Towards clean air: Are cities prepared?

Anumita Roychowdhury

Orientation workshop on urban air quality: Agenda for action

Centre for Science and Environment

Hyderabad

October 26, 2016
More cities in grip of toxic pollution

Source: based on National Ambient Air Quality Status, CPCB for 2009 and 2012 (latest available)
How is urban air quality in southern region at the onset of this winter?

Source: Based on AQI reported by CPCB
Mixed trend in cities

PM10 levels: 2010-2015

Stable and declining trend

Increasing trend

Source: Ministry of Environment and Forests
Challenge of maintaining the momentum: Delhi

PM10: Decline and rise again

NO2 levels rising steadily

PM2.5: stabilising?

Source: Based on CPCB data
Multi-pollutant crisis

Delhi: City wide average summer ozone concentrations (8 hourly average, April and May, 2015 and 2016)

Source: Based on DPCC air quality data
Toxic air

Toxics are harmful even at trace amount

Ozone is dangerous even for short duration
Need regional action

Annual PM2.5 mean

Source 2015, Norwegian Institute for Air Research, International Institute for Applied Systems Analysis, IITM
Local action can be compromised if regional action is weak

Odd-Even 2.0 proves the point

- Average PM2.5 level during the first week was 24% lower than the average of the preceding fortnight of April 2016. But pollution peaks during second week.

Source: CSE analysis of DPCC real time data
Farm fires push up pollution

Figures:
NASA Satellite Images showing open crop burning in Punjab, Haryana (From April 1 – 30, 2016)

Source: NASA Fire Mapper
Who pollutes?
Vehicles’ contribution to particulate pollution is significant

Hyderabad

- Vehicles: 47%
- Road dust: 33%
- Industries: 5%
- Biomass burning: 6%
- Secondary PM: 9%

Bangalore

- Transport: 41%
- Industry: 15%
- Construction: 14%
- Road Dust: 20%
- Hotel: 0%

Composition of PM10 emissions in Bangalore (tonnes per day)

Chennai

- Paved and Unpaved Road Dust: 73%
- Vehicle Exhaust: 14%
- Construction: 9%
- Industry: 2%
- Domestic Combustion: 0%
- Restaurants: 1%
- Others: 1%
NOx load from different sources
How these numbers lend to action?

- Vehicles are responsible for 2/3rds of NOx emissions.
- Diesel generator and transport emissions contribute to more than 90% of the NOx emissions in the Bangalore city. (Sources: National summary of source apportionment studies)
Public health is a driver

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

Enormous equity impacts with high urban poverty
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, and how much time we spend close to the pollution source than what occurs generally in the air that is 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, -- cannot indicate exposure and health outcome.
Reduce integrated exposure

- With new monitoring technologies, digital data management, remote sensing, and modeling, it is possible to do exposure apportionment.
- Need exposure mapping across micro environment
Exposure to Vehicle Emissions

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

<table>
<thead>
<tr>
<th>Location</th>
<th>Exposure (iF)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>21</td>
</tr>
<tr>
<td>World</td>
<td>39</td>
</tr>
<tr>
<td>China</td>
<td>45</td>
</tr>
<tr>
<td>India</td>
<td>51</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>63</td>
</tr>
<tr>
<td>Bangalore</td>
<td>68</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>69</td>
</tr>
<tr>
<td>Chennai</td>
<td>72</td>
</tr>
<tr>
<td>Mumbai</td>
<td>79</td>
</tr>
<tr>
<td>Delhi</td>
<td>100</td>
</tr>
<tr>
<td>Kolkata</td>
<td>150</td>
</tr>
</tbody>
</table>

• Clean air action in cities...........
What have we done?

Dynamic assessment of top 10 populous cities – Delhi, Chennai, Bengaluru, Hyderabad, Mumbai, Pune, Ahmedabad, Kolkata and Lucknow, Jaipur

Assessment of urban air quality management capability and capacity to implement clean air action plan to meet clean air targets

Establish base line of action in cities -- air quality monitoring and planning, Pollution source and health assessment; clean air action plan to address vehicles technology and fuels; public transport, walk and cycle, restraint on cars; industrial/ power plant sources; dust control in construction and trash burning.

Five stages of progress:
- **Lowest stage I** -- common minimum programme
- **Top stage V**: Going beyond best practices and norms to make impact and achieve clean air.
- **Stage II to III** intermediate stages based on level of progress

Indicators developed to define each stage

Transparent publicly available and those shared by departments
Selected cities represent 24% of urban population of India and none meet air quality standard.

Source: CPCB and Census of India
• National action on emissions standards are common to all and part of stage I development – unless proactive demand from states to improve

• Data and information not equally robust or exhaustive for all sectors. This creates bias in detailing. Data bases are not always directly comparable across cities.

• Benchmarking of stages puts great expectations on cities

• Focus on assessing direction of change in cities

• As air quality management has not matured equally across sectors and cities, progressive action is not uniform. Cities may have done well in one sector while languishing in others.

• Positive initiative highlighted in individual sectors
Desired clean air goals

- City has **good ambient air quality** (50% below Indian Standard); eliminated household exposure and controlled exposure from all sources; minimised health impact.

- City meets **Indian air quality standard; nearly eliminated household pollution**; control of air pollution and exposure from all sources. Reduced health impact.

- City has robust system to monitor and assess air quality and implements **time-bound action plan** to meet standards and reduce exposure.

- City has **adequate capacity to monitor and assess** air quality and has developed air quality action plan to reduce all exposures.

- City does minimal air quality monitoring and has taken minimal action to control air pollution.
Monitoring capacity in cities

- All cities have a combination of manual and real time monitoring
- 34 cities have real world monitoring facilities but air quality index is reported for 22 cities.

Share of manual and real time stations

Source: CPCB
How clean is our air?

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Good air quality – 50% below the standards</td>
</tr>
<tr>
<td>IV</td>
<td>Meets the ambient air quality standards and reduce exposure</td>
</tr>
<tr>
<td>III</td>
<td>Improvement</td>
</tr>
<tr>
<td>II</td>
<td>Stabilisation</td>
</tr>
<tr>
<td>I</td>
<td>Lost gains</td>
</tr>
</tbody>
</table>
Target cities have poorer air than the average of their climatic region.
Target cities have poorer air than the average of their climatic region.
Target cities have poorer air than the average of their climatic region.
Lost gains
Trend in PM10

Source: Based on parliament questions and answers on air pollution related questions
Stable trend but exceeds standards
PM10 trends

Mumbai

Pune

Lucknow

Ahmedabad

Kolkata

Source: Based on parliament questions and answers on air pollution related questions
Twin trouble
Nitrogen dioxides rising

Underestimation of problem
CSE audit of air quality monitoring has shown how manual monitoring method of underestimates Nox pollution

CPCB and SPCB should process real time data and publish

Source: Based on parliament questions and answers on air pollution related questions
Twin trouble
Nitrogen dioxides rising

Vijaywada: Rising trend

Source: Based on parliament questions and answers on air pollution related questions
Twin trouble
Nitrogen dioxides stable or declining

Source: Based on parliament questions and answers on air pollution related questions
South has comparatively lower pollution levels than North...

.....But health impacts are large. Most of the health effects occur at much lower levels. Need to meet tighter targets.
Manual vs Realtime

Comparison of DPCC and CPCB data PM10 levels (Average of 2011-2014)

Underestimation of problem
Data reported under National Ambient Air Quality Monitoring Programme are based only on manual monitoring

This underestimates pollution compared to real time monitoring
Mumbai, Chennai, Hyderabad, Delhi, Lucknow are using only 25 to 50 per cent of their realtime station capacity for reporting AQI

<table>
<thead>
<tr>
<th>Cities</th>
<th>Number of realtime stations used for AQI</th>
<th>% of realtime stations used for AQI data (Jan to August 2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai</td>
<td>4</td>
<td>25, 30</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>5</td>
<td>30, 41</td>
</tr>
<tr>
<td>Delhi</td>
<td>11</td>
<td>41, 50</td>
</tr>
<tr>
<td>Chennai</td>
<td>5</td>
<td>46, 50</td>
</tr>
<tr>
<td>Lucknow</td>
<td>4</td>
<td>50, 60</td>
</tr>
<tr>
<td>Kolkata</td>
<td>2</td>
<td>60, 100</td>
</tr>
<tr>
<td>Bangalore</td>
<td>5</td>
<td>60, 100</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>1</td>
<td>100, 100</td>
</tr>
<tr>
<td>Jaipur</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Pune</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Based on data available in CPCB and state websites
## Data capture for reporting AQI

<table>
<thead>
<tr>
<th>Cities</th>
<th>Number of real-time stations</th>
<th>Average operational stations used for AQI</th>
<th>Number of days AQI available (Jan to August 2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaipur</td>
<td>1</td>
<td>1</td>
<td>61</td>
</tr>
<tr>
<td>Lucknow</td>
<td>4</td>
<td>2</td>
<td>74</td>
</tr>
<tr>
<td>Mumbai</td>
<td>4</td>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>Pune</td>
<td>1</td>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>Chennai</td>
<td>5</td>
<td>2</td>
<td>81</td>
</tr>
<tr>
<td>Bengaluru</td>
<td>5</td>
<td>3</td>
<td>92</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>5</td>
<td>1-2</td>
<td>93</td>
</tr>
<tr>
<td>Delhi</td>
<td>11</td>
<td>4-5</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: Based on data available in CPCB and state websites
Advancing monitoring system

Tamil Nadu takes the lead in introducing continuous Emissions Monitoring System to track industrial pollution
Emergency Action for Pollution

Emergency Action only in Delhi

Odd and even scheme
Capacity to assess Polluters...........

Not a dynamic process
Do not lend to effective action

Source: Final emission inventory study, MOEF, 2011; * the Delhi study is conducted by the IIT Kanpur in 2015
Towards clean air action plan

- Cities under judicial scrutiny have framed clean air action plans and Task Force to monitor: - Bengaluru, Hyderabad, Chennai, Ahmedabad, Delhi

- Not a dynamic process in most cities to inform and push action in all sectors

- Guidance issued from time to time in specific sectors

- Action plan limited in scope and not linked effectively with all sectors of mitigation for effective reduction

- Several drafts in Delhi on short and medium term action

- Need implementation strategy for time bound action to meet specific targets
### Air quality monitoring and management

<table>
<thead>
<tr>
<th>Level</th>
<th>Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>No city</td>
</tr>
<tr>
<td>IV</td>
<td>No city</td>
</tr>
<tr>
<td>III</td>
<td>Delhi, Bengaluru</td>
</tr>
<tr>
<td>II</td>
<td>Chennai, Ahmedabad, Kolkata, Hyderabad, Lucknow</td>
</tr>
<tr>
<td>I</td>
<td>Pune, Mumbai, Jaipur</td>
</tr>
</tbody>
</table>
• Air pollution control ..... national action
Motorisation and dieselisation

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

In Delhi diesel cars are 25% of total car fleet; contributes 78% of PM2.5 from vehicles. ICCT estimates –4 times greater cancer risk in Delhi from diesel cars compared to petrol cars. More than 280,000 avoidable cancers due to diesel exhaust. (IIT Kanpur study)

Source: CSE
Emissions standards

April 2017: BSIV nation-wide

Is automobile industry ready?

Current % Volume of fuel (As on 01.04.16)

<table>
<thead>
<tr>
<th></th>
<th>BSIV Petrol</th>
<th>BSIV Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54%</td>
<td>51%</td>
</tr>
</tbody>
</table>

Source: HPCL and MoPNG, June 2016
Supreme Court directives on diesel in Delhi region since 2015

Action on trucks:

Environment compensation charge (ECC) on each diesel truck entering Delhi – numbers dropped by close to half after its introduction. ECC revenue to go to clean air fund

Ban on entry of pre-2006 trucks. Opens up discussion on freight modal share Rail vs Trucks

Temporary ban on 2000 cc engine and above passenger diesel cars
Ban lifted but ECC imposed.

All diesel taxis being phased out – replaced with CNG taxis

Environment cess on each litre of diesel sold to create Air Ambience Fund (pre 2015)

National Green Tribunal: Extending restriction on old vehicles in other cities as well
Leapfrog to Euro VI

Technology roadmap

• Notification to skip Euro V and leap directly to Euro VI in 2020

• Now focus on real world performance
Challenge of mobility crisis
Vehicle numbers: Explosive (2003-2013)

% increase in the motor vehicles from 2003 to 2013

Source: MoRTH, 2015
Volume of travel much higher in bigger cities
Total daily trips (in lakh)

Source: Anon Wilbur Smith/MOUD
Can we retain our advantage?
Majority walk, cycle and take public transport
Compact city design reduces travel distances

Average travel distance high in Bengaluru, Hyderabad, Chennai. But less in smaller cities. Majority trips within small distance range

Chennai and smaller cities walking and cycling trips higher than car and two-wheelers trips.
In Hyderabad it is nearly equal
In Bengaluru and Kochi walking and cycling trips fallen below car and two-wheeler trips
Congested and paralysed......

Bengaluru, Chennai, Hyderabad face severe congestion

Source: Anon Wilbur Smith/MOUD
Clean air and mobility

How people travel influence the quality of air.

Walking and cycling are zero emissions modes

Bus, metro, train etc carry more people but emit less per person

Auto and taxis are high frequency-low occupancy vehicles for connectivity.

Cars and two wheelers occupy maximum road space, carry much less people and emit more per person. They edge out sustainable modes and incur huge social and health cost
Environment Protection Act 1986 and Air Act 1981: Both are in the Union’s List-I. Powers of the Union are exclusive and overriding. The Motor Vehicles Act 1988 is under the concurrent list (List III, E 35) to give the Union’s Act priority. EPA asks to meet air quality standards

Air Act – Chapter IV – Prevention and control of air pollution

20. **Power to give instructions for ensuring standards for emission from automobiles** -- the State Board under clause (g) of sub-section (1) of section 17 - - State Government shall, in consultation with the State Board, give such instructions as necessary to concerned authority in charge of registration of motor vehicles under the Motor Vehicles Act, 1939 (Act 4 of 1939), and such authority shall be bound to comply with such instructions.

Central Pollution Board is Advisory and to plan and cause to be executed a nationwide programme for the prevention, control or abatement of air pollution; Similar provisions for the State Governments. Central and State Government may give directions to the Central and State Board respectively.


**Accountability mechanism not clear**
Weak link

• Rapid review of available clean air action plan and guidance from most cities show very poor linkage between clean air action and mobility action

• Lose linkage with augmentation and integration of public transport, walk and cycle

• No linkage with compact city and road design; transit oriented development practices

Think of mobility not cars
Which city has highest share of public transport, walk and cycling trips?

No strategy to protect current usage of sustainable modes

When a city has a combined modal share of more than 90 per cent for all forms of public transport -- buses, trains, autos/taxis, and walking and cycle.

When a city has combined modal share of 81 - 90 per cent for all forms of public transport -- buses, trains, autos/taxis, and walking and cycle.

When a city has combined modal share of between 71 - 80 per cent for all forms of public transport -- buses, trains, autos/taxis, and walking and cycle.

When a city has combined modal share of between 61 - 70 per cent for all forms of public transport -- buses, trains, autos/taxis, and walking and cycle.

When the city has modal share of equal to or less than 60 per cent for all forms of public transport -- buses, trains, autos/taxis, and walking and cycle.
Indian cities have one of the best baselines in the world

Even today majority in our cities walk, cycle and use public transport

Most people are too poor to even use public transport

Compact city design that has reduced distances

Some cities have invested in public transport – to improve quality of service

Clean air action plan to protect and improve the modal share

**Modal Share (in %)**

<table>
<thead>
<tr>
<th>City</th>
<th>Personal Cars &amp; 2 Wheelers</th>
<th>Public Transport (Bus, IPT &amp; Train) &amp; Non-Motorised Transport (Walk &amp; Cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmedabad</td>
<td>60</td>
<td>39</td>
</tr>
<tr>
<td>Bengaluru</td>
<td>32</td>
<td>63</td>
</tr>
<tr>
<td>Chennai</td>
<td>36</td>
<td>69</td>
</tr>
<tr>
<td>Delhi</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>39</td>
<td>62</td>
</tr>
<tr>
<td>Jaipur</td>
<td>39</td>
<td>64</td>
</tr>
<tr>
<td>Lucknow</td>
<td>38</td>
<td>41</td>
</tr>
<tr>
<td>Pune</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td>Kolkata</td>
<td>11</td>
<td>88</td>
</tr>
<tr>
<td>Mumbai</td>
<td>12</td>
<td>87</td>
</tr>
</tbody>
</table>

Race to walk, cycle and use public transport

Stage IV: Mumbai, Kolkata: global best Practice

Stage II: Bengaluru, Jaipur, Delhi, Chennai & Lucknow with 61% To 70%.

Stage I: Ahmedabad, Hyderabad, Pune equal or less than 60%.

Clean air action plan to protect and improve baseline
Kolkata: Integrated modes

Most diverse public transit modes

MOVEMENT OF PASSENGERS
AVERAGE WEEKDAY PASSENGER VOLUME IN LAKHS

<table>
<thead>
<tr>
<th>MODES</th>
<th>2001</th>
<th>2025</th>
<th>% INCREASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBURBAN RAIL</td>
<td>32.5</td>
<td>46.0</td>
<td>41</td>
</tr>
<tr>
<td>METRO RAIL</td>
<td>2.0</td>
<td>13.0</td>
<td>550</td>
</tr>
<tr>
<td>CIRCULAR RAIL</td>
<td>0.2</td>
<td>4.0</td>
<td>1900</td>
</tr>
<tr>
<td>TRAM/LRT</td>
<td>2.0</td>
<td>10.0</td>
<td>400</td>
</tr>
<tr>
<td>BUS</td>
<td>113</td>
<td>175</td>
<td>55</td>
</tr>
<tr>
<td>PARA TRANSIT</td>
<td>35.0</td>
<td>67.0</td>
<td>91</td>
</tr>
<tr>
<td>INLAND WATER TRANSPORT(Ferry)</td>
<td>2.4</td>
<td>7.0</td>
<td>191</td>
</tr>
<tr>
<td>TOTAL</td>
<td>187.0</td>
<td>322.0</td>
<td>72</td>
</tr>
</tbody>
</table>
Public Transport-Modal Share

- No city
- Kolkata and Mumbai
- No city
- Delhi, Chennai, Jaipur, Lucknow, Bengaluru
- Ahmedabad, Hyderabad & Pune
Don’t miss the bus

• Buses are critical as spine of city mobility – 40-60% of daily trips

• allow greater flexibility, geographical coverage, cost effectiveness, and space efficiency

• Buses move people in most cost-effective way – emits a lot less per person
Goals for good city bus service

City is providing a **integrated** bus service that is highly efficient sufficient, reliable, affordable and segregated with advanced passenger info service.

City provides bus service that is **sufficient**. Innovation in augmenting quality of bus service, reserving right of way, optimal use of **infrastructure**. Scope of improvement in quality.

City provides bus service that is **insufficient but optimally utilizes its existing infrastructure**. Efficiency and reliability can be improved.

City provides bus service that is **insufficient and sub-optimally utilizes its existing infrastructure**. Overall the service is stressed and unreliable.

City provides bus service that is **insufficient and poorly utilizes its existing infrastructure**. The service is inefficient and unreliable.
City Bus Service: Indicators

Efficient bus operations
- Number of buses and route planning to serve the population with reliable service
- Fleet utilisation
- Kilometre Efficiency and load factor
- Distance travelled and trips /day
- Average age of bus
- Fuel Efficiency
- Staff per bus
- Dead mileage
- Infrastructure optimisation

Planning and policy – regulatory and fiscal – Innovations – Management strategies
- Service guarantee programme
- Dedicated urban transport fund etc
What matters most -- Bus Service

**Bus service per 3 minutes during peak hour and 5-7 minutes during non-peak hour; serves entire population effectively; uses advanced passenger information system for reliable services; quality service, dedicated right of way, well integrated with other modes; affordable; runs on clean fuels**

Demonstrates substantial improvement from baseline on fleet utilisation; utilisation of passenger carrying capacity; route rationalisation ‘for geographical and population coverage; improves operated kilometer; starts enforcing bus lanes and provide dedicated right of way, passenger information and ITS application

Demonstrates improvement from baseline on fleet utilisation; utilisation of passenger carrying capacity; route rationalisation ‘for geographical and population coverage; improves operated kilometer; starts enforcing bus lanes

Inadequate and unreliable services. Poor fleet utilisation; underutilisation of passenger carrying capacity; no route rationalisation and poor geographical and population coverage; Operated kilometer are much less than scheduled kilometer; no dedicated right of way for buses
Trend of bus fleet (2010-2015)

Onl y11% of the total buses

Source: MoRTH February 2016
How many buses per lakh population?

- Bengaluru with 68 buses /lakh population is at Stage IV.
- All other cities at Stage I with less than 40 buses per lakh population.

The share is only of Culcutta STC which is 11 % of the total buses (Source: Kolkata CMP-2008)

Source: MoRTH February 2016
City Bus Service

Trend in passengers carried by city bus services (2010-2015)

- Only BMTC shows increase
- Delhi shows imixed trend -- improvement and decline
- Pune stable
- Rest – consistent decline

Source: MoRTH February 2016
Fleet utilisation of buses

- Most cities are at Stage IV
- Lucknow & Pune at Stage III

Source: MoRTH 2015
Distance travelled by a bus per day

- Stage IV: Chennai with highest kilometers -- 226-275 kms a day.

Source: MoRTH 2015
How much of passenger carrying capacity is utilised

- Stage IV: Chennai, Delhi & Pune

Source: MoRTH, CSE
Some initiatives

• Bengaluru Metropolitan Transport Corporation
  • Scraps old buses that covered 8.50 lakhs Kms or 10 years of age. Replacement with BS-IV buses. Planning CNG bus programme
  • Stratified bus service according to affordability
  • Revenue generation model
  • Bus Day

• Delhi: Renewed bus fleet twice – once to CNG; the to urban buses; age cap on buses; moved to CNG; to increase bus numbers by 3000 this year

• Ahmedabad: Bus rapid transit network
Hyderabad

Planning battery operated buses

Mini buses to serve larger areas

App for door step services

Fearing losses on metro routes
New systems in other smaller cities—An opportunity

-- **Tumkur** city bus service started in 2011 with one depot and 51 buses and to do 36 km scheduled km. The cost -- Rs 28.62/km. Earnings is also Rs 28.82/km. They have low floor buses with destination board, GPS system, electronic ticketing. The bus cost Rs 18.77 lakh/bus

-- **KSRTC reports 20 per cent modal shift** – mainly from para transit. The major competitors to bus are the 4000 autos. As bus has to compete with the autos they have to ensure reliable frequency and time table compliance. About 10 minutes frequency is maintained and entire city is covered. They have adopted bus branding – wide doors, with more standing area etc.

-- **Initially promotional fares of Rs 1 for a year. Thereafter increased.** They have also adopted automatic fare revision.

-- **The challenge here is not to let losses build up.** Find new funds to keep fares affordable can be challenging in smaller cities.
Proposed multi-modal public transport network in Bangalore

• A multi-modal public transport network for the BMA has been proposed to be
Delhi is developing guidelines for modal interchange location

---

**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.
Coordinated action

Hyderabad
- Formation of a Unified Metropolitan Transport Authority (UMTA) for HMA. UMTA act as a singular authority in decision making relating to traffic and transport.

Bangalore
- BMLTA through executive order. BMLTA is mainly concentrated to Bangalore city and DULT concentrates more on two tier cities.
- INITIATIVES: Intermodal hubs planned at 3 stations, comprehensive transportation study for the city
- Service level benchmarking twice in the city in 2008 and 2011; Integration of ticketing system with BMTC and metro. NMT projects undertaken; renovation of 40 odd to accommodate NMT facilities according to IRC guidelines. All the metro stations are supposed to accommodate NMT facilities.

Chennai
- The Chennai Unified Metropolitan Transport Authority (CUMTA) was formed in November 2010 as a single nodal agency that directs planning, operations, and monitoring of various transport modes in Chennai Metropolitan Planning Area.
- Key responsibilities -- preparation of a Comprehensive Transport Plan that looks at the planning and development of public transport options and their implementation through various agencies
City Bus Service
Where cities stand?

- Hyderabad, Jaipur, Lucknow
- Ahmedabad, Delhi, Mumbai, Pune, Chennai, Kolkata
- Bengaluru
- No city
- No city
Without right to walk we cannot take a bus

We cannot cross the road
Chennai: Dare to walk and cycle...
Hyderabad: immobility...

Cycling, walking?? Can you

Wait for bus...or take a two wheeler?

Roads are meant for vehicles isn’t it?

Source: CSE
Bangalore: Bus reforms...a step way forward. But need mobility management to reduce congestion and pollution

Source: CSE
Walking and cycling

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>City provides <strong>safe and dedicated</strong> infrastructure for NMT with <strong>zero pedestrian and cyclist fatalities.</strong> 50% of the daily trips are NMT.</td>
<td></td>
</tr>
<tr>
<td>City has <strong>dedicated NMT infrastructure</strong> and has <strong>increased</strong> its NMT modal share over last 5 years.</td>
<td></td>
</tr>
<tr>
<td>City has <strong>advance NMT infrastructure with pedestrian rights</strong> while stabilising its NMT modal share.</td>
<td></td>
</tr>
<tr>
<td>City is <strong>improving its NMT infrastructure</strong> and has adopted pedestrian and cycling friendly schemes.</td>
<td></td>
</tr>
<tr>
<td>City provides <strong>minimal NMT infrastructure</strong> and has high pedestrian and cyclist fatalities.</td>
<td></td>
</tr>
</tbody>
</table>
NMT modal share
Safe access
Integrated NMT policy
NMT initiatives

(Street design guidelines, bike sharing, street audits, mandatory implementation of NMT guidelines of IRC, bicycle master plan, car free days, NMT as part of clean air action plan, any dedicated dept./cell and fund for NMT)
Modal share for walk and cycle in cities

Source: Census 2011
How safe are the roads in these cities
Road accidents reported (2011 to 2014)

- Delhi and Kolkata showing increasing trend
- Bengaluru, Mumbai & Chennai declining trend.
- Others stable trend.

Source: 2011-2014, Accidental Deaths & Suicides in India, NCRB, Ministry of Home Affairs, GoI
Good news from cities

Chennai

Only city to notified comprehensive non-motorised transport policy

Mandates a minimum of 60% of Corporation’s transport budget to NMT infrastructure.

Chennai Street Design Manual.

City corporation selected 448 bus routes (358 km) for improvement. With grants from the Tamil Nadu Road Infrastructure Funds, the corporation has begun work on footpaths of 71 bus routes, approximately over 49 km.

Reclaimed space from carriageway

To prohibiting encroachments on footpaths etc. Car free streets

In contrast to the old footpath on Police Commissioner Street which was narrow, with utility boxes obstructing pedestrian activity; the new footpath (right) is wide with utility boxes moved to provide a continuous pedestrian realm that is accessible to all.
Good news from cities

**Bengaluru**
City government with Bangalore City Connect Foundation has initiated a public-private initiative named Tender SURE. Redesigned footpaths.

DULT organises Cycle Days in Bengaluru.
Hyderabad: Charminar Pedestrianisation Project

• Hyderabad Urban Development Authority (HUDA): Pedestrianise Charminar

• A hand-out by HUDA: “implementation of the Charminar Pedestrianisation Project remains ‘elusive’ and has resulted in an ‘unchecked damage to the physical environment’

• But why ban public transport?
Potentially Viable Open Spaces that can be Developed to Perform Functions of Public Open Space *Urban Streets As Interaction Spaces*

Present

Proposed

Needs support from public and business

Source: Charminar Pedestrinisation Project
Good news from cities

Delhi

• New state budget allocates funds for redevelopment of PWD roads with walk and cycling facilities
• Delhi’s ‘Green Bike’ initiative
• Car Free Days every 22\textsuperscript{nd} of the month.
• Supreme Court directive – invest revenue from pollution tax on trucks on public transport as well as walking and cycling infrastructure
• Street design guidelines
• More than 40 km of dedicated walking and cycling tracks near games venues
Jaipur

Johari Bazaar and Chaura Rasta in Walled city

- Walkable and shaded verandah is unique to the old city; The verandah is covered all along, -- a continuous and shaded space for walking.
- Shopkeepers display but keep clear width of 1-1.5 metre for walking
- PPP model for bike sharing for 1,000 cycles and 72 cycle stands.
- Footpath redesign in other areas
Walking and cycling
How cities fare?

- Chennai, Bengaluru
- Mumbai, Delhi, Pune, Ahmedabad, Hyderabad, Jaipur, Lucknow, Kolkata
- No city
- No city
- No city
bad news
Bengaluru

One-ways increase distance, driving, fuel use and pollution

Most road less than 4 lanes wide are designated one-way.

Bengaluru has best bus service but worst accessibility to bus according to MoUD

One-ways limit access to bus stops: pedestrian can't cross roads

Jaanagraha survey: Only 0.33% of 238 kms of footpaths surveyed have good walkability
Why steel flyover in Bengaluru?

- Proposal to build a steel flyover covering a distance of 6.7 km connecting the airport
- Large protests
- Why spend Rs 1,800 crore on steel flyover and not on mass transit and other lasting solutions?
Delhi: Flyover capital and yet gridlocked

Flyovers make people drive longer; destroy walk and cycling trips; Increase emissions

Source: CSE
MMRDA had planned 50 skywalks in Mumbai Metropolitan Region to connect railway stations or commercial areas. The Bandra (E) station and Kalanagar (Bandra-Kurla Complex) skywalk -- actual usage couple of hundred in peak hour. 81.4 per cent say skywalks are unsafe (survey of St Xavier’s College).
Link road and urban design with air pollution mitigation............
Roads designed for cars; not people

Engineering changes once made cannot be reversed easily… It permanently decides our travel choices
Pedestrians are pushed to foot over-bridges or underground crossings....

Increase road accident risk

Increase distances and travel time for people.

Discourage use of public transport, walking and cycling.
Case Study Delhi – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B

Originally 30M across the road
Case Study Delhi – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B – Pedestrian Route 1

1000M via FOB
Case Study – Gurgaon Sector 28

Accessing Metro from ITC Laburnam Apts

- Shortest route not possible.

Source: CSE
Case Study – Gurgaon Sector 28

Accessing Metro from ITC Laburnam Apts

Source: CSE
Avoid car feeders to buildings –
Public transport to define the urban form

1a) **High Density Mixed Use within 5-min walk of stations…**

Reason for success of BRT in Curitiba:
Maximum people Live, Work & Play within 5-min walk of **RAPID TRANSIT Stations**
Density disparity along metro line in Delhi....

- Chawri Bazar
- Race Course
- Green Park
Where will you feel more safe to walk?

Why do we have building setbacks and boundary walls?
• Need restraint..........
Why current parking policy will lock in more air pollution?

Unlimited and free parking incites more car ownership and usage that cause more pollution

**Wasteful use**: 90 to 95% of the time a car is parked and makes enormous demand on land

**Inequitous use of land** A car gets more space (23-26 sqm) to park than poor households get land to make houses (18-25 sq m).

**Parking takes away space from other important development, walkways from pedestrians, and green areas**
Parking policy to control air pollution

- **Parking -- most wasteful uses of cars**: For about 90 to 95 per cent of the time a car is parked.

- **Insatiable demand for land**: In Delhi, cars use up 10.8% of the city’s urbanised area. The forest cover in Delhi is 11.5%.

- **In Hyderabad and Bengaluru**, the land requirement for parking is more than 100 football fields in a year. In Delhi, it is equal to 310 football fields.

- **Inequitous use of land**: Poor families get less land (about 18-20 sqm of land to build houses) than car parking slots (23 sqm). The car-owning minority uses up more road space and urban space.
Parking aggravates congestion

On-street parking very high in Kochi (56% of roads used for parking, Madurai (52%) and Trivandrum (47%) which impedes both NMT and motorised movement and walkability

Source: Wilbur Smith/MOUD
Why are we wasting so much valuable space for parking?

A 100 sqm plot built to the full allowable FAR (315 sq m) needs 161 sq m of parking space by Law - more than half. This is equal to one and half storey or space of 4 EWS dwellings....
Parking charges in Indian cities are some of the lowest in the world.

Source: Handbook of Urban Statistics 2016, MoUD
Parking policy to restrain car usage

City provides **limited legal parking with a cap** and prices it effectively to **reduce car ridership and ownership**.

City **limits creation of legal parking** and prices it based across all land uses on the **actual social and environmental cost associated with parking and motorisation**.

City allows **legal parking caps** and it is **regulated and priced**. Some parking restraint like proof of parking is available.

City allows minimum parking and prices it high and variably. There is a **fine for illegal parking**.

City provides unlimited parking and it is free or minimally priced to carter to increasing vehicular population. Illegal parking is unregulated.
Acceptance of demand management principles

National Urban Transport Policy: 2006

- Urban land is valuable. Levy high parking fee that represents value of land occupied. Graded parking fee should recover the cost of the land. Make public transport more attractive.
- Public transport vehicles and non-motorised modes of transport be given preference in parking space allocation.
- Park and ride facilities for bicycle users with convenient interchange are a useful measure.
- In residential areas byelaws need changes to free the public carriageway.

Supreme Court/EPCA:

“Land is limited and there is a limit to the additional parking space that can be created in the city. This will also require …. pricing policy to control the demand for parking.”

- The provision of parking for personal motorised vehicles cannot be considered as a matter of public good.
- The ‘user pays’ principle should govern the pricing of parking.
- Government should not subsidise this cost
Other countries are using parking policy to restrain car use

**Boston** has frozen parking requirements at 10 per cent higher than the 1973 levels. This has helped Boston to meet the federal clean air standards.

**Portland, Oregon** set an 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 of downtown office space.

**San Francisco** limits parking to seven per cent of a downtown building’s floor area.

**New York**: Very high parking fees and limited parking supply have lowered car ownership far below the average rates in other US cities.

**Amsterdam** -parking fees expanded to meet NO2 and PM10 standards.

**Zurich** considers total NO2 emissions when determining the amount of parking to be allowed.

**Bogota** has removed limit on the fees that private parking companies can charge. The additional revenue is dedicated to road maintenance and public transit service improvement.
Other countries are limiting and pricing parking

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
Step towards restraint

- **Bengaluru**: Stage II- Has a notified parking policy.

- **Jaipur**: Stage II- Introduced proof of parking system for purchase of car.

- **Kolkata**: Stage II- Introduced parking charges in residential areas and has restrictions on night time parking on narrow streets

- **Ahmedabad, Chennai, Delhi, Mumbai, Pune, Hyderabad & Lucknow**: 
  - **Stage I-** All have minimum parking standards and supply unlimited & free parking.
Get the principles right

• Establish goals of the parking policy – It is a travel demand management tool to reduce pollution and dependency on personal vehicles
• Limit parking requirements - cap absolute supply of parking spaces
• Make parking standards flexible based on accessibility - Parking plans need to account for the changes in parking demand with improvement in public transport in different zones
• Parking should be public, shared and priced
• Need good on-street parking management
• Prepare parking management plan for a zone and not a site
• Need appropriate street geometry to reduce modal conflict and protect walk and cycle lanes from parked cars
• Improve efficiency in utilisation of available parking spaces
• Design parking for multimodal integration and improving public transport usage
• “Park and Walk” facilities may be included in zonal plans
• Multi-level parking should not be planned in isolation for a site but as a overall parking plan of a zone
• Enforce strict penalty for violation of parking regulations and walkway encroachment
• Meet the parking needs of public transport buses, non-motorised transport and freight
• No free parking – introduce high and variable parking rates according to duration of parking etc
• Promote common public-shared-priced parking in residential and mixed land-use parking
Parking as a restraint measure

<table>
<thead>
<tr>
<th>No city</th>
</tr>
</thead>
<tbody>
<tr>
<td>No city</td>
</tr>
<tr>
<td>No city</td>
</tr>
<tr>
<td>Jaipur, Kolkata &amp; Bengaluru</td>
</tr>
<tr>
<td>Ahmedabad, Chennai, Delhi, Mumbai, Pune, Hyderabad &amp; Lucknow</td>
</tr>
</tbody>
</table>
Fiscal measures to control pollution
Think and do differently

• Correct what we are doing so wrong:
  • Tax car more than bus
  • Charge for parking
  • Charge/tax diesel use in private cars

• Use all this to create facilities for all; convenient modern and accessible to take the bus or cycle or walk
Fiscal Measures to bring change

City applies **polluter pay principal** to change citizen behaviour and commuting choices. **Cleaner technology and commute options are the cheapest.**

City has advance fiscal system based on polluter pay principal and **has removed perverse incentive to dirty technologies.**

City has **aggressive environmental tax** on polluting technologies and commute options and has minimised skewed distortion in technology pricing.

City **has green tax on dirty fuels and dedicated funds** to incentivize cleaner technologies and modes of commute.

City has no fiscal intervention with skewed distortion in fuel and commute option prices providing perverse incentive to dirty technologies.
Indian style socialism
buses pay more taxes annually than cars

### Sources:
MoPNG

**Note:** DNR: Data Not Reliable

Cars of up to Rs. 6 lacs and buses of 32 seats have taken for comparison

<table>
<thead>
<tr>
<th>City</th>
<th>Tax paid by cars annually (in Indian Rupee)</th>
<th>Tax paid by buses annually (in Indian Rupee)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmedabad</td>
<td>2,400</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Bangalore</td>
<td>3,600</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Chennai</td>
<td>10,000</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Delhi</td>
<td>4,000</td>
<td>1,600</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>17,420</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Jaipur</td>
<td>D.N.R</td>
<td>2,000</td>
</tr>
<tr>
<td>Kolkata</td>
<td>6,200</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Lucknow</td>
<td>3,200</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Mumbai</td>
<td>3,200</td>
<td>D.N.R</td>
</tr>
<tr>
<td>Pune</td>
<td>D.N.R</td>
<td>D.N.R</td>
</tr>
</tbody>
</table>

**Buses in all cities pay more than cars**

**Ahmedabad** – smallest differential

**Kolkata:** Minimal difference

**Bangalore** – Highest tax on buses

Graphs showing the comparison of annual tax paid by cars and buses across different cities.
Tax on petrol higher than diesel

- Lowest tax differential between petrol and diesel in Ahmedabad & Mumbai -- 2%
- Highest differential in Bengaluru & Lucknow -- more than 9%
- Lowest tax on diesel in Delhi

Source: MoPNG
Polluters Pay Principle: small beginning

• Delhi
  • Air ambience fund -- environment cess on per litre of diesel sold, to create an air ambience fund to finance pollution control activities.
  • Environment compensation charge on trucks. Dedicated fund for public transport, walk and cycle

• Maharashtra: Green tax under Bombay Motor Vehicles Tax (Amendment) Ordinance, 2010. Public and private vehicles over eight and 15 years old pay a green tax every year.

• Karnataka: State Level Urban Transport Fund

• Rajasthan: State and city level urban transport fund
Fiscal measures

- Ahmedabad, Pune, Mumbai, Kolkata
- Delhi, Chennai, Bengaluru, Hyderabad, Jaipur, Lucknow,
Benefits of restraints on personal vehicles
Odd and even scheme: Temporary restraint measure in Delhi (January 2016)

Aerosol Optical Depth: Pre Odd-Even Trial December 18 to 31, 2015

Aerosol Optical Depth: During Odd-Even Trial January 1 to 15, 2016

<table>
<thead>
<tr>
<th>Good</th>
<th>0 to 0.3</th>
<th>0.3 to 0.45</th>
<th>0.45 to 0.60</th>
<th>0.60 to 0.75</th>
<th>0.75 to 0.90</th>
<th>&gt; 0.90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Benefits of removing cars from the roads

During odd and even when car numbers were reduced other mobility showed up

Public transport more efficient: Buses, autos and taxis could do more kilometres and carry more people. Metro ridership increased. Bus passengers increased by 8%.

More efficient utilization of the bus fleet: DTC bus fleet utilization improved from 84% in normal days to 95% during Odd-even scheme. Overall petrol and diesel sales dropped by 4.7% and 7.8% from December 2015 to January 2016.

Average journey speed increased

Average occupancy in personal cars increased from 1.4 to 2.1 during the odd and even period

How do we frame permanent measures to sustain these gains?
## Emissions from on-road vehicles

City ensures **that in-use vehicle do not emit more than their designed maximum emission** and has completely weeded out gross polluting vehicles.

City has **advance pollution monitoring and control system with real world testing facility** and has majorly weeded out gross polluting vehicles.

City has **advance pollution monitoring system** (advanced emissions testing, on board monitoring) and **adopted polluting vehicle management**

City has **improved upon mandatory pollution control infrastructure** and has **adopted additional measure like cleaner fuel**.

City does minimum required as per the national law and standards to restrain emissions from in-use vehicles.
Strategy of alternative fuels

- **Delhi**: has the largest refuelling network
- **Public transport** entirely on CNG
- **Mumbai**: Large CNG bus and taxi fleet and large pvt vehicle fleet.
- **Chennai, Hyderabad, Bengaluru and Kolkata**: Limited LPG uptake in small vehicles like autos
Initiatives to control emissions from in-use vehicles

Delhi
- Environment compensation charge on truck entry
- Entry of pre-2006 trucks banned
- Truck diversion
- Introduced RFID technology and for electronic monitoring and payment

- All PUC testing centres are connected to a centralised server in real-time. Lambda test introduced
- Upgraded vehicle fitness testing facility for commercial vehicles
Initiatives taken for in-use vehicular management – Mumbai and Bangalore

- **Mumbai:**
  - Has one of the largest city-bus fleets running completely on CNG
  - Also autos and taxis on CNG
  - Incentivise a large no. of private cars to convert to CNG
  - Transit-oriented travel network which enables high efficiency for its public transit network
  - Overall dependence on MRTS has meant that the vehicular fleet in the city is one of the smallest

- **Bangalore:**
  - Restricted old, polluting vehicles and does not let them into the city
  - Restricted 2 stroke vehicles
  - Established a real-time monitored pollution under check network
  - Supported by a robust bus network that is used by commuters, and supported by enterprises as well as civil society organisations in the city
In-use Vehicle emissions

- No city
- No city
- Delhi, Mumbai
- Bengaluru, Hyderabad, Ahmedabad, Lucknow
- Kolkata, Chennai, Pune, Jaipur
C&D Waste (mis)Management

On 29 March, 2016 MoEFCC notified India’s first ever rules construction and demolition waste management. Challenge now is to have these rules implemented and reduce generation and littering of this waste which is a major source of fugitive dust pollution in cities. As part the study each city's preparedness to adopt and implement the new rules was assessed.
| **V** | City has **developed a circular economy of waste**. It has minimised generation, effectively collects, recycles and uses all the generated waste. |
| **IV** | City has dedicated C&D waste management system and infrastructure in place. It **collects and recycles most of the waste generated**. |
| **III** | City has developed a dedicated system of collection and disposal of C&D waste and it **is implemented as pilot in some portion of the city**. |
| **II** | City has initiated a dedicated system of C&D waste collection and disposal. But it has **not piloted the system**. |
| **I** | City does not have a dedicated C&D waste policy and its **infrastructure to effectively handle and utilize C&D waste is minimal**. |
C&D Waste Management - Indicators

1. Quality of C&D waste quantification
2. City’s existing and proposed C&D waste recycling capacity
3. Qualitative assessment of the city’s existing and proposed C&D waste policy
4. Assessment of the city’s C&D waste handling initiatives
C&D Recycling Infrastructure

Stage IV:
Delhi with installed capacity to recycle 50-60% of 4,000-5,000 TPD waste

Stage III
Ahmedabad – 42% Bengaluru – 37%
Bengaluru


- Comprehensive guidelines linked the C&D waste management with the building construction permit system.

- BBMP notified six abandoned queries as designated C&D waste dump sites.

- City also plan to setup three C&D waste recycling plants with combined recycling capacity of 2,250 TPD.

- Private recycling facility with 1,000 TPD capacity run by Rock Crystals, a BBMP empanelled vendor.
Delhi: Pioneered recycling

- Municipal corporations of North Delhi and East Delhi have a 2000 TDP and 500 TDP capacity **C&D waste recycling plant** respectively.

- Government mandates use of a minimum of two per cent recycled products from construction waste in all future contracts for building works and 10 per cent recycled products for road works undertaken by its agencies.
C&D Waste Management

Chennai, Hyderabad, Jaipur, Kolkata, Lucknow, Pune, Mumbai

Ahmedabad

Delhi, Bengaluru

Chennai, Hyderabad, Jaipur, Kolkata, Lucknow, Pune, Mumbai
• Big problems … uncertain data…
Trash and Biomass Burning
Linking with waste paradigm

Improper management of landfills and frequent fire. Municipal Waste (mis) Management and urban poverty

Legal ban on trash burning does not work – link it with waste management

Solid waste management rules – Poorly enforced

Make households and institutions accountable for decentralised management, segregation, and payment of waste they generate

No landfill. Charge and penalty

‘Not In My Backyard’ – an opportunity

Promote circular economy
NCR: Court ruling penalising open burning

<table>
<thead>
<tr>
<th>State</th>
<th>Number of challans</th>
<th>Amount recovered</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>326</td>
<td>Rs. 7,37,600</td>
<td>No challan was issued by NDMC and North-DMC</td>
</tr>
<tr>
<td>Haryana</td>
<td>27</td>
<td>Rs. 52,000</td>
<td>Faridabad: awareness campaign; whatsapp based violation reporting system, but no challan till date</td>
</tr>
<tr>
<td>UP</td>
<td>8</td>
<td>Rs. 20,000</td>
<td>Only Greater Noida Authority has issued challans</td>
</tr>
</tbody>
</table>

Delhi NCR: NGT order of penalty of Rs. 5000/- for each violation.

Supreme Court directed strict compliance with the order.

Implementation process started

Over Rs. 8,00,000 have been recovered in fines this winter.
## Power plants and industry

<table>
<thead>
<tr>
<th>City</th>
<th>Number of plants</th>
<th>Installed Capacity in MW</th>
<th>Reported PM levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>2</td>
<td>840</td>
<td>50-70</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>1</td>
<td>422</td>
<td>40-90</td>
</tr>
<tr>
<td>Mumbai</td>
<td>1</td>
<td>750</td>
<td>20-60</td>
</tr>
<tr>
<td>Chennai</td>
<td>3</td>
<td>4,980</td>
<td>50-150</td>
</tr>
<tr>
<td>Kolkata</td>
<td>4</td>
<td>925</td>
<td>14-250</td>
</tr>
</tbody>
</table>

**Delhi:** shut down Rajghat plant and scales down generation at Badarpur plant.

**Kolkata** 4 plants -- three are Old. Approved shutting down of one at New Cossipore; Southern Thermal Plant restricted.

**Challenge of tracking small scale industrial pollution**
Solid fuel burning: most neglected areas

2001 census: Total number of households using firewood – 100.84 million

2011 census: Total number of households using firewood – 120.87 million
Opportunities
Access to clean energy

Health Ministry Committee -- Make clean fuel available: Make LPG affordable and accessible for the poor. Restructure subsidies for clean fuel to target poor better. Recommends mission on smokeless villages.

Government of India’s ‘Give It Up’ campaign -- Households that earn more than Rs. 10 lakh per annum to surrender LPG subsidy. To cover 1.5 crore households below poverty line in 2016-17 and 5 crore more below poverty line households in next two years. To achieve universal coverage of cooking gas. About 75 lakh households have given up LPG subsidies.

CPCB 2014 Draft Indoor Air Pollution Monitoring Guidelines

Energy access and electricity for cooking

Biogas: encourage innovation -- Address last mile problems to ensure quicker uptake

Missing link in clean air action plan
Diesel generator sets

Source of high exposure: 6-8% of all diesel consumed for power generation. This includes grid connected diesel based power plants of more than 10 MW, captive plants and DG sets

Focus on emissions and energy efficiency

Revised emissions standards are equivalent to Euro Stage IIIA for all size classes in Europe until 2010. Europe has further tightened the standards since then for all size classes. Stage IV in Europe in 2015

Energy efficiency: Average energy efficiency levels fall short of the global benchmark – percentage difference of about 7-8% (Shakti study)

Bureau of Energy Efficiency proposal for energy efficiency standard and labelling

Enforcement mechanism and energy audits to improve operation and maintenance

Real solution – reliable access to electricity – address the gap between power generation and supply and other reforms; interface with rooftop solar programme
Sector: Stage III: Cities

Air Quality Monitoring and Management:
• Delhi, Bengaluru, Chennai, and Hyderabad

Public Transport: Kolkata, Mumbai, Bengaluru

Walking and cycling: Chennai, Bengaluru

Restraint on personal vehicles: Kolkata, Jaipur, Bengaluru

Controlling in-use emissions: Delhi

Dust control from construction: Delhi, Bengaluru
Stand behind change

- Recognise the actions – small as they may seem – which change this trajectory

- Cities that recognise that they must grow differently

- No big answer yet: **but this is the second coming**
Our health is non-negotiable

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