Towards Clean And Low Carbon Mobility: Addressing Affordability and Scaling up of Sustainable Transport

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International Conclave
Towards Clean And Low Carbon Mobility: Addressing affordability of sustainable transport and reducing real world emissions

New Delhi, September 4-5, 2018
The convergence: Climate Change, Clean Air and Urban Agenda
Public health challenge

More than 18 million healthy life years lost due to air pollution.

Exposure to toxic emissions from vehicles high.
Toxic Air
More cities in grip of critical level of PM10

Source: Centre for Science and Environment of CPCB air quality data submitted to Rajya Sabha for 44 cities
Action builds up in Delhi-NCR to bend the curve

Analysis of CPCB’s Daily AQI bulletin for Delhi 2017-18 and 2016-17

Source: CSE’s analysis of CPCB AQI data
Energy Insecurity
Over 40% of oil and oil products in India go into running of vehicles

Trends in primary oil consumption in India—present (2000–13) and projected (2013–40)

Energy use by different transportation modes (2013 and 2040)

Personal vehicles and heavy duty trucks drive the consumption

- **2013**: light-duty vehicles used up 13% of overall energy consumption by the transport sector;
- **2040**: This share to increase to 27%
- Share of heavy-duty trucks to increase from 23% in 2013 to 34%

• Growth rate for energy consumption is expected to be highest in the transport sector compared to all other sectors of industry, buildings, agriculture, and other uses. This demands aggressive and stringent roadmap at the current level of growth.
What is India’s strength?

• The 2011 all India Census shows that 77 per cent of all work trips in urban India are by public transport, cycle, walk, intermediate public transport, railways and water ways. About 23 per cent are by cars and two wheelers.

• As per the Census of India (2011) about 24 per cent of the population work from home which could be due to the fact that there are lot of mixed use buildings in Indian cities that combine trade and residence.
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

- The cumulative share of non-motorized transport (NMT) sums up to 36 percent against that of private transport, which is 21 per cent.
- The greater share of NMT does not stem from preference but the state of our economy. A major fraction of India’s population does not have the monetary luxury of owning vehicles.

Source: Based on 2008 Study on traffic and transportation policies and strategies in urban areas in India, Wilbur Smith Associates for Ministry of Urban Development, Delhi
All cities are sprawling today…………

Cities have grown about twice as fast in area as they grew in population, -- declining average city population densities and increasing sprawl.

Faster population growth on the peripheries of major cities.

For the 12 largest Indian cities, satellite imagery shows that:

--- 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)
What have we tried to do?

Assess toxic and warming emissions and energy guzzling only from urban commute in cities.... From the way we travel in our cities.........
Who pollutes and guzzles more from urban commute?

Cities under scanner

Megacities-- Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad

Metropolitan cities: - Ahmedabad, Pune, Jaipur, Lucknow, Kochi, Bhopal, Vijaywada, Chandigarh

How are cities coping to reduce emissions and energy use from urban commute?

- Particulate matter
- Nitrogen oxides
- Heat-trapping carbon dioxide
- Energy consumption
What parameters influence energy use and emissions from urban commute?

Parameters that require policy focus

- Population – How many 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

Challenges of such assessment

- Lack of official data base
- Mobility plans, Census of 2011, project reports, research studies
- Better data may modify ranking but the overall message from ranking will not change
What is this ranking?

Cities have been ranked based on two approaches:

i) Ranking based on overall aggregated emissions and energy use from urban commute: Based on combined score for all parameters – establishes the overall position of all cities

ii) Ranking based on per trip emissions in cities: A smaller city may have lower overall pollution but may have high emissions per trip due to a polluting mode. Emission is influenced by the mode of travel for a trip we make and the level of its technology and fuel quality. This is a better indicator to plan remedial measure

• Where are our cities in this race?
Comprehensive Ranking of the Cities (All Modes)

Based on overall emissions and energy consumption

Based on per travel trip emissions and energy consumption

Source: CSE analysis
Mega Cities Ranking

Based on overall emissions and energy consumption

Based on per travel trip emissions and energy consumption
From a public policy stand-point, it is important to 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.
Population and population densities (2017) of the selected 14 cities

Source: UN Population Projections, 2017
More people in city, higher 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 Hyderbad: -- 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.

Source: Base figures from multiple transport studies; projections using factors given in “Review of Urban Transport” prepared by CSTEP and IUT
Share of different modes of transport in motorized trips

<table>
<thead>
<tr>
<th>City</th>
<th>Public transport</th>
<th>IPT</th>
<th>Two-wheelers</th>
<th>Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucknow</td>
<td>10%</td>
<td>5%</td>
<td>30%</td>
<td>55%</td>
</tr>
<tr>
<td>Chandigarh</td>
<td>15%</td>
<td>10%</td>
<td>20%</td>
<td>55%</td>
</tr>
<tr>
<td>Pune</td>
<td>20%</td>
<td>5%</td>
<td>20%</td>
<td>55%</td>
</tr>
<tr>
<td>Vijayawada</td>
<td>15%</td>
<td>10%</td>
<td>20%</td>
<td>55%</td>
</tr>
<tr>
<td>Jaipur</td>
<td>20%</td>
<td>5%</td>
<td>15%</td>
<td>55%</td>
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<tr>
<td>Ahmedabad</td>
<td>25%</td>
<td>5%</td>
<td>15%</td>
<td>55%</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>30%</td>
<td>5%</td>
<td>10%</td>
<td>55%</td>
</tr>
<tr>
<td>Bengaluru</td>
<td>35%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td>Bhopal</td>
<td>40%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td>Chennai</td>
<td>45%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td>Kochi</td>
<td>50%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
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<tr>
<td>Delhi</td>
<td>55%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td>Kolkata</td>
<td>60%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td>Mumbai</td>
<td>65%</td>
<td>5%</td>
<td>5%</td>
<td>55%</td>
</tr>
</tbody>
</table>

- **Mega cities**: Public transport share higher; has the highest personal vehicle dependence for work trips-- Hyderabad, Bengaluru, Chennai and Delhi, with Mumbai and Kolkata bucking the trend.

- **Metropolitan cities**: Share of personal vehicle usage high -- Close to 80 per cent in Chandigarh; Lucknow, Ahmedabad and Jaipur at 70, 65 and 60 per cent respectively.

- Two-wheeler usage very high.
Share of private and public transport in motorized trips

- **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
Average distance travelled by different modes of transport

Personal vehicles dominate the daily distance travelled in all the cities.

- Two-wheelers travel the maximum, -- in Delhi, Chennai, Hyderabad and Bengaluru.

- Kolkata and Mumbai, -- lowest share of personal vehicle trips in terms of total kilometres travelled.

- Metropolitan cities -- personal vehicles dominate

Source: CSE analysis
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: MoRT&H statistics
Total particulate emission load from urban commuting in the 14 cities (kg per day)

Particulate load from urban commuting in Bhopal is 11 times lower than Delhi.

Source: CSE analysis
Particulate emission load per trip from private and public modes of transport (in g per year)

Source: CSE analysis
Total NO2 emission load from urban commuting in the 14 cities (kg per day)

Source: CSE analysis
Nitrogen oxide emission load per trip from private and public modes of transport (in g per year)

Source: CSE analysis
Heat Trapping Gases increase Climate Risk in Cities

CO2 emission load from urban commuting in the 14 cities (in tonnes per day)

Source: CSE analysis
Heat Trapping Gases increase Climate Risk in Cities

CO2 emission load from different modes of transport (in tonnes per day)

Per trip CO2 emission load in cities (kg)

Source: CSE analysis
Energy consumption for urban commuting in the 14 cities (in MJoules per day)

Source: CSE analysis
Maximum Energy guzzler-- Cars and two-wheelers

Mode-wise distribution of energy consumption (in MJoules per day)

Per trip energy consumption in cities (in MJoules per year)

Source: CSE analysis
Lessons from cities............
Bhopal ranks best among all
Advantage of early action

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 wins among mega cities: Advantage of a compact city

-- Sixth among all 14; -- Wins among six mega cities
-- Third highest volume of trips due to large population,
-- 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.
-- Early investment in diverse and connected public transport and physical restraints
-- Public transport culture, compact city design, high street density, short travel distances restricted availability of land for roads and parking -- good practices.
-- Most diverse public transport systems buses (now upgrading to electric buses), metro, trams, suburban rail, para-transit and waterways. -- Public transport and IPT trips 88 per cent.

-- Proves - only high population, high travel volume and economic growth need not necessarily lead to higher automobile dependency.
Kolkata have natural pedestrian precincts, by virtue of the sheer volume of pedestrians. This can be further built on to make pedestrian zones.
Good practice in Kolkata: Mixed use development

The TOD Building typology - in Kolkata:

-- Roof of retail used as public space for residents.
-- Zero Setbacks.
-- Mixed Use (Commercial/ Civic/ Residential within same block)
-- Privacy of residents ensured.
-- Retail facing the street with homes overlooking, keeps pedestrians (women) safe
Good practice in Kolkata: Mixed use development
Rajarhat: Gated-community and inaccessible design. Wrong urban principle. Urban design make people captive users of car.
Is this paradigm sustainable?
Super blocks, opaque boundary walls, no street activity, limited access....

Source: CSE
Car centric design

Poor walking access

Footpaths for beautification

No mid block crossings for pedestrians – Advantage to vehicles

Source: CSE
Mumbai stays ahead with public transport spine

-- Ranks 10th

-- Ahead of all mega cities except Kolkata.

-- Highest volume of trip generation.

-- Average trip length of all modes second highest.

-- Average distances of different modes are comparatively smaller than six other cities.

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

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

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

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

-- Even with highest per capita GDP among the six megacities and highest volume of trip generation use of personal modes is lowest in Mumbai.
Delhi’s dilemma
Ahead and yet a loser

The paradox of Delhi
-- Total volume of trip generation is lower than Kolkata, Mumbai, Chennai, and Bengaluru.

-- Average trip length for different modes is lower than Chennai, Mumbai, Bengaluru, and Hyderabad.

-- Delhi’s public transport share is the third best among all cities. Delhi is 7th in per trip pollution generation.

-- Despite these relatively better overall positions why is Delhi at the bottom rank?

Reason
-- Higher population than other megacities. Highest vehicle stock
-- Volume of trips, even with lower trip rate, are very high
-- 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.
-- Eclipsed benefits of CNG, and better travel parameters than other cities
-- Requires much more ambitious and harsh measures to bend the curve
How does Delhi’s paradox look like?

**Total PM emission load from urban commuting:** • Delhi emits 5 times more than Kolkata, 3 times more than Mumbai, 13 times more than Bhopal, 9 times more than Chandigarh and 8 times more than Vijayawada

**Total CO2 emission load from urban commuting:** • Delhi emits 4 times higher than Kolkata, 2.3 times higher than Mumbai, 1.7 times higher than Hyderabad; 26 times more than Bhopal, 15 times more than Vijayawada and 11 times more than Chandigarh

**Total energy consumption for urban commuting:** • Delhi consumes 5 times more energy than Kolkata, 2.4 times more than Mumbai, and 2 times more than both Hyderabad and Bengaluru; 28.4 times more than Bhopal, and 15 and 13 times more than Vijayawada and Chandigarh respectively

**BUT……….Delhi fares relatively better on per trip emissions**

**Based on per trip emissions:** Hyderabad and Kochi emit 3 times more PM than Delhi; Chandigarh and Hyderabad emit about two times higher CO2 than Delhi and twice more energy

Delhi’s comparatively higher public transport modal share, effect of CNG programme, in-use emissions management shows up in per trip emissions
Mega cities. Mega problem

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

-- Chennai and Bengaluru with large population have high trip generation and volume of travel.
-- Average trip length for different modes especially cars among the highest; particularly in Chennai.
--- Share of public transport ridership is lower than Mumbai, Kolkata and Delhi.
-- Average distances or total vehicle miles traveled by different modes are among the highest.
-- Signs of urban sprawl - increasing distances and dependence on personal vehicles.

-- Even with lesser number of vehicles than Delhi, recorded highest annual average growth rate for vehicles among all mega cities.
-- Comparatively lower population than Delhi leading to overall lower number of trips and lesser kilometres travelled by vehicles.

--- 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

Depending on what direction their mobility policies go over the next years and decades, their pollution levels may increase or decrease accordingly.

They need to take corrective measures now and avoid the fate of the megacities.
The challenge of upscaling affordable solutions? Are we prepared? Why will anything change?
Legal mandate for mobility transition in Delhi-NCR

March 6, 2018: CPCB notified CAP for Air Pollution Control In Delhi and NCR under Section 3 and Section 5 of The Environmental (Protection) Act, 1986.

Short term priority action

• 10,000 buses; Route Rationalization;– modernize fleet, (GPS etc)
• Passenger information systems
• Multi- level bus parking in depots
• Bus fare policy to remain affordable
• Enforce bus lanes; Augment service of Metro
• Implement electro-mobility for three-wheeler

Medium terms

• Multi-modal integration plan for bus-Metro IPT-NMT.
• TOD: Influence Zones demarcation around metro stations
• BRTS / LRTS to be implemented
• Fare integration; Common mobility cards.M
• NCR connectivity for public transport –CNG mode.
• Rationalization of entry taxes in NCR Regional Rapid Transit System; Integrated passenger terminals; Traffic impact assessment of infrastructure project
March 6, 2018: CPCB notified CAP for Air Pollution Control In Delhi and NCR under Section 3 and Section 5 of The Environmental (Protection) Act, 1986.

**Implement network plan for footpaths and cycle tracks**
- Plan and upgrade pedestrian / NMT crossings.
- Reduce block sizes to reduce walking and cycling distances.
- Synchronization of signals - IT-based traffic management system
- Cycle sharing systems
- Make safety and walkability audits of walking and cycling infrastructure mandatory
- Remove encroachment from NMT lanes

**Parking policy as a demand management measures**
Need massive investments

National Transport Development Policy Committee:
-- By 2031, Rs 10900-18500 billion needed for urban transport;
--- about 55% for public transport.
-- Urban India needs about 196,000 buses with an investment of Rs 1181 billion by 2031.

How to meet this cost of investment and keep services affordable?
-- Even the existing public transport is unable to sustain itself financially -- huge gap to be bridged

Magnitude of Funding required: -- A pointless discussion without identifying the funding sources / implementation mechanism
How can investments be augmented for a scale?

Annual Budgetary Allocations for Smart Cities Mission

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Allocation in the Union Budget (Rupees Crore)</th>
<th>Percentage of share from Annual Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-14</td>
<td>7,016</td>
<td>31</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,020</td>
<td>9</td>
</tr>
<tr>
<td>2016-17</td>
<td>3,205</td>
<td>14</td>
</tr>
<tr>
<td>2017-18</td>
<td>4,000</td>
<td>18</td>
</tr>
<tr>
<td>2018-19</td>
<td>6,169</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: Twenty-second Report of the Standing Committee on Urban Development (March 2018)

Out of the total allocation to the Smart City scheme, share of urban transport projects – 21%.

Out of total number of projects under AMRUT only 7.4% under urban transport and comprises only 1.75% of total cost of projects.
### Transport funding under Smart Cities programme

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road infrastructure (smart roads, junctions, Flyovers, ROBs others)</td>
<td>31%</td>
</tr>
<tr>
<td>Parking</td>
<td>15%</td>
</tr>
<tr>
<td>Intelligent Transport System (ITS) (traffic management, smart card, others)</td>
<td>14%</td>
</tr>
<tr>
<td>NMT and Pedestrian infrastructure (incl FOB, skywalks, PBS etc)</td>
<td>8%</td>
</tr>
<tr>
<td>Transit &amp; Transit infrastructure (BRT, bus, IPT BQS, terminals, MMH, depot)</td>
<td>26%</td>
</tr>
<tr>
<td>Others (any sub category can be included if major)</td>
<td>6%</td>
</tr>
</tbody>
</table>

- **Road infrastructure** -- largest share – 31% and active transport has the lowest (8 %). Parking – 15%

- **Pilot scale**

*Sources: Ministry of Housing and Urban Affairs*
Massive escalation in Metro funding (2009-2017)

<table>
<thead>
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<tbody>
<tr>
<td>Total Ministry of Urban</td>
<td>6077</td>
<td>6547</td>
<td>6858</td>
<td>6563</td>
<td>7297</td>
<td>11013</td>
<td>18419</td>
<td>32550</td>
<td>34212</td>
</tr>
<tr>
<td>Development Budget* (INR, Cr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GoI Investment in Metro</td>
<td>4212</td>
<td>5025</td>
<td>4212</td>
<td>4955</td>
<td>5458</td>
<td>6016</td>
<td>11937</td>
<td>19172</td>
<td>18366</td>
</tr>
<tr>
<td>Projects (INR, Cr)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total investment of GoI</td>
<td>12%</td>
<td>46%</td>
<td>23%</td>
<td>15%</td>
<td>16%</td>
<td>55%</td>
<td>65%</td>
<td>59%</td>
<td>54%</td>
</tr>
<tr>
<td>in Metro Project as compared to Department of Urban Development, GoI budget (%)</td>
<td></td>
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Note: * This includes all the expenses and budgetary allocations of Ministry of Housing and Urban Development, GoI including administrative. Source: https://openbudgetsindia.org/dataset?tags=metro+projects

- **Imbalance in investments** – not taking care of all integrated modes.
- **2009**: About 12% of MoHUA’s budget; **2017**: it increased to 54%. Investment on metro projects in 2017 about 3.7 times of that in 2010
- **No commensurate increase for buses, or for system integration.**
Mounting evidences of massive slide in public transport ridership in cities.

Delhi bus services: Share of public transport reduced from 64% in 2001 to 54% in 2010. Since 2013, DTC bus ridership is declining at an average rate of 8.88 per cent per annum. Overall, dropped by as much as 34%.

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

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

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

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

No strategy to make public transport work in cities – poor last mile connectivity for public transport, cheap or free parking, subsidised road taxes for cars, lack of integration, lack of operational reforms are big barriers
Declining bus fleets and ridership in Delhi

Source: DTC Operational Statistics, November 2016
Bus neglected........

-- Barely any national policy to support buses; FAME policy for electric buses in 10 cities; JNNURM programme for bus stimulus package

-- Even in cities with metros buses prime mover across all cities.

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

-- Massive slides in bus ridership; Since 2013 – DTC has lost 13% ridership; BEST reports loss in ridership; BMTC – curtailing routes; Ahmedabad BRT – stagnant ridership Vijaywada BRT – not operational and so on...

Need cohesive national policy
### Massive shortfall in metro ridership

**Actual and projected ridership**

<table>
<thead>
<tr>
<th>City</th>
<th>Existing Ridership</th>
<th>Year</th>
<th>Projected Ridership</th>
<th>Year</th>
<th>Existing Ridership as compared to Proposed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>2,700,000</td>
<td>2018</td>
<td>3,950,698</td>
<td>2016</td>
<td>-46%</td>
</tr>
<tr>
<td>Bangalore</td>
<td>314,166</td>
<td>2017</td>
<td>1,083,000</td>
<td>2016</td>
<td>-245%</td>
</tr>
<tr>
<td>Mumbai</td>
<td>380,000</td>
<td>2017</td>
<td>1,006,000</td>
<td>2016</td>
<td>-165%</td>
</tr>
<tr>
<td>Jaipur</td>
<td>17,649</td>
<td>2017</td>
<td>210,420</td>
<td>2014</td>
<td>-1092%</td>
</tr>
<tr>
<td>Lucknow</td>
<td>25,000</td>
<td>2017</td>
<td>429,250</td>
<td>2015</td>
<td>-1617%</td>
</tr>
<tr>
<td>Chennai</td>
<td>55,000</td>
<td>2017</td>
<td>756,466</td>
<td>2016</td>
<td>-1275%</td>
</tr>
<tr>
<td>Kochi</td>
<td>33,570</td>
<td>2017</td>
<td>381,868</td>
<td>2015</td>
<td>-1038%</td>
</tr>
</tbody>
</table>

- No strategy to increase ridership of any system — metro, BRT or modern buses, in cities.
- Actual ridership of metro systems falls woefully short of the projected ridership.
- Existing ridership of Jaipur, Lucknow and Chennai metro show a deficit of greater than 1000 percent, when compared with their projected ridership.

Source: Metro project reports.
How are we going to address the issue of investments and affordability?

-- With further expansion of Metro rail
--- Modernisation of city bus system and its infrastructure
-- Cities implementing bus rapid transit system
-- Electric buses
-- Integration of systems
-- Infrastructure for safe access and walkability

All will cost a lot: Where do find money and how do we keep services affordable?
DMRC price hike – decoding the puzzle
It’s just not about metro fare … but integrated Journey Cost that has not been taken into account by Fare Fixation Committee while recommending Fare hike for Delhi Metro.

Source: Times of India dated 30th November, 2017
Lower income group badly hit

Students and Lower Income Group

**Janmejay Kumar (20) | Student**
Distance travelled | Pandav Nagar to South Ex (16km)
Before May hike | ₹21 (metro)
After Oct hike | ₹40 (metro)
Travel cost now | ₹15 (bus)

**Ram Sagar Verma (40) | Labourer**
Distance travelled | Khora Colony to Kashmere Gate (16km)
Before May hike | ₹32
(₹10 RTV + ₹22 metro)
After Oct hike | ₹50
(₹10 RTV + ₹40 metro)
Travel cost now | ₹30
(₹10 bus + ₹20 bus)

**Rajesh Pal (46) | Office assistant**
Distance travelled | Bharthal village near Dwarka to Okhla (31km)
Before May hike | ₹40
(₹10 rickshaw + ₹30 metro)
After Oct hike | ₹70
(Rs ₹10 rickshaw + ₹60 metro)
Travel cost now | ₹25
(Rs ₹15 bus + ₹10 bus)

Source: *Times of India* dated 30th
What is affordable?

-- No absolute threshold for affordability

-- 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 as it cannot afford it.

-- Higher spending on transport leads to lower spending on housing, health and education and hampering inclusive growth of the society.
Middle income groups (Rs. 12,500 to Rs. 42,000 -- middle 30% of the population) -- after accounting for integrated journey cost (at a conservative estimate of 25 per cent of the system cost – a person using a metro would likely to spend at least 25 per cent of the cost paid to the metro to get to the metro station and then reach the destination from the metro station),

AC buses and Metro are close to unaffordable for them too, with them having to spend on an average 9% and 14% to use AC bus and Metro as the main mode of their journey.
### Premium public transport services beyond reach for lower income groups

<table>
<thead>
<tr>
<th>City</th>
<th>Minimum Wages (Rs per day)</th>
<th>Monthly Income (Rs.)</th>
<th>Average Trip Length (KM)**</th>
<th>Fare</th>
<th>Monthly Expenditure on PT (Rs.)</th>
<th>% of Transportation expenses over Total income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Skilled Manpower</td>
<td>Unskilled Manpower</td>
<td>Skilled Manpower</td>
<td>Unskilled Manpower</td>
<td>PT Mode</td>
<td>Fare (Rs per Trip)</td>
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<td>Delhi</td>
<td>648</td>
<td>534</td>
<td>16848</td>
<td>13884</td>
<td>Bus (Non AC)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Bus (AC)</td>
<td>25</td>
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<tr>
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<td></td>
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<td>Metro</td>
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<tr>
<td>Bangalore</td>
<td>565.4</td>
<td>471.95</td>
<td>14704</td>
<td>12271</td>
<td>Non AC Bus</td>
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<td>AC Bus (Vajra)</td>
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<tr>
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<td>312</td>
<td>8559</td>
<td>8112</td>
<td>BRTS</td>
<td>20</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>City Bus</td>
<td>12</td>
</tr>
</tbody>
</table>

- Except in case of Non AC Buses services in Delhi, lower income group needs to spend more than 10% of their monthly income on Non Premium Transportation Services.

- Any additional Trips required to access schools and Health facilities increase costs significantly.

*Source: Minimum wage Notification of Delhi, Karnataka and Gujarat as on April, 2018, **Source: Census 2011*
Delhi Metro is the second most unaffordable among 9 metros globally charging less than USD 0.5 per trip.

Out of 9 metropolitan cities with metro across the world (where cost for a 10 km trip is less than half a dollar) – Delhi Metro is second most unaffordable system.

UBS publishes "Price and Earnings Report (A comparison of Purchasing Power across the Globe)" at interval of every 3 years since 1971. Comprehensive database provides price comparison across 73 global cities. Data is drawn from network of UBS branch offices, many universities and many researchers.

*Source: UBS report on Price and Earning, 2018*
Unsustainable

--- If difference between cost per passenger trip and revenue per passenger trip is considered: ---

--- Jaipur Metro per passenger trip subsidy is Rs 50;
-- Lucknow Rs 78 per passenger trip;
-- Kochi Rs 28 per passenger trip.

Where is funding strategy to keep these systems sustainable?
Delhi Metro fare hike puzzle: Whether policy?

Shock increase of Delhi Metro fare has stirred larger policy questions. Why?

-- DMRC’s fare revenues were enough to meet the operating expenditure up to 2016-17.

-- The Fourth FFC made forecast of revenues and expenses to justify metro fare hike.

-- Situation reverses – forecast shows projected rise of 74% in operating expenditure from 2017-18 onwards.

-- While forecasting the gap between earning and operating expenses in the future it has not accounted for all of its non-fare revenue (consultancy projects, etc.).

-- Should metros seek to meet their future costs of loan repayment and other fixed (depreciation etc) from fares? Or should it look at other financing methods and non-fare revenue? This is not just about Delhi Metro but about a cohesive policy for all metros.
DMRC: Is Fare revenue able to recover the Operating expense?


Forecasted without considering Fare hike

Commissioning of 100 KM. of Phase III.

1. Approximate Estimate of 3528 Nos. of extra Manpower required to Operationalize the Network.

2. Impact of IDA Fare revision from Jan 2017.

3.

Operating Expenditure

Fare revenue
Need innovative financing policy

DMRC – Fare and Non-fare revenues
What can buses do?
Bangalore story: Only success story is turning around

BMTC Financial Analysis

Even for a high patronage denser bus system like BMTC, fare income can now recover only about 87% of the operating costs.

BMTC generates other income from commercial development of around 10-12 terminals for which it earned Rs. 124 crore in 2016-17.

Source: BMTC reports
How are we going to fund the transition?

-- Investments in metro, modern buses, or bus rapid transit systems across cities, cannot deliver if not supported by fiscal policies to mobilize resources, and keep fares affordable for all. Urgently adopt innovative financing policy.

-- Simultaneously ensure urban planning, transit oriented development and overall urban transport policy to increase public transport ridership.
Step forward

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

-- Central government needs to link funding strategies with reforms in public transport sector in cities.

-- Need dedicated funding streams to finance integrated multi-modal public transport systems as per the requirements of the cities. Scale up non-metro funding to enable massive transition

-- Need fiscal strategies to keep public transport services affordable for all as well remove public transport deficit for all income classes.

-- Frame innovative funding policies including fare and non-fare based instruments

-- Integrate urban planning with transportation planning and adopt transit oriented planning to improve accessibility and ridership of sustainable modes

-- 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 emissions and fuel efficient vehicle technologies and electric mobility

-- Apply sustainability indicators for evaluating progress of urban transport interventions to lower emissions, carbon and to induce modal shift towards sustainable modes.
Who is bending the curve?
Who has made a difference in terms of modal shares?

Paris

Berlin

London

Source: The EPOMM modal split tool
Understand the problem

Modernise this paradigm
Thank You