



# City Level Indicators

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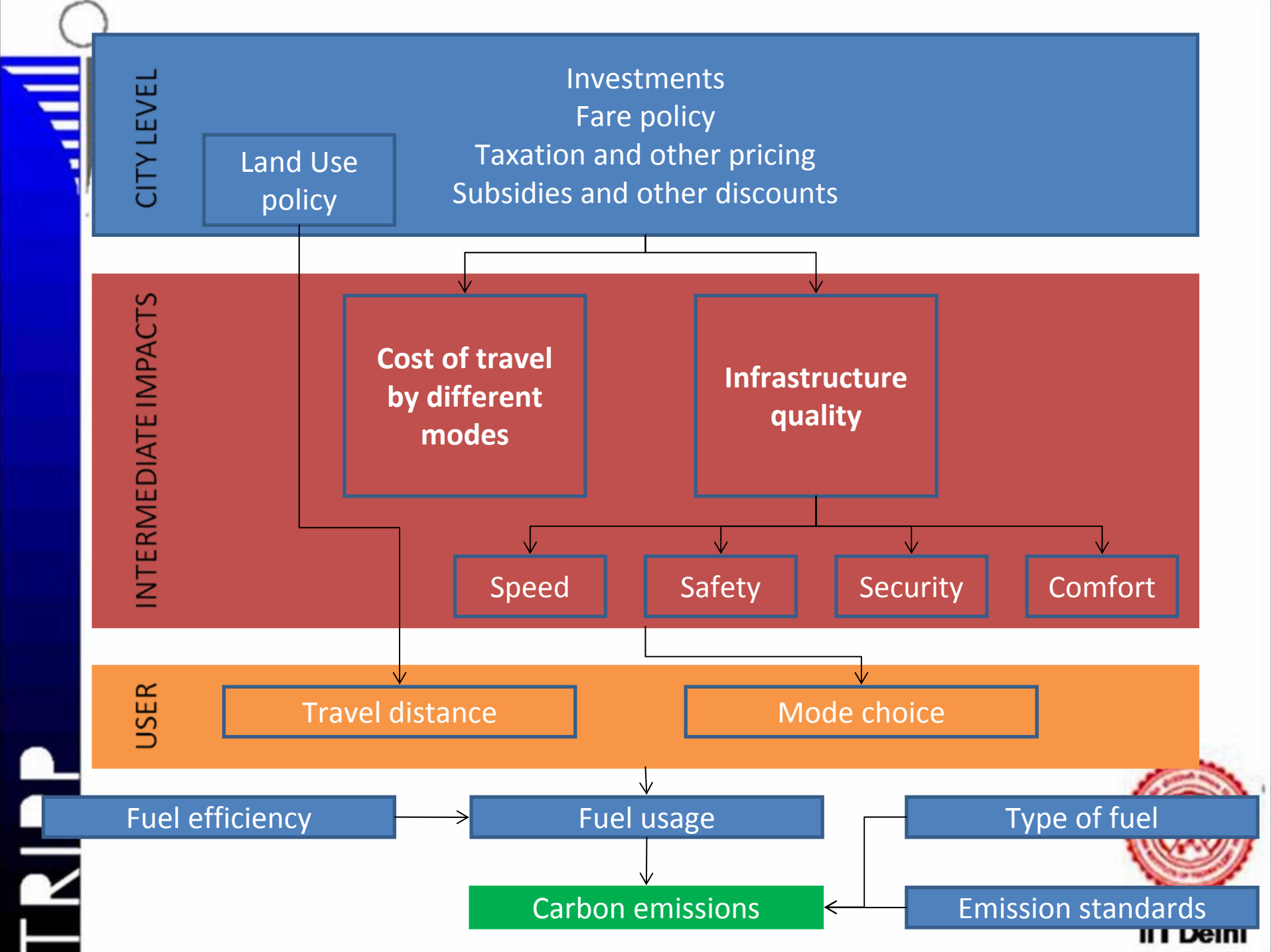
D. Jain

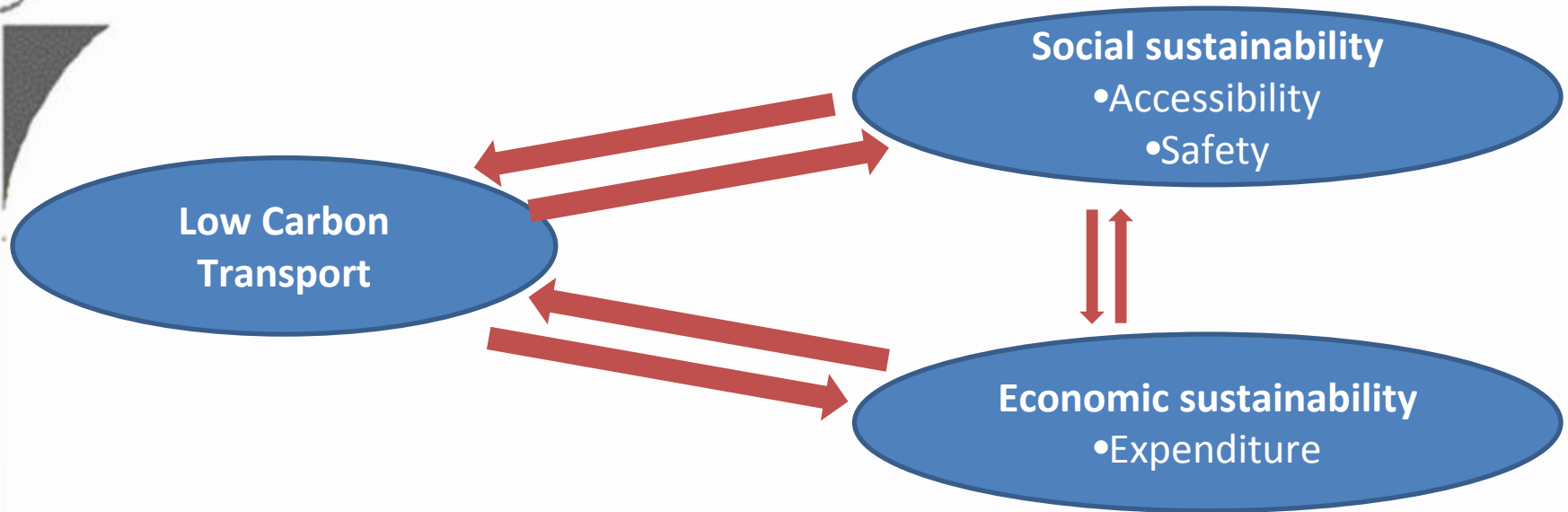
Indian Institute of Technology Delhi

**Promoting Low Carbon transport in India  
National Workshop 19-20 October, 2011, Delhi**



**IIT Delhi**





## Need for indicators that deal with all three aspects

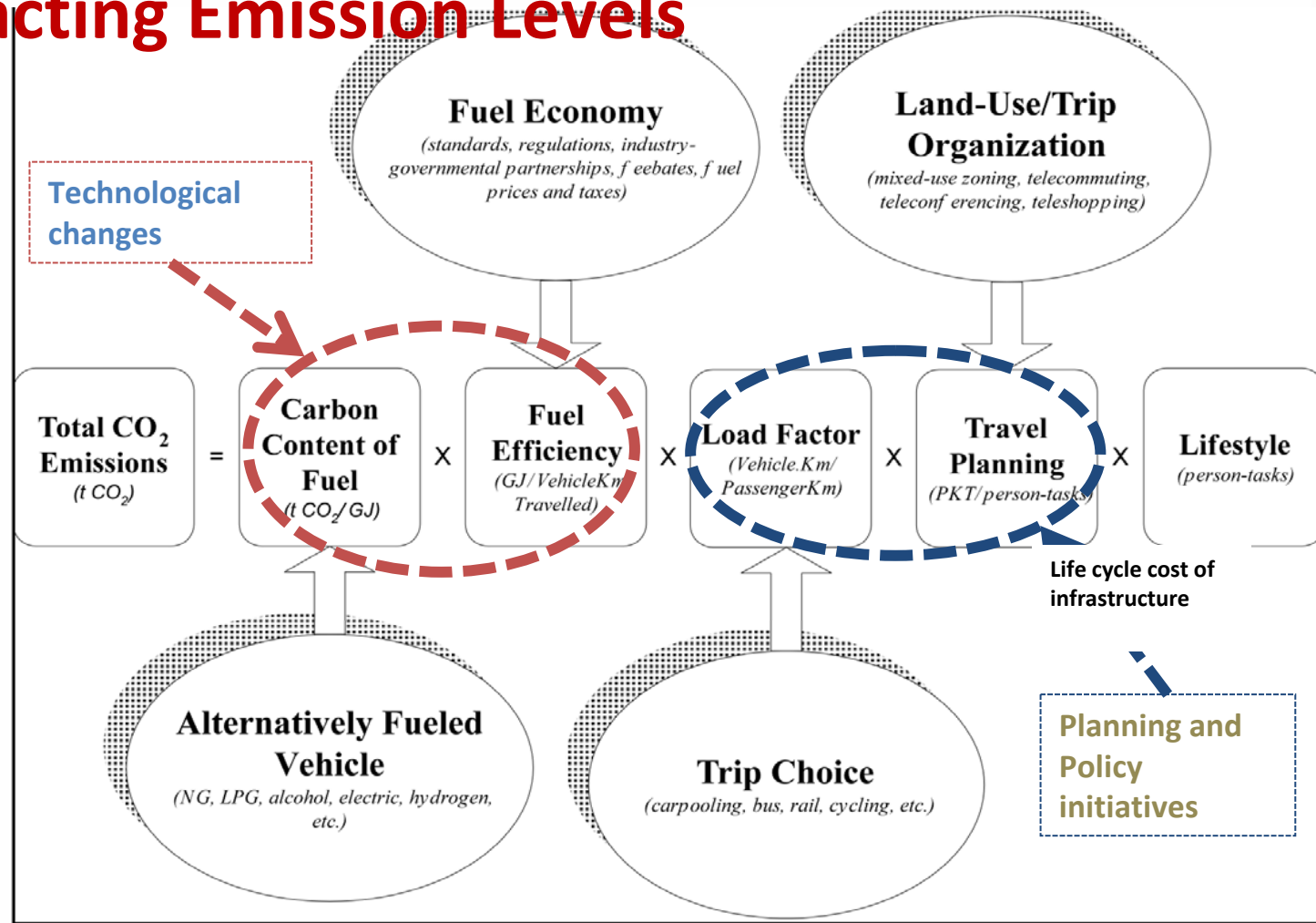
**Pressure** The indicators measuring activities having impact on any aspect like passenger km, modal share

**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.



# Factors Impacting Emission Levels



Source: Tellus institute, 2002

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



# Outcomes of workshop

29<sup>th</sup> August 2011, Ahmedabad

- 31 experts from research institutes, government authorities, private consultants and CSOs attended the workshop
- Key issues raised were:
  - Need to identify the overlapping indicators and appropriately exclude the same
  - Necessary to decide the benchmarks for the indicators
  - Need to narrow down the indicators to manageable number



# Objective of indicators

The indicators are expected to deal with the following issues relevant towards achieving the goal-

- Accessibility and mobility
- Spatial accessibility
- Infrastructure quality
- Safety, comfort and security
- Cost and Affordability
- Environmental impacts
- Health impacts
- Policy response (investments and tax policies)





# 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)	<ul style="list-style-type: none"><li>•To understand the movement towards or away from the goal of low carbon transport.</li><li>•To identify the preferable modes for various trip purposes and thus the intervention areas.</li><li>•For example, improving infrastructure for students so that they can use NMT.</li></ul>
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.



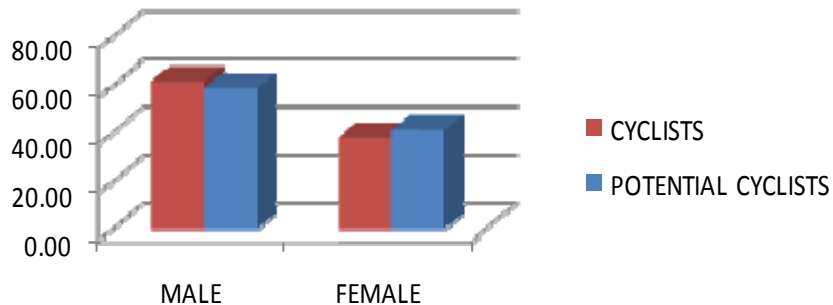




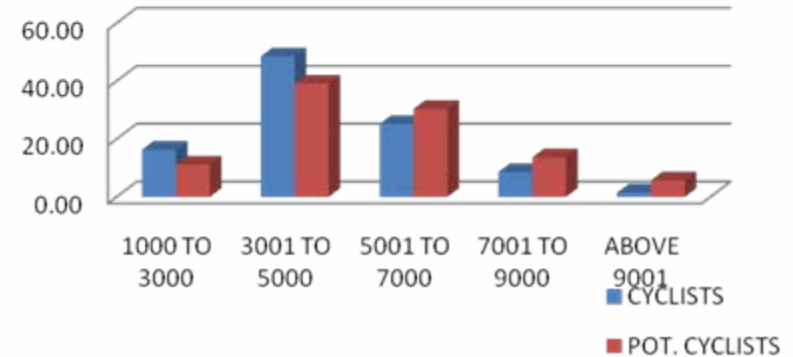
# Examples

## Cyclists vs. Potential cyclists

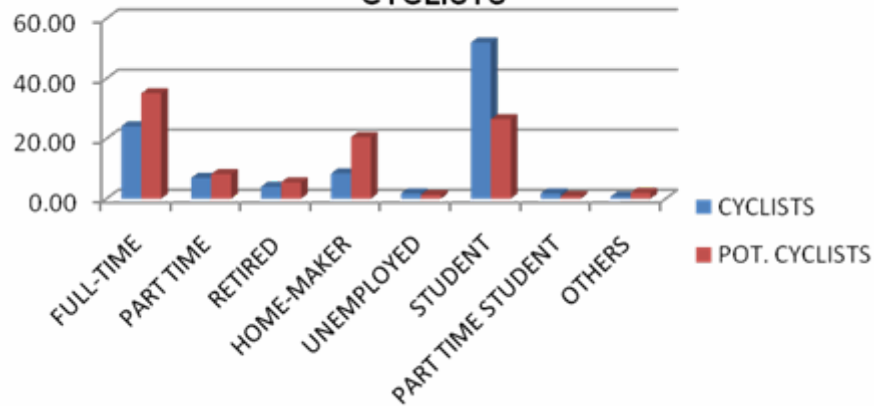
PERCENTAGE SHARE OF CYCLISTS & POTENTIAL CYCLISTS



HOUSEHOLD INCOME COMPARISON AMONG CYCLISTS AND POTENTIAL CYCLISTS



OCCUPATION OF CYCLISTS & POTENTIAL CYCLISTS



## Mobility and accessibility- Travel time

Description	Measurement / Data source	Relevance
Average travel time by trip purpose using different modes <sup>1</sup>	Household surveys	To identify intervention areas  Shorter travel time by PT/NMT will encourage use of these modes by choice
Trip purpose wise average travel time disaggregated by social groups	travel time by specific social groups for different trip purpose, household activity surveys	Indicates social exclusion additional time cost, with the help of disaggregation by trip purpose, specific measures can be taken to improve social sustainability



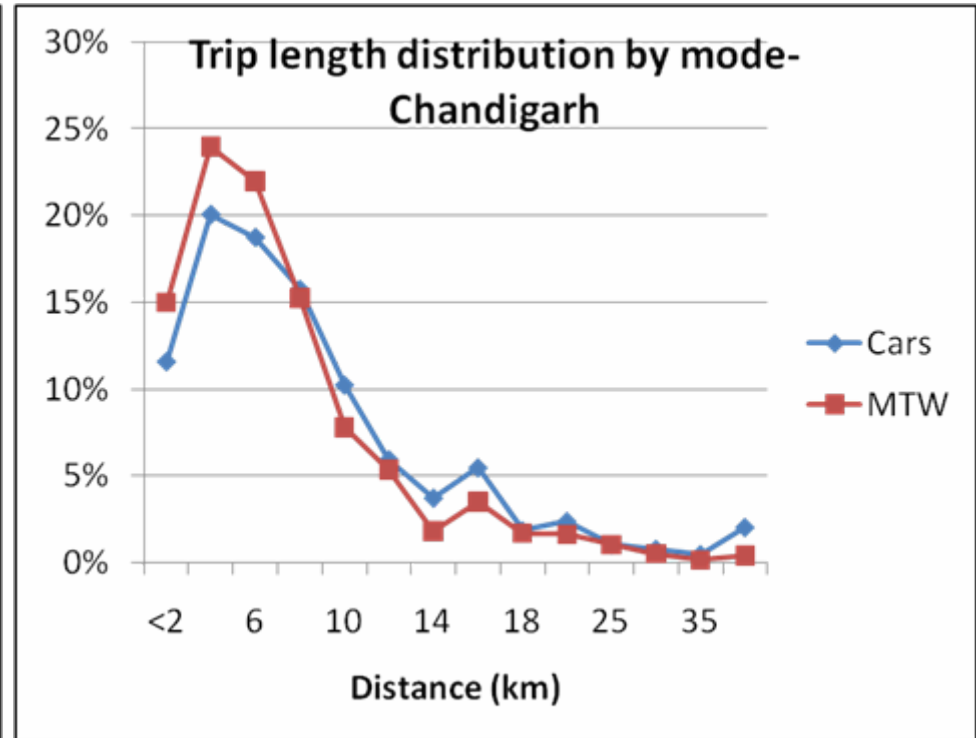
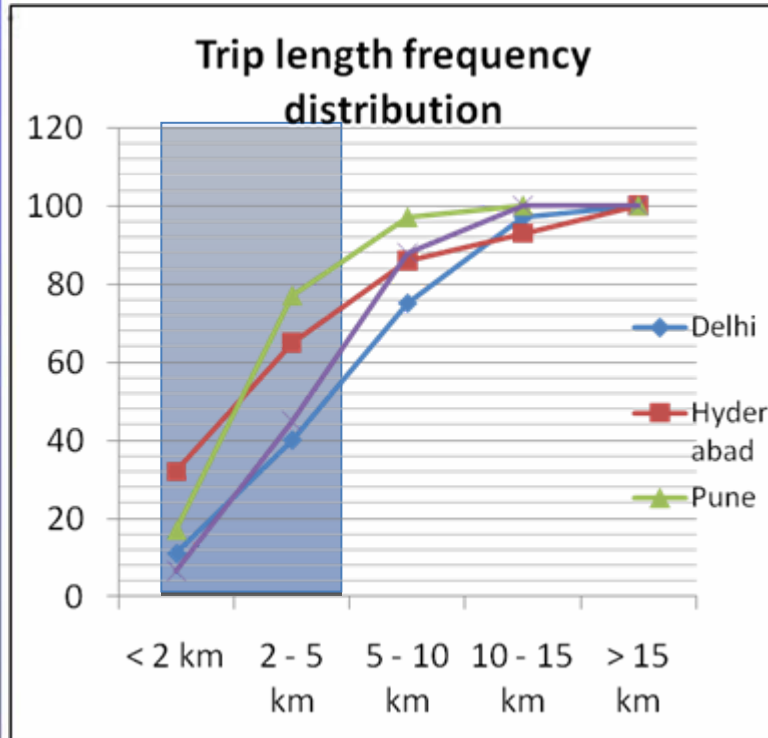
## Mobility and accessibility- Trip length

Description	Measurement / Data source	Relevance
Average trip length frequency distribution	CMP or CTTS for specific cities	<b>Shows the potential of using NMT and Public transport (PT).</b>
Mode wise average trip length disaggregated by social groups <sup>1</sup>	Household survey	<b>Defines the social cohesiveness in city. Longer trip length using NMT by lower income group as compared to high income group indicates social exclusiveness and unaffordability of public transport system.</b>
Trip purpose wise average trip length disaggregated by social groups	Household survey or relevant data from NSSO	<b>To identify the required change in land use structure specifically for the different groups of society</b>



# Examples

## Accessibility and Mobility- Trip Length



Indicator Name	Description	Measurement / Data source	Relevance
<b>Land use accessibility</b>			
<b>Mobility and accessibility- land use parameters</b>			
	Description	Measurement / Data source	Relevance
Land use mix intensity	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	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	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
Percentage of trips made by Para-transit to access PT stop			
Average number of interchanges per trip			



# Infrastructure quality, ease and comfort

Description	Measurement / Data source	Relevance
Average speed on roads of different modes <sup>1</sup>	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 , 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 <sup>1</sup>	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

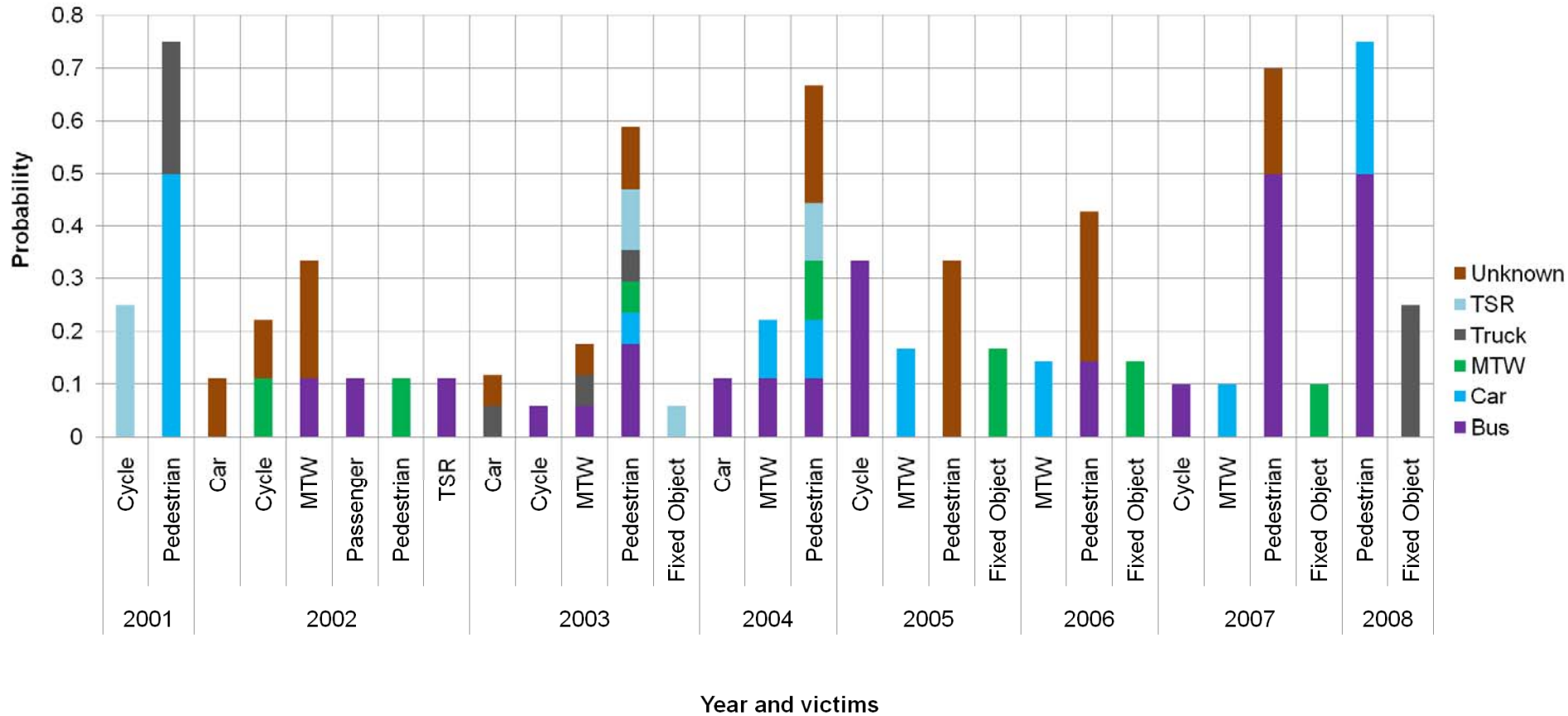
# Safety

Description	Measurement / Data source	Relevance
Risk exposure mode wise <sup>1</sup>	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 <sup>1</sup>	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	High speed means high risk to the society
Quality of footpath infrastructure	Percentage of roads with $\geq 2$ m	Determines utility level of footpath and impacts 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 t; 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

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 <sub>2</sub> emissions per passenger km by mode	Identify modes that require more attention to reduce emissions
Lifecycle cost of different modes <sup>1</sup>	Total of- CO <sub>2</sub> emissions from construction of facility per km CO <sub>2</sub> 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 <sup>1</sup>	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.

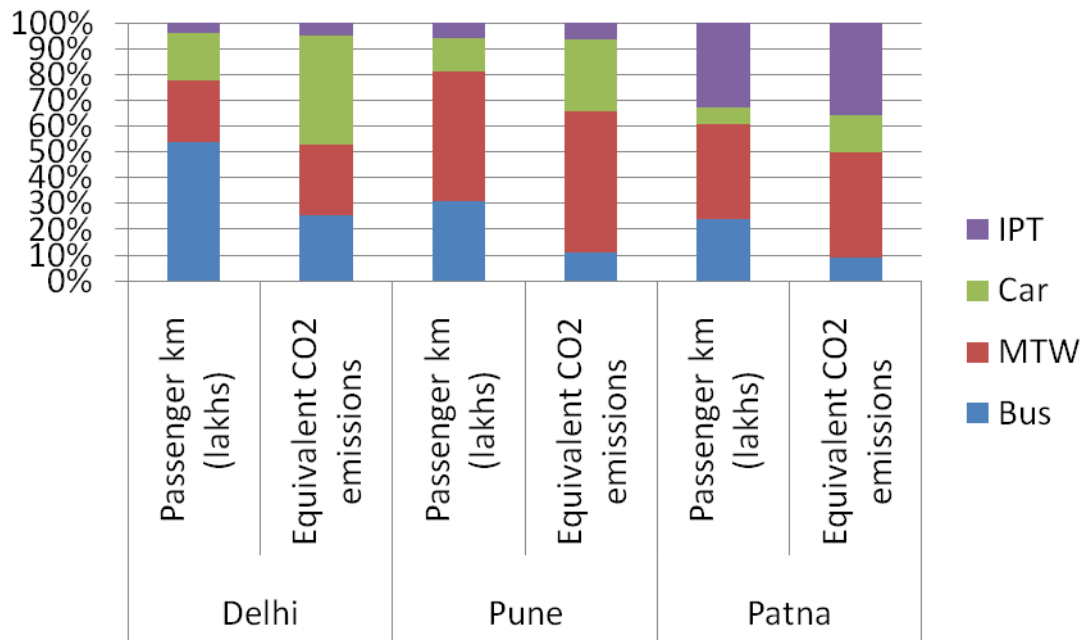
## Health hazards

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	

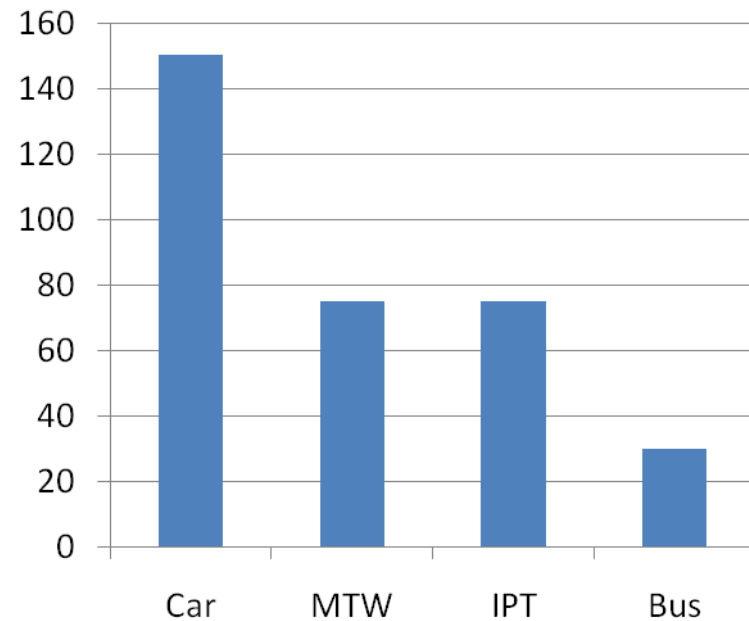
# Examples

## Equivalent CO<sub>2</sub> Emissions by Mode and Passenger -km

Share of modes in passenger-km and equivalent CO<sub>2</sub> emission



Equivalent Co<sub>2</sub> emission per passenger-km (Delhi)





# RESPONSE INDICATORS

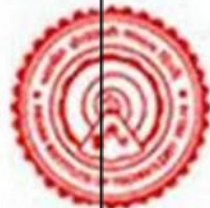
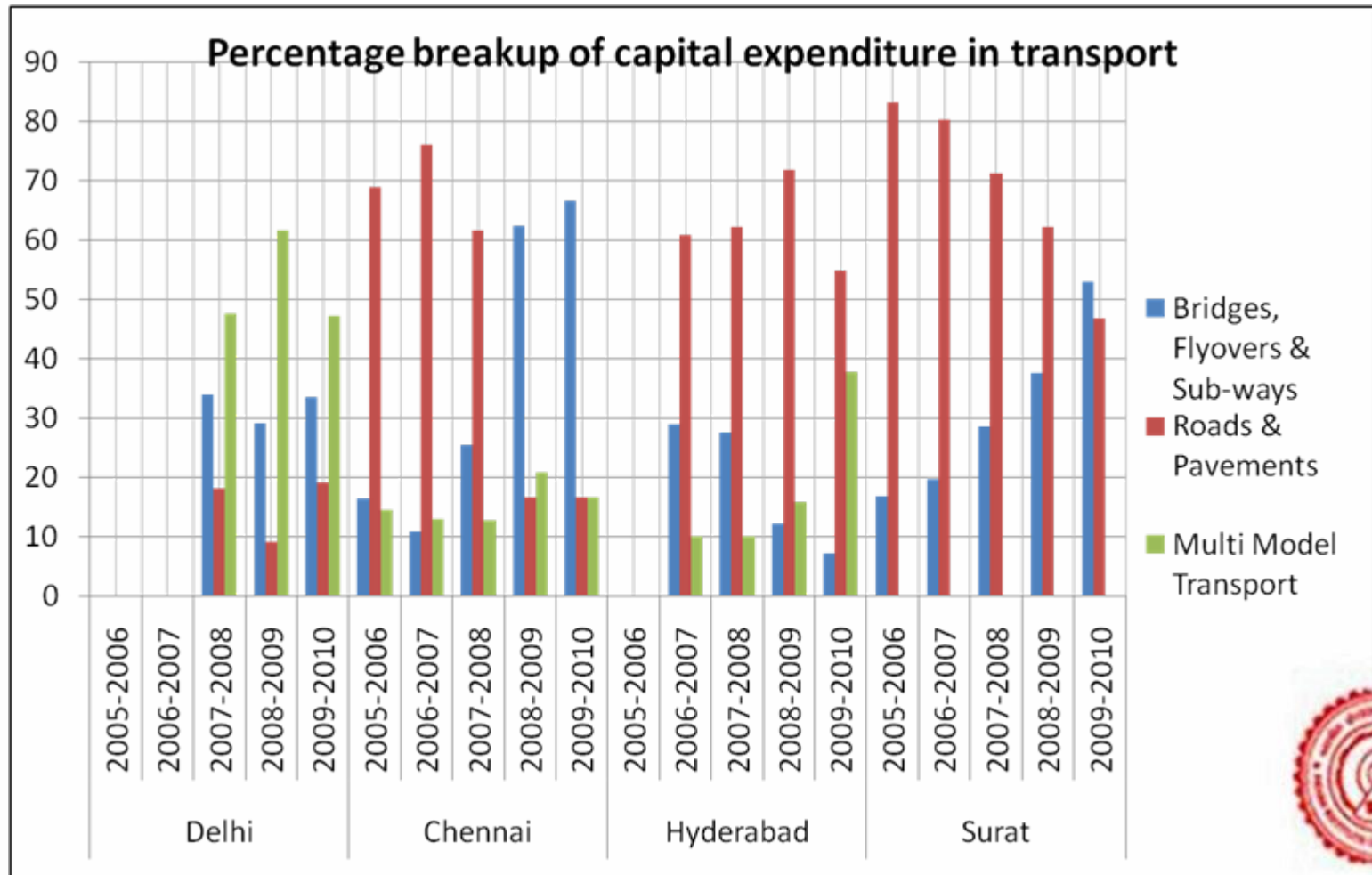


## Economic indicators- response

Description	Measurement / Data source	Relevance
Trend in investments for development of infrastructure for various modes <sup>1</sup>	Data from city budgets across years	Shows the trend in development of infrastructure for low carbon modes of transport
Tax burden mode wise <sup>1</sup>	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 <sup>1</sup>	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

# Examples

## Response Indicators- Investments



# 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**

