Bhopal LCS Scenario: Expected Outcomes

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Agenda

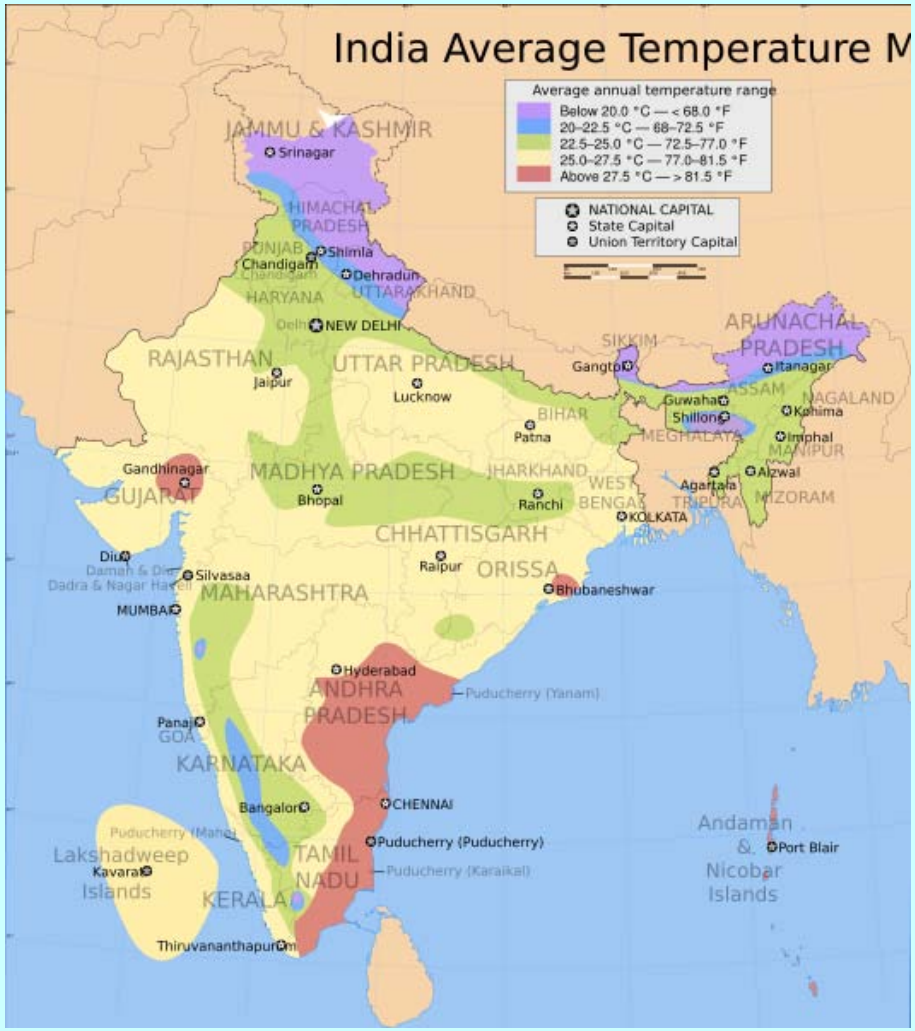
- Indian Cities: Characteristics
- Regional Variability
- Bhopal Case Study
  - Drivers of Change
  - BAU Results
  - Building Sector
- LCS Actions
- Future Work

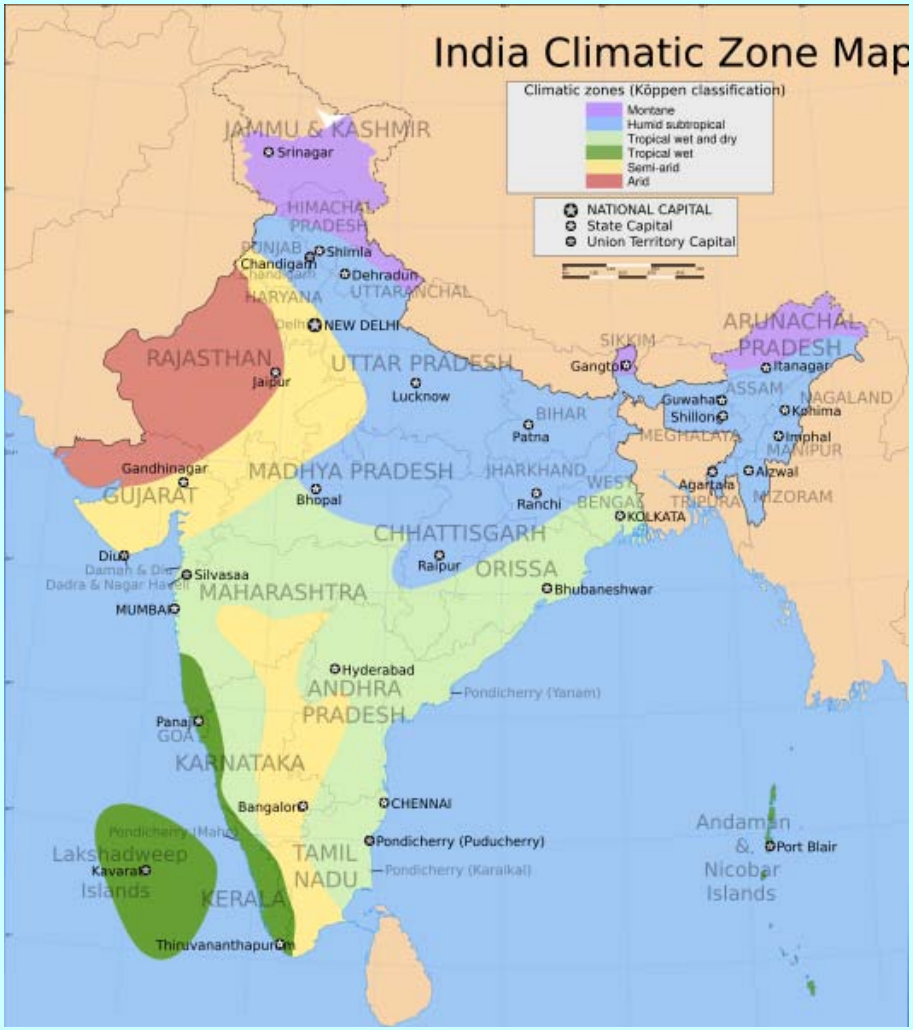
Indian Towns and their Population (2001)

Class	Population Range	No of Towns	% of towns	Population (million)	% Population
I	≥ 100,000	423	8.20	172.044	61.48
II	50,000 to 99,999	498	9.65	34.431	12.30
III	20,000 to 49,999	1386	26.86	41.974	15.00
IV	10,000 to 19,999	1560	30.23	22.603	8.08
V	5,000 to 9,999	1057	20.48	7.983	2.85
VI	< 5,000	237	4.59	0.801	0.29
	All Classes (I -VI)	**5,161**	**100.00**	**279.837**	**100.00**

- India has 5,161 towns out of which 27 are metropolitan cities, 423 are class- I, 498 are class –II, and the rest are 4240 below 50,000.(2001 Census)
- Slow growth of population in smaller towns and fast urbanisation in larger cities
- Large cities are provider of major services and smaller towns are centres of development for surrounding rural area
- Towns are close to rural agriculture economy and cities are modernising faster
- IT revolution has been a major influencing factor in recent years

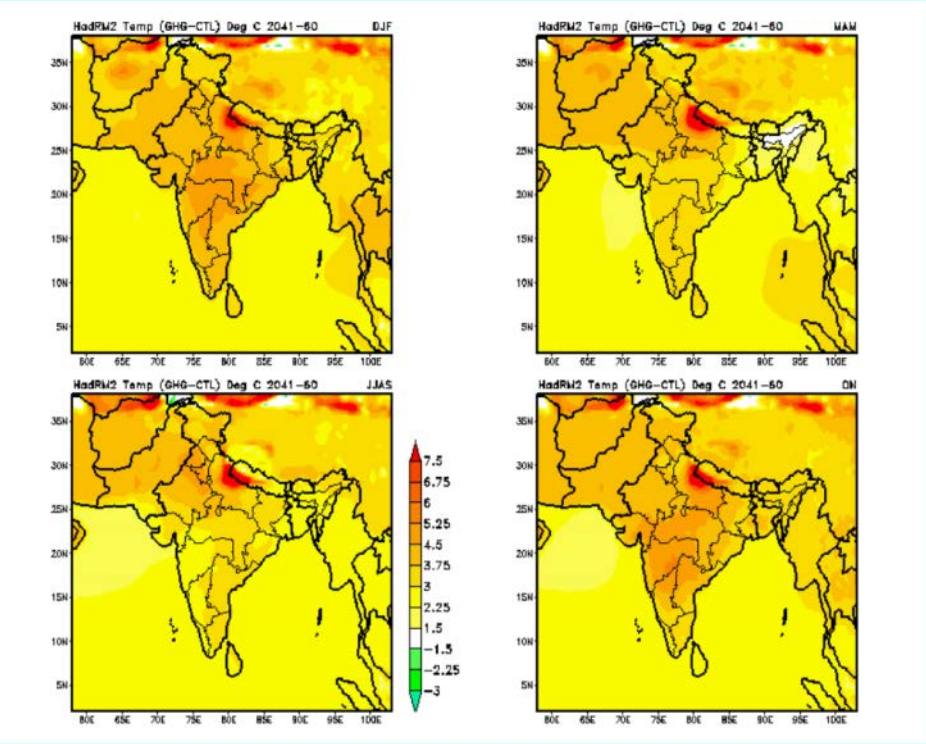
Regional Variability: Geographic Factors

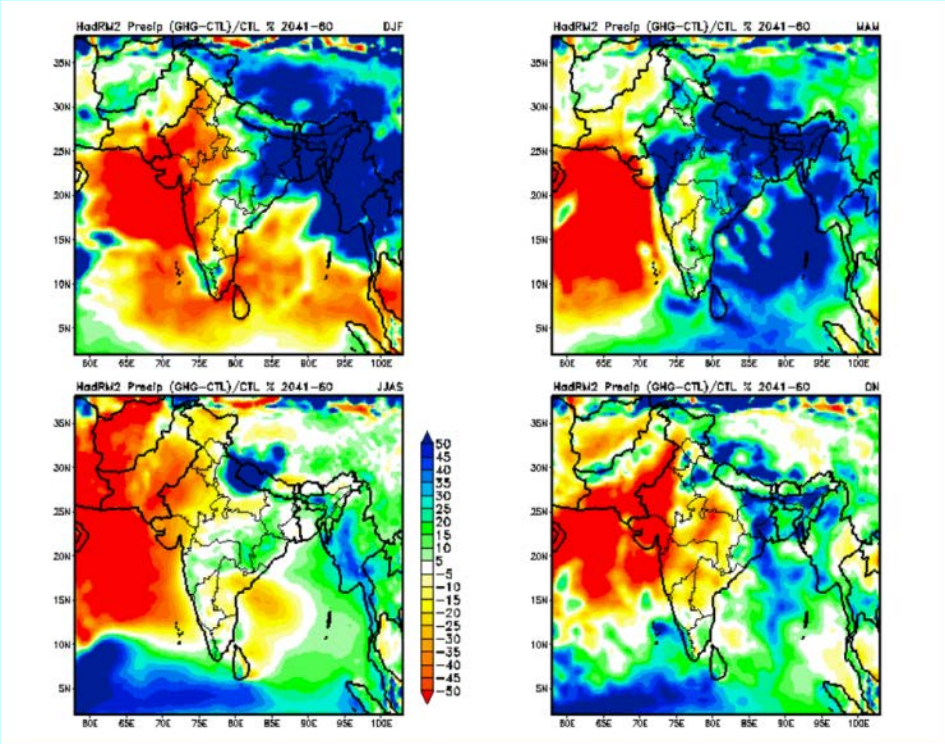




http://upload.wikimedia.org/wikipedia/commons/8/88/India_climatic_zone_map_en.svg

Projected Changes in Temperature and Precipitation

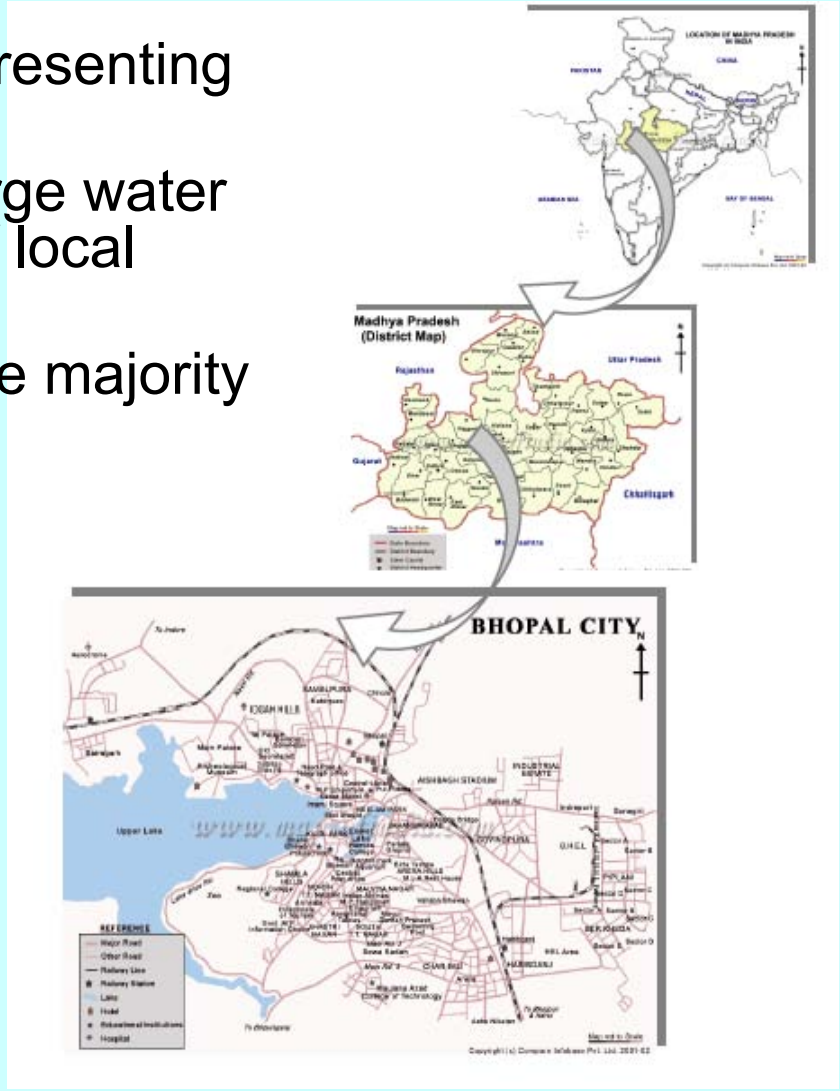




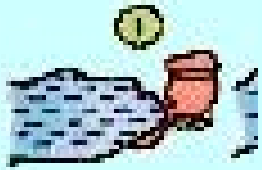
Projections of seasonal precipitation for the period 2041-60, based on the regional climate model HadRM2
Source: India NATCOM

Case Study City: Bhopal

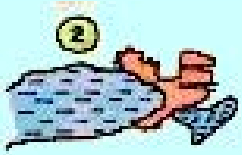
- The city is centrally located
- The climate is composite climate representing a large part of the country.
- The city has physical features like large water body, Hills and forests for analysis of local variations.
- A million plus city, it can represent the majority of Indian cities.
- Availability of data



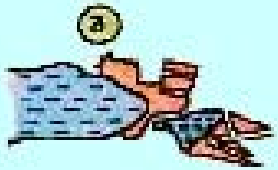
Bhopal: Chronological Development



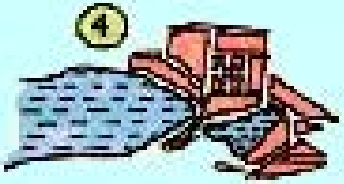
1010 - 1200 AD



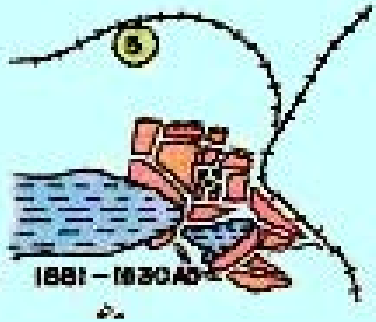
1201 - 1800 AD



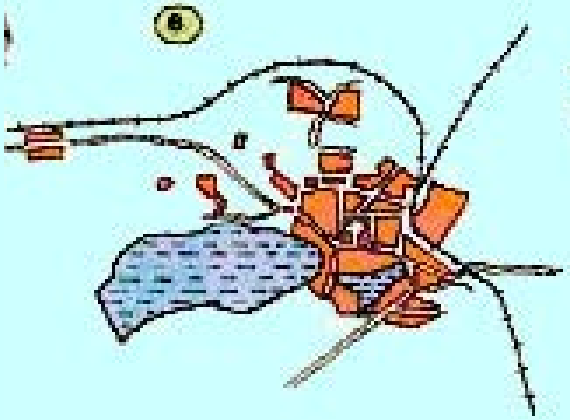
1801 - 1850 AD



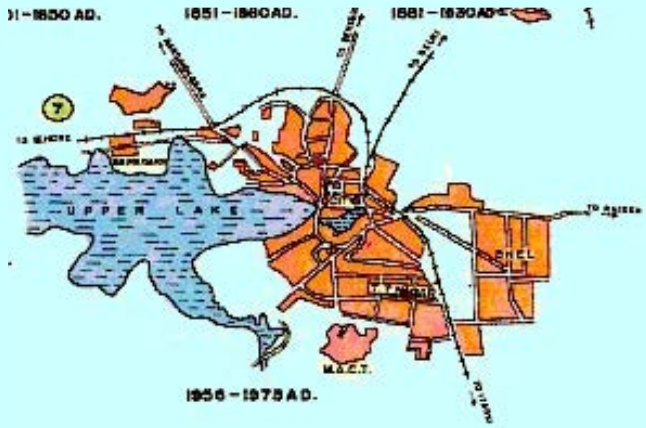
1851 - 1880 AD



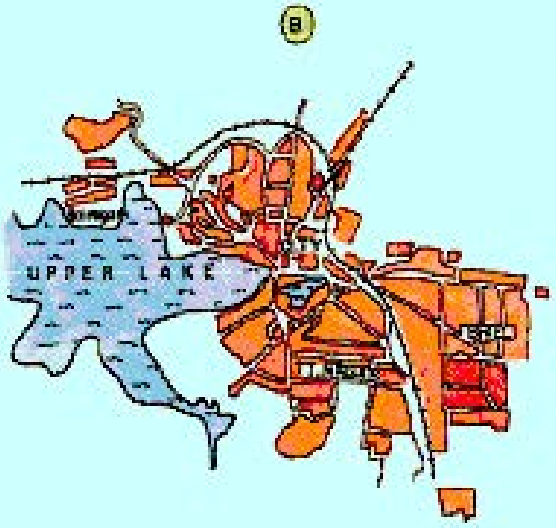
1881 - 1930 AD



1931 - 1955 AD

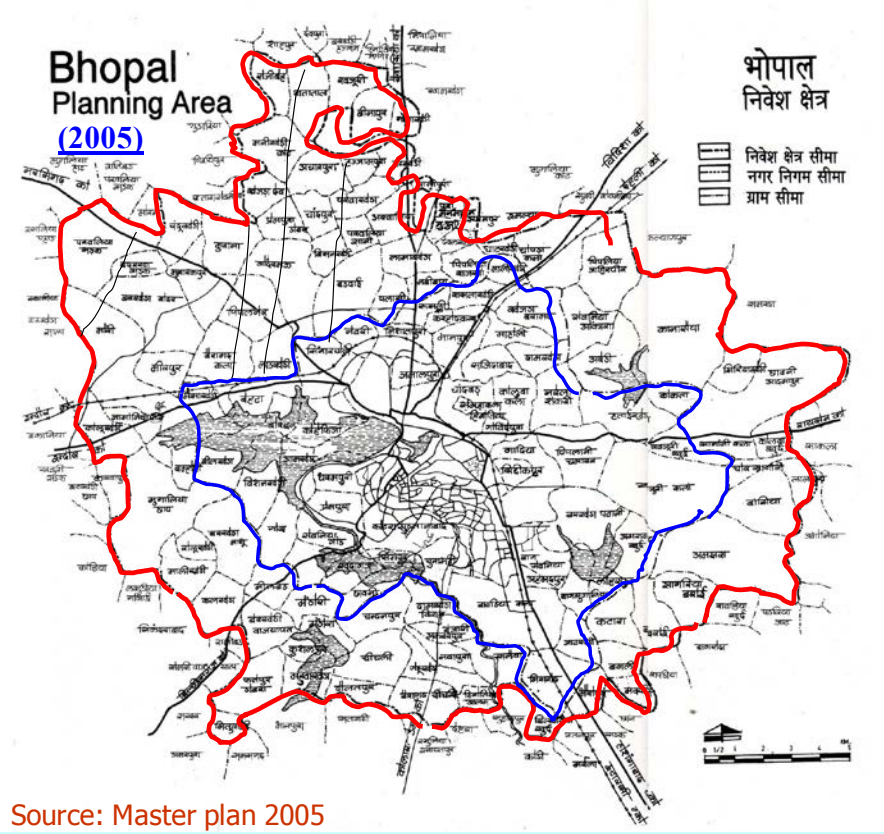


1956 - 1973 AD

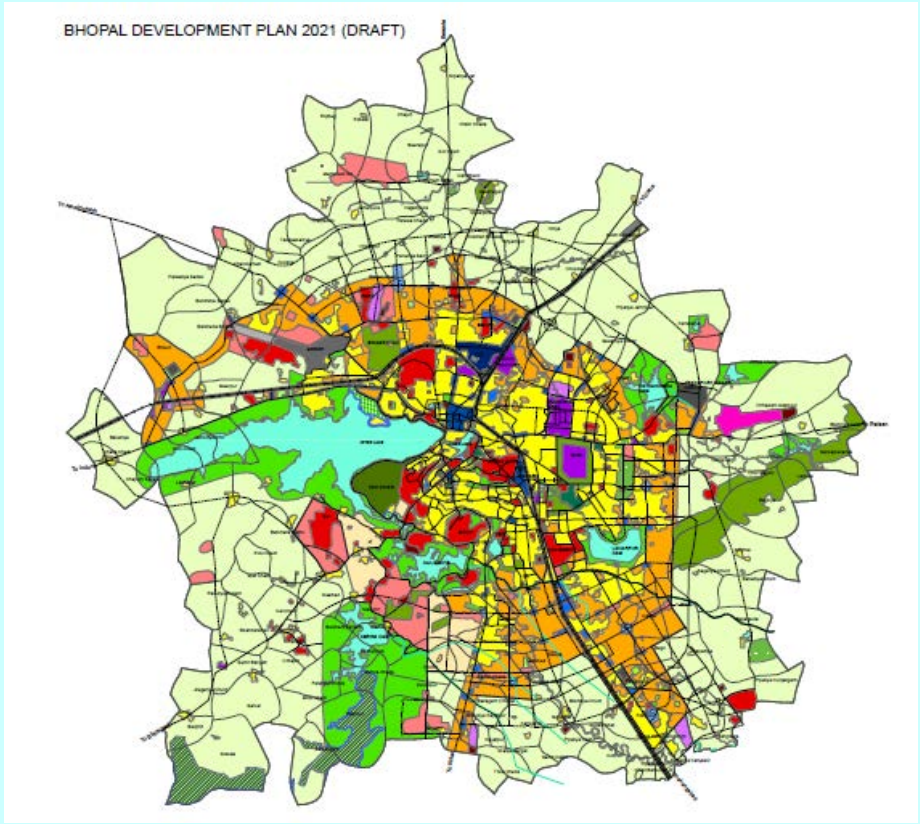


1974- 2000 AD

Landuse 2021

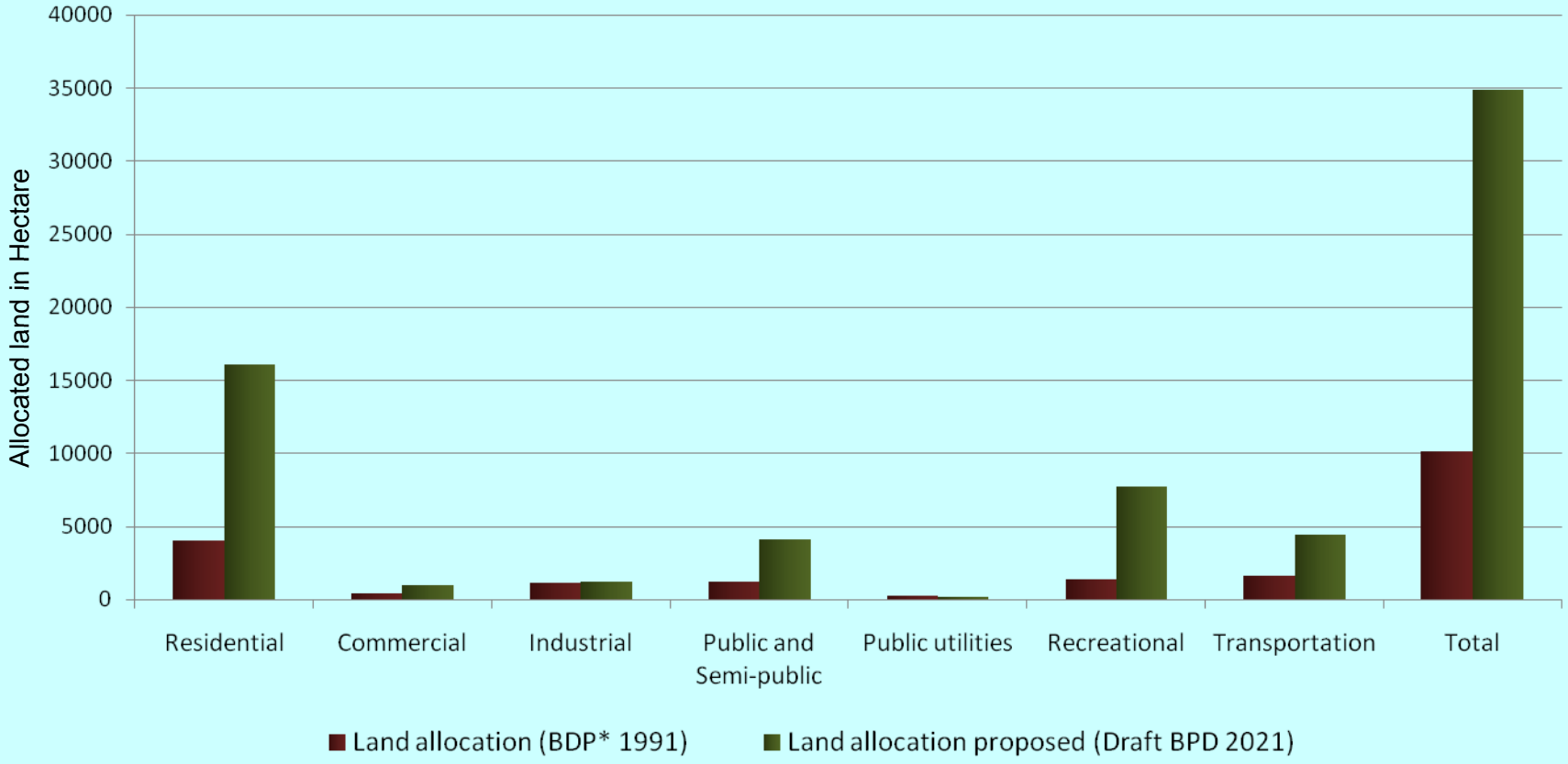


Source: Master plan 2005



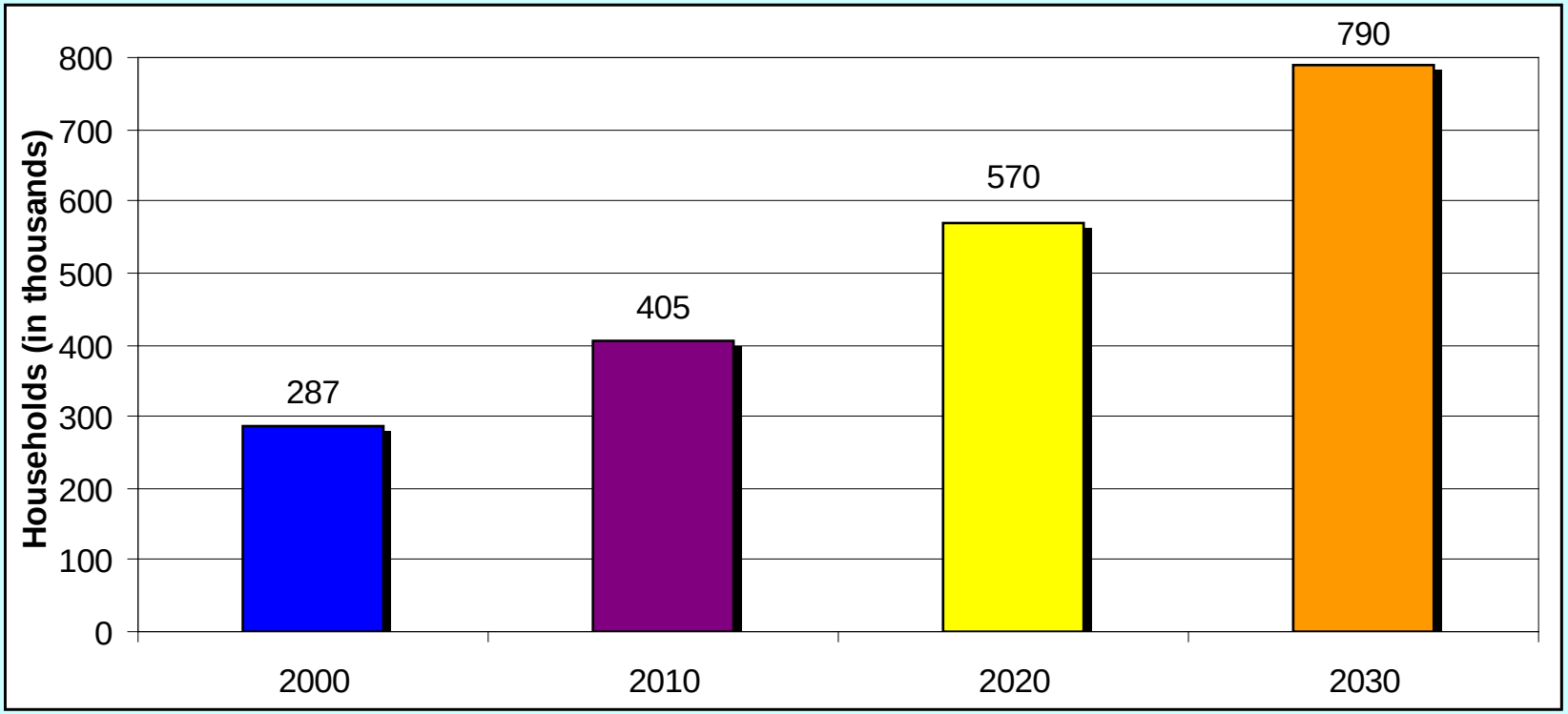
Drivers of change

- Land-use change
  - The development plan area has expanded as the density of many wards is likely to grow above 400 households/hectare
  - The residential area is likely to expand more than three times with rise in population.



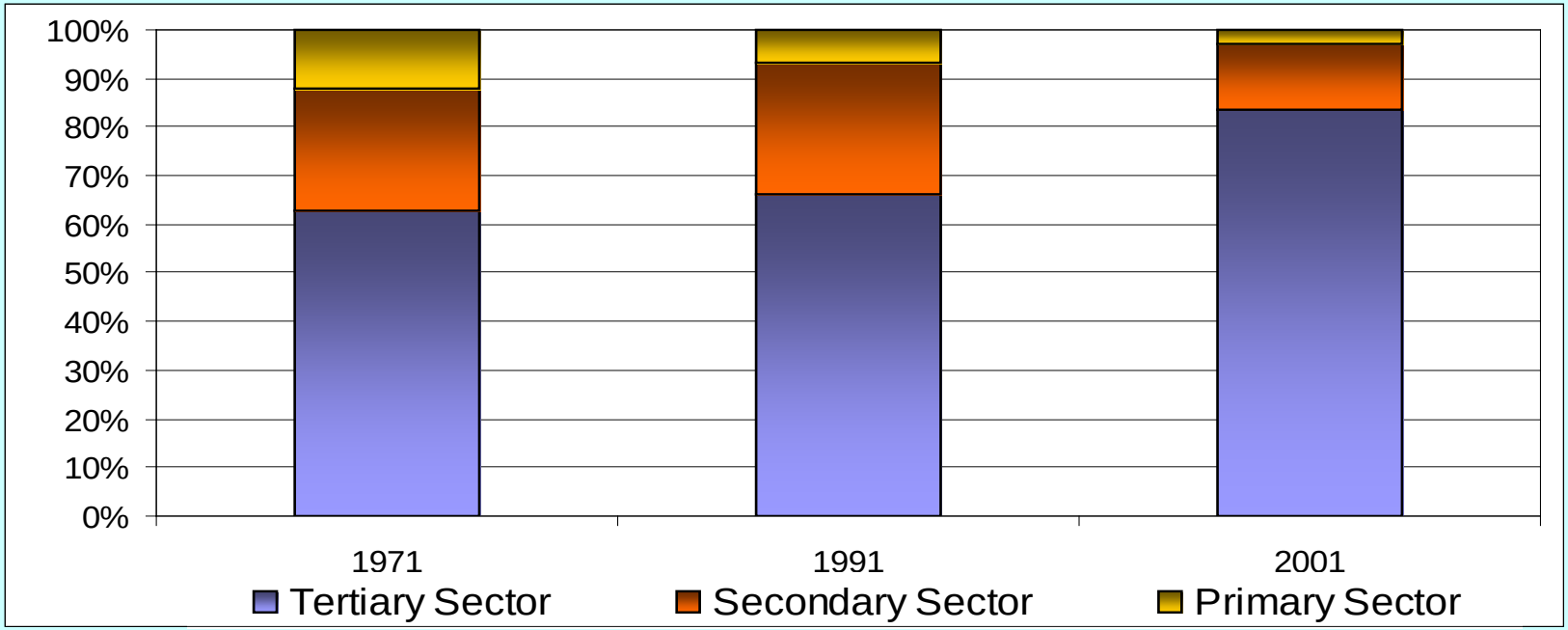
Drivers of change

- Population growth
  - The longer perspective and various estimates indicate that the city would grow around 3.5 million by 2021.



Drivers of change

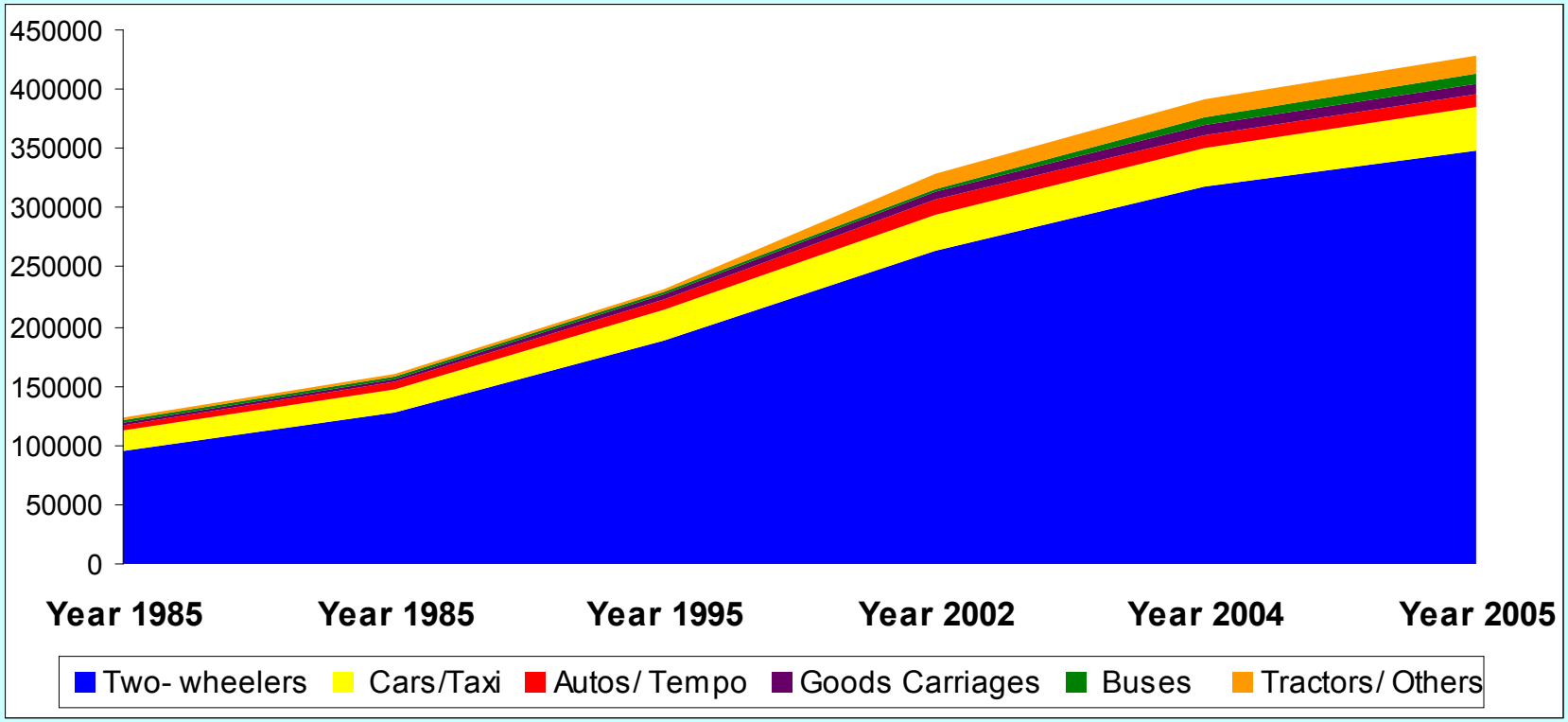
- Changing occupational pattern
  - The occupation in tertiary sector has grown from 64% in 1971 to 87% 2001.
  - The distribution of workers in secondary sector has moved up from 33% to 36% in 1991 which saw steep decline to 15% in 2001.



Source: NRS, 2002

Drivers of change

- Vehicular growth in two decades
  - In last two decades the total motor vehicles have grown more than three times.
  - Two wheelers registered growth from 79% in 1987-88 to 94% in 2003-04.



Source: Road Transport Office, Bhopal, Ministry of Road Transport, Government of Madhya Pradesh

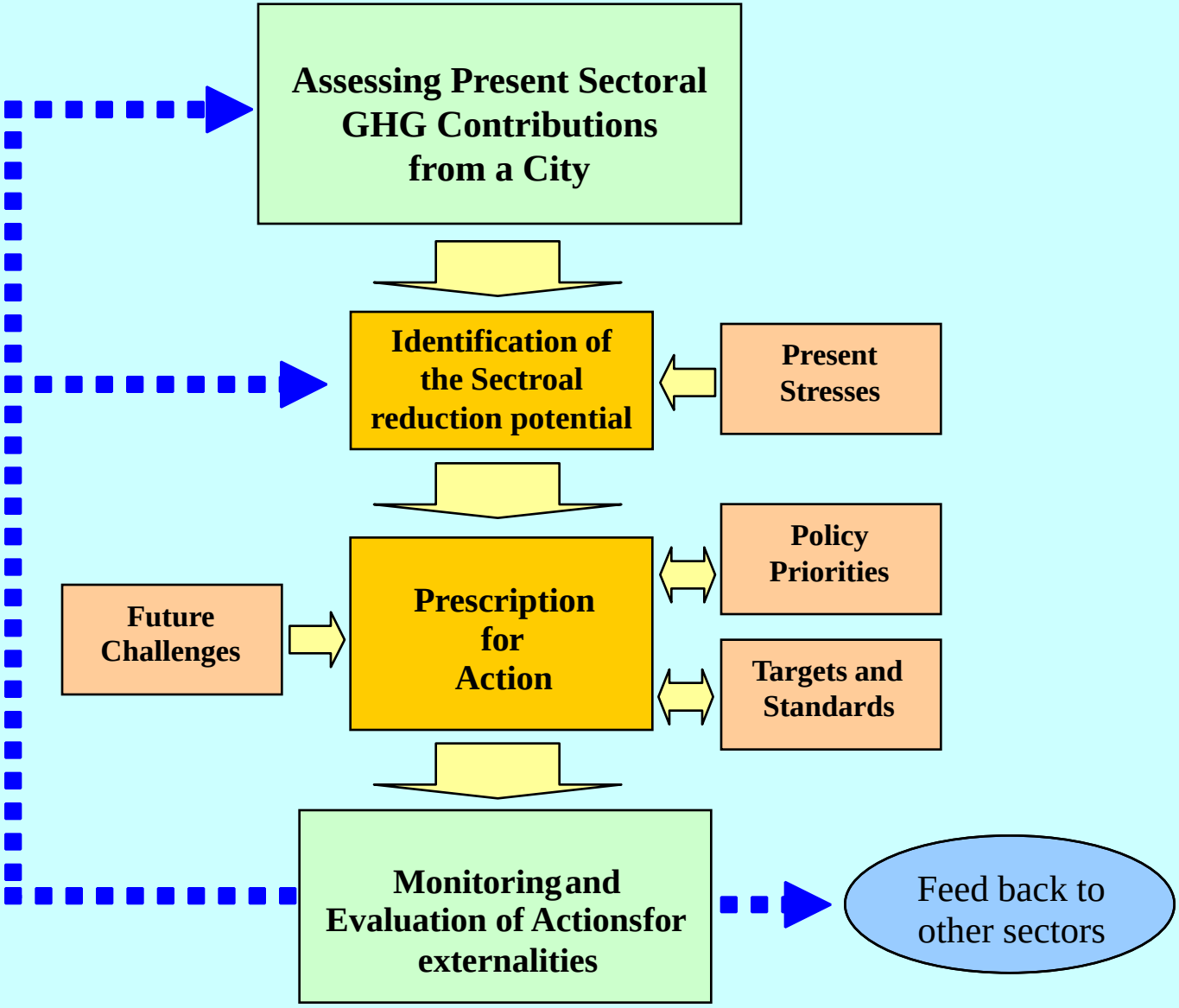
Drivers of Change

- 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.

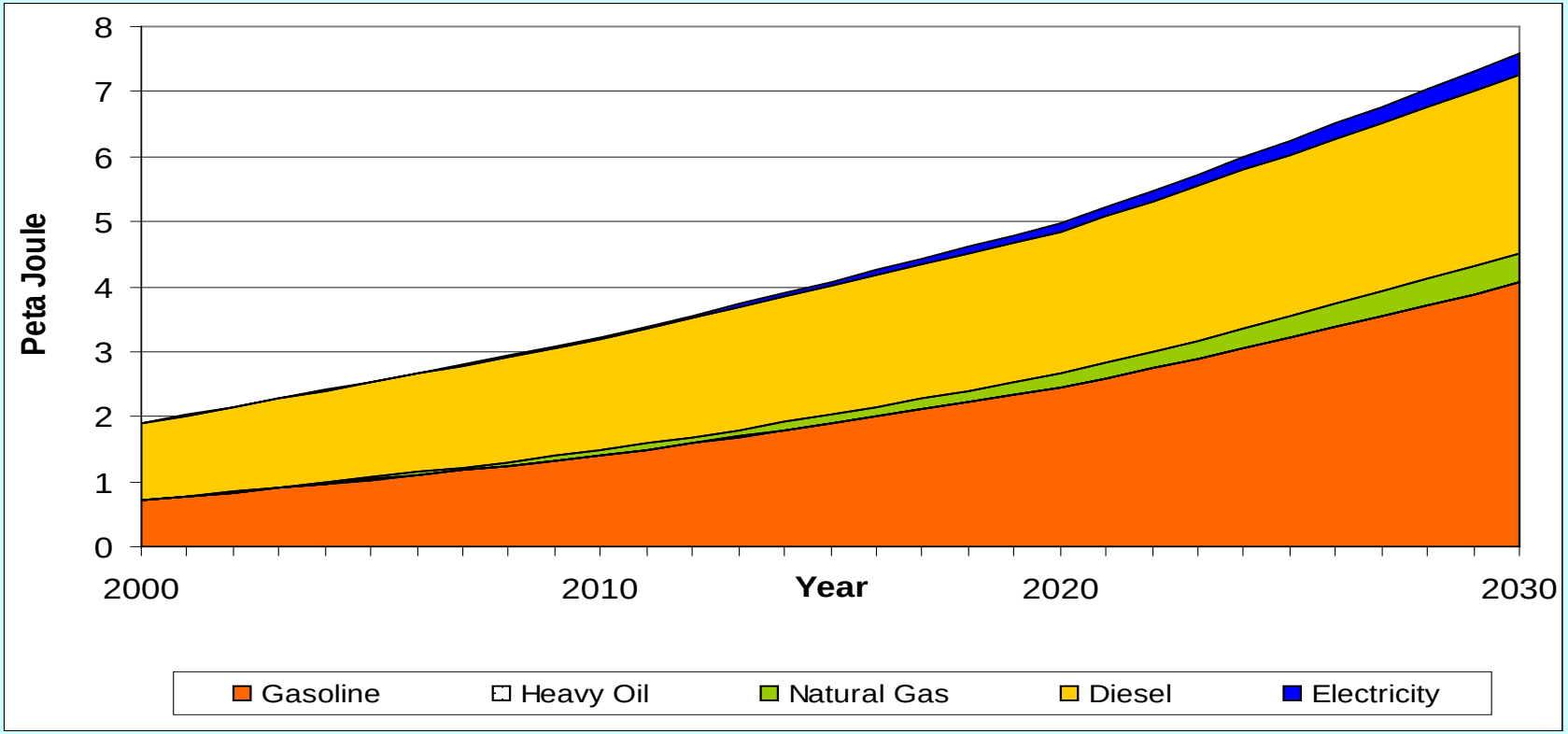
Generic Process for LCS Actions



The Scenarios

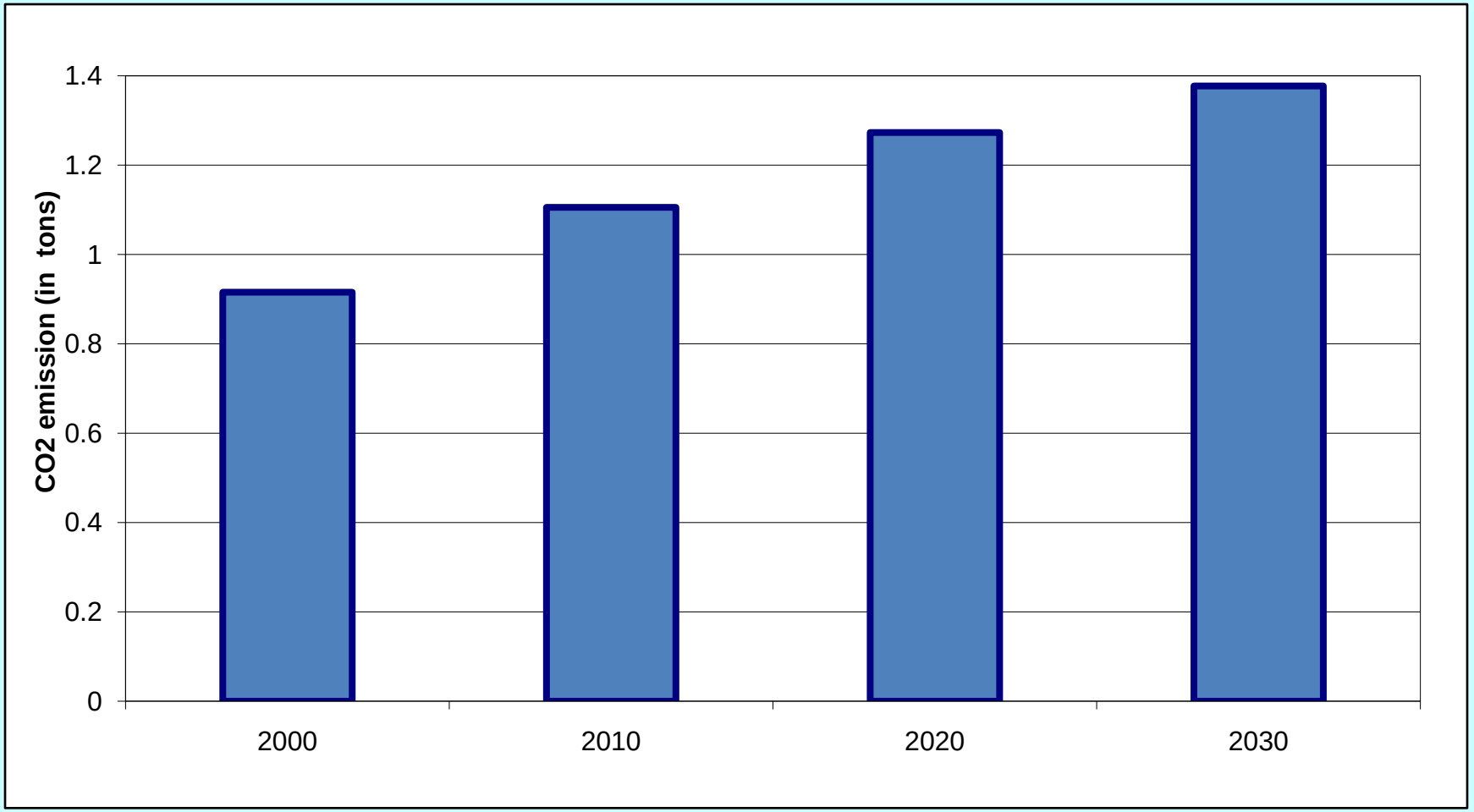
- Business As Usual (BAU) scenario
  - The present trend in Bhopal city has been considered with existing technology in both residential and transport sector with prevailing economic and demographic trends. The BAU scenario for future energy consumption and emissions projection in Bhopal city envisages 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 city that is expected take it towards ***Low Carbon Society***. the energy consumption trajectory / emissions trajectory in residential and transport sector in 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

BAU: Fuel mix in Transport sector



- Total fuel consumption grows by 4 times
- Petrol and Diesel together constitute 90% of the fuel mix Yr 2000
- Share of petrol (Gasoline) in transport fuel mix is likely to grow

BAU: Per Capita Carbon Emissions



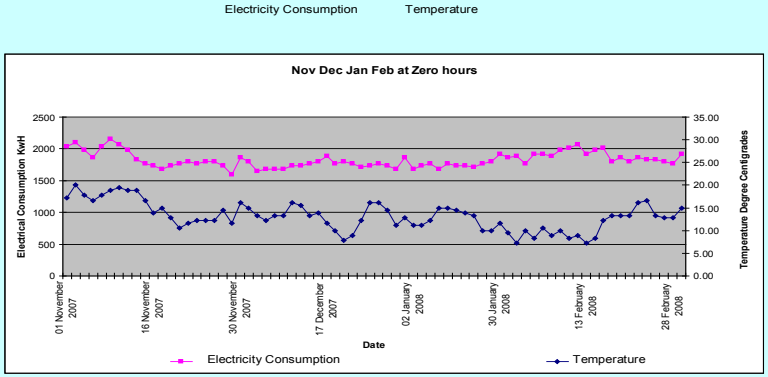
Building Sector Studies

- Assumptions
  - The energy consumption in built environment is primarily a function of “Cooling” and “Heating” needs
  - Case Study Approach provides opportunity to study local variations and developing suitable actions
  - Building Design: Form (shape), Orientation, Materials and Technology play an important role
- Temperature change and electricity demand
  - Temperature data of the city analyzed for one year period
  - Seasonal variations in electricity consumption identified
  - Hourly temperature data and electricity consumption compared and analyzed
- Simulation
  - Double storey building considered with select parameters
  - Six alternate configurations analysed
  - Software used for simulating the building.

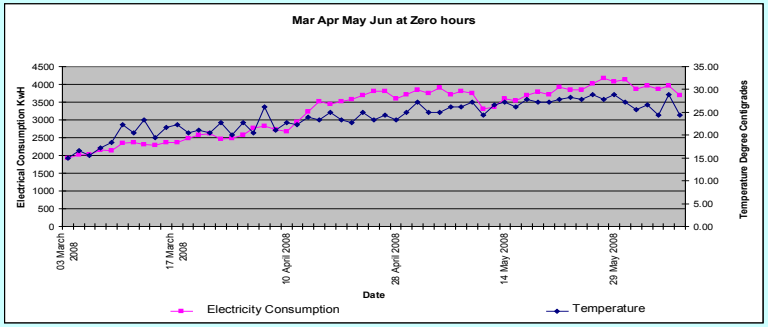
Emerging Findings: Temperature Effect

- Electricity consumption in buildings is dependent on many factors.
- It is necessary to eliminate the effects of other influences to bring out the effect of temperature.
- Marked seasonality and periodicity in electricity demand
- Electricity consumption well correlated with temperature change
- The correlation is more prominent during night hours
- CDD and HDD analysis more useful

July-Aug-Sept-Oct



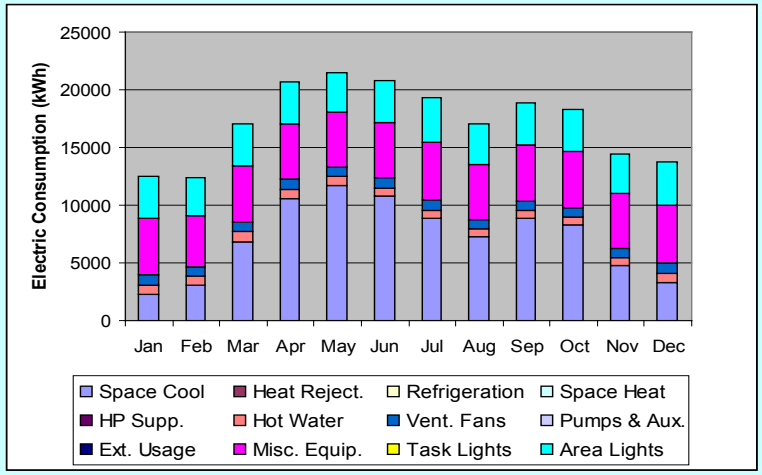
Nov-Dec-Jan-Feb



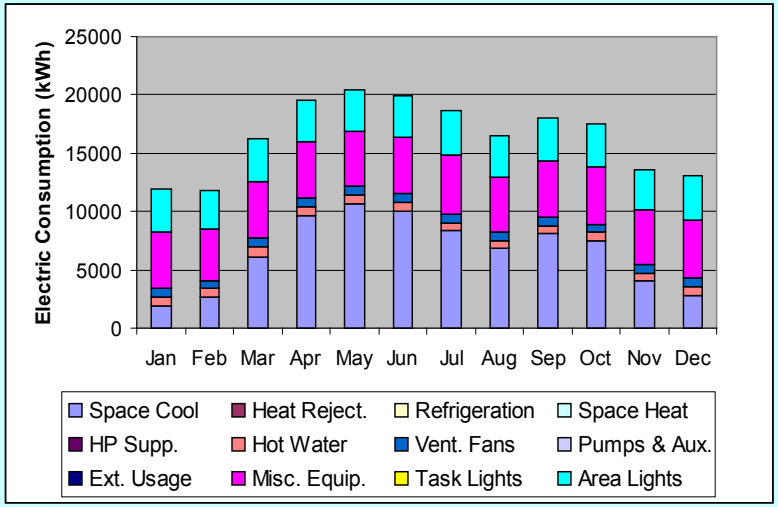
March-Apr-May-June

Emerging Findings: Simulation

- Building with longer axis north-south consumes the highest energy
- The most efficient orientation is obtained when longer axis is north-east to south-west
- Energy consumption well correlated with temperature change
- Highest energy consumption in summer months
- Space cooling requires maximum amount of energy
- Suitable construction material or provision of adequate insulating material may further reduce energy consumption



Longer axis north-south



Longer axis north-east to south-west

Actions: Residential Sector

- ***Shading***
  - By planting shade trees outside west or east-facing windows
  - Install exterior shade screens with thicker weave.
- ***Lighting efficiency***
  - Use of Compact fluorescent lamps use 25% to 33% less electricity as a comparable incandescent bulb and last 9 to 12 times longer.
  - *Solar energy systems like* solar recharging units for backup and outdoors
- ***Hot water efficiency***
  - Use of solar water heating systems in residential areas
- ***Improved Refrigeration and other energy efficient appliances***
  - Using improved and high efficiency innovative appliances
- ***Demand-side management programmes***
  - electric and gas companies have used programmes to reduce demand for energy and consequently save on the cost of supplying energy.

Actions: Residential Sector

- ***Energy audit programmes***
  - Conducting energy audits to evaluate the most cost effective improvements.
- ***Fiscal Incentives***
  - Loan, grants, and incentives programmes for energy conservation measures
- ***Energy code for New buildings***
  - Encourage or require increased installation of efficient lighting systems
  - Requirement of more efficient heating and cooling systems
  - Increase window insulating values and requirement of shading devices
- ***Harnessing renewable energy***
  - Use of renewable energy sources to meet rapid growth of energy demand, supporting economic development without increasing atmospheric greenhouse gas concentrations.

Actions: Transport Sector

- ***The cost-effectiveness of technology-specific policies:*** to be carefully considered like banning certain vehicles or prohibiting traffic in certain areas.
- ***Use of alternative fuels*****:** vehicles using LPG/CNG emit considerably less particulate matter than conventional diesel.
- ***Traffic management measures:*** such as coordination of traffic lights, zebra crossings, side paths, left turns which yields significant economic benefits because it decreases congestion and improves mobility.
- ***Demand management:*** through provision of public transport, fiscal measures, area wide licensing, pricing instruments such as differential pricing for access, and preferential treatment of high-occupancy vehicles. Public transport dedicated bus.
- ***Use of non-motorized transport (NMT) mechanism*****:** to be promoted by curtailing motorization and elimination of impediments to NMT. Government intervention, like introducing stringent parking restrictions and constructing safe bicycle routes.
- ***Inspection and maintenance*** *of vehicles and retirement and scrapping;* retirement and scrapping of old vehicles and improved maintenance.

Actions: Transport Sector

- ***Fiscal measures:*** Higher taxation on purchase of new vehicles and for polluting fuels providing indirect incentive for penetration of cleaner fuels and technologies.
- ***Equitable allocation of road space:*** Reserving lanes and corridors exclusively for public transport and non-motorized modes of travel
- ***Parking in city centres and commercial areas:*** Provision of planned parking spaces away from busy commercial areas with park and ride facilities
- ***Freight traffic management:*** *Staggered f*reight and passenger traffic
  - By enforcing the use off-peak passenger travel times to move freight.
  - By using and developing by-passes for the through traffic.
- ***Private sector participation:*** for activities like the operation and maintenance of parking facilities, certification facilities, repair facilities, construction and management of terminal facilities, etc.
- ***Public awareness and cooperation:*** To organise awareness campaigns on the ill effects of the growing transport problems in urban areas with aim at encouraging individuals, families and communities to adopt “Green Travel Habits”.

Barriers to LCS Pathways

- No common generalized policies can be developed, Individual solutions are needed 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

Future Work

- Context of Climate Change for Development actions
- Linking LCS to future projects and services at city level
- Changing the Building Code/ Standards
  - Increased efficiencies in thermal conditioning
- Attention to transportation and Infrastructure sector
- Effect of financial mechanisms to provide incentives
- Need for shared responses and awareness and capacity building
- Working-out specific local requirements and actions
- Consultation and participation of the local governments and policymakers

Thank You….