An Assessment of Urban Development Pathways for Delhi Using Emission Trajectories

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Outline of the Presentation

- Background
- Emission Estimates
- Development Pathways and Development Goals
- Conflict of interests of various stakeholders
- Impacts of policy decisions
- Sum-up
Salient Features of Delhi

• Unique City State in India
• Area 1483 km²
• Highest per capita Income in India
• Constantly expending opportunities due to capitalization of economic policy reforms
• Only 8% population lives below poverty line
• Forest Covers over 7.5% of Delhi’s Geographical Area
• Fundamental problems
  – Migration
  – Power and water supply
  – Public Health
  – Public Safety
Delhi – Historic Development

900 BC to 1947
P = 274

1981

P = Population Density (person/km²)

1958
P = 1176

2001
P = 9294
National Capital Region (NCR) Towns

NCTD – National Capital Territory of Delhi
### Emission Inventory: Significance sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>CO₂</th>
<th>CH₄</th>
<th>N₂O</th>
<th>NOₓ</th>
<th>CO</th>
<th>SO₂</th>
<th>Particulate</th>
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<tbody>
<tr>
<td><strong>Energy &amp; Transformation Industries</strong></td>
<td>X</td>
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<td>X</td>
<td>X</td>
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<tr>
<td><strong>Transportation</strong></td>
<td>X</td>
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<td>X</td>
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<tr>
<td><strong>Biomass Burning</strong></td>
<td>X</td>
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<td><strong>Industrial processes</strong></td>
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<td><strong>Cement</strong></td>
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<td><strong>Steel</strong></td>
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<td><strong>Agriculture</strong></td>
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<td><strong>Enteric fermentation</strong></td>
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<td><strong>Rice cultivation</strong></td>
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<td><strong>Agriculture soil</strong></td>
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<td>X</td>
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<tr>
<td><strong>Agricultural residue burning</strong></td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td><strong>Land-use and forestry</strong></td>
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<td><strong>Waste</strong></td>
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**Embodied emission**

*IPCC 1996 Guidelines for Inventory Preparation*
Pollutants emission from gasoline consumption in Delhi

Pollutants emission from diesel consumption in Delhi

Pollutants emission from CNG consumption in Delhi

Emission Inventories from Transport Sector in Delhi
Emission Inventories for Delhi

Total CO2 emission from Direct and Indirect sources in Delhi

Total CH4 emission from direct & Indirect sources of emission
Human Development Report of Delhi (August 2006) advocates the Development Approach as:

‘..Purpose of development is to create an enabling environment for people to enjoy long, healthy, creative and secure lives.’
Delhi Development Goals

- Goal 1: Eradicate Poverty and Hunger (three targets)
- Goal 2: Achieve Universal Elementary Education (Seven targets)
- Goal 3: Promote Gender equality and Empower women (Three targets)
- Goal 4: Reduce Child Mortality (Two targets)
- Goal 5: Improve Maternal Health (One Target)
- Goal 6: Combat HIV/AIDS, malaria and Other Diseases (Three targets)
Delhi Development Goals

• Goal 7: Ensure Environmental Sustainability
  – Target #20: Increased Forest Cover
  – Target #21: Reduce carbon dioxide emissions
  – Target #22: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and sanitation
  – Target #23: Increase proportion of population with access to improved sanitation
  – Target #24: Achieve a significant improvement in the lives of slum dwellers
Delhi Development Goals

- Goal 8: Strengthen Bhagidari (Three targets)
- Goal 9: Improve Public Safety (Three targets)
Development Pathways

• Land Use Pattern is supposed to be guided by successive City Master Plans
  – Presently Master Plan 2001 is operational
  – Modification of Master Plan is expected to be notified very soon as a result of conflict of competitive interests
Compliance of Policy decisions are often influenced/ catalyzed by the stakeholders’ activism

- Recent examples:

  1. Ongoing drive for complete closure of commercial activities in residential areas ordered by superior courts to force compliance with the provisions of current Master Plan

  2. Implementation of reforms in transport sector to improve ambient air quality
     - Introduction of CNG for Public transport
     - Introduction of tougher emission norms for new vehicles
     - Improvement of fuel quality
     - Restriction of movement of commercial vehicles
Contribution of Various Sectors to Ambient Air Pollution (Source: MoEF)
Category wise increase in Number of Vehicles in Delhi

<table>
<thead>
<tr>
<th>Year</th>
<th>Car &amp; jeeps</th>
<th>MotorCycle &amp; Scooters</th>
<th>Auto Rickshaws</th>
<th>Taxies</th>
<th>Buses</th>
<th>Goods Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
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<td>1991-92</td>
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<td>1992-93</td>
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<td>2001-02</td>
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<td>2002-03</td>
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<td>2003-04</td>
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</tbody>
</table>
Vehicle Emission Norm Schedule in India

1990 - 1st set norms notified
1995 - Emission norms for catalytic vehicles
1996 - 2nd set norms notified
2000/01 - Euro-I equivalent (Country) Euro-II eqv. For cars (4 metros)
2005 - Euro-II (Country) Euro-III (11 cities)
2010 - Euro-III (Country) Euro-IV (11 cities)

April 1997 - Sulphur 0.25% Delhi & Taj
April 1998 - Sulphur 0.25% 4 metros & Taj
August 1997 - Sulphur 0.25% Metro cities
April 2000 - Sulphur 0.25% Entire Country
April 2000-04 - Sulphur 0.05% 11 cities
April 2005 - Sulphur 0.05% Entire Country & 0.035 (11 cities)
April 2010 - Sulphur 0.005% (11 cities) & 0.035% (Entire Country)

Diesel Sulphur Reduction Programme
Impact of Interventions on Air Quality of Delhi (1996 vs. 2003)

+ denotes increase & - denotes decrease

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1996</th>
<th>2003</th>
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<tr>
<td>SPM (µg/m³)</td>
<td>450</td>
<td>410</td>
</tr>
<tr>
<td>RSPM (µg/m³)</td>
<td>350</td>
<td>245</td>
</tr>
<tr>
<td>CO (10 x µg/m³)</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>NOx (µg/m³)</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>SO₂ (µg/m³)</td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>Pb (ng/m³)</td>
<td>100</td>
<td>40</td>
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</table>
Impacts of Policy Decisions on Criteria Pollutants Emissions from Transport Sector

Application of stricter Emission Norms for Vehicles
2000-01 = Euro –I
2002-03 = Euro-II
CO2 Emission from Diesel and CNG consumption in Buses in Delhi

Co-benefits: Reduction in CO₂ Emission

Euro-II: Provisional Scenario for Euro-II Bus Fleet – Completely Phased Out

Savings
New Initiative in Delhi

- Successful completion of first phase of Metro rail and start of Second Phase

- In order to prepare city for the upcoming Commonwealth Games in 2010, big infrastructure development projects are being planned

- A multi-mode transport system comprising of Metro, LRT and high Capacity Bus system is being planned
To Sum-up:

- Development trajectory is a result of complex interplay of interests of various stake-holders especially in democratic set-up.
- The issue of decarbonization has been recognized but issues related to air quality improvement have dominance over CO$_2$ reduction issues.
Acknowledgement:
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IHDP
GCP

Thanks