Low Carbon Comprehensive Mobility Plans
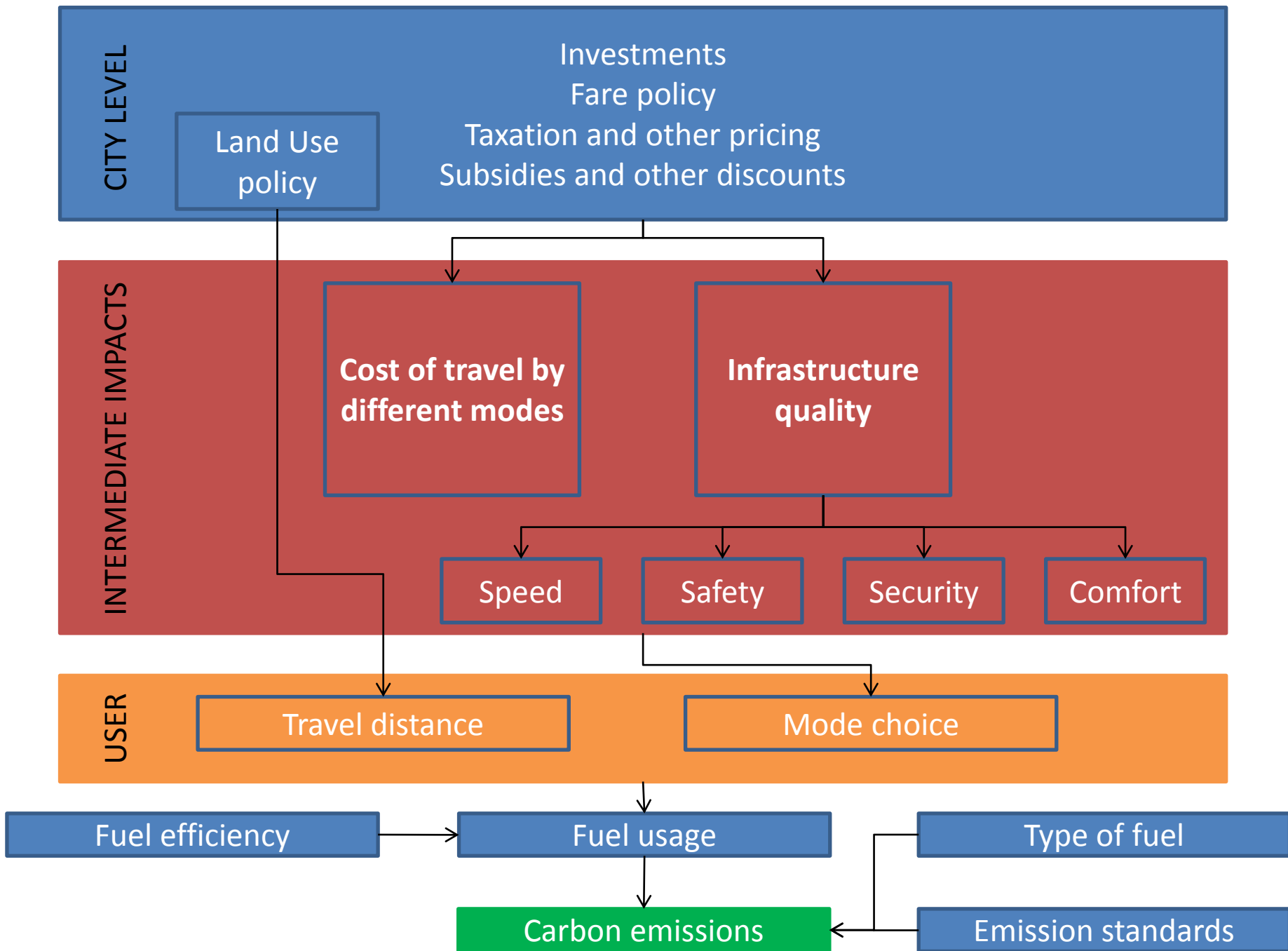
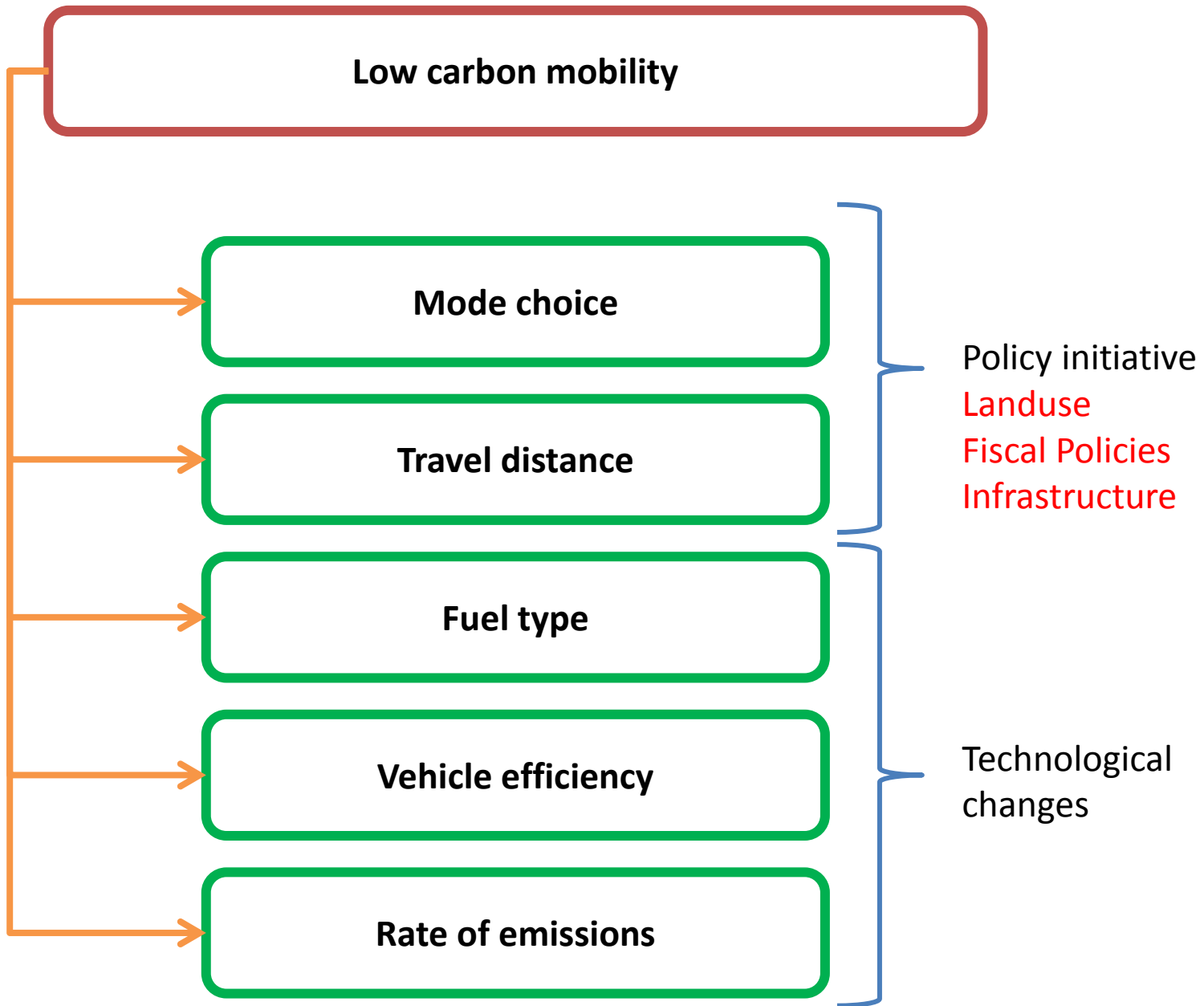## Methodology for developing low carbon mobility plan
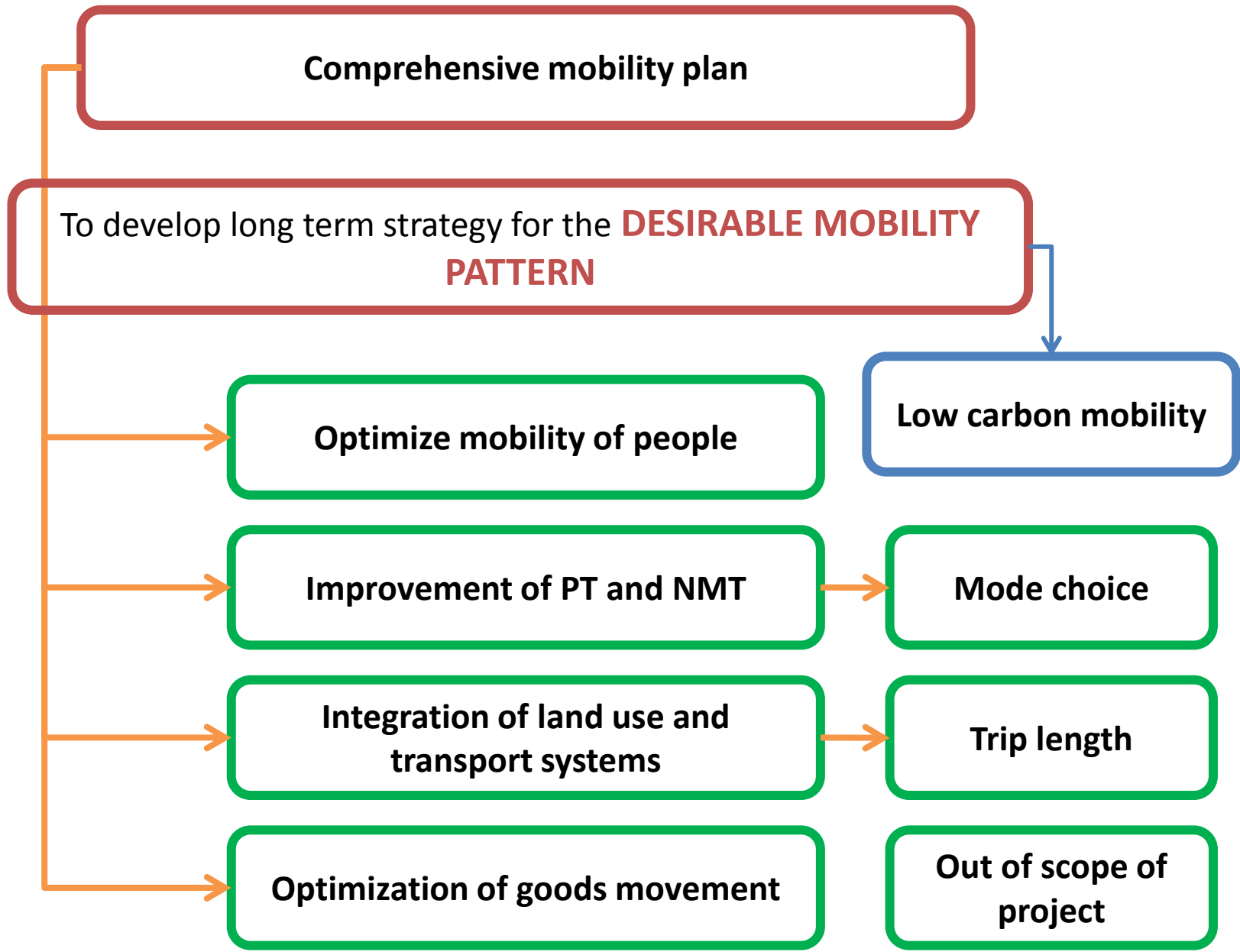
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2 important components

- Scenarios
  - Landuse-City Structure,Location of LIC households, Densities, Mix Landuse patterns
  - Infrastructure- NMT, PT,PMV
  - Technology- Vehicle,Fuel
- Indicators
  - Accessibility/Mobility
  - Environment(local/global)
  - Health

Low carbon mobility

Mode choice

Travel distance

Fuel type

Vehicle efficiency

Rate of emissions

Policy initiative
Landuse
Fiscal Policies
Infrastructure

Technological changes

Comprehensive mobility plan

To develop long term strategy for the **DESIRABLE MOBILITY PATTERN**

Optimize mobility of people

Low carbon mobility

Improvement of PT and NMT

Mode choice

Integration of land use and transport systems

Trip length

Optimization of goods movement

Out of scope of project

Factors Impacting Emission Levels

Fuel Economy
(standards, regulations, industry-governmental partnerships, f eebates, f uel prices and taxes)

Land-Use/Trip Organization
(mixed-use zoning, telecommuting, teleconf erencing, teleshopping)

Technological changes

Total CO$_2$ Emissions *(t CO$_2$)* = Carbon Content of Fuel *(t CO$_2$/GJ)* X Fuel Efficiency *(GJ/VehicleKm Travelled)* X Load Factor *(Vehicle.Km/PassengerKm)* X Travel Planning *(PKT/person-tasks)* X Lifestyle *(person-tasks)*

Life cycle cost of infrastructure

Alternatively Fueled Vehicle
(NG, LPG, alcohol, electric, hydrogen, etc.)

Trip Choice
(carpooling, bus, rail, cycling, etc.)

Planning and Policy initiatives
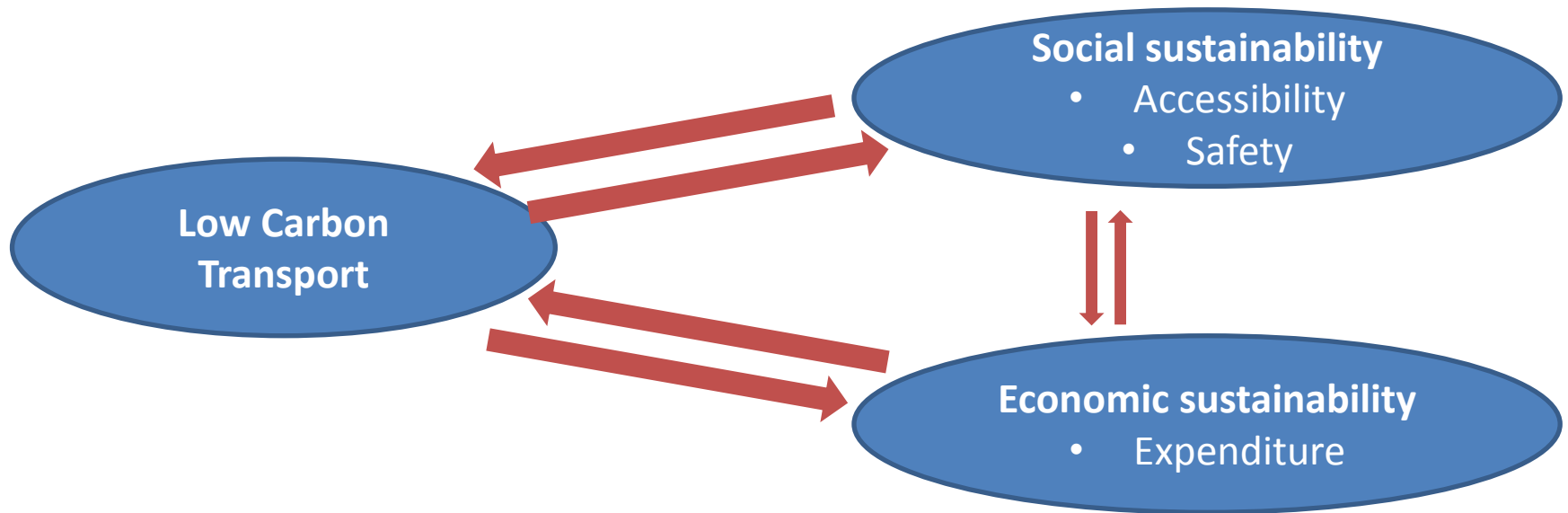
Source: Tellus institute, 2002

Life cycle cost of infrastructure (construction; operation) and vehicle (production; transfer)

Need for indicators that deal with all three aspects

Some indicators are common for two or all three aspects. They may be pressure or serve as impact for any one of the aspect.

Indicators can be better understood as-

Pressure   The indicators measuring activities having impact on any aspect like passenger km, modal share

State   The indicators that measure the influence on the aspect like pollution levels, accessibility

Response   The indicators that measure the policy initiatives taken in response to attain sustainability like expenditures, land use policy, etc.
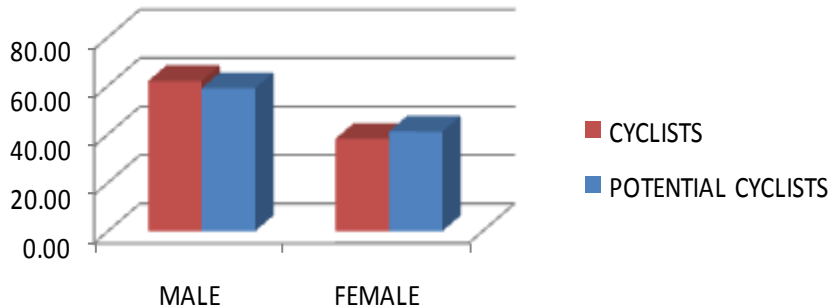
STATE AND PRESSURE INDICATORS

Mobility and accessibility- Modal shares

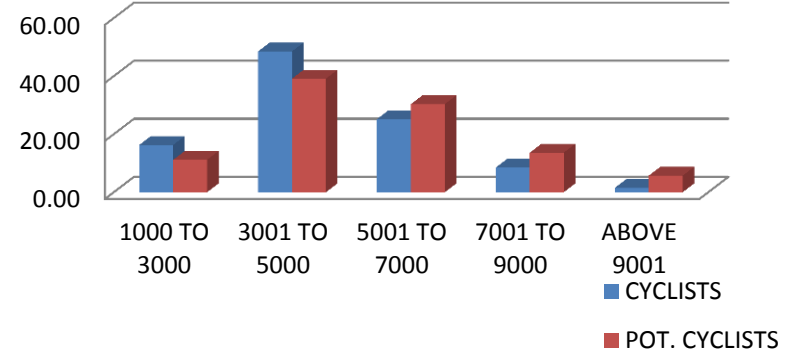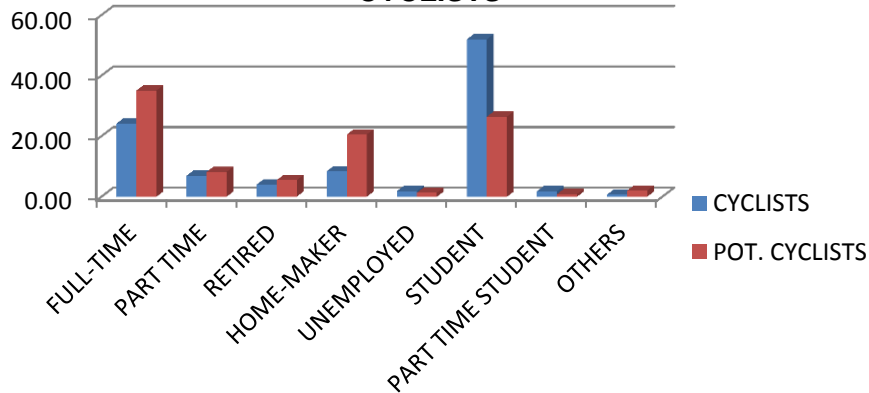| Description	Measurement / Data source	Relevance
Modal shares by trip purpose	Household surveys and some relevant data may also be available in City Traffic and Transport Study (CTTS) and Comprehensive Mobility Plan (CMP)	To understand the movement towards or away from the goal of low carbon transport. To identify the preferable modes for various trip purposes and thus the intervention areas. For example, improving infrastructure for students so that they can use Non-Motorized Transport (NMT).
Modal shares by social groups	National Sample Survey Organization (NSSO) data and household surveys	To understand whether the low carbon transport is by choice for vulnerable groups of society.

Examples
Cyclists vs. Potential cyclists
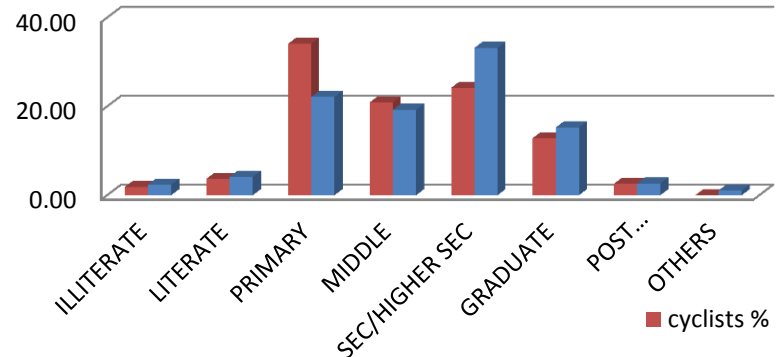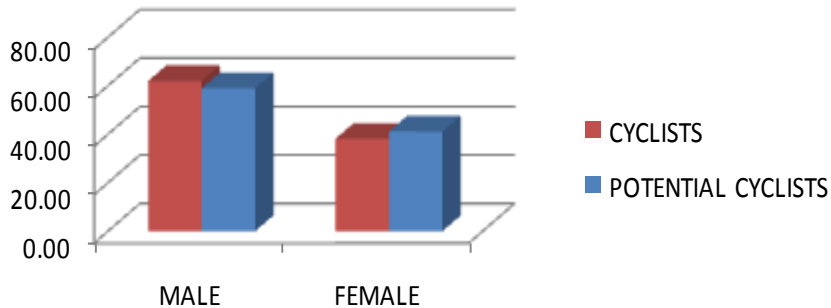
Examples
Cyclists vs. Potential cyclists

PERCENTAGE SHARE OF CYCLISTS & POTENTIAL CYCLISTS
(Bar chart showing MALE and FEMALE categories, with CYCLISTS and POTENTIAL CYCLISTS)

HOUSEHOLD INCOME COMPARISON AMONG CYCLISTS AND POTENTIAL CYCLISTS
(Bar chart with income ranges: 1000 TO 3000, 3001 TO 5000, 5001 TO 7000, 7001 TO 9000, ABOVE 9001, with CYCLISTS and POT. CYCLISTS)
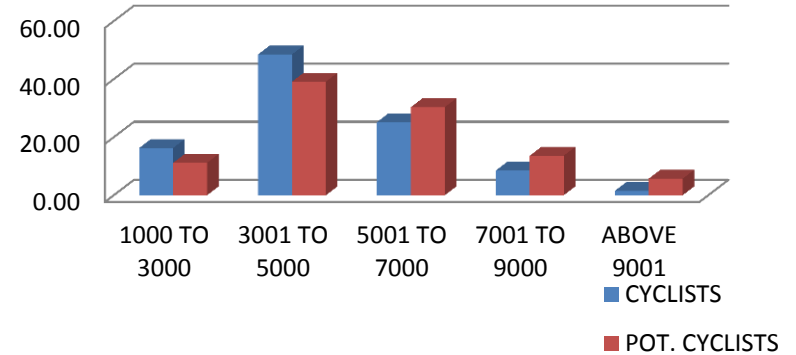
OCCUPATION OF CYCLISTS & POTENTIAL CYCLISTS
(Bar chart with categories: FULL-TIME, PART TIME, RETIRED, HOME-MAKER, UNEMPLOYED, STUDENT, PART TIME STUDENT, OTHERS, with CYCLISTS and POT. CYCLISTS)
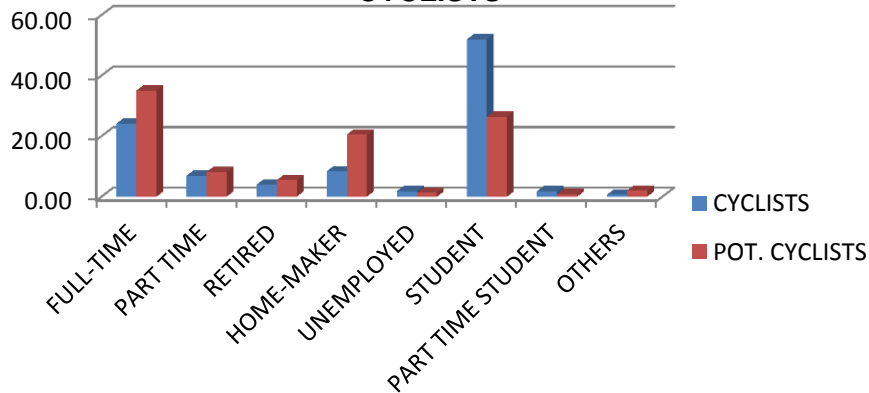
LEVEL OF EDUCATION AMONG CYCLISTS AND POTENTIAL CYCLISTS
(Bar chart with categories: ILLITERATE, LITERATE, PRIMARY, MIDDLE, SEC/HIGHER SEC, GRADUATE, POST..., OTHERS, with cyclists %)
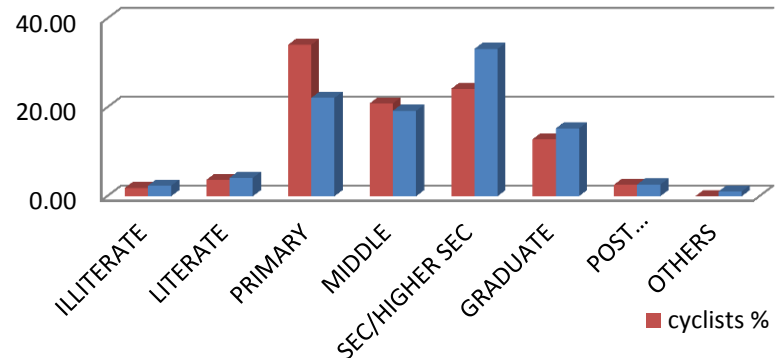
Mobility and accessibility- Travel time

Description	Measurement / Data source	Relevance
Average travel time by trip purpose using different modes[1]	Household surveys	To identify intervention areas For example, less travel time to school using cycle will motivate students to use cycle to go to school and this can be done by taking up policies related to land use and infrastructure improvement.
Trip purpose wise average travel time disaggregated by social groups	Four step model to capture travel time by specific social groups for different trip purpose	Indicates social exclusion and with the help of disaggregation by trip purpose, specific measures can be taken to improve social sustainability

Mobility and accessibility- Trip length

Description	Measurement / Data source	Relevance
Average trip length frequency distribution	CMP or CTTS for specific cities or four step model	**States the potential of using NMT and Public transport (PT).**
Mode wise average trip length disaggregated by social groups[1]	Household survey	**Defines the social cohesiveness in city.** **Longer trip length using NMT by lower income group as compared to middle or high income group not only indicates social exclusiveness but also unaffordable public transport system for the group.**
Trip purpose wise average trip length disaggregated by social groups	Household survey or relevant data from NSSO	**To identify the required change in land use structure specifically for the different groups of society**

Examples
Accessibility and Mobility- Trip Length
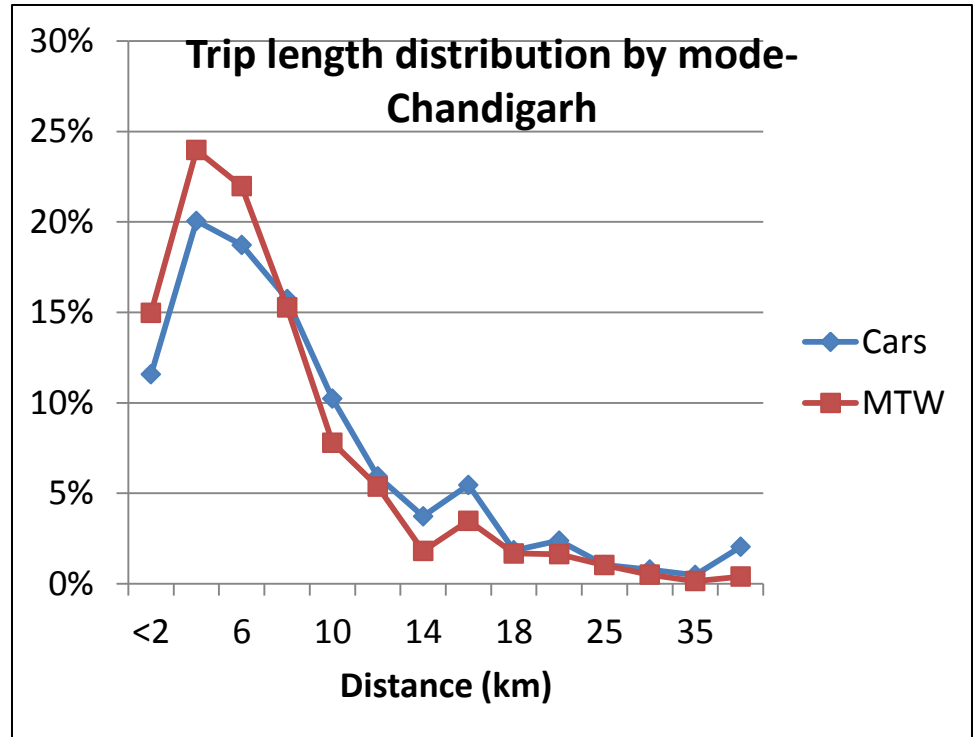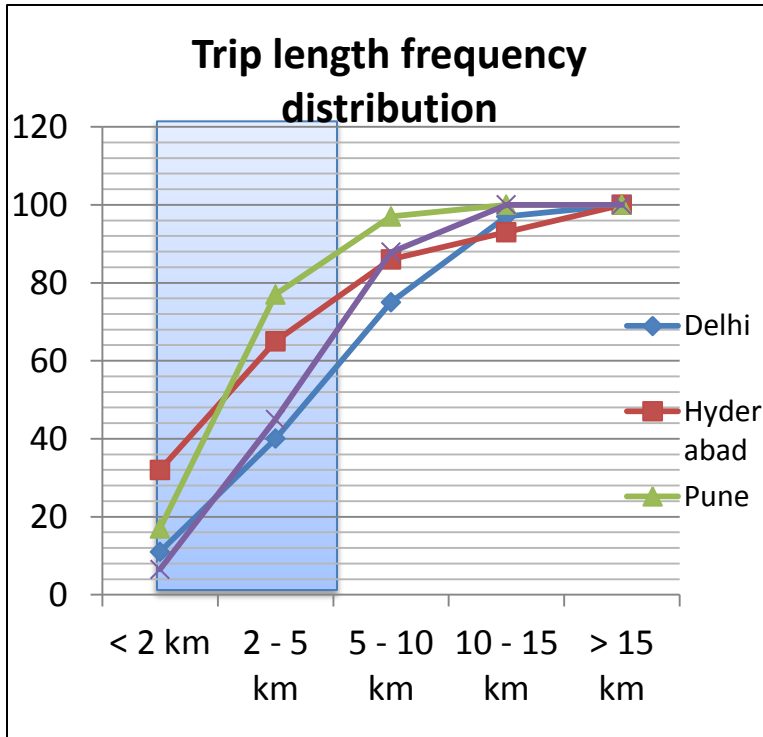
Mobility and accessibility- land use parameters

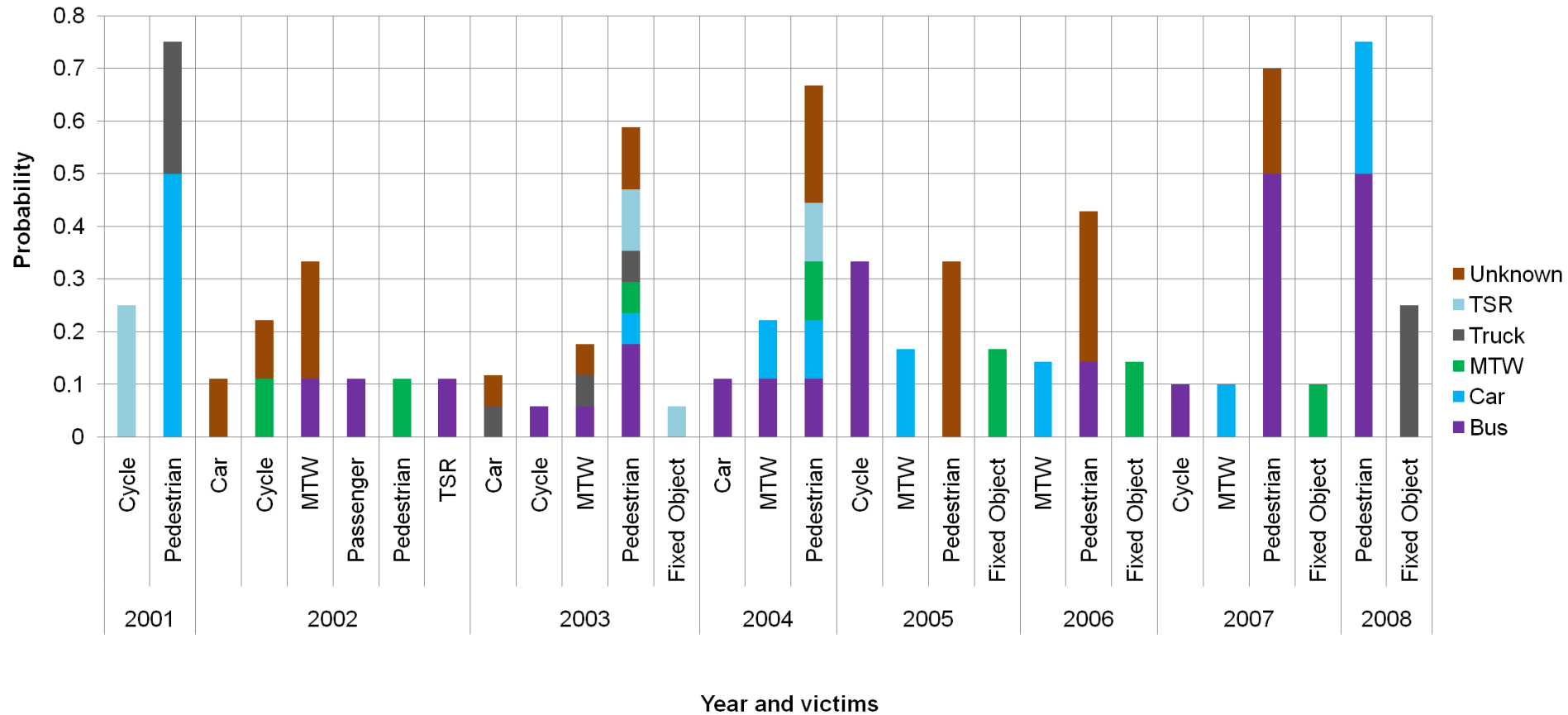| Description	Measurement / Data source	Relevance
Land use mix intensity	Job-housing balance determined using census data available at ward or electoral block level	Indicates land use pattern that has impact on the trip rate and trip length
Income level heterogeneity	Concentration index of different income groups in a zone Determined by the asset ownership or housing type data in census-households	Indicates social cohesion
Kernel density of roads, junctions and PT stop	Requires road inventory and public transport network data in vector form	Determines all over accessibility of city areas to transport infrastructure irrespective of the scale of study

Infrastructure quality, ease and comfort

Description	Measurement / Data source	Relevance
Average speed on roads of different modes[1]	Available in CTTS, CMP and City Development Plan (CDP) for specific roads in cities	Infrastructure projects resulting in increase speed of Personal Motorized Vehicle (PMV) vs. PT will result in more users of PMV.
Access to PT stop	Percentage of Household within 10 min walking distance of PT and para-transit stop	Short distance to PT stop provides easy access to PT thereby increasing the utility of PT.
Average number of interchanges per PT trip	Household surveys	Determines the efforts required to use public transport that effects competitiveness of PT with PMV
Accessibility for disadvantaged by different modes[1]	More specific indicators to be able to measure accessibility for disadvantaged people needs to be developed and data be collected	Ensures barrier free accessibility to the society by Non-Motorized transport and Public transport system

Safety

Description	Measurement / Data source	Relevance
Risk exposure mode wise[1]	Number of fatal accident per 100,000 users of the mode. Detailed accident data can be collected from traffic police	More the risk to a particular mode user less is the preference of the mode.
Risk imposed by modes[1]	Number of accidents caused by the mode on other road users per 100,000 of all the road users. Detailed accident data can be collected from traffic police	Determines the cost imposed by a mode on the society.
Overall safety	Number of fatal accidents per 100,000 populations.	Determine health impact of motorized transport on society
Speed limit restrictions	Percentage of roads having speed limit $\geq$ 50 kmph	More speed means more risk to the society
Quality of footpath infrastructure	Percentage of roads with $\geq$ 2 m	Determines utility level of footpath and thereby has impact on safety

Examples
Safety by Victim and Impacting Mode

Security

Description	Measurement / Data source	Relevance
Percentage of road lighted	Data needs to be collected	Determines the security aspect on the road
Percentage of footpaths lighted	Data needs to be collected	Determines the security aspect on the footpath thereby encouraging people to walk
Percentage of people feeling safe to walk/cycle and use PT in city by	Specially designed stated household surveys	Perception of people regarding security aspect of using low carbon modes of transport that may avoid them to use these

Affordability

Description	Measurement / Data source	Relevance
Affordability of PT and para-transit fare by social group	Measured as percentage of Household income likely to be spend if PT/ para-transit is used	Determines the affordability to different modes by different social groups.
Cost of commuting	% of Household income invested for travelling disaggregated by social groups	Determines social equity.

Environmental impacts- emissions

Description	Measurement / Data source	Relevance
GHG emissions	Equivalent CO_2 emissions per passenger km by mode	Identify modes that require more attention to reduce emissions
Lifecycle cost of different modes[1]	Total of- CO_2 emissions from construction of facility per km CO_2 emissions from production of vehicle or mode per unit Co2 emission unit transit	Identify the carbon intensive modes throughout their lifecycle The indicator is useful for technological improvements

Environmental impacts- land resource depletion

|		
Per capita consumption of land for transport activity	Land use data from CDP or master plans of cities	Determines whether there is over or under consumption of land for transport infrastructure
Land consumed for different transport activities[1]	Percentage of total land used for different type of transport infrastructure- road, parking bus lanes, railways, etc.	Determines the impact of different type of transport infrastructure on land depletion

Environmental impacts- fuel consumption

Description	Measurement / Data source	Relevance
Fuel consumption	Per capita fuel consumption by mode and fuel type	To determine the movement of development towards or away from the goals.
Vehicle efficiency by mode and fuel type		To identify technological changes required to reduce emissions from motorized modes.

Health hazards

|		
Percentage of population exposed to air pollution	Need to map air quality in city and mark households in the buffer area or; Get the relevant morbidity data from hospitals or medical authorities	Determine the health impact of transportation and identify the obnoxious gases or other such factors that need to be reduced from transport sector to improve health.
Percentage of population exposed to noise levels > 50 dB*	Need to map exceedance of noise levels in city and mark households in the buffer area	

Examples

Equivalent CO$_2$ Emissions by Mode and Passenger -km
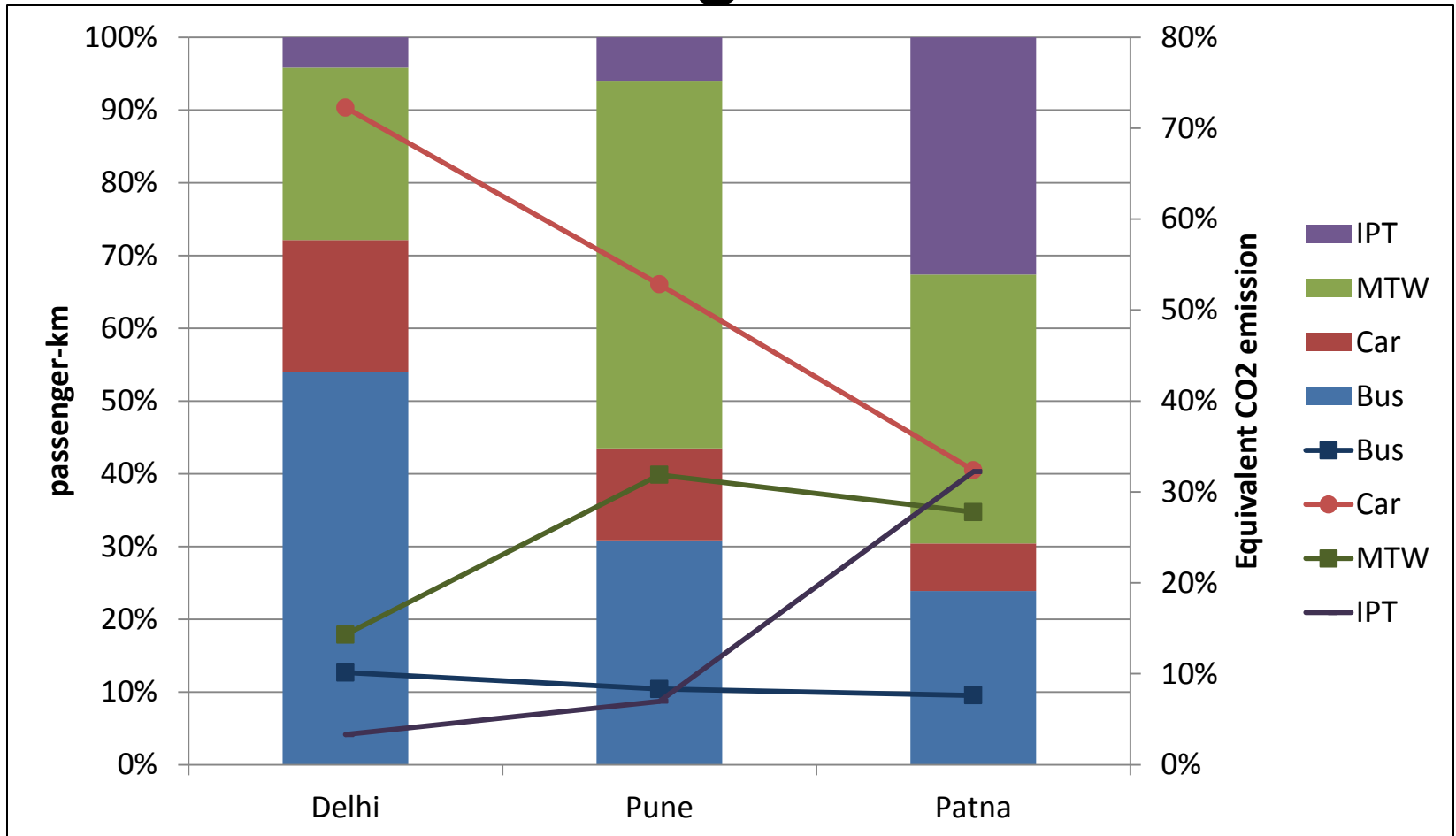
RESPONSE INDICATORS

Examples
Response Indicators- Investments

Percentage breakup of capital expenditure in transport
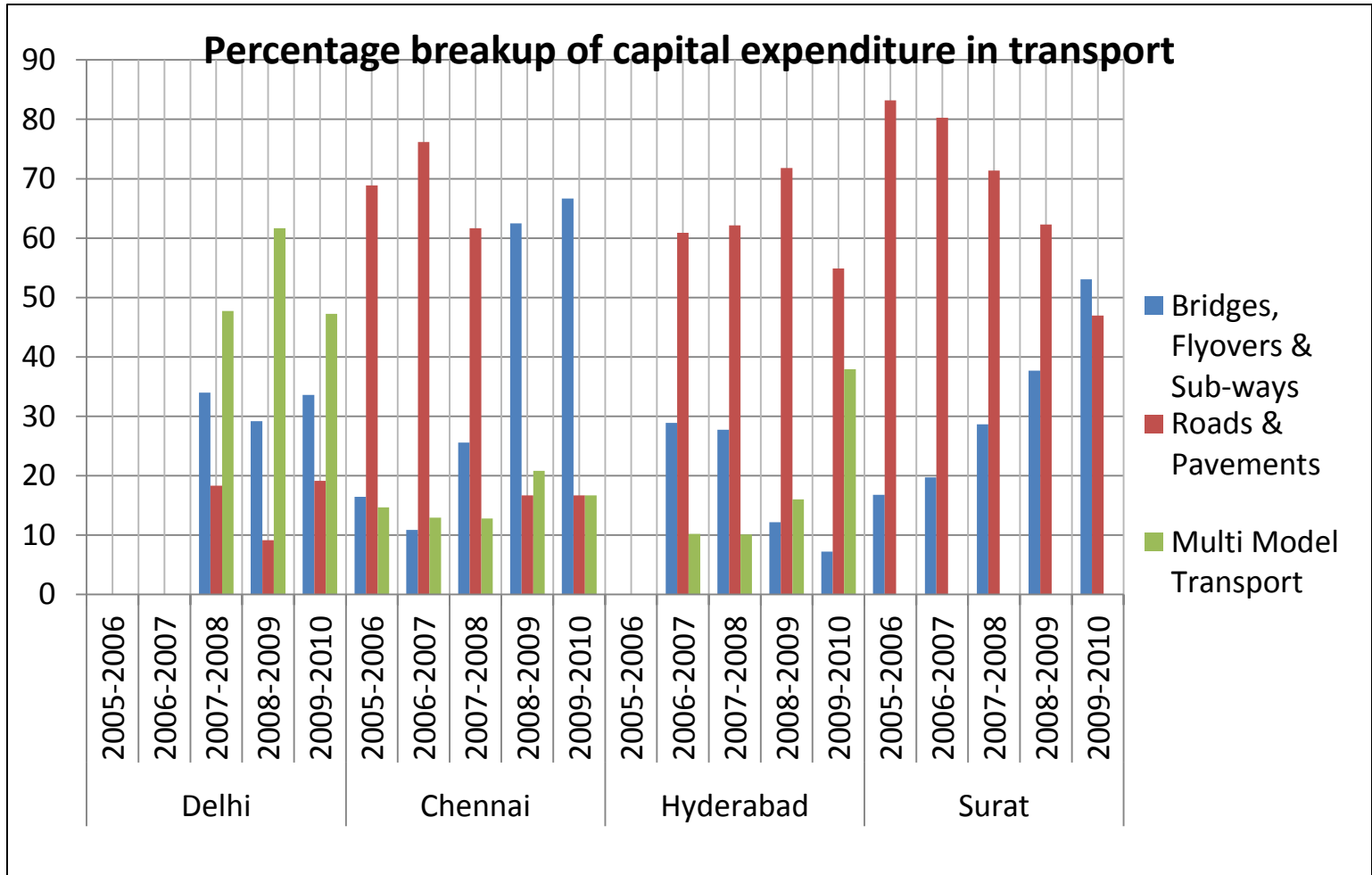
Summary

1. **Mobility and accessibility- Modal shares**
2. **Mobility and accessibility- Travel time**
3. **Mobility and accessibility- Trip length**
4. **Mobility and accessibility- land use parameters**
5. **Infrastructure quality, ease and comfort**
6. **Safety**
7. **Security**
8. **Affordability**
9. **Environmental impacts-Emissions, Fuel consumption**
10. **Environmental Impacts-land resource depletion**
11. **Health Hazards**
12. **Economic Indicators**

CMP   VS   LCMP

Economic indicators- response

Description	Measurement / Data source	Relevance
Trend in investments for development of infrastructure for various modes [1]	Data from city budgets across years	Shows the trend in development of infrastructure for low carbon modes of transport
Tax burden mode wise [1]	Data to be collected from Regional Transport Office	Determines whether the tax policy takes into account the external cost imposed by different modes
Fuel prices at pumps by fuel type		Determines the trend in fuel consumption as with the change in fuel prices
Other charges levied as applicable at city level disaggregated by modes[1]	Transport Department	For example, the high toll and parking charges on cars will discourage people from using it.
Percentage of subsidies granted	Transport department	Determines vertical equity among different social group
Percentage of population owning passes	Transport department	Determines the utility rate of discounts offered on passes for the use of public transport

Difference between Focus

Comprehensive mobility plan	Low carbon mobility plan
Desirable mobility plan	Desirable is low carbon
Propose strategies to accomplish the vision of city	Propose strategies to promote low carbon modes
Mobility needs for all modes including walk and NMVs	Stress is on accessibility rather than mobility. Making NMT and PT systems efficient, safe and attractive for making the low carbon transport modes more preferable to be used by all sections of society
Integration between land use and transport	Integration to reduce the need of travelling and provision of appropriate PT stops as per land use requirements
	Other strategies also include technological improvements that CMP does not account for
Impact of strategies analyzed as per EIA and SEA	Impact of strategies needs to be analyzed for moving towards/away from LCMP

Difference between data requirements- infrastructure

Comprehensive mobility plan	Low carbon mobility plan
Details on ongoing and proposed projects	
Road network inventory including road length per sq km	
Inventory of footpaths and underpasses	
Inventory of major intersections	
Inventory of parking facilities	
Inventory of traffic control facilities	
Inventory of NMV facilities	
Inventory of Bus Operation, Maintenance, and Economic and Productivity Indicators	
Economic and Productivity Indicators and Operator Safety Concerns	
Inventory of Para-Transit	
Inventory of Major Intermodal Interchanges	

Difference between data requirements- safety

Comprehensive mobility plan	Low carbon mobility plan
Summary of Traffic Accidents	Define risk rate to victims and risk imposed by impacting modes
Summary of enforcement	Includes by type and cost- needs to include mode wise
Agencies/organizations related to transport	
Inventory of Environmental Monitoring Data	Measures at city level and does not include contribution by mode
Survey – transport related issues- parking, accident, congestion, etc.	
Population and socio-economic- income, employment structure, population	
Vehicle ownership data	
Traffic count surveys	Does not explicitly include pedestrians
Queue length, Travel speed and travel time survey	

Difference between data requirements- safety

Comprehensive mobility plan	Low carbon mobility plan
Household survey- income, travel pattern, cost, o-d survey	
Road side O-D survey	
Public transport and freight movement survey	
New development areas	
List of proposed projects	
Project evaluation form includes- rationale, objectives, time frame, description, SEA and EIA, implementation strategy and costing	Needs to also evaluate project as per the indicators defined for low carbon transport

Major Task taken up in CMP	
Review of existing transport system	
Transport demand survey	
Review of land use plan	
Analysis of urban transport situations	
Preparation of future land use scenario	
Transport demand forecast model	
Network evaluation	
Preparation of mobility framework	
Formulation of urban transport measures	
Social and environmental impact assessment	
Institutional scheme for project implementation	
Preparation of implementation programs	
Stakeholder consultation	
Periodical update and maintenance	