

Responding to Climate Change: Role of Low Carbon Human Settlements



Manmohan Kapshe
School of Planning and Architecture,
Bhopal, India

First Annual Meeting of Low Carbon Asia Research Network (LoCARNet)
“Mobilizing Wisdom for a Low-Carbon Asia”

Hotel Novotel Bangkok

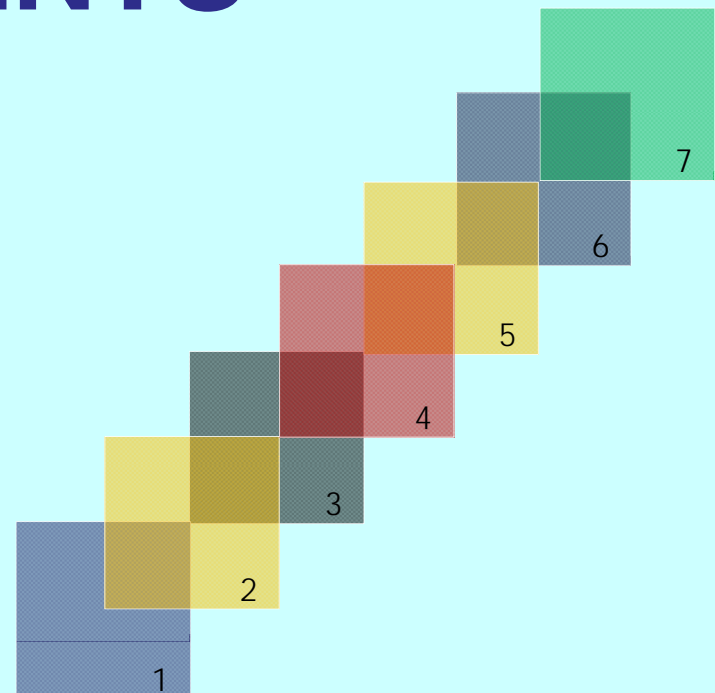
16-17 October 2012

Presentation Sequence

- ❖ Climate Change and Human Settlements
- ❖ Indian Scenario
- ❖ Bhopal Low Carbon Society Approach
- ❖ Barriers for LCS Studies



CLIMATE CHANGE AND HUMAN SETTLEMENTS



Why Human Settlements?



Cities cover less than
1% of the world's
surface area



Yet cities consume
some **75%** of the
world's energy and
are responsible for
80% per cent of
greenhouse gas
emissions.

50% of the world's
population live in
cities (set to rise to
60% by 2030)



**Cities are major contributors to global climate change and can
play a significant role in mitigation**



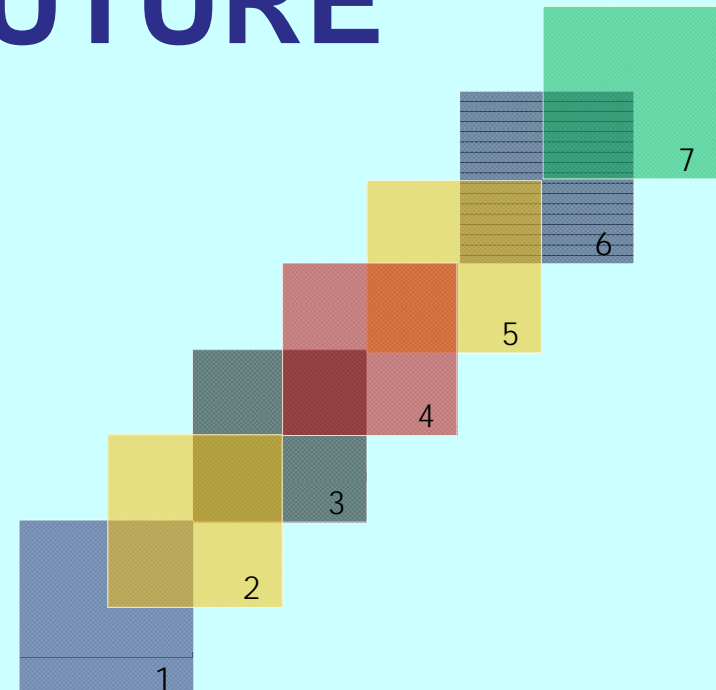
Settlements: Sensitivity and Vulnerability

- Economically significant. However, not generally considered to be heavily affected by climate change.
- Sensitivity to climatic variability and change is relatively lower because of a high capacity to adapt in response to changes in climate.
- Especially vulnerable are informal settlements within urban areas, which tend to be built on hazardous sites and to be susceptible to floods, landslides, and other climate-related disasters.
- Coastal Settlements and industry show a higher vulnerability.

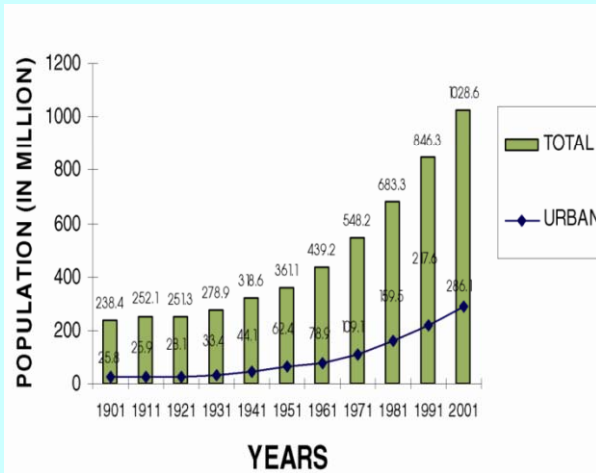
**Climate stresses are superimposed on existing stresses
(multiple stresses)**



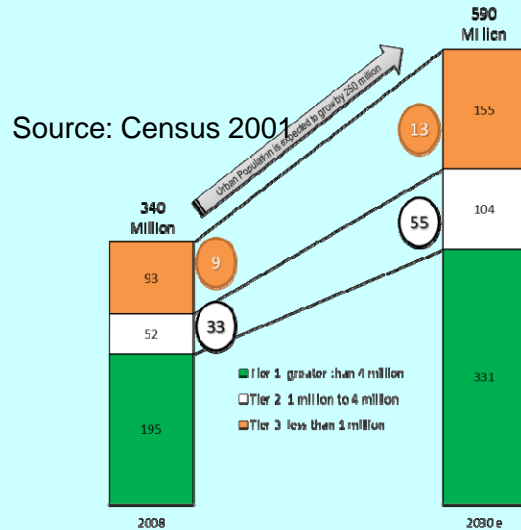
INDIAN SCENARIO PRESENT AND FUTURE



Demographic trends and projections



Share of Urban population



Growth of large cities in India

Source: Mckinsey 2010



Million-plus Cities and Urban Agglomerations

Fast growth and increasing number of urban centers is a cause of concern



India: Commitments, Actions and Drivers

Commitments and Actions

Copenhagen Commitments

- 20 to 25% Emissions Intensity Reduction from 2005 to 2020
- Per Capita Emissions Below OECD Average (through 2100)

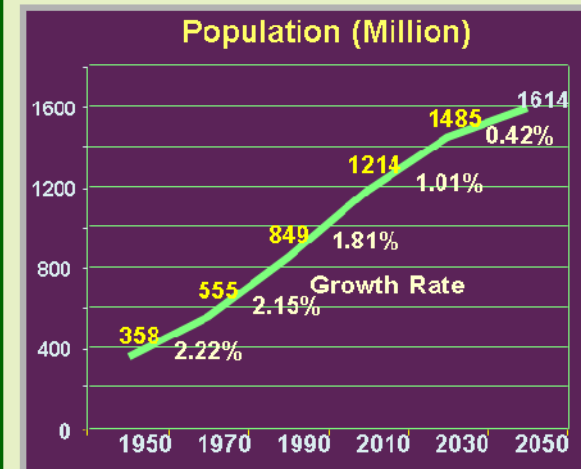
National Climate Change Action Plan - 8 National Missions

1. Solar Energy (20 GW by 2022; 2 GW off-grid; 20 m sq. m collectors)
2. Enhanced energy efficiency (Avoided capacity of 19000 MW by 2014-15)
3. Sustainable habitat
4. Water Sector (20% water use efficiency improvement)
5. Sustaining the Himalayan eco-system
6. A "Green India" (20 Mil. Hectare afforestation by 2020; Forest cover from 23 to 33%)
7. Sustainable agriculture (micro irrigation promotion in 40 m ha)
8. Strategic knowledge for climate change

Domestic Actions

- Carbon tax on coal to fund clean energy
 - US \$1/ton on domestic & imported coal; funds to be use for Clean Energy
- Enhanced Energy Efficiency measures
 - National Solar mission (20 GW by 2022; 2 GW off-grid; 20 m sq. m collectors)
- Mass Distribution of CFLs
 - Potential reduction of 6 GW of electricity demand

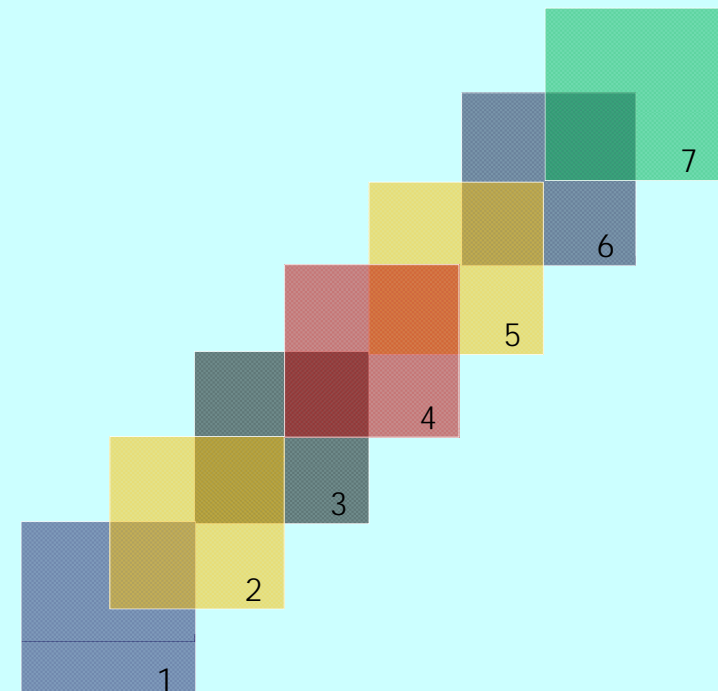
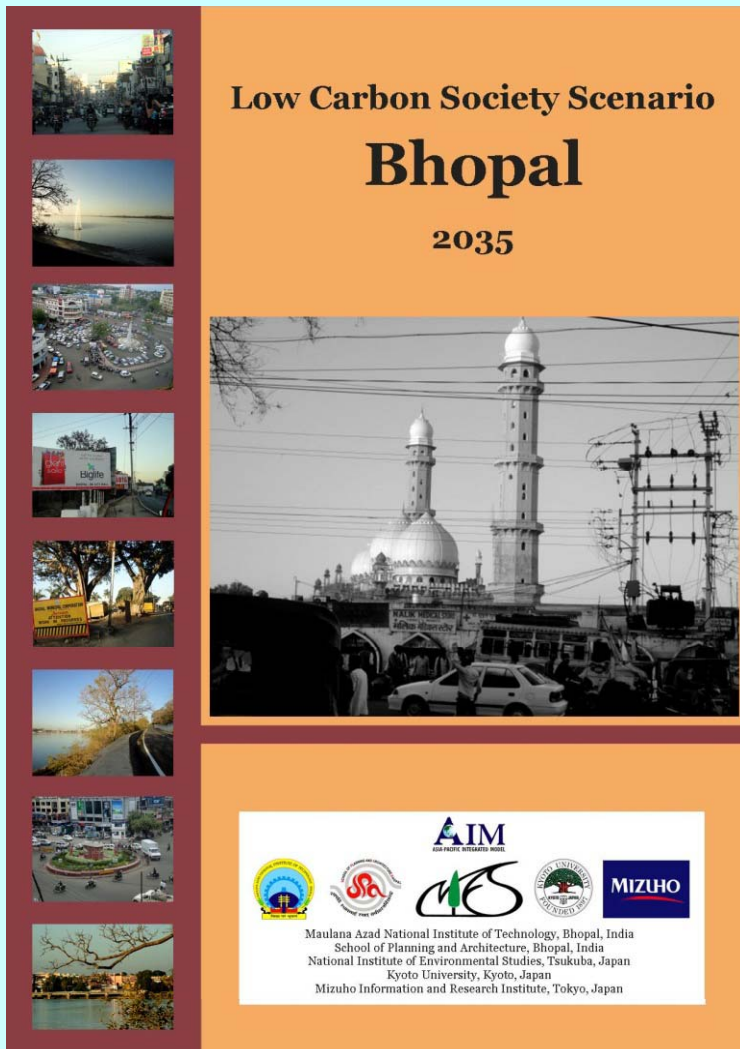
Drivers of Economy



Many actions are being taken. Successful implementation equally important



LOW CARBON SOCIETY: BHOPAL



Developing Bhopal LCS Scenario 2035

- Methodology
 - Quantification of scenario estimates
 - Narrative storylines of likely future
 - Description of sector-wise details of likely future
 - Quantification of the macro-economic considerations and social aspects
 - Identification of possible effective policy measures
 - Develop action plan for policy measures



AIM/ExSS Model

Model Design

- A static, accounting type model
- Consists of simultaneous equations
- Keep consistency using IO analysis
- CO₂ emissions from energy use focus
- Extendable to other sectors and env. Loads
- Program : GAMS, Input & output: Excel

Model Application

- Illustrate quantitative future snapshot of a area in question in order to DESIGN a LCS and evaluate its feasibility
- Analyze relationship between socio-economic conditions and environmental load
- Define a portfolio of the measures to meet the environmental target

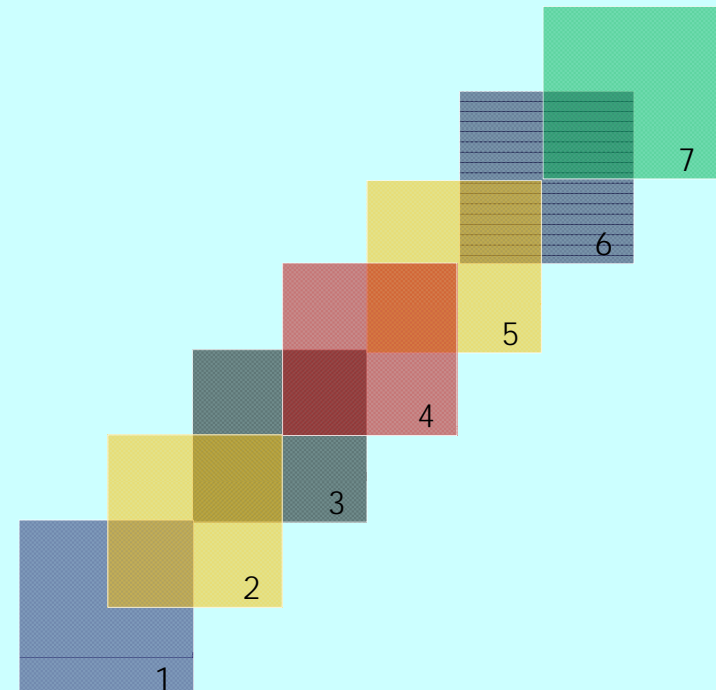
Model Output

- ❖ Socio-economic activity level
- ❖ Environmental load (emissions)
- ❖ Low-carbon measures

Model Developed by: Dr. Kei Gomi, Kyoto University, Japan

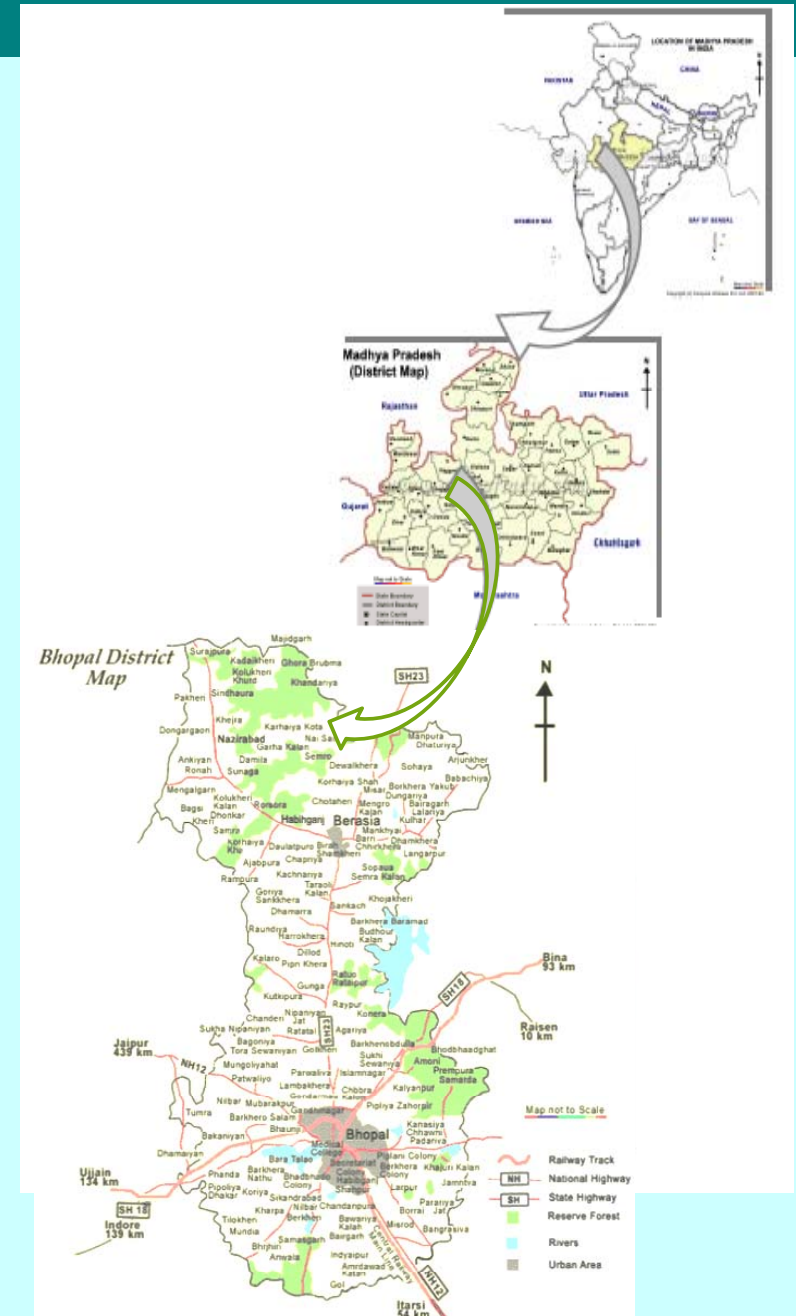


BHOPAL – AN INTRODUCTION



Bhopal, India

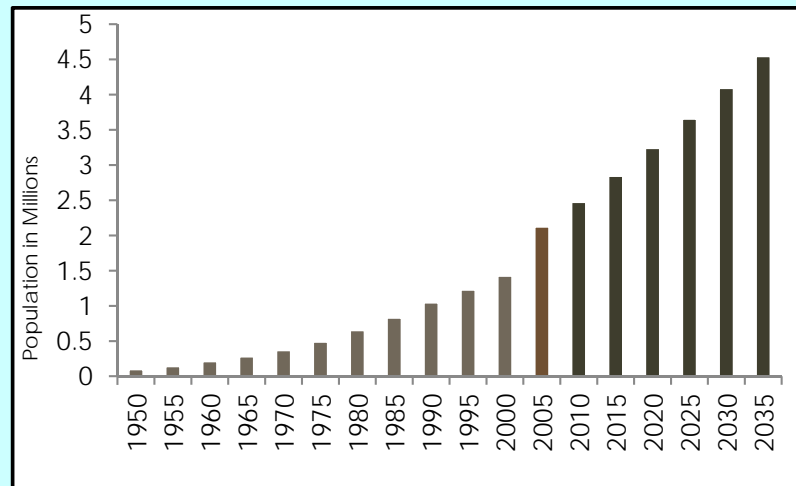
- The city is centrally located.
- Has composite climate representing a large part of the country.
- Physical features like large water body, hills and forests for analysis of local variations.
- A million plus city, it can represent many large Indian cities.
- Old city with new development
- Whole district along with rural area taken as case study



Drivers of Change

Demographic Trends and Projection

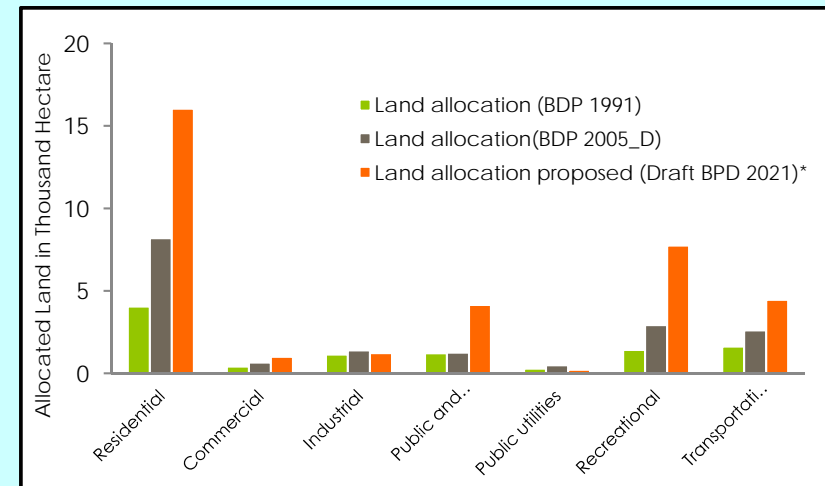
- Urban population has increased at an average decadal growth rate of over 70% in last 4 decades.
- The longer perspective and various estimates indicate that the city would grow around 4.5 million by 2035.
- No of Household would grow by three times



Estimates based on World Urbanization Prospects (Revised 2009) and UN mid term growth rates projections.

Land use change

- The development plan area has expanded as the density of many wards has reached to more than 400 persons/hectare.
- The residential sector has doubled in between 1991-2005 plan period.

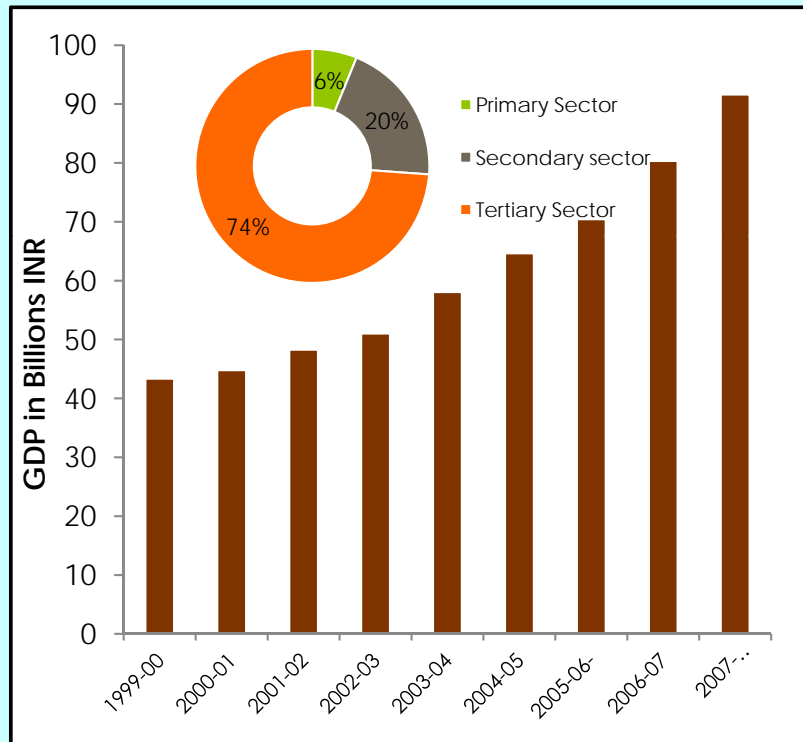


Source: Bhopal Development Plan 1991, Draft 2005, Draft 2021



Drivers of change

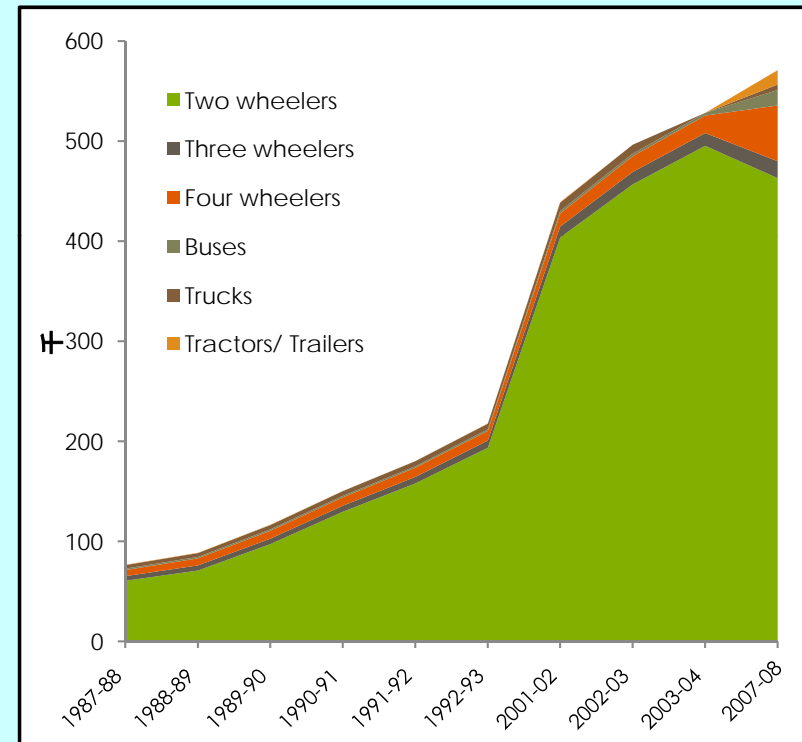
○ Growing district economy



Bhopal DGDP (at Current Prices) & Sectoral distribution

Source: District Development Report 2007-08, and Indicus District GDP 2005-06

○ Transport growth trends



No of Vehicles registered in Bhopal

Source: Road Transport Office (2006-07) Government of Madhya Pradesh



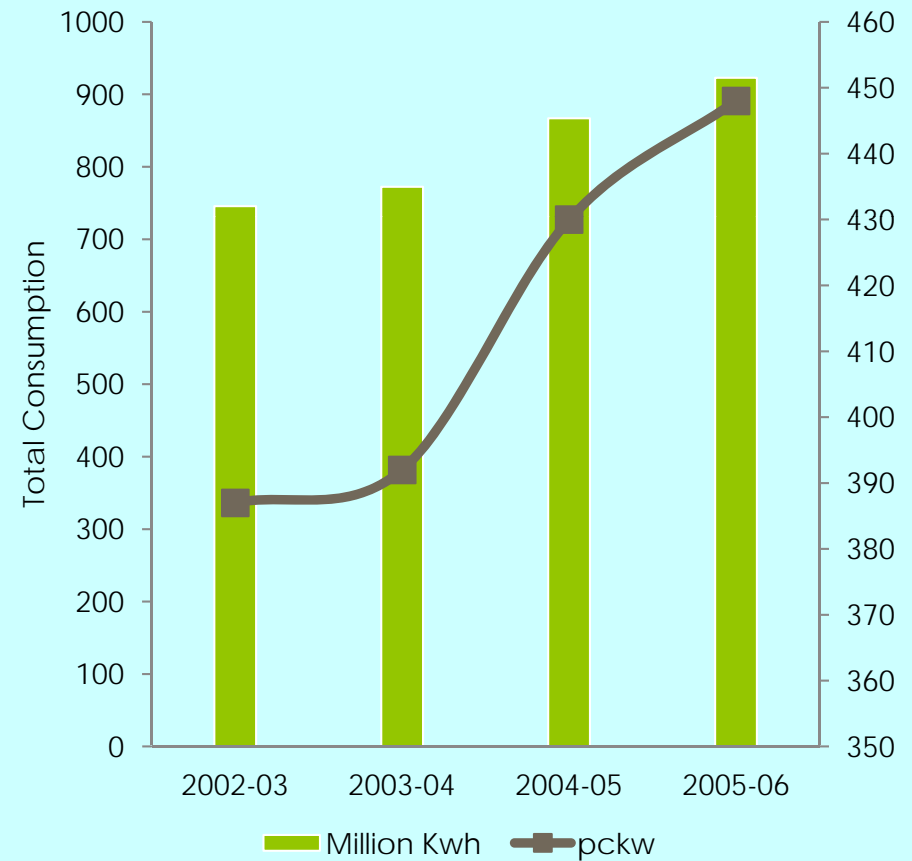
Energy Consumption Trends

- Fuel consumption is growing with rising human and vehicular population

Period	Petrol (Kilo lit)	Diesel (Kilo lit)	LPG (no. of cylinders)
2003-04	31300	38400	3608000
2004-05	33100	40900	3800000
2005-06	34900	42700	3903000

Source: Department of Civil Supplies, Government of M. P.

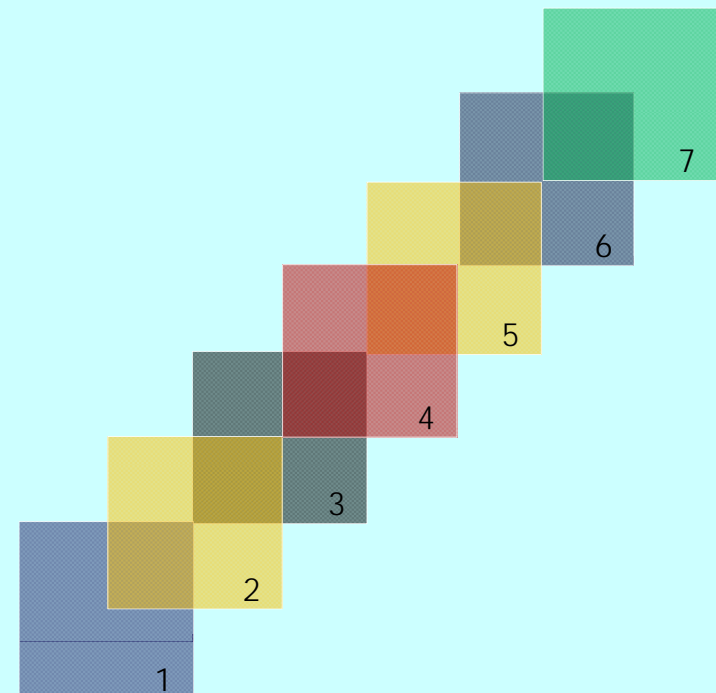
- Electricity Consumption rise



Source: District Development Report 2007-08,



LCS VISION, TIMELINE AND TARGET



The Bhopal LCS vision

To be a sustainable low carbon city in line with national policies

- Ready for future and resilient to change
- Conservation and green orient for quality of life
- Economic and social competitive clean and green industries
- Efficient transport system
- Community participation in city development

Timeline and Reduction Target

- **Time Horizon:** Year 2035
 - To align city development plans and policies with national and global targets
- **Reduction Target:**
 - 40% of 2035 BAU Emissions



Shopping and Residential Area



The Streets



The Scenarios

- **Business As Usual (BAU) scenario**
 - The present trend in Bhopal has been considered with existing technology and prevailing economic and demographic trends. The BAU scenario for future energy consumption and emissions projection in Bhopal envisages the continuum of present government policies, and capture forecast for various economic, demographic, land use and energy use indicators.
- **Low Carbon Society (LCS) scenario**
 - For analysing the possibilities of reducing the GHG emissions in future, a sustainable development future scenario is drawn here for Bhopal, that is expected to take it towards **Low Carbon Society**. The energy consumption trajectory / emissions trajectory are drawn in all the sectors of Bhopal that would result from aggressive policies to promote demand side management, energy efficiency, development of renewable energy, and other policies to promote sustainable development .



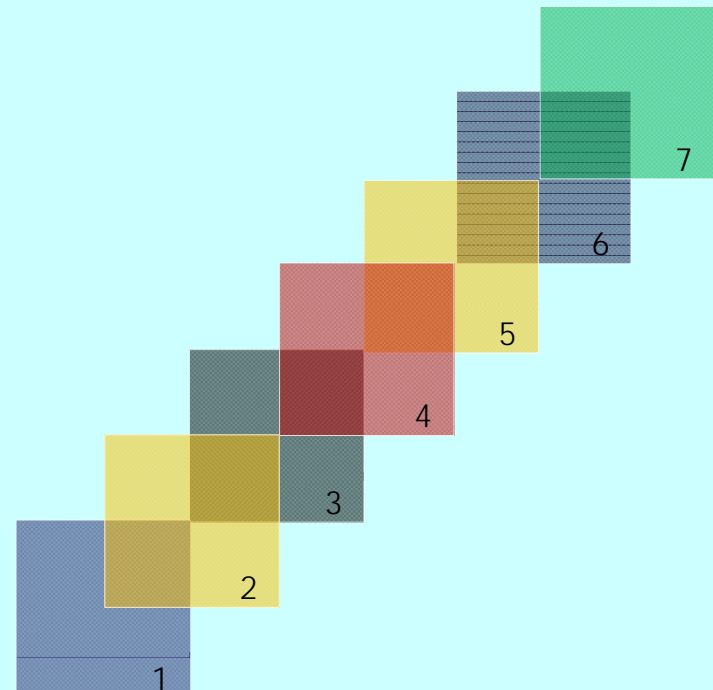
Socio Economic Assumptions and Energy, Emission estimates

AIM/ExSS Model Output

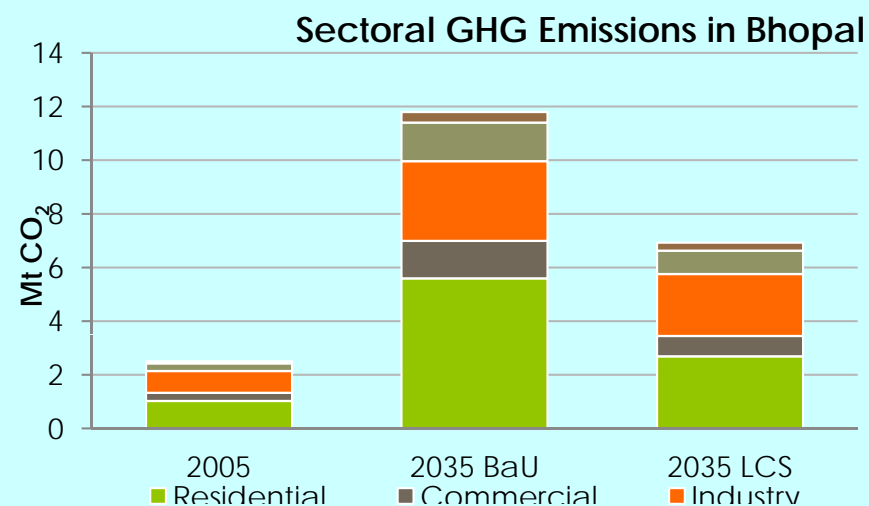
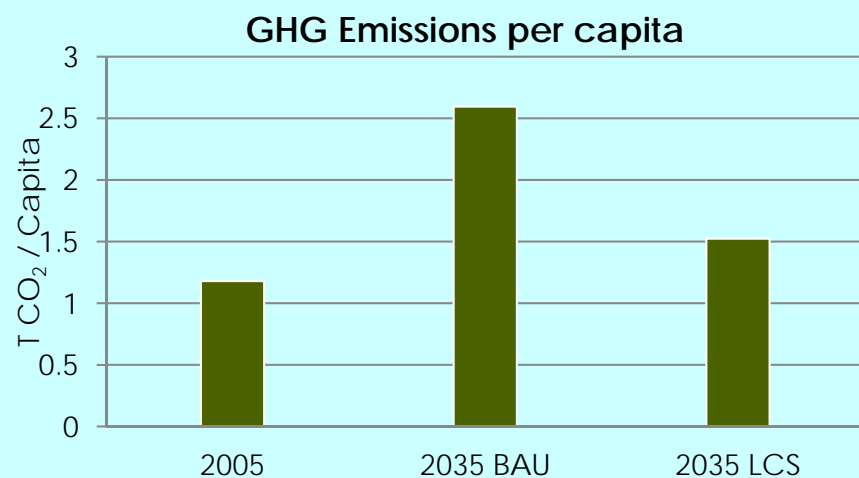
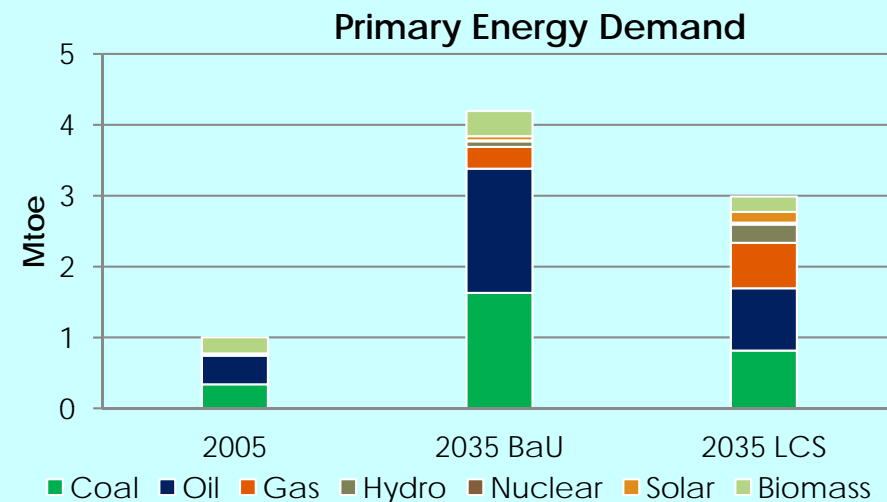
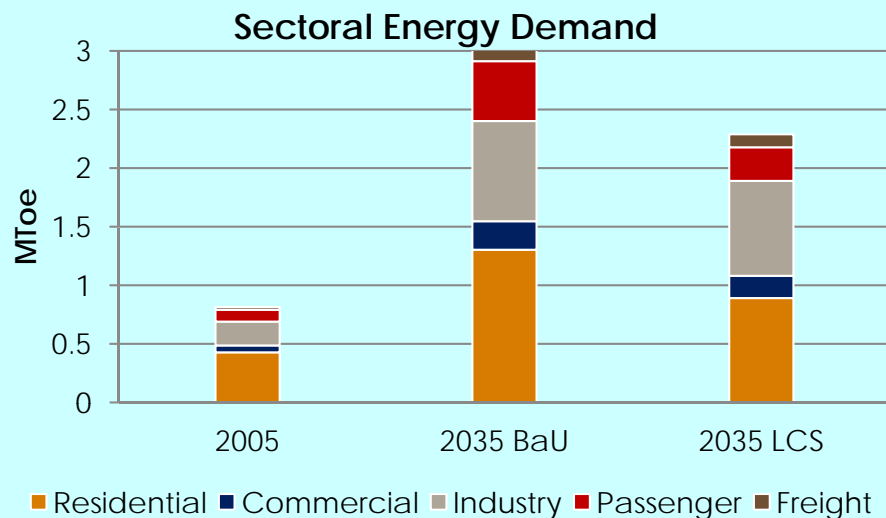
Socio Economic Assumptions	2005 (Base)	2035 (BAU)
Population	2121617	4546081 ^{2.6%}
Household	385970	1136406 ^{3.7%}
GDP in Billion INR	70	383 ^{5.8%}
Commercial Floor Area (in Sq Km)	61	344
Passenger Transport (MPKkm)	5204	24742
Freight Transport (MTKkm)	617	3591
Energy Demand (Ktoe)	815	3044
CO2 Emissions (KtC)	683	3217



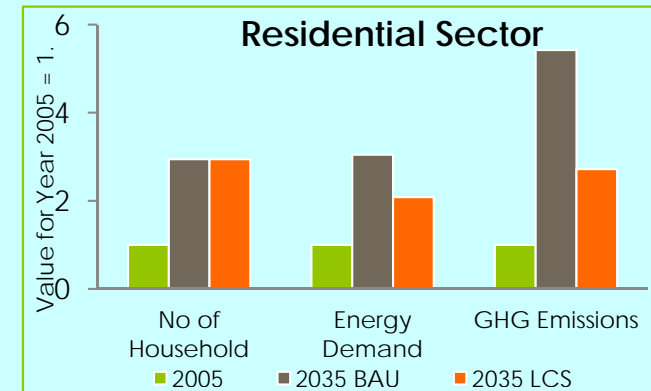
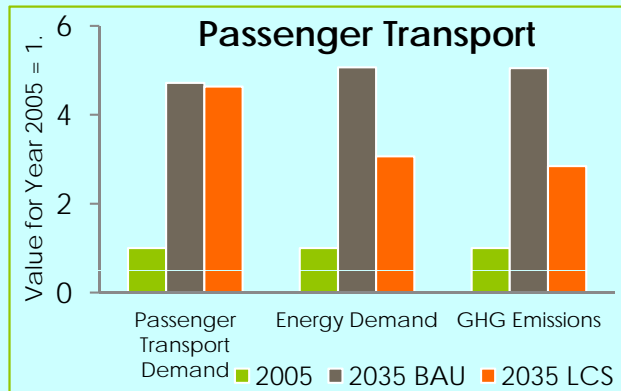
SIMULATION RESULTS AND ANALYSIS



Energy Demand and GHG Emission

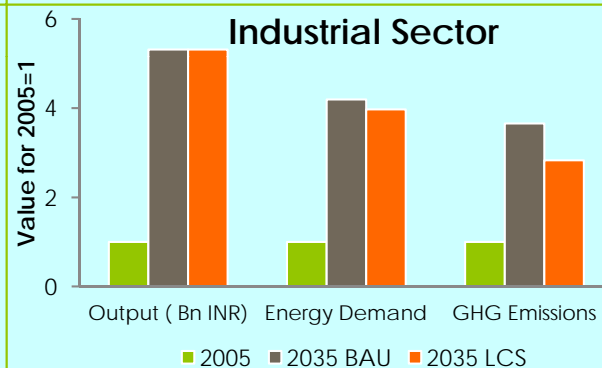


Sector wise Mitigation Contribution



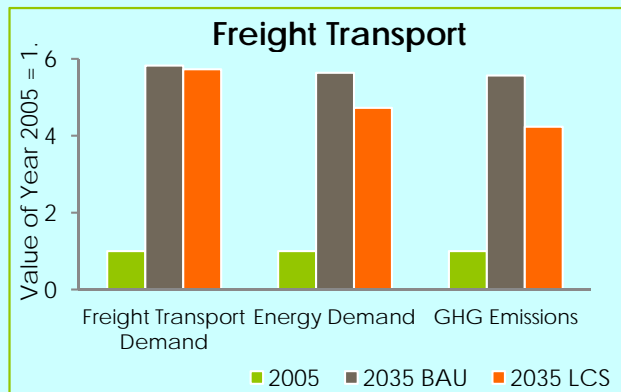
Transport Sector

- Technology Efficiency Improvements
- Fuel Switch
- Improved Traffic Management
- Shift to Public Transport & I
- Implementing Integrated Transport Management System



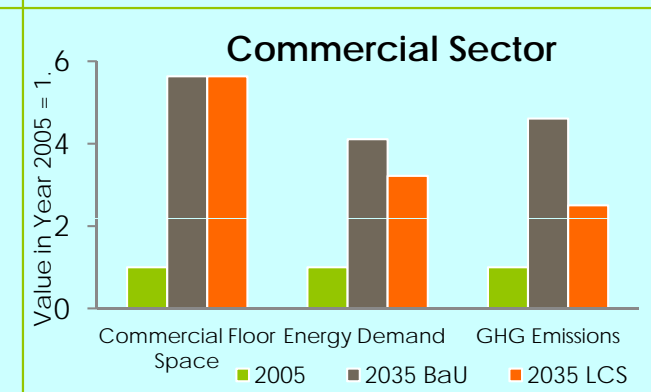
Residential & Commercial Sectors

- Efficiency Improvements in End Use Devices
- Fuel Switch
- Behavioral Changes
- New Technology Adoption & Retrofitting
- Improved Material Efficiency in Buildings
- Change in the Nature of Power Supply



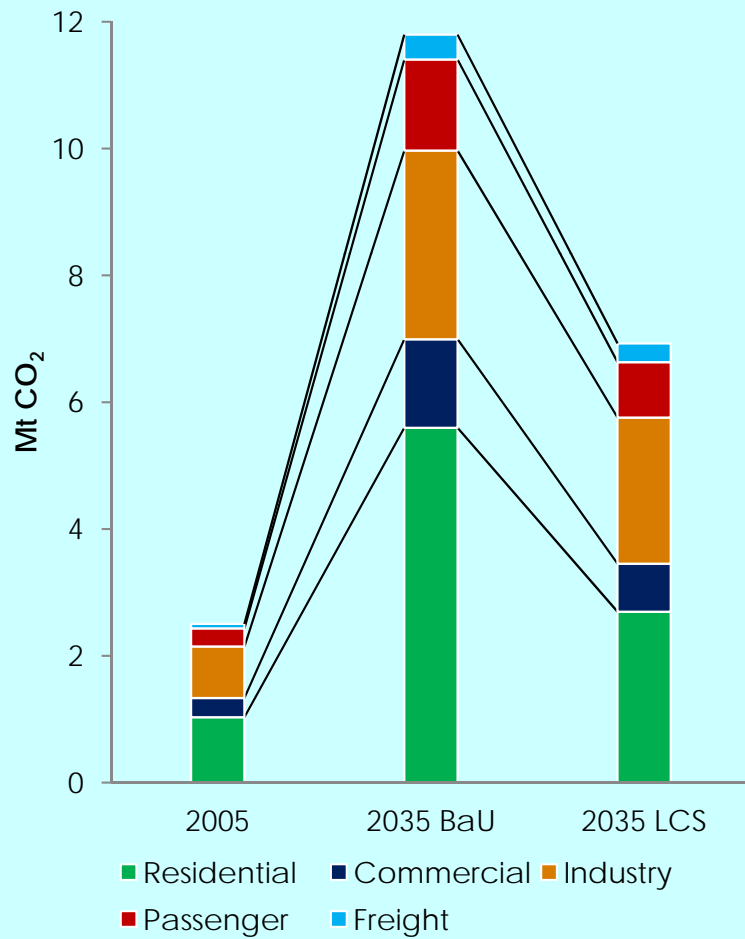
Industrial Sector

- Technology Efficiency Improvements
- Fuel Switch

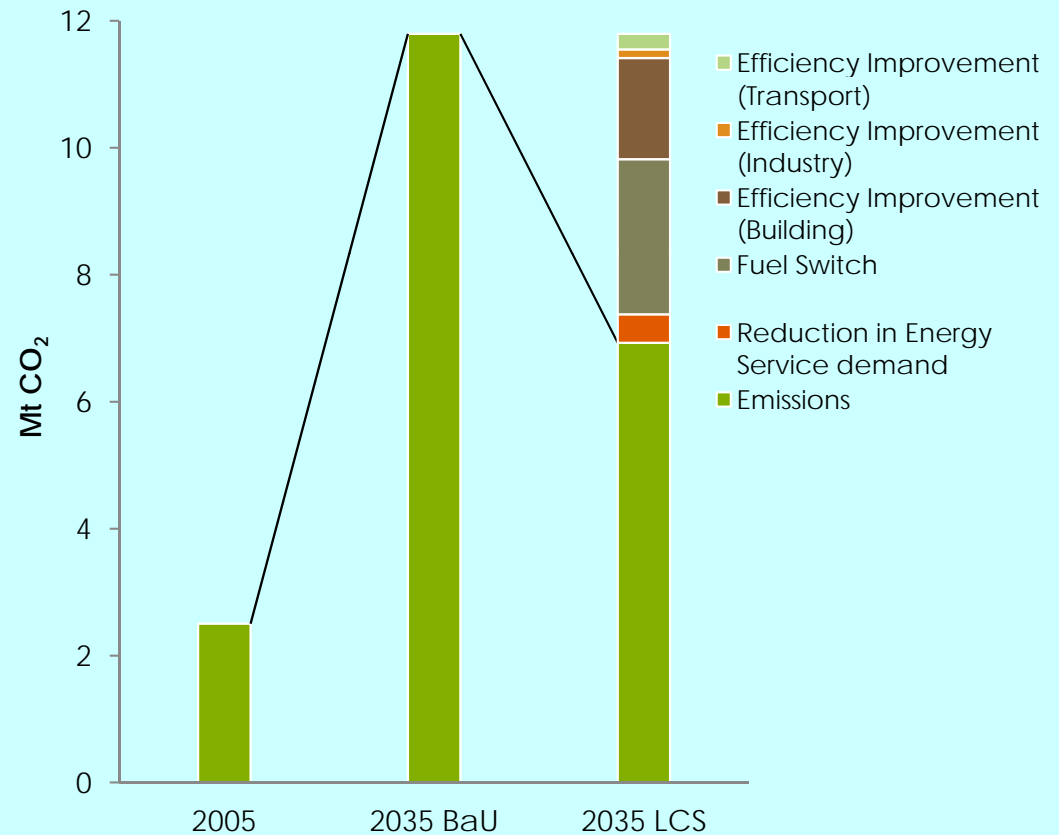


GHG Emission Scenario and Mitigation Contribution

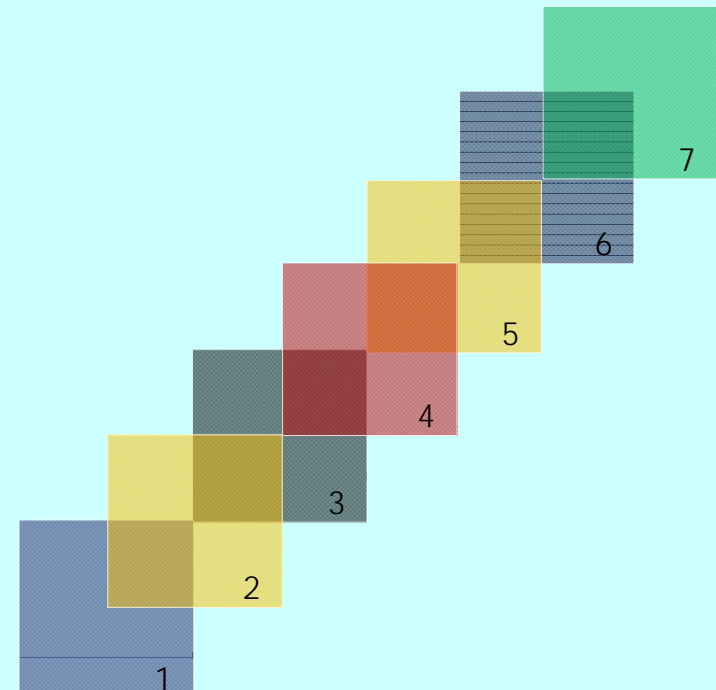
GHG Emissions Scenario



Mitigation Contribution



LCS ACTIONS AND STRATEGY FORMULATION



Policy challenges

❑ Residential and Commercial Sector

- fuel use varies from wood, biomass, charcoal to kerosene, electricity and LPG depending on the income level.
- use of inefficient fuel and technologies is the primary cause for high GHG and local emissions.
- lower rate of conversion to new technologies, as the alternative inefficient fuel is freely and easily available and low preference for energy efficient technologies over consumer durables.
- Inefficient building designs.

❑ Transport Sector

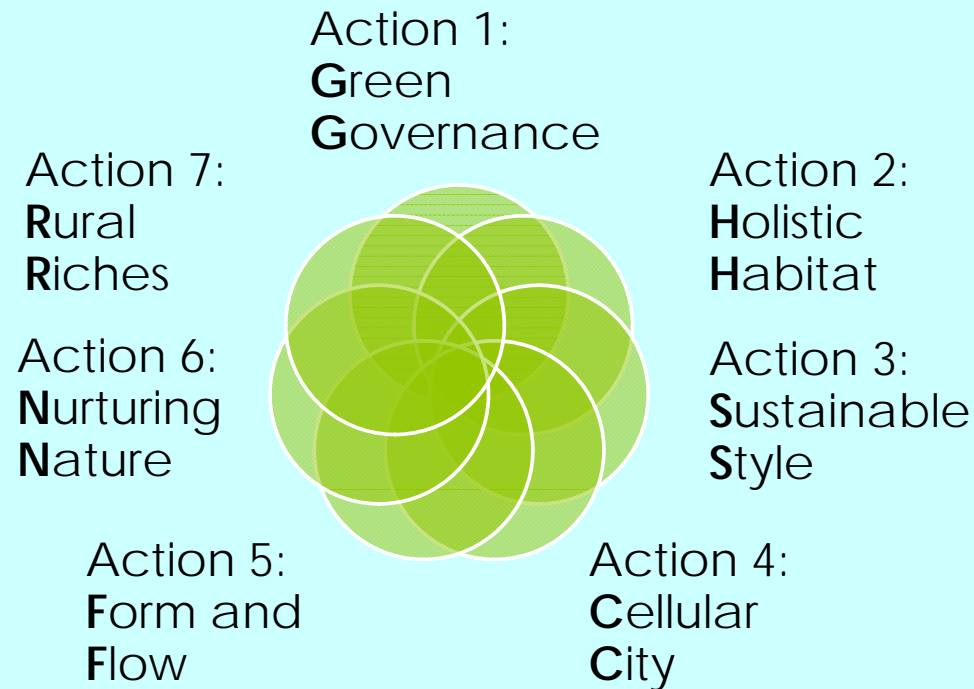
- limited network of roads
- high traffic density
- increasing number of private vehicles
- inadequate provisions for non motorized transport

❑ Industrial Sector

- large share of unorganised industrial activities
- use of inefficient fuel and technologies
- low rate of conversion to new technologies



Bhopal LCS: Seven Actions Concept



		SECTORAL CONTRIBUTION				
	ACTIONS	Residential	Commercial	Industry	Passenger Transport	Freight Transport
1	GREEN GOVERNANCE					
2	HOLISTIC HABITAT					
3	SUSTAINABLE STYLE					
4	CELLULAR CITY					
5	FORM AND FLOW					
6	NURTURING NATURE					
7	RURAL RICHES					

Next is...Developing Road Map for LCS Actions for Bhopal

Barriers to LCS Pathways

- No common generalized policies can be developed, Individual solutions are needed for each of the city
- Success depends on the participation of local government / people
- Almost no awareness in smaller cities
- Capacity building is slow and time taking
- Good quality infrastructure and services are almost always necessary that are already stressed
- Development priorities may not be in line with LCS objectives
- Economic implications are not easy to anticipate





Thanks.



mkapshe@gmail.com

For more information on LCS please visit <http://2050.nies.go.jp>

Session Summary

- **1. Low Carbon Cities**

- Why this session theme is important to realize low carbon development in Asia?
- What is the implication of this theme to low carbon development policy in Asia?
- How common is the theme throughout the region?

- **2. Major findings:**

- What are the major findings from the presentation / discussion?
- How are the state-of-the art areas in this research field?
- What kind of methodologies are useful for promoting research/ policy?
- What are the major barriers in research/applying research to low carbon development policy?

- **3. Research challenge:**

- What are the frontiers that the research community should tackle now to move forward with the policy?
- What are the key data/ research item to apply research to real low carbon policy?
- How can the research community collaborate to take further steps ?

- **4. Collaboration:**

- What kinds of collaboration (with other organizations / business/ government) is needed to make it happen?

- **5. Conclusion**

