



Understanding Air Pollution - Workshop
August 23, 2021
Rajasthan



Understanding air pollution crisis, health effects and mitigation efforts



एयर पलूशन से खतरे की घंटी

वीरेंद्र वर्मा ॥ नई दिल्ली

देश में हवा इतनी जहरीली हो गई है कि यह मौत का एक बड़ा कारण बनती जा रही है। ग्लोबल बर्डन ऑफ डिजीज (जीबीडी) की रिपोर्ट के मुताबिक, पिछले 13 साल में भारत में एयर पलूशन से मरने वालों की तादाद 6 गुना से ज्यादा बढ़ गई है। 2000 में जब यह रिपोर्ट आई थी तो एयर पलूशन



6.2 लाख लोगों की असमय मौत एयर पलूशन से भारत में पिछले 13 साल में

300% तक बढ़ी एयर पलूशन से मरने वालों की तादाद पूरी दुनिया में

क्या कहते हैं दिल्ली वाले

सीएसई ने दिल्ली में भी एक सर्वे कराया था। लोगों ने कहा कि पिछले 2 महीने के अंदर प्रदूषण में बढ़ोतरी फील हुई है। सीएसई की इन्वेस्टिगेशन डायरेक्टर अनुमिता राय चौधरी ने सुझाव दिया कि प्राइवेट वाहनों पर कंट्रोल करना होगा। पूरे देश में एयर क्वालिटी के

79% ने कहा, बढ़ते वाहनों की संख्या पलूशन का कारण 74% के मुताबिक, जहरीली हवा सांस की कठिनाई का

'सांसें' पर स्मॉग की 'स्याह' परतें

Updated on: Thu, 15 Nov 2012 02:00 AM (IST)



The Guardian

It's positively alpine!': Disbelief in big cities as air pollution falls | Air pollution | The Guardian

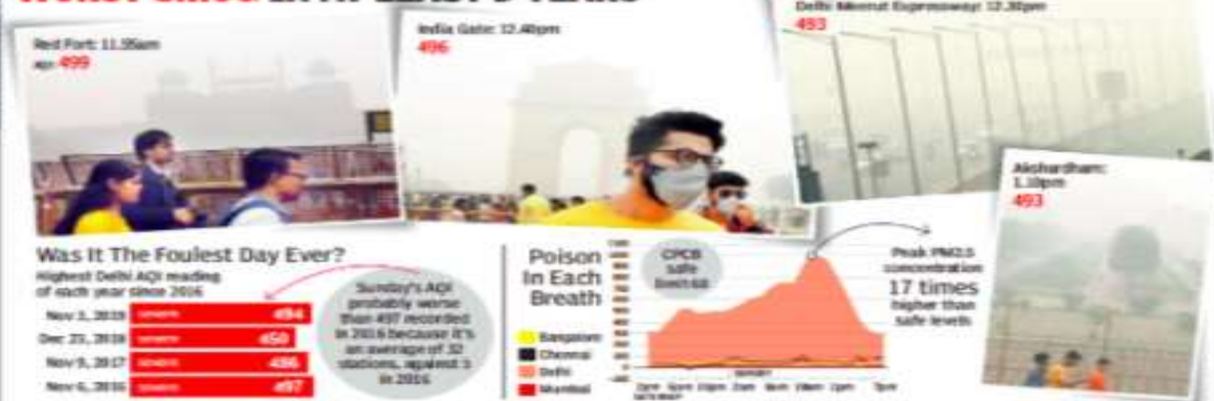
World's Most Polluted City: At 145pm, Delhi Had AQI (US Scale) Of 1065, Almost 7 Times No. 2 Lahore's 163

Atmosfear: Delhi Victim Of Sick Choke

Capital A Gas Chamber After Light Drizzle

New Delhi: People in Delhi-NCT woke up on a Sunday morning to a grey, opaque and overwhelming smog hanging in the air and the city's main arteries as road closures and traffic jams. This is what the smoggy could look like. It is assumed too dangerous to step outside because the world air almost immediately scorched nostrils and stung eyes, staying indoors or wearing the breathing apparatus was the only option.

WORST SMOG IN AT LEAST 3 YEARS



Times View

Governments at the Centre and in Delhi, Haryana, Punjab and UP need to start debating as if they recognise that the 54.70 in Delhi is a environmental public health emergency. This is no time for blame games or cornering credit for what few positive measures have been taken. Even concerted action by all governments may not be enough to deal with the crisis in the short to medium term, but anything less would be criminal neglect of their duty and a complete abdication of leadership. Let's also not argue about which source of pollution deserves priority action. Every source, minor or major, needs urgent tackling. Central and state governments should jointly commit to a 5-year plan with annual targets of 40% reduction in fine dust PM by 2017, and below 50 microg/m³.



Asian Age/New Delhi/February 14, 2013

'Air pollution 5th largest killer in India'

RASHME SEHGAL
NEW DELHI, FEB. 13

obstructive pulmonary diseases in India in 2010 are directly attributed to

dio-respiratory physiology at the Vallabhbhai Patel Chest Institute warned

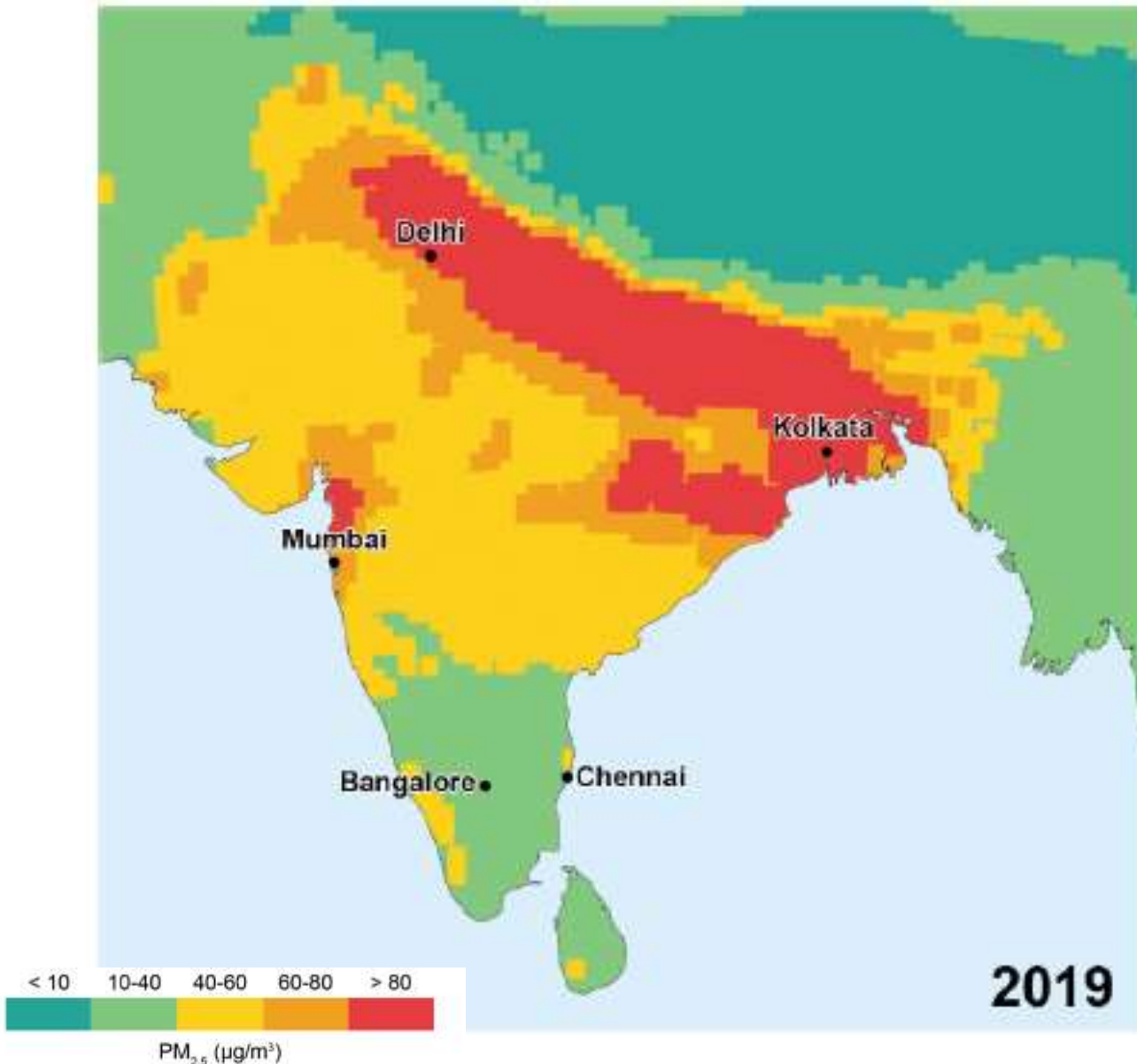
incidence of cancer caused by indoor air pollution," Prof. Guleria said.

▲ New Delhi's India Gate war memorial on 17 October 2019 and on 8 April 2020. Photograph: Anushree Fadnavis/Adnan Abidi/Reuters



Average annual PM_{2.5} concentration levels in India

About 70% of the country exceeded the recommended national annual average concentration level of 40 $\mu\text{g}/\text{m}^3$ of PM_{2.5}, and almost one-fifth experienced levels over 80 $\mu\text{g}/\text{m}^3$



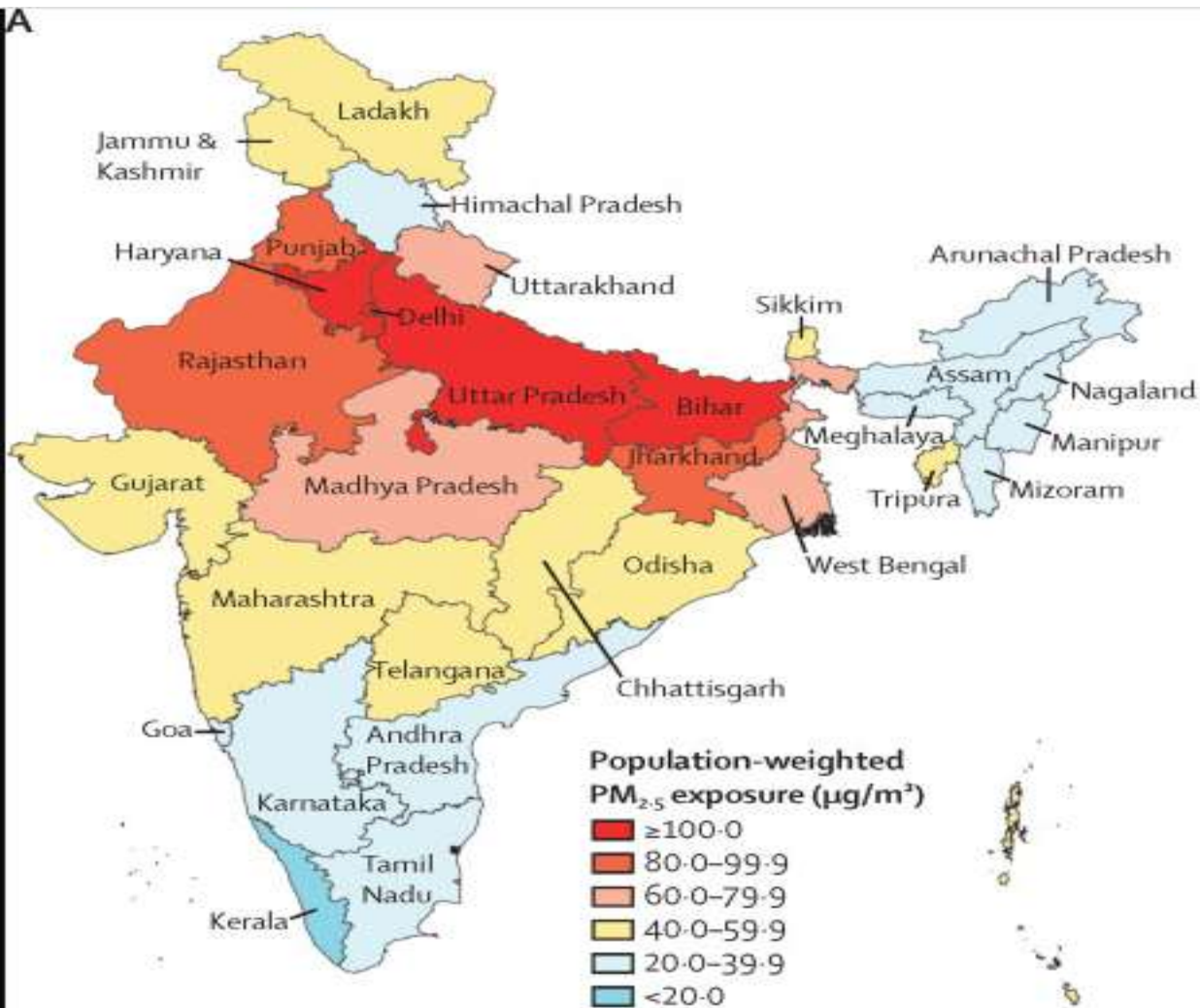
Air quality monitoring network

- **Manual ambient air quality stations :** under National Air Quality Monitoring Programme (NAMP) are total 804 spread across 344 cities/towns and few villages.
- **Continuous ambient air quality monitoring:** 278 realtime monitoring stations are operating in 148 cities.
- Considering 6,166 urban agglomerations/ cities / towns in India (Census 2011) the monitoring network is very limited -- **present coverage is only about 7 per cent of cities/towns**

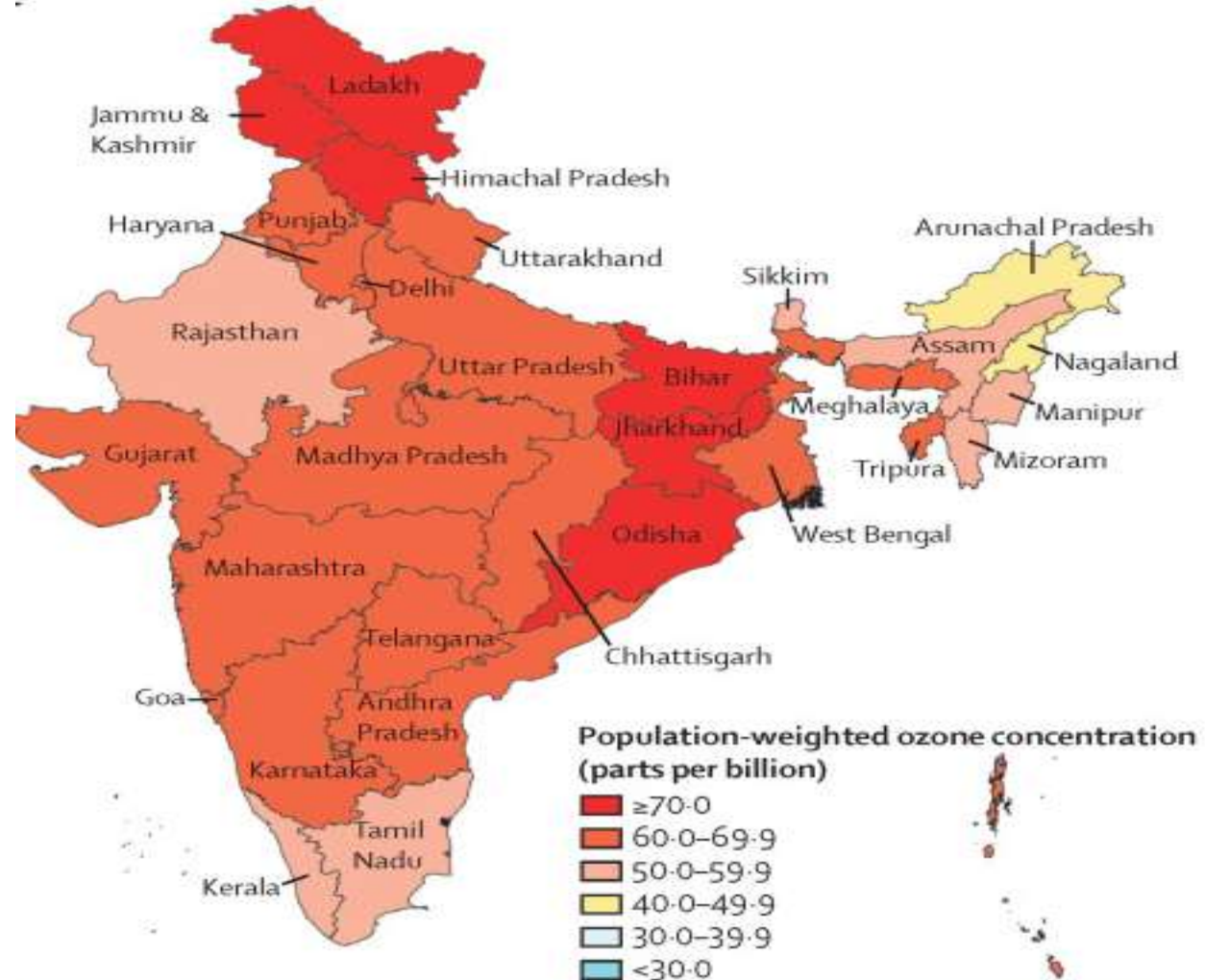


Widespread exposure to air pollution.

PM_{2.5} exposure



Ozone concentration



Deaths attributable to air pollution in India in 2019

	Number of deaths, in millions
Air pollution	1.67 (1.42–1.92)
Ambient particulate matter pollution	0.98 (0.77–1.19)
Household air pollution	0.61 (0.39–0.86)
Ambient ozone pollution	0.17 (0.08–0.26)

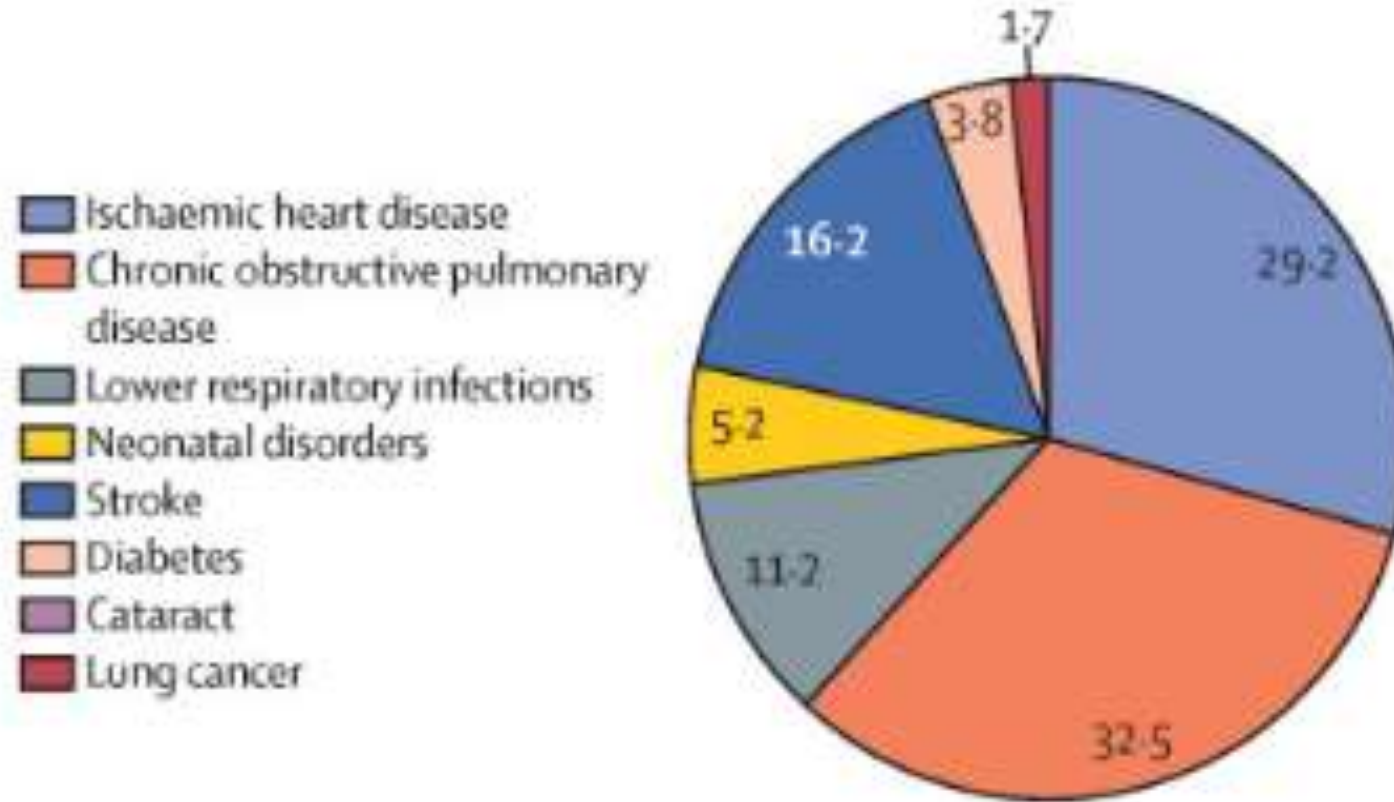
Air pollution causes 17.8% of total deaths (9.39 million);

On an average 4,575 deaths daily across India



Heart and pulmonary diseases are the major health outcomes

Health impact outcomes leading to deaths, attributable to air pollution in India, 2019



Mortality trend in states

PM causes deaths even at comparatively much lower concentration level.

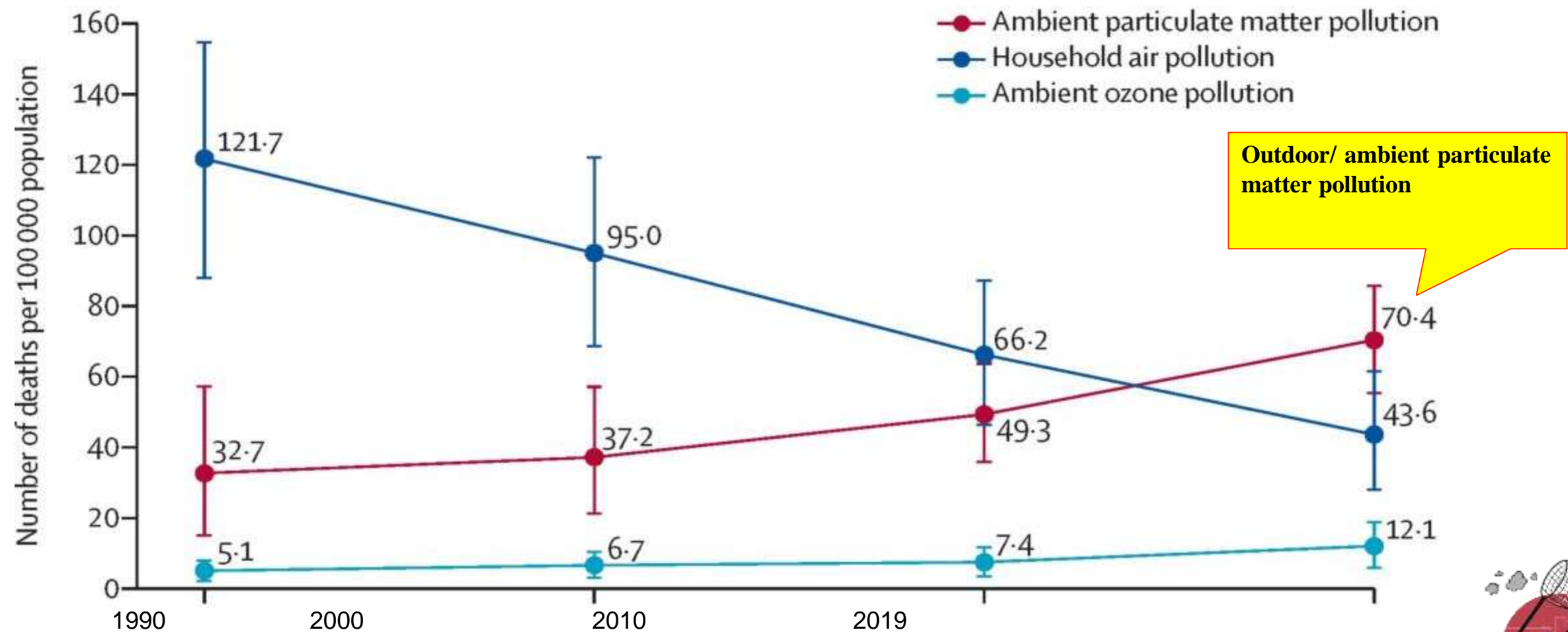
Even cleaner states have high death rate

State	Number of deaths attributable to air pollution: 2017	Death rate/100,00 population attributable to air pollution
Uttar Pradesh	260,028	111.1
Maharashtra	108,038	86.9
Bihar	96,967	79
West Bengal	94,534	93.3
Rajasthan	90,499	112.5
Madhya Pradesh	83,045	97
Karnataka	64,333	94.8
Tamil Nadu	61,205	75.9
Gujarat	58,696	84.9
Andhra Pradesh	45,525	83.7
Odisha	31,118	65.3
Chattisgarh	29,841	98.9
Haryana	28,965	100.1
Kerala	28,051	79.3
Punjab	26,594	86.3
Jharkhand	26,486	69
Telengana	26,000	65.8
Assam	25,888	72.3
NCT of Delhi	12,322	65.3
Uttarakhand	12,000	106.4
Jammu and Kashmir	10,476	75.4
Himachal Pradesh	7,485	99.7
Tripura	3,711	91.1
Manipur	1,949	57.2
Meghalaya	1,440	42.7
Nagaland	958	48.8
Goa	892	58.2
Mizoram	652	52.9
Arunachal pradesh	608	36
Sikkim	413	61.5

Death rate due to outdoor air pollution has surpassed household air pollution



Trend in death rate attributable to ambient PM pollution, household air pollution, and ambient ozone pollution per 100 000 population in India, 1990–2019



Source: The Lancet Planetary Health 2021 5e25-e38DOI: (10.1016/S2542-5196(20)30298-9)



Health of children compromised..

2012 epidemiological study on children in Delhi (CPCB and Chittaranjan National Cancer Institute of Kolkata):

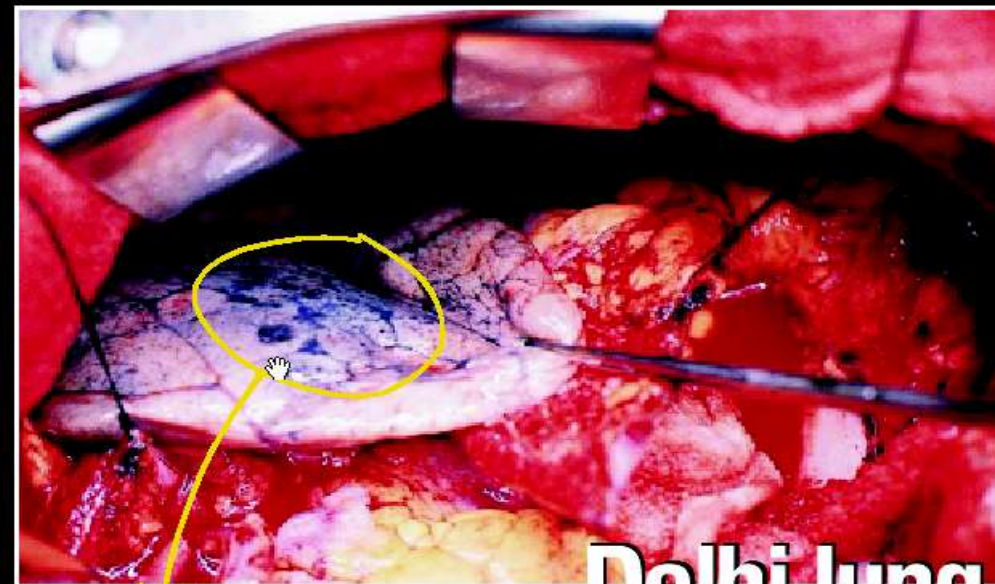
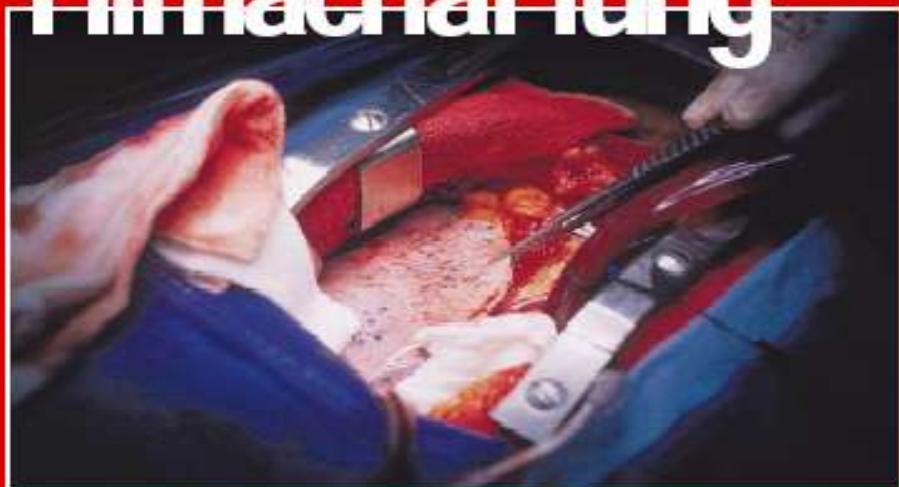
- Every third child has reduced lung function.
- Sputum of Delhi's children contains four times more iron-laden macrophages than those from cleaner environs, indicating pulmonary hemorrhage.
- The levels of these biomarkers in children have been found to be higher in areas with high PM₁₀ levels.



Bad air! We all know about it. But the fact that it gets into our bodies and inflicts fatal injuries is unknown to most of us. Surgeons who have the privilege of seeing inside us have a funny story to tell. They can tell, just by looking at the colour of the lungs, whether the person is from a dirty big city or not. Actually a shocking tale!

Look at the spotless lung below. The fortunate owner comes from a relatively cleaner place.

Himachal lung



Delhi lung

Capital punishment

Look at these black spots on the lung. The unfortunate owner lives in Delhi and has been breathing polluted air. Air full of carbon particles which accumulate in the lungs (black spots). What you can't see is a cocktail of gases and tiny particles, even smaller than carbon that get into our bodies. Actually, you are getting polluted.

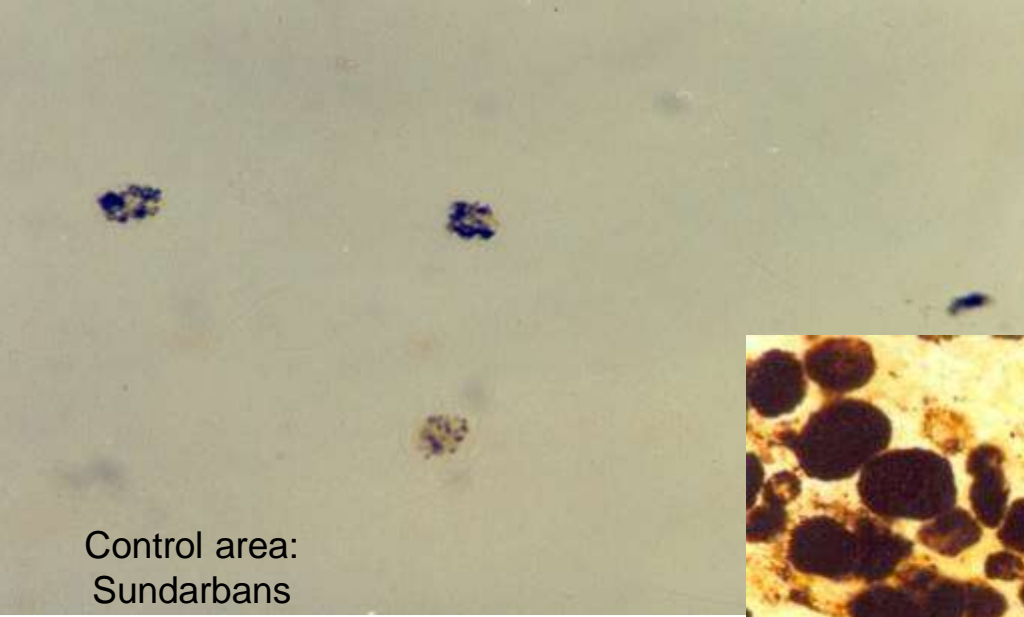
Scary? But those cars are so sexy!



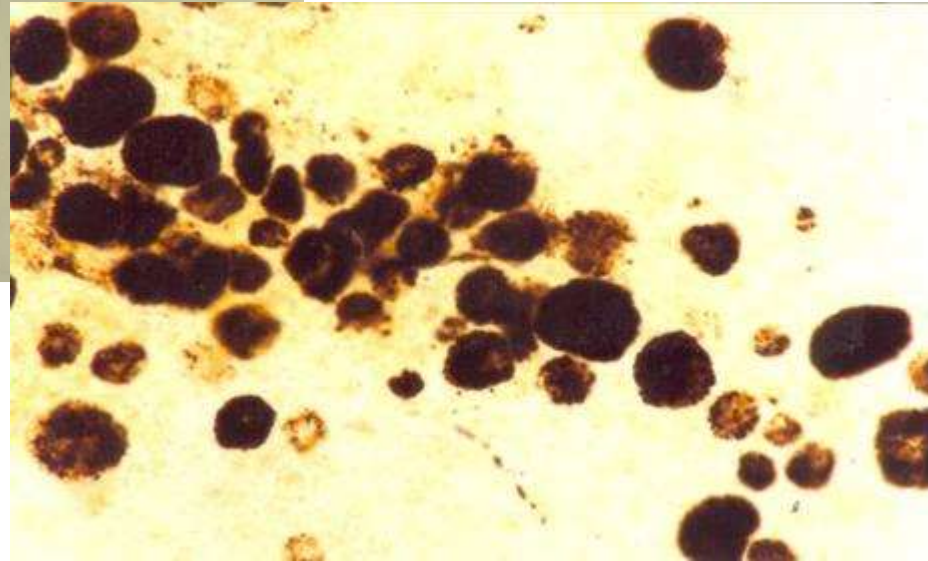
Emerging evidences of health impacts in India.....



Alveolar macrophage - biomarker of air pollution



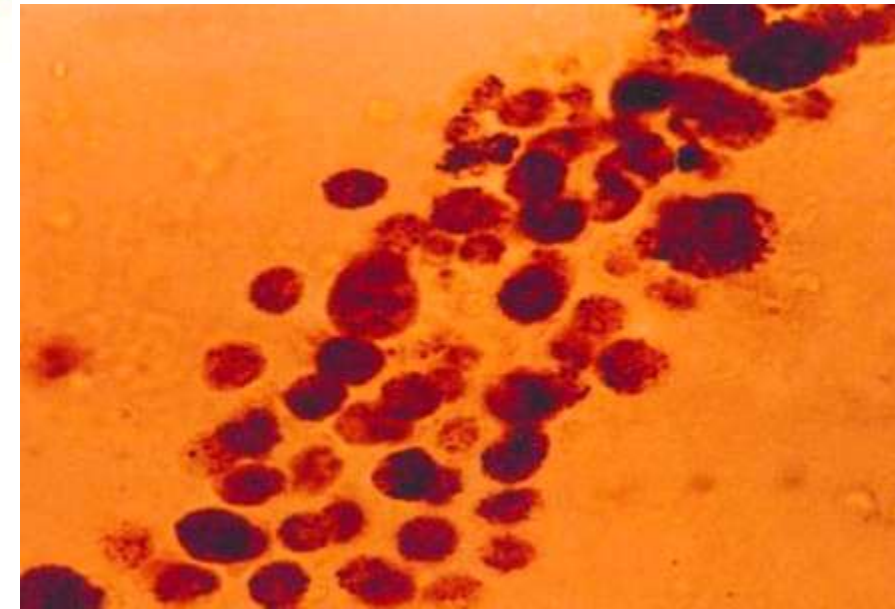
Control area:
Sundarbans



Larger AM – particle laden

Exposed group; Kolkata taxi driver
Increase in AM number

Sputum cytology of a 14-year old girl, showing abundance of particle laden AM





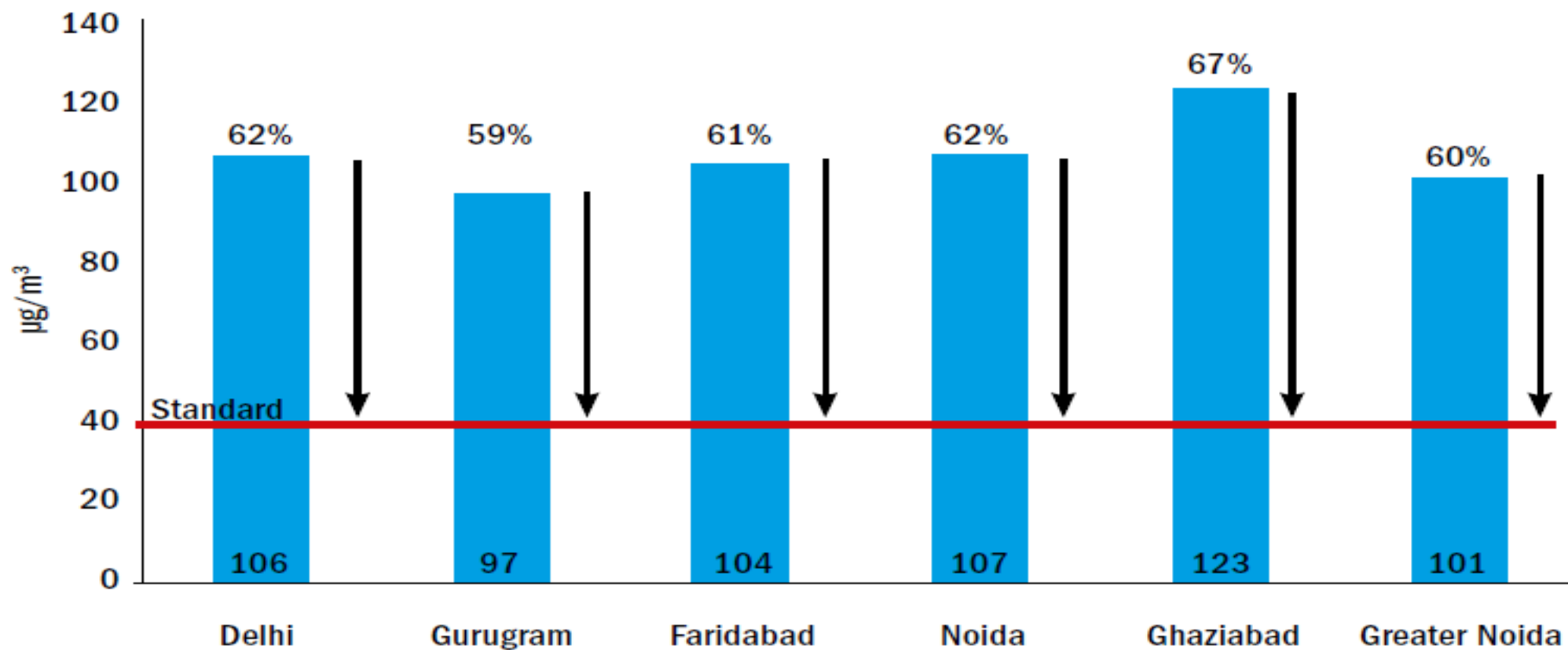
National Clean Air Programme



- **GOAL:** to meet annual average ambient air quality standards
- **MID TERM :** Reducing air pollution by 20-30% by 2024, taking 2017 as base year
- **PLAN:** City specific air pollution abatement action plan (122 non-attainment cities)
- **PROCESS:** National emission inventory, air quality information, source apportionment studies, guidelines for indoor air pollution, rural monitoring stations



Reduction targets for annual PM_{2.5} concentration in six major cities of Delhi-NCR

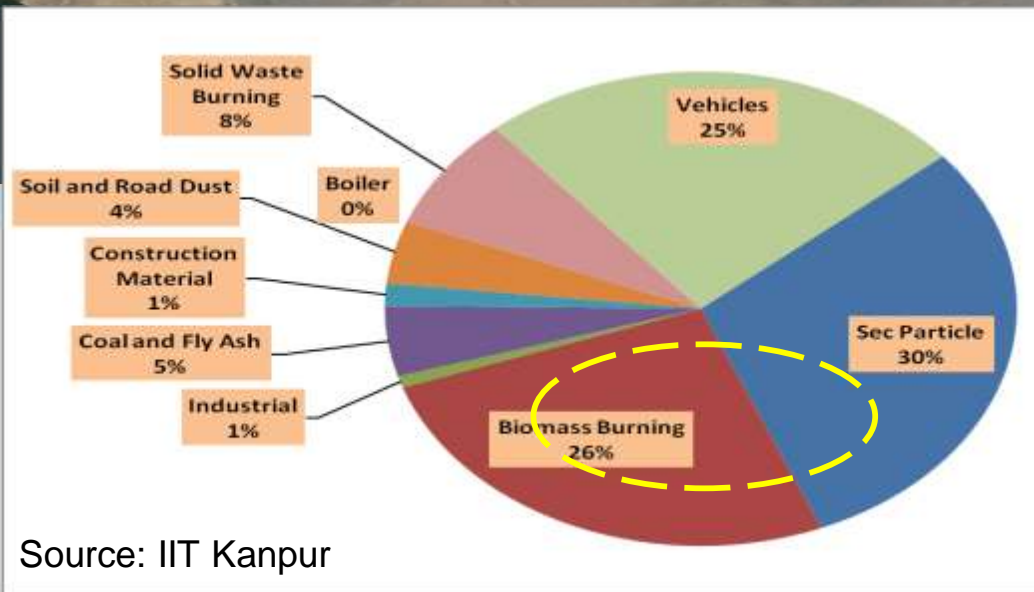
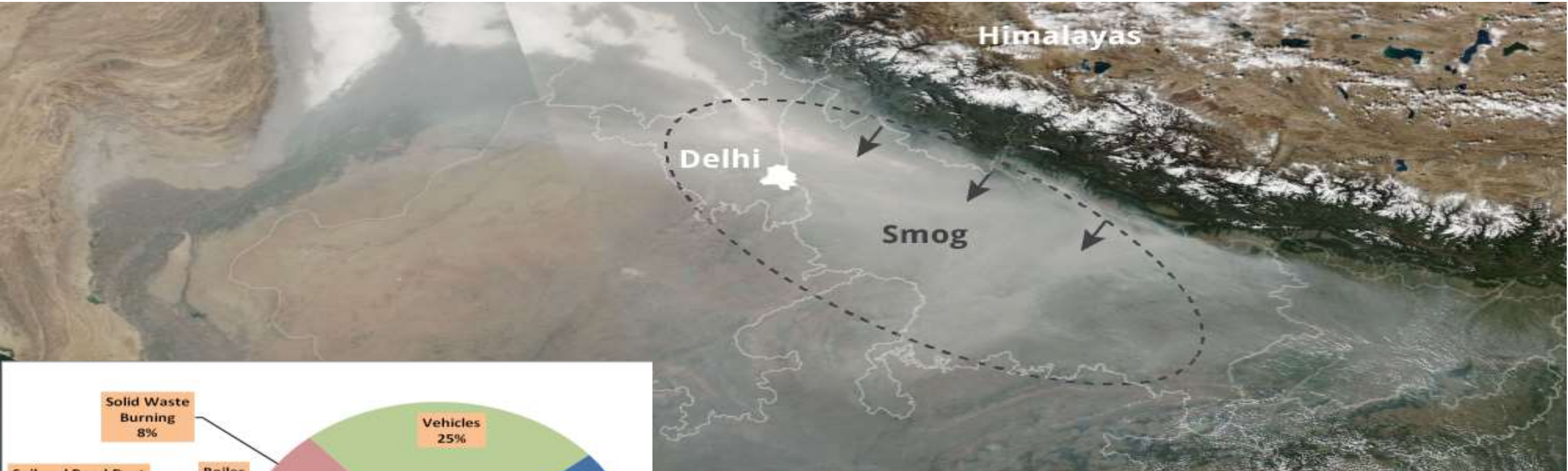


Note: Mean of 3-yr average of all CAAQM stations that have been working in the city since 2018. Data upto 31 Dec 2020.

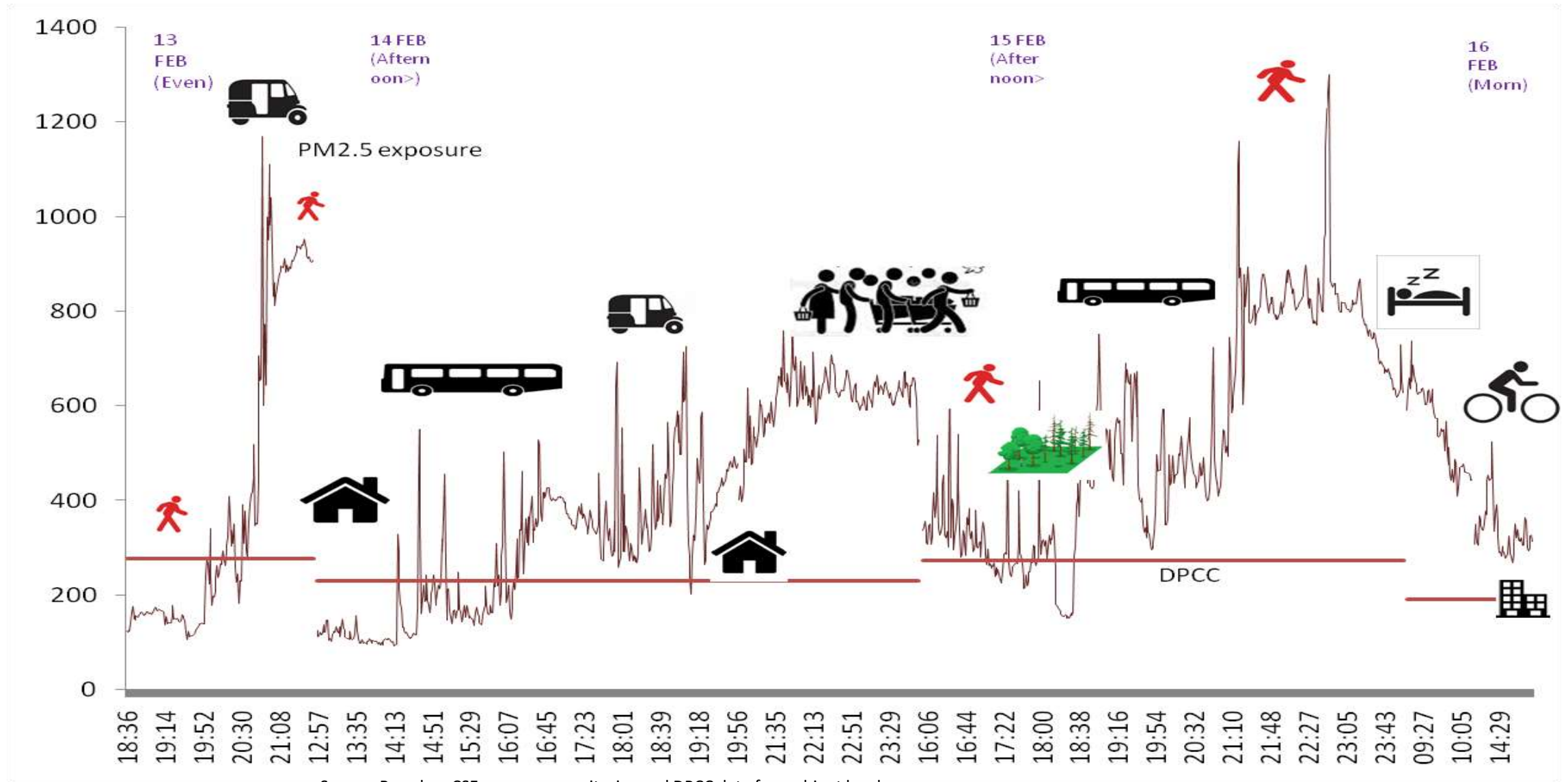
Source: CSE analysis based on CPCB data



Winter air pollution



How much pollution we breathe while travelling?



Source: Based on CSE exposure monitoring and DPCC data for ambient levels



Source: Industrial emissions

Action status:

- Industries shift out of Delhi to neighboring NCR while continuing to pollute in the common airshed.
- Delhi has also taken more active steps to scale up access to PNG in its industrial areas and taken the more ambitious decision of banning coal and other dirty fuels including petcoke and furnace oil.
- Challenge of regulating and monitoring large numbers of informal small scale units outside the designated industrial areas. Enforcement of clean fuel notification --a challenge.
- Controlling pollution in the industrial areas includes improving stack emissions and access to clean fuels,
- Control of fugitive emissions from material handling and movement of heavy duty trucks, and reduction in open burning of industrial waste.
- Need to expand PNG in industrial clusters of NCR and ensure connectivity with units to replace coal.
- Ensure implementation of SO₂ and NO_x emissions standards notified by MoEFCC on 29 January 2018 for 16 categories of industries



Source: Industrial emissions

What more needs to be done...

- Till the time full transition to gas and electricity as industrial fuel becomes possible, it may be useful to assess the use of intermediary fuels like agro-residue for industrial combustion.
- Promote smart monitoring of industrial stacks emissions with continuous emissions monitoring system and with strong quality control. CEMS has to be installed and operated properly for credible and accessible data. The emissions data should be available in the public domain for transparency.
- Implement industrial waste management plan to prevent open dumping and burning. In Delhi large scale burning of industrial waste was noticed during field survey in Mundka and Bawana areas where non-usable plastic and rubber waste from the recycling plants was found dumped for open burning.
- Mandate all industrial units to prominently display details of the Consent to Operate within their premises to prevent illegal operations: This is urgently needed to stop illegal operations of industries.
- Implement siting plan for industrial units outside the industrial zones for regulations and monitoring: There are large numbers of illegal units operating in non-conforming areas.





Source: Power Plants

Action points:



- CPCB has identified eleven coal based power plants that are within 300 km of Delhi and are part of the common airshed. These plants will require stringent time-bound action to meet the emissions standards. Delhi has closed down all coal power plants.
- MoEFCC introduced stricter environmental standards for coal-based thermal power plants (TPPs)
- First deadline to meet the norms was 2017; this was extended to 2022. However norms were also diluted.
- Govt has now given a deadline in phased manner which will be implemented during 2022 to 2024 for different category power plants considering population criteria of cities.
- Estimations of penalty indicates that cost of non-compliance is lower than that of compliance—no deterrence
- To incentivize implementation of the new norms, preferential scheduling of electricity from cleaner power stations has to be adopted. Along with renewable energy or must-run plants, a new category of clean coal power plants need to be included as first-run or priority-run plants.



Source: Vehicles

Action strategy

New vehicle Standards

- Technology neutral (but technology-forcing...) emissions standards for new vehicles.
- Must consider emissions from all mobile sources: on-road, offroad, marine, locomotives, aviation...
- Limit values only as good as: - Compliance and enforcement - Real-world performance

Fuel quality standards

- High fuel quality (especially low sulfur levels) enables advanced emission control technologies to be deployed in the fleet.
- Fuel quality compliance programs critical to prevent damage to engines and prevent mis-fueling

In-use vehicle emission control

- In-use vehicle emission control
- Clean up legacy vehicles on the roads
- Comprehensive program includes:
 - Catching gross-emitters (I/M, remote sensing, maintenance, etc.)
 - Cleaner fuels
 - Scrap-page
 - replacement programs
 - Retrofit programs
 - Low emission zones

Action taken on vehicles— emission norms

Source: Vehicles

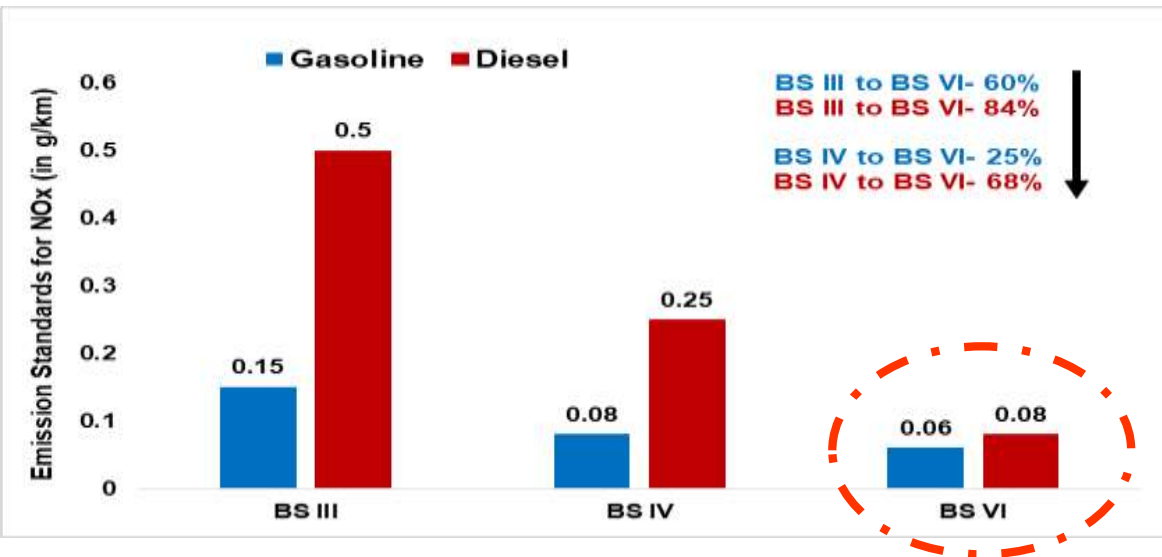
Action Taken:

- It was in April 1999 that the Supreme Court had directed that all vehicles in India would have to meet BS I norms by the June of that year. It also directed that BS II would be mandatory in the NCR by April 1, 2000.
- **The government set up Auto Fuel Policy committee. In 2003**, it was agreed that 13 cities would get BS-III by April 2005, and the rest of the country by April 2010. Then there was a pause for 5 years.
- **In 2015**, the road map for the rest of the country was decided—fuel progressively made available. BS-IV implemented on April 1, 2017
- **In 2016**, Government agreed to skip BS V and leapfrog directly to BSVI for all vehicles in April 2020. BS-VI norms were advanced by 5 years.

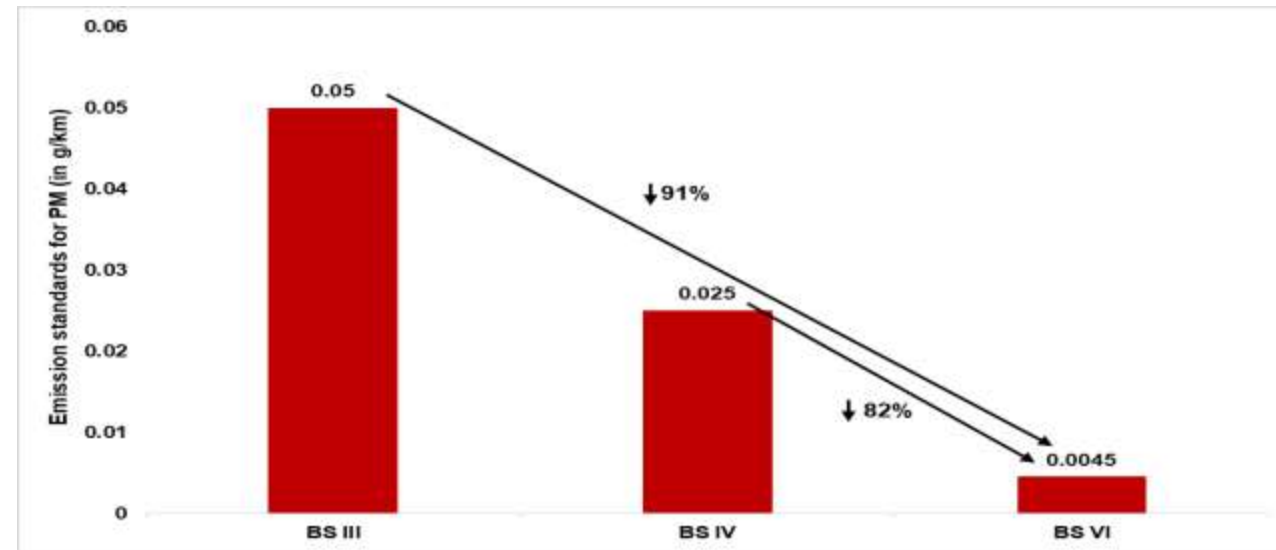


Passenger cars emission norms: reduction in key pollutants

NO_x: 25 to 68% reduction BS4 to BS6

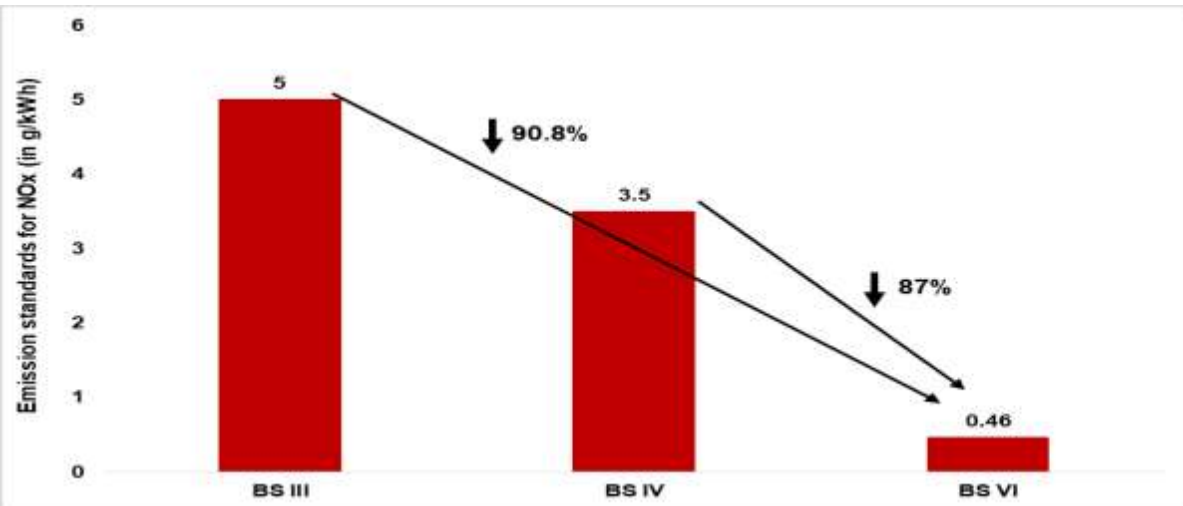


PM: 82% reduction BS4 to BS6

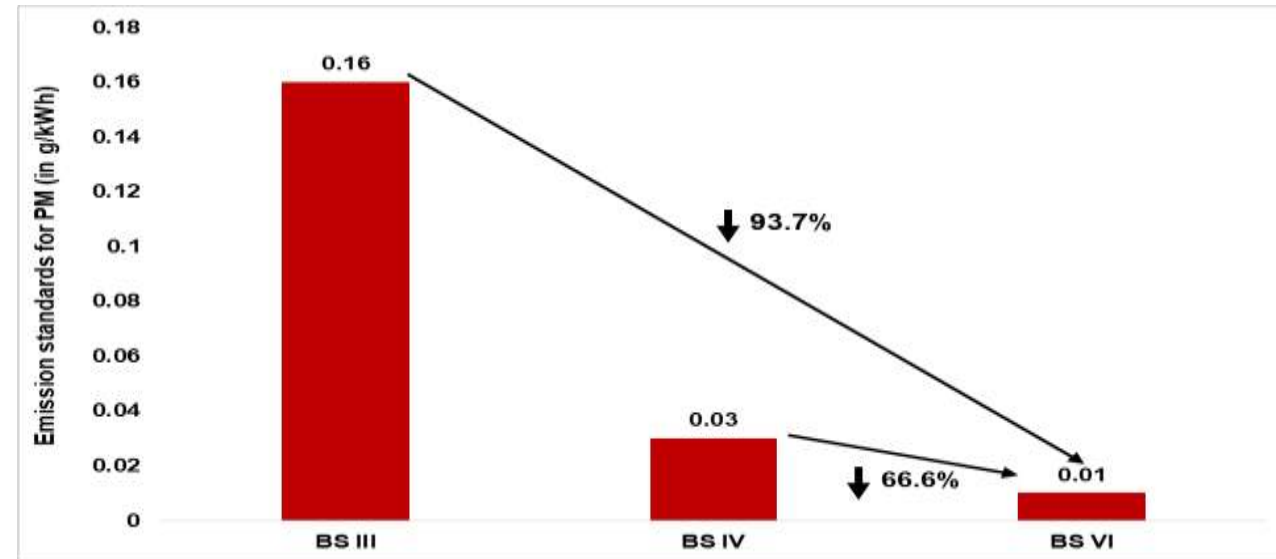


Buses and trucks emission norms: reduction in key pollutants

NO_x: 87% reduction --BS4 to BS6



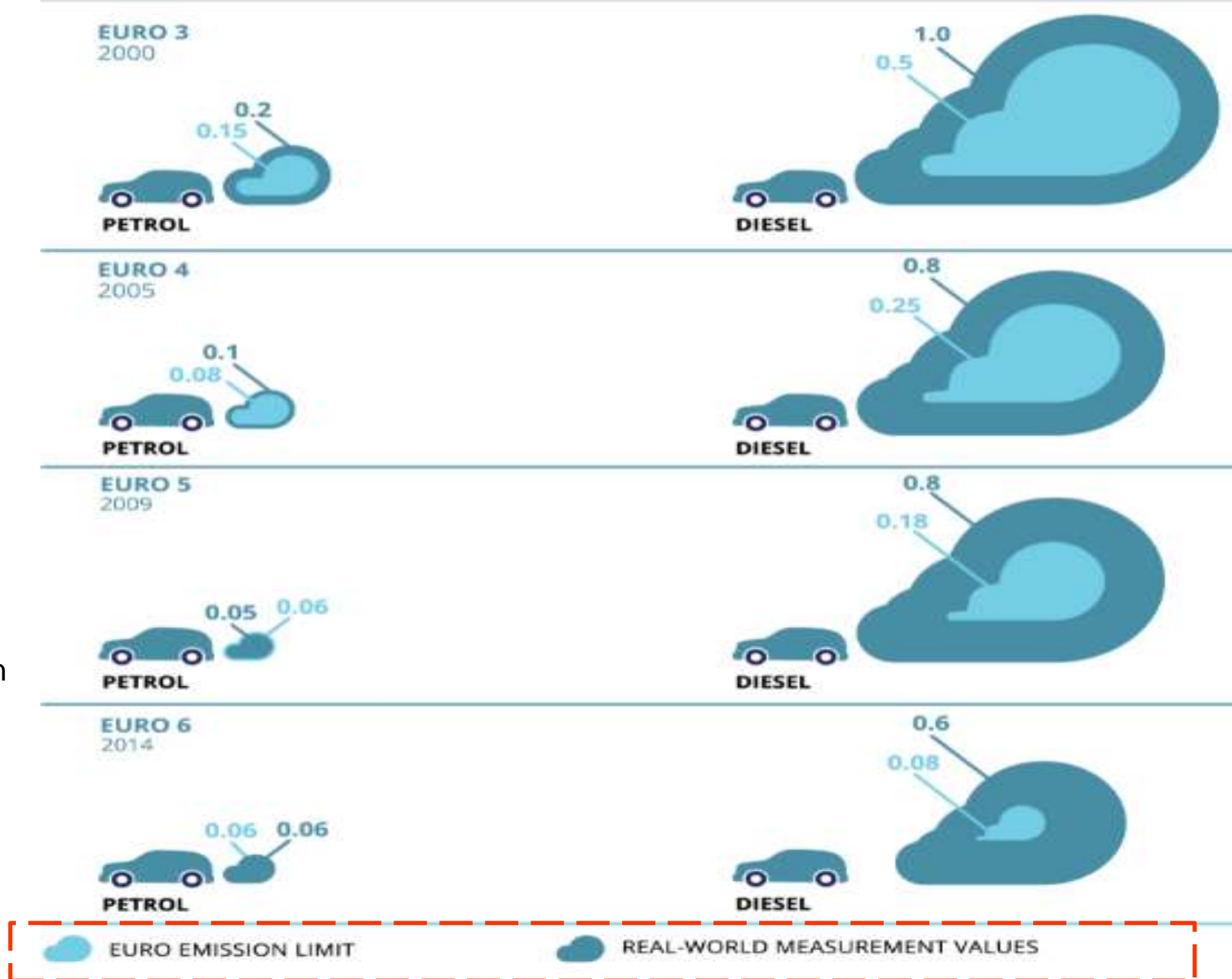
PM: 67% reduction BS4 to BS6



Challenge of Real World Emissions

Comparison of NOx emission standards for different Euro classes of Vehicles

In 2015 Volkswagen admitted to having installed emissions-cheating devices in its vehicles, which cost the company over \$33 billion in vehicle refits and regulatory fines, in the United States.

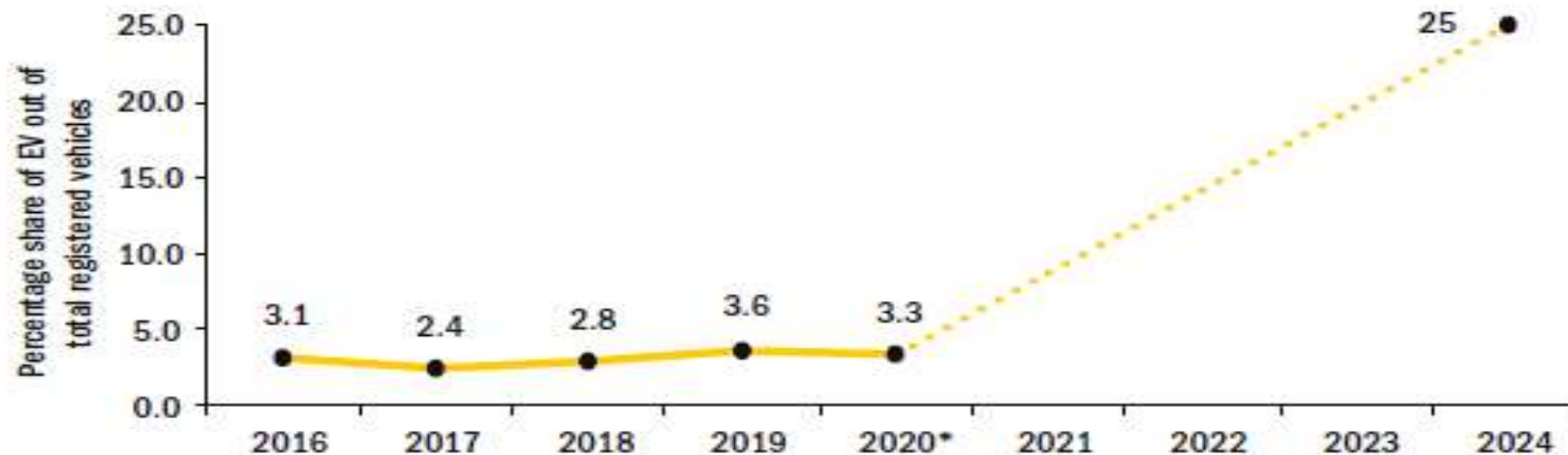


Electrification: is the future

Electric vehicles account for barely 1.3 percent of total vehicle sales in India currently.

The Delhi EV policy, envisages that 25 per cent of all new vehicle registrations should be EVs) by 2024

Share of new electric vehicle registration in Delhi and target of EV policy



*Note: 2020 registration numbers till 31 July

Source: MoRTH 2020, VAHAN Dashboard



Action taken —on road trucks

Source: Trucks

Action Taken:

- SC imposed ECC on trucks in 2015
- Number of trucks has reduced by **50-60%** after the doubling of ECC.
- Reduction in pollution by – after the ECC imposed.
- The entry of pre-2006 registered trucks (10 year old) stopped entering Delhi.
- Western and Eastern peripheral expressways are being used by many trucks now, helping reducing emissions in Delhi
- Installation of RFID based tolling is intended to reduce congestion at toll gates and streamline



On-road emissions management

- Number of PUC stations in the city; availability of 4-gas analyser; audit of the centres
- Level of compliance – how many vehicles turn up for tests
- Failure rate
- Any programme to do visual check of visibly polluting vehicles?
- Fitness and roadworthiness tests of the commercial vehicles
- Restraints on truck movement – bypassing trucks? Freight traffic: Management of warehousing, loading & unloading; Develop Urban Freight Consolidation centres in suburbs; Weigh-in-motion bridges
- Any phase out plan for older vehicles? Any scrappage policy?
- Clean fuel programme for vehicles
- Install vapour recovery system to control evaporative emissions and emissions of VOCs, benzene etc
- Intra and inter-state freight transport on railways to reduce dependence on trucks



Source: Crop residue burning

Issues and action:

- More than half of this burning happens in 3 states – Punjab, Haryana and Uttar Pradesh. 40% of all crop residue burning is attributable to Paddy Straw, 22% to Wheat Residue and 20% to Sugarcane.
- Apart from air pollution, burning crop residue results in the loss of nutrients from the topsoil layer.
- Govt has begun supporting agri-implements such as the Happy seeders, choppers and balers that can process crop residue to prepare it for utilization – either on the field or in industries
- However, the cost of agri-implements needed to reduce. As these implements are used only for two to three weeks a year, farmers do not consider these worth investing.
- Augment incentives to small farmers and making it accessible to larger number of farmers , promoting co-ownership models and encouraging its usage in power plants, bio-fuels, etc are needed. Intensive and continued action is must for lasting impact in this sector



Source: Road Dust

Action points:

- The Supreme Court had directed the Delhi government to repair the pavements and also to procure vacuum cleaning machines.
- The Delhi government has bought mechanised cleaners, ensuring dust disposal – however it has to be implemented across NCR
- Recycled water sprinkling is also a solution
- Government needs to devise wide spread green coverage



Source: Solid waste

Action points:

Local Municipal Authority

- Identify gaps in implementation in Solid waste management Rules and regulations, 2016 -- Implement decentralised waste management for residential and commercial areas
 - Properly manage landfills sites to prevent fires
 - Enforce complete ban on garbage burning
 - Ensure proper collection of horticultural waste and composting cum gardening – create facilities
 - Waste to Energy Plants – Only if needed - Strict implementation of emission norms, use state-of-art technology; provide emission data to SPCB
 - Implement emission norms for incinerators
 - Ensure robust collection system that focuses on collection of segregated waste.
 - Develop a siting policy for WTE plants.
 - Roadmap for zero landfill policy
-
- Help poor people during winter -- warm cloths, electric heaters, night shelters



Source: Industrial waste burning

- Need enforcement
- Waste management – recycling



Mobility crisis- Must recognise the threat and opportunity

Cars and two wheelers occupy 90 per cent of road space

Inadequate safe space for sustainable modes such as bicycle or walking, buses and last mile connectivity modes

40-60% use bus and metro

10-20% cycle

20-30% walk

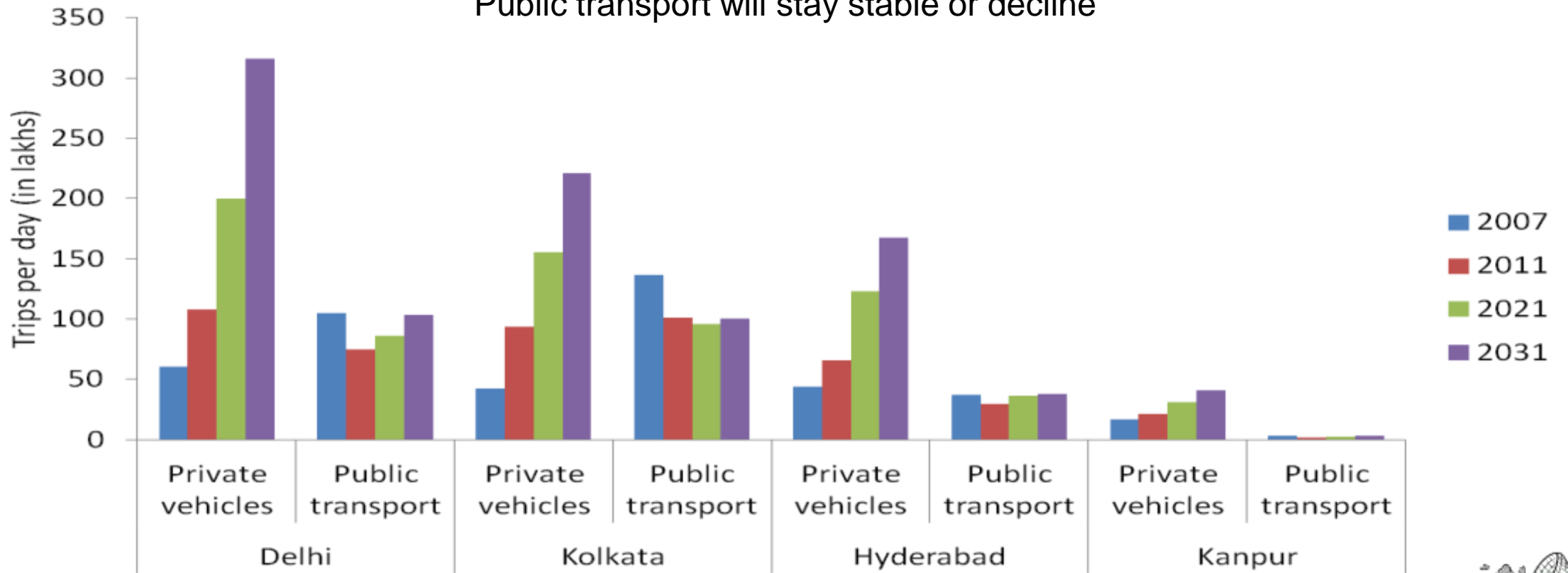
Only 10-20% use car and two-wheeler



Shadow of things to come

Travel mode share 2007-2031

Private vehicle usage will increase.
Public transport will stay stable or decline





Public transport needs safe walk access

In Delhi accidents near foot over bridges
have increased



Delhi: wrong road design force people to cross in unsafe manner. This compromises public transport usage



Public transport needs
safe walk access

In Delhi accidents near
foot over bridges have
increased



Delhi's Karol Bagh: Impact of pedestrianisation of streets (CSE, May 2019)

- Car-free Ajmal Khan Rd of Delhi has lower particulate exposure & 2.7 times more pedestrian count than surrounding roads.

Before



After



- PM_{2.5} exposure on Arya Samaj Road was much higher than pedestrian only street during late afternoon/early evening.
- The exposure on Arya Samaj Road was 35 per cent higher than the car free stretch of Ajmal Khan



Air pollution: great equalizer

- **Air pollution is a great equalizer:** rich cannot buy their way out of the air pollution crisis – at the same time poor also suffer more
- **Airshed is one and has no boundaries** – cities, rural areas all get impacted in a region

Therefore, we need to take action.

Governments are responding to control air pollution; action initiated. But much more needs to be done and this needs us to think differently.

Act with scale, speed and with difference in strategy



THANK YOU