Clearing the air in our cities: Agenda for action

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With
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Centre for Science and Environment

Kolkata City dialogue

Kolkata, January 30, 2016

Air pollution makes headlines in Delhi

City enveloped in smog, back to pre-CNG

Gains Of Switch To Cleaner Fuel Frittered Away

Neha Lalchandani | TNN

New Delhi: Delhi's air pollution has reached alarming levels. For proof, just look out of the window. The grey-white 'haze' that has been covering the city since October 28, say experts, is actually smog that is linked to the rapid rise in

▶High pollution, P 6

CITY AIR WORSE THAN EVER

Delhi winter smog is not an act of God

Nov 22, 2012

During the first week of November, Delhi went under a thick h
smog. The breeze nearly stopped, and the skies tur
and calm weather led to fumes settling cl
masks, scarves or handkerchiefs

The resultant outcry in the smog-h
nothing new and that it happened e

The new twist came
agricultur

'सांसों' पर स्मॉग की 'स्याह' परतें

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

Smog leaves Delhi gasping for breath

TNN | Nov 3, 2012, 01.33 AM IST

poisonous gases . Not co- air quality, the judiciary (See graphic—)

insisting that this was

billowing

Smog delays Sheila Dikshit's flight to Punjab

2.44AM IST

| Punjab | NASA | flight | Flashpoint | Apex

udhiana trip by Delhi chief minister Sheila Dikshit in a chartered
telecom industrialist family became the flashpoint of the ongoing
Delhi and Punjab when the plane was delayed by nearly three hours

Disadvantage Delhi: Smog here to stay

Darpan Singh, Hindustan Times
New Delhi, November 08, 2012

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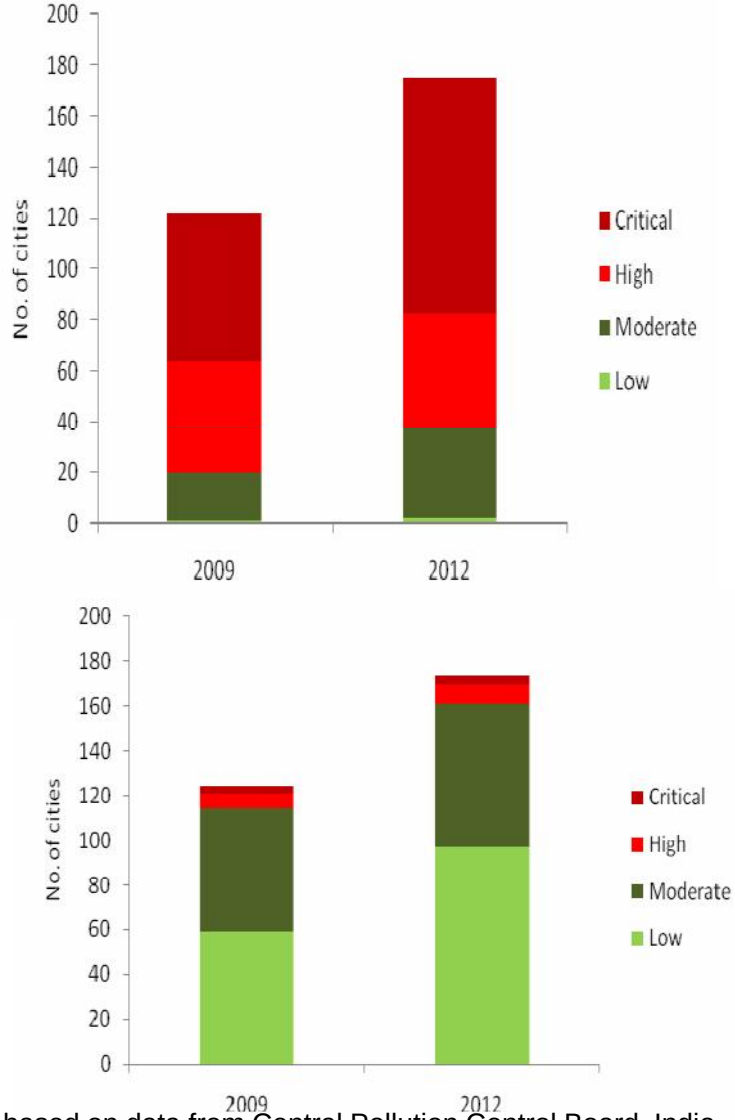
email print 0 Comments Like 3 Tweet 0

The Centre for Science and Environment (CSE), in its latest report, has delivere
The smog is here to stay. It has also warned that Delhi is in the grip of a multi-p
matter is not the only thing choking us. Nitrog

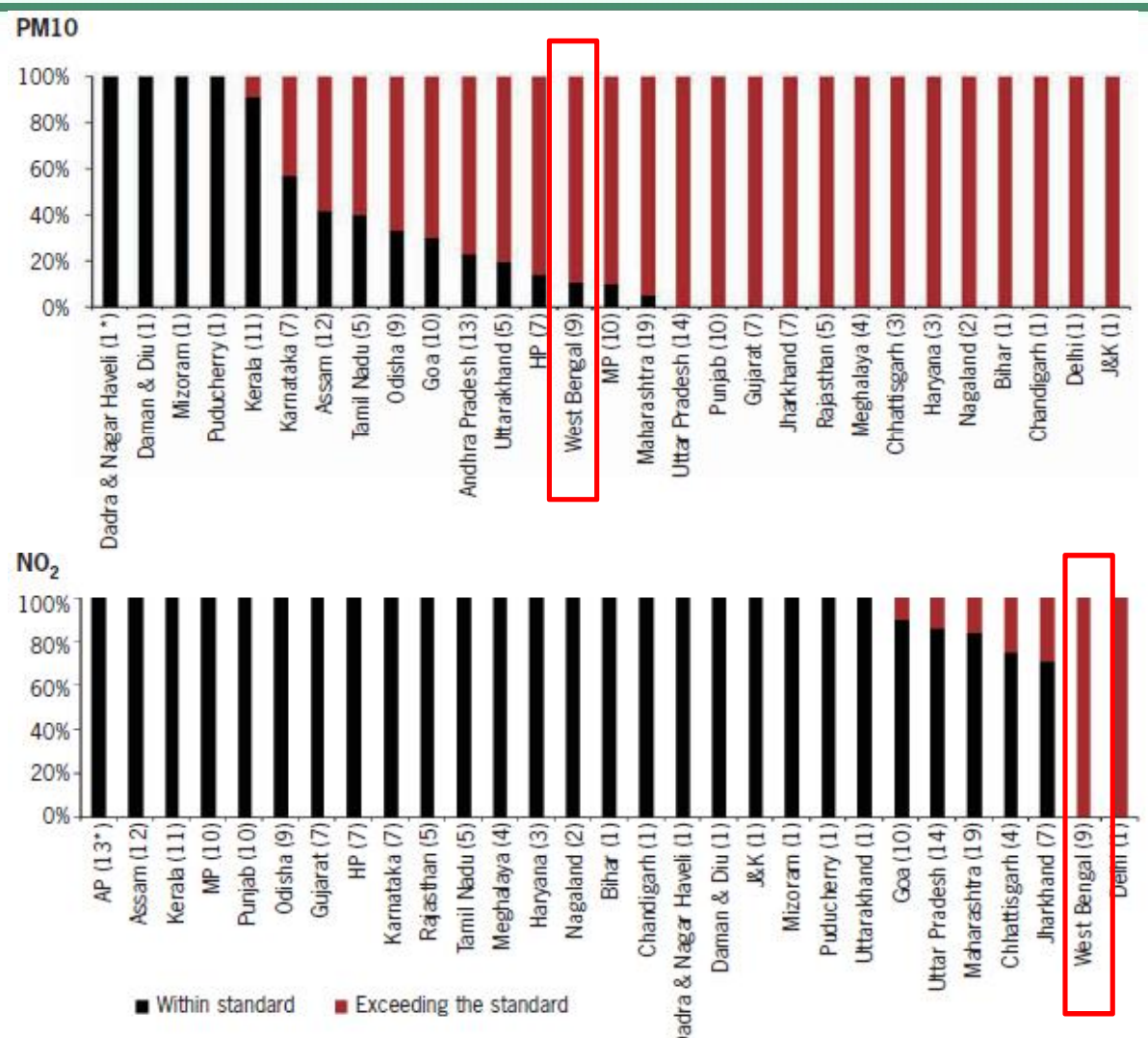
India: In grip of killer particles and multi pollutant crisis

- Close to half of urban population breath the air which exceeds the standard of PM10.
- NO_2 is rising steadily
- Ozone levels are rising
- Unacceptable levels of toxins and heavy metals



Source: CSE computed based on data from Central Pollution Control Board, India

Cities of West Bengal: In grip of air pollution crisis



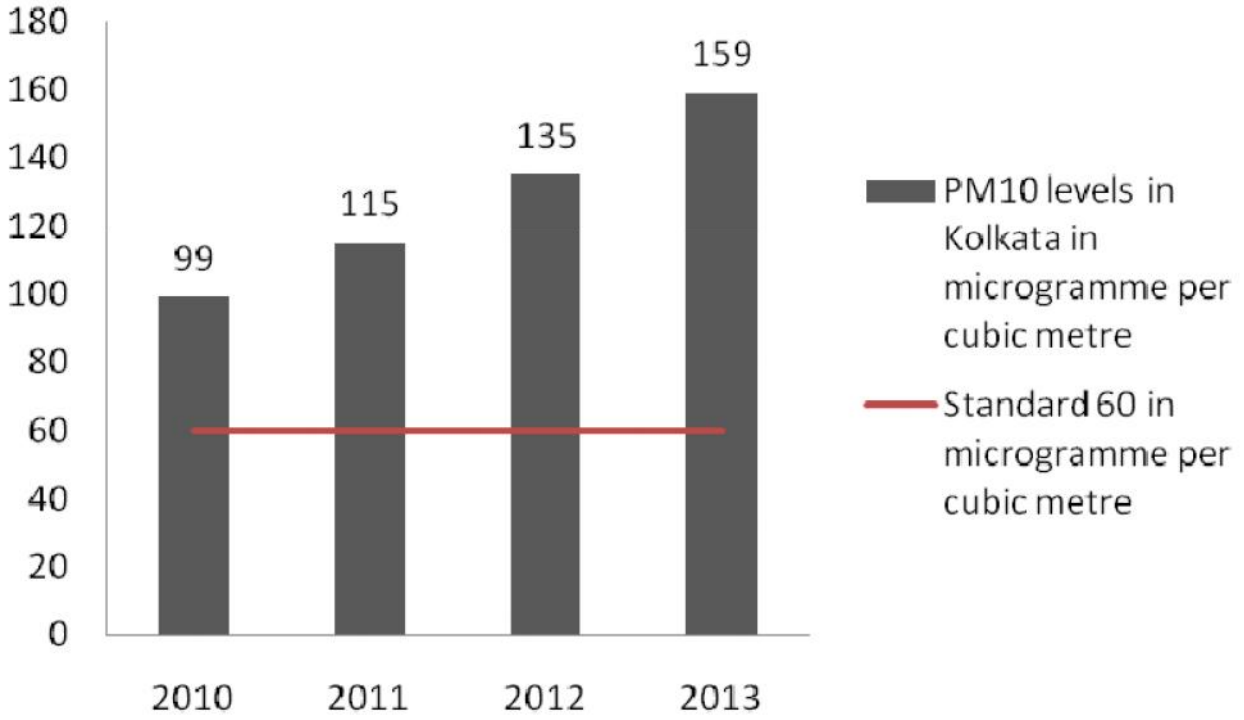
78% cities in West Bengal **exceed PM10 Standards**

All cities monitored **exceed standard for Nitrogen dioxide**

Source: Based on the CPCB report -- National Ambient Air Quality Status & Trends In India-2010, Central Pollution Control Board, Ministry Of Environment & Forests, January 2012

Killer particles in Kolkata’s air

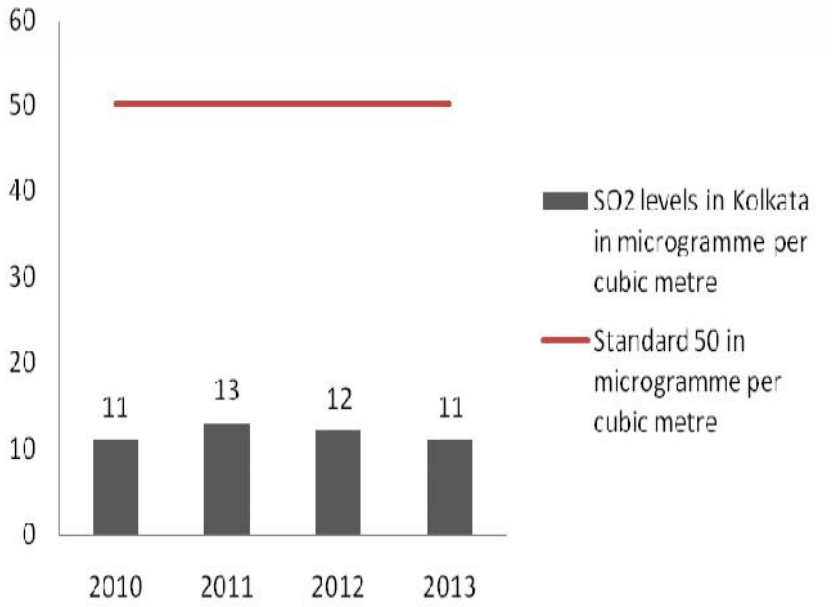
- PM10 levels 2.7 times the standard



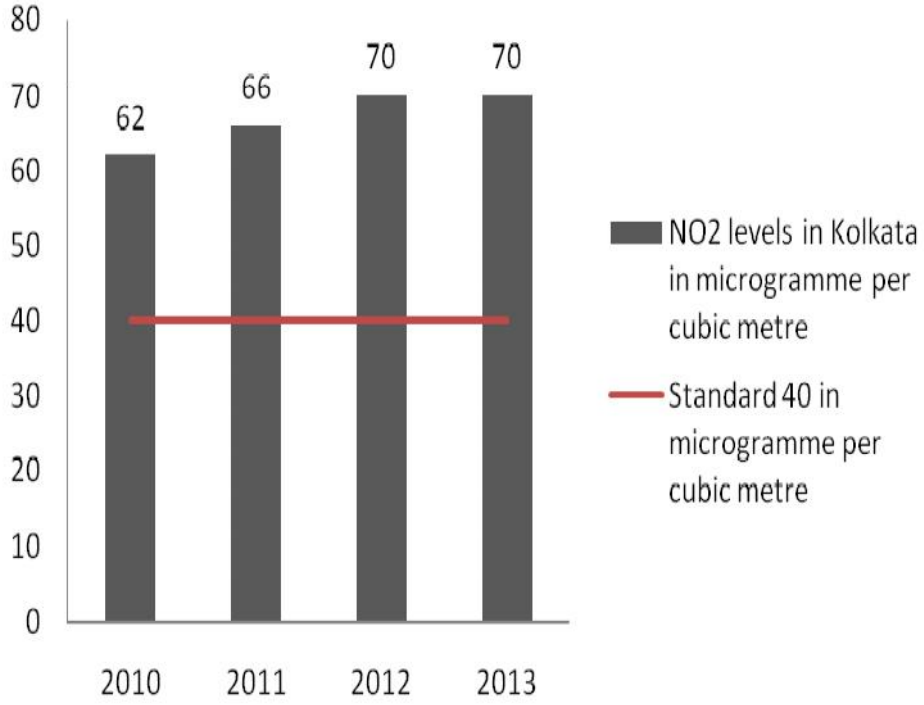
Source: Based on data provided in Parliament questions and answer sections

Wins and losses

- **Sulphur dioxide levels under control. But Kasba, Dalhousie and Cossipore experience periodic rise**



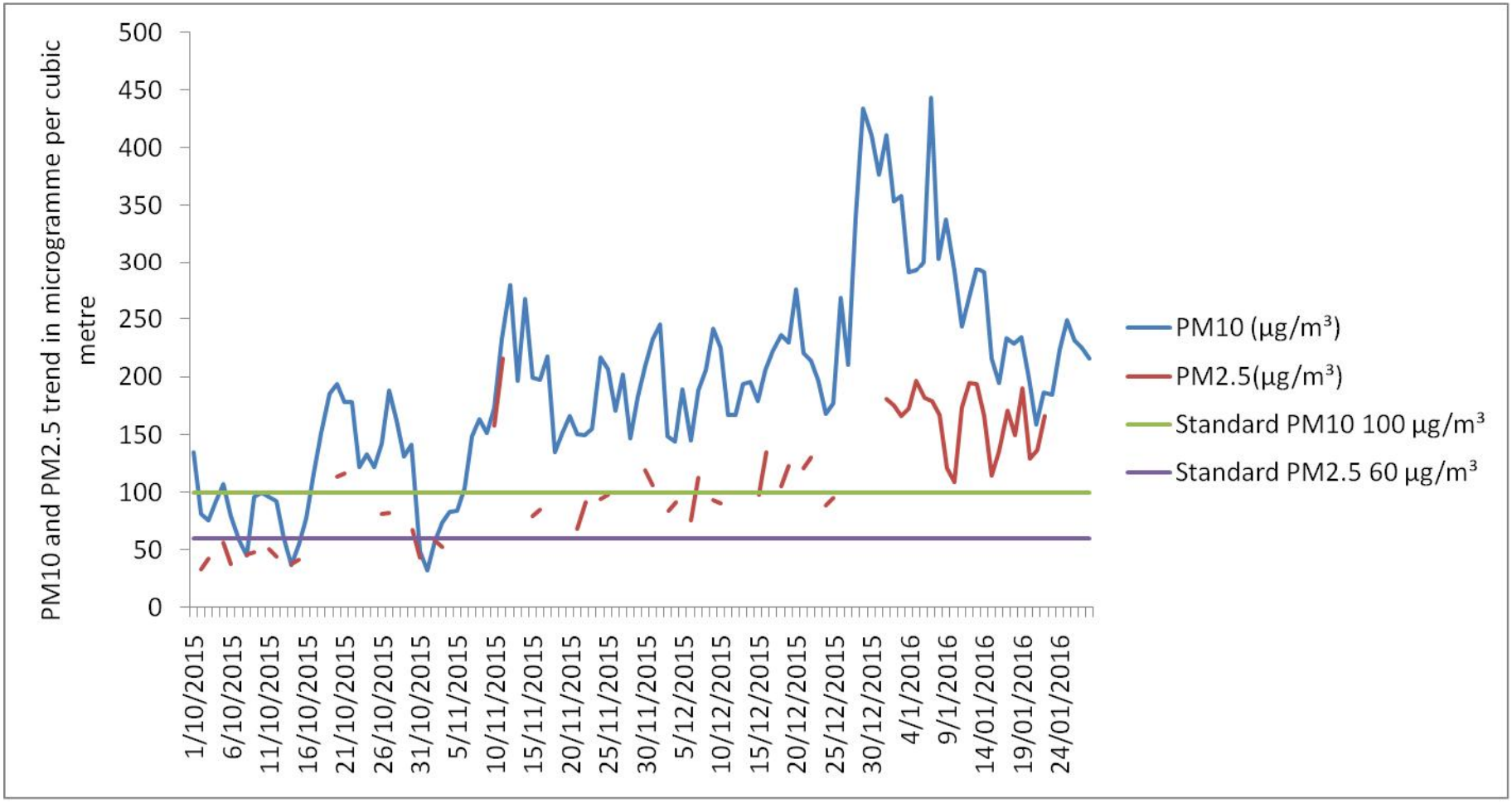
- **Nitrogen oxide levels rising -- exceeding standard by 1.8 times**



Source: Based on data provided by Ministry of Environment and Forests

Winter woes

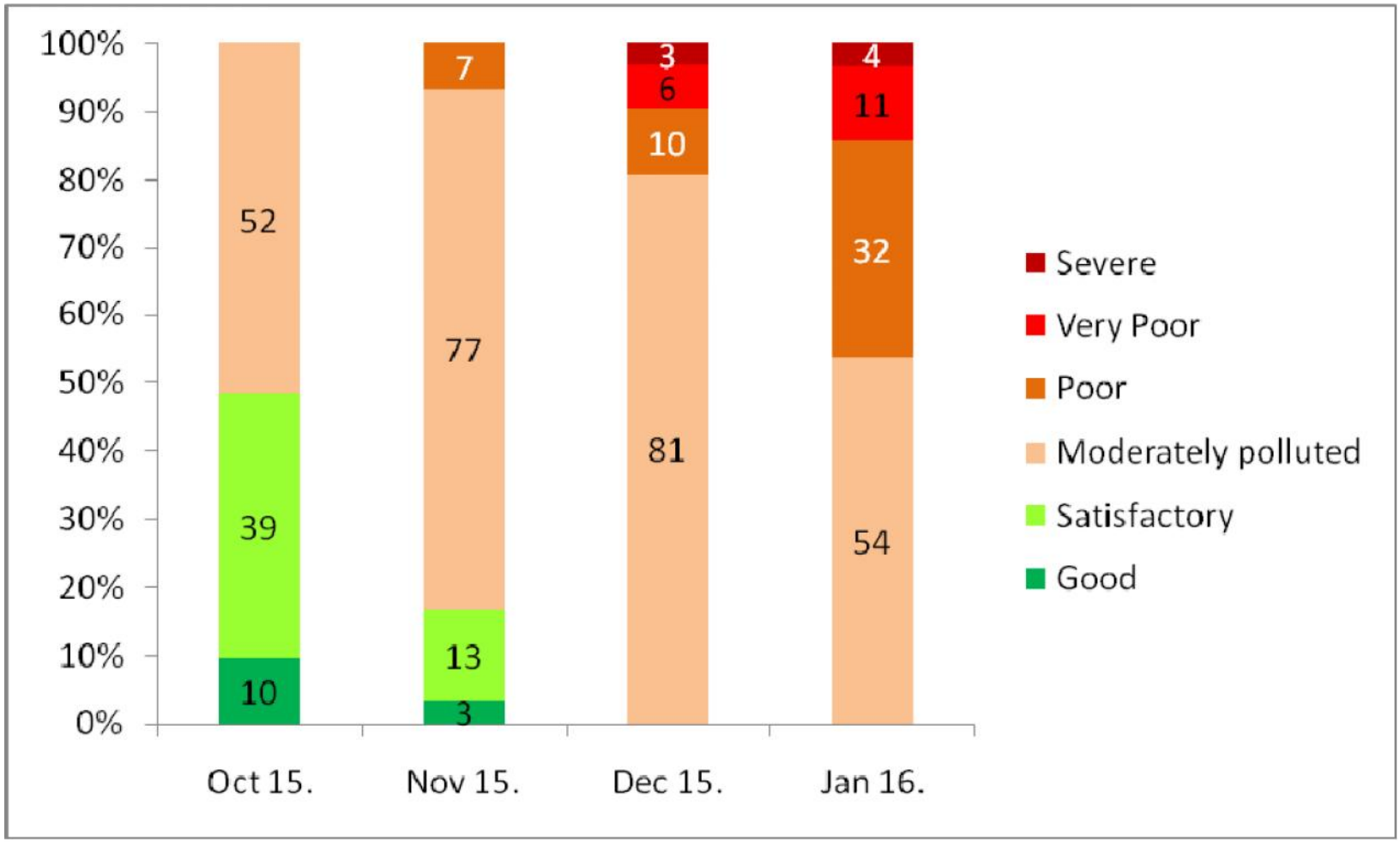
- **During winter particulate levels hit four times the standards**



Source: Based on WBPCB data

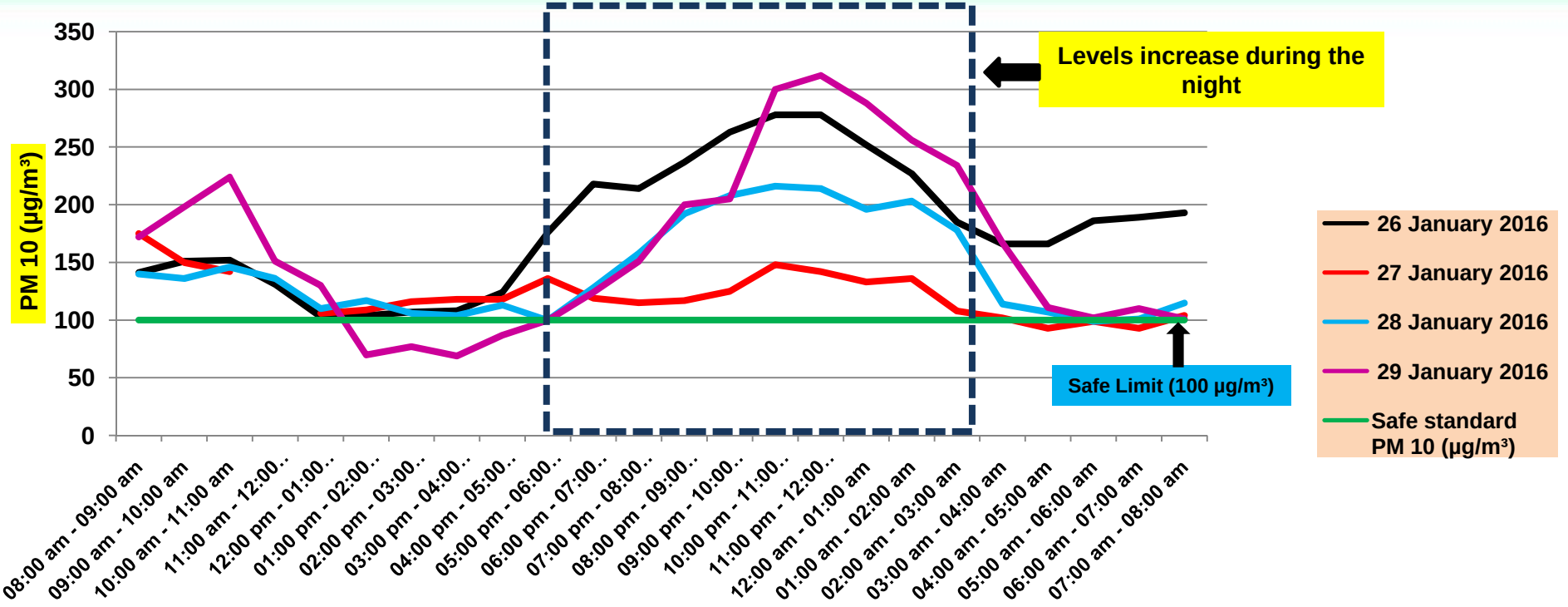
More days in poor and severe category during winter months

- During the January month 47% of the days are in poor, very poor, severe category (till 28th Jan 2016)



Source: Based on WBPCB data

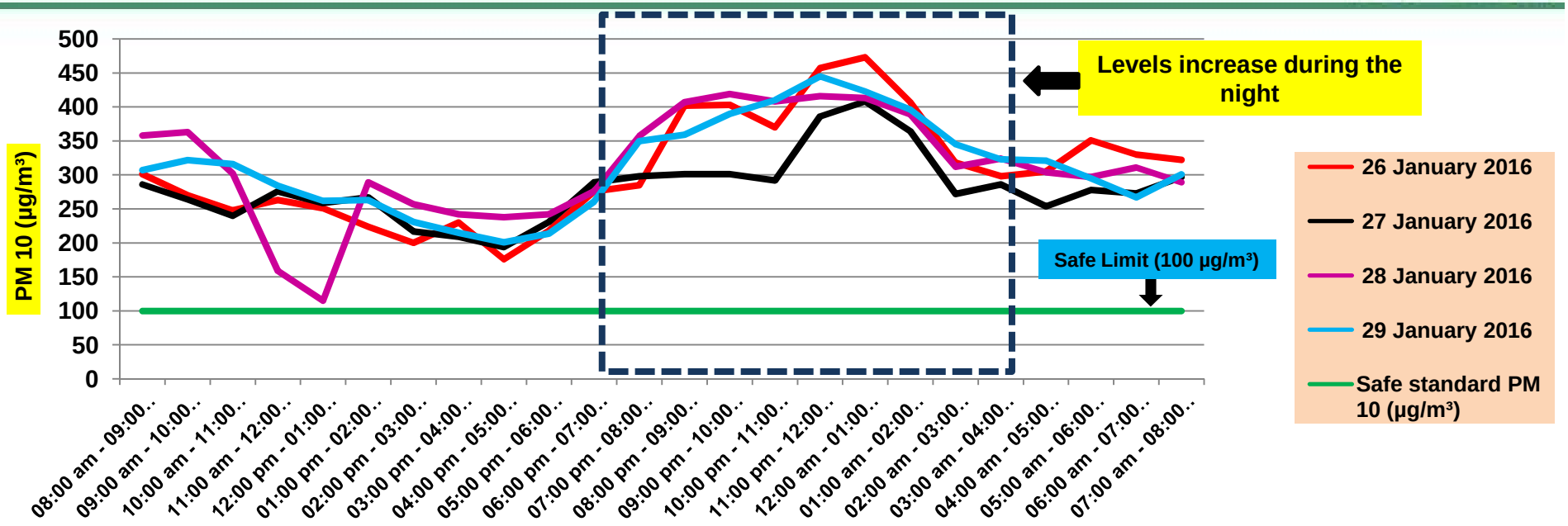
Hourly average of PM 10 at Victoria Memorial Station
High night time pollution during winter



(Source: Based on data provided by real time air quality monitoring by West Bengal Pollution Board)

•The average PM 10 levels for Victoria memorial station was 150 µg/m³ which is 1.5 times of the safe limit of 100 µg/m³.

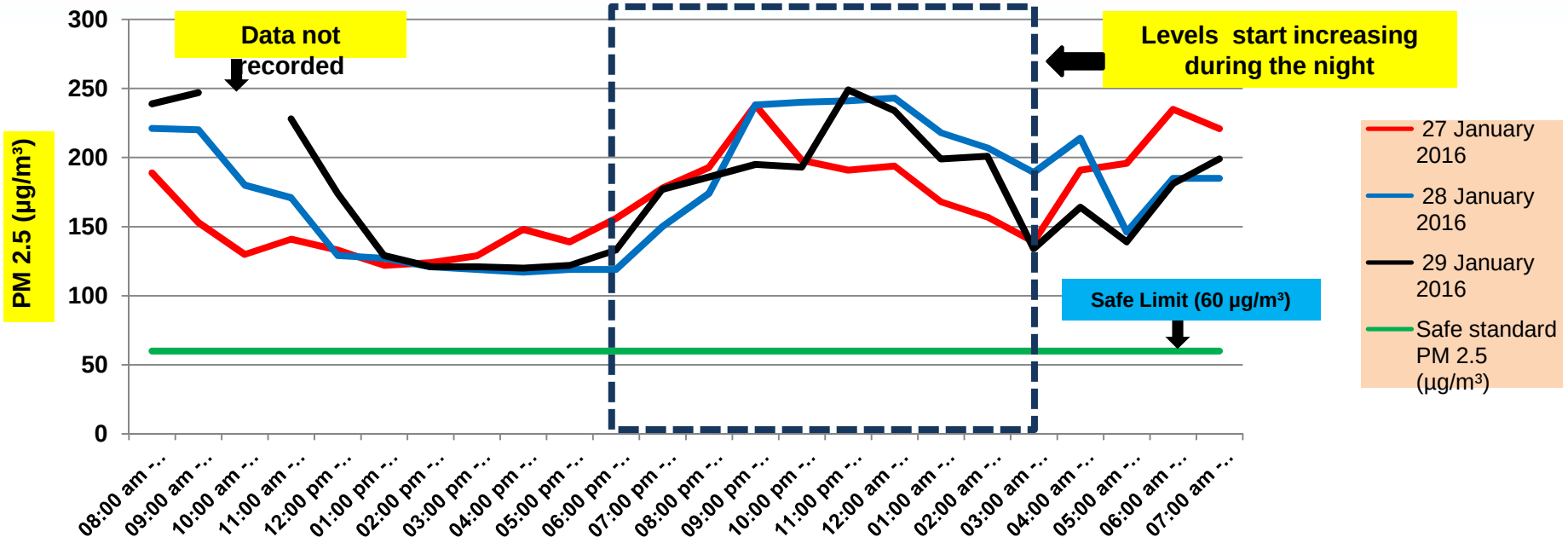
Hourly average of PM 10 at Rabindrabharti Station



(Source: Based on data provided by real time air quality monitoring by West Bengal Pollution Board)

•The average PM 10 levels for Rabindrabharti station was 300 µg/m³ which is 3 times of the safe limit of 100 µg/m³.

Hourly average of PM 2.5 in Kolkata



(Source: Based on data provided by real time air quality monitoring by US Embassy, Kolkata)

- The average levels of PM 2.5 monitored is 170 µg/m³ which is 3 times of the standard limit of 60 µg/m³.
- The levels started building during night.
- NGT order on PM2.5 monitoring

Pollution hotspots

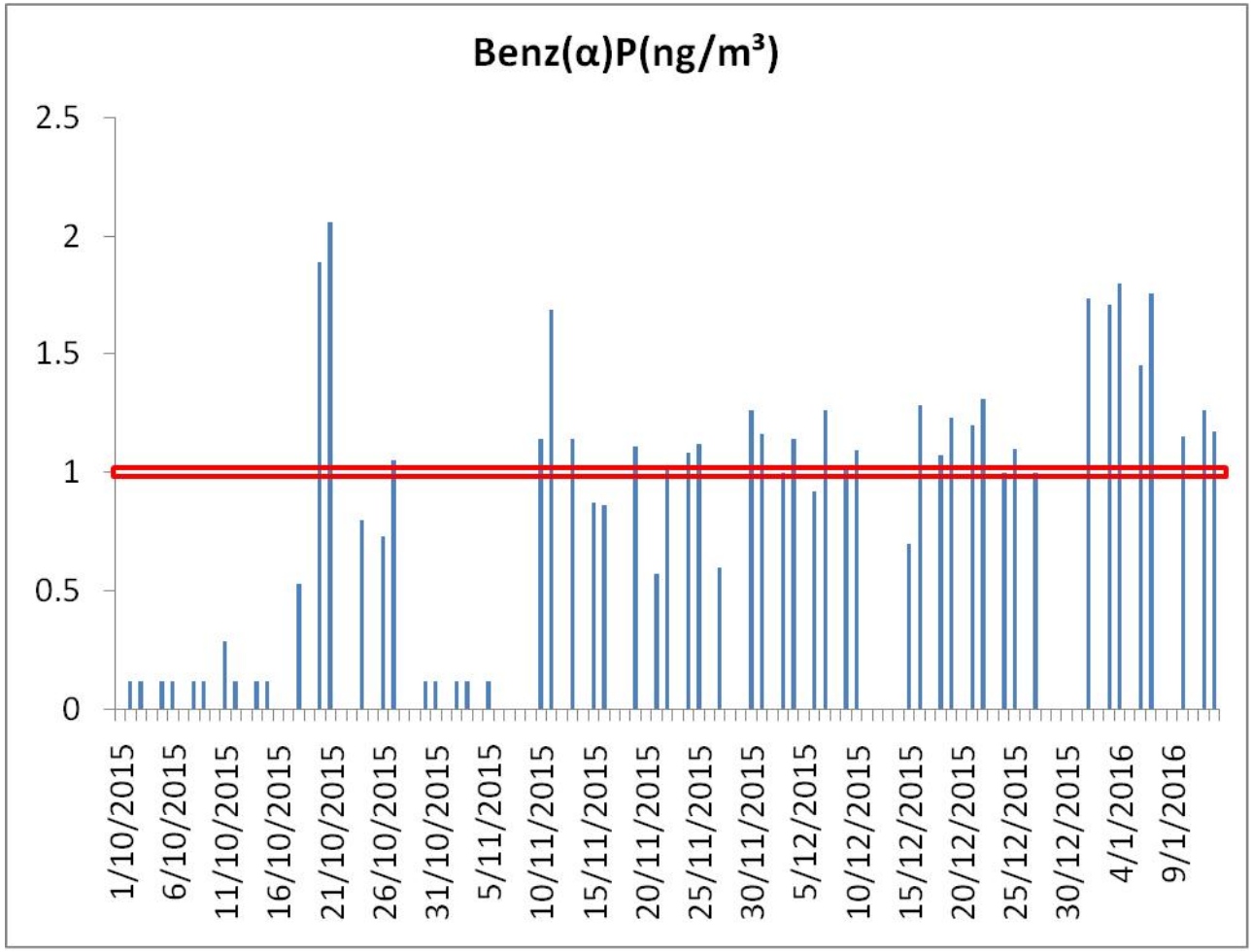
Unique challenge,-- both PM10 and NO2 levels are at critical level in most locations

	SO2	NO2	PM10
Salt Lake, Rooftop of CK Market	Low	Moderate	High
Moulali, Rooftop of KMC office Building	Low	Critical	Critical
Minto Park, Inside Park AJC Bose Road	Low	High	Critical
Dunlop Bridge, National Sample Survey	Low	High	Critical
Behala Chowrasta, Traffic Guard Building	Low	Critical	Critical
Baishnabghata, Upanagari Sporting Club	Low	Critical	Critical
Cossipore Police Station, B.T. Road	Low	Critical	Critical
Dalhousie Square, Lal Bazzar Police Headqtr.	Low	Critical	Critical
Kasba	Low	Critical	Critical

Source: Based on CPCB data 2012

Air toxins are dangerous even at small doses… carcinogens

Winter trend of benzo(a)pyrene in Kolkata

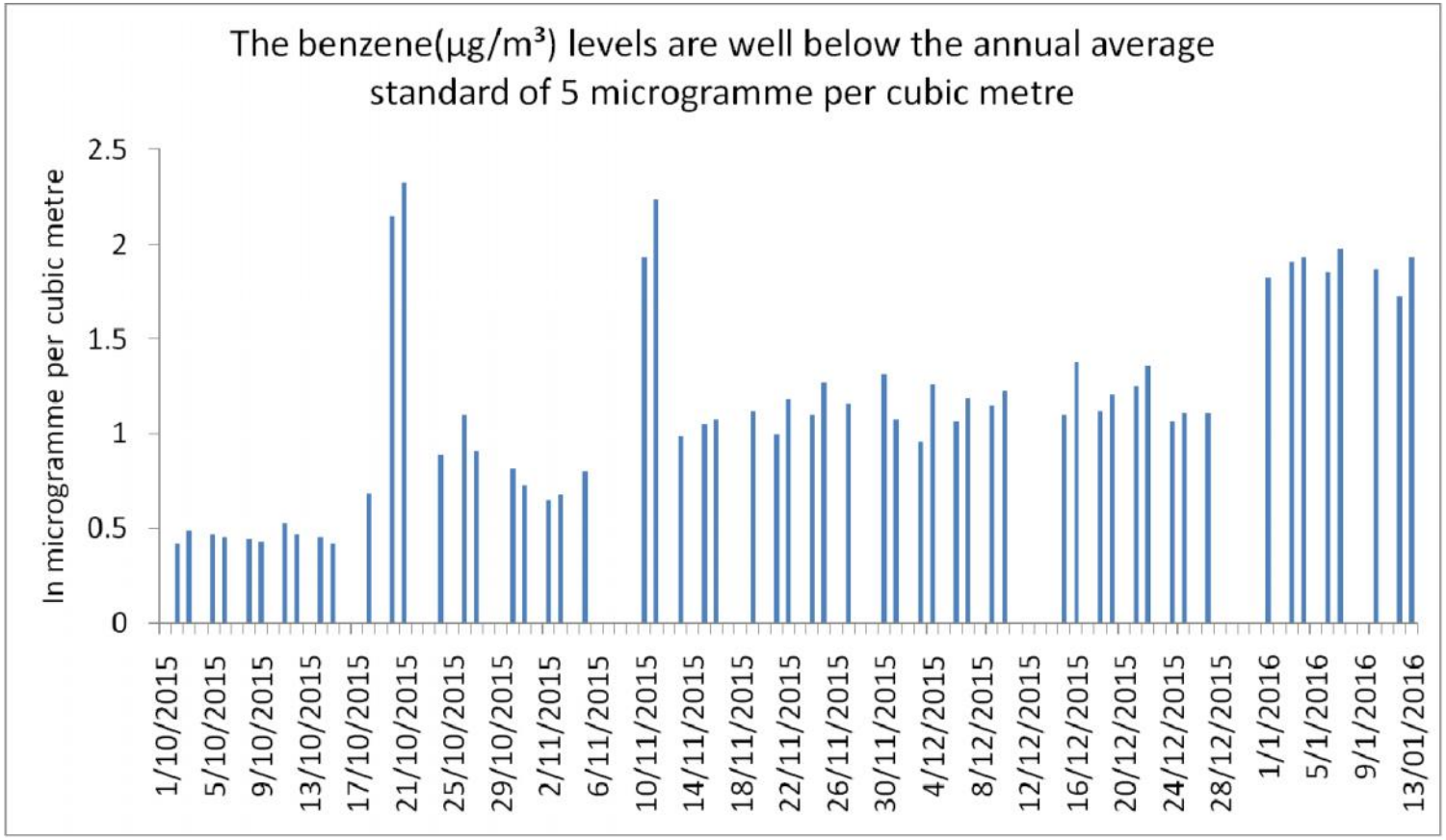


Source: Based on WBPCB data

- Air toxins are carcinogens

Benzene levels lower than the last decade

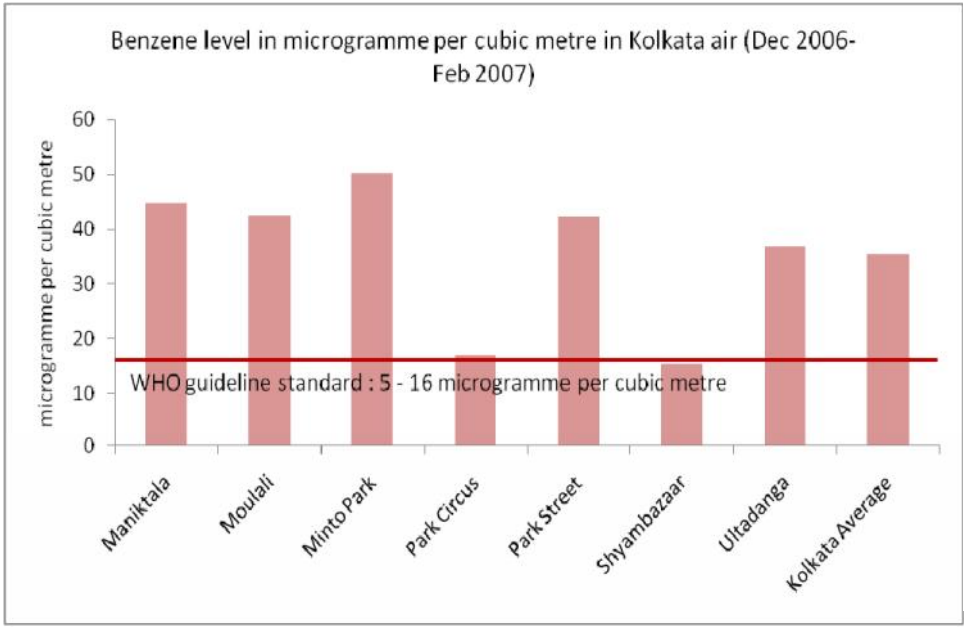
Winter trend of benzene



Source: Based on WBPCB data

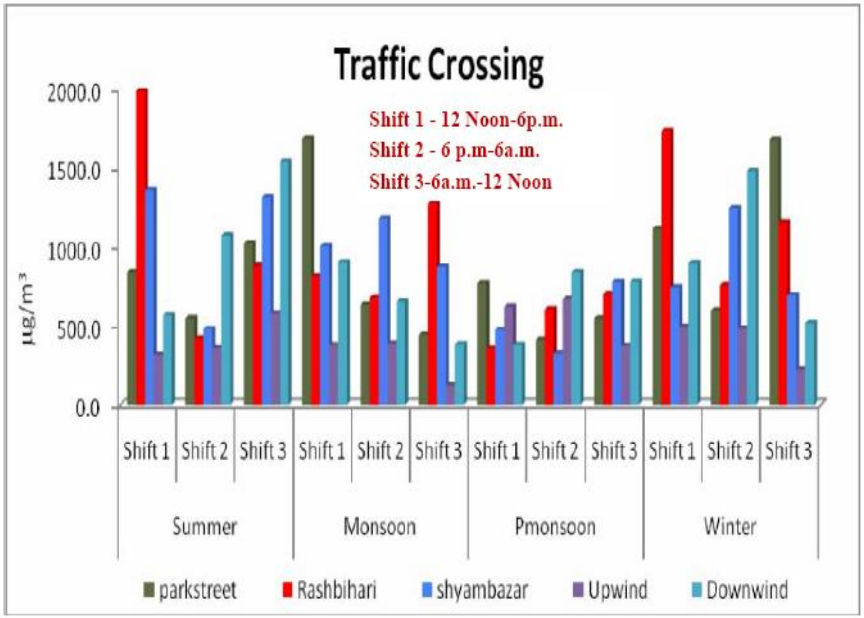
Air toxic levels: dangerous at trace amount

The carcinogen benzene in Kolkata



Source: Based on presentation of D Chakraborty 2009, Alarming air quality of Kolkata – a real health concern..,, Chief Scientist, West Bengal Pollution Control Board

Total carbonyls at Traffic Inter. in Kolkata (seasonal variations)



Source: CPCB 2010, Study of Urban Air Quality in Kolkata for Source Identification and Estimation of Ozone, Carbonyls, NOx and VOC Emissions, Cotntrol of Urban Pollution Series: CUPS/72/ 2010-11, August, 2010

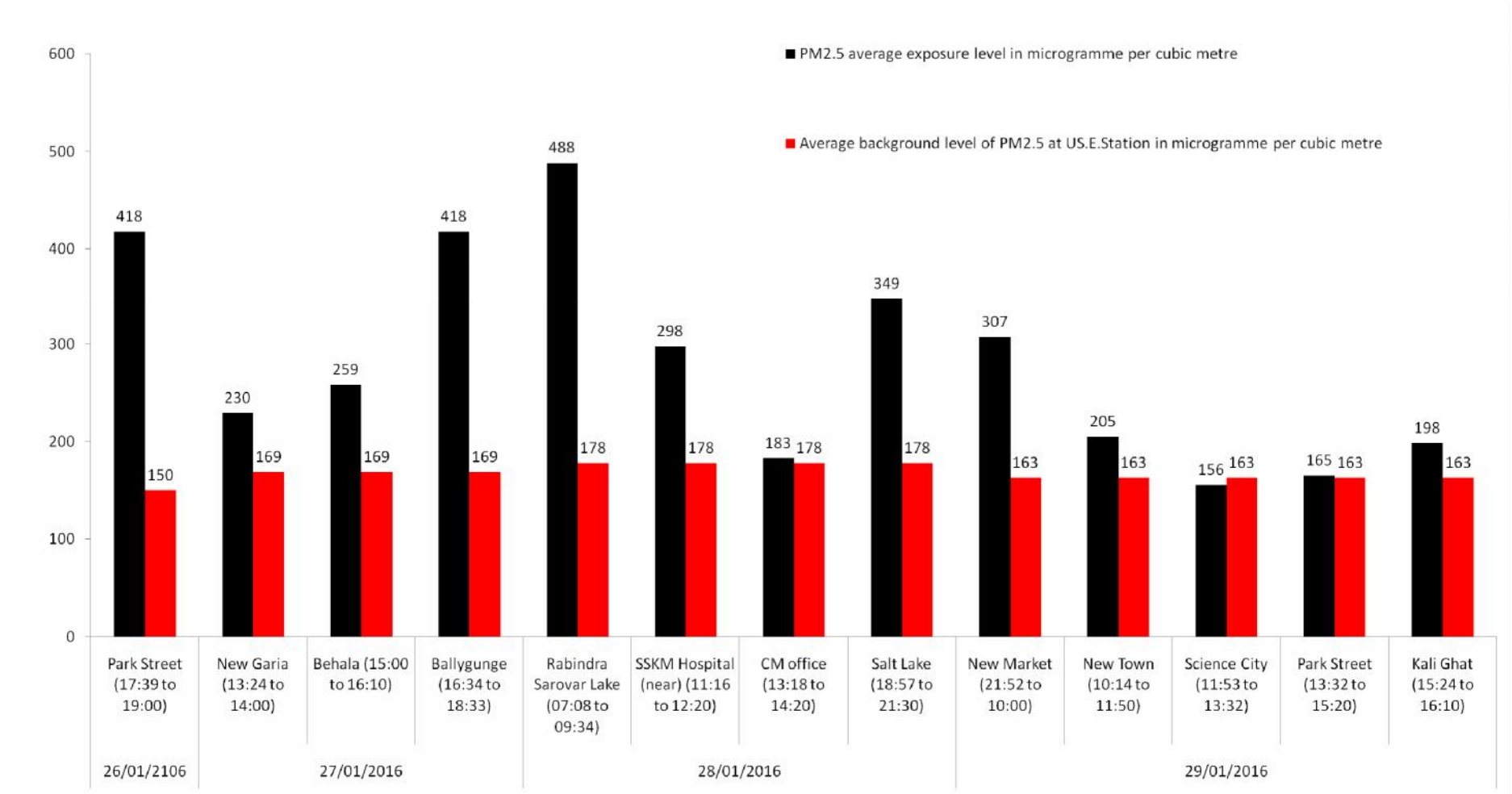
CSE exposure monitoring.....

--- Dustrak Aerosol Monitor measures mass and size of particulate matter.

--- Monitoring in sensitive areas -- hospitals and schools, and residential areas. Monitoring on different transport modes including
walking, bus, car and auto.

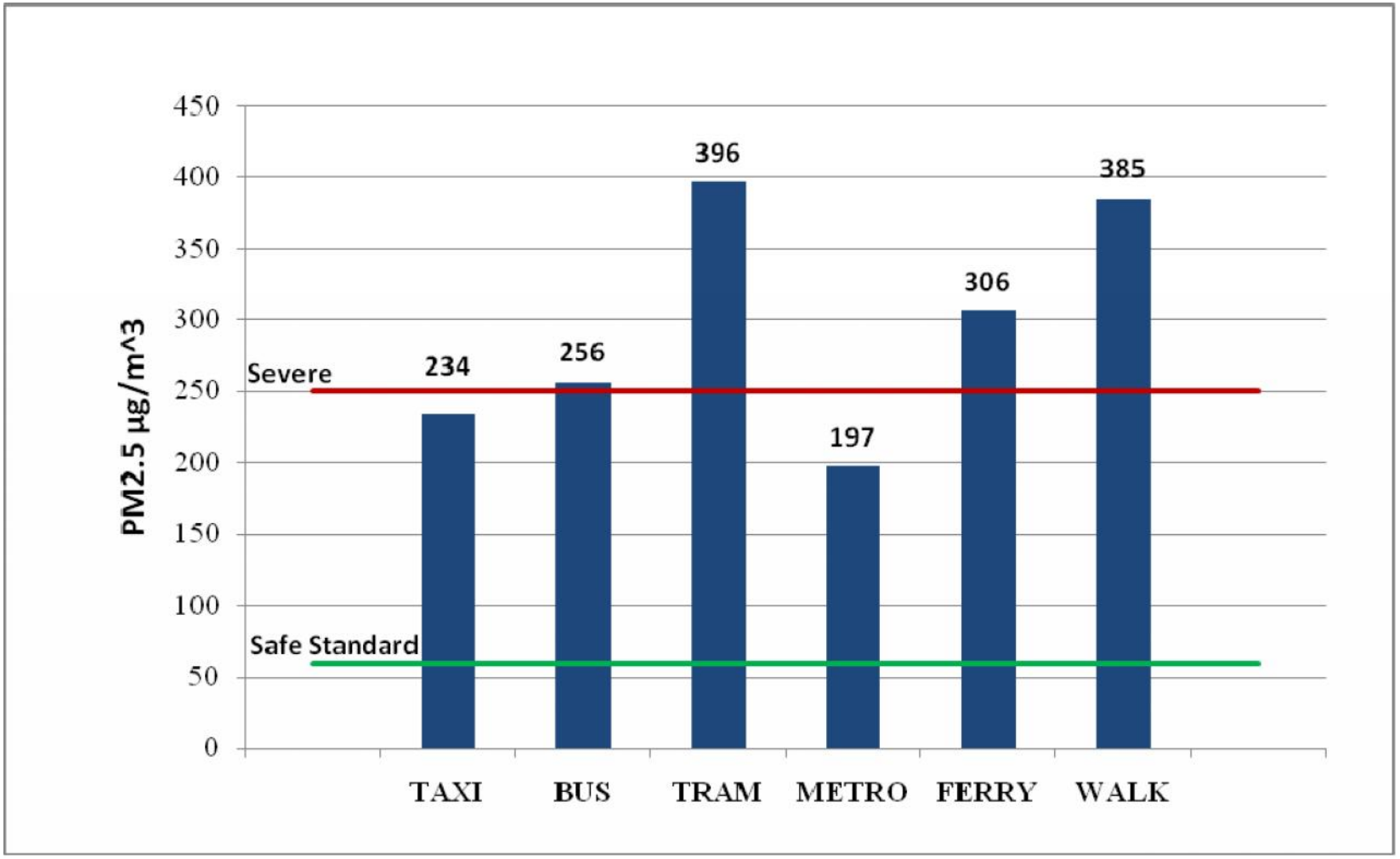
--- Exposure compared with background ambient levels from official ambient air quality monitoring. Captures what people are exposed to in immediate surroundings. This has direct impact on health.

Exposure to PM2.5 -- one to 3 times higher than the ambient levels

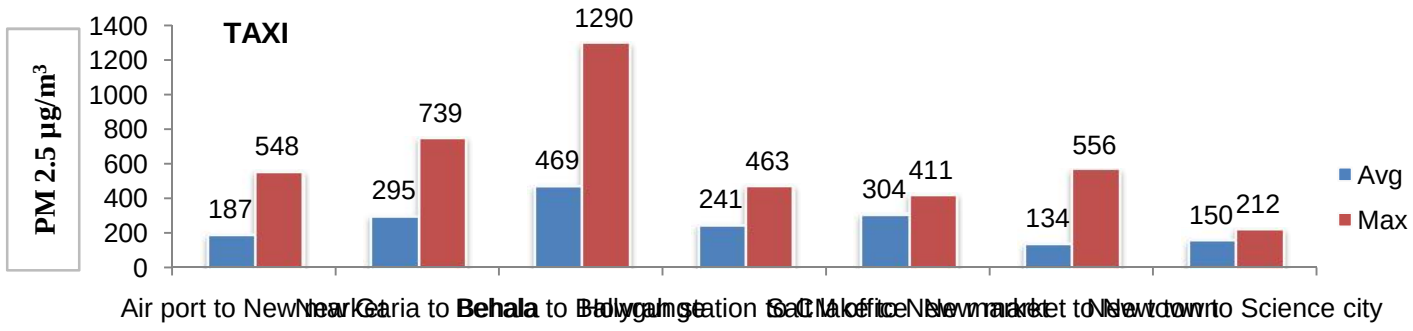


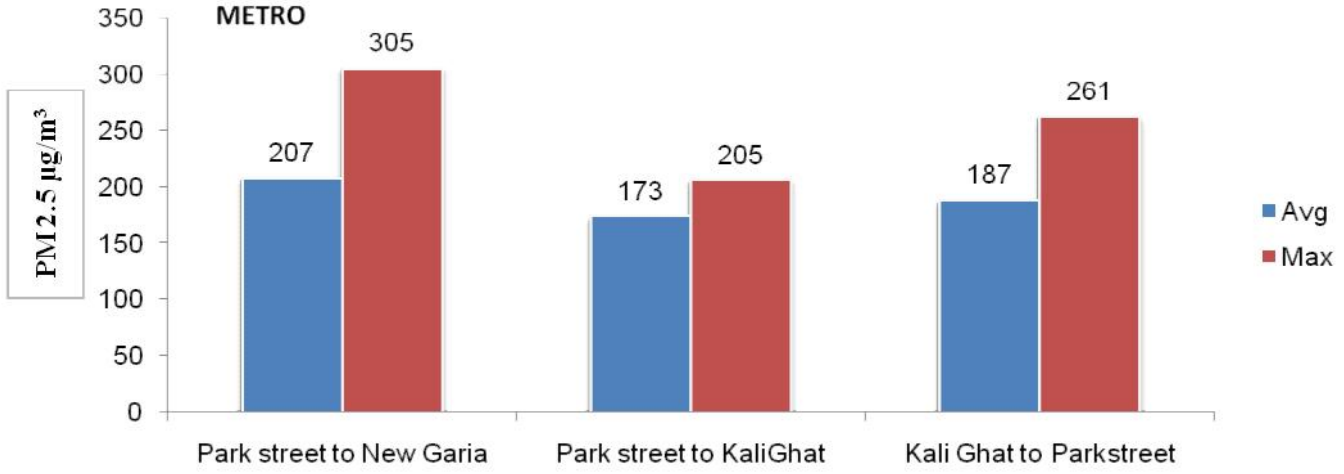
Walkers and public transport users are inhaling very high pollution in Kolkata. AC car users are also not safe

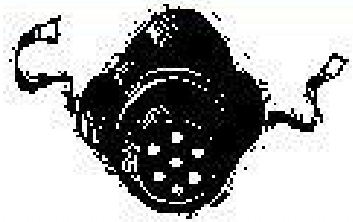
High exposure while travelling…



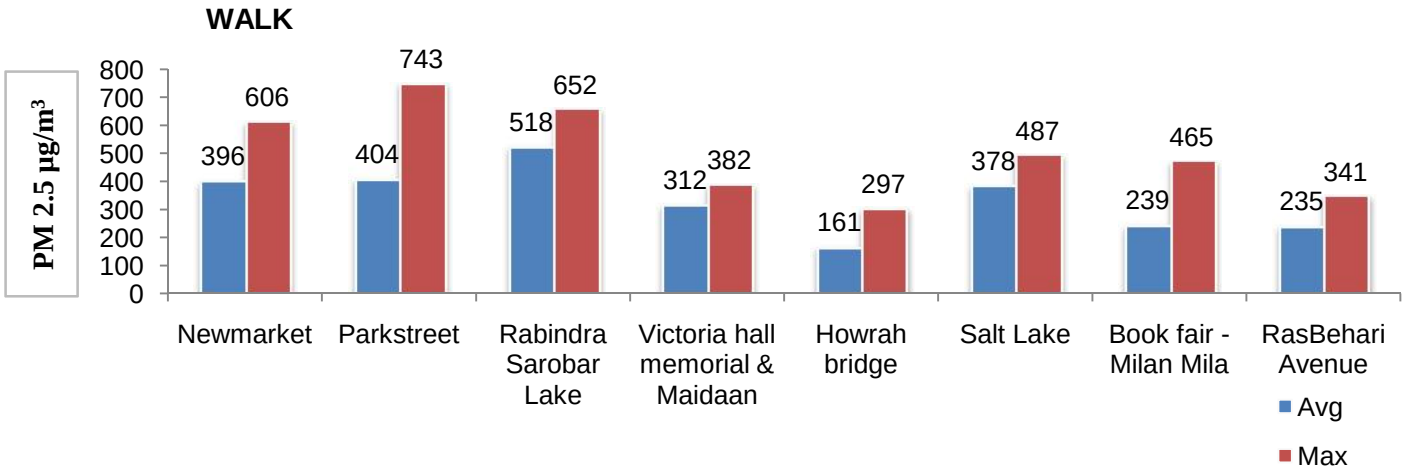
Maximum exposure can be very high

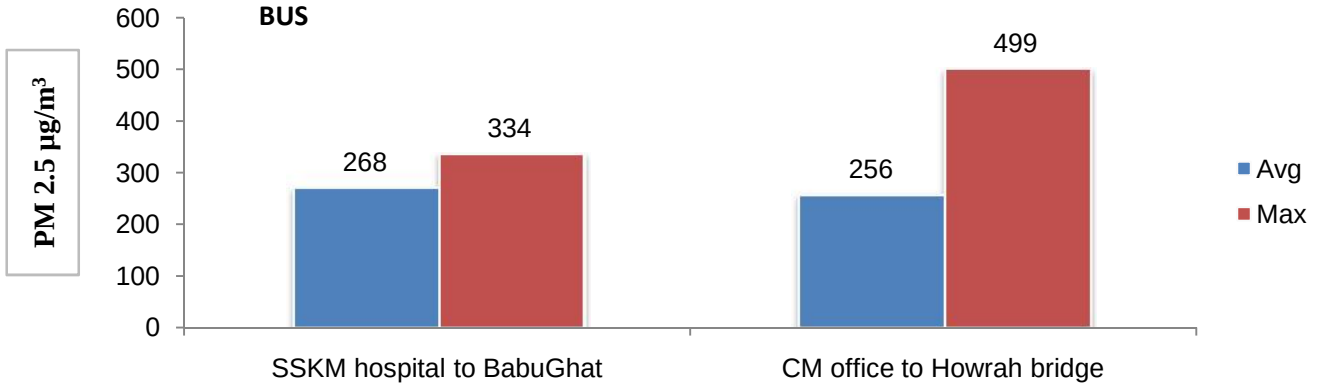




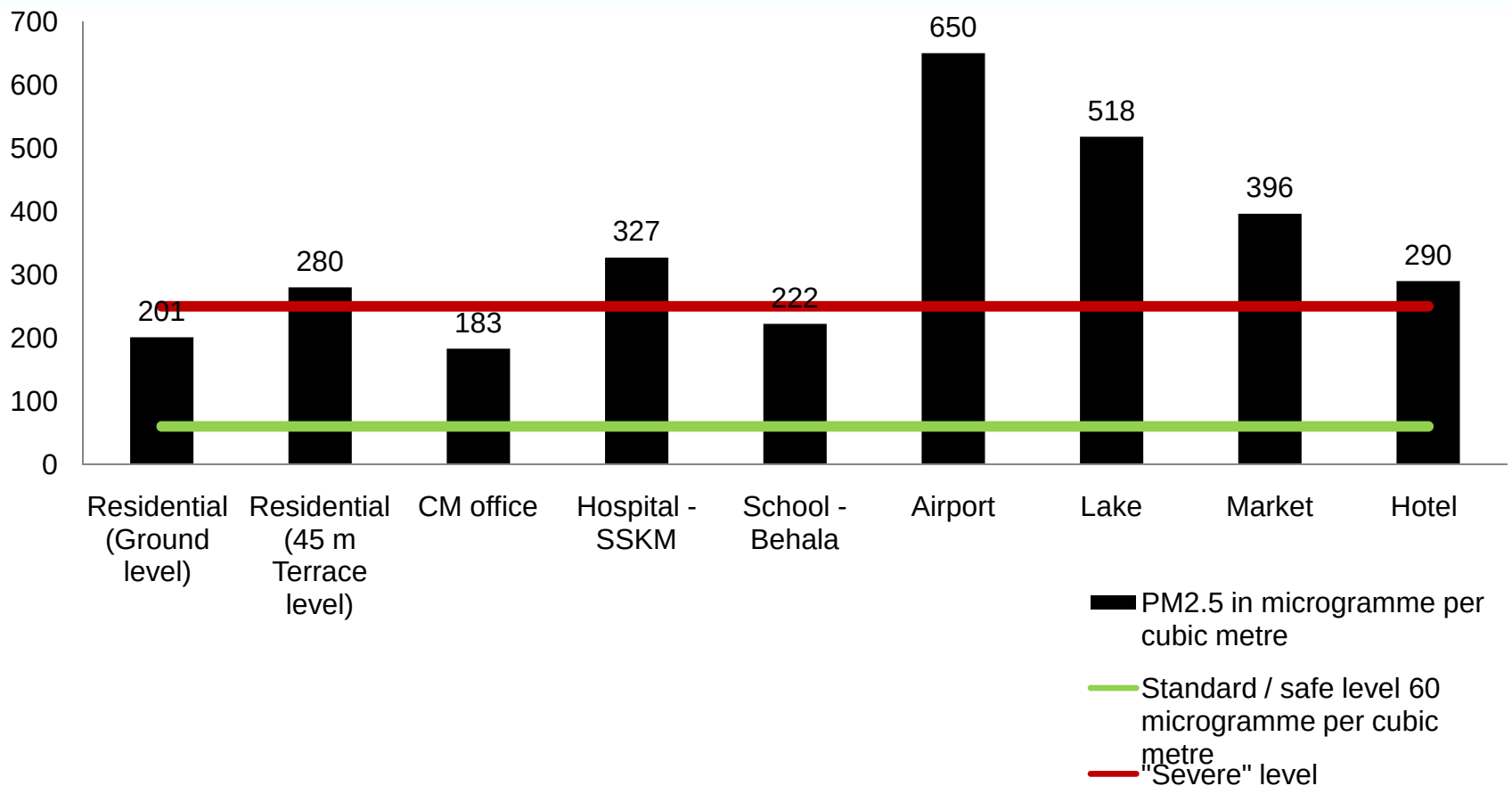


High exposures...



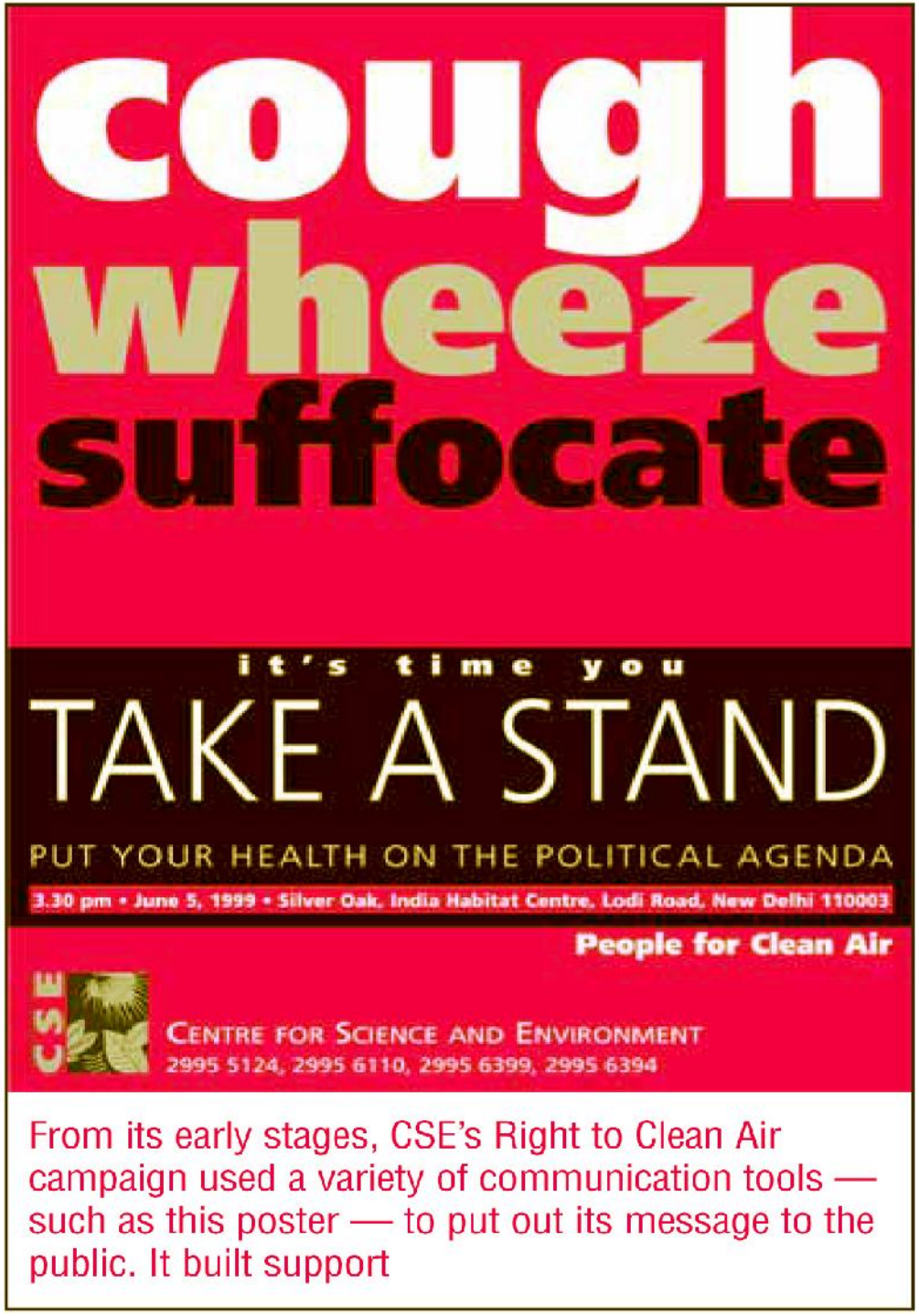


Mapping exposure in micro environment



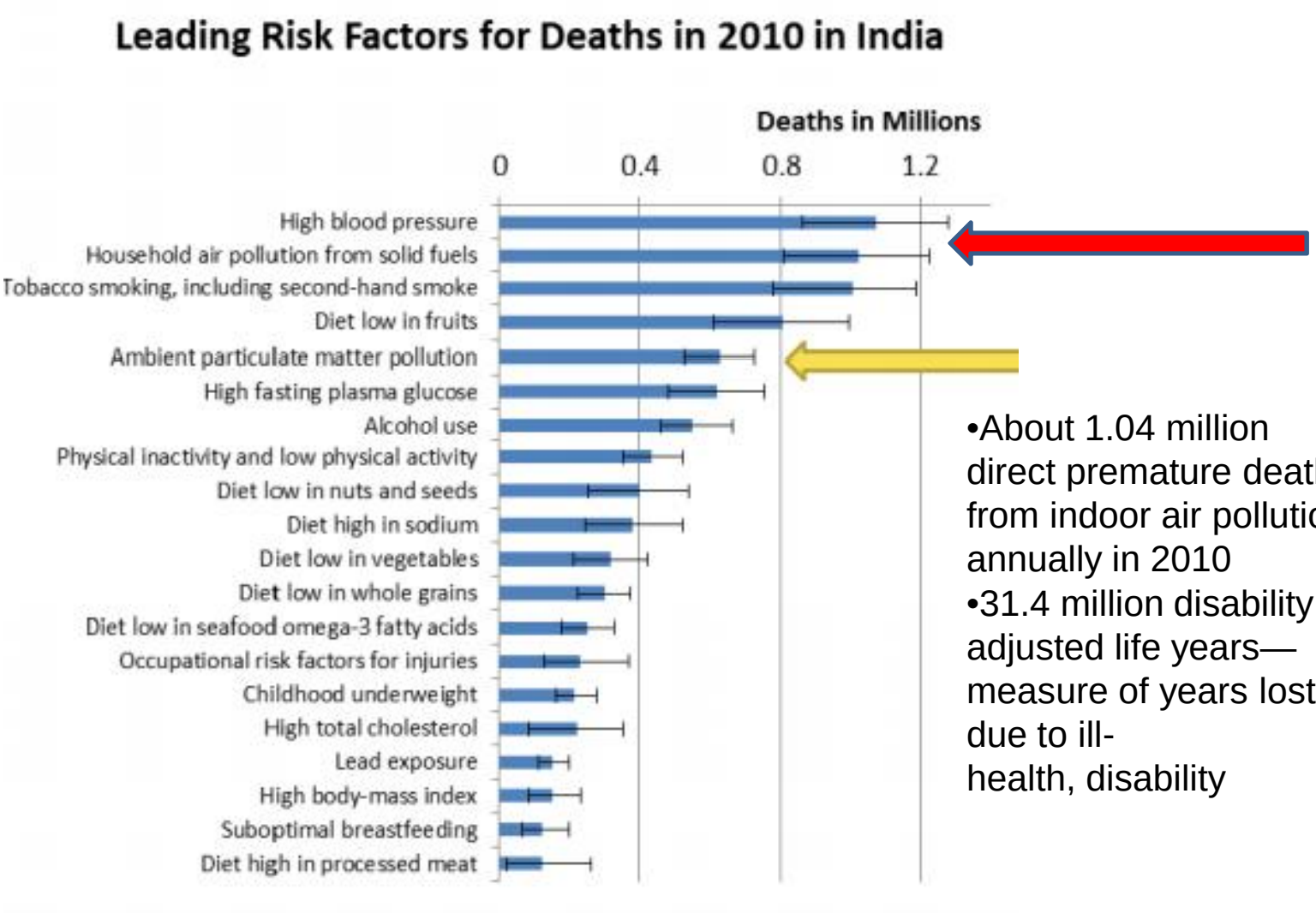
The human story….

Our health is at stake…yet risk perception is very poor…….



From its early stages, CSE's Right to Clean Air campaign used a variety of communication tools — such as this poster — to put out its message to the public. It built support

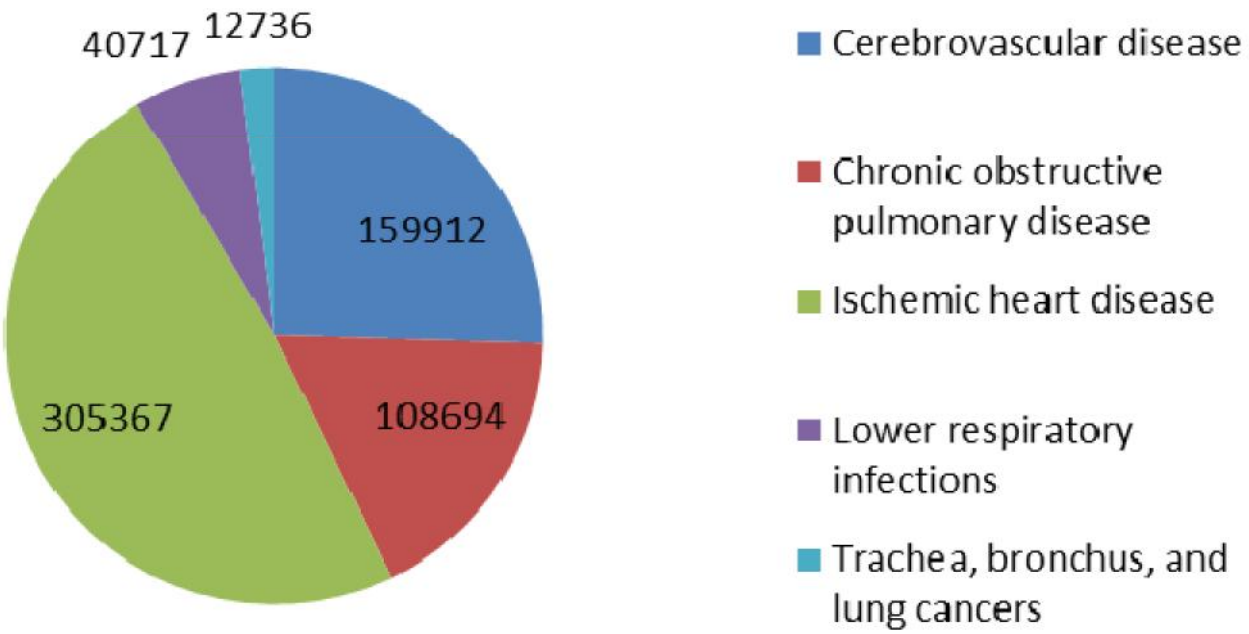
Global Burden of Diseases 2010: House hold air pollution second largest killer in India…….



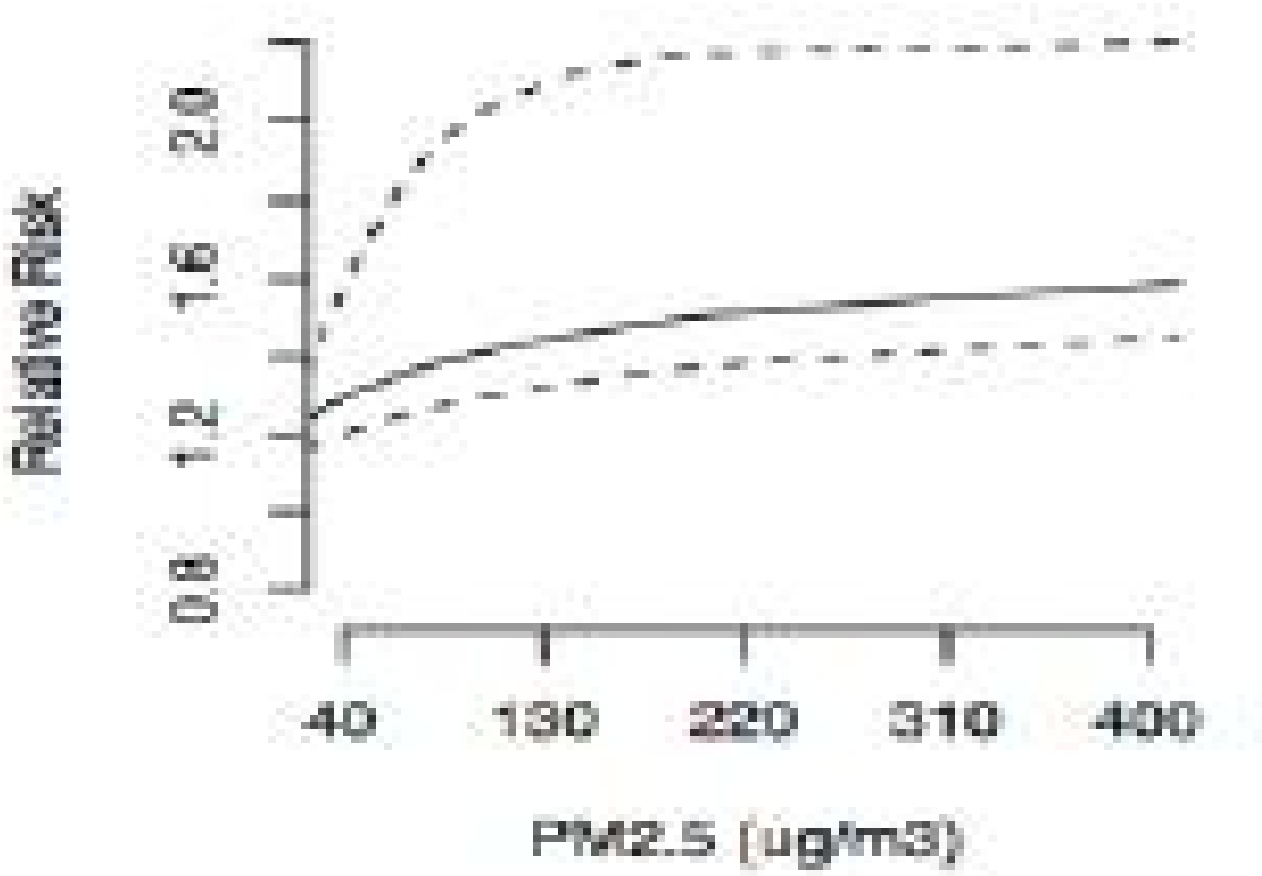
- About 1.04 million direct premature deaths from indoor air pollution annually in 2010
- 31.4 million disability adjusted life years—measure of years lost due to ill-health, disability

Source: http://cseindia.org/content/air-pollution-now-fifth-largest-killer-india-says-newly-released-findings-global-burden-dise
Source: http://cseindia.org/userfiles/global_burden_aaron.pdf

The GBD numbers……..



Be warned: Most health effects occur at much lower levels than reported in our cities



Integrated Exposure-Response function for Ischemic Heart Disease

HEI Global Burden of disease, 2013

Mounting global health evidences…..

Scale of global studies provide clinching evidences…….

Eg. the Arden Pope study (Journal of American Medical Association 2002) based on American Cancer Society data …..**16 years, about 500,000 people in 116 metropolitan areas** to arrive at **irrefutable findings**.

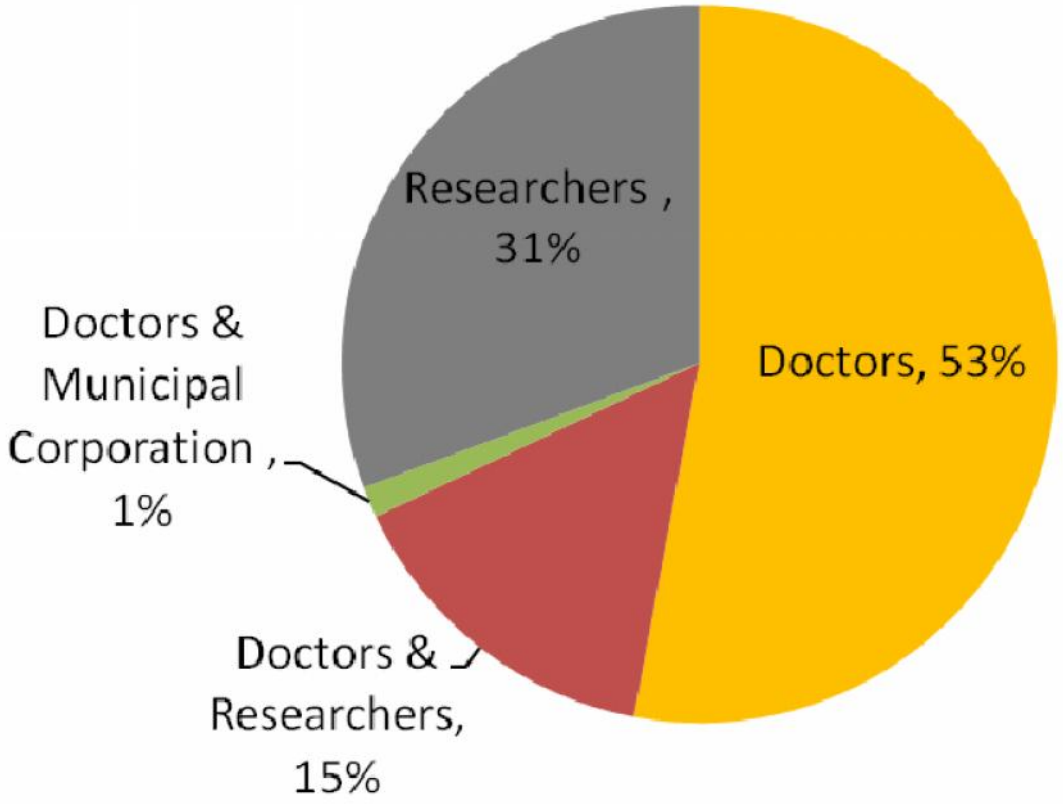
……. a mere increase of 10 microgramme per cum of PM2.5 can increase the risk of lung cancer by 8 per cent, cardiopulmonary deaths by 6 per cent, all deaths by 4 percent.

These findings are equally valid for India …

Lungs are same everywhere…….

Most studies done by doctors themselves…….

Who has done the studies?

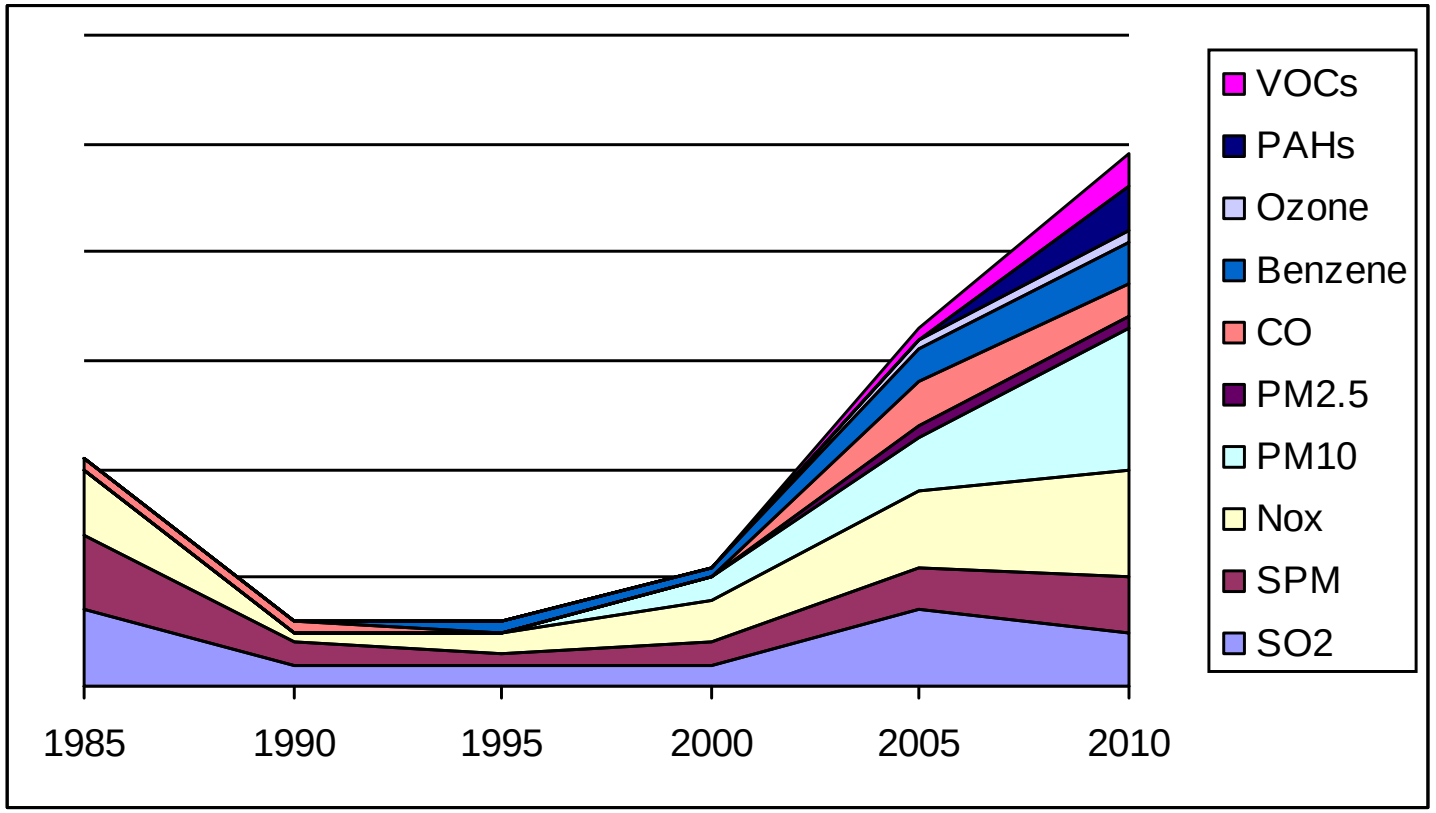


Source: CSE

Studies have responded to the emerging concerns in air quality…

-- **Early years**: Primary focus on SPM, SO2, and little on NOX – nearly 60%

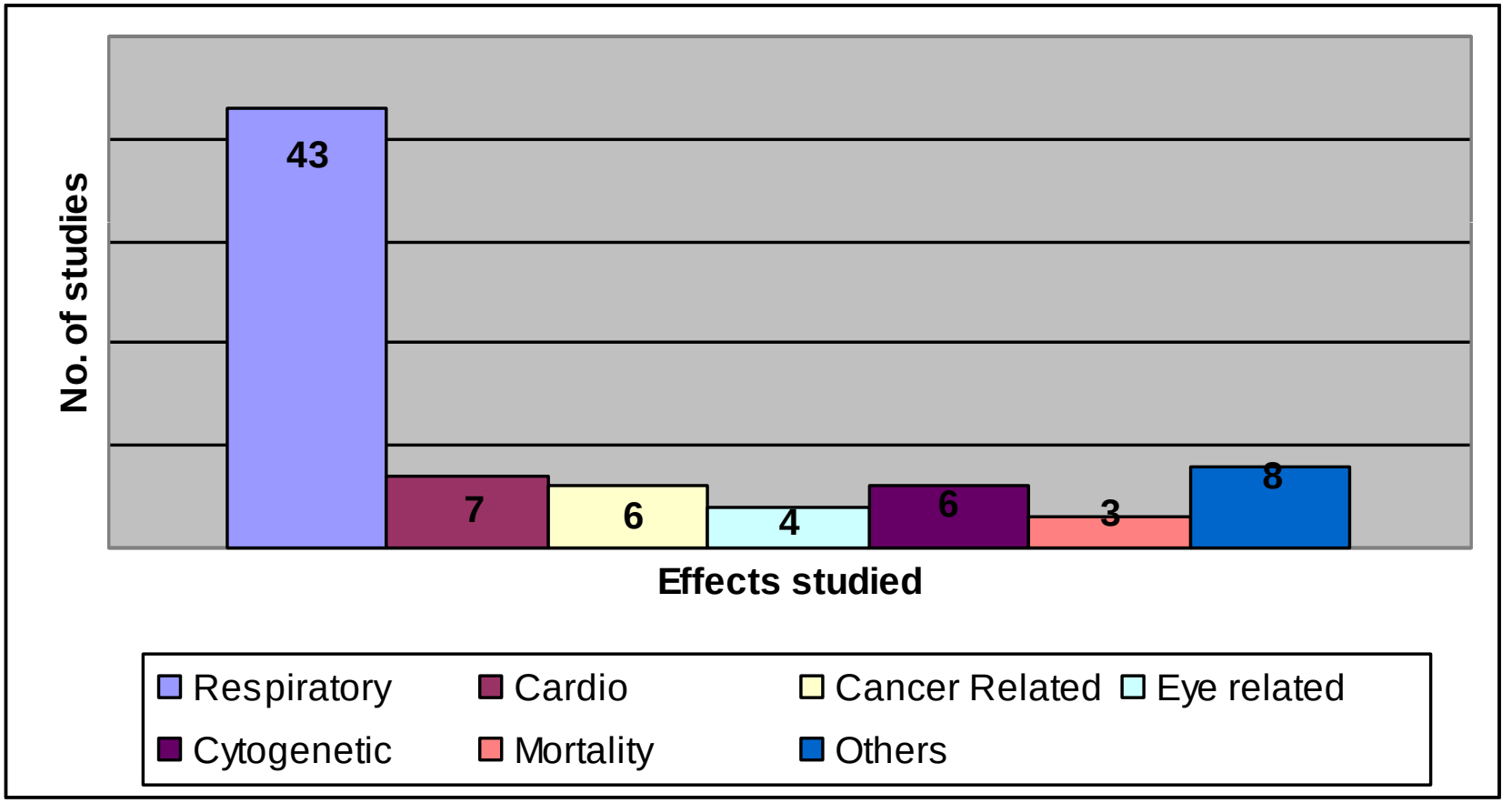
-- **Subsequent years: A wider pollutant basket**:



Source: CSE

Studies looking at a more diverse health end points….

Predictably respiratory health symptoms dominate….
Broadens to other health end points – cardiovascular, eye disorders, cellular changes, cancer, premature deaths….



Source: CSE

Global studies ….

Looking beyond lungs ……

Diabetes: First large-scale population-based study links diabetes with air pollution. Increase in insulin resistance in lab test …. and an increase in markers of inflammation (which may contribute to insulin resistance) after particulate exposure.

Strong and consistent association between diabetes prevalence and PM2.5 concentrations. For every 10 µg/m3 increase in PM2.5 exposure, there was a 1 percent increase in diabetes prevalence. Counties with highest versus the lowest levels of PM2.5 pollution had a more than 20% increase in diabetes, which remained after controlling for diabetes risk factors. (Diabetes Care 2011)

Heart:

Acute Effects of Fine Particulate Air Pollution on Cardiac Arrhythmia:Conclusion: PM2.5 exposure within approximately 60 min was associated with increased PVC counts in healthy individuals. (He F et al 2011The APACR Study. Environ Health Perspect)

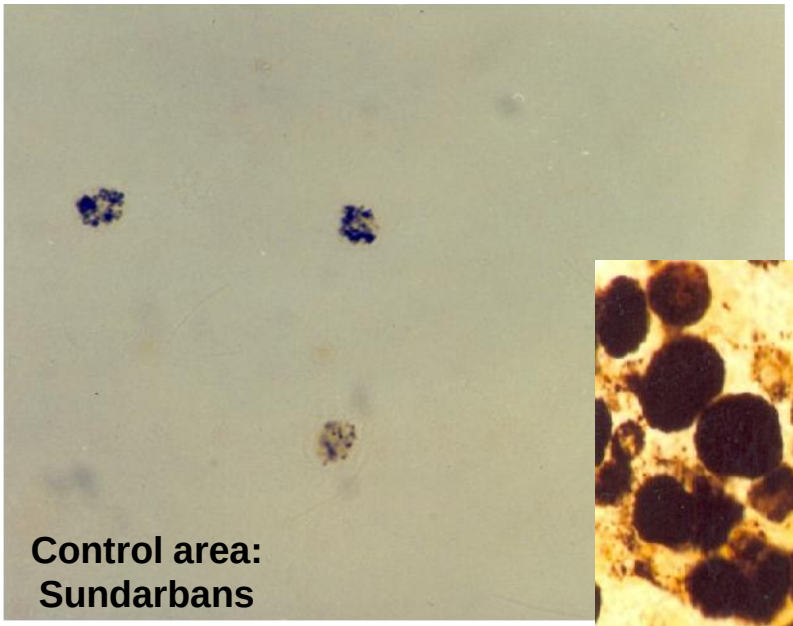
Blood pressure

Traffic-related Air Pollution and Blood Pressure in Elderly Subjects With Coronary Artery Disease**:** Found positive associations of systolic and diastolic BP with air pollutants. The strongest associations were with organic carbon, multiday average exposures, ect. (Delfino, Ralph J.a et al 2010,, Epidemiology, May 2010)

Effect on foetus: Studies have shown damaging impact of PAH on even fetus

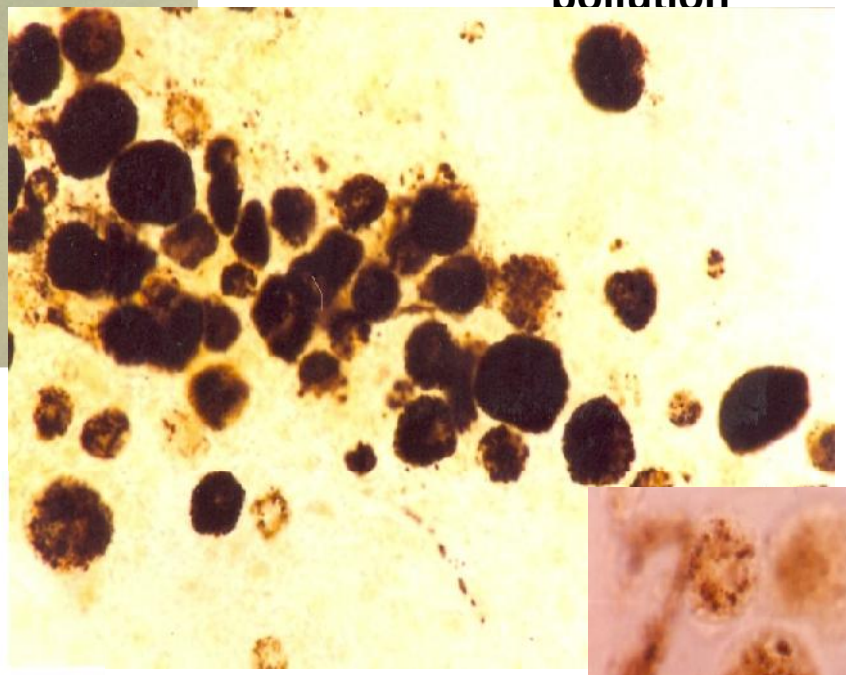
Source: CSE

Emerging evidences of health impacts in India……



Control area: Sundarbans

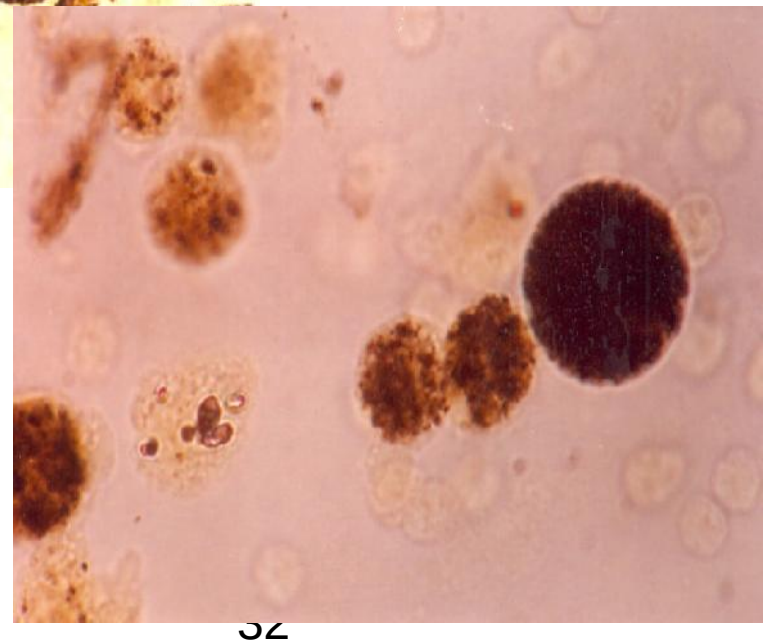
Alveolar macrophage - biomarker of air pollution



Exposed group; Kolkata taxi driver

Increase in AM number

Larger AM – particle laden



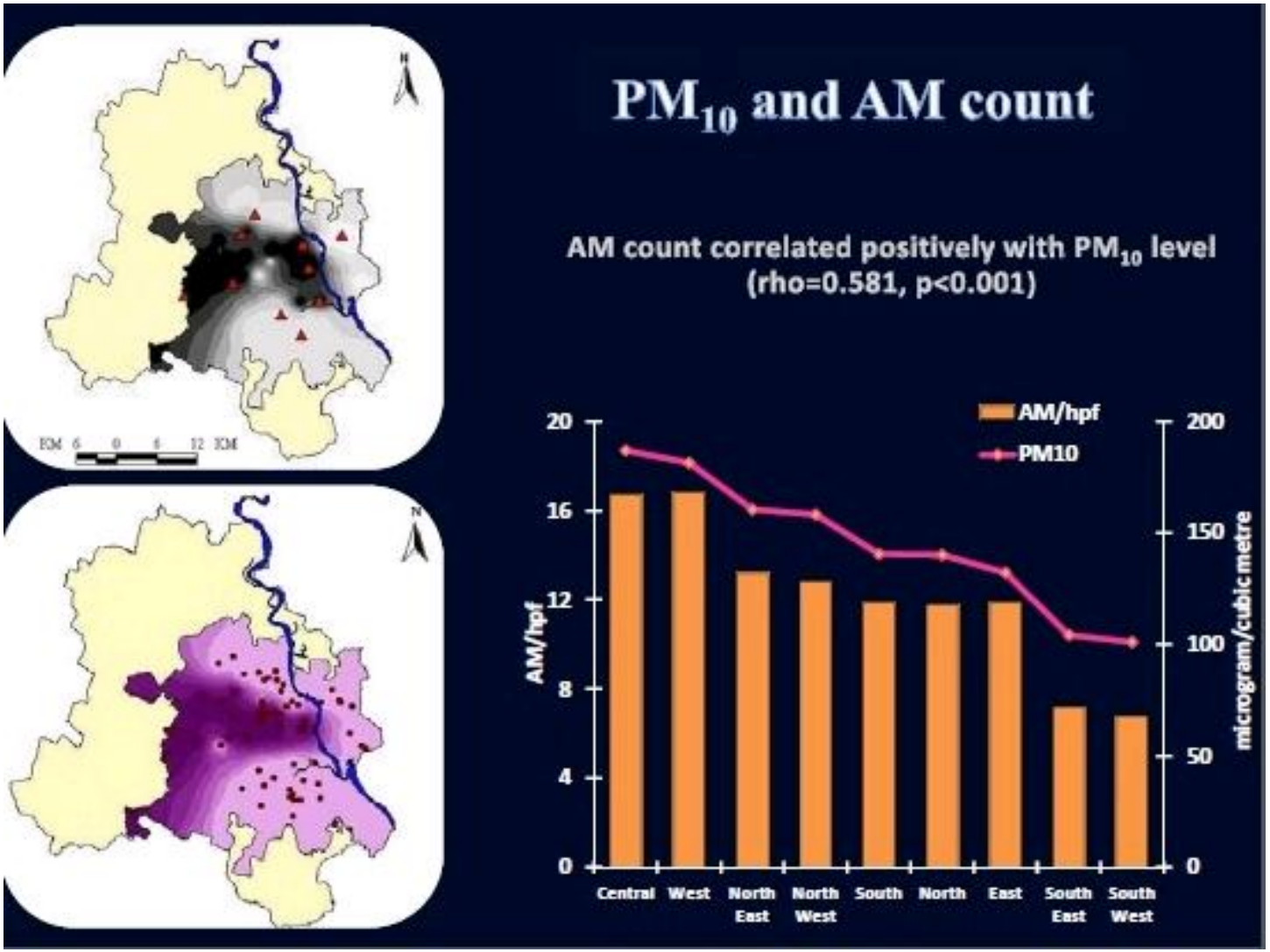
Health of children compromised……

2012 epidemiological study on children in Delhi (CPCB and Chittaranjan National Cancer Institute of Kolkata):
-- Covered **11,628 school-going children from 36 schools**.

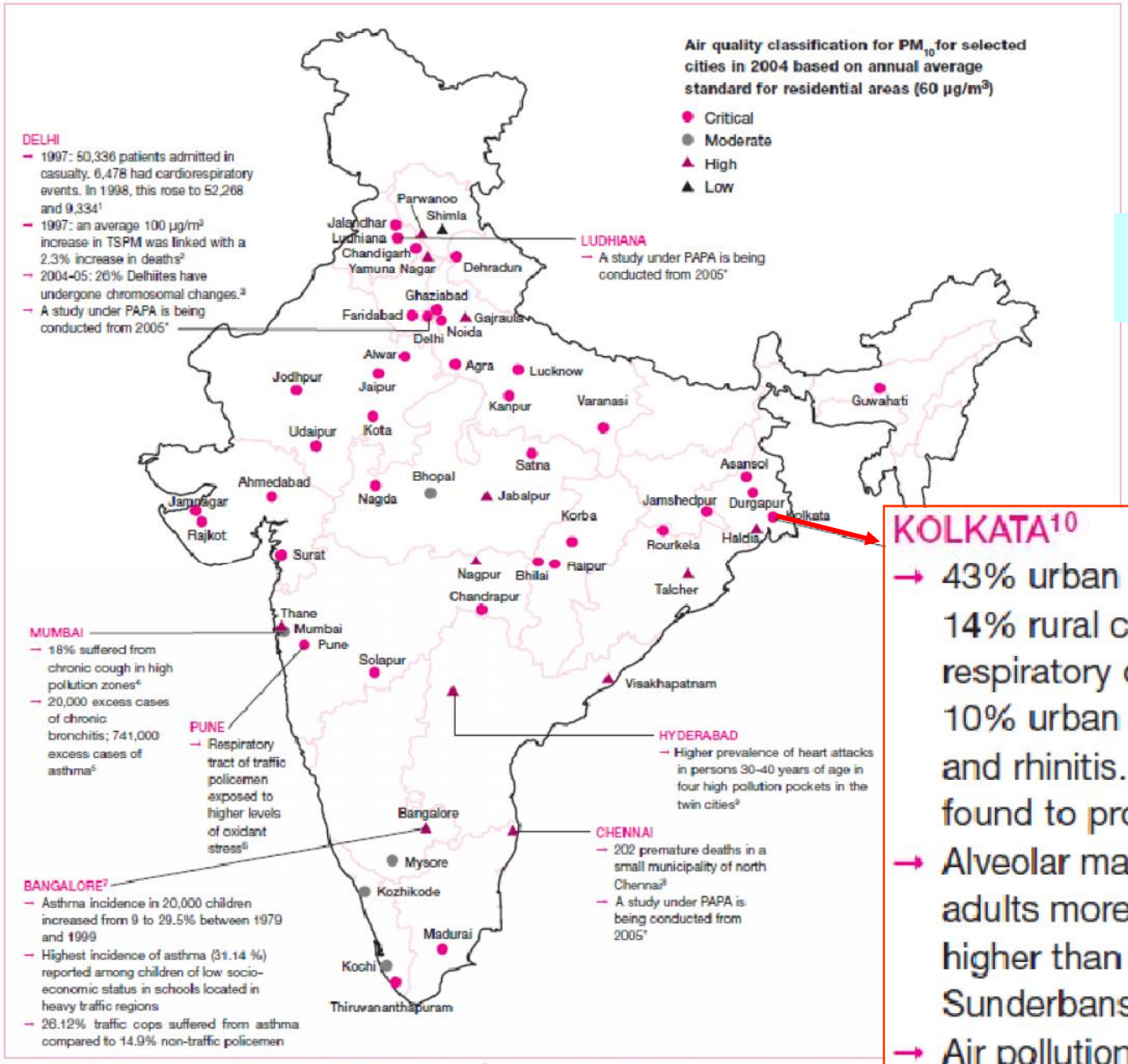
-- **Every third child has reduced lung function. Sputum of Delhi's children contains four times more iron-laden macrophages** than those from cleaner environs, **indicating pulmonary hemorrhage**.

-- **The levels of these biomarkers in children have been found to be higher in areas with high PM10 levels**.

Co-relating health evidences with air pollution in Delhi



Scourge



KOLKATA[10]

- 43% urban children and 14% rural children have respiratory disorders. 19% and 10% urban children have cough and rhinitis. 94-96% children found to produce sputum
- Alveolar macrophage counts of adults more than eight times higher than the people in the Sunderbans
- Air pollution related allergies seven times higher

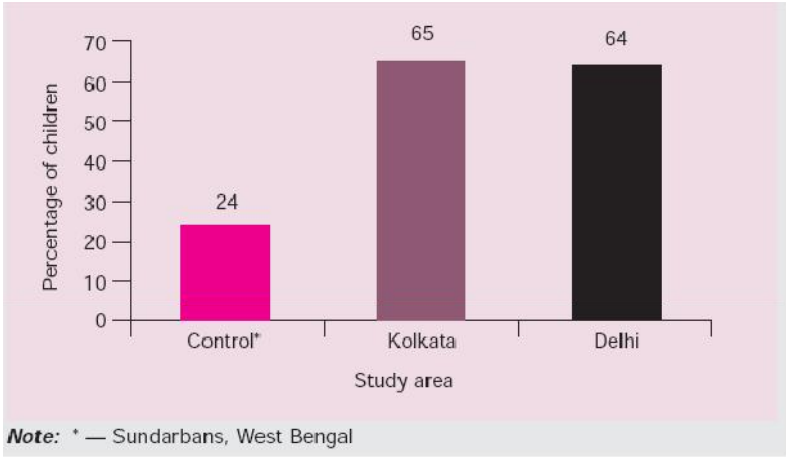
Notes: *PAPA — Public Health and Air Pollution in Asia Program; µg/m³ — microgramme per cubic metre; TSPM — total suspende

Sources: 1. J N Pandey *et al* 2002; 2. Maureen Cropper *et al* 1997; 3. CNCI and CPCB 2005; 4. CPCB and IIT, Mumbai; 5. S P *et al, mimeo;* 7. H Paramesh, *mimeo;* 8. Sri Ramchandra Medical College and Research Institute, Chennai; 9. Andhra Pradesh Pollut *et al* 2000

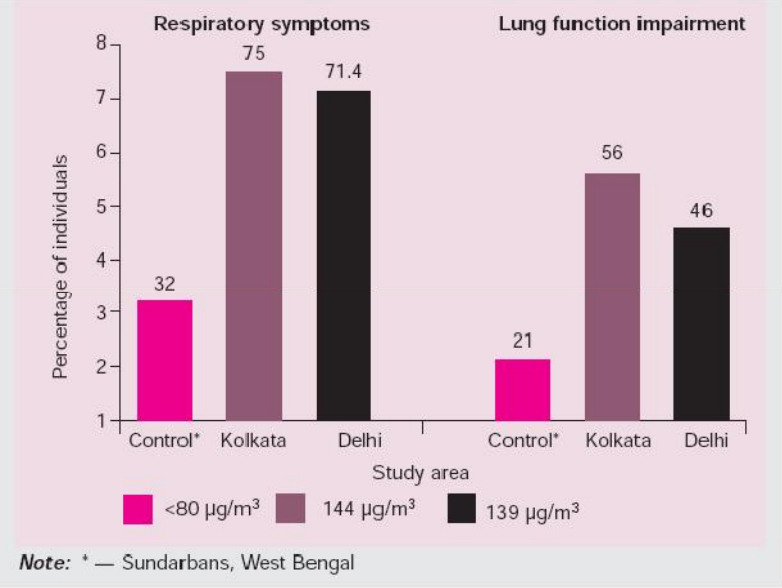
Mounting evidences…….

Impaired lungs in Kolkata and Delhi

More than 60% children in Kolkata and Delhi showed lung function impairments compared to a mere 24 per cent in controls



Healthy individuals/ non-smokers show respiratory symptoms and lung function impairment



Source: Twisha Lahiri 2004, assistant director and head, department of neuroendocrinology, Chittaranjan National Cancer Institute, Kolkata, CSE conference: The leapfrog factor, New Delhi, April 2004

Air pollution and toxic risk

The endpoint of the toxic risk is cancer.

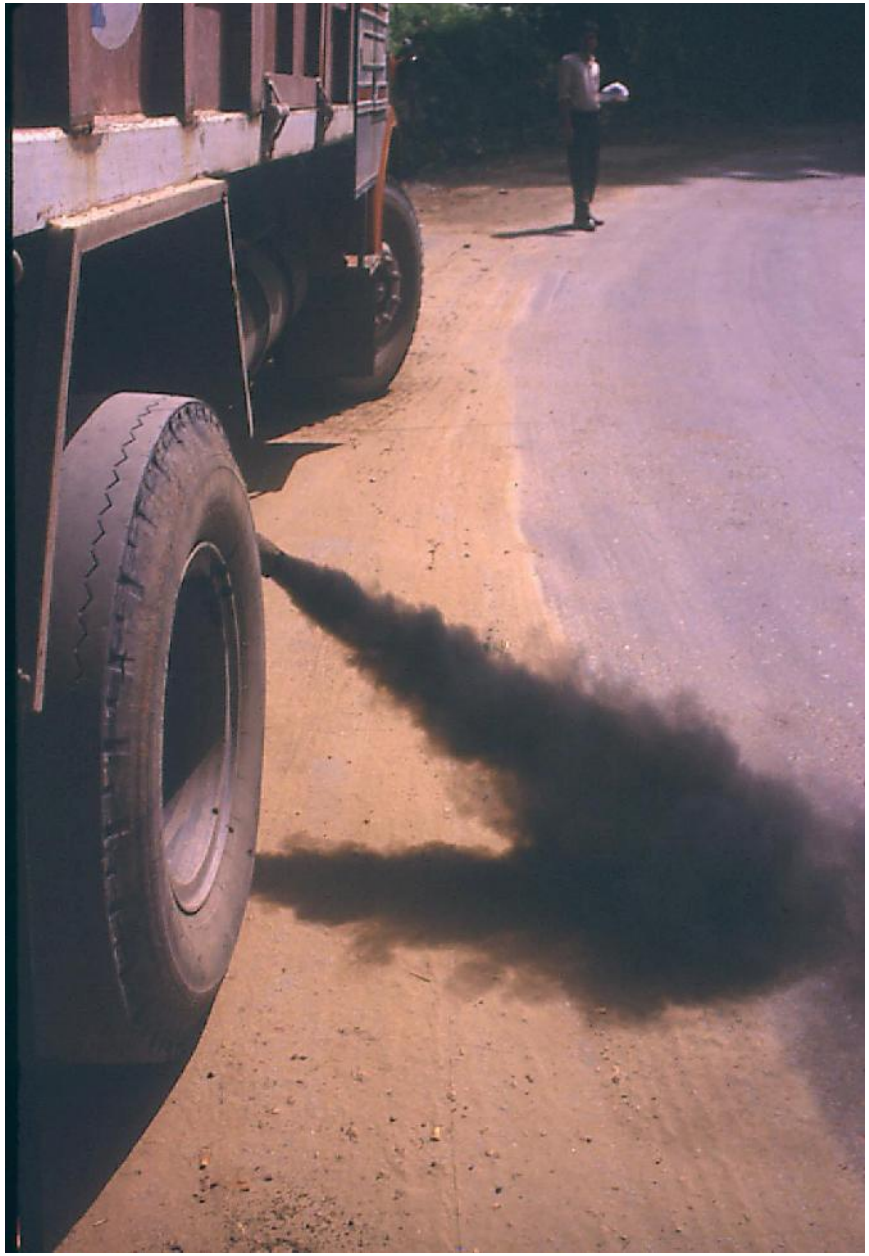
According to the the National Cancer Control Programme in India over 700,000 new cases and 300,000 people are set to die every year. NCCP's forecast -- by 2026, more than 1.4 million people will be falling in the grip of the disease.

-- NCCP has listed greater exposure to **environmental carcinogens** as one of the most important reasons.

-- The mitigation strategy must reduce environmental risk from all factors – and air pollution is an important factor

Numerous studies in the West assessed the causes such as genetic susceptibility, environment factors and lifestyle.

Found overwhelming influence of environmental factors.



There are several sources of pollution – need stringent action on all to get clean air

Recent Supreme Court ruling in Delhi on diesel vehicles, trucks, trash burning, road dust, construction dust, power plants etc...

Kolkata also needs source-wise action plan

Vehicles need special attention .....

Vehicular pollution: High exposure

Vehicular emissions contribute to significant human exposure. Pollution concentration in our breathe is 3-4 times higher than the ambient air concentration.

In densely-populated cities more than 50 – 60% of the population lives or works near roadside where levels are much higher. This is very serious in low income neighborhoods located close to roads.

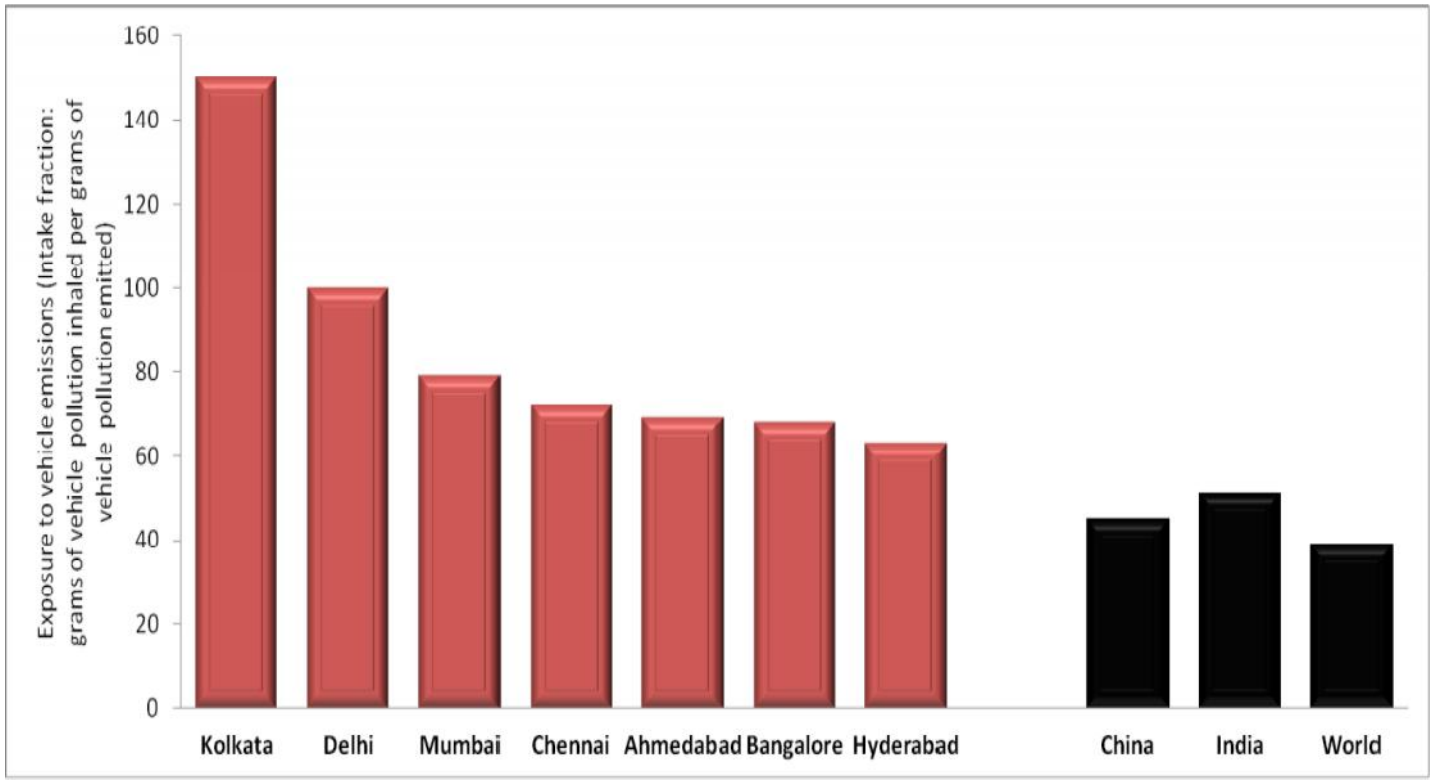
The WHO report of 2005: Epidemiological evidences for the adverse health effects of exposure to transport related air pollution is increasing.

Some of the deadliest air toxics, also carcinogens, are related to vehicular emissions. Blamed even for killing foetus.

About 60% of health studies in India have focused on exposure to traffic pollution…

Exposure to Vehicle Emissions

In Kolkata and Delhi, the people's exposure to vehicle exhaust is 3 to 4 times higher than the world average



Exposure (iF) is the population-weighted intake fraction, or the grams of vehicle pollution inhaled per grams of vehicle pollution emitted.

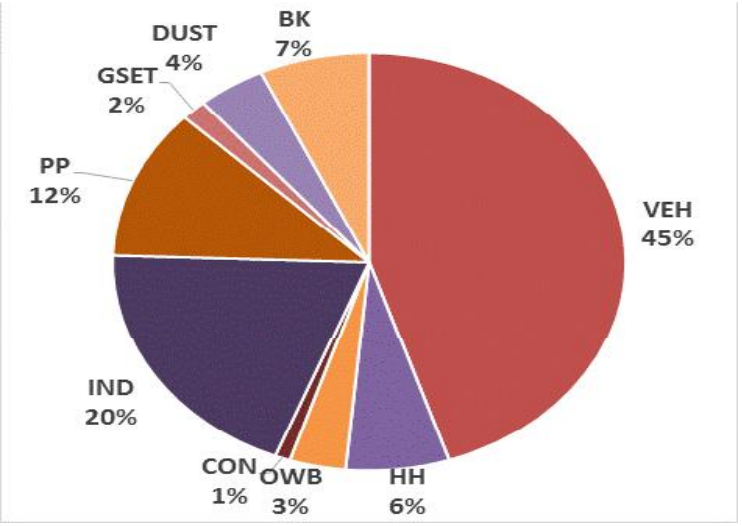
Estimates from Apte, J. S., Bombrun, E., Marshall, J. D., & Nazaroff, W. W. (2012). Global Intraurban Intake Fractions for Primary Air Pollutants from Vehicles and Other Distributed Sources. *Environmental Science and Technology*, *46*(6), 3415–3423.

Ambient air quality vs Exposure

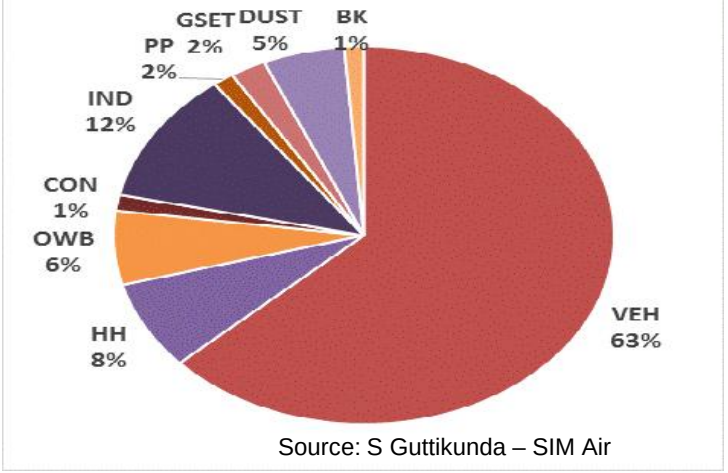
More important to understand the relative health risk of various sources in cities – Exposure -- emission-to-intake relationship for a specific source as the fraction of emissions inhaled by an exposed population .

Eg from Chennai

$PM_{2.5}$ emission apportionment



$PM_{2.5}$ exposure apportionment

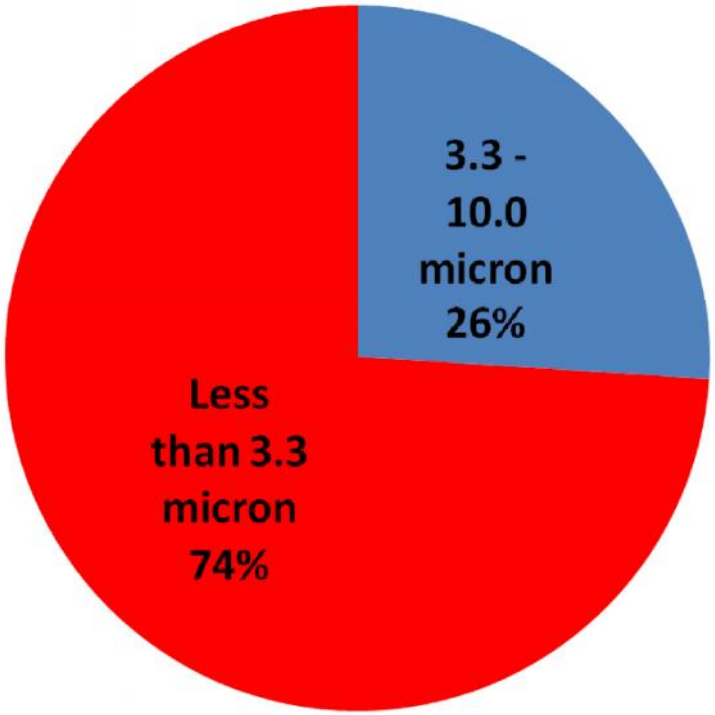


Source: S Guttikunda – SIM Air

:

Extremely tiny particles indicates high automobile contribution

Kolkata: Size distribution of PM10



Source: Dipak Chakraborty 2009, Alarming air quality of Kolkata – a real health concern, cost of inaction will be too high, a presentation, Chief Scientist, West Bengal Pollution Control Board

- According to the WBPCB studies, nearly two-thirds of PM10 comprises particles less than 1.1 micron size.

- The WBPCB scientists: Automobiles are expected to contribute significantly to particulates of the size class of 1.1 micron and account for nearly 50 per cent of the air pollution load.

- It also forecasts a decline in the share of pollution from industrial sources but an increase from automobiles.

Source: D CHAKRAVARTY 2004, *senior scientist, West Bengal Pollution Control Board, Kolkata, India, CSE conference: The leapfrog factor, April 2004, New Delhi*

Air pollution control: a difficult challenge….

What has Delhi achieved?

First generation action 1998-2008

Enforced Euro II emissions standards in 2000, five years ahead of schedule, Euro III in 2005; unleaded petrol

Mandated pre-mix petrol to two- and three-wheelers

Implemented largest ever CNG programme: Largest ever public transport bus and three-wheeler fleet on natural gas

Capped the number of three-wheelers

Phased out 15 year old commercial vehicles

Strengthened vehicle inspection programme (PUC)

Efforts made to bypass transit traffic

Relocated polluting industry; Stricter action on power plants; two power plants on natural gas; Ban on open burning

Second generation action 2008 - 2014

Metro system expanded

Close to 6000 new buses

Euro IV standards in 2010; upgraded PUC tests

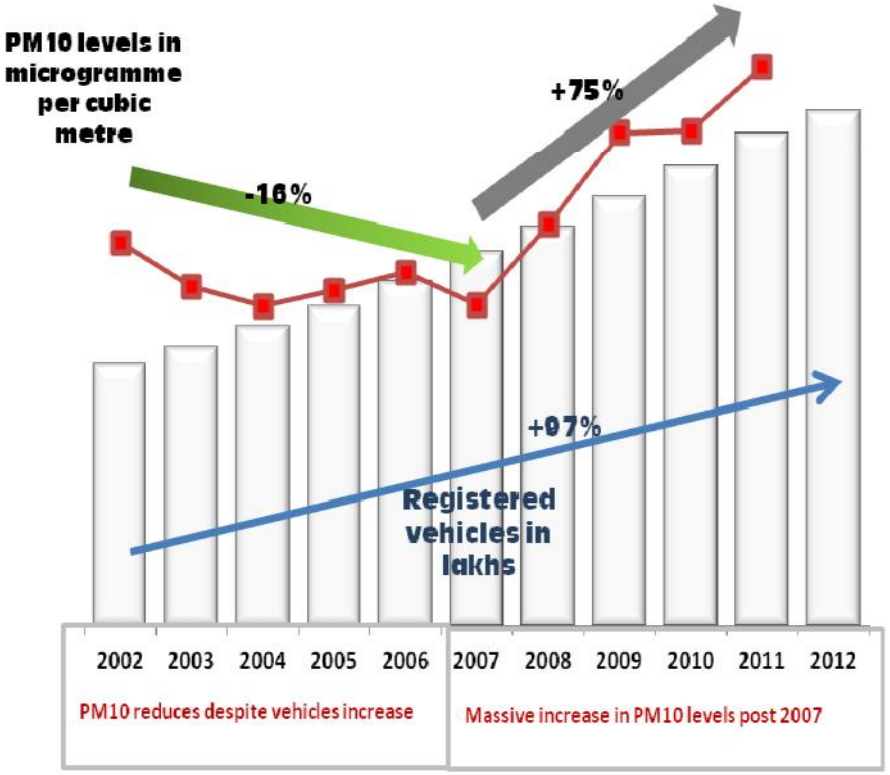
Air Ambience Fund in 2009

40 km of cycle tracks with new footpaths in 2010

Marginal increase in parking prices in NDMC area

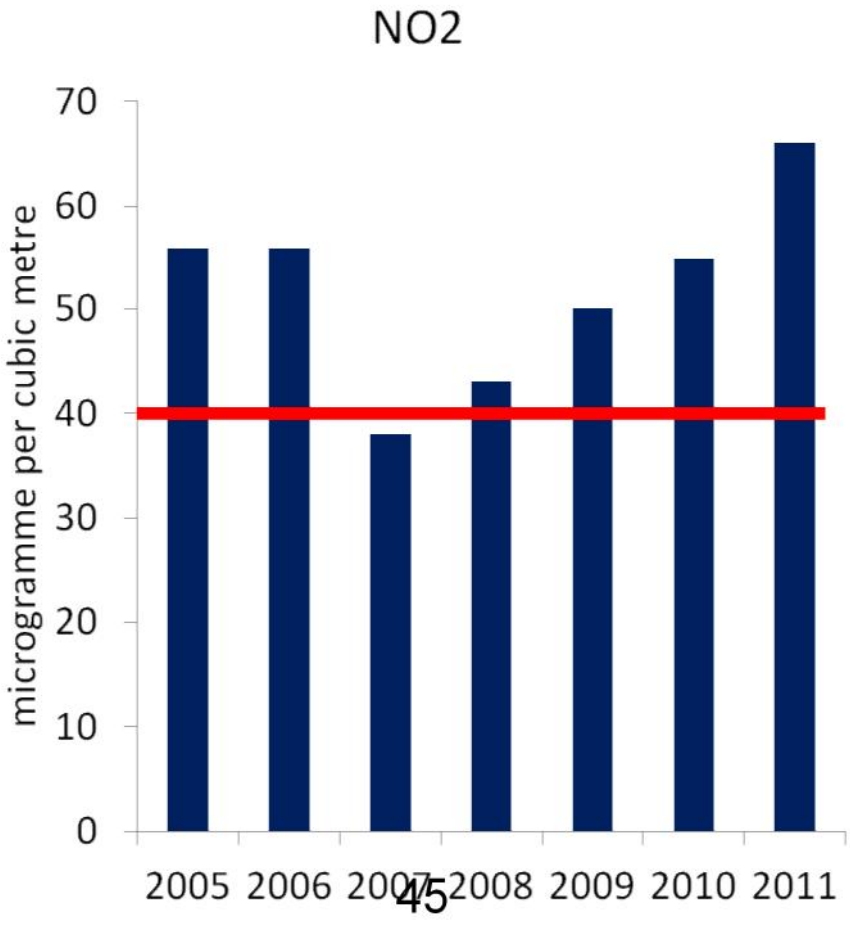
Delhi has lost its gains. After a short respite pollution curve turns upward

Particulate pollution decline and rise again due to rapid increase in vehicle numbers



Based on CPCB data

NO2 levels rising steadily



Kolkata has begun action….

Strong public opinion, Judicial and Executive Action, have catalysed first generation Programme..

Action on vehicles:-

- Introduced Bharat Stage IV norms for vehicles in 2010 and 50 ppm sulphur fuels
- Two-stroke autorickshaws banned
- Pre-mixed 2-T oil mandatory within Kolkata Metropolitan Area since November 2001.
- Ban on supply of loose 2T oil.
- Old vehicles phase out
- Up gradation of PUC emission testing centers
- Unleaded petrol introduced in February,.2000.
- Benzene content in petrol reduced to 3 percent from 2001 subsequently to one percent
- Only LPG driven three wheelers are registered in Kolkata since June 2003.
- Petrol blended with 5 percent ethanol mandatory since January 2003
- City has diverse public transport modes

Action on industry:-

- Stricter location policy for new industrial units and restriction on setting up of polluting industries in KMA area
- Efforts to ensure regulatory compliance for grossly polluting industries
- stricter emission standards for boilers, ceramic kilns, foundries and rolling mill of KMA since May 11, 2001
- Mandatory use of clean fuels
- Financial assistance for installation of pollution control devices in small-scale industries etc.
- Coal use restricted in industries
- About 67% of the coal fired boilers and about 73% of the coal fired ceramic kilns converted to oil fired ones.
- Financial assistance to the small industries for pollution control by the WBPCB and the State Government;
- WBPCB encouraging industries to go ‘beyond compliance and good performers are honoured with ‘Environmental Excellence Award’;
- Thermal power plants are also regularly monitored to control the emissions.

But not enough…

Need legally enforceable air quality targets

- **No punitive action on state governments for not meeting the ambient air quality norms**.
- **Abatement plans are not designed to meet local air quality targets**
- **Emissions regulations are kept weaker for most of India.**
  - In the US the air quality standards are federally enforceable. EPA impose sanctions if states fail to meet the air quality targets -- such as cut highway funds.
  - Civil society can sue the state governments.
  - "Citizen Court Suits" allowed against EPA for failure to promulgate NAAQS, emissions standards or implement state implementation plans.

- **In India the eleventh five year plan mandates the central government to set monitorable target of air quality -- achieve the standards of air quality in all major cities by 2011–12**

Ensure enforcement of air quality standards, accountability and compliance.

Courts uphold our rights to clean air and health`

Evokes principles underlying environmental governance

- Right to Life
- The precautionary principle
- The polluter pay principle

Basis of the court rulings

Article 21: The right to wholesome environment incorporated into a fundamental right to life under article 21 of the Constitution.

Article 39: The state shall direct its policy towards securing health …

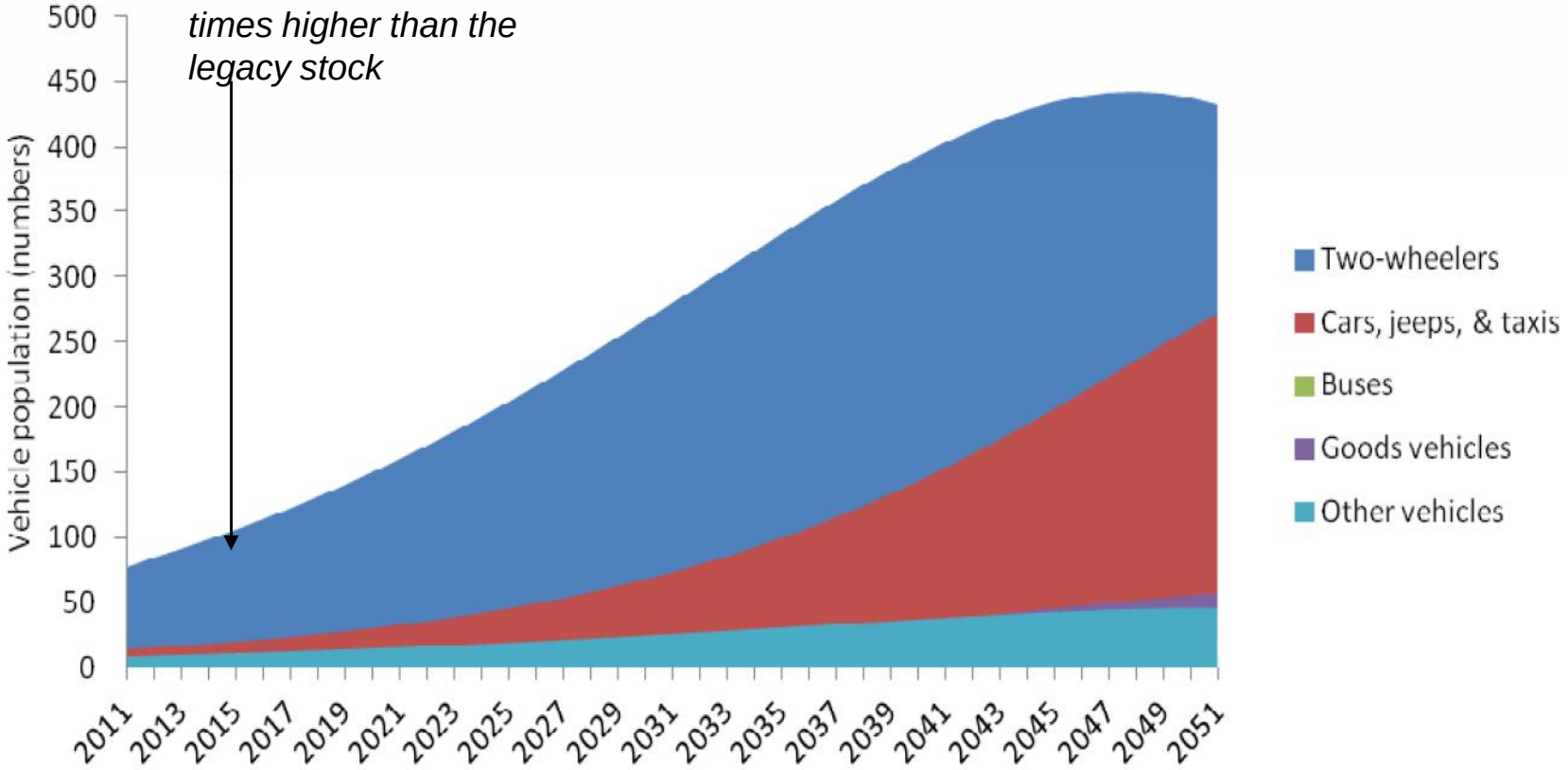
Article 47: Duty of the state to raise the level of nutrition and standard of living to protect public health…

Article 48: protection and improvement of environment…

Second generation challenge……

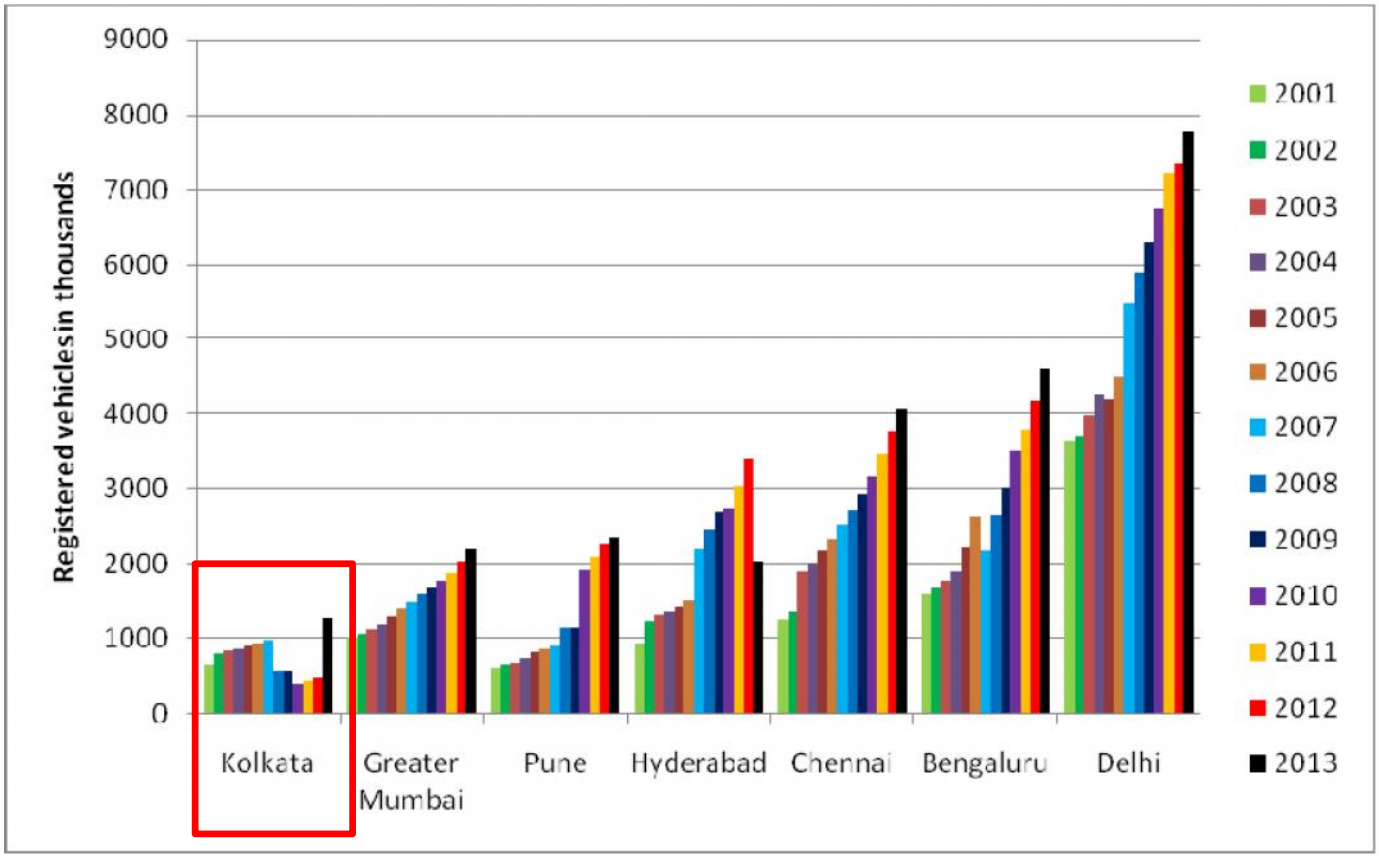
Motorisation based on outdated polluting technology and fuels locking up enormous pollution and ill health…..

Need stringent and preventive action and decision here to influence the future stock -- several times higher than the legacy stock



Source: CSE

Motorisation: Unique trend in Kolkata



-Compared to other Metro cities vehicular growth is lower in Kolkata

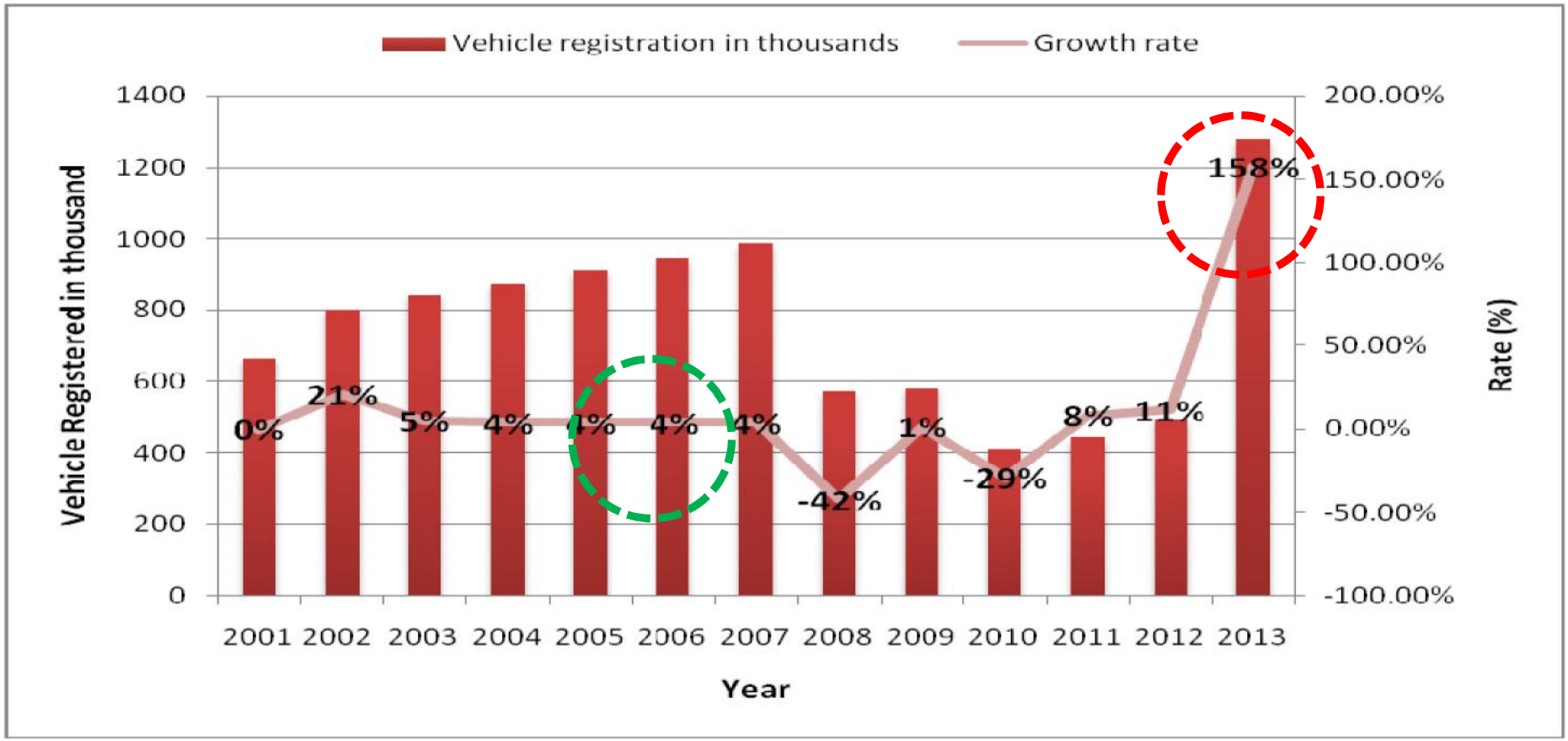
-- Even declined between 2007 and 2010.

-Sharp increase after 2011

Source: 2003 to 2013- Road transport year book (2012-13), Ministry of Road Transport & Highways, 2015
2001-2002: Statistical Year Book, India 2015, Online source - http://mospi.nic.in/Mospi_New/upload/SYB2015/index1.html

Explosive.....

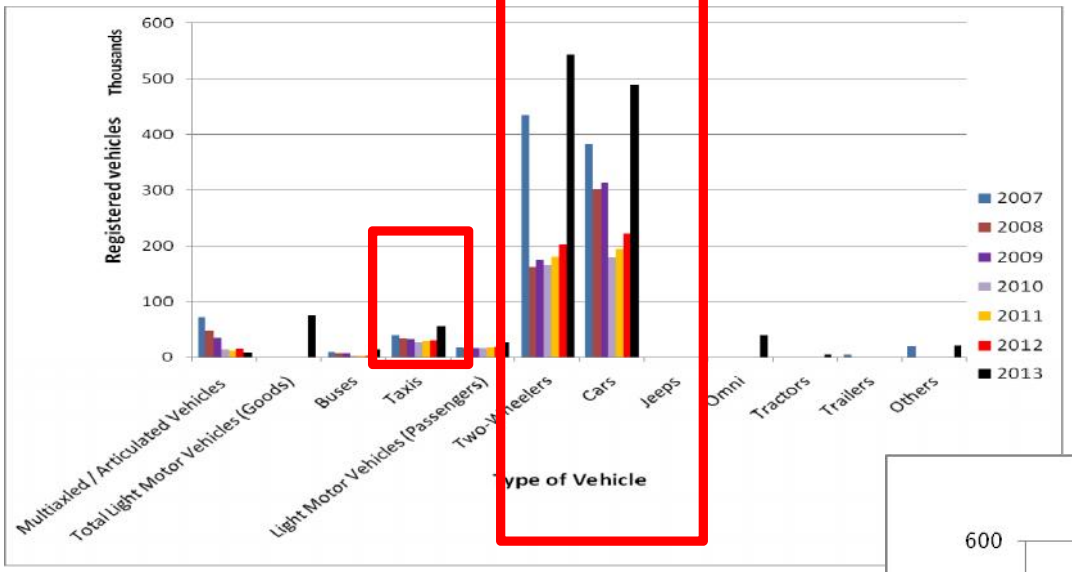
Motor Vehicle registration over the years (Growth rate)

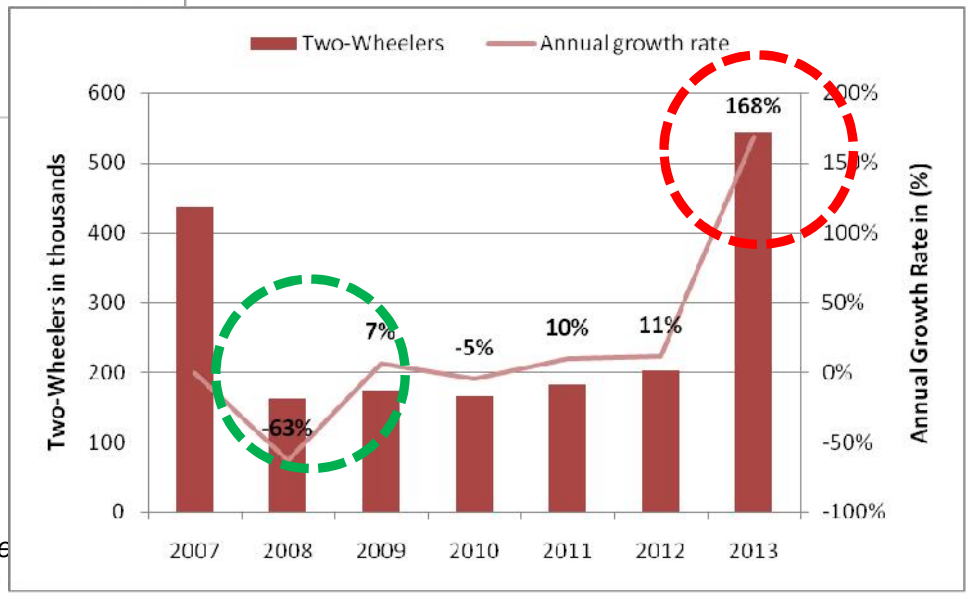


Source: 2003 to 2013- Road transport year book (2012-13), Ministry of Road Transport & Highways, 2015
2001-2002: Statistical Year Book, India 2015, Online source - http://mospi.nic.in/Mospi_New/upload/SYB2015/index1.html

Rapid increase in personal vehicles

Cars and two-wheelers dominate the trend……

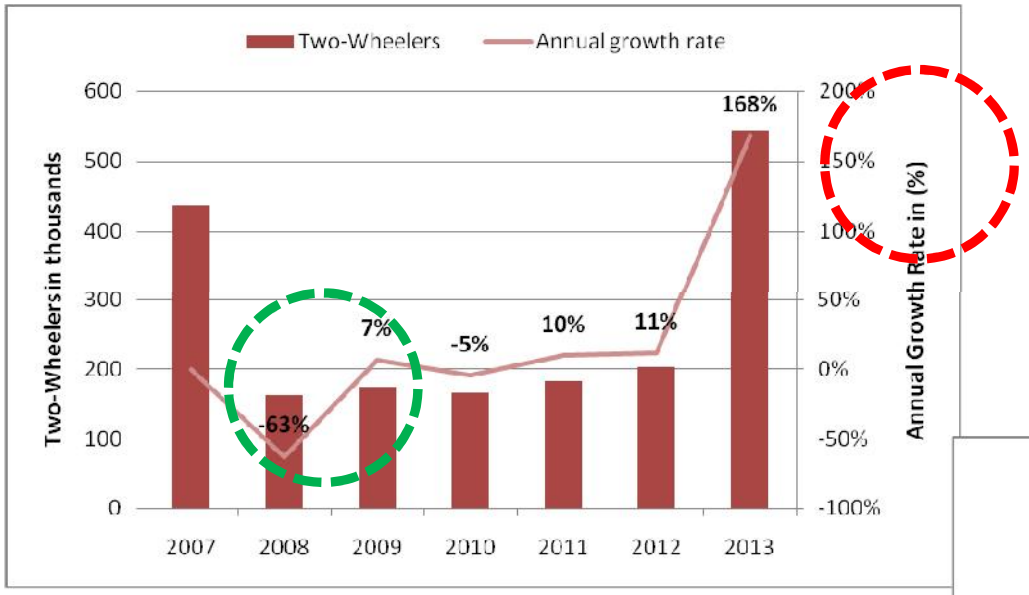




Source: 2007- 2012- Compiled from online data source data.gov.in (Ope
(https://data.gov.in/catalog/registered-motor-vehicles-million-plus-cities)
2013- Road transport year book (2012-13) Ministry of Road Transport & Highways, 2015

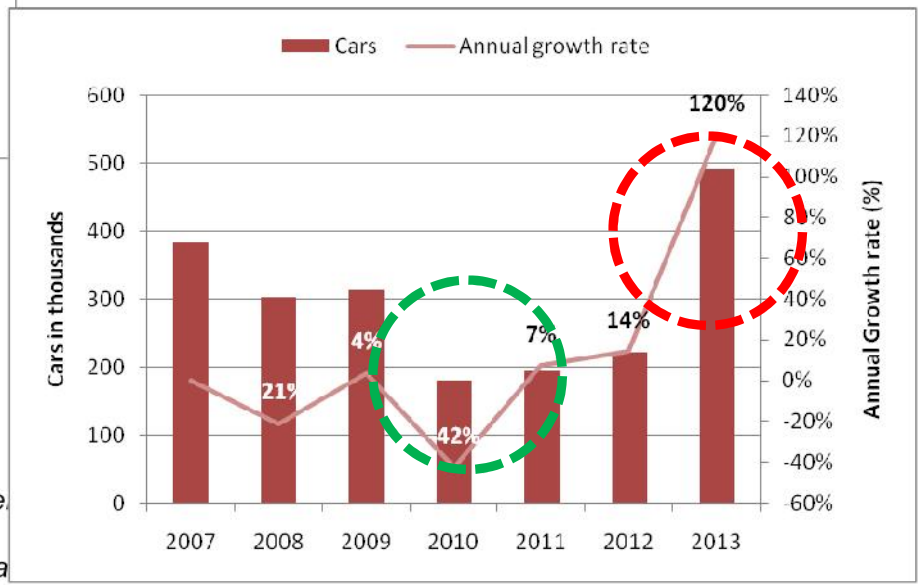
Cars and two-wheelers: explosive

2007-2013: Two-wheelers increased by 28 %



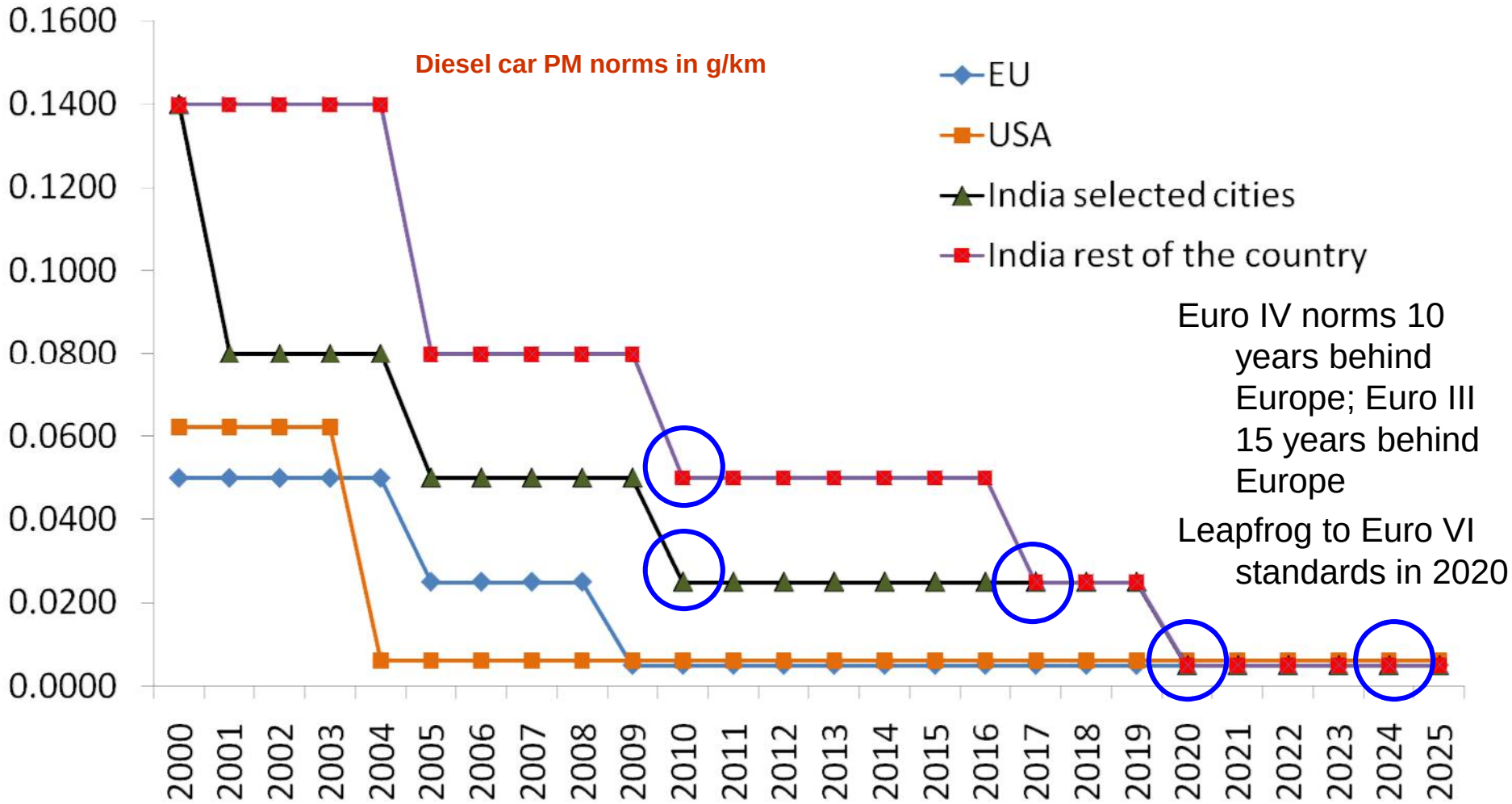
Massive Increase in cars - 2007-2013: **25 %**

From 2012 to 2013 – number of of cars got doubled.



Source: 2007- 2012- Compiled from online data source data.gov.in (Open Gove
(https://data.gov.in/catalog/registered-motor-vehicles-million-plus-cities)
2013- Road transport year book (2012-13) Ministry of Road Transport & Highwa

India motorisaing based on weak emissions standards …. 10-15 years behind Europe



Source: India, Europe compiled from Diesel Net, USA data provided by Axel Friedrich, Germany

Note: Europe has additionally introduced particle number standards at Euro V level
Future norms of US and Europe are tightening NOx norms for diesel more

Diesel Capital……..

Diesel mania in Kolkata

•A study by University of Kolkata shows (*Bhaduri S. University of Kolkata 2013*):

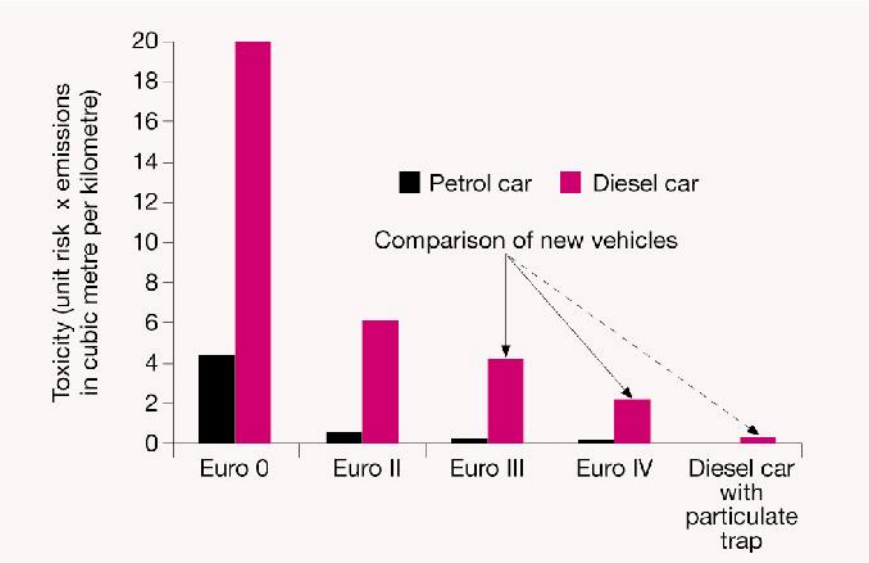
•As opposed to the national trend 65% of new cars in Kolkata are diesel driven

•Diesel constitutes 45% of total oil consumption by car users.

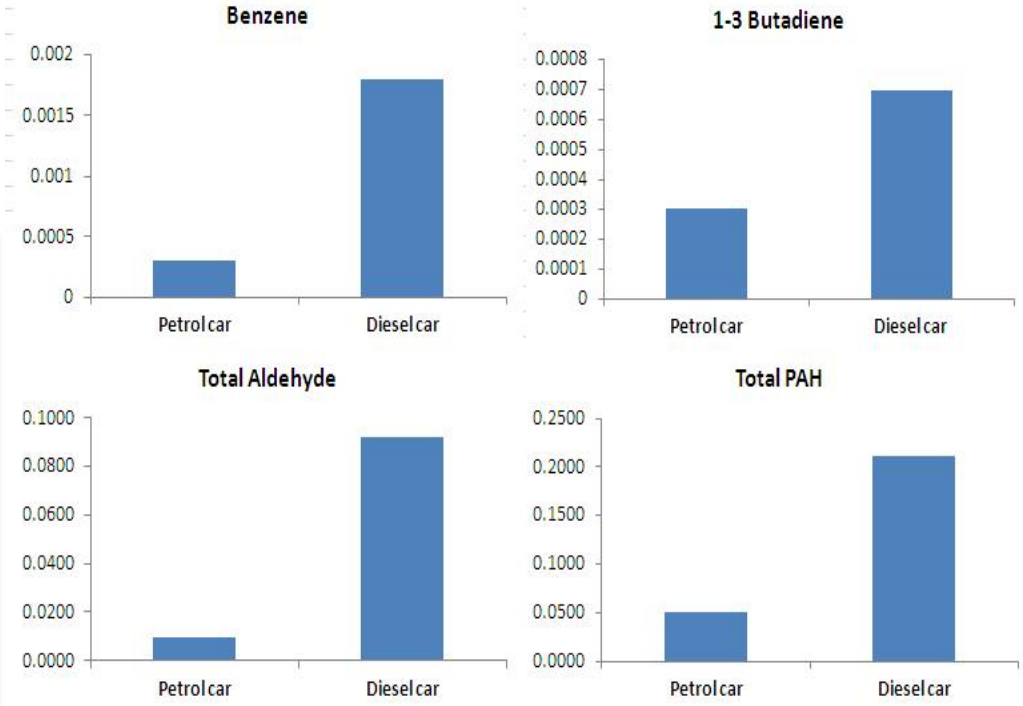
•About 99 per cent of commercial vehicles in Kolkata are diesel driven.

Toxic…..

June 2012: The WHO/ International Agency on Cancer Research reclassified diesel emissions as **class 1 carcinogen**, -- same class as tobacco for its strong link with lung cancer.



High toxic emissions from diesel cars



Potent carcinogen…

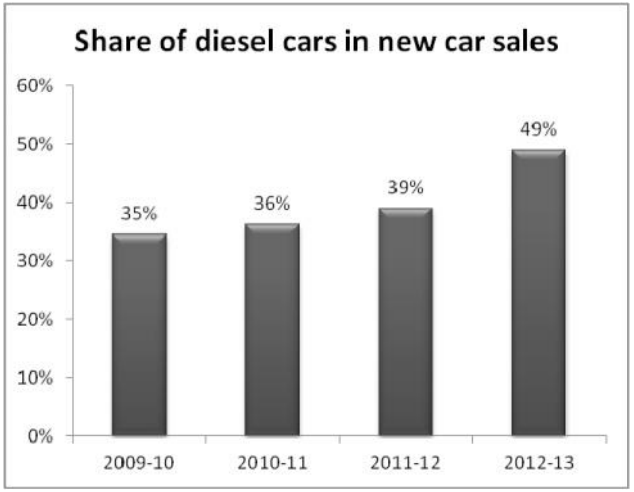
Toxic Air Contaminant	Unit Risk/Million People	Detection limit (ppb)
Acetaldehyde	2.7	0.10
Benzene	**29**	**0.05**
1,3-Butadiene	**170**	**0.04**
Carbon Tetrachloride	42	0.02
Chromium, Hexavalent	150,000	0.06 (in nanogram)
Para-Dichlorobenzene	11	0.30
Formaldehyde	6	0.10
Methylene Chloride	1	0.10
Perchloroethylene	5.9	0.01
Diesel particulate matter	**300**	**N/A**

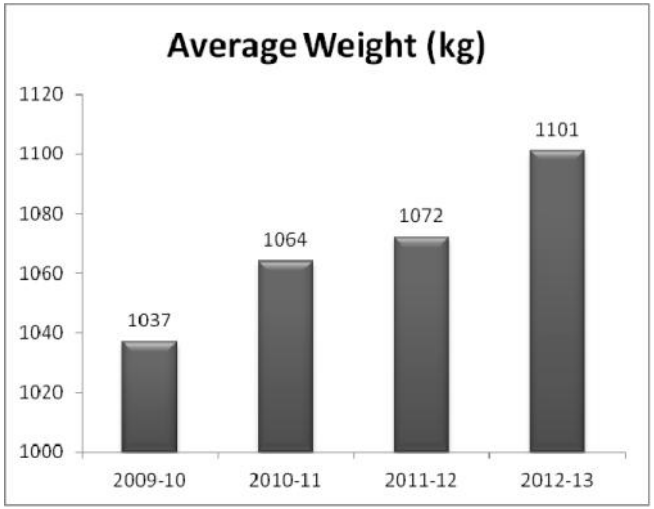
Diesel particulate cause 300 excess cancer cases per million people per micrgramme per cubic meter of concentration over a 70 year lifetime exposure

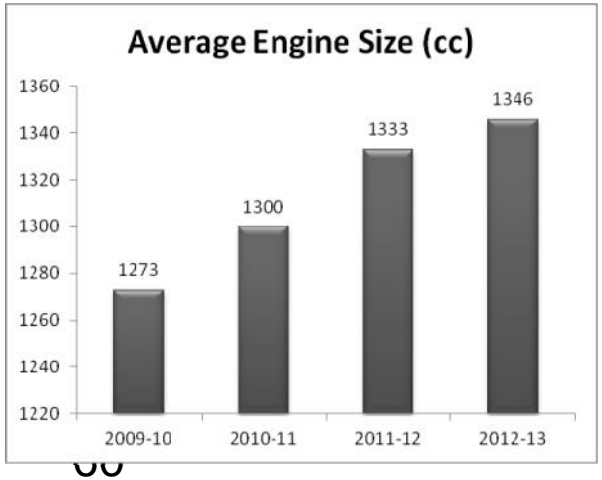
Note: Unit Risk represents the number of excess cancer cases per million people per micrgramme per cubic meter TAC concentration over a 70 year lifetime exposure
A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the “Risk Reduction Plan to reduce Particulae Matter Emissions from Diesel Fuelled Engines an vehicles (ARB, October 2000)
Source: California Air Resource Board

Dieseliation and energy challenge

- On an average every year, the weight and size of new vehicles is increasing at a rate of 2%.
- While 87% of petrol cars have engine size below 1.2 litres, 40% of diesel is 1.5 litre and the rest are more. During recession SUVs sales had increased 42% annually. This threatens fleet-wide fuel economy
- Average weight and engine size during 2009-10 and 2012-13 has increased by 6%.
- Makes case for emissions based taxation







Trade off

Fuel efficiency vs toxic risk

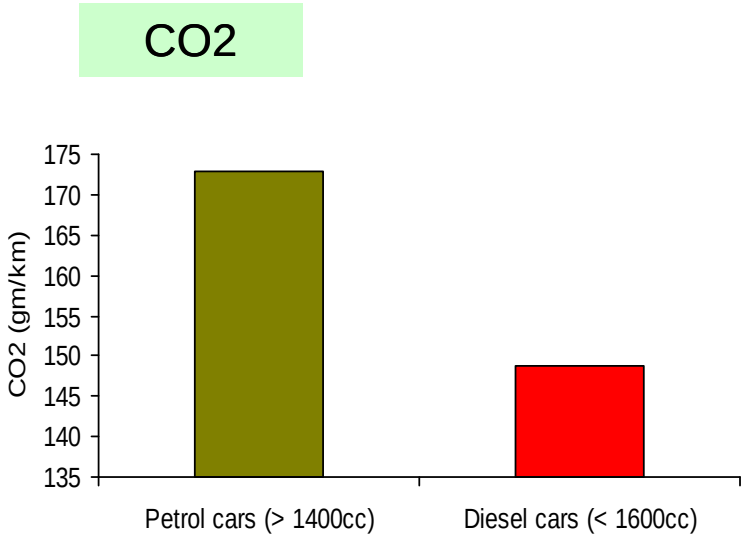
Diesel cars emit seven times more particulates and five times more Nox and contribute toward formation of ozone – pollutants of concern in our cities

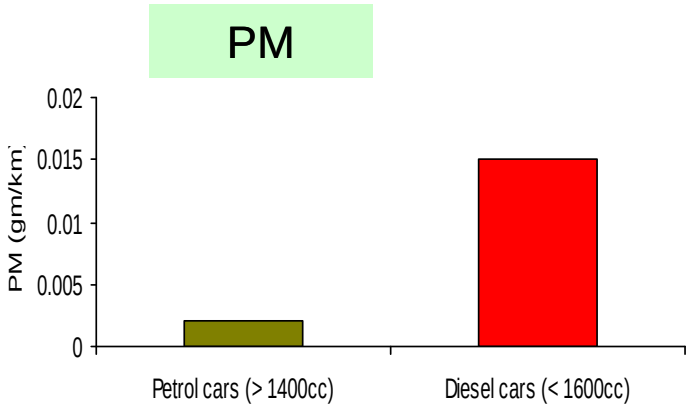
Black carbon emissions from diesel vehicles are several times more heat trapping than CO2

CO2 emissions from the upstream diesel refining process will increase:European Commission has found lifetime pollution costs of Euro IV compliant diesel car is much higher than petrol cars.

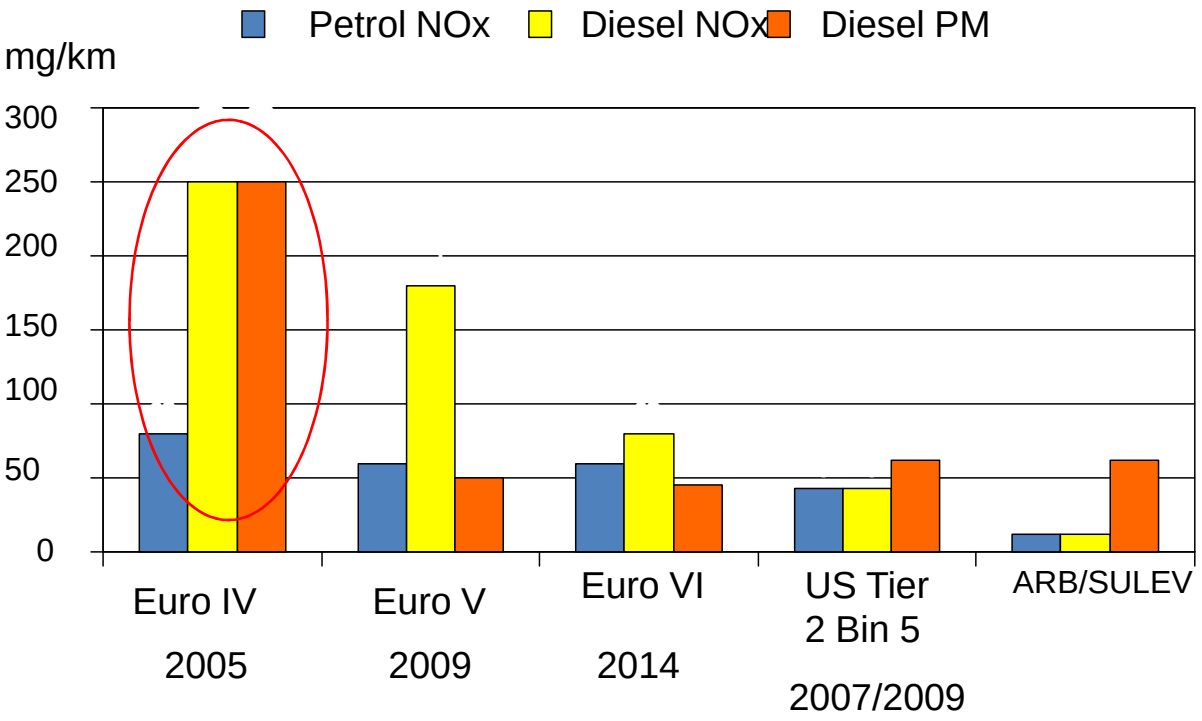
Rebound Effect: Diesel fuel has higher carbon content than petrol. If more diesel is burnt encouraged by its cheaper prices and more driving, more heat-trapping CO2 will escape.

Nullifies marginal greenhouse gas reduction benefit of diesel car ……





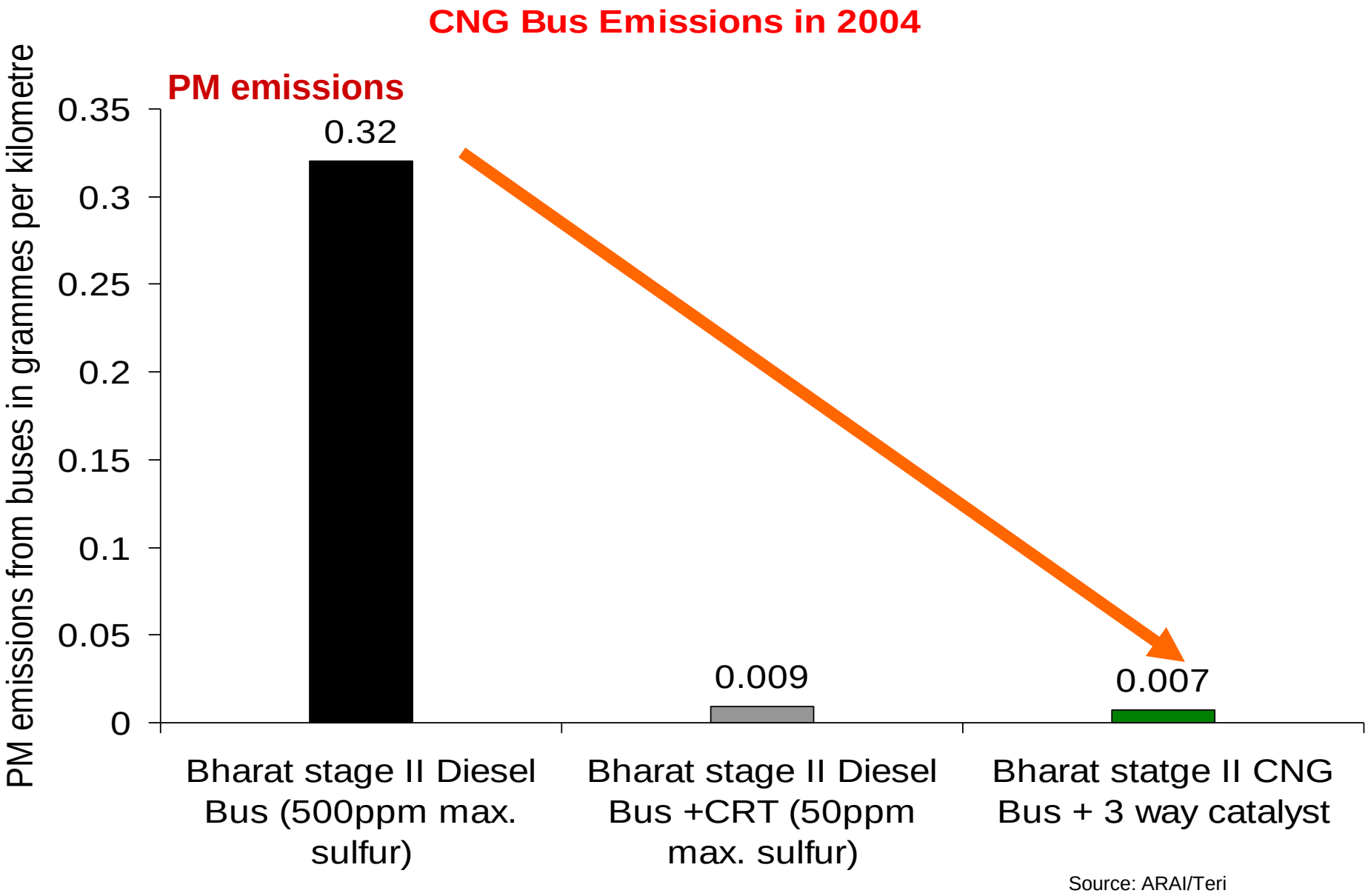
Leapfrog to Euro VI emissions standards
Technology exists to clean diesel vehicles



Euro 5+ (2011) and 6 include 6 X 10^{11}/km particle number limit
Euro 6 PM mass limit uses revised PMP mass protocol

Basis of the decision: CNG was an opportunity to sidestep poor quality diesel and leapfrog

Euro II diesel bus emitted nearly 46 times higher PM than Euro II CNG bus in India.



Source: ARAI/Teri

Comparative emissions of Indian diesel and CNG buses (Euro II vintage)

Type of bus	CO g/km	HC g/km	NOx g/km	PM g/km
Euro II diesel bus on 500 ppm sulphur fuel + DOC	1.45	0.29	6.24	0.35
Euro II diesel bus on 350 ppm sulphur fuel + DOC	0.65	0.15	5.85	0.11
Euro II diesel bus on 50 ppm sulphur fuel + CRT	1.42	0.04	13.58	0.009
Euro II CNG bus +three way catalytic converter	**3.18**	**1.455**	**5.35**	**0.0065**

Source: ARAI/Teri

Source: TERI

Second generation

CSIR-IIP-University of Alberta study:

:

-- Ultrafine particles from Euro IV Indian diesel bus - 600 to 2000 times more than the Euro IV CNG bus.

-- CNG ultrafine emissions are less or close to Euro VI standards for particulate number.

-- Diesel bus emits 1000 times more ultrafine particle numbers than Euro VI limit on transient cycle.

-- CNG buses have performed much better on all parameters than the diesel bus – CO, NMHC, NOx, and are close to Euro VI norms

-- Diesel bus – CO is19 times higher, NMHC 47 times higher, and NOx 17 times higher than Euro VI emissions standards.

What can Kolkata do?

Early introduction of Euro VI?.

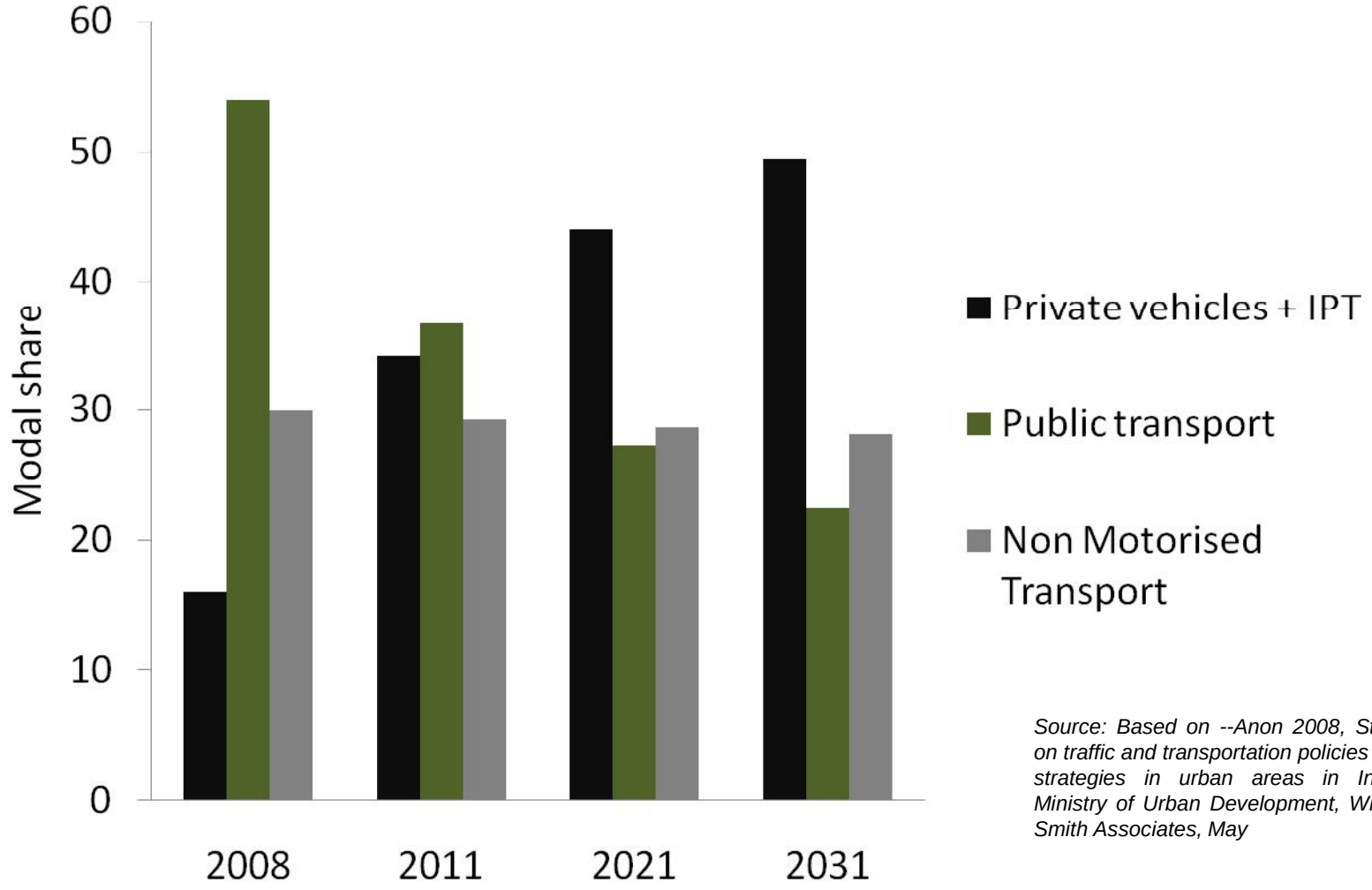
CNG, LPG, niche application of electric vehicles?

	CO (gm/kwh)	**NMHC (gm/kwh)**	**NOx (gm/kwh)**	**Total Particles**
Diesel bus				
Acceleration	7.87	7.58	8.42	$6.45x10^{14}$
Cruise	2.68	-	7.14	$4.46x10^{14}$
CNG bus				
Acceleration	0.43	0.15	0.87	$2.78x10^{11}$
Cruise	2.2	0.57	0.82	$4.37x10^{11}$
Euro VI (WHSC)	**1.5**	**0.13**	**0.40**	
(WHTC)	**0.40**	**0.16**	**o.46**	

MOBILITY CRISIS

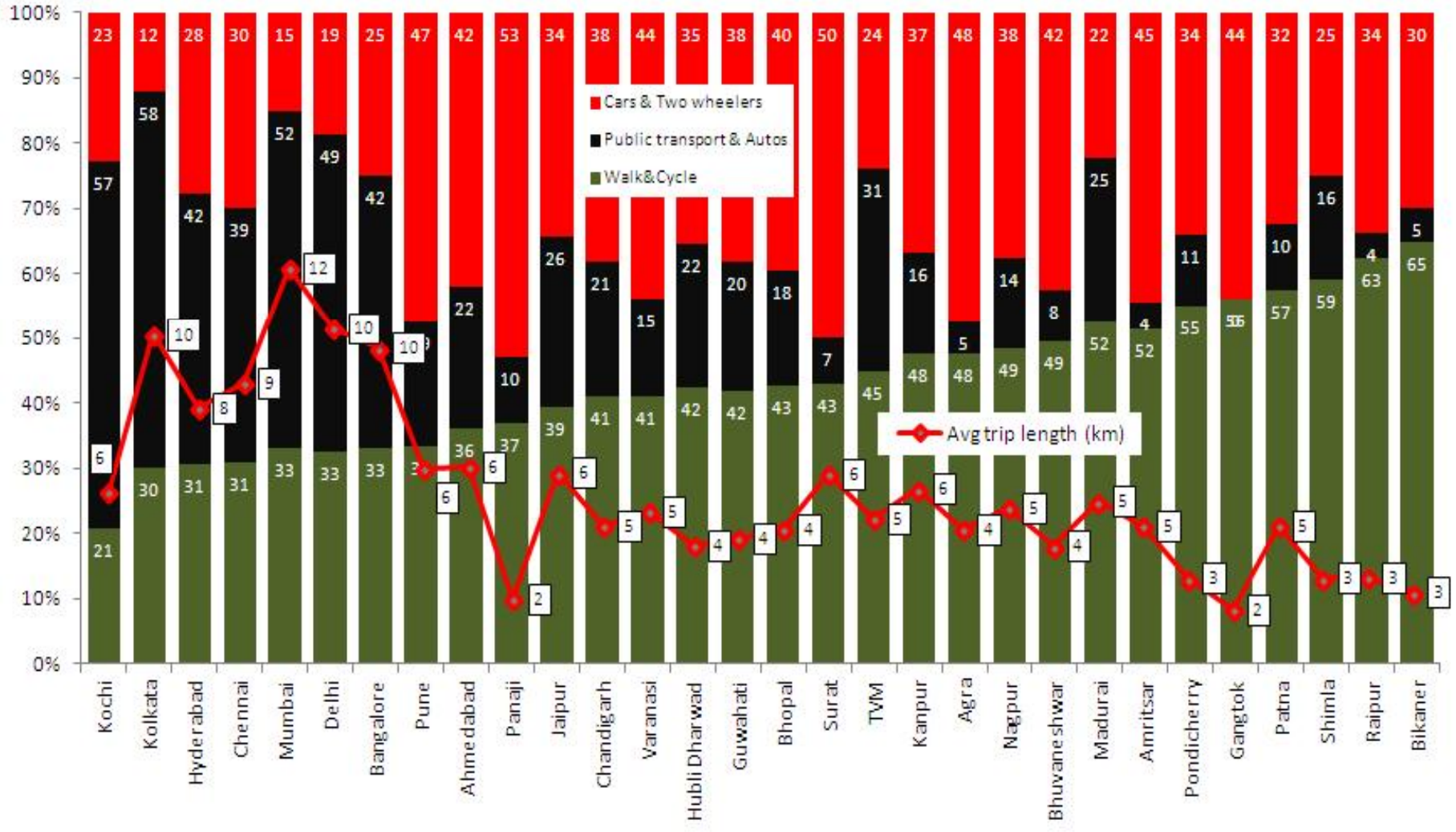
Cities are losing battle of car-bulge: The rapid increase in vehicles is destroying all gains of air pollution and health

Share of public and non-motorized transport trips to slide in Kolkata



Source: Based on --Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Wilbur Smith Associates, May

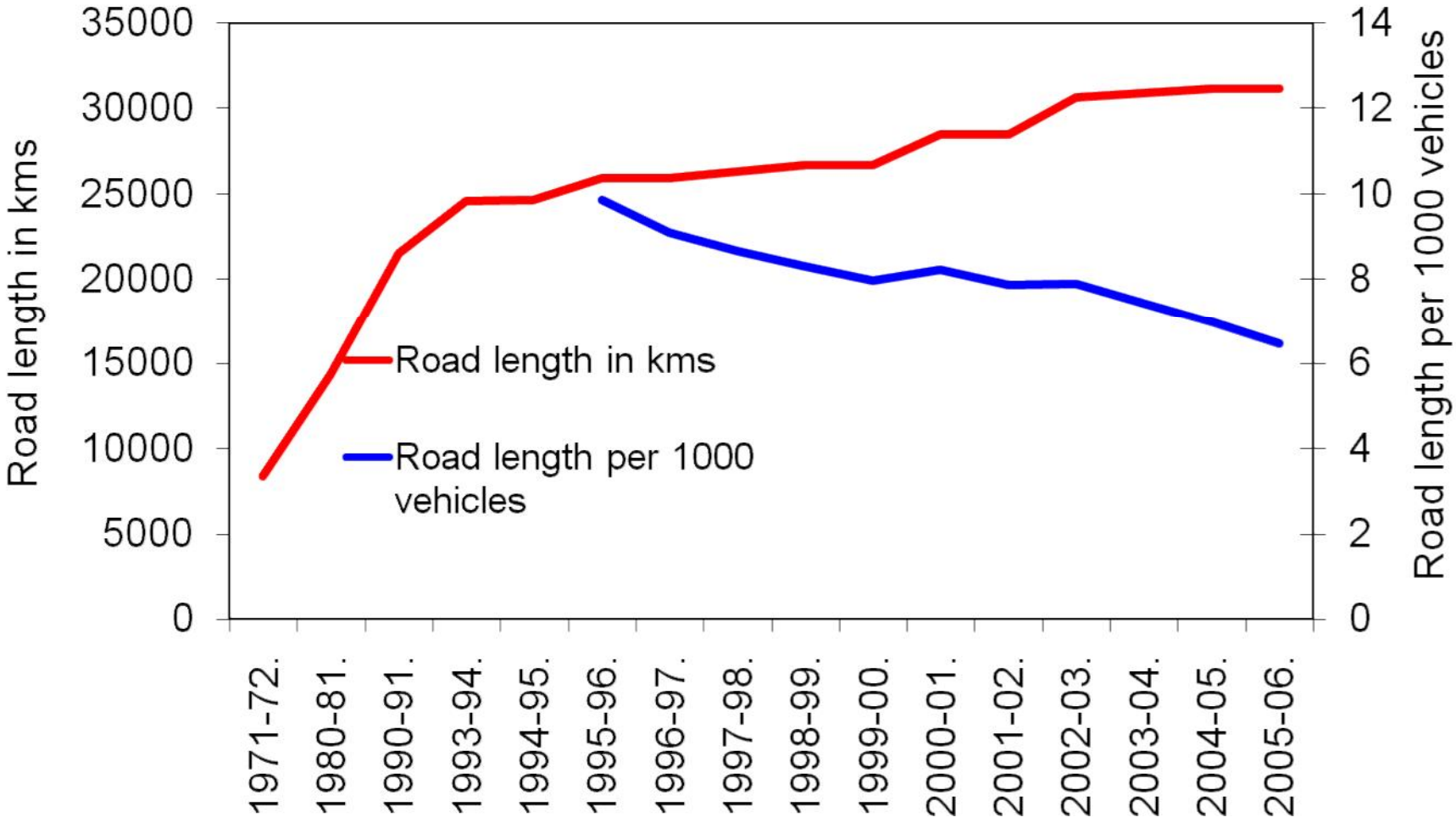
Need mobility transition



Source: Based on analysis of data provided in reports: 1) ICLEI-South Asia 2009 2) WSA/MOUD 2008

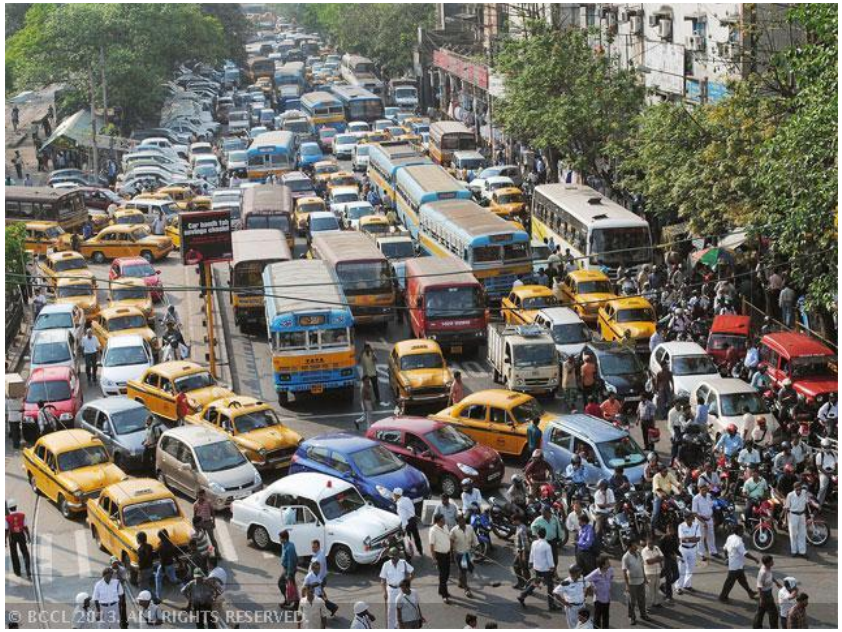
Can building more roads help?
Delhi has failed to solve the problem of congestion by widening road network

..... We can never build enough roads



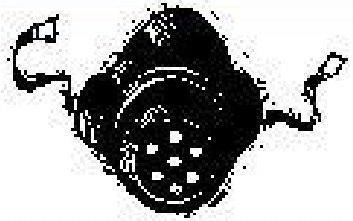
Source: On the basis of Economic Survey, Delhi Govt

Jammed….



- Cars cater to only 6% of the passengers but occupies 29% of the road space while buses serve 76% of the population and occupy 32% of the road space. (Source: A study was done by Switch ON, Environment Conservation Society, in Kolkata in 2013.)

- Delay in different corridors of Kolkata range from 20 minutes to about 60 minutes (Maparu and Pandit, 2010).



Cost of delay……

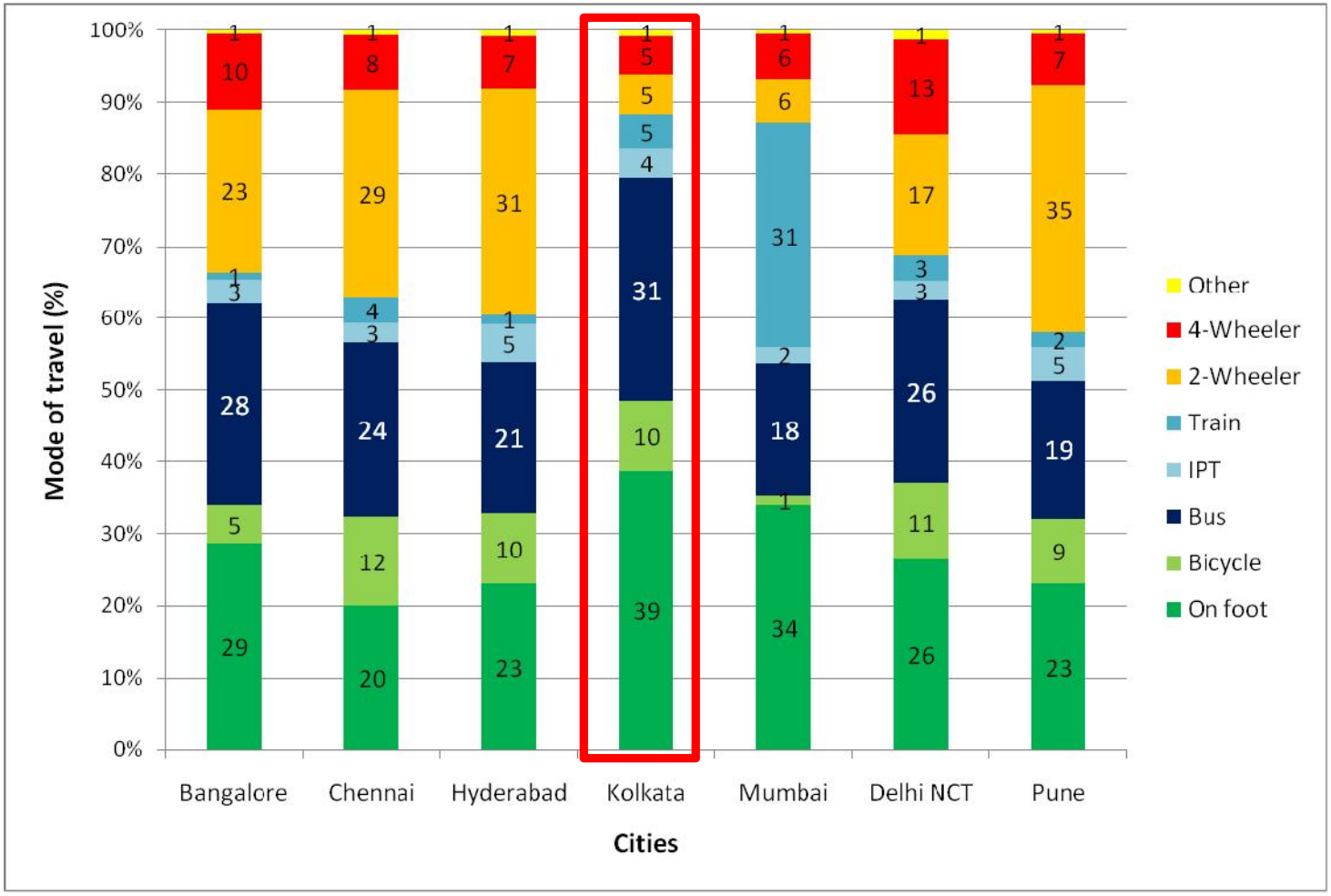
Arterial Roads	Corrid-or Speed	Length of Road	PCUs at Morning Peak	PCUs in Evening Peak	Total Time Loss (Hours)	Value of Time Lost (Rs.)
Vivekananda Road	40	1.2	1202	1768	17.82	338.58
Chittaranjan Avenue	25	4	2028	2112	331.2	6292.8
Mahatma Gandhi Road	9	3	1507	1599	848.97	16130.49
R. G. Kar Road	18	2	1397	1415	199.96	3799.32
Acharya Jagadish Chandra Bose Road	18	6	1915	1851	803.41	15264.85
Jawaharlal Nehru Road	25	3	2237	2246	268.98	5110.62
Lenin Sarani	20	2	1042	1225	136.02	2584.38
Deshapran Sashmal Road	15	2	1693	1848	330.49	6279.37
Raja Subodh Mallick Road	16	4	2678	2487	878.05	16682.95
Jatindra Mohan Avenue	20	1	1390	1407	83.91	1594.29
Total			17089	17958	3898.82	74077.66

Source: Centre for Urban Economic Studies, University of Culcutta, Kolkata

- Rs. 74,077.66 lost in only two hours (i.e. 9 - 10 a.m. and 6 - 7 p.m.) in a day on selected roads.
- Annual loss as much as Rs. 2, 66, 67,957.6.

Yet … one of the best scores mobility practices…

Mode of travel to work place in different cities

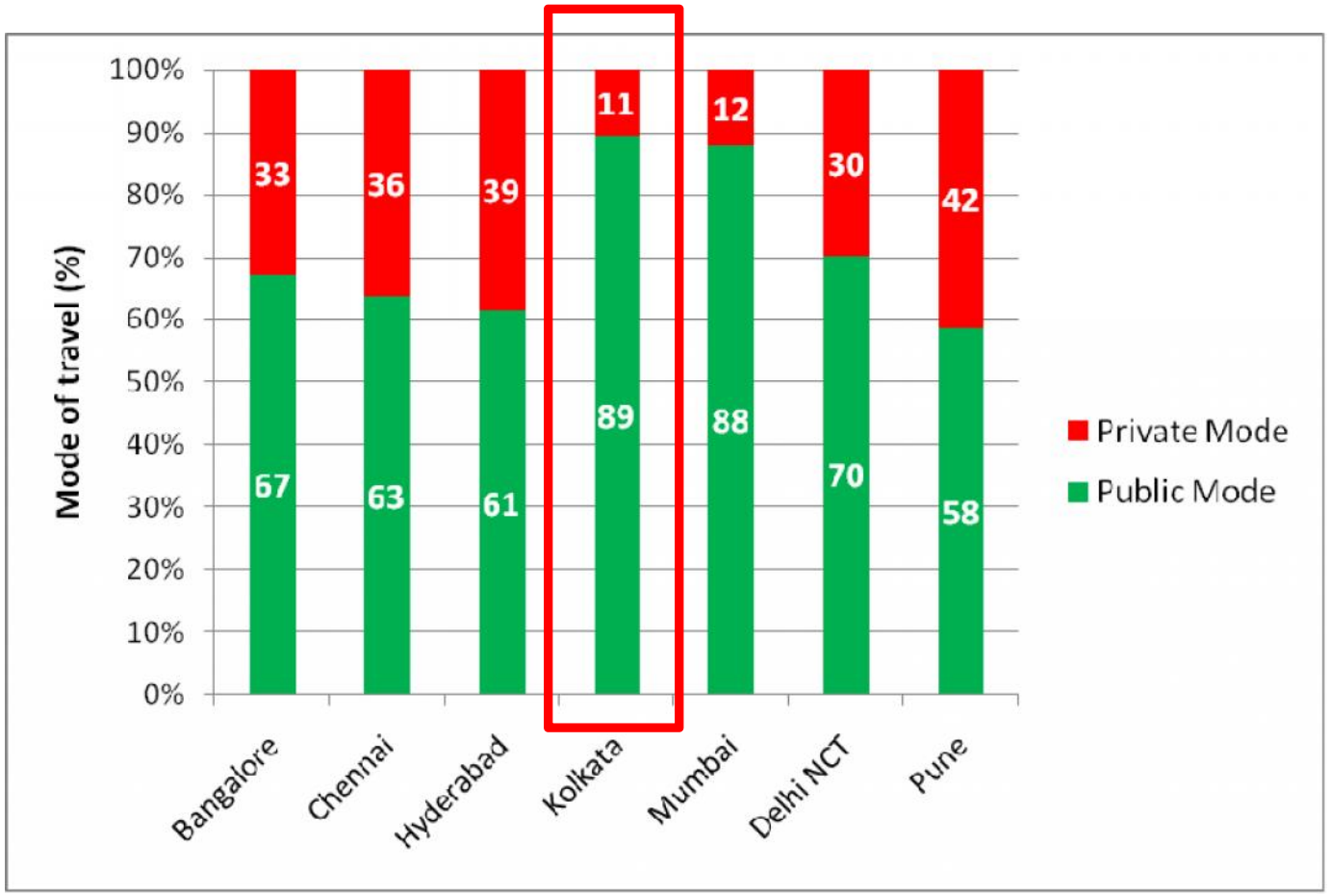


Source: Census of India, 2011 – CSE analysis

- Kolkata has maximum share of **walk trips -39 % and bus trips 31%**

Note:
IPT(Intermediate Para-Transit) includes tempo, auto-rickshaw and taxi
Work trips constitute major portion of all trips.

Sustainable … but under stress…

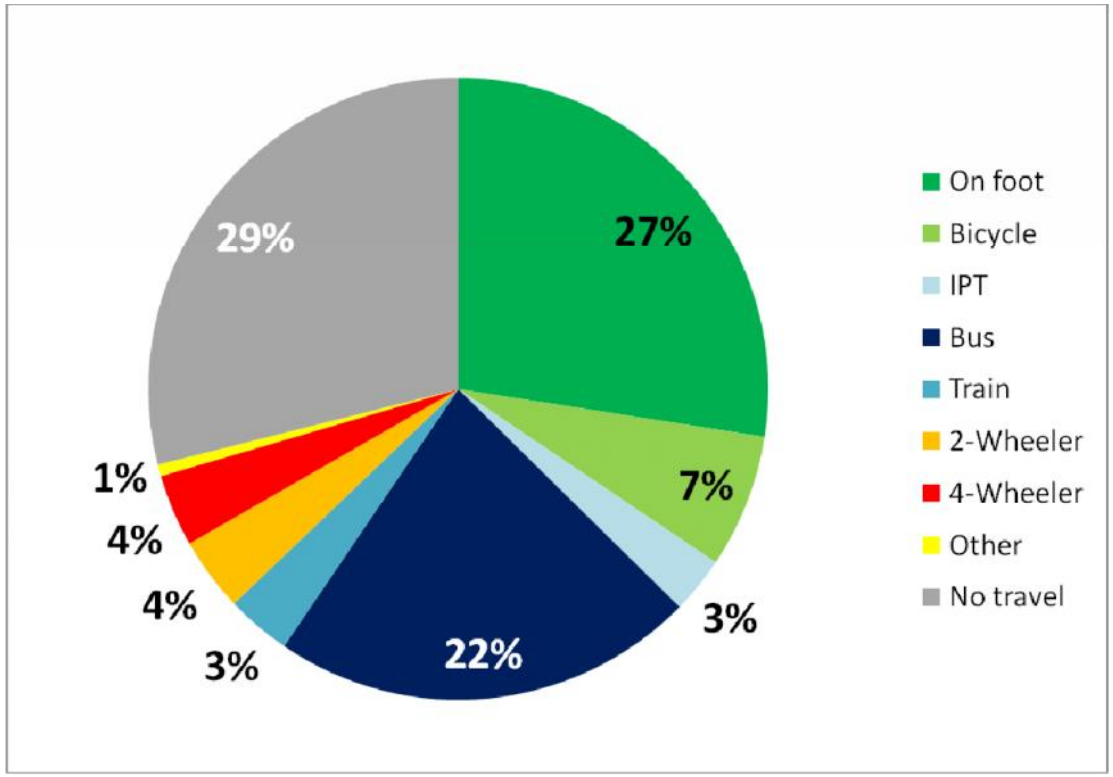


Source: Census of India, 2011 -- CSE analysis

Note:
IPT(Intermediate Para-Transit) includes tempo, auto-rickshaw and taxi
Work trips constitute major portion of all trips.

How people of Kolkata travel to work?

Census 2011: Mode of travel to work place in Kolkata



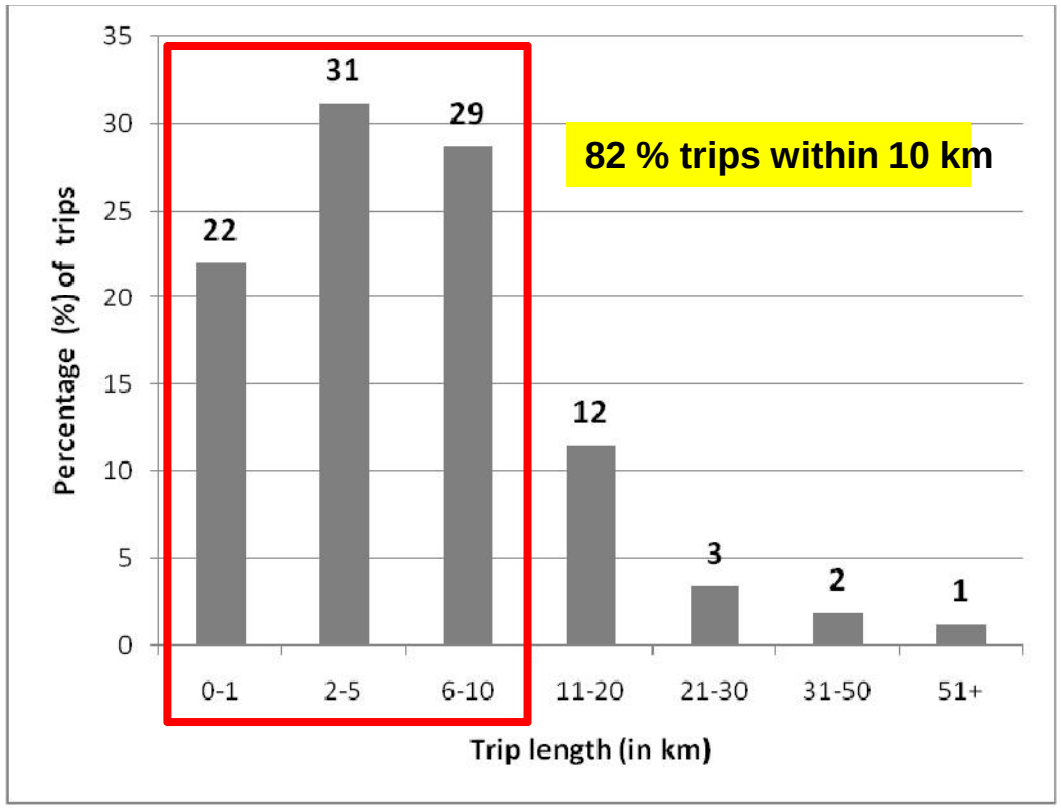
- More than **1/4 of the working population walk to work.**
- Nearly **1/3** of the working population **work from place of residence** and do no travel daily.
- **Nearly ½ of the working population commute by bus, bicycle, train and IPT.**
- **Rest commute by private mode and other modes**

Note:
IPT(Intermediate Para-Transit) includes tempo, auto-rickshaw and taxi
Work trips constitute major portion of all trips.

Source: Census of India, 2011 – CSE analysis

Advantage: Short distances

Percentage of trips based on trip length



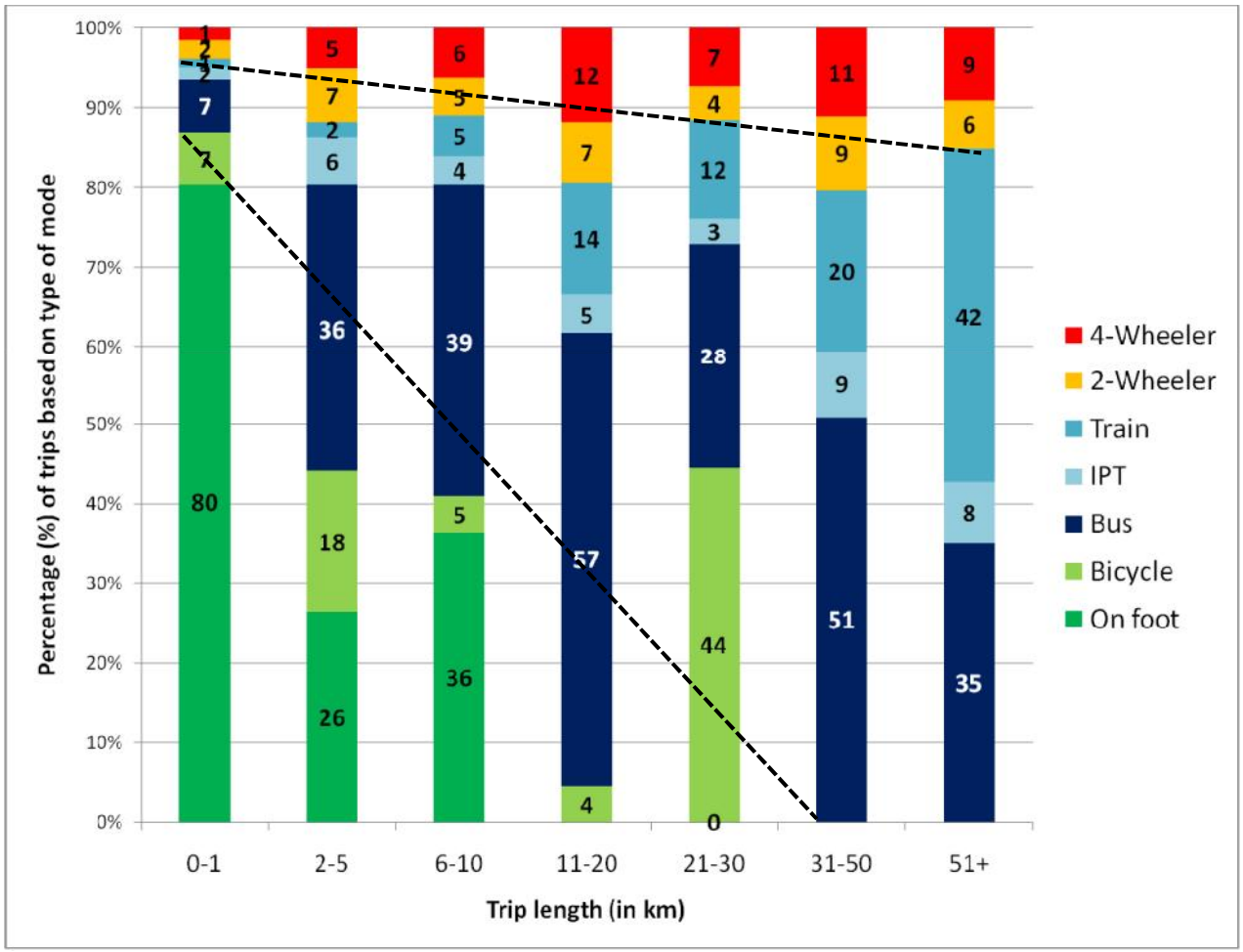
- 31% of trips are in range of **2-5 km**
- **29 % in range of 6-10 km**
- **22 %** of trips fall in the range of **0-1** km

- Walk, cycling and public transport access can transform the city….

Source: Census of India, 2011 – CSE analysis

Travel Behaviour based on distance

Percentage of trips based on trip length by type of mode



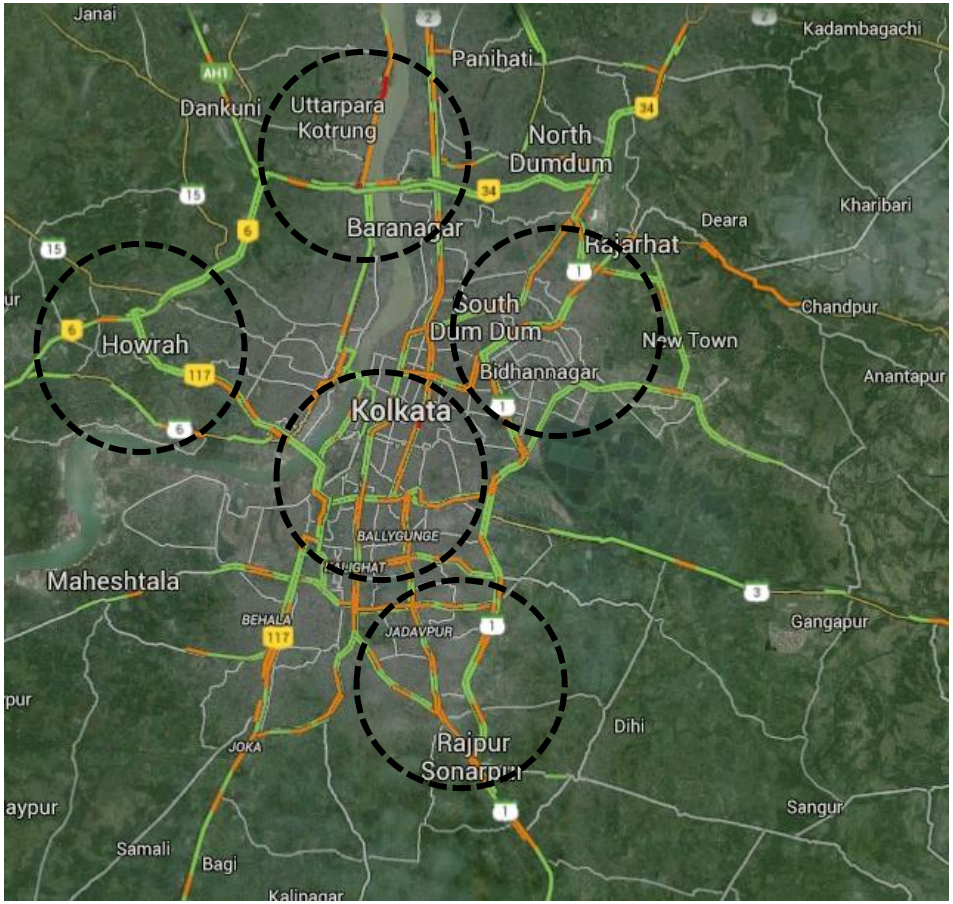
- As the distance increases percentage share of walk and cycle trips decreases.

- Dependency on private mode increases with increase in distance from residence to place of work.

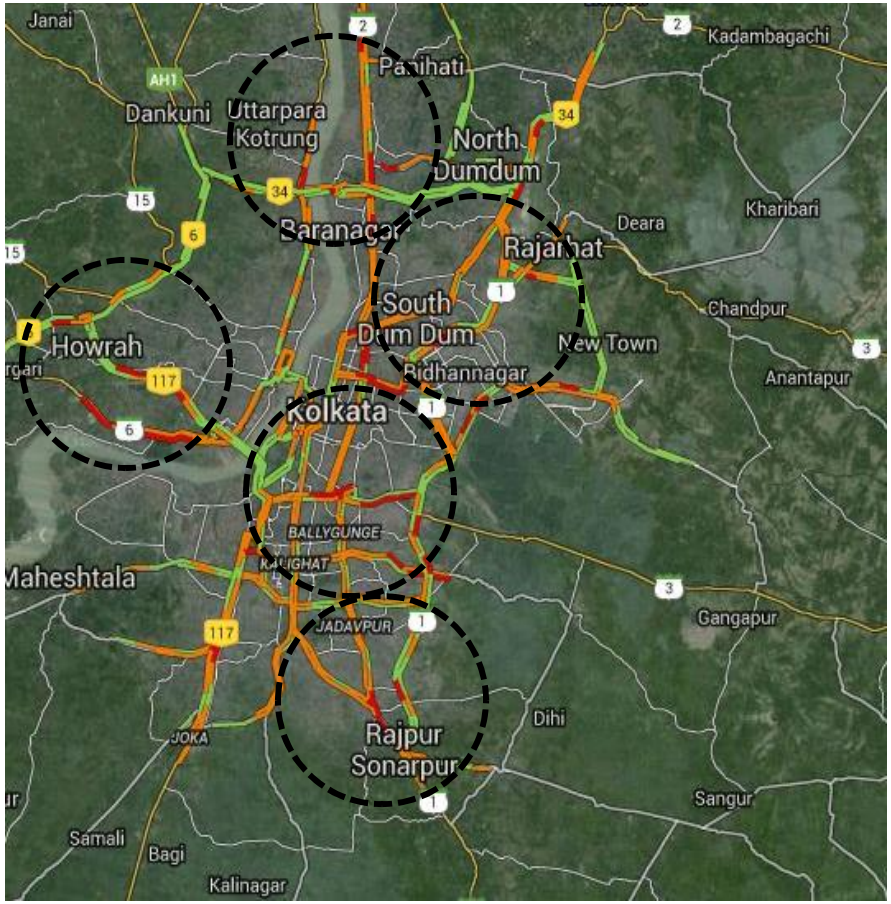
Source: Census of India, 2011 http://www.censusindia.gov.in/2011census/B-series/B_28.html

Traffic: Satellite Images (Morning Peak)
Republic day 2016 and after

Republic Day : 26 January 2016
Time – 10:00 am



Normal Day : 27 January 2016
Time – 10:00 am

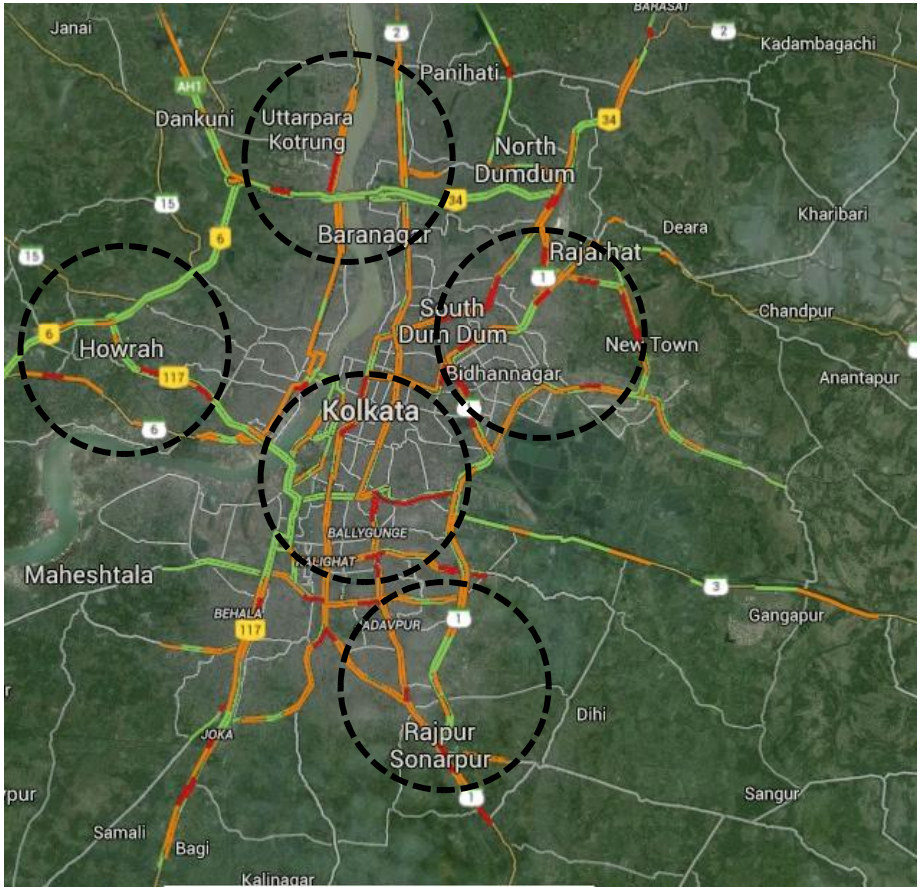


Fast moving			Slow moving

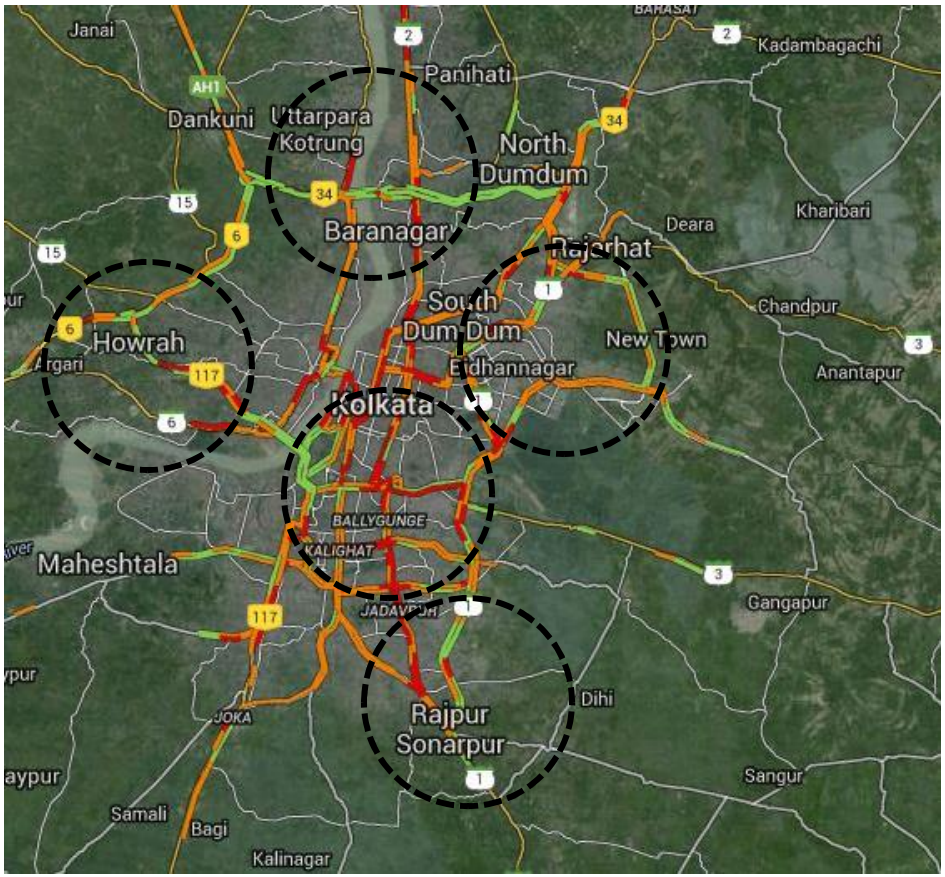
Source: CSE from Google Maps

Traffic: Satellite Images (Evening Peak)

Republic Day : 26 January 2016
Time – 07:00 pm



Normal Day : 27 January 2016
Time – 07:00 pm



Fast moving		Slow moving

Source: CSE from Google Maps

The future can be different…

KMDA expects massive increase in ridership of circular railway, metro and tramways: But BUS will dominate the increase

City Mobility Plan projects that even in 2025, amongst all public transport modes (metro, bus and ferry, bus), bus trips will be more than half

MOVEMENT 0F PASSENGERS

AVERAGE WEEKDAY PASSENGER VOLUME IN LAKHS

MODES	2001	2025	% INCREASE
SUBURBAN RAIL	*32.5*	*46.0*	*41*
METRO RAIL	*2.0*	*13.0*	*550*
CIRCULAR RAIL	*0.2*	*4.0*	*1900*
TRAM/LRT	*2.0*	*10.0*	*400*
BUS	113	175	55
PARA TRANSIT	35.0	67.0	91
INLAND WATER TRANSPORT(Ferry)	2.4	7.0	191
TOTAL	187.0	322.0	72

Source:

Bus needs to be the game changer: But neglected

City expands bus fleet

1200 buses sanctioned for Kolkata under JNNURM stimulus package. Many are on the road

-- Lack of coordination between operating agencies

-- Unorganised – large number of small time operators

-- Obsolete and poorly maintained fleet

-- Routes not rationalised

-- Poor level of service

-- Lack of performance and service standards

Strategy proposed – Increase number of buses, introduce high capacity buses, and extend routes to peripheral areas

Are we on right track?

Need service level guarantee…

Will Kolkata let tram die?

Why are we taking away road-space from trams – zero emitter?

Tram represents the equitable distribution of road space

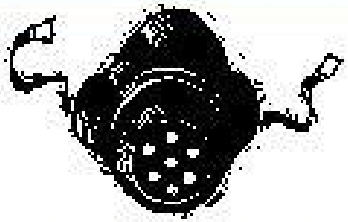
-- But Tram fleet downsized -- Utilisation is less than 50 per cent.
-- Passenger capacity dropped 10 times since the seventies.
-- Sharp drop in earnings
-- Worse -- 17 KM of tram tracks de-reserved and trams lose their right of way; 20 Km of tracks closed, and 12 KM temporarily suspended. --De-reserved tracks are extremely unsafe.
-- Sharp and progressive decline due to lack of investments and modernisation and unreliable service. **But Why?**

Trams after years of neglect meet 2% of travel demand. Metro with all its fancy trappings meets 5%

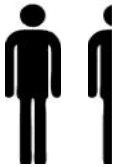
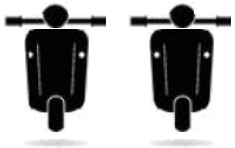
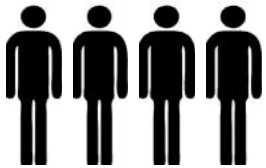
Trams are part of the solution, not problem….

Intermediate public transport: Taxis and autos

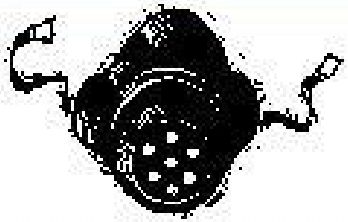
Courtesy: http://live-less-ordinary.com/dakshineswar-kali-temple-river-kolkata/



Auto-rickshaws decongest, reduce pollution and save fuel in Kolkata…….

Mode	PCU (Passenger Car Unit)	Average Occupancy	CO2 Emission (g/km)
CAR		 1.25	 146 g/km
2- Wheeler			 37g/km
Auto-rickshaw			 0.1 g/km

(*Source: Draft report on Integrating intermediate public transport within transport regulation in a megacity region, CPR and iTrans)*



Auto rickshaws help to save emissions and fuels

- **71% reduction in CO emission, 31% reduction in CO2 emissions-** if two-wheeler is replaced by auto-rickshaw (trips).

- **82% reduction in CO emission, 83% reduction in CO2 emissions-** if car is replaced by auto-rickshaw (trips).

- Huge reduction in traffic volume is possible (in terms of passenger car unit - PCU) - **75445 PCUs** saved by two-wheelers and **133022 PCUs** saved by four wheelers.

Source: Draft report on Integrating intermediate public transport within transport regulation in a megacity region, CPR and iTrans

Other cities reorganising autos and rickshaws

Share of para-transit trips in Kolkata
Para-transit trips are increasing 5% a year

Para transit trips	% share of para transit trips
Taxi	17.1
Auto rickshaw	**46.5**
Cycle rickshaw	**34.0**
Others	2.5

Para transit – a very important feeder for public transport. High frequency and affordable travel

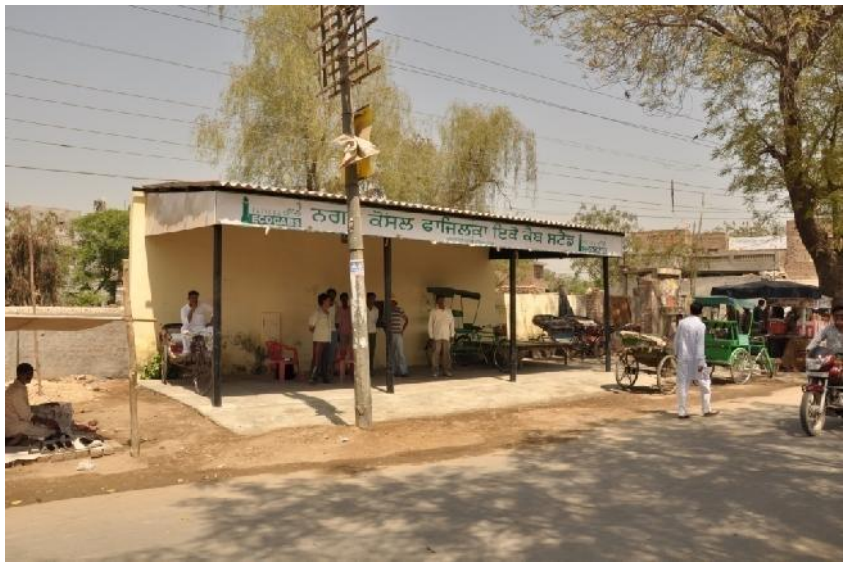
Autos and cycle rickshaws are part of the solution….

Delhi is reorganising this sector:
-- All three-wheeler drivers to get public service vehicle badge and smart cards.
-- GPS connectivity to improve the meters and compliance.
-- In-use vehicle fitness and emission testing systems
--Integrate with mass transit system.
-- Delhi is framing cycle rickshaw policy
-- Manage competition between public transport and para-transit

Eco cab Service in cities of Punjab

- Revolution starts from a small town of Fazilka –by Graduates Welfare Association Fazilka
- Ecocab initiative – dial a rickshaw scheme – organised non motorised transport
- Till date the service has been launched in 20 districts of Punjab

Eco cab service launched in Chandigarh



Dedicated rickshaw stand, Fazilka

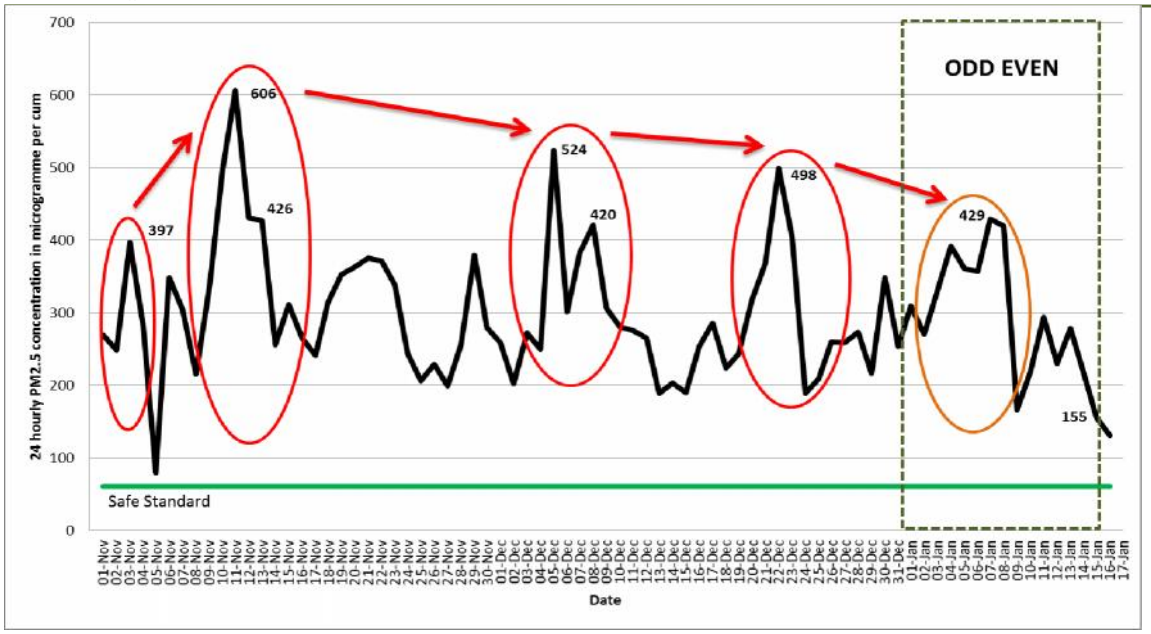
Image Source: Fazilka ecocabs

Road rationing is part of the solution

Reorganise road space according to road users…..

Right of the way segregated according to users --- bus users, walkers, cyclists and motorised vehicles.

Lesson from Delhi: Drop in intensity of smog episodes during odd-even fortnight in Delhi

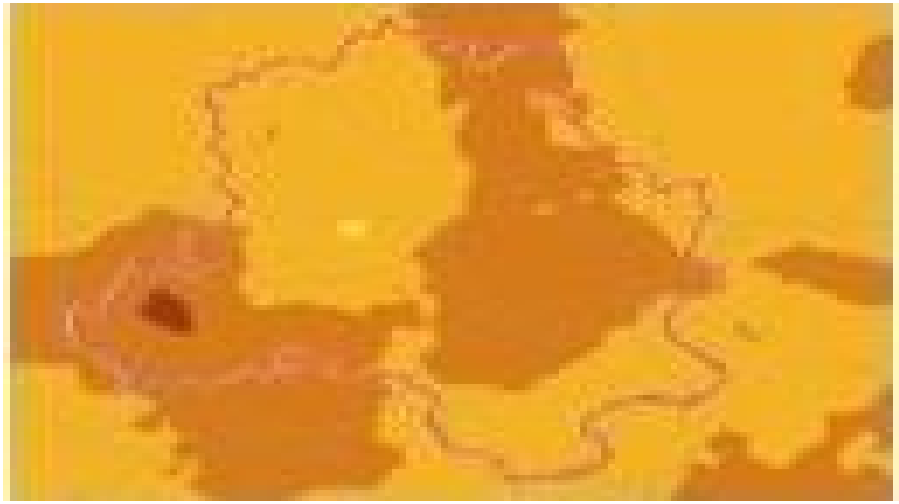


Bus passengers increased by 8%. Metro ridership increased by 7%

DTC bus fleet utilization improved from 84% in normal days to 95% during Odd-even policy.

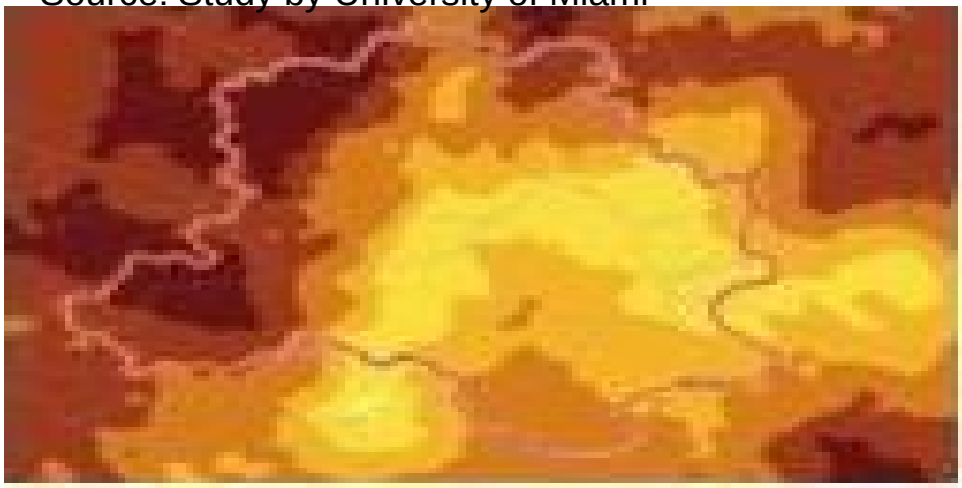
Fuel sale dropped by as much as 7.8%

Fortnight preceding odd and even scheme: Delhi more polluted than NCR



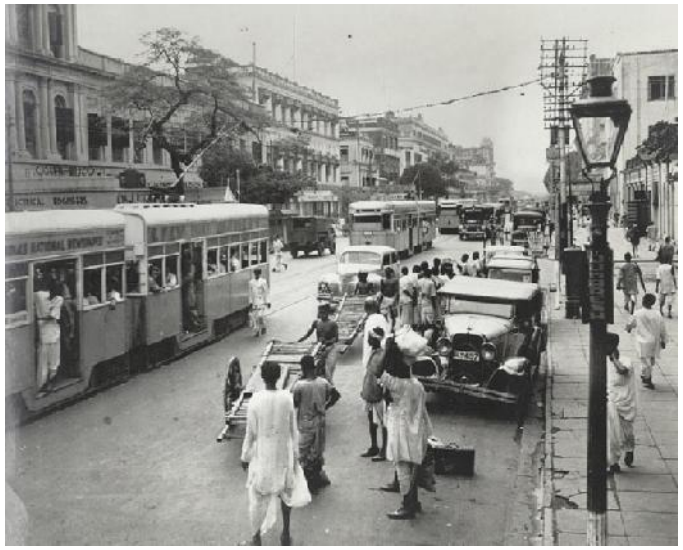
During odd and even fortnight: Delhi less polluted than NCR

Source: Study by University of Miami

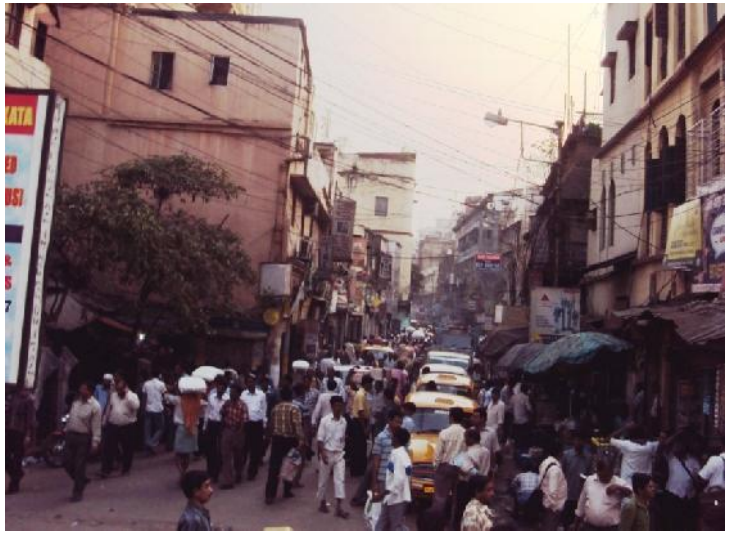


We built walkable cities…….

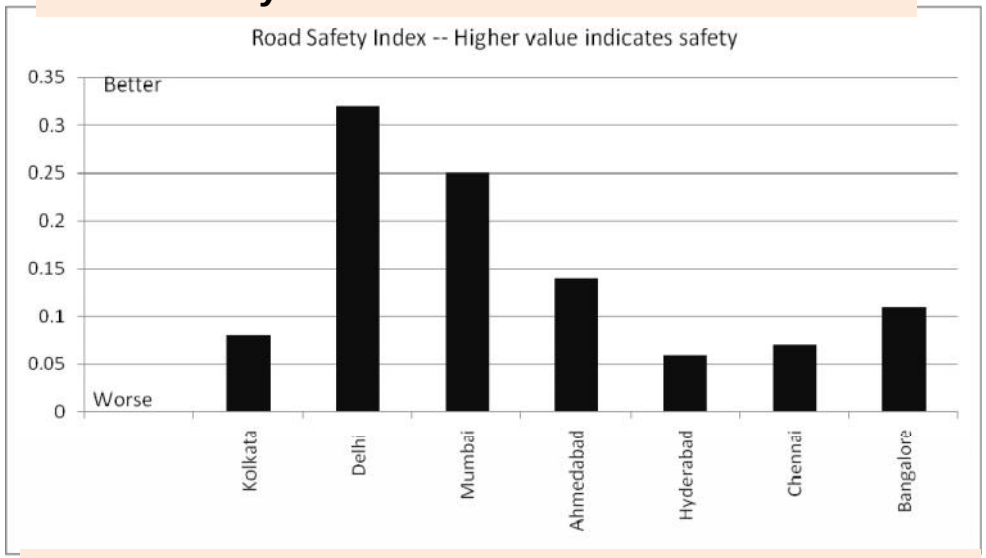
Kolkata: 1900s



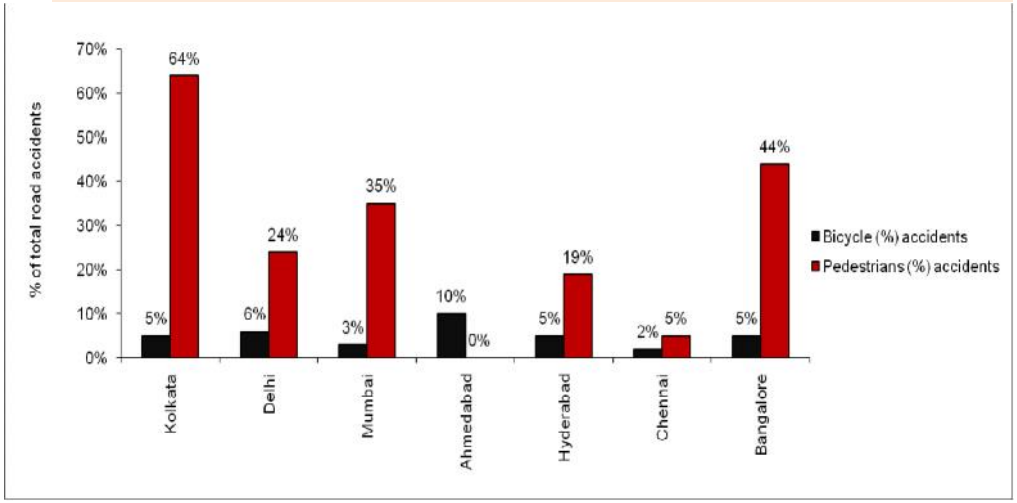
Kolkata: 2011



Road safety index: Kolkata gets poor score in MOUD study



Share of Bicycles and pedestrians in road accidents: Kolkata 64% pedestrian accidents



Jay walking….asserting their right to cross where convenient But car centric design does not allow safe, quick and shortest crossing

Sai Chowk, Patparganj

Scindia House, CP

Seamless and signal free traffic is interrupting shortest direct route for pedestrians. This is inciting jay walking

Source: CSE

Retrofitting changes…..

Connaught Place

- Sidewalks are now being rebuilt in Delhi

Source: CSE

Walking and cycling for health security

Credit: SG Architects

WHO – Need active transportation to cut pollution and secure public health…

Link between urbanity and life style….. Corelation between walking and cycling and obesity.
Eg, China – 1.8kg weigh gain after and twice as likely to get obese for a Chinese who acquired a car.
-- In the US more active neighbourhoods show less obesity

Street design provides for vendors

Good practice in Bhubaneswar

- Street vending zone included in street design
- There are on street 52 vending zones in the city.

Walking needs policy strategy

Good practice in Kolkata: New pavements are more sensibly designed than those in Delhi

Reform and enforce mandatory pedestrian guidelines for new roads as well as rebuild, beautification of existing roads – transform the entire city network

Public transport plan needs linkage with pedestrian plan

Urban local bodies must conduct periodic walkability and safety audits

Legislate right to walk: Should we have comprehensive road users act?

Need zero tolerance policy for accidents

Involve communities on decisions on use of road space

Need pedestrian network plan

Adopt traffic volume reduction plan

Bicycles and cycle rickshaws – the ultimate zero emitters and feeders for multi-modal integration

Momentous court order in Delhi to protect these vehicles…..

Bus-bike integration in Delhi: Delhi experiment with rented bicycles as feeders to metro

Kolkata: About 23% of households own bicycles. But Kolkata bans them on major roads/ stretches.

Enormous captive ridership of bicycles but declining

Need priority access to NMT. Eg. Delhi to implement bicycle master plan

Kolkata is taking different decision

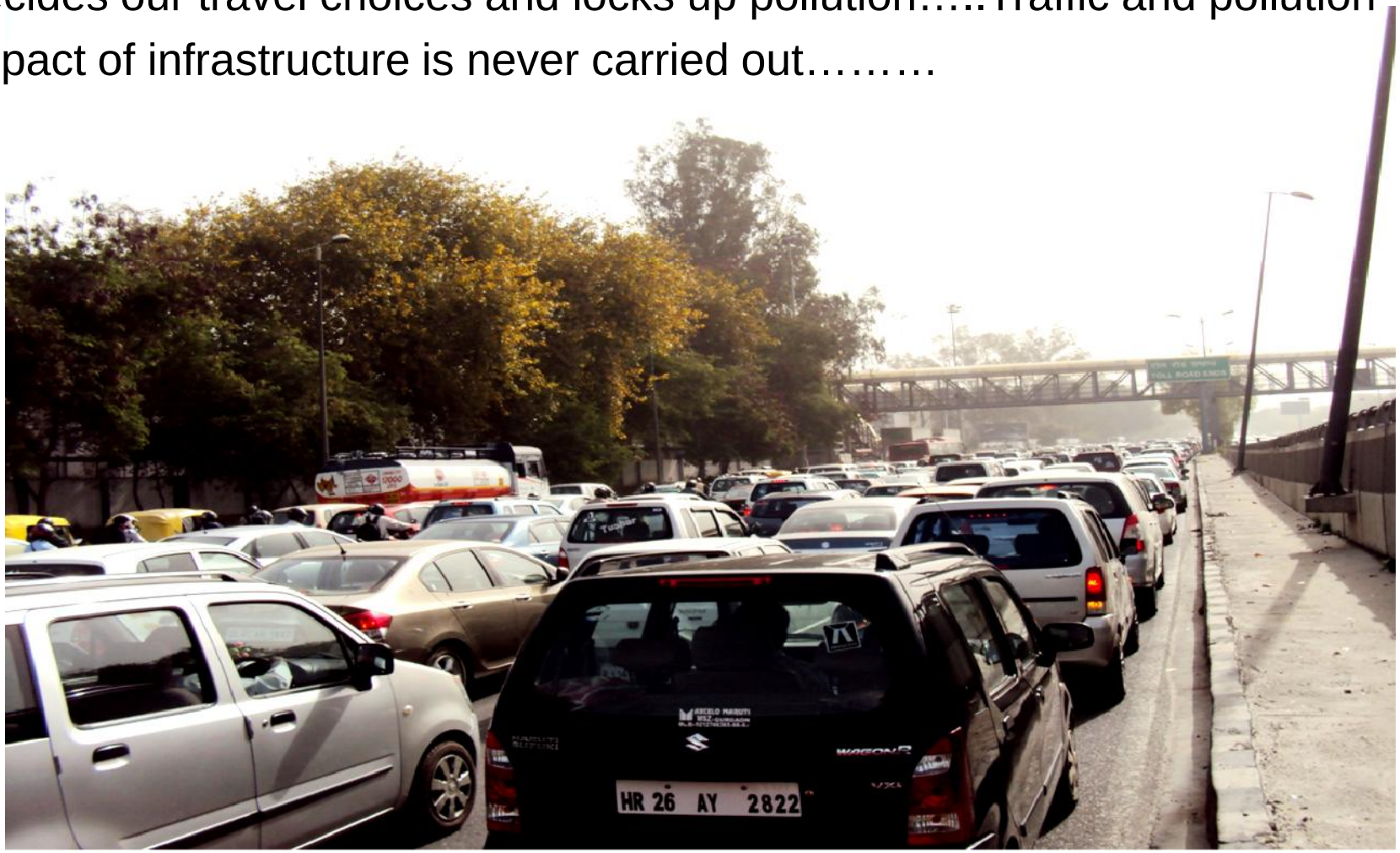
"In exercise of power conferred …. ***with a view to providing for safe, and uninterrupted movement of vehicular traffic,*** *do hereby order that no bicycle shall ply or remain standing between 09.00 hrs and 19.00 hrs on all days on the following roads*"

Source: Kolkata traffic police, August 2008, Notification

Do you know Copenhagen has more bicycle than cars?

Car centric infrastructure: How can public transport, walk and cycle work here?

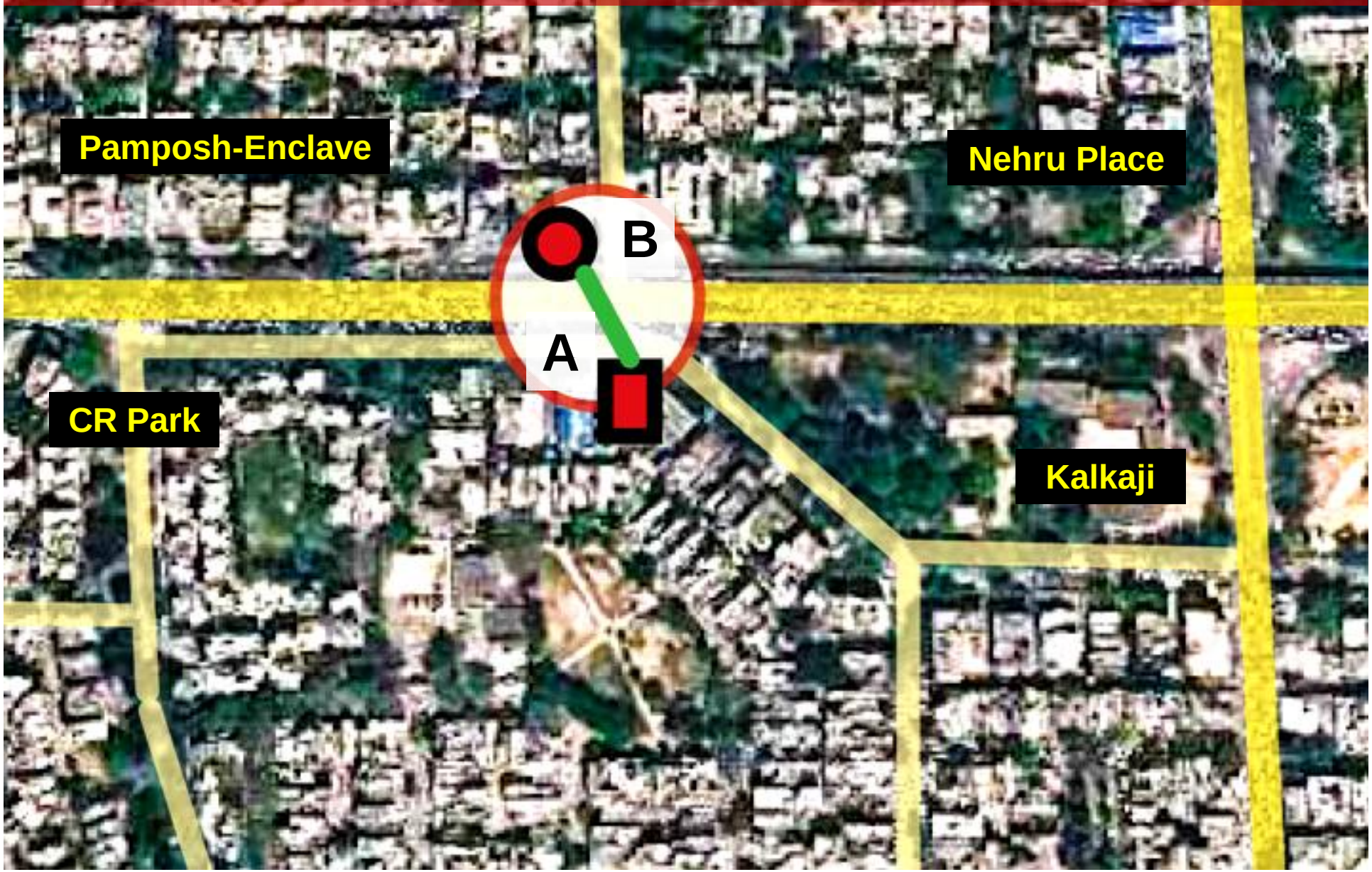
Engineering changes once made cannot be reversed easily… It permanently decides our travel choices and locks up pollution…..Traffic and pollution impact of infrastructure is never carried out…….



Case Study – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B

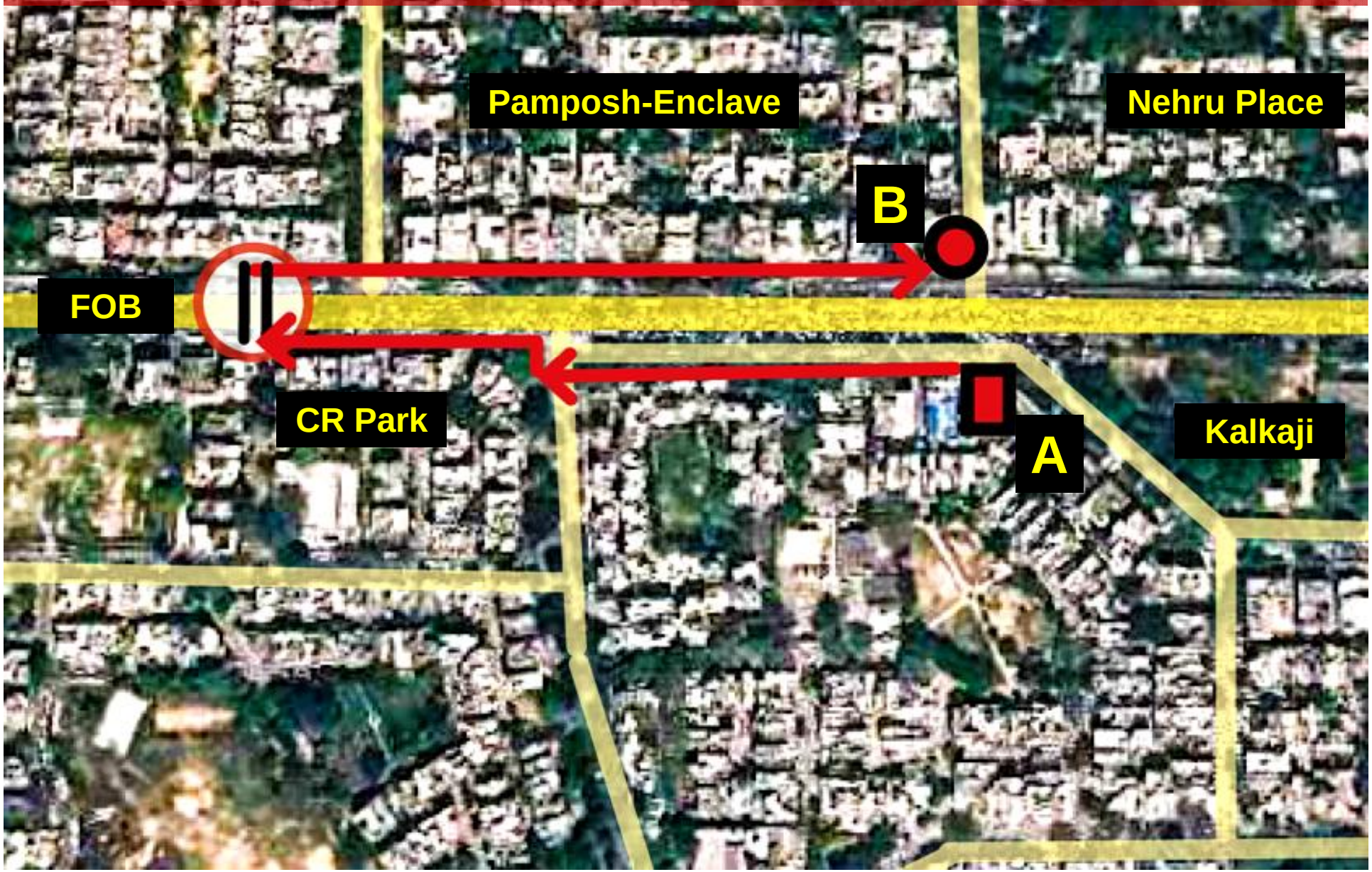
Originally 30M across the road



Case Study – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B – Pedestrian Route 1

1000M via FOB



Kolkata and New Town:
Why this difference in urban form?

Old Kolkata by the Hoogly

New Town Kolkata

New Town.....
Efficiency gains lost in a sprawled city

Super blocks

Source: CSE

No mid block crossings for pedestrians – Advantage to vehicles

Build compact city

……Devil is in detail

National Habitat Standard Mission of the Ministry of Urban Development….. Also Transit Oriented Development norms in Delhi

Guidelines for compact mixed land use

-- 95% of residences should have daily needs retail, parks, primary schools and recreational areas accessible **within 400m walking distance.**

-- 95% residences should have access to employment and public and institutional services by public transport or bicycle or walk or combination of two or more.

-- At least 85% of all streets to have mixed use development.

-- Need small block size with high density permeable streets etc

UTTIPEC guidelines

Hierarchy of Facilities	Accessibility Standard from each home/ work place.*
MRTS Station	Approx. 800 m or 10 min walk
Metro feeder/ HOV feeder Stop	Approx. 400 m or 5 min walk
Bus Stop	Approx. 400 m or 5 min walk
IPT/ auto-rickshaw Stand	Approx. 250 m or 3 min walk
Cycle Rickshaw Stand	Approx. 250 m or 3 min walk
Cycle Rental Stand	Approx. 250 m or 3 min walk
Shared private parking garage	Approx. 500 m or 6 min walk

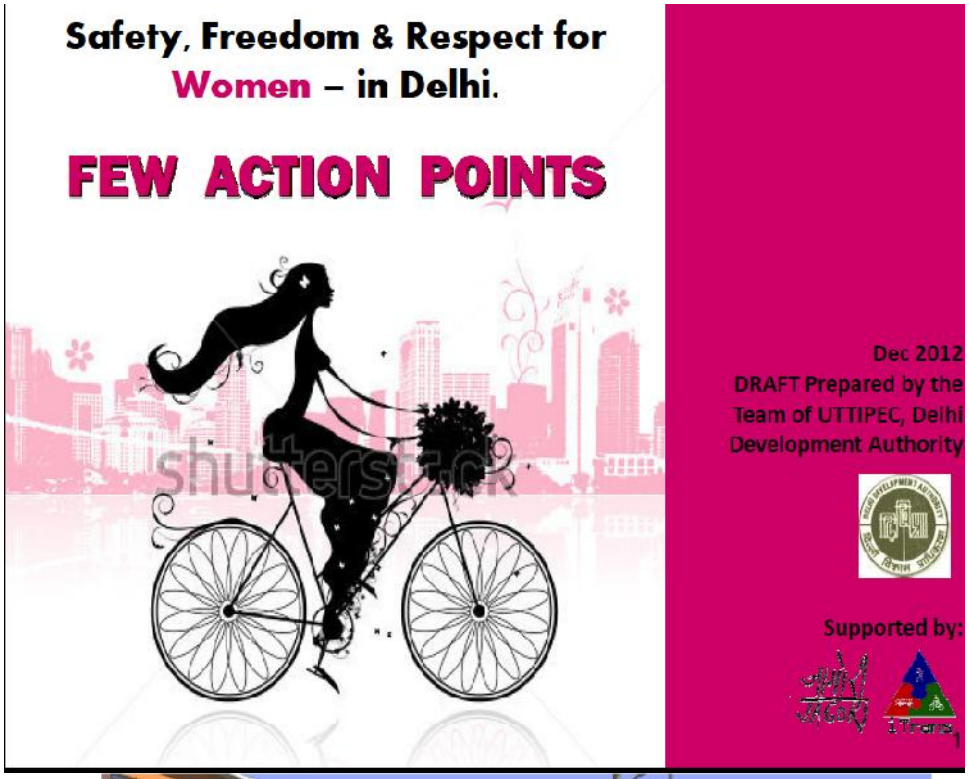
Central Kolkata

Older cities -- dense network of streets with excellent connectivity. The average block with public access streets under 1 hectare with block circumference of 400m or less.

New law in California: SB 375 law -- requires jobs, recreation and housing planned in a way that people can live and work closer together, and drive less.

Where will you feel more safe to walk?

Why do we have building setbacks and boundary walls?



To ensure Safety of Pedestrians:

Safety and urban planning…

Excerpts:

Initiate planning and road design schemes where unwatched streets can be transformed... to make safe urban areas:

- **Get rid of walls and setbacks. Add street edge uses -- for road safety at night,**

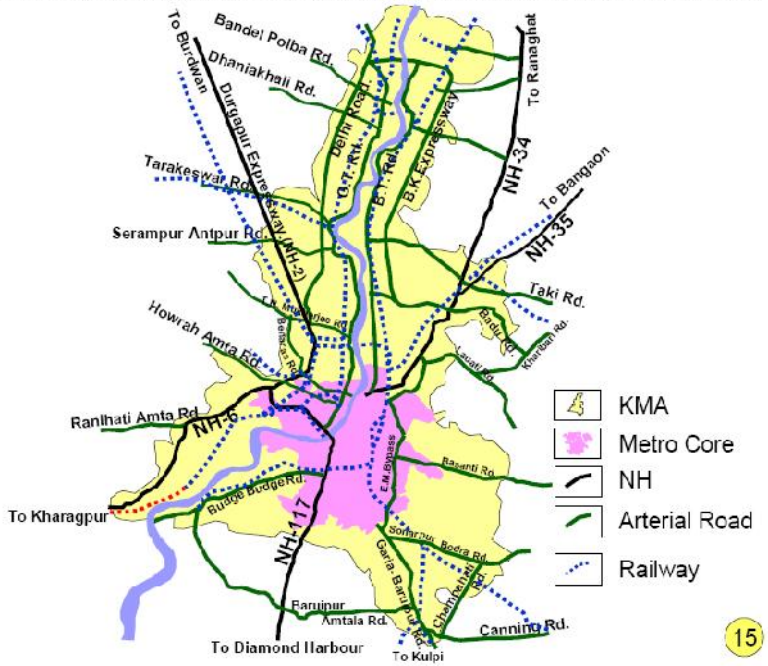
Transparent fencing shall be used above 300 mm high toe wall from ground level.

- Add planned hawker zones.

- Adhere to IRC 103:2012 for Street Design.
- Introduce planned mixed-use housing …along road edges of major vulnerable roads.

Integrate, integrate integrate…….

EXISTING METROPOLITAN HIGH WAYS & ARTERIAL ROADS WITH RAILWAY NETWORK



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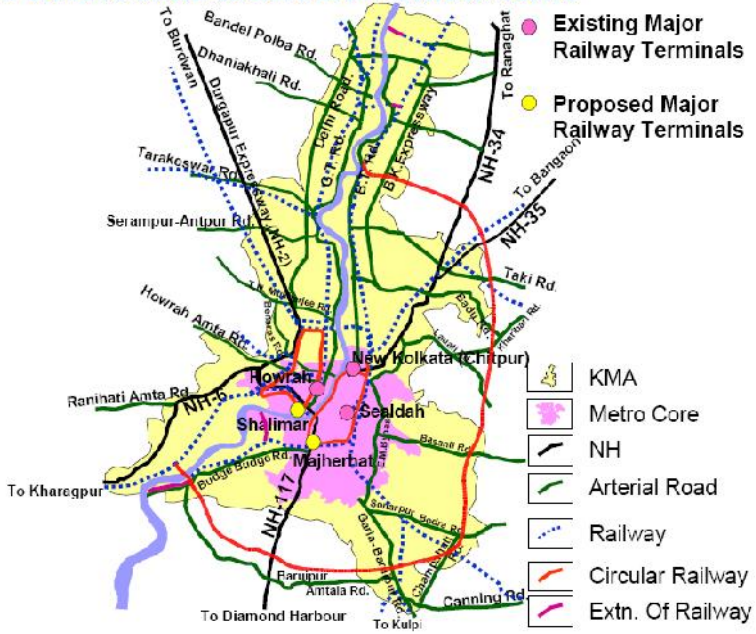
The Challenge of multimodal integration

Need design guidelines to integrate multi modal public transport systems as a city-wide system

Improve connectivity in the interchange points Need system design and physical integration for easy transfers and access.

Introduce common ticketing in different modes

EXISTING &PROPOSED RAIL NETWORK IN KMA



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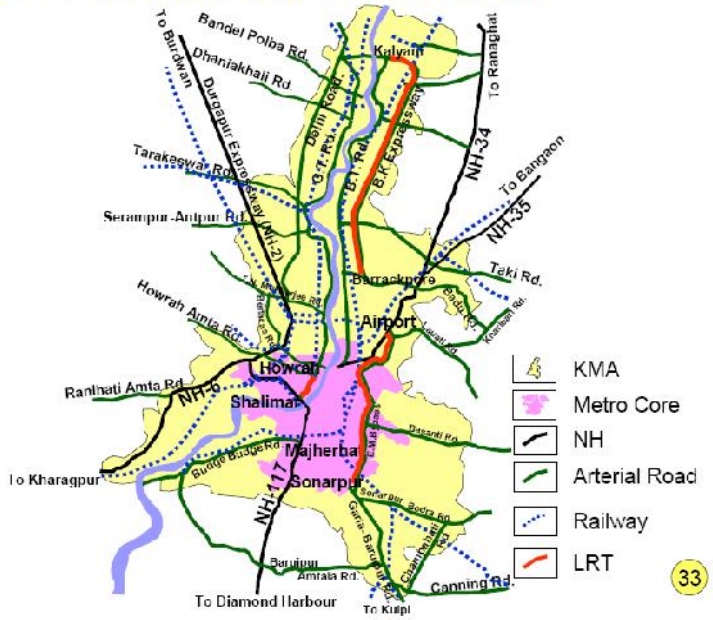
PROPOSED LIGHT RAIL TRANSIT ALIGNMENTS IN KMA



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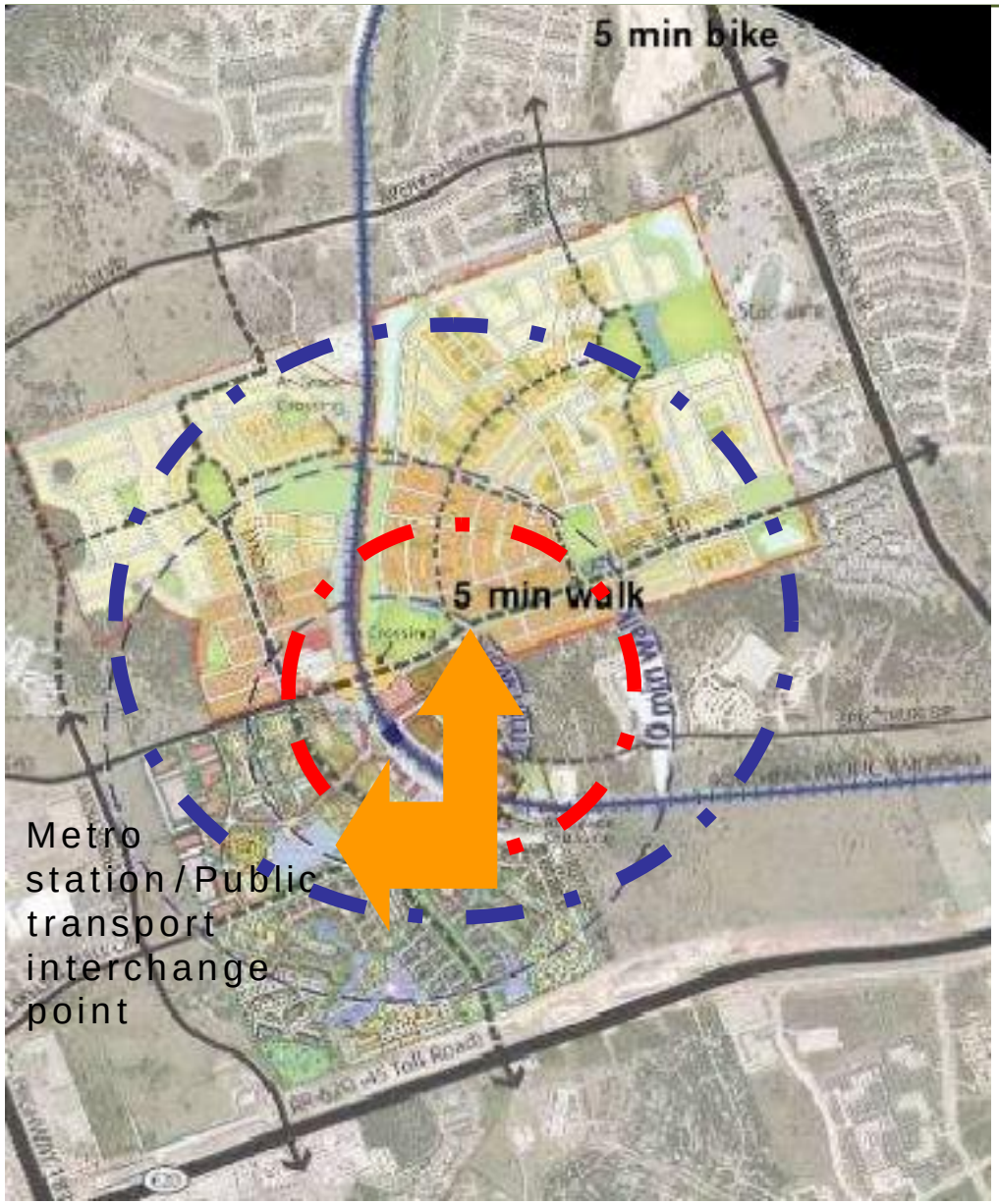
Source:

Delhi is developing guidelines for modal interchange location

Delhi-- UTTIPEC/DDA guidelines



Bus stop, cycle rental: within 50 meter level walk from station exit

Cycle and two wheeler parking :within 100 meter level walk from station exit

Auto rickshaw stand: within 150 meter level walk from station exit

Private car/taxi/auto rickshaw "drop off": with barrier-free of exiting pedestrians and NMT

Pedestrian exits, bus-stops and Cycle-rickshaw stands must be closest to main pedestrian exits from station.

Car parking if provided, must be BEYOND 250 M distance of Station/ or PT interchange point

Pairing of Origin-Destination (O-D) Nodes:

Provide cycle/ auto stands at nearby important destinations.

Signages at both end locations.

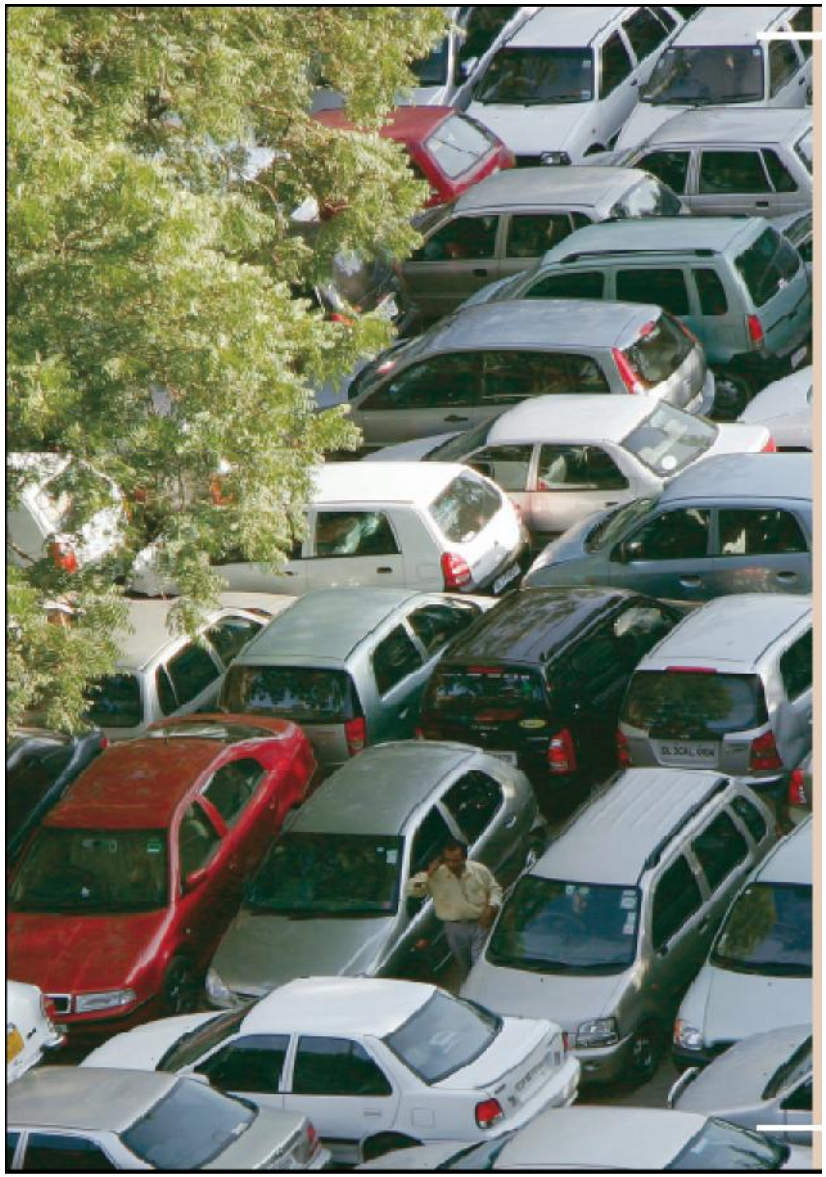
Private car parking only at Terminal Stations.

Discourage car parking at Stations within inner-city urbanized areas.

Remove hidden subsidies to cars……..

Parking: pressure on public space...

- **Parking: wasteful use of cars**: For about 90 to 95 per cent of the time a car is parked. (CRRI)
- **Insatiable demand for land**: Annual registration of cars generate demand for land bigger than 310 football fields in Delhi! Land is expensive and can be used for other social and public amenities
- Parking demand from all cars in Kolkata is equivalent to 1150 football fields
- **Inequitous use of land**: A car is allotted 23-26 sq m for parking. Under low cost housing scheme only 18-25 sq m is allotted to very poor families.
- **Parking takes away walkspace from pedestrians**
- **Urban common, green spaces, walkways at risk.** Neighbourhood brawls



Other countries are limiting and pricing parking to meet clean air target

Capping parking supply

Portland, Oregon Overall cap of 40,000 parking spaces downtown. This increased public transport usage from 20-25 per cent in the 1970s to 48 per cent in mid 1990s.

Seattle allows a maximum of one parking space per 100 square metres at downtown office

San Francisco limits parking to seven per cent of a downtown building's floor area

Parking pricing strategy to reduce car usage. Benefits public transport

New York: Very high parking fees and limited parking supply lowers car ownership far below the US average.

Bogota Removed limit on the fees charged by private parking companies. The revenue goes to road maintenance and public transit improvement.

Shenzhen: Hike in parking fees during peak hours leads to 30% drop in the parking demand.

Bremen: No free parking in city centre. Parking charges higher than public transport cost.

Barcelona– Parking revenue directed to a special fund for mobility purposes.

London: parking income channeled to transportation projects.

Strong enforcement and penalty

Tokyo: Enforcement against parking violations cuts congestion drastically . Private firms allowed to issue tickets for parking violations. This makes on-street parking expensive.

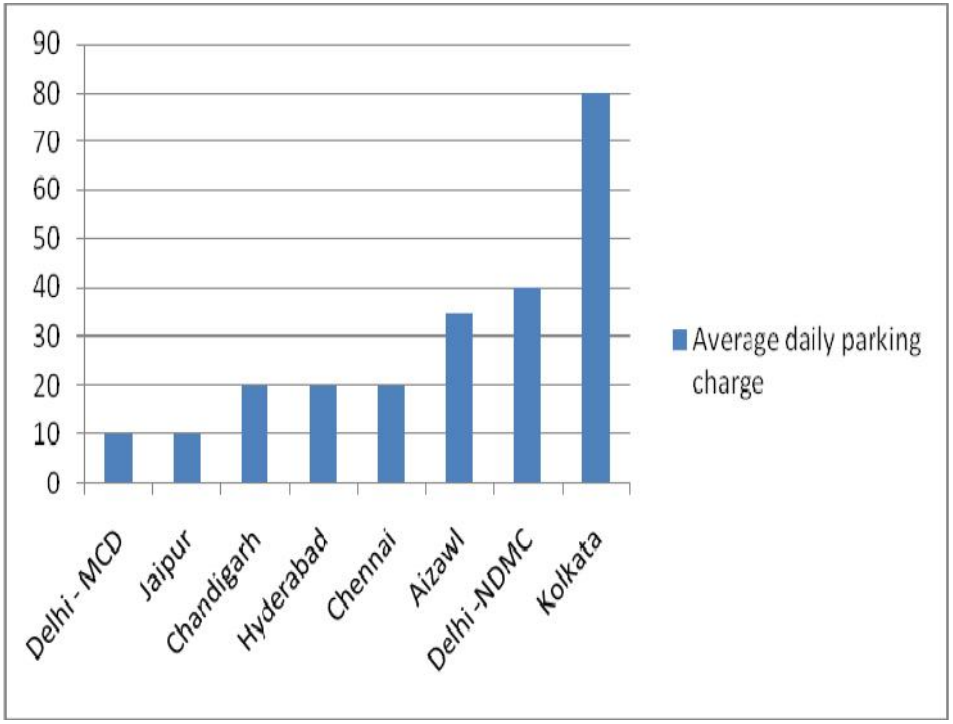
Antwerp: parking fines are invested into mobility projects

Free up public space

Paris: Street space freed for bike sharing and trams

Copenhagen: Streets freed up for bike lanes etc

Kolkata – leading but needs to do more



Maximum restraint principles

• **Until recently highest parking charges for personal vehicles:** Surface parking charges are highest in Kolkata – Rs 10 per hour. In Delhi Rs 20 per hour now....

•**Only city with residential parking pricing policy:** Personal vehicles pay night charges for on street parking in neighbourhoods with narrow streets.

•Those who cannot park on roads rent spaces to park cars. They pay in the range of about Rs. 1000-1200 per month.

•This is similar to Tokyo model

On-street parking pricing has major impact on vehicualr use.....

No meters

Meters

Prices quadrupled

Grosvenor square, London

Source: TRL in ITDP (2011): Europe‘s Parking U-Turn

Parking policy: Guiding principles….

- Adopt flexible parking standards and review parking standards. Do not create oversupply. Account for improved public transport access and reduction in personal vehicle travel.
- Integrate parking design with multi-modal integration. Priority to NMT and public transport
- More stringent parking controls and enforcement in areas well served by public transport. Phase out on-street parking in targeted areas.
- Parking pricing -- Minimise free parking, restrict on-street parking, use variable parking rates, avoid fixed annual payment, price parity between surface and multi-level parking
- No parking on green spaces, pavement, NMT lanes, and service lanes. Non-negotiable.
- Need parking strategy for residential areas and mixed land use areas.
- Use parking revenue for other congestion reduction strategies and local amenities
- Stringent penalty on parking violations.
- Develop parking strategy for special localities like hospitals, railway station, cinemas, shopping malls, schools, high impact events etc
- Provide parking for public transport vehicles
- Need innovative parking strategies for residential areas for demand management

Policy opportunity: National Urban transport policy provides for parking as a restraint measure; JNNURM reform agenda; Supreme Court directives on parking and congestion.

Need tax and pricing signals…….

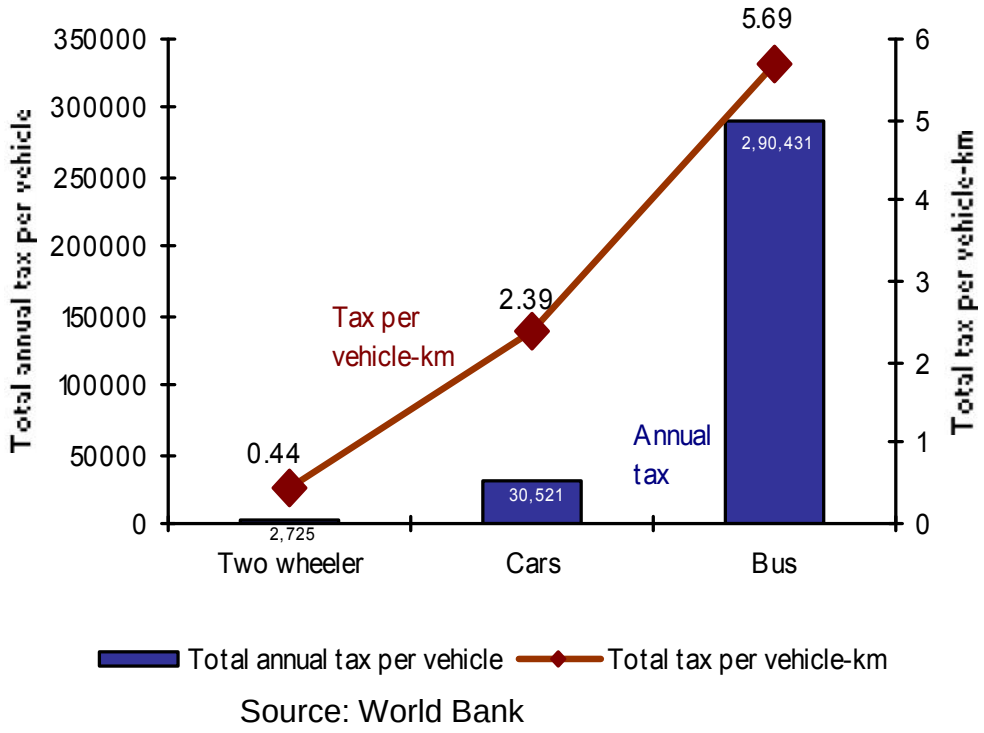
Indian style socialism

We tax our public transport more than cars…

Correct distortions…

Kolkata: A car pays road tax for its lifetime what a bus pays every year

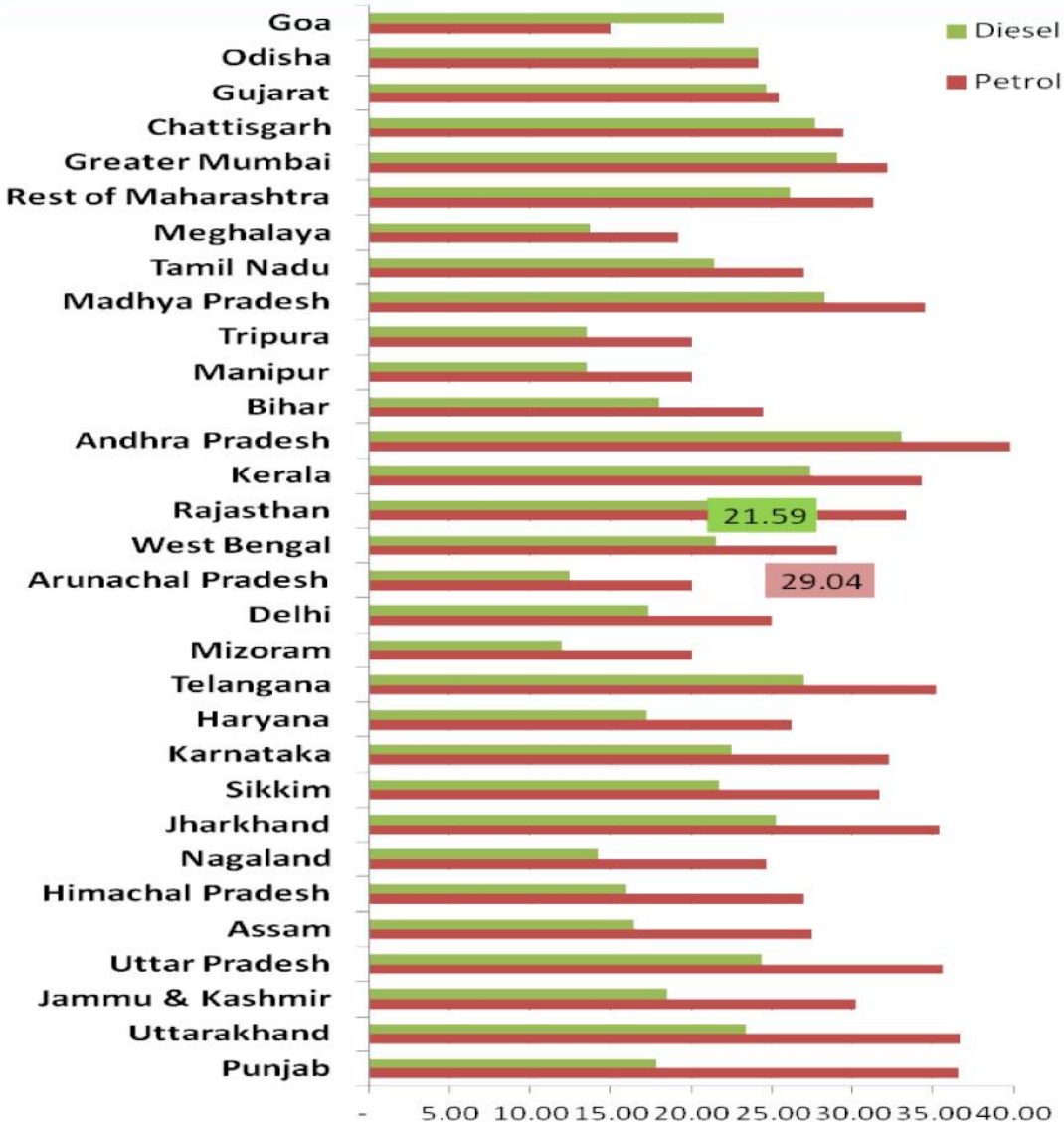
If bus fares are raised, a substantial public transport ridership can be lost to two wheelers with running cost of just Re 1/km



Source: World Bank

Source: Road transport year book MOSRTH

Fuel Taxes



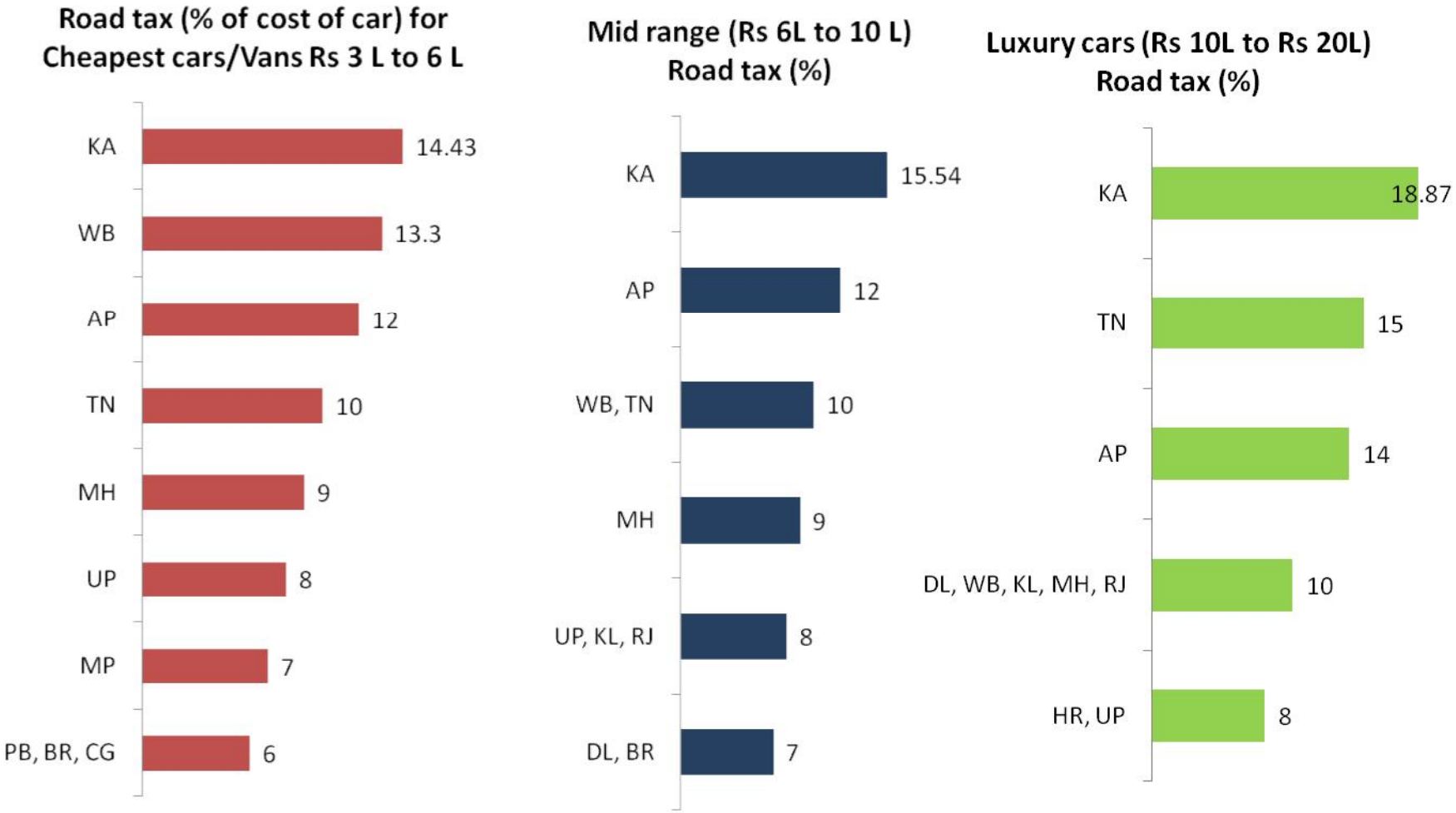
- All states except Odisha and Goa tax diesel more than petrol
- In Goa, the tax on Petrol is 7% lower than Diesel
- In West Bengal, tax on diesel is 7.45% lower than petrol

Source: Source: CSE computation based on Basic Statistics
on Indian Petroleum and Natural Gas, 2015-16, Ministry of

West Bengal charges higher tax on small cars.

Tax on small cars - 13.3%; 10% on mid range and luxury cars.

Karnataka -- higher tax on big cars - 18.87%; on mid range cars -- 15.54%. On small cas - 14.43%



Source: ET, Apr 15, 2015

Need innovative fiscal strategy

Urban transport fund: Tap revenue from vehicle taxes, parking charges, advertisement revenue etc

Rationalise transport sector spending to augment resources for public transport

Non-conventional sources – land value capture, better ment levy etc

Action in Delhi

Air Ambience Fund from environment cess on diesel fuel:

Air Ambience fee of 25 paise per litre on sale of diesel fuel has been implemented. Revenue from this cess is used to create Air Ambience fund to meet the cost of Delhi's clean air action plan.

Environment compensation charge on trucks entering Delhi

Our cities need upscaled transition
Avoid future emissions

Opportunity to provide scaled up alternatives

- Public transport and integration
- Infrastructure for walking and cycling

Reduce demand for travel and vehicle usage

- Land-use planning
- Road pricing
- Tax rationalisation
- Parking policy and charges

Leapfrog technology

- Emissions standards
- Fuel economy standards

Fund the transition: Need tax measures to allocate resources efficiently and raise revenue. Taxes on public transport is 2.6 times higher.

Action on pollution sources….

Reduce emissions from power plants

Tighter control on coal based power plants

Shift to natural gas for power

Reduce emissions from air polluting industry

Review the challenges of industrial emissions and control measures

Reduce emissions from generator sets

Tighter emission standards for generator sets

Siting and acoustic measures for big gen sets

Energy efficiency measures to reduce electricity demand

Action on open burning

Enforcement mechanism, monitoring and awareness campaign

Road dust and construction activities

Adopt dust control measures for construction industry, roads, and traffic; enforce stringent penalty

Cities are moving away from car centric infrastructure…….

Before

After

Seoul's Cheonggyecheon restoration project

Cities that have destroyed roadways

San Francisco

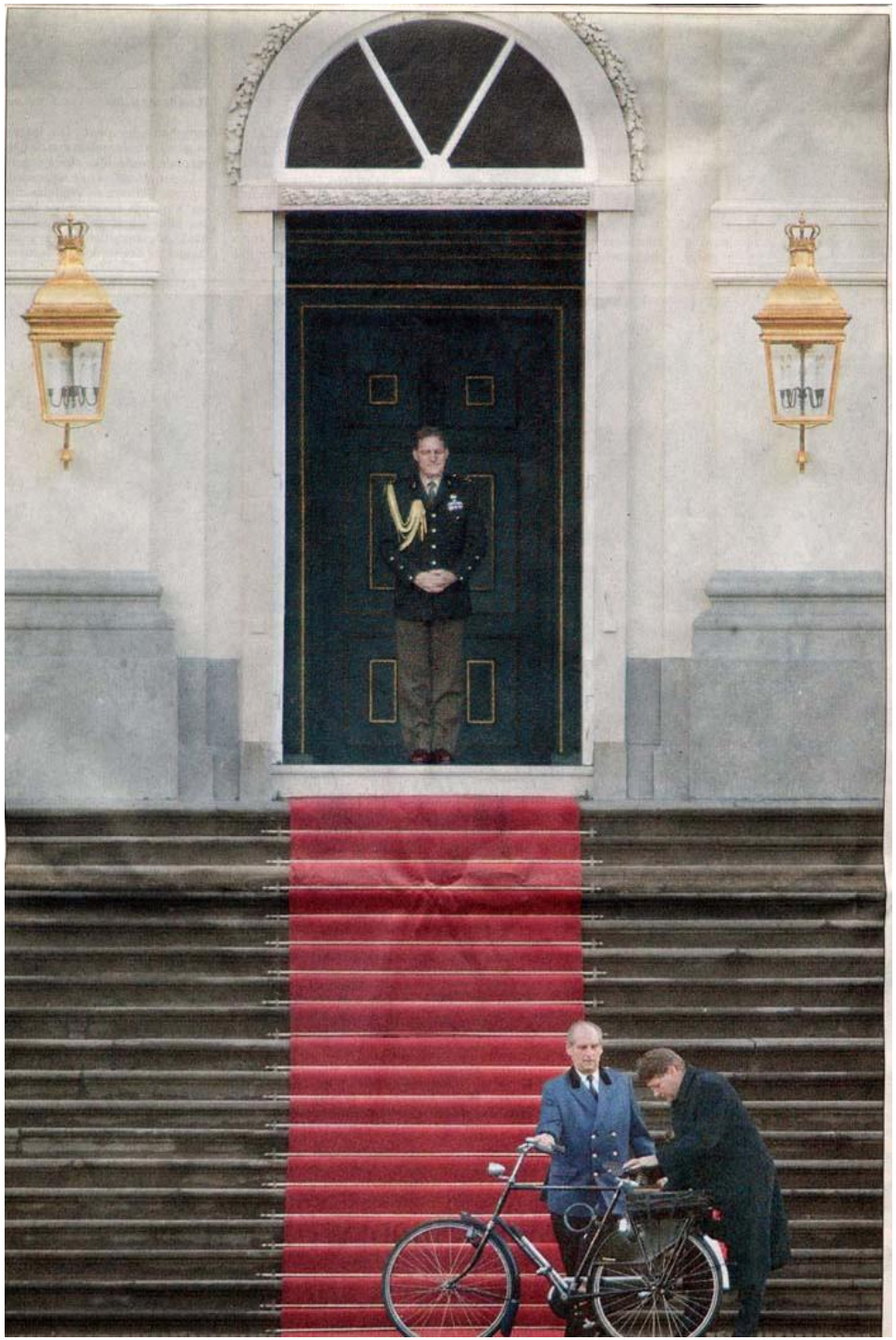
Milwaukee

New York

Portland

Toronto

Seoul



Dutch Minister visits the queen on a bicycle

Source: GIZ

Let us manage the health risk transition well….

The question that we face is not …….

……whether we should implement strict controls, but how soon the controls should be put in place….

We cannot afford to wait……..

Thank You…