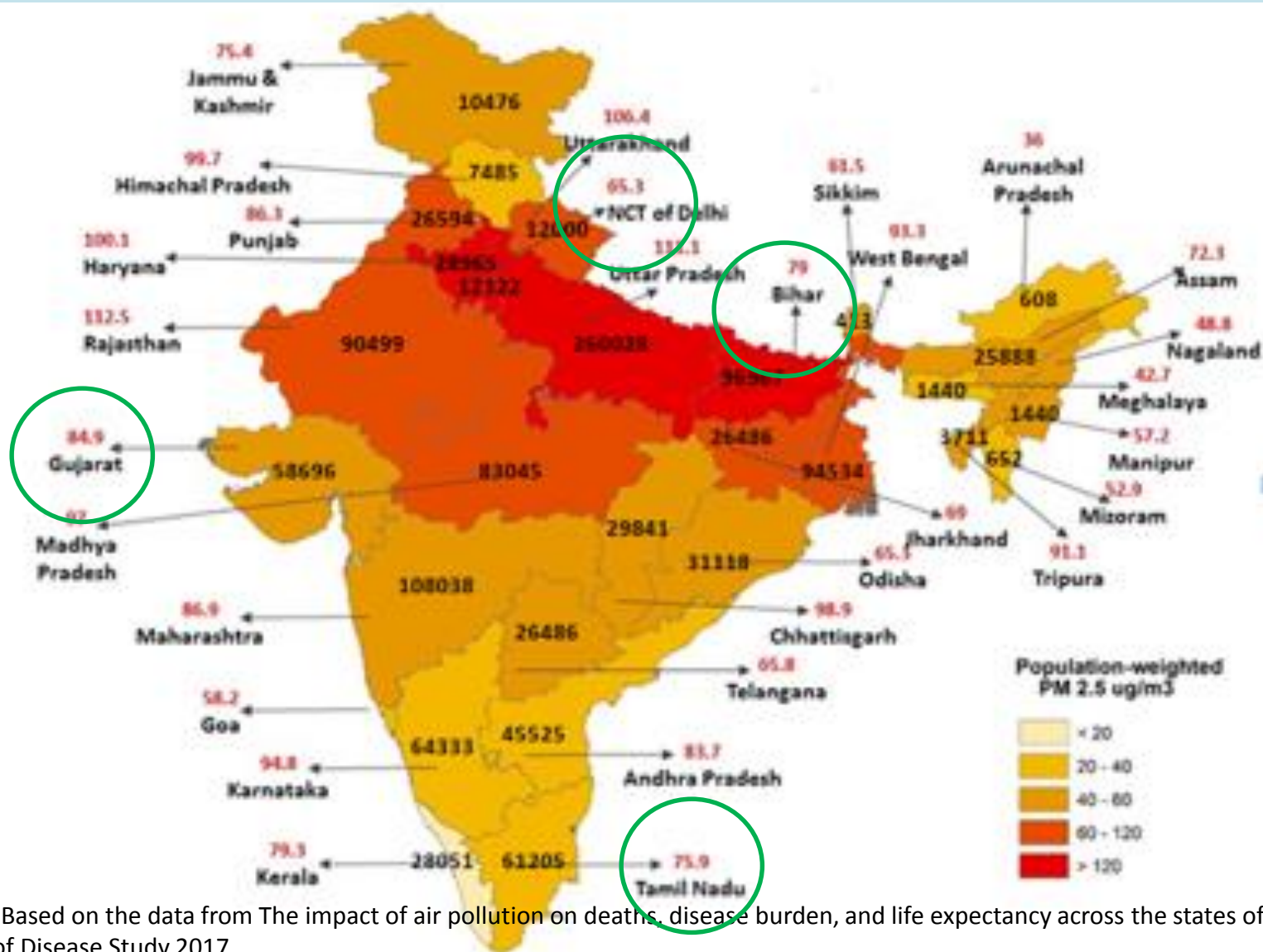# Clean Air Action Plans and Sustainable Mobility

PRESENTED BY:
ANUMITA ROYCHOWDHURY
CENTRE FOR SCIENCE AND ENVIRONMENT
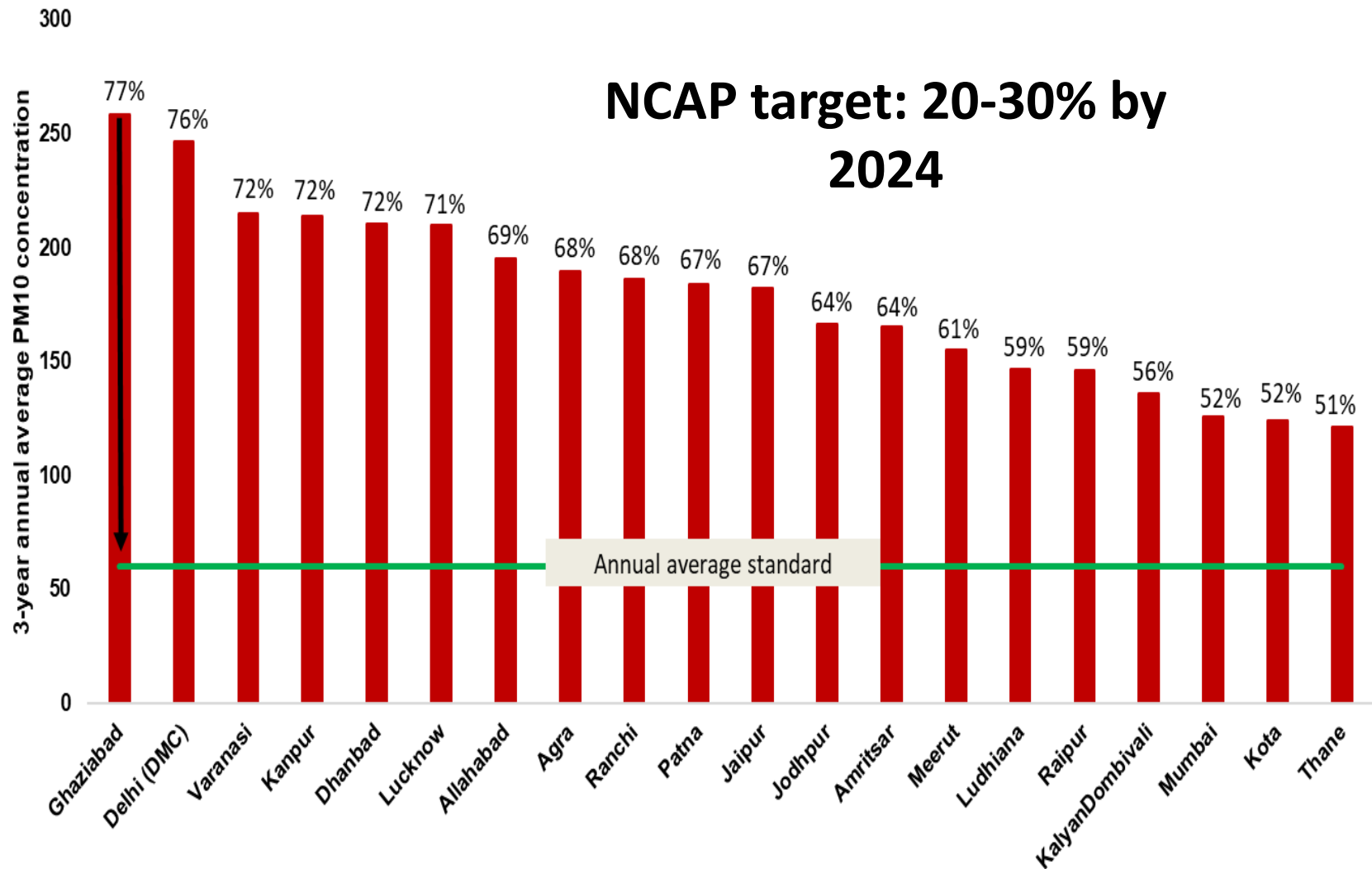
Digital India
Power To Empower

GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS

150 YEARS OF CELEBRATING THE MAHATMA

स्वच्छ भारत
एक कदम स्वच्छता की ओर

UPMRC

12th Urban Mobility India Conference & Expo 2019

INSTITUTE OF URBAN TRANSPORT (INDIA)

Air Pollution and Public Health Risk

Reduction target to meet clean air standards
(PM10 standard)

NCAP target: 20-30% by 2024

Y-axis: 3-year annual average PM10 concentration (0 to 300)

Annual average standard (green line)

Bar values (left to right):
- Ghaziabad: 77%
- Delhi (DMC): 76%
- Varanasi: 72%
- Kanpur: 72%
- Dhanbad: 72%
- Lucknow: 71%
- Allahabad: 69%
- Agra: 68%
- Ranchi: 68%
- Patna: 67%
- Jaipur: 67%
- Jodhpur: 64%
- Amritsar: 64%
- Meerut: 61%
- Ludhiana: 59%
- Raipur: 59%
- KalyanDombivali: 56%
- Mumbai: 52%
- Kota: 52%
- Thane: 51%

3
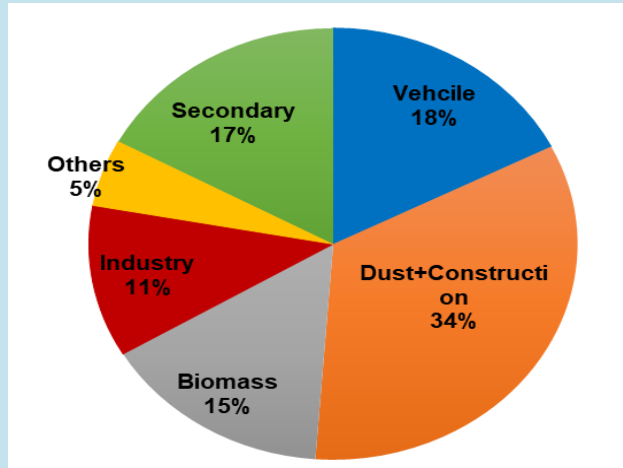
Many sources of pollution…...

Why vehicles are a special problem?

Delhi: PM2.5

Source aportionment

Summer

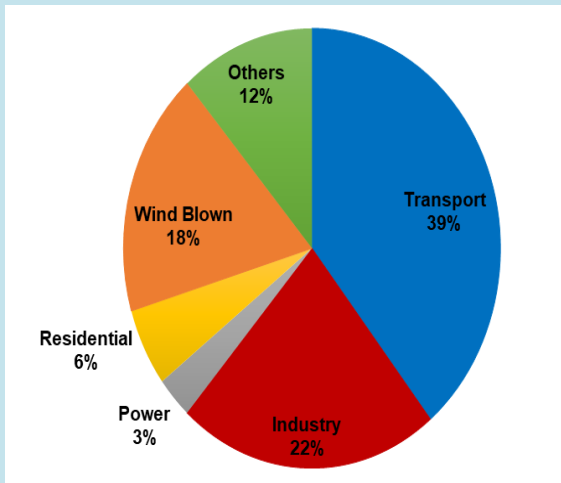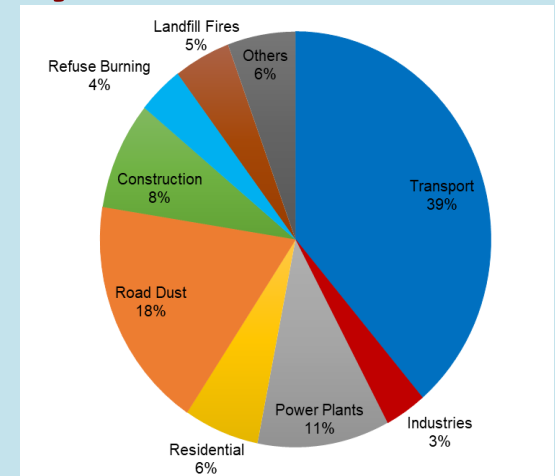- Secondary 17%
- Vehcile 18%
- Others 5%
- Industry 11%
- Biomass 15%
- Dust+Construction 34%

Winter

- Secondary 25%
- Vehcile 23%
- Others 4%
- Industry 11%
- Dust+Construction 16%
- Biomass 21%

Emissions inventory

SAFAR/IITM

- Others 12%
- Transport 39%
- Wind Blown 18%
- Residential 6%
- Power 3%
- Industry 22%

TERI- ARAI

- Landfill Fires 5%
- Refuse Burning 4%
- Others 6%
- Construction 8%
- Transport 39%
- Road Dust 18%
- Residential 6%
- Power Plants 11%
- Industries 3%
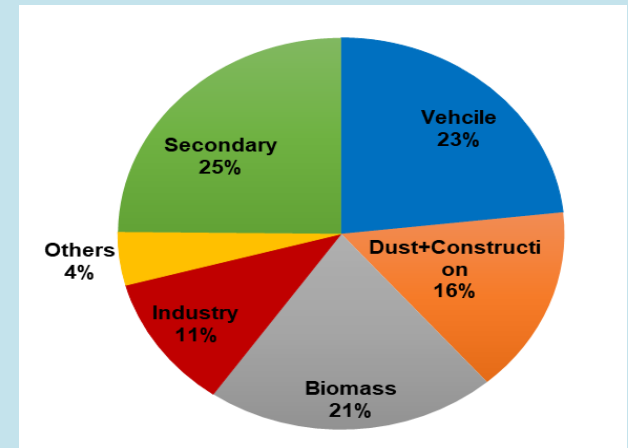
Source: August 2018, Source Apportionment of PM2.5 & PM10 of Delhi NCR for Identification of Major Sources, Prepared by ARAI and TERI

5

High exposure from vehicles

2015: Union Ministry of Health and Family Welfare Report of *Steering committee on air pollution and health related Issues'*,

More important to know how close we are to the pollution source, what are we inhaling, time we spent close to the pollution source than what occurs generally in the air more influenced by climate and weather.
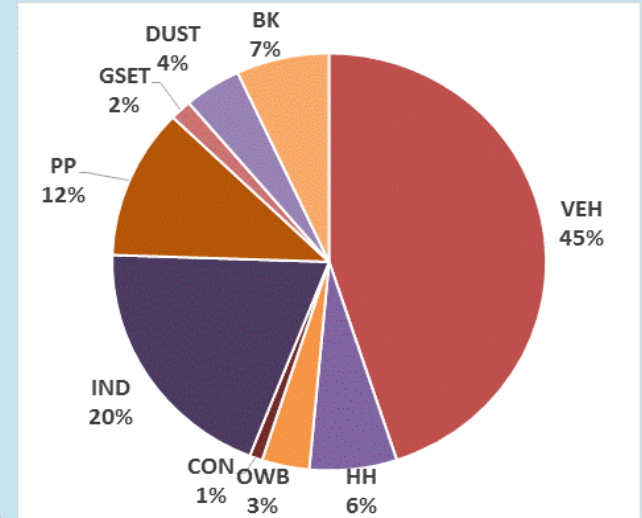
Shift from concentration management to exposure management

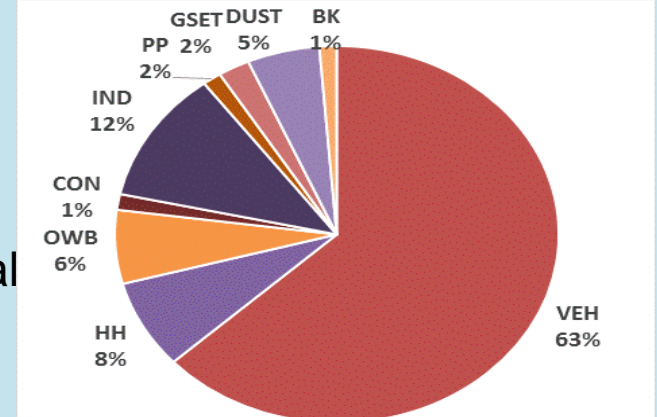Ambient concentrations do not always well represent human exposures,

Ambient concentration is not a good surrogate for total air pollution risk to indicate exposure and health outcome

Chennai

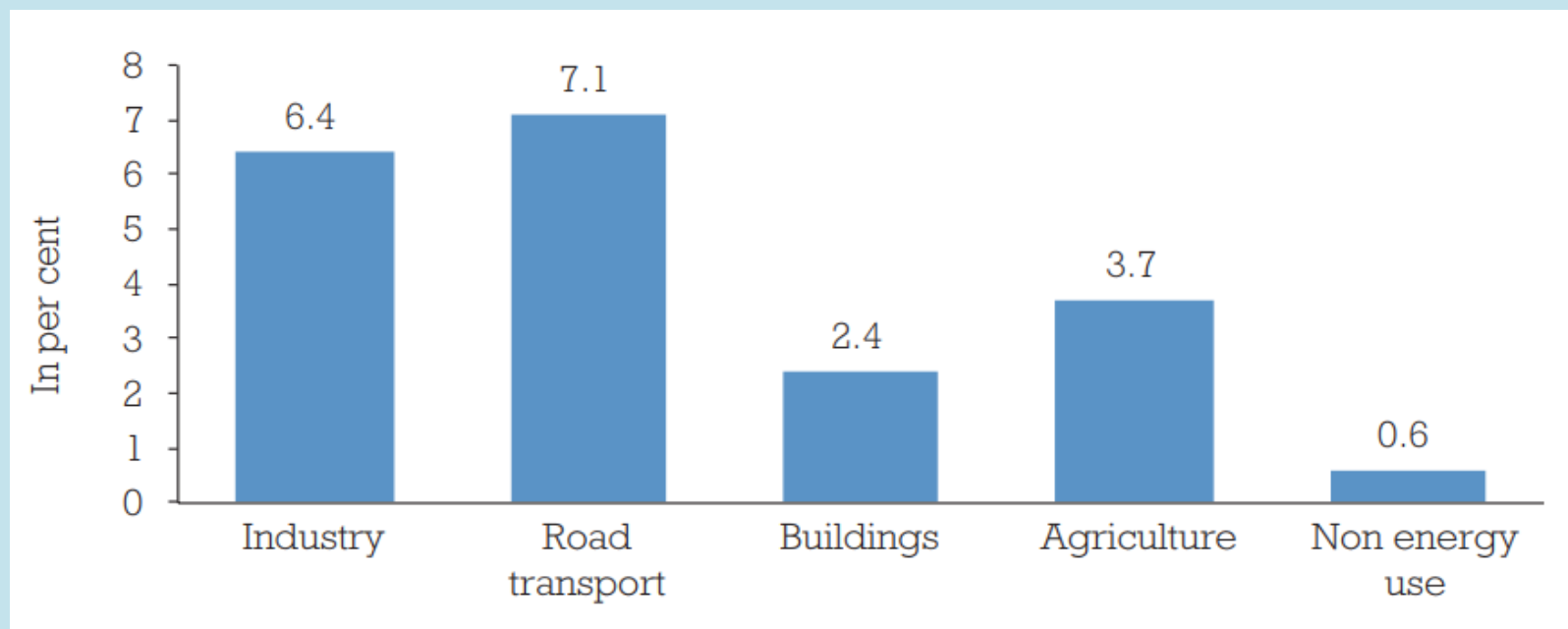$PM_{2.5}$ emission apportionment

$PM_{2.5}$ exposure apportionment

Source: S Guttikunda – SIM Air

Growth Rate in Energy Consumption in different sectors (CAGR 2000–13)

Till 2040, the transport sector in India will continue to record the highest growth rate in energy consumption

- **2013**: light-duty vehicles used up 13% of energy consumption by transport
- **2040**: This share to increase to 27%
- Share of heavy-duty trucks to increase from 23% in 2013 to 34% (IEA 2016)
- Over 40% of oil and oil products in India go into running of vehicles

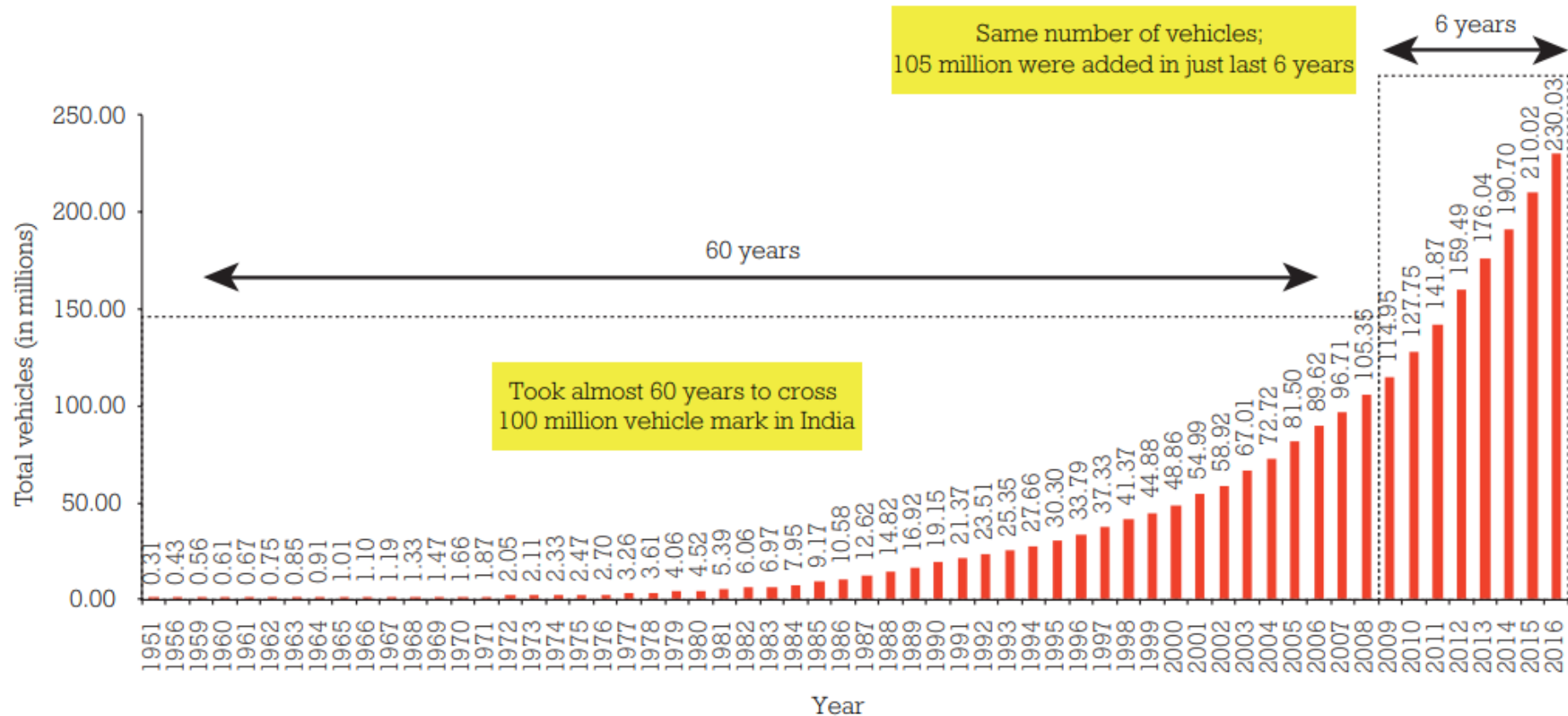# Explosive motorisation

Trends in total vehicle registrations in India (1951–2015)

Total vehicle registrations—the number has increased 700 times

Source: Road Transport Yearbook, MoRTH, 2016

Decline in share of Non-Motorised Transport
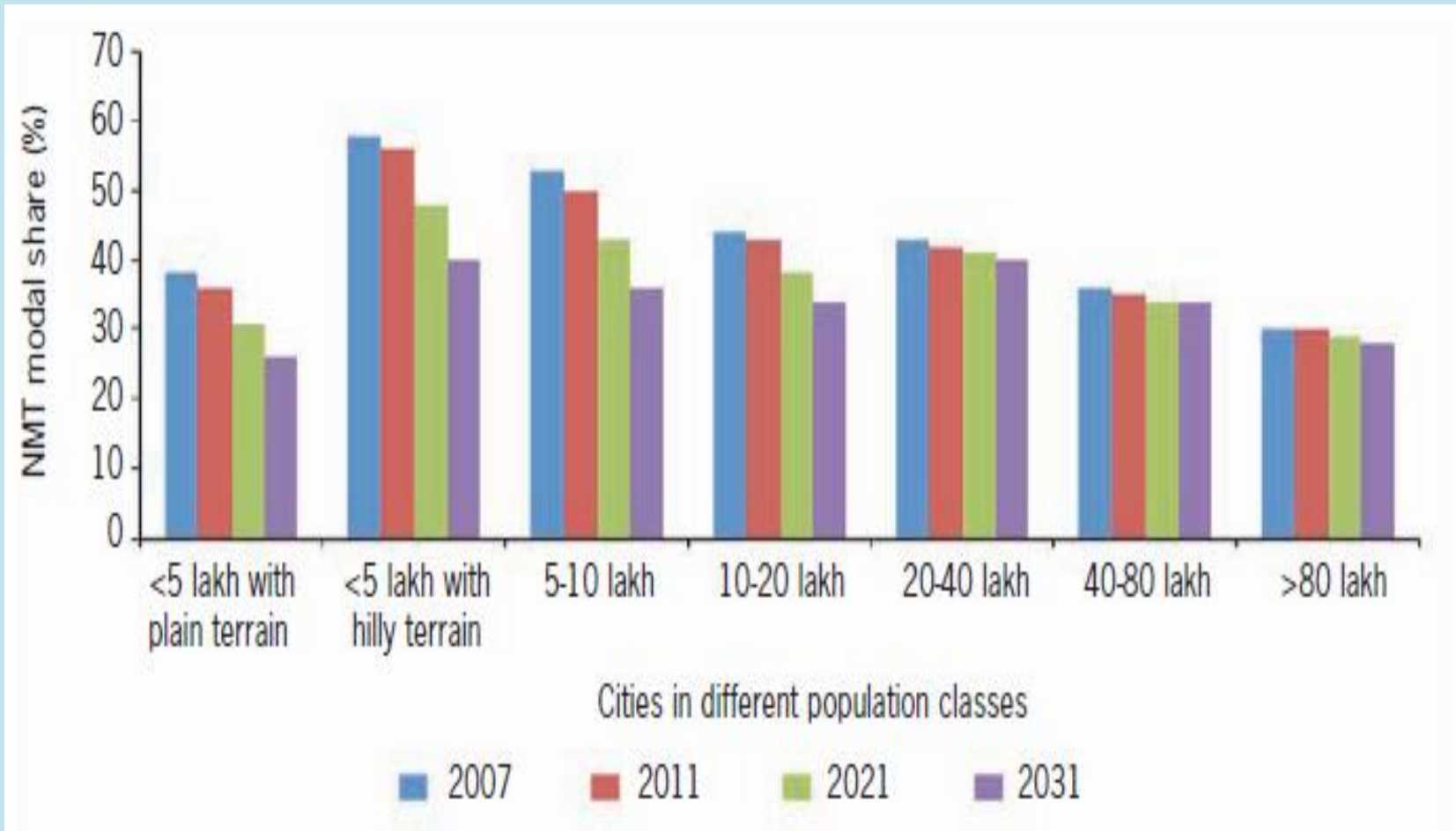
Sprawling cities….......

Cities grown twice as fast in area as they grew in population,

Faster population growth on the peripheries of major cities.

For the 12 largest Indian cities, satellite imagery shows:

    --- Proportion of built-up area outside a city's official boundaries exceeds that within its boundaries

    --- Also exceeds the proportion of population, -- low density sprawl. (World Bank 2015)

Focus on urban commuting…..

Assess toxic and warming emissions and energy guzzling only from the way we travel in our cities……….

National Clean Air Programme and mobility

-- 129 cities implementing action plans to meet reduction targets

-- Transportation and mobility strategies integral part of this implementation

-- Challenge of finding solutions to big and small cities and towns

Clean air action plans
Strategies to reduce tailpipe emissions

-- On-schedule implementation of BSVI emissions standards

-- Reform PUC system;

-- Implement remote sensing of vehicles; Integrate OBD

-- Centralised vehicle inspection centres for commercial & diesel vehicles

-- Scrappage policy

-- Targeted natural gas programme

-- State level electric vehicle policy and prgramme

-- Action on freight traffic

Clean Air Action Plan
Public transport and mobility strategies

City based action

Public transport modernisation

Bus reforms – service level improvement and full range of ITS integration

Bus lanes and bus rapid transit

Multi-modal integration

Implement integrated fare policy to keep journey cost affordable

Introduce parking policy as a vehicle restraint measure

Adopt a state level street design guidelines

Adopt compact urban form code to create high density, mixed use, mixed income development; high density accessible streets to reduce distances

Smaller cities

Appropriate public transport & para transit & **integration**
Walking, and cycling strategy
Restraint measures for personal vehicles usage – (parking policy etc)

Specific plan for Delhi under Clean air action plan

Specific directions in Delhi
- Improvement in bus numbers and services
- Route rationalisation
- Augment metro service
- Fare integration
- Multi-modal integration
- Electric vehicle programme
- Rapid rail system to connect NCR
- Implement Delhi de-congestion plan

Non-motorised transport
- Zonal NMT network plan
- Pedestrianise key commercial areas (Ajmal Khan, Krishna Nagar etc)

Vehicle restraint measure
- Parking rules as demand management measure: Notified – under implementation

Traffic management
- IT based traffic management – Under implementation

Total particulate emission load from urban commuting in the 14 cities (kg per day)

Overall aggregated emissions and energy use from urban commute
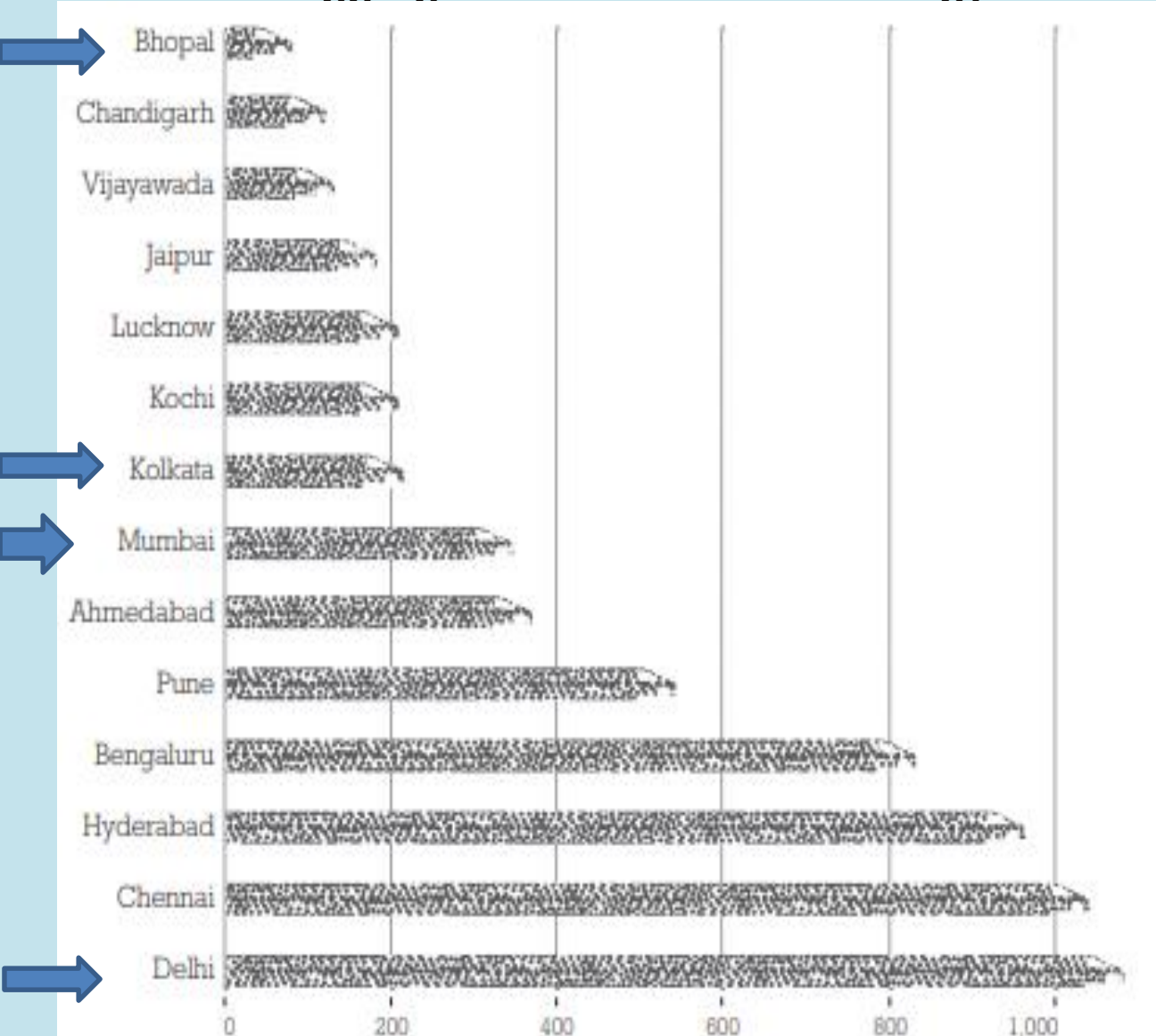
Parameters
-- Population
– Planning for number of people
-- Per person trip generation and volume of daily travel trips
-- Average trip length by modes of transport
-- Share of different modes in all motorised trips
-- Average distances that modes cover and total kilometers they travel
-- Level of vehicle technology and fuel quality

Source: CSE analysis

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Particulate emission load per trip from private and public modes of transport
(in kg per year)

■ Per trip (private transport) PM emission load
■ Per trip (sustainable modes, including public and non-motorized transport) PM emission load
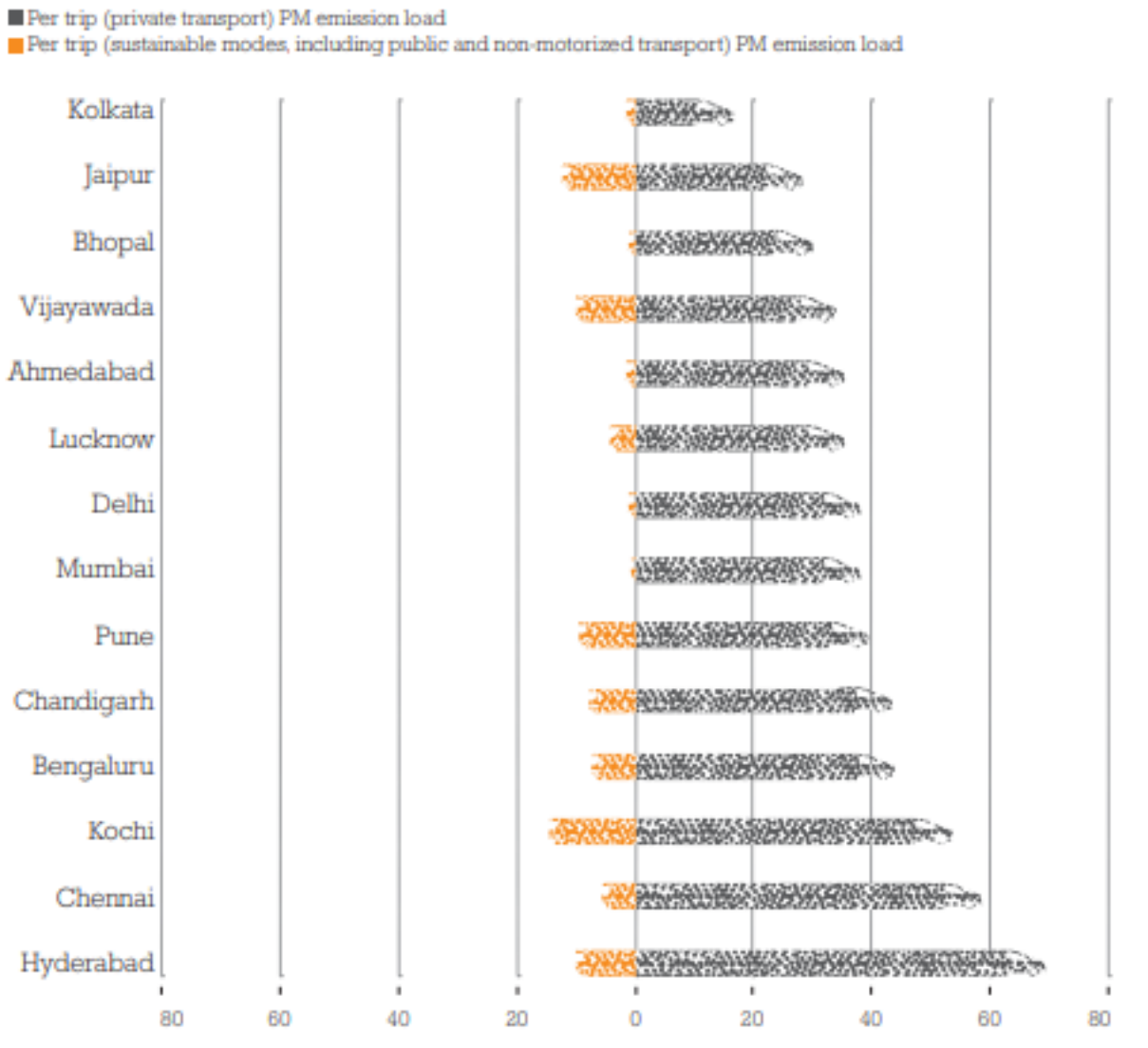
Cities (top to bottom): Kolkata, Jaipur, Bhopal, Vijayawada, Ahmedabad, Lucknow, Delhi, Mumbai, Pune, Chandigarh, Bengaluru, Kochi, Chennai, Hyderabad

X-axis: 80 60 40 20 0 20 40 60 80

Per trip emissions in cities: A smaller city may have lower overall pollution.
But emissions per trip may be high due to polluting mode.
This is a better indicator to plan remedial measure

Source: CSE analysis

Recognize that the difference between cities in terms of emissions of toxic and warming gases and transport energy use, **is not a matter of chance**.

It is a matter of choice—a result of conscious decision-making and prioritization related to sustainable modes, compact urban form and road design, and transportation planning, that influence commuting choices of the masses.

Share of private and public transport in motorized trips

Public transport (motorized trips only) | Personal transport (motorized trips only)

- **Mumbai and Kolkata:** Highest share of public transport trips followed by Delhi and Chennai.
- Bengaluru at lower level

- **Metropolitan cities**: High share of personal vehicle trips

Source: Base figures from multiple transport studies, projections using factors given in "Review of Urban Transport" prepared by CSTEP and IUT

Trip generation

## (Per capita travel trip rate) 2017

- Population size, gender and work profile influence trip generation and travel demand

- Megacities with very high population are at the top

- Mumbai in the lead, followed by Chennai, Kolkata and Delhi.

- Bhopal, Pune, Vijayawada, Lucknow, Kochi and Jaipur are placed in that order.

Note: *For Hyderabad, the trip rate is for Greater Hyderabad Municipal Corporation area which was constituted in 2007 and thus exhibits a non-uniform level of urban development within its boundary, possibly leading to a rather lower trip rate.

Source: Base figures from multiple transport studies; projections using factors given in "Review of Urban Transport" prepared by CSTEP and IUT

What is the average trip length of cars, two-wheelers and taxis/ autos in cities
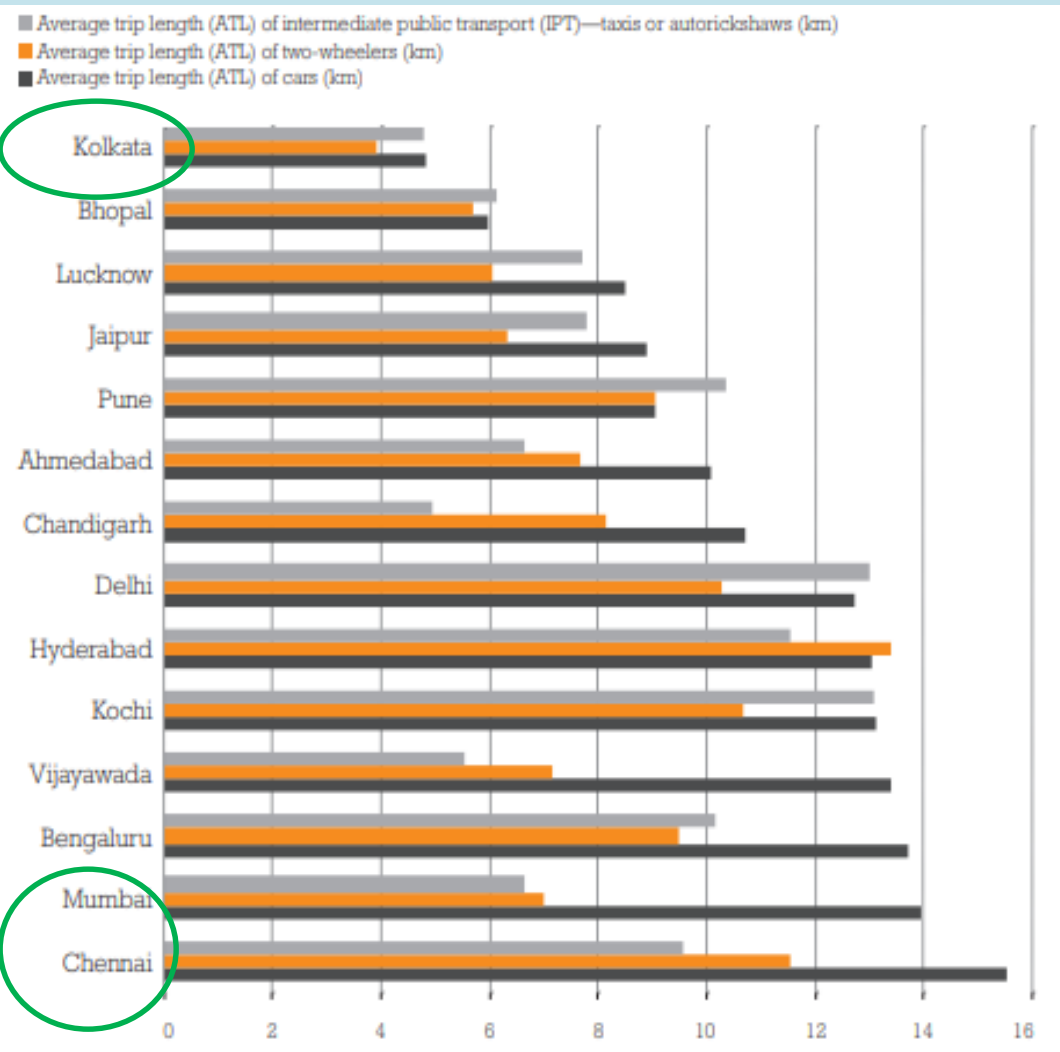
- Mumbai, Chennai, Delhi Hyderabad: -- high average trip length.

- Metropolitan cities of Kochi and Vijayawada: on the higher side (e.g. twin cities of Kochi–Ernakulam)

- Kolkata, - a megacity, but with smallest average trip length among 14 cities.

Levels Of Motorization in Different Cities

Trend in total registered vehicles and average annual growth rate in the 14 cities (2006–16)
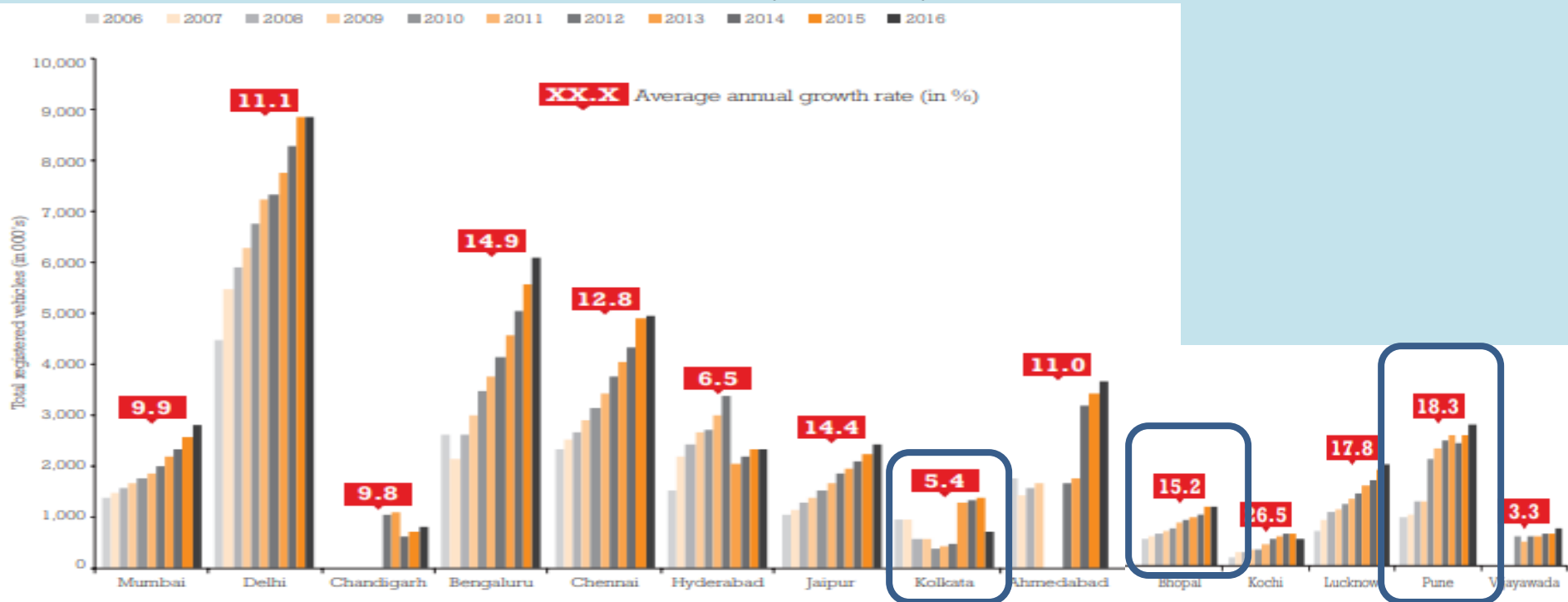
- Mega cities have very high vehicle stock

- Metropolitan cities with smaller base have recorded very high growth rate

Source: MoRTH statistics

Lessons:
Smaller metropolitan cities: Advantage of early action

Eg Bhopal: Advantage

-- Lower population

-- Personal transport usage is higher, but average trip length of different modes is second lowest; average distance travelled by different modes also lowest

-- Vehicle numbers among lowest. Less vehicle miles travelled

-- Lowest particulate, nitrogen oxide load and CO_2 load

-- **Early action** to build bus and bicycle programme with enhanced bus fleet, bus rapid transit system and public bike sharing schemes. Modal share of public transport -- 23%

-- Transit-oriented development policy has progressed here.

Kolkata's winning sreak

-- **Lowest average trip length for all different modes**

-- **Average distance travelled by different modes lowest** among all mega cities.

-- **Lowest vehicle stock; second highest share of public transport**.

-- **Most diverse public transport systems** buses, metro, trams, suburban rail, para-transit and waterways. -- Public transport and IPT trips 88 per cent.

-- **Compact city design,** high street density, short travel distances restricted availability of land for roads and parking

-- **Proves - only high population, high travel volume and economic growth need not necessarily lead to higher automobile dependency.**

Mumbai stays ahead with public transport spine

-- **Public transport spine** –suburban rail system. Public transport and para transit -- 89 per cent of all motorized trips.

-- **Despite having highest trip generation and volume of travel Mumbai could reduce impacts by adopting public transport strategy.**

-- **Highest trip length for personal vehicles ; Yet overall guzzling and emissions are lower**

-- **Even with highest per capita GDP among the six megacities and highest volume of trip generation use of personal modes is lowest in Mumbai.**

--- **Vehicle stock higher than Kolkata; but much lower than other mega cities.**

Delhi's Dilemma

Eclipsing gains…..

-- Highest vehicle stock

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

-- Total vehicle kilometres generated far exceeds that of any other megacity.

-- But Metro system + Bus meet much less than 10 million trips – Massive deficit

Clean air action plan requires multi-modal integration and last mile connectivity

Chennai, Bengaluru, Hyderabad – weighted down by growth and automobility

-- Large population, high trip generation and volume of travel (Chennai and Bengaluru)

-- **Average trip length for different modes especially cars among the highest ; (Chennai)**

--- **Higher trip rate, trip length, low modal share of public transport have increased emissions per trip, -- worse than Delhi.**

-- **Hyderabad - average distance travelled by cars and two wheelers is among the highest. Its public transport ridership is lowest among all mega cities.**

Cities at cross roads

Cities at crossroads can turn for the better or for worse:

Ahmedabad, Lucknow, Vijayawada, Pune and Jaipur at an inflection point

Their per-trip emissions are in the middle of the spectrum

Action has started – Bus fleet renewal, BRT, street design etc. but not enough

Depending on what direction their mobility policies go, their pollution levels may increase or decrease accordingly.

Need corrective measures now to avoid the fate of megacities.

Massive slide in public transport ridership in cities

Delhi bus services: Since 2013, Delhi (DTC) bus ridership declining at an average rate of 8.88% per annum. Overall, dropped by 34%.

Bangalore Metropolitan Transport Corporation (BMTC): Since 2009, ridership increased by 9%. But dropped recently. Cut down full-day bus operations on 2,253 routes.

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

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

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

No clear strategy to make public transport work in cities:
- Poor last mile connectivity, Cheap or free parking, Subsidised road taxes for cars, Lack of multi-modal integration….

Multi-modal integration
Mandate in Delhi
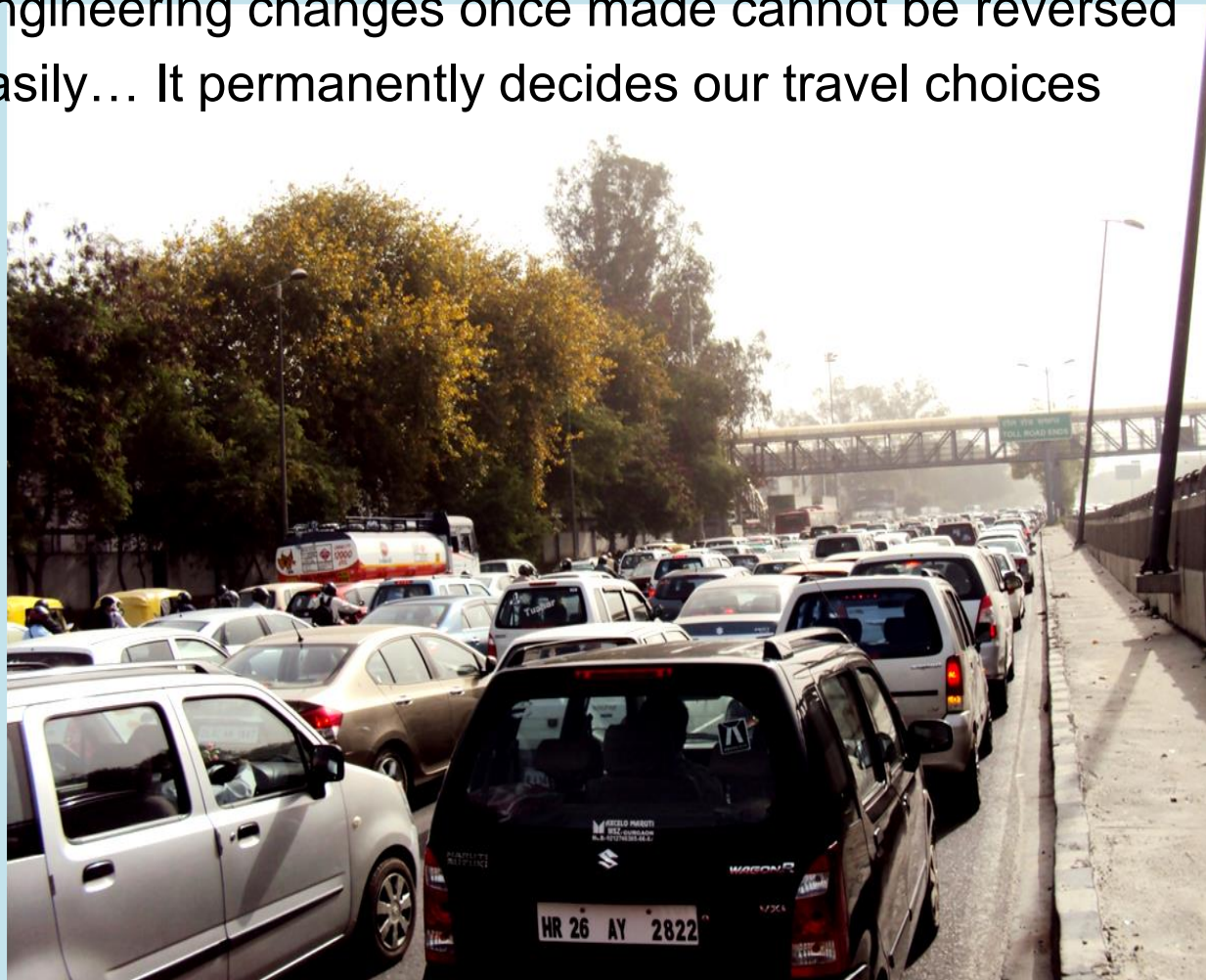
70 Metro station to be redesigned

Before

After

UTTIPEC Concept Plan

Car centric road design locks in enormous pollution

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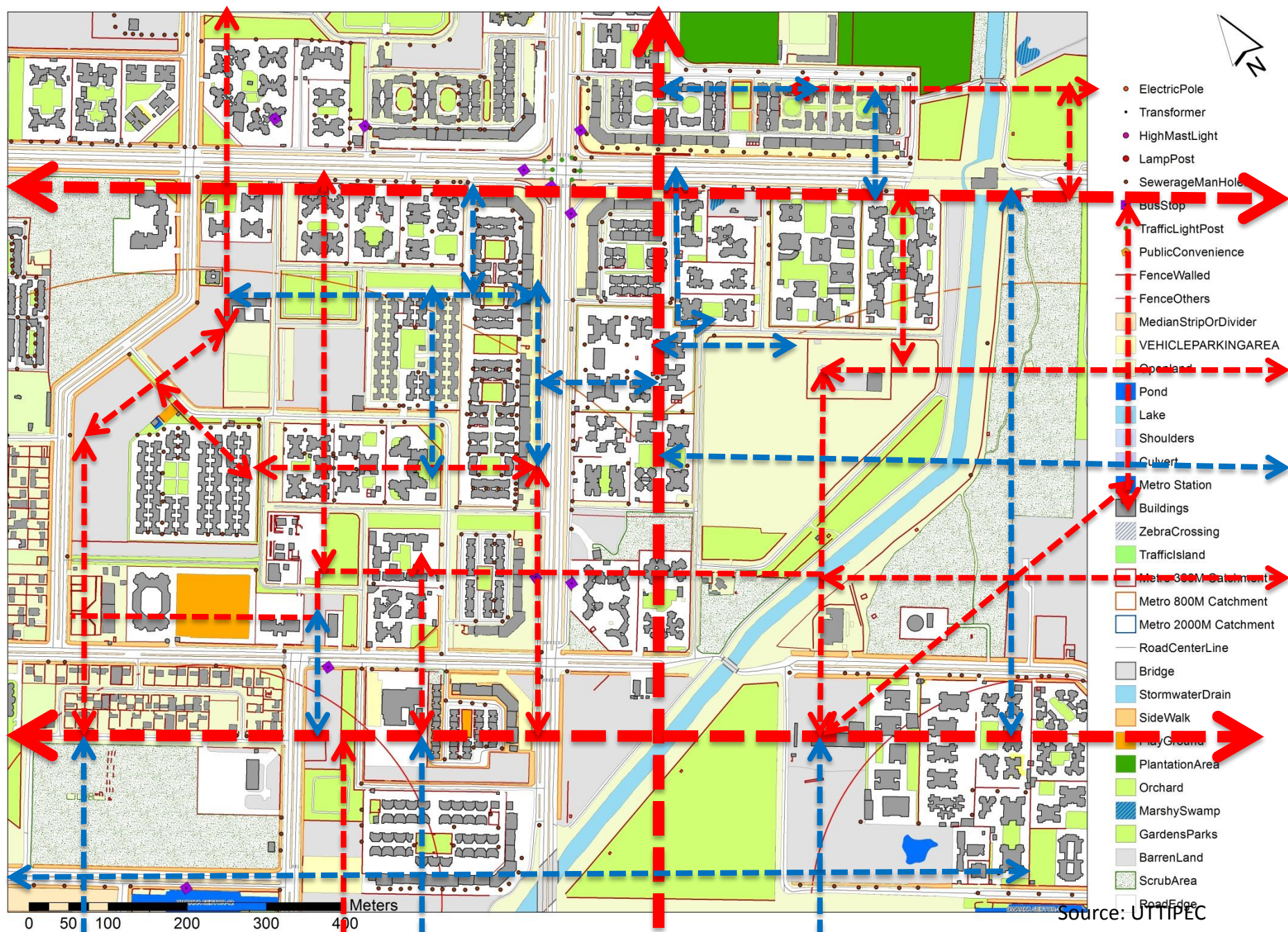
Car centric design

Poor walking access

Footpaths for beautification

Source: CSE

No mid block crossings for pedestrians – Advantage to vehicles

Source: UTTIPEC

Legend

- ElectricPole
- Transformer
- HighMastLight
- LampPost
- SewerageManHole
- BusStop
- TrafficLightPost
- PublicConvenience
- FenceWalled
- FenceOthers
- MedianStripOrDivider
- VEHICLEPARKINGAREA
- Openland
- Pond
- Lake
- Shoulders
- Culvert
- Metro Station
- Buildings
- ZebraCrossing
- TrafficIsland
- Metro 300M Catchment
- Metro 800M Catchment
- Metro 2000M Catchment
- RoadCenterLine
- Bridge
- StormwaterDrain
- SideWalk
- PlayGround
- PlantationArea
- Orchard
- MarshySwamp
- GardensParks
- BarrenLand
- ScrubArea
- RoadEdge

Meters
0 50 100   200   300   400

Clean air action plans require complete street management for all road users

Exisitng

Proposed

Pedestrians walking on Service lane | NMT traffic merging with Pedestrians | Cars parked on Footpath

CSE

Natural pedestrian precincts, by virtue of the sheer volume of pedestrians. This can be further built on to make pedestrian zones.

Car-free Ajmal Khan Rd of Delhi: Exposure to PM2.5 on nearby heavy traffic road 35% higher than pedestrian street

To pedestrianise 22 more commercial streets/areas in Delhi

Before

After

Is this paradigm sustainable?
Super blocks, opaque boundary walls, no street activity, limited access....

Source: CSE

Parking
Towards vehicle restraint measures

CSE

Clean air plans:

-- Parking Rules and guidelines to restrain demand, notified

-- Parking area management plan for neighbourhoods

-- Parking pricing and penalty

-- No parking in green areas, emergency vehicle lane etc

Strong opposition

Parking Rules:
Not well understood

It is an area level plan to be prepared local body
Demarcates all types of legal parking spaces for all modes
- On-street, off-street and multi-level parking facilities and there integrated management
  - Vending zones
  - Multi-modal integration facilities
  - Green open spaces along with the allied traffic
  - Pedestrian / NMT circulation plans
  - No parking in green areas, near intersection, near bus stands etc

Penalise illegal parking

Introduce variable parking pricing

Promote shared, priced and public parking

Parking revenue for local area development

IT based parking area management; reform parking contracts

Supreme Court directs pilot projects on area parking plans in Delhi

CSE

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How parking area management plan helps?

Pilot project: Lajpat Nagar II, New Delhi

Housing plots: 448

Total number of floors: 1680

Total cars: 3510

After applying parking rules – (no parking on footpaths, green areas, parks, near intersection and keeping one lane free from encroachment)
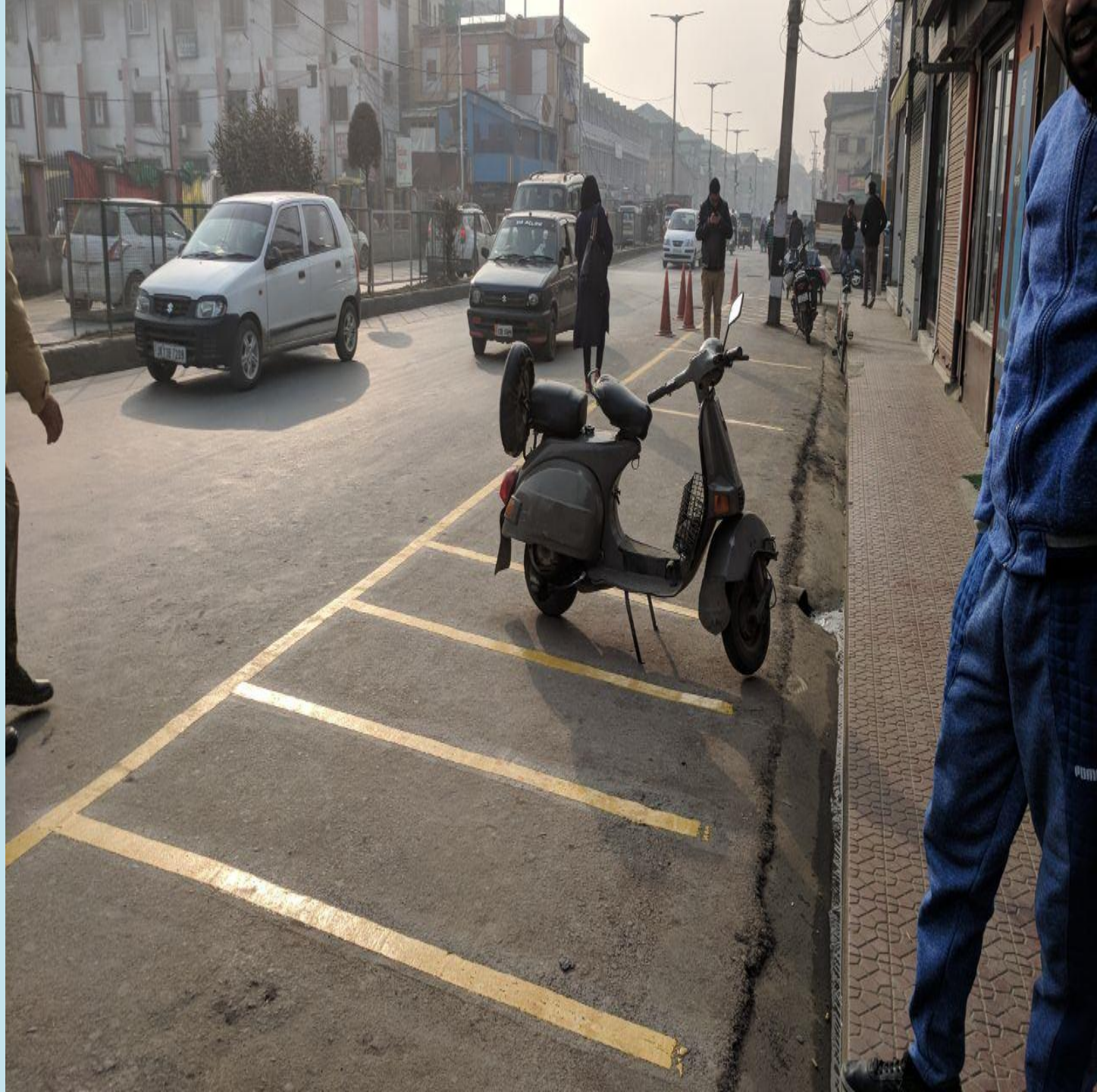
Total number of cars accomodated: 1830

Gap : 1680

Alternative sites outsode the colony identified

Informal Residential Parking Pricing already in place

Clean air and compact city design

Mixed use development to promote transit usage and control sprawl

National Habitat Standards and Transit Oriented Development Policy

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

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

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

-- Zero Setbacks.

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

-- Privacy of residents ensured.

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

Keep public transport affordable and sustainable

-- India Ranked Second in Household Spending on Transport related Expense (15%)
(Eurostat, Director General of European Commission)

-- Globally it is accepted that about 10-15% of household income can be the upper cap for transport to be affordable-- Or, where bottom 20% of households do not spend more than 10% of income transport

-- Compared to the threshold of 10- 15% of income, -- almost 1/3rd or 34 per cent of Delhi's population stands excluded from basic non-AC bus services

-- Higher spending on transport leads to lower spending on housing, health and education and hampering inclusive growth of the society.

Need innovative financing for affordability and sustainability of the public transport system

Missing legal mandate
Public transport regulated, but not mandated

- Ministry of Road, Transport and Highways: - Motor Vehicle Act lays down conditions for plying of public transport (permits, insurance, etc.)

- Ministry of Housing and Urban Affairs – Funding based reform

- State Transport Authorities (STAs) - regulation at State level (routes, fares, etc.)

- Public transport agencies formed under (RTC) Act, Companies Act, are also regulatory frameworks for the organization's operation.

- No Act *mandating* the provision of public transport in cities at any level;

- 12th Schedule of Indian Constitution (that lists functions of Municipal agencies as per the 74th Constitutional Amendment Act, 1992) does not mention public transport. PT remains an *optional* function under the Municipal Corporation Acts.

- Disconnect with urban planning; Provision of 'amenities' considered a requirement for developed land under the Delhi Development Act; 'amenities' includes roads, but does not extend to public transport

Clean Air Action Plan can be notified under Environment Protection Act

12th Urban Mobility India Conference & Expo 2019

Step forward

Set time-bound targets for improving modal share of public transport, walking and cycling

 Integrate urban planning with transportation planning and adopt transit oriented planning to reduce distances and motorized trip generation and improve access to sustainable modes

Promote compact urban form – small block sizes, density norms, mixed land use, mixed income neighbourhood, dense and permeable streets with active edges, etc

Need restraint measures for personal vehicle usage through parking policy, low emissions zones approach, tax measures and congestion pricing approaches.

 Integrate urban mobility strategies with clean and fuel efficient vehicles, zero emissions technologies and clean fuels.

Need strong in-use emissions management

 Link funding strategies with reforms in public transport sector

 Apply sustainability indicators for evaluating progress of programmes to ensure lowering of emissions and carbon and inducing modal shift towards sustainable modes.

Understand this problem

Modernise this paradigm

Image Credit: istockphoto.com/Radiokukka

Thank You