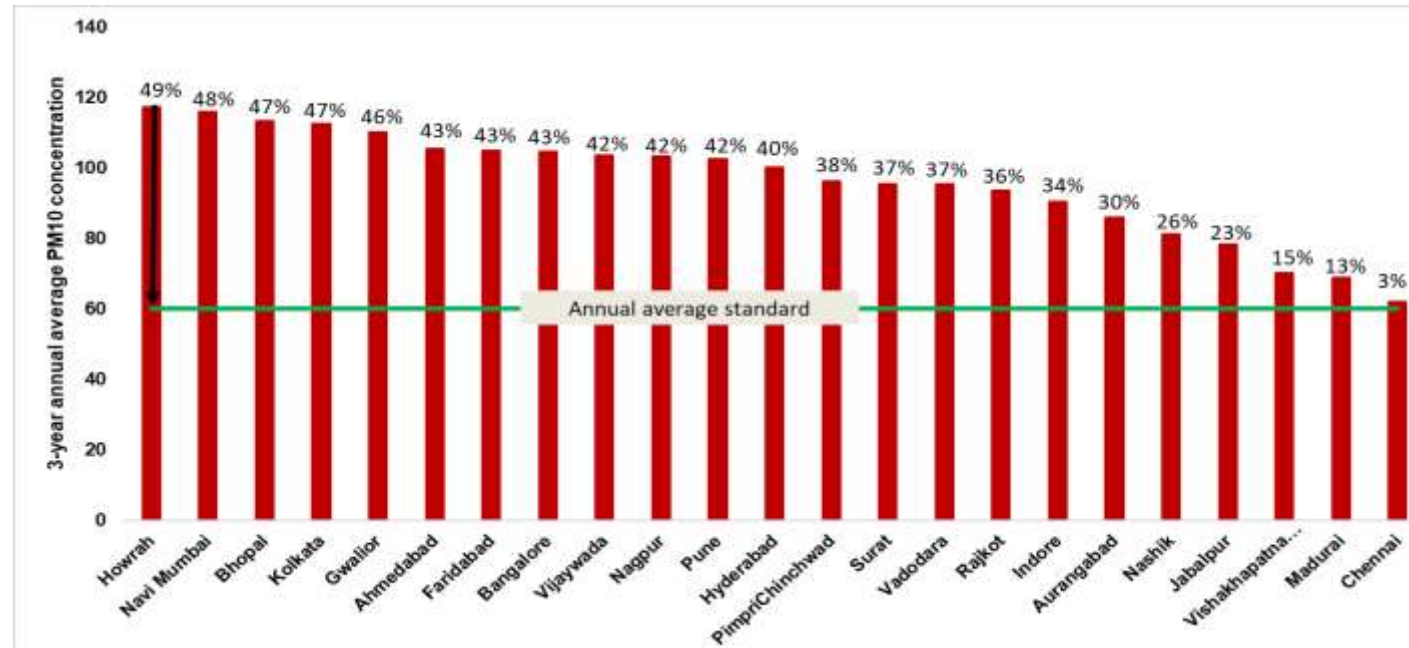
Source: CSE's analysis of CPCB air quality data present on ENVIS centre

Health Emergency…

- **A 2018 Lancet report:** Close to 1.24 million premature deaths in India due to air pollution related diseases. India has disproportionately high burden of chronic respiratory diseases.

- **WHO 2017:** India records highest premature deaths of children under five years due to toxic air. 98% are breathing unsafe air that exceed WHO guidelines

- **2017: IHME-ICMR-PHFI study**: Outdoor air pollution caused 6.4% of India's total life years lost due to illness and premature deaths and 4.8% due to household pollution.

- **The Lancet Planetary Health 2018:** PM2.5 linked diabetes high in India (600,000 premature deaths).

- **Journal of Pediatrics 2017**: Children in polluted environment growing up with smaller lungs

Air Pollution high risk factor in Indian states (1990 vs 2016)
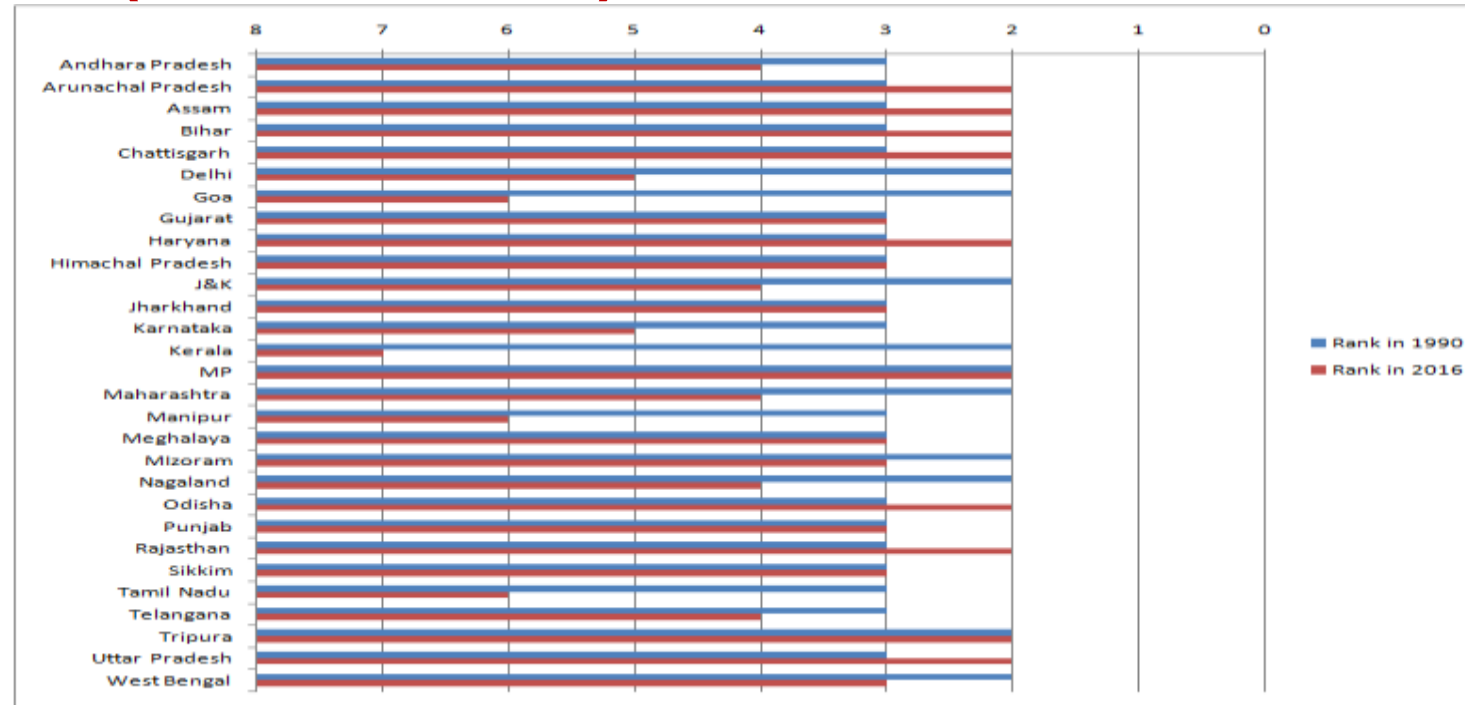
Source: India's Health of Nation's States Report, 2017: IHME-ICMR

Be warned …. Most of the health effects occur at lower annual average levels

Integrated Exposure-Response function for Ischemic Heart Disease
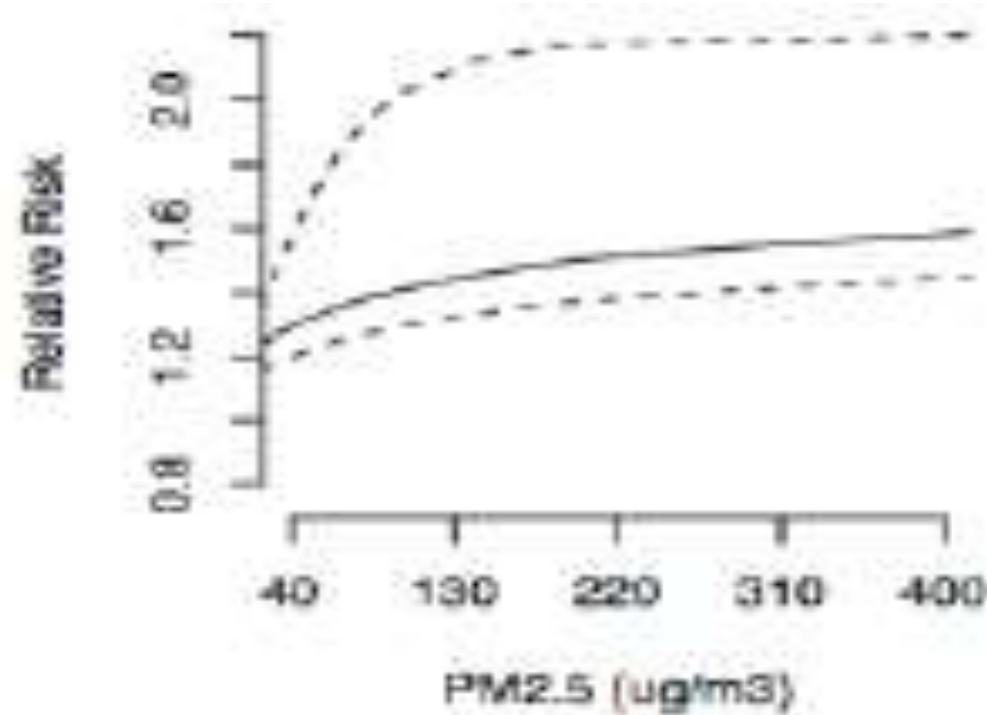
National Clean Air Programme

How can cities achieve 20-30% reduction?

- No compliance strategy or accountability for implementation of clean air plans

- No fiscal strategy to fund the programme

- Enable higher level of local ambition at state/city level

- No clarity on what makes a clean air plan effective – pathways for clean energy and technology, mobility and transport and waste management

- Scepticism towards health impacts continues

- No guidance on development of strategies

Need deep cuts in all sources of pollution
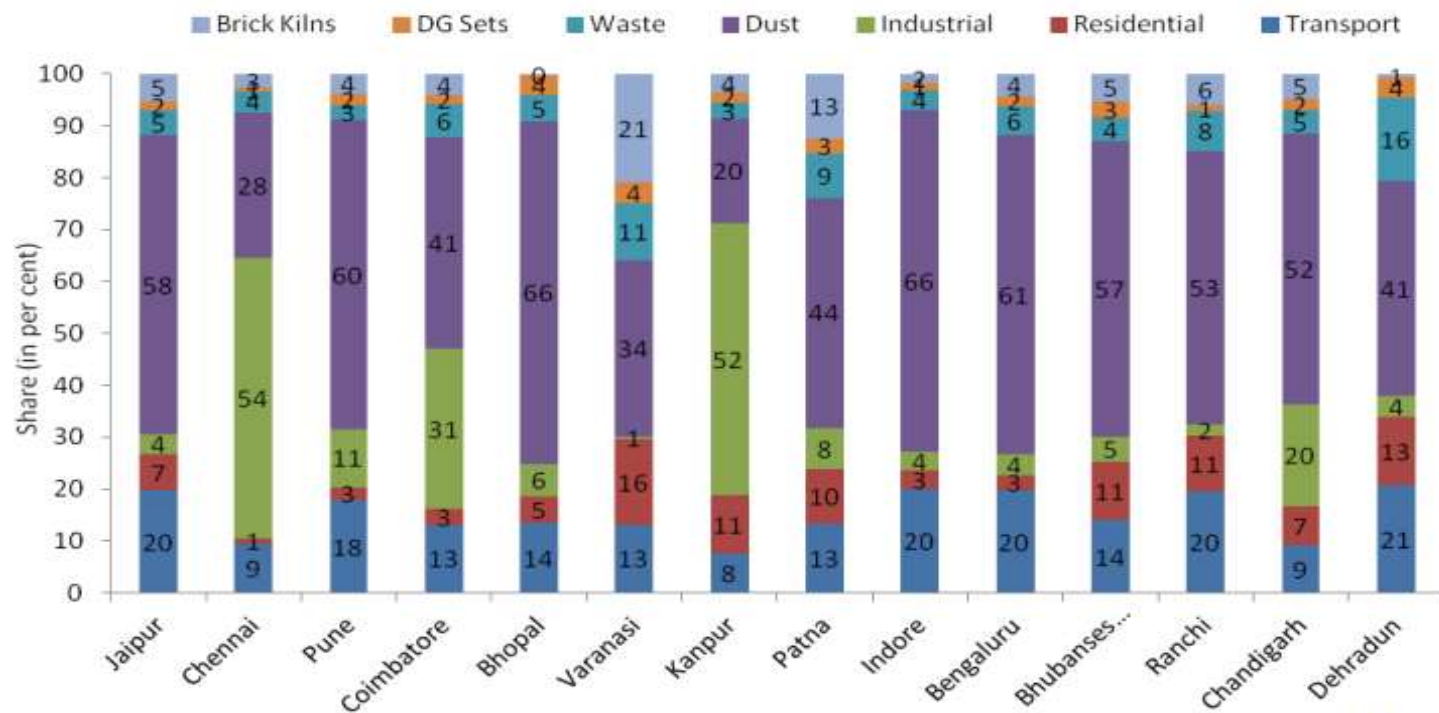
Source: Urban Emissions, 2017, http://www.urbanemissions.info/wp-content/uploads/apna/frontpage/index.html

Delhi's challenge
PM2.5 Emission inventory

SAFAR/IITM
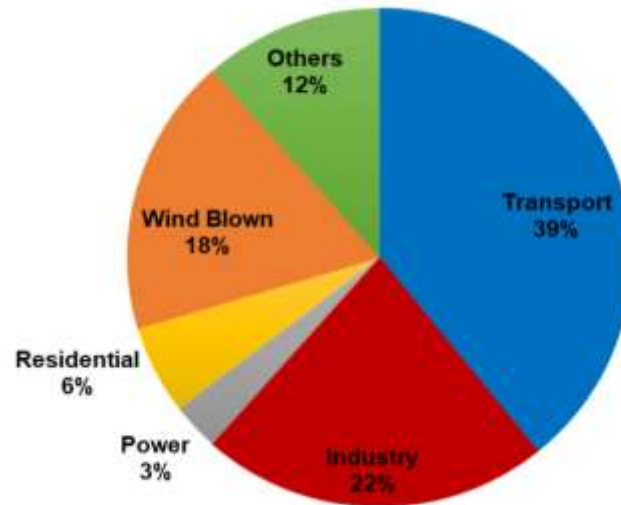
Industry and transport emissions registered maximum increase since 2010

Source: 2018, SAFAR High Resolution Emission Inventory of Delhi City, Indian Institute of Tropical Meteorology

Delhi: The learning curve

Two Action Plans

Graded Response Action Plan – January 12, 2017

Comprehensive Clean Air Action Plan – June 2018

Delhi's challenge: Need to reduce annual average PM2.5 level by over 76%

Supreme Court asks Government: *"Do you have a plan before city shuts down?"* Need Graded Response Action Plan

National Air Quality Index and Health advisory

AQI Category (Range)	PM$_{10}$ 24-hr	PM$_{2.5}$ 24-hr	NO$_2$ 24-hr	O$_3$ 8-hr	CO 8-hr (mg/m³)	SO$_2$ 24-hr	NH$_3$ 24-hr	Pb 24-hr
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	101–168	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	801–1200	2.1–3.0
Very poor (301–400)	351–430	121–250	281–400	209–748★	17–34	801–1600	1200–1800	3.1–3.5
Severe (401–500)	430 +	250+	400+	748+★	34+	1600+	1800+	3.5+

AQI	Associated Health Impacts
Good(0–50))	Minimal Impact
Satisfactory (51–100)	May cause 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 impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity

Link GRAP with National Air Quality index (NAQI) notified in 2015

This classifies daily air Quality based on degree of severity

Health advisory defined

Graded Response Action Plan

Moderate – When PM2.5 is between 61-90 µg/m3 or PM10 is between 101-250 µg/m3 **Poor – When PM2.5 levels are between 91-120 µg/m3 or PM10 levels are between 251-350 µg/m3**	1. Stringent **enforcement/stop garbage burning in landfills** 2. Close/strictly **enforce pollution control regulations in brick kilns and industries** 3. Strictly **enforce pollution control in thermal power plants** through PCB monitoring 4. Periodic **mechanized sweeping of roads** 5. Strict vigilance and **no tolerance for visible emissions** 6. Strict vigilance and **enforcement of PUC norms** 7. Stringently enforce rules for **dust control in construction sites** and **close non-compliant sites** 8. Deploy traffic police for smooth traffic flow at identified vulnerable areas 9. Divert **non-destined truck traffic** 10. Strictly enforce Supreme Court ban on firecrackers 11. Ensure fly ash ponds are watered every alternate day during summer months 12. **Information dissemination** social media, mobile Apps should be used to inform people
Very Poor - When PM2.5 levels are between 121-250 µg/m3 or PM10 levels are between 351-430 µg/m3	1. **Stop use of diesel generator sets** 2. **Enhance parking fee by 3-4 times** 3. Augment public transport **services** by increasing frequency 4. **Stop use of coal/firewood in hotels and open eateries** 5. RWA's and individual house owners to **provide electric heaters** during winter **to security staff** to avoid open burning by them 6. **Alert in newspapers/TV/radio to advise people** with respiratory and cardiac patients to avoid polluted areas and restrict outdoor movement.
Severe - When PM2.5 levels are above 250 µg/m3 or PM10 levels are above 430 µg/m3	1. **Close brick kilns, Hot Mix plants, Stone Crushers** and other polluting units 2. **Shut down polluting coal based power plant** 3. **Intensify public transport services**. Introduce differential rates to encourage off-peak travel. 4. **Increase frequency of mechanized cleaning** of road and sprinkling of water on roads 5. Restrict movement of trucks inside the coal field mine areas
Severe + or Emergency - When PM2.5 levels cross 300 µg/m3 or PM10 levels cross 500 µg/m3 (5 times above the standard) and persist for 48 hours or more	1. **Stop entry of truck** traffic into city (except essential commodities 2. **Stop construction activities** 3. **Introduce odd and even scheme for private vehicles** based on license plate numbers and minimize exemptions 4. **Task Force to take decision on any additional steps** including shutting of schools

Action to be taken by public...

AQI categories	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 during Severe and Very Poor conditions
	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 and avoid using private vehicles

Source: Graded Response Action Plan, MoEF&CC, 2017

Number of 'very poor' and 'severe' categories increase significantly during winter (Average of 37 stations)
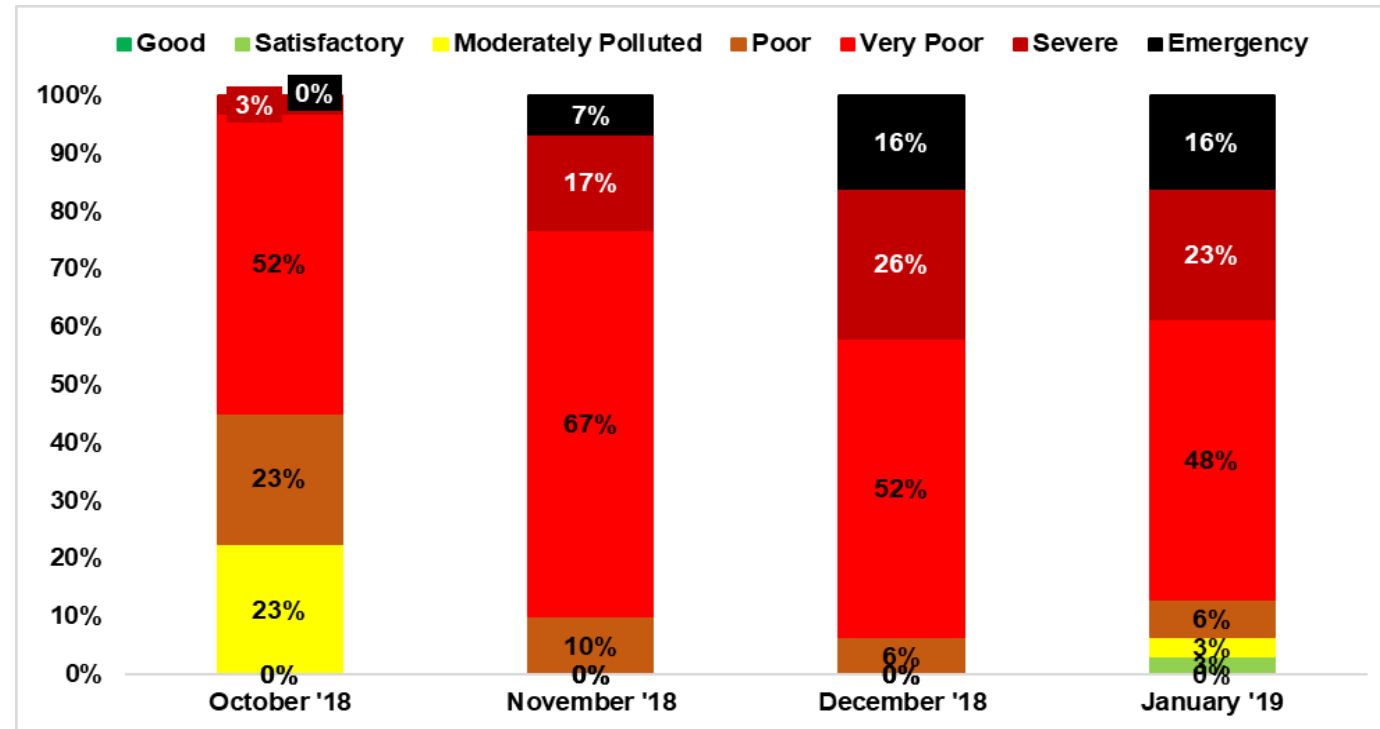
Source: CSE's analysis based on CPCB air quality data available for 37 stations

Desperate measures during winter

October 12, 2018 to March 15, 2019 - Very Poor category action implemented

- Badarpur coal power plant closed (Now permanently)

- Diesel generator sets not allowed

- Industrial units on coal and biomass shut; Brick kilns shut

November 1-12, 2018

- Ban on construction activities, hot mix plants and stone crushers

November 4-12, 2018

- Industries using coal and biomass as fuel shut

November 8-12, 2018

- Truck entry ban

December 24-26: Emergency action

- Industries closed in hotspots

- Construction ban

- Enforcement on waste burning and construction (enforcement challenges)

January 4-5, 2019

- Truck entry ban

Round-the-year Action

Dirty industrial fuels
Furnace oil and Petroleum Coke

(Left) Sample of Fuel/ Furnace Oil

(Bottom) Sample of Petroleum Coke

EPCA-CSE investigation: Extremely high sulphur levels -- more than 20,000 ppm to 74,000 ppm in contrast to 10 ppm in BSVI fuels

Petcoke and furnace oil: --

SC order -October 24, 2017: Ban on pet coke and furnace oil as fuels in Delhi, UP, Haryana, Rajasthan – Exemption to cement, calcium Carbide, Lime kilns, Graphite Electrode

SC order November 17, 2017: Requests all States of India to take measures to ban Furnace Oil and Petroleum Coke usage.

DGFT Notification 24.8.2018 – Ban import of petcoke; Also MOEFCC to restrain its domestic use to be WTO compliant

SC order - December 31, 2017: SOx and NOx standards for 34 groups of industry

Approved Fuels: Delhi Government - Notification of Approved fuels list inDelhi: Coal, biomass and high sulphur fuels banned (selective use of charcoal)

SC order to all states in NCR to prepare approved fuel list

Power Plant

Delhi

- **Closure of Badarpur power plant**

- **Strategies for fly ash pond**

- **Gas supply for Bawana plant – implemented in July 2018**

NCR and National: Implementation of new thermal power plant standards by an early date

  - **Supreme Court Order 2018 –** Prioritise high density areas - 400 persons per sq km –
  - 57 central government units to meet SOx and PM standards by December 2021
  - NOx standards by December 2022
  - Need roadmap of state and private power plants;
  - Ministry of Power to assess use of Merit Order Dispatch to accelerate the process

- **Need phase out plan for very old plants**

- **Need plant-wise roadmap for phase in, and Incentivize them through Merit dispatch order**

- **Potential of gas based power plants**

Hotspot action

- **Hotspot monitoring and identification for local issues**: Anand Vihar, Delhi Technical University in Delhi and Ghaziabad, Bhiwadi in NCR during 2017.

- DPCC preparing local area action plan for key monitoring stations

- **2018 micro level action planning and action** –
  - Bawana and Narela: vacant plots full of industrial waste, plastic, rubber etc
  - Two private players responsible for clearing industrial waste penalised Rs 10 lakh each. DSIIDC was fined Rs 50,000 each for lack of accountability
  - Industrial waste problem detected in Mundka, Dwarka, Nangloi, Tikri etc
  - More than 12,125 tonnes of waste cleared from these areas
  - Fines on 44 industries, two DDA construction sites for dust management

Vehicles: Leapfrog and compliance

New vehicles

BSIV and BSVI transition

- Eliminating time gap between registration of new and old models on BSIV (Supreme Court direction of March 29, 2017 and (SC order October 24 2018)

- BS VI fuel introduced on April 2018. NCR on April 2019.

- Real world emissions monitoring (ensured that RDE is adopted as actual on road test not as a lab test)

- Diesel fight – EPC on diesel cars etc

On-road vehicles

Assessment of PUC programme :

-- Poor compliance

-- Lack of quality control and inappropriate tests

Supreme court direction: August 10, 2017:

• Link annual vehicle insurance with valid PUC certificate

• Evaluate remote sensing for on-road surveillance. ICAT to carry out pilot study for inclusion in in-use inspection programme

Diesel Trucks

CSE survey of truck entry (2015)

- Environment compensation charge – dedicated fund

- **RFID system** – installed at 13 locations –Process of implementation underway

- Weigh in motion bridge

- Entry restriction on more than 10 year old trucks

- Eastern and Western Peripheral Expressways

Clean to zero emissions

Need legal zero emissions mandate

- Electric vehicle policy

- Review of Delhi government's electric bus policy

- Linking with public transport and para transit and feeders etc

H-CNG

IOC R&D Centre pilot – 8 months – programme to roll after that. (Hydrogen-CNG blend at 18%)

Sticker system

- **December 6, 2018, the MoRTH notified the Motor Vehicles (High Security Registration Plates) Order, 2018.**

- **To be implemented nation-side for all new vehicles** from April 1, 2019, and can subsequently also be enforced for older vehicles.

- **Delhi-NCR – old and new**

- **OEMs given the responsibility – single vendors out**

- **Differently colored stickers** for CNG, petrol and diesel vehicles under implementation

- Can regulate vehicle movement during high pollution days -- like Low Emission Zones (LEZs), (Eg Paris, London, Berlin, Amsterdam and Chinese cities etc.)

What is falling through the crack?
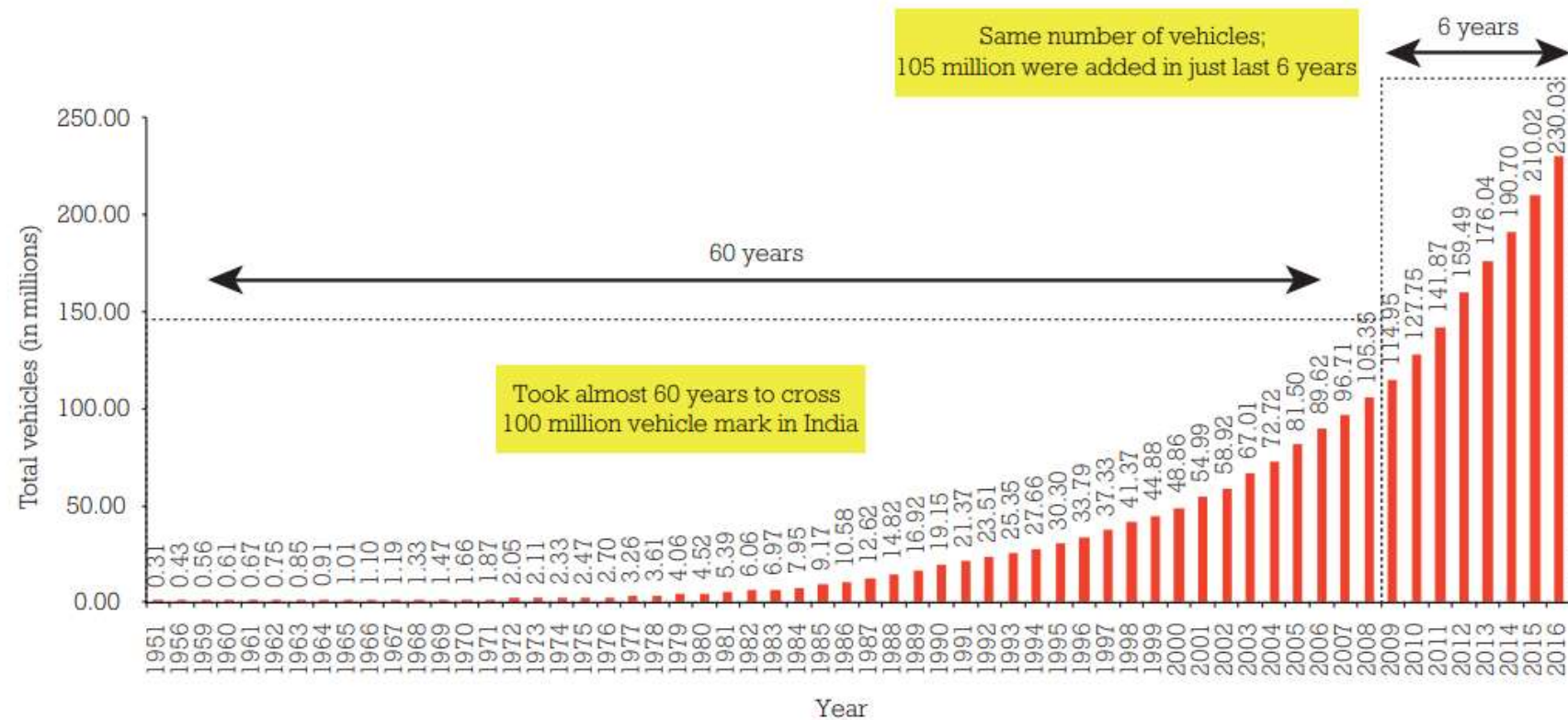
Public transport and mobility strategies

Explosive numbers

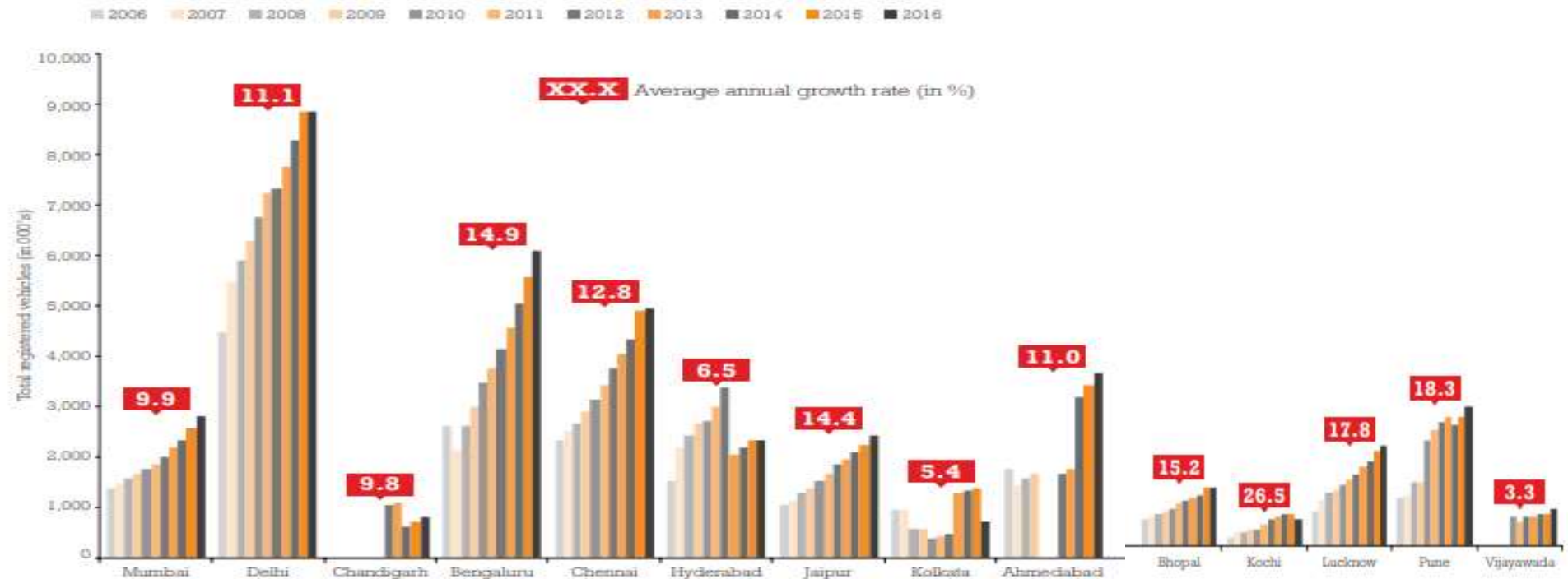## Trends in total vehicle registration in India (1951–2015)

Total vehicle registrations—the number has increased 700 times

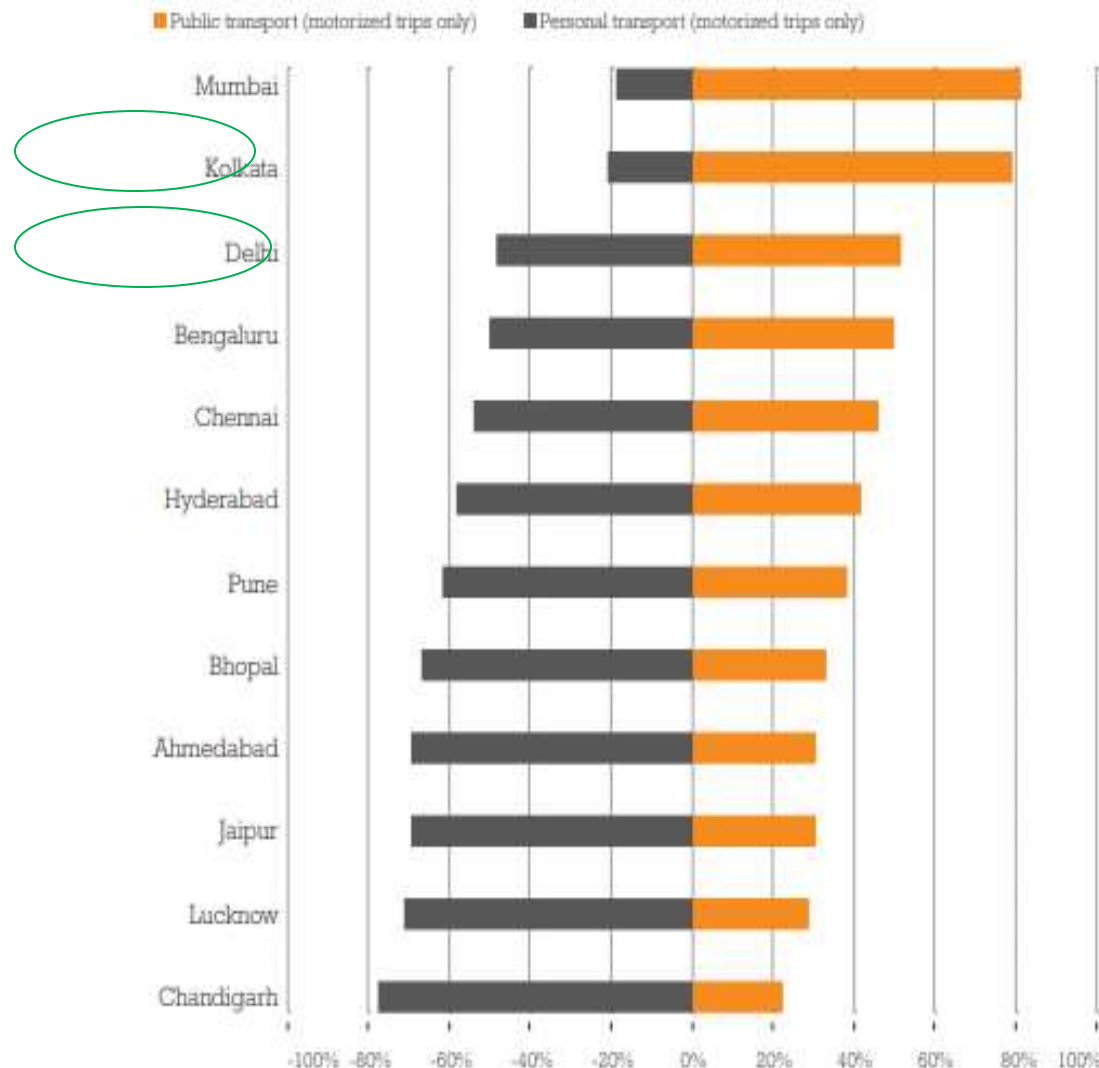*Source: Road Transport Yearbook, MoRTH, 2016*

Motorization in Cities

Trend in total registered vehicles and average annual growth rate in the 14 cities (2006–16)

- Mega cities have very high vehicle stock; **Delhi highest**
- Metropolitan cities with smaller base have recorded very high growth rate

Source: MoRTH statistics

Share of private and public transport in motorized trips

Legend: Public transport (motorized trips only) / Personal transport (motorized trips only)

Cities (top to bottom): Mumbai, Kolkata, Delhi, Bengaluru, Chennai, Hyderabad, Pune, Bhopal, Ahmedabad, Jaipur, Lucknow, Chandigarh

- **Only mega cities have higher share of public transport ridership.** Mumbai and Kolkata have highest share

- **Other Metropolitan cities**: Very high share of personal vehicle trips

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Bus neglected……

Massive slide in public transport ridership in cities
Delhi bus services: Since 2013, DTC bus ridership declining at an average rate of 8.88% per annum. Overall, dropped by 34%.

Bangalore Metropolitan Transport Corporation (BMTC): Since 2009, ridership increased by 9%. But dropped recently -- accumulated losses. Withdrawing buses from low-revenue-generating routes – creating service deficit. Cut down full-day bus operations on 2,253 routes.

Brihanmumbai Electric Supply and Transport (BEST): Daily ridership of BEST buses gone down to its lowest ever: -- a sharp fall of 40% in the past seven years.

Ahmedabad: BRT services – expanded network from 35-km corridor 125km but passenger traffic has not seen an upswing. - BRT passenger traffic stagnant

Vijaywada: Made an early transition to BRT. But it has stopped operating the system

Yet buses prime movers – Jaipur: buses move 11 times more commuters than metro; Lucknow – 2.4 times; Delhi – 1.1 times; Chennai – 88 times; Bengaluru – 12 times (as of 2017).

No strategy to make public transport work in cities – poor last mile connectivity, Cheap or free parking, Subsidised road taxes for cars, Lack of integration, Lack of operational reforms are big barriers

Eclipsing gains…..

-- Massive travel volumes – need to move 2-4 crore trips a day

-- **Mumbai and Kolkata's winning streak** – have public transport spine –-- 88-89% of all motorized trips.

Delhi's dilemma
-- Highest vehicle stock

-- Per day around 20-30 million more trips than Kolkata, Chennai, Hyderabad and Bangalore.

 -- Eclipsing benefits of CNG, improved emissions standards and better travel parameters than other cities

No strategy for affordability and financial sustainability

-- Given the threshold that transport cost cannot exceed 10- 15% of income, -- almost 1/3rd or 34 per cent of Delhi's population cannot afford basic non-AC bus services

Inability to implement design rich solutions

Car centric road design locks in enormous pollution

Engineering changes once made cannot be reversed easily… It permanently decides our travel choices

Complete street management for all road users is not scalable yet

Pedestrians walking on Service lane | NMT traffic merging with Pedestrians and Footpath

Footpath for the Pedestrians | Segregated Track for NMT, Cars & Cycles parked in Parking Bay

Parking policy: Losing the plot

Parking Policy: not well understood

It is an area level plan to be prepared local body
Demarcates all types of legal parking spaces for all modes in a given area

- On-street, off-street and multi-level parking facilities and there integrated management
  - Vending zones
  - Multi-modal integration facilities
  - Green open spaces along with the allied traffic
  - Pedestrian / NMT circulation plans
  - No parking in green areas, near intersection, near bus stands etc
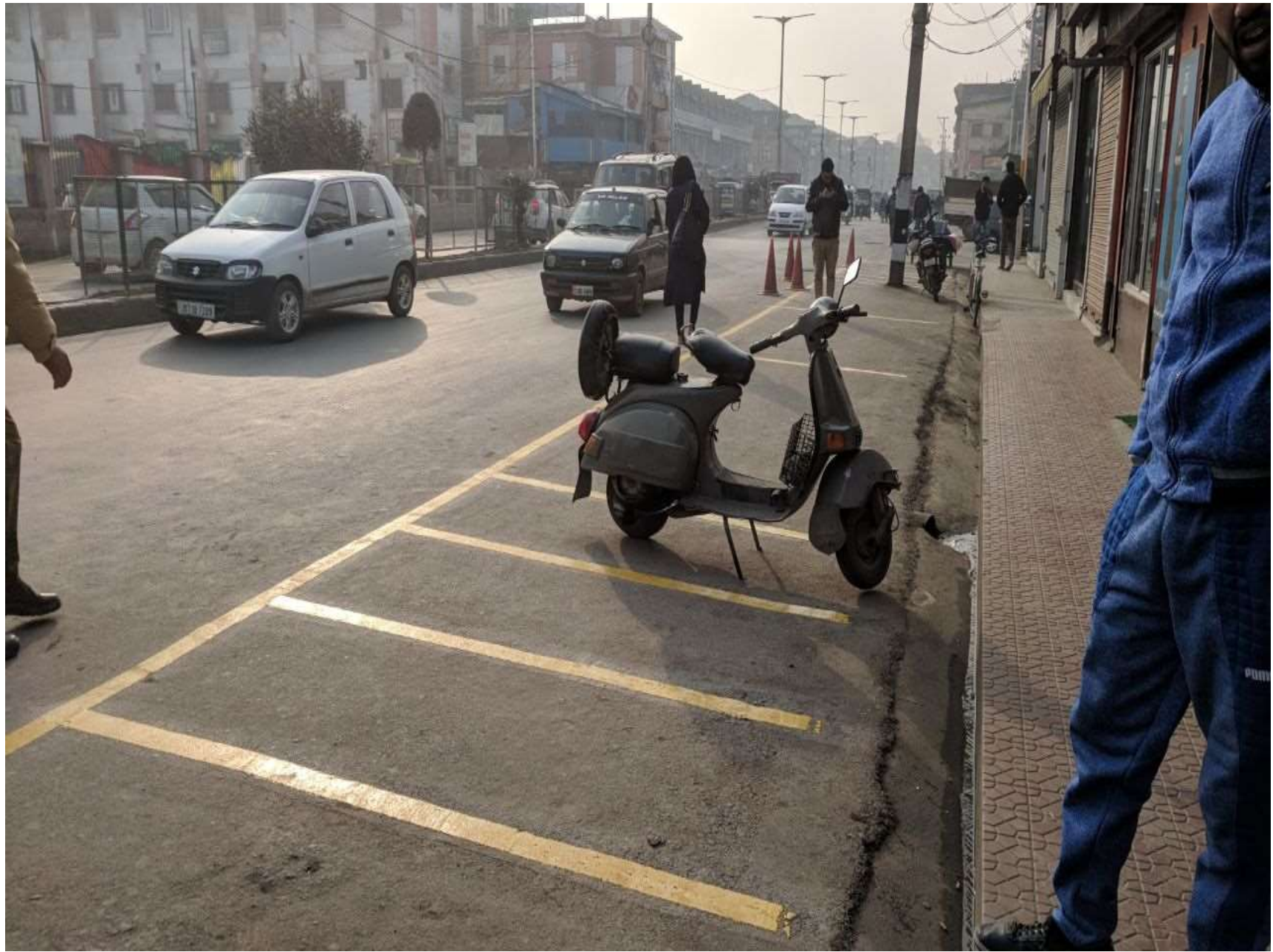
Penalise illegal parking

Introduce variable parking pricing

Promote shared, priced and public parking

Parking revenue for local area development

IT based parking area management and reform of contractual agreement

If we ignore parking area management…

There will be massive spill over from commercial streets to residential streets; Also commercial vehicles can park in neigbourhoods

Streets for walking and cycling will become dysfunctional due to parking encroachment

Emergency vehicles cannot enter neigbourhoods at night

Parking revenue can augment funds for local area improvement

Multiple owners of cars in our neighbourhood can grab more land for free

Massive neighbourhood conflicts – since 2009 we have recorded deaths of neighbours and scuffles over free parking

Why initiative to improve footpath and public bike sharing programmes will not work without parking policy?

Example from Bhubaneswar

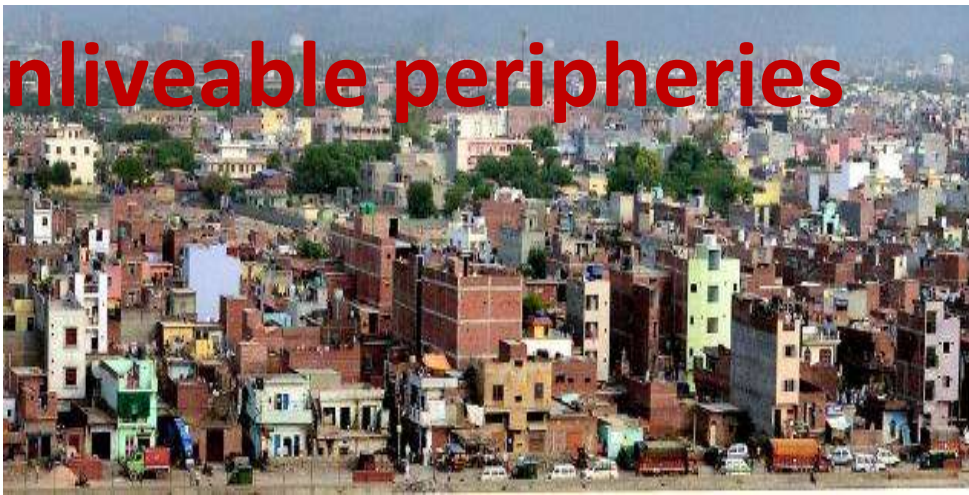# New Bus stops in Bhubaneswar: Passenger information enabled

But street management missing
Parked cars on cycle lane
NMT policy also requires Parking Policy

Bhubaneswar

2018-12-21 16:00

Illegality and invisibility

Unliveable peripheries

Gated development

For the 12 largest Indian cities, satellite imagery shows that, the proportion of built-up area outside a city's official boundaries exceeds that within its boundaries --- also exceeds the proportion of population, -- low density sprawl.(World Bank 2015)

Municipal services and pollution control do not work here

Massive tension and conflict around all new redevelopment projects in the city: Example -- Kidwai Nagar redevelopment plan…

Rules of Transit Oriented Development Policy ignored

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Good practice in Kolkata: Mixed use development; Meet all needs and yet reduce parking and traffic chaos

The TOD Building typology - in Kolkata:

-- Roof of retail used as public space for residents.

-- Zero Setbacks.

-- Mixed Use (Commercial/ Civic/ Residential within same block)

-- Privacy of residents ensured.

-- Retail facing the street with homes overlooking, keeps pedestrians (women) safe

Internalise rules

Construction and Demolition Waste:
- **Ensure dust pollution from construction**. Check list for inspection of construction sites prepared under directions of NGT and EPCA.
- **Undertake control measures for fugitive emissions from material handling, conveying and screening operations**. Needs enforcement.

- **Provide a network of decentralized C&D waste segregation and collection sites across the city.**
- **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.**
- **Promote recycling of construction and demolition waste;** change schedule of rates

Waste Burning

- **Implement Solid Waste Management Rules and Regulations**

- **Household level segregation, decentralised recycling and reuse**

- **Landfill management**
- **Zero landfill policy**

- **Waste to Energy Plants – Only if needed** - Strict implementation of emission norms, use state of the art technology and provide emission data to State Pollution Control Boards.
- Ensure a robust collection system that focuses on collection of segregated waste.

- Develop a siting policy for WTE plants.

Clean energy access
Domestic Solid Fuel

- **A targeted programme to be implemented for 100 per cent coverage of households** by distribution of LPG/PNG in all non compliant cities.

- **Promote and give access to LPG and electricity** in low-income neighbourhoods, as well as roadside eateries/dhabas/ restaurants etc. **Mandate and link commercial license to clean fuels.**

- **Restrict use of coal in hotels and restaurants**, link this with licensing policy

- 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

Open fires and Crop Fires

…ellite Image— 1st April to 31st April, 2018
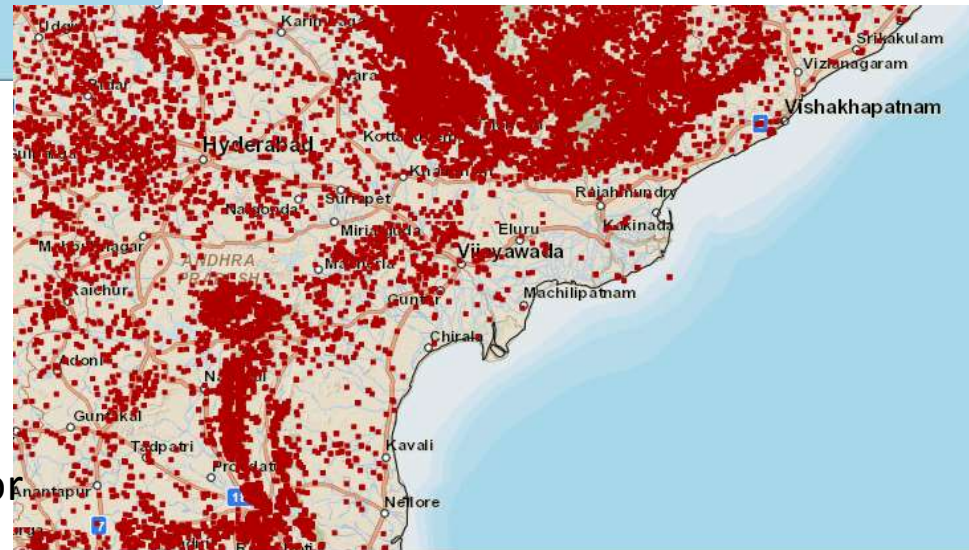
Cumulative fires mapped—o…
the entire month of March
2018 (peak fires)

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

Crop burning: A Roadmap

Provide farmers with alternatives and educate them on stubble burning

In field solution

Mulch and mix with soil; Can reduce fertiliser cost for farmers

Ex-situ solution

Promote biomass-based power plants

Production of biofuels and fertilizers

Biomass pellets and other uses

R&D and crop diversification

Uniform decentralized mechanism for the collection, storage and commercial sale of crop residue

What Beijing did for 25% reduction?

- Targeted coal reduction in all sectors
- Restructured industrial sector
- Shifted industry out
- Massive public transport roll out
- Capped the number of cars that can be sold in a year
- Yellow labelling of vehicles to not allow old vehicles to enter targeted zones and city centres
- Real world emissions tracking and much more
- Governments held legally accountable for implementation

Need massive transition

Transition to clean fuels and technology

Massive mobility transition

Paradigm shift in waste management

Need scale and effectiveness

Need accountability

Thank You