Low Carbon Mobility Plan For Indian Cities

Data Requirement and BAU Scenario

Workshop on Developing Policies and Strategies for Low Carbon Transport in India, 24-25 August, 2012

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In Indian context

- NMT and Public transport is used by people who do not have other mode choice available, i.e. **CAPTIVE USERS**
- Captive users are likely to shift to carbon intensive modes because of
  - Existing hostile NMT and public transport infrastructure
  - Increase in income levels
- Short trip lengths due to compact city structure resulting in high percentage of potential users of NMT

Low carbon mobility plan

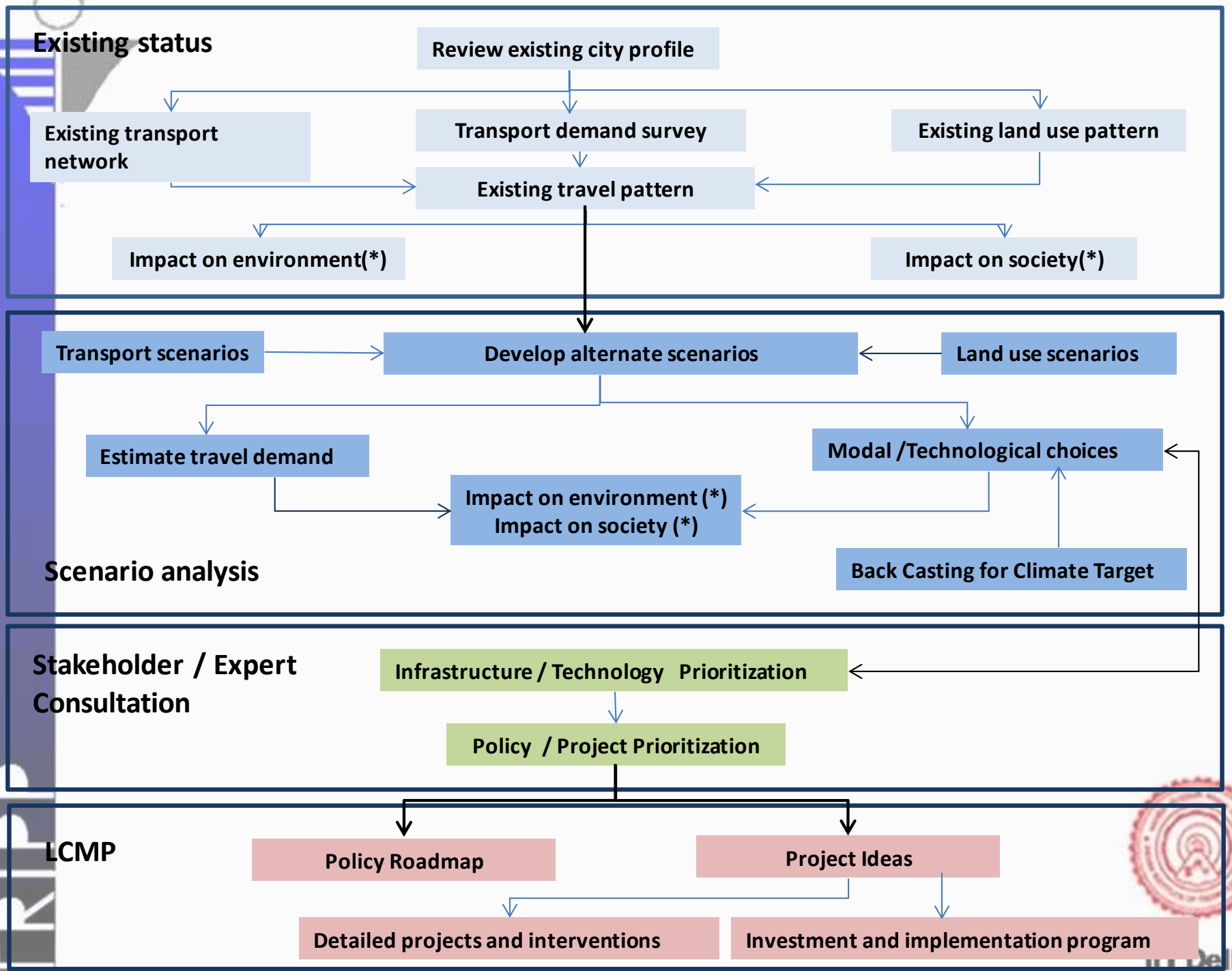
Retain

Shift

Improve

Expected Outcome of LCMP

- Propose strategies and plans to
  - Cause NMT and public transport users to shift from captive to choice users
  - Encourage the use of NMT and public transport by the potential users
  - Technological improvements to reduce emissions from motorized transportation
- Evaluate impact of strategies, plans and projects on emissions, accessibility, and social sustainability


Existing status
Review existing city profile
Existing transport network
Transport demand survey
Existing land use pattern
Existing travel pattern
Impact on environment(*)
Impact on society(*)
Transport scenarios
Develop alternate scenarios
Land use scenarios
Estimate travel demand
Modal /Technological choices
Impact on environment (*)
Impact on society (*)
Back Casting for Climate Target
Scenario analysis
Stakeholder / Expert Consultation
Infrastructure / Technology Prioritization
Policy / Project Prioritization
LCMP
Policy Roadmap
Project Ideas
Detailed projects and interventions
Investment and implementation program

Data collection strategy

Data for modelling travel behaviour in existing situation, BAU and alternate scenarios required to be collected

City wide

- Data like
  - City profile
  - Land use
  - Accident and reported crimes
  - Energy and air quality
- Secondary data resources
  - Census of India
  - Planning documents and city authorities
  - Traffic police

Sampled data

- Data like
  - Infrastructure inventory
  - Traffic volume
  - Household survey
  - Vehicle efficiency

Used where primary data needs to be collected

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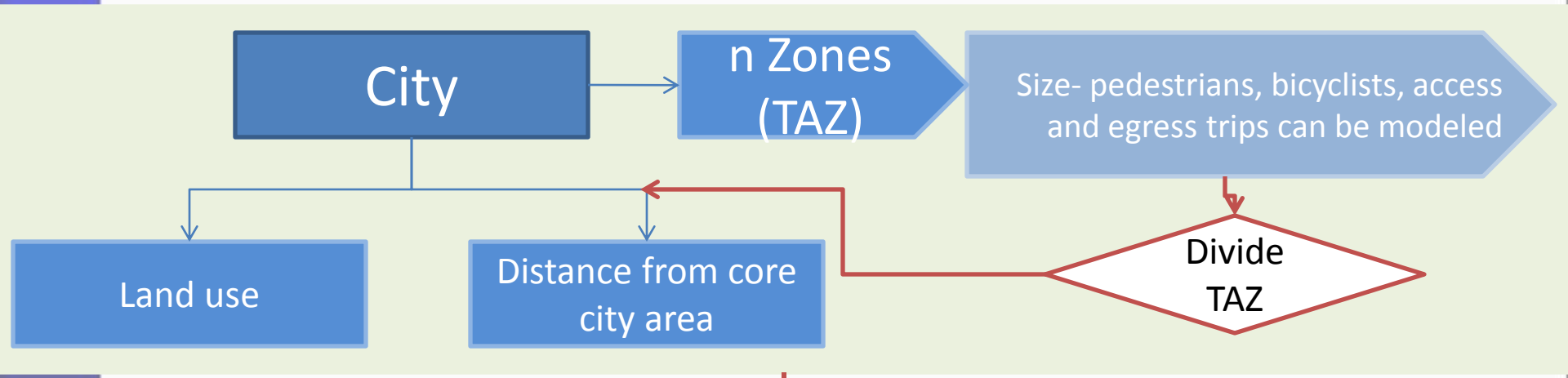
Data collection Strategy
Sampling Methodology

Stratified sampling both for household and road inventory survey



	Residential	Slums	Commercial/ industrial	Total
0 – 1 km				
1 – 3 km				
3 – 5 km				
Total				**n**

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Data collection Strategy Sampling Methodology

From broad categories defined sample of TAZ to be surveyed is selected

Household Survey

- Sample represents Socio-economic construct of city
- Sample size is significant at 95% confidence interval
- From selected sampled TAZ
  - Use housing typology
    - slums and chawls
    - independent bungalows
    - twin bungalows
    - low rise apartments and
    - high rise apartments

  to identify settlements for survey

Road inventory survey

- Road inventory is developed on GIS for entire city
- Detailed survey on randomly selected 30 - 40 roads
- From selected sampled TAZ
  - Three road types
    - Arterial or sub-arterial
    - Collector roads and
    - Local roads

  based on ROW and purpose
- Based on LU & spatial location data is extrapolated

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Constructing Scenario

BUSINESS-AS-USUAL (BAU)

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Introduction to BAU Scenario

Project travel behaviour and city growth based on past trends

- Landuse, population growth, and densities
- Vehicle ownership
- Infrastructure growth and investments
- Vehicle technology penetration

Estimation of

- Number of trips
- Mode choice
- Trip lengths

Estimation of Sustainability Indicators

- Mobility
- Accessibility
- Safety ,Security
- Environment

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Data requirement for BAU

- **Population growth**
  - projected for horizon year based on last 2 – 3 decades
  - recent changes in migration patterns can also be studied
- **Demographic trends**
  - project population by social groups
    - gender, age and education level.
- **Trends in changing development pattern**
  - project the changing
    - land use pattern,
    - density and
    - mixed intensity in the city.
  - previous years master plans, land use plans and upcoming projects.
- **Economic growth and per capita income levels**
  - Employment share
  - income levels by population and
  - Vehicle ownership in the horizon year.

Case Study results
1. Delhi Metro

- **Revenue**
- Fare-box contributes less than 50 percent of total revenue of Delhi metro
- dependence of metro systems on real estate development and hence a permanent change in the city's structure.
- **Costs**
- DMRC has a current debt of $3 billion and the annual interest and financial charges reached more than $ 36 million for 2011
- With increasing cost of operations and debt repayment with an increasing network size, the cost burden of Delhi metro is going to increase significantly

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Delhi Metro results cont.

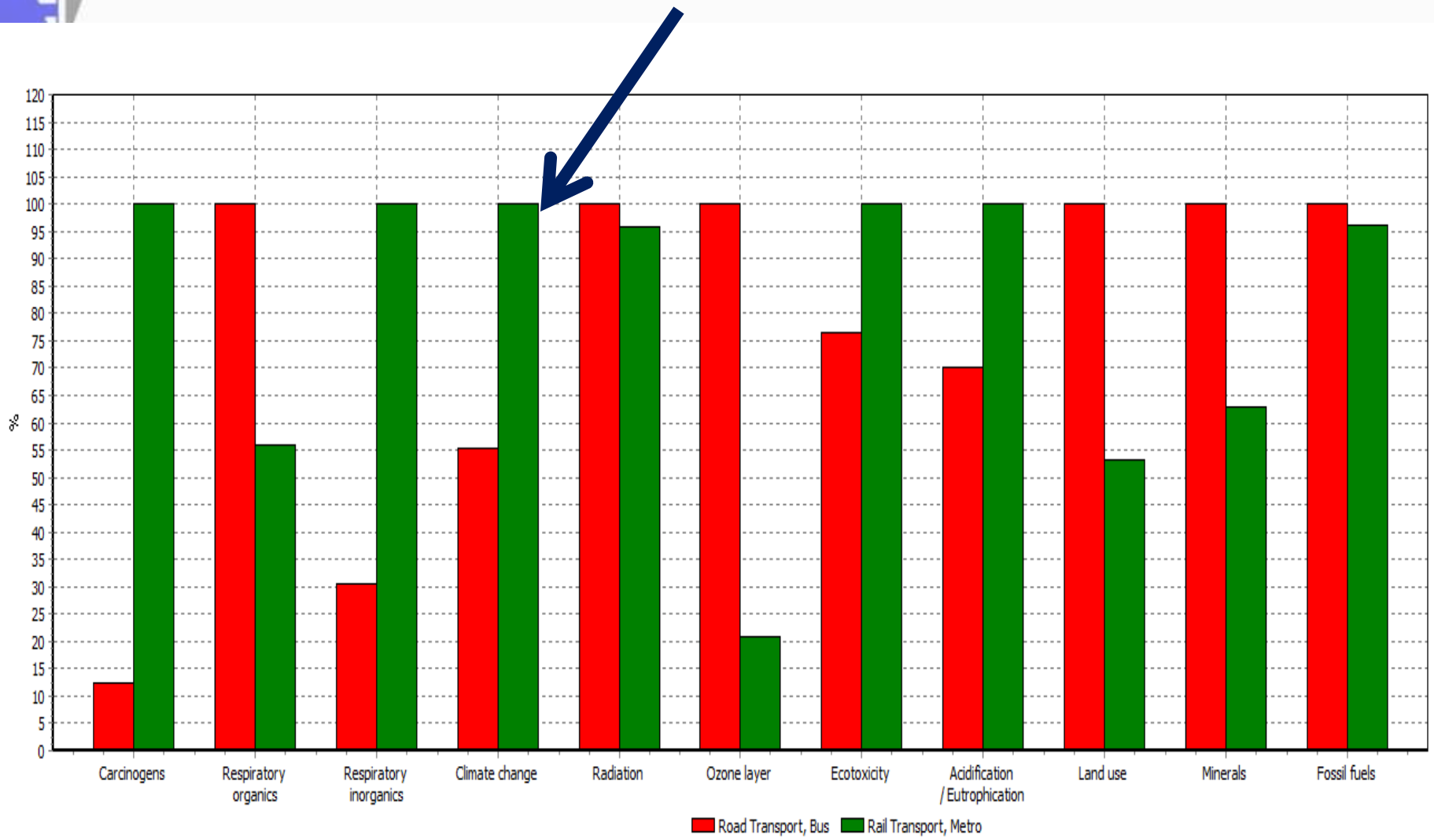
- **Ridership**
- Actual ridership of Metro is at most one-fourth of the projected ridership, leading to overestimation of benefits (and unfair justification) of metro system in the DPRs during the planning phase

- **Long Trip Lengths**
- While more than 80 percent of all the respondents travelled more than 10 km of distance on metro, only 17 percent of trips are more than 10 km long in Delhi
- While Metro can cater to long trips (10 km or more), transport policies should focus on improving NMT and Bus transport infrastructure in order to cater shorter trips which comprise more than 80 percent of all the trips in Delhi

Delhi Metro results cont.

ITEMS	UNIT	TOTAL LIFE CYCLE		OPERATIONAL	
		CNG BUS	METRO	CNG BUS	METRO
Energy	MJ/PKM	0.414	0.384	0.163	0.202
GHG	g CO_2 e/PKM	14.1	24.2	6.82	12.6
CO	g/PKM	0.045	20.2	0.0294	6.88
SO_2	mg/PKM	30.2	205	0.04	110
NO_X	mg/PKM	77.8	68.2	49.5	35.2
VOC	mg/PKM	26	12.8	3.33	6.65
PM_{10}	mg/PKM	3.13	8870	0.52	4590
Pb	µg/PKM	N/A	13.2	N/A	6.1

CNG Bus and Delhi Metro



Comparing 1 personkm 'Road Transport, Bus' with 1 personkm 'Rail Transport, Metro'; Method: Eco-indicator 99 (E) V2.06 / Europe EI 99 E/E / damage assessment

Comparison of Delhi CNG Bus & Delhi Metro transportation by Impact categories (%)

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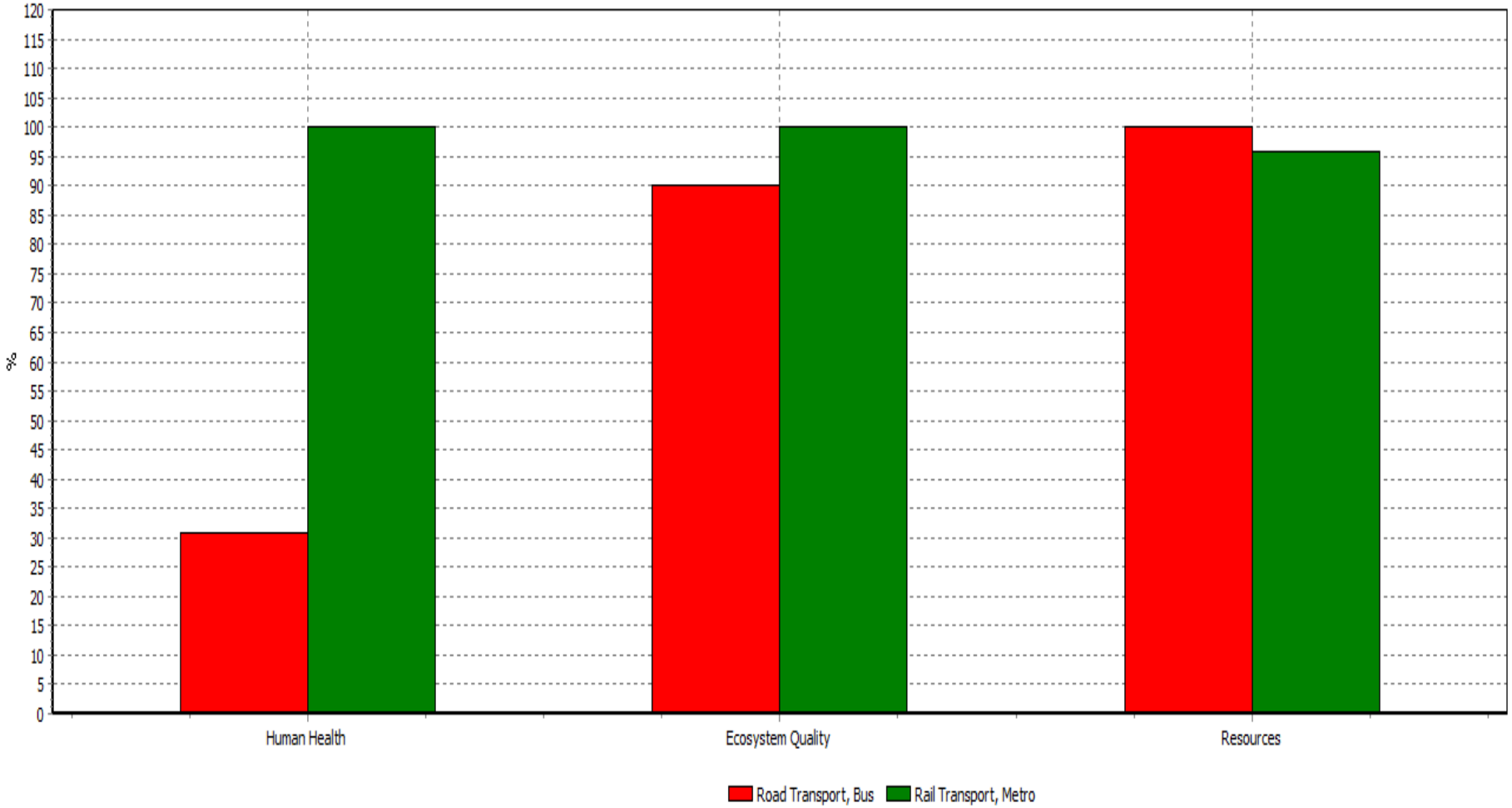
CNG Bus and Delhi Metro



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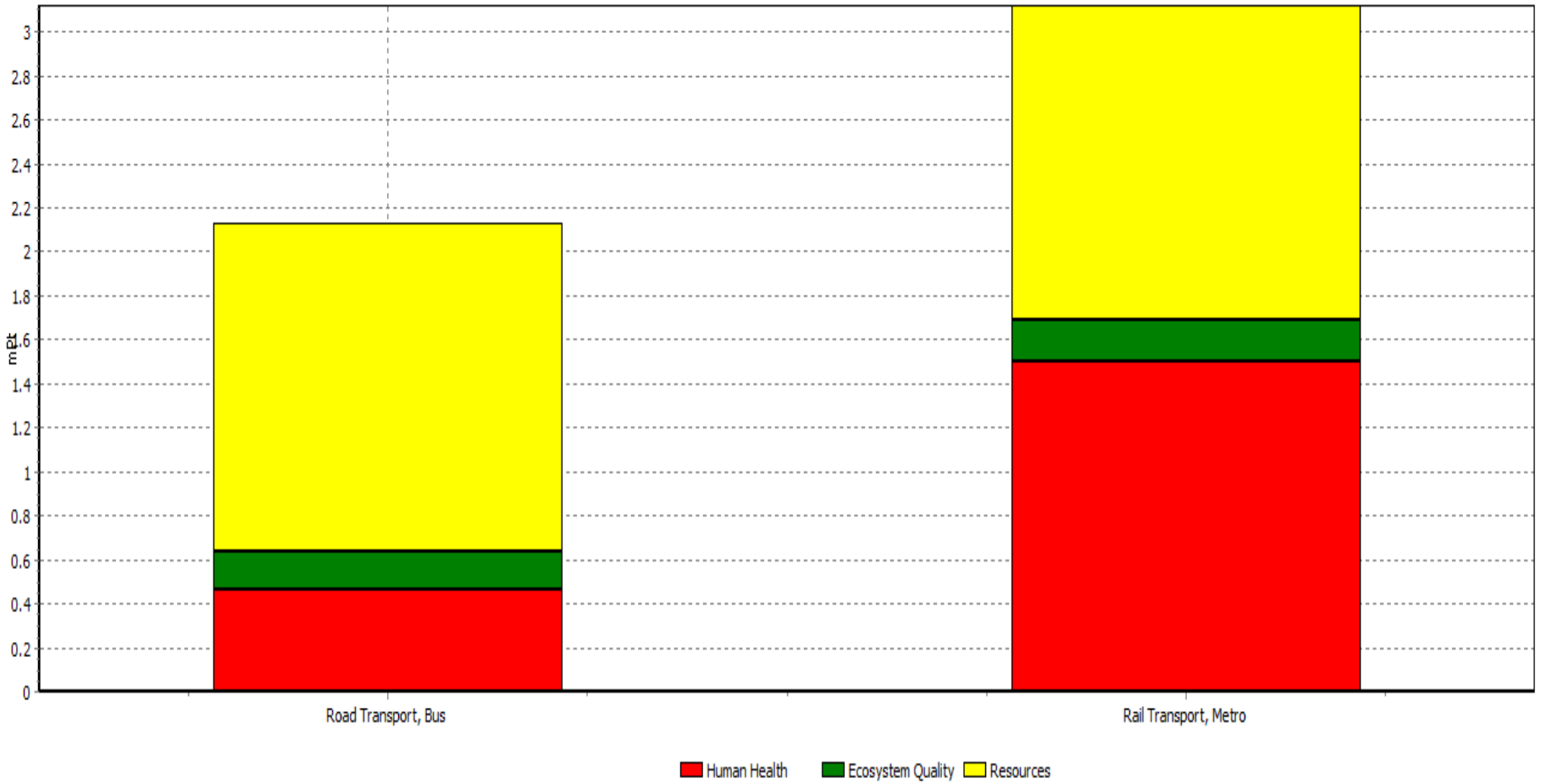
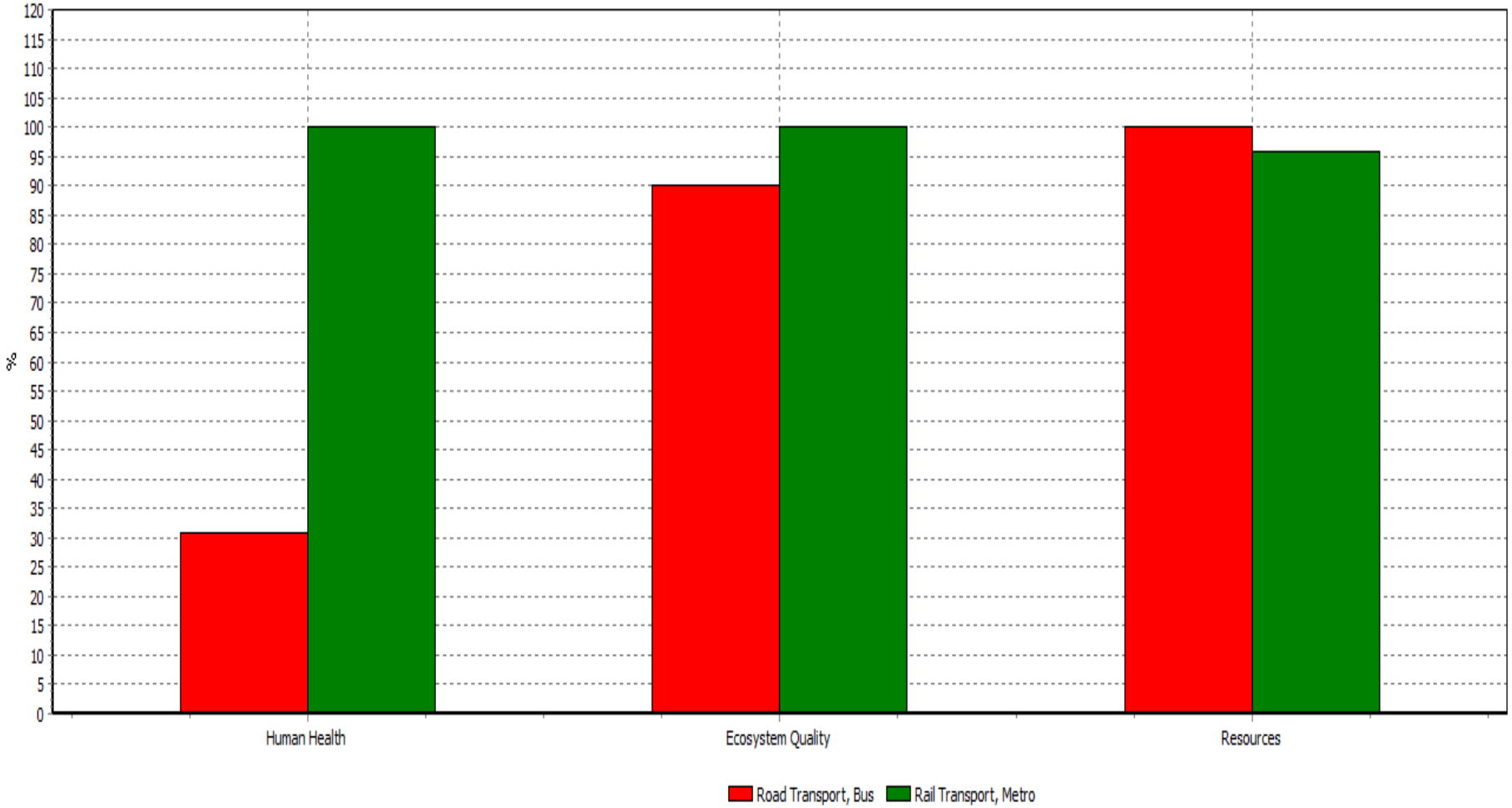


Single score of environmental impact of Delhi CNG Bus and Delhi Metro rail transportation and its structure with respect to three aggregate damage categories

CNG Bus and Delhi Metro



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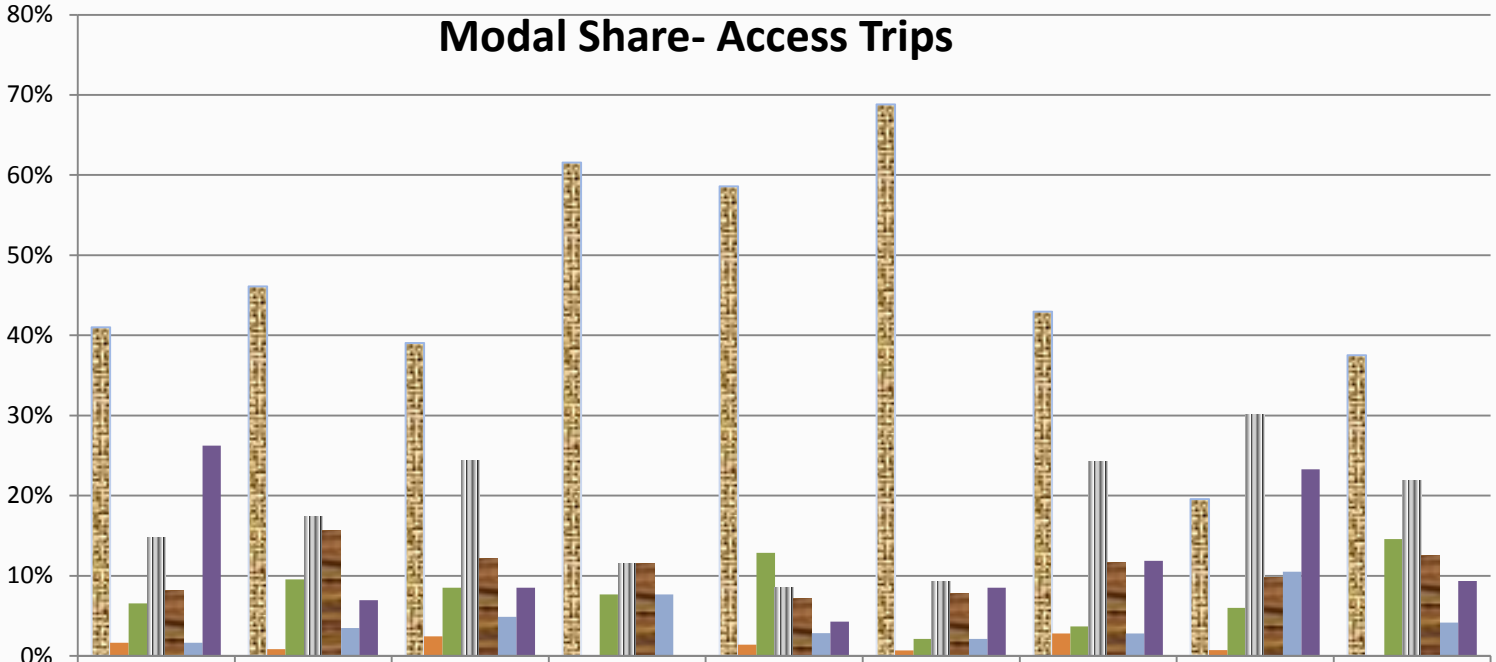
Access at Delhi Metro stations



	Northwest	North	East	Central	West	New Delhi	South	Gurgaon	Noida
Walk	41%	46%	39%	62%	59%	69%	43%	20%	38%
Cycle	2%	1%	2%	0%	1%	1%	3%	1%	0%
Rickshaw	7%	10%	9%	8%	13%	2%	4%	6%	15%
Auto	15%	17%	24%	12%	9%	9%	24%	30%	22%
Bus	8%	16%	12%	12%	7%	8%	12%	10%	13%
Motorcycle	2%	3%	5%	8%	3%	2%	3%	11%	4%
Car	26%	7%	9%	0%	4%	9%	12%	23%	9%

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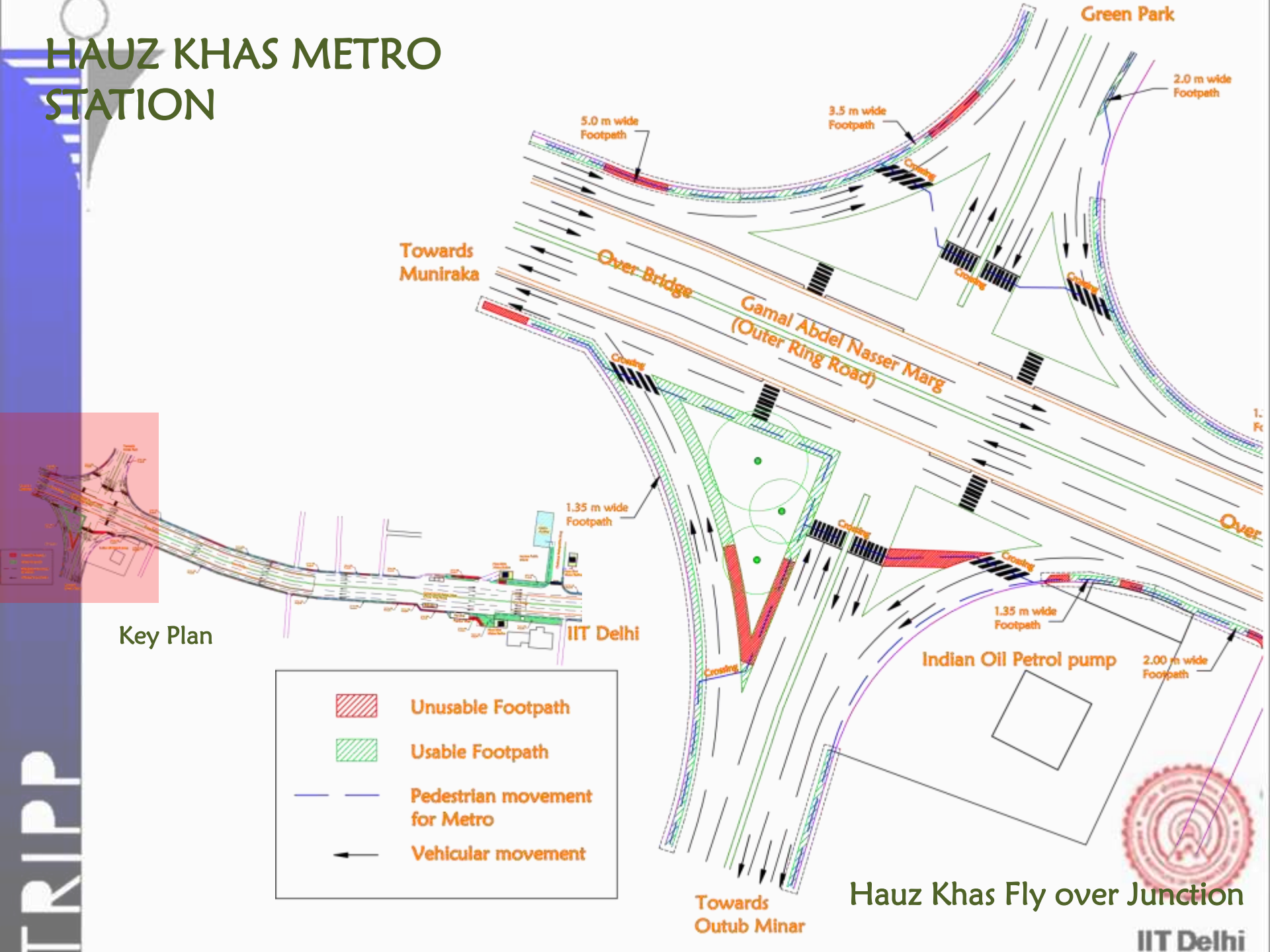
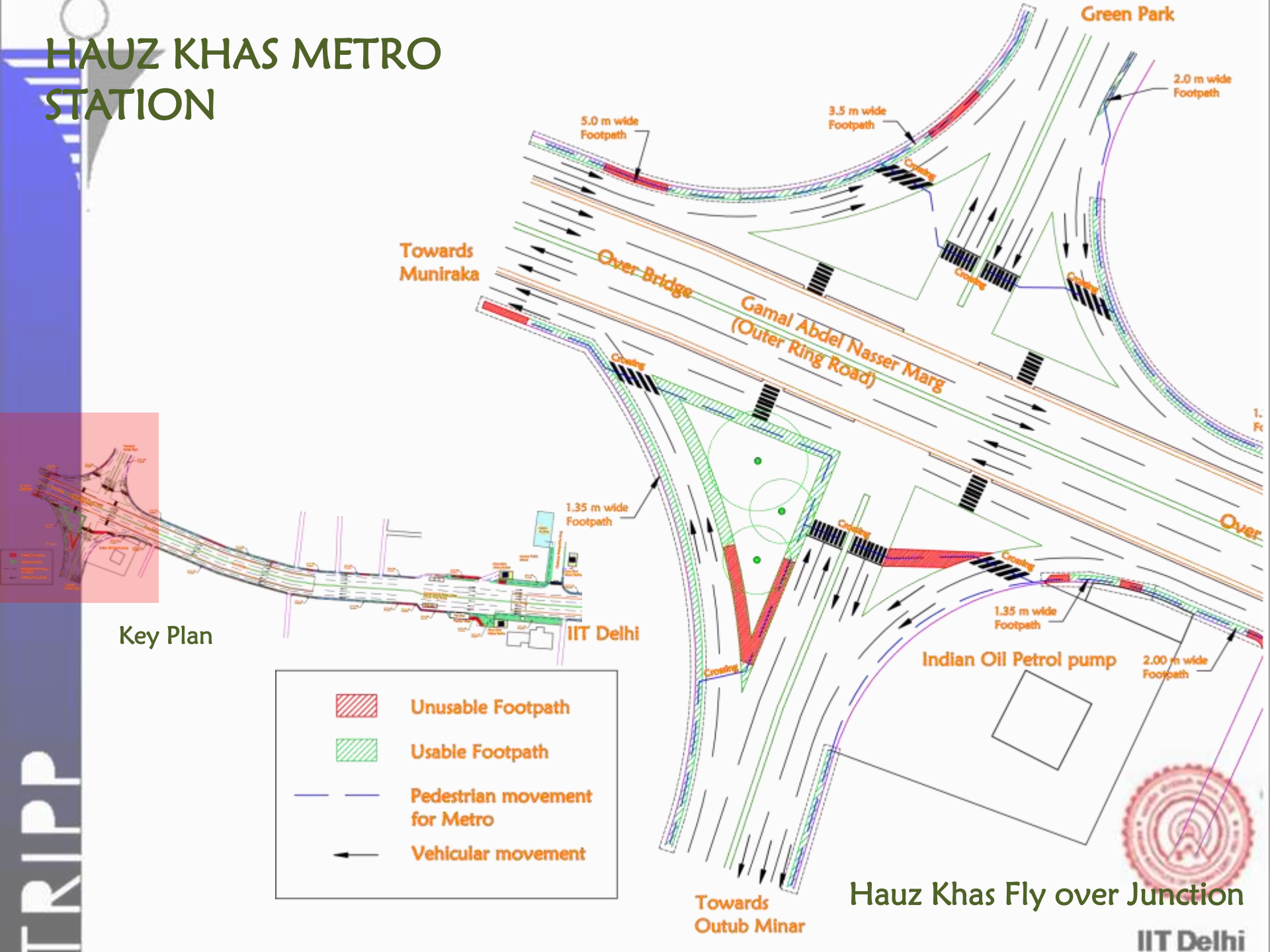
HAUZ KHAS METRO STATION



Sr. No	Aspects	Compli -ance	Observations	Remarks
1.	Distance of Junction from Metro station		550 m, 7-9 min (walking time)	Hauz Khas Flyover junction. Three Metro (Entrance and Exit) gates.
2.	Footpath along the road	Yes	1.3 m to 5 m (on both side of road). 10 m in front of metro station. Height of footpath – 0.15 to 0.60 m.	Usable footpath -78% , Unusable footpath -22% (Obstructions for Pedestrians on footpath- Hawkers, Trees, Electric Wires-Poles, Temple, Open drainage line, Parking, missing of steps, variation in widths)
3.	Pedestrian Crossing at Junction	Yes	100 m, 4 min (along the outer ring road) 70 m, 1.5 min (across the outer ring road)	Vehicular signal cycle length – 180 min.
	A. Crossing Along the road			
	Pedestrian signalized crossing	No		
	Zebra crossing (at grade)	Yes	Total zebra marking length- 70 m and width-3m	Zebra marking is in Good condition on both side.
	Subway or FOB	No		
	B. Crossing Across the road			
	Pedestrian signalized crossing	No		
	Zebra crossing (at grade)	Yes	Total zebra marking length- 30 m and width-3m	Zebra marking is in Good condition on both side.
	Subway or FOB	No		
	C. Barrier free design	No		No provision of Ramps to climb the footpath.

HAUZ KHAS METRO STATION



HAUZ KHAS METRO STATION

Key Plan

At Metro Station

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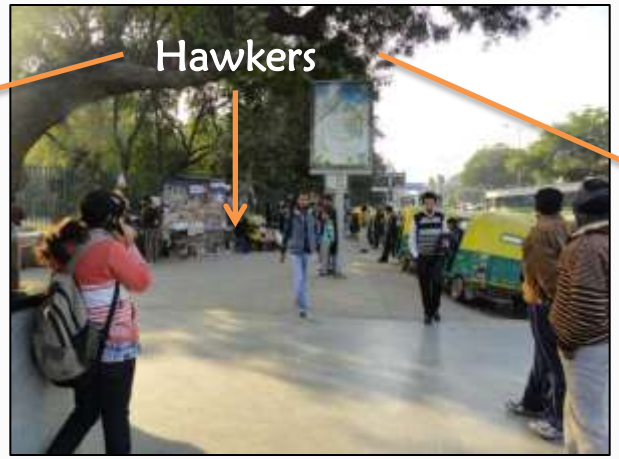
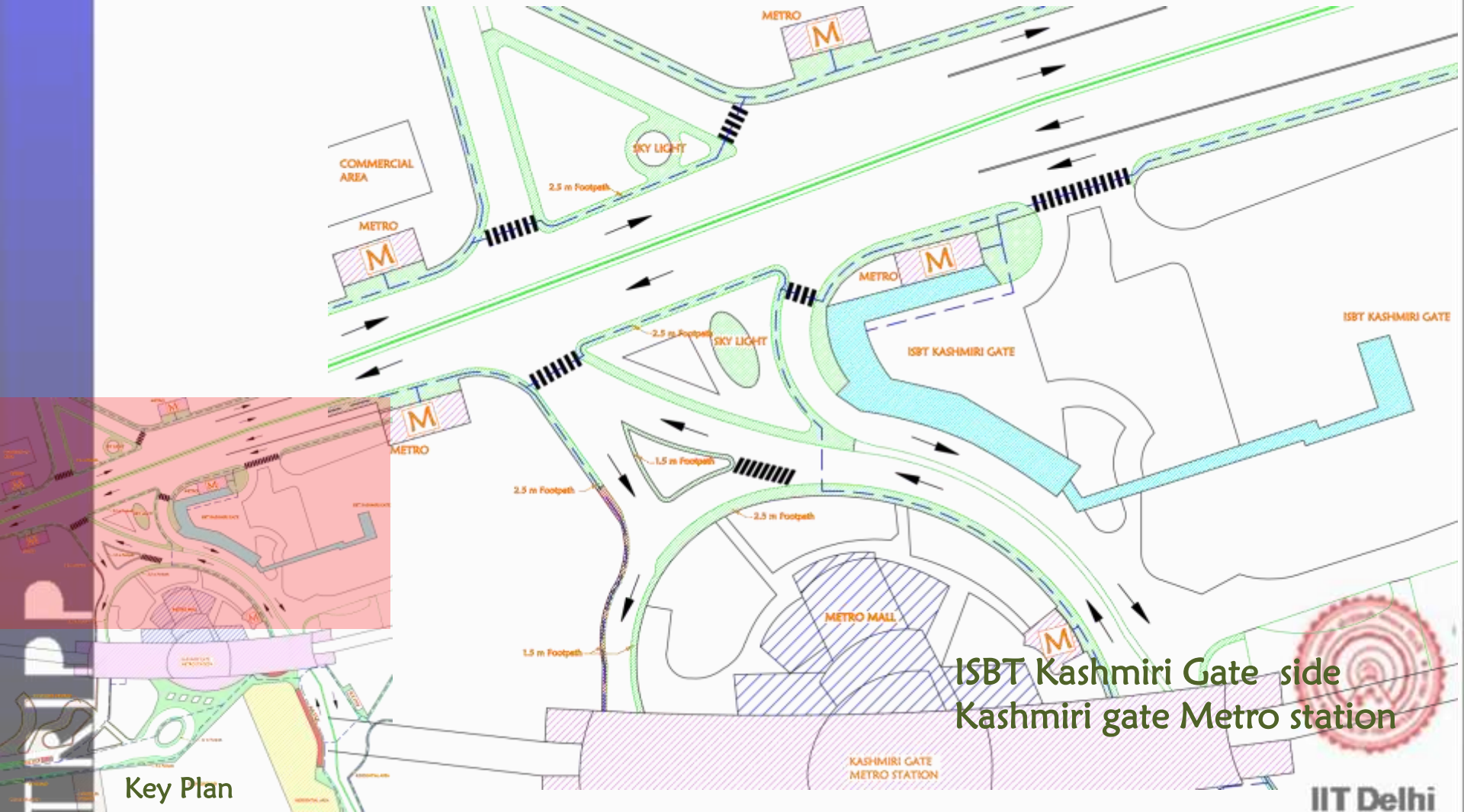
FOOTPATH – way for Pedestrians

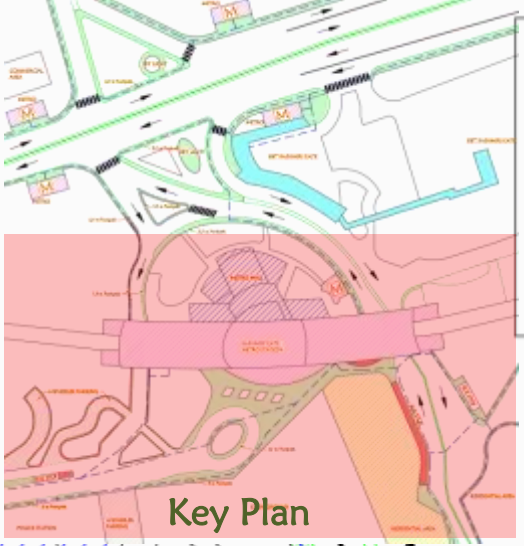
Footpath is a type of trail intended only for pedestrians, that offers more expedient or safer routes in urban areas. But many problems; like trees, poles, hawkers, encroachments, access, problems in designing of footpath like its width , height, lack of maintenance; make it unusable. Some of them are following:



KASHMIRI GATE METRO STATION



KASHMIRI GATE METRO STATION

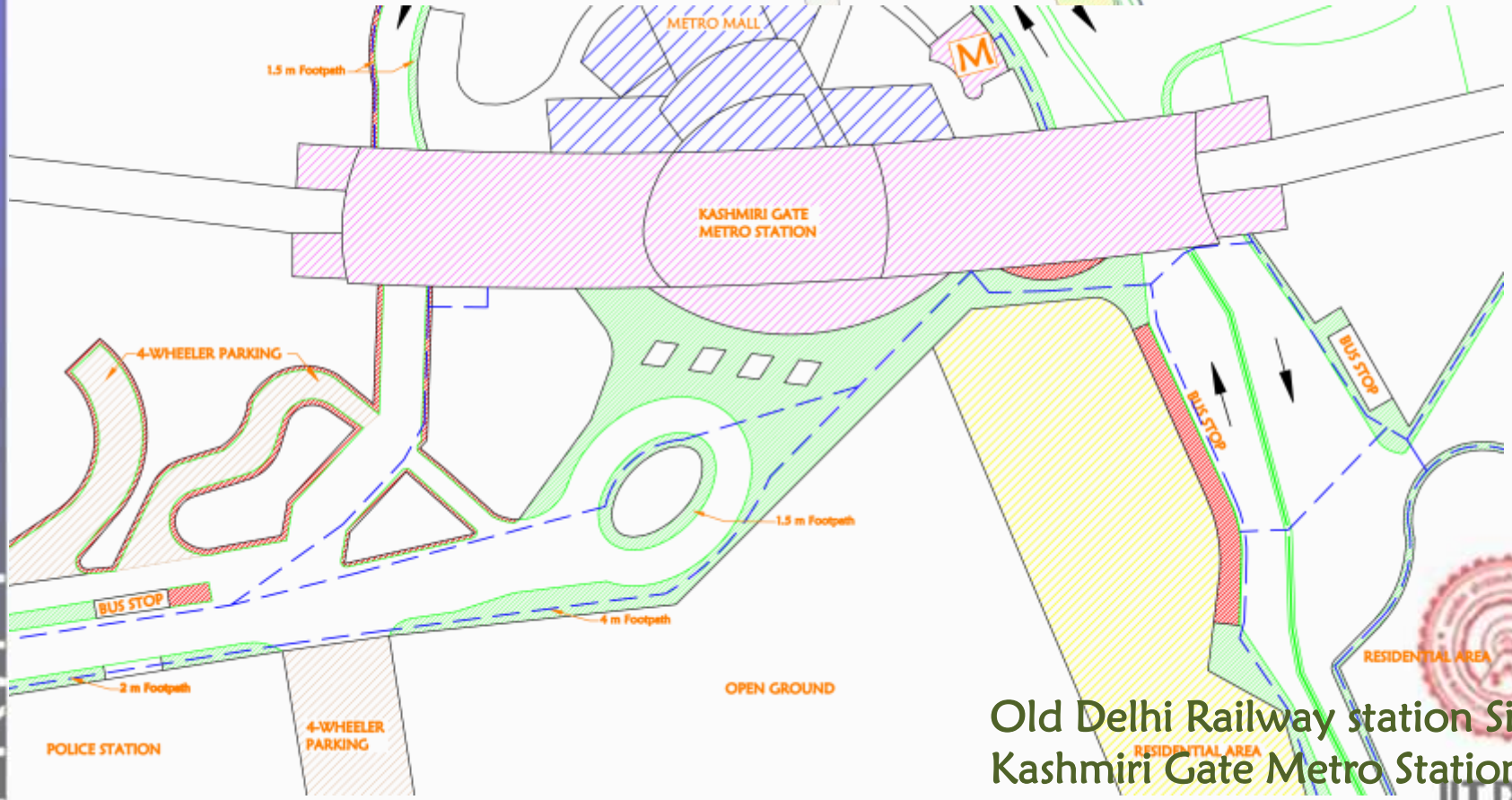


Unusable Footpath

Usable Footpath

Pedestrian movement for Metro

Vehicular movement



Old Delhi Railway station Side, Kashmiri Gate Metro Station

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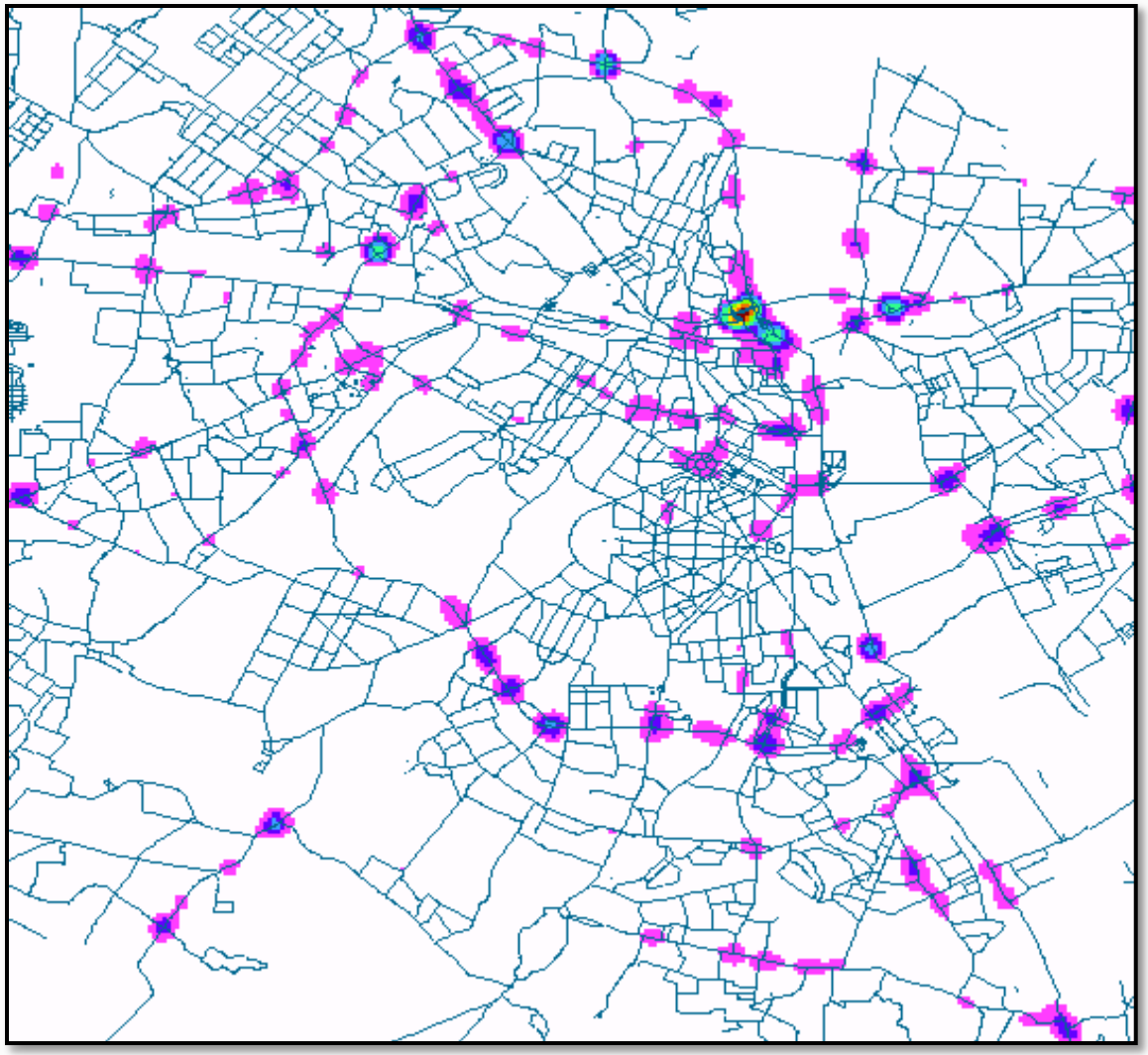


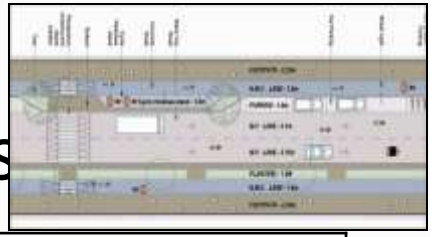
Density map for pedestrian accidents in Delhi, 2006-09

Case Study 2: NMT in Indian Cities

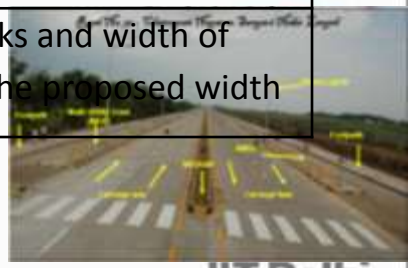
Data Gaps

	Bus	*Car/Jeep*	*2 wheeler*	*IPT*	*Cycle*	*Train*	*Walk*	*Other*	*Source*
Chennai	29	4	18	2	13	5	28	1	CDP 2006
	32	20	20	8	9		22		WSA 2008
Bengaluru	41%	4.56	30.4	5.77	1.68		16.26	0.37	CDP 2006
	41.91	6.62	29.4	11.56	2.22		8		CTTS 2007

Case Study 2: NMT in Indian Cities



	Proposed integration		Implementation status
Cities	**Walk**	**Cycle & cycle rickshaws**	
Ahmed.	2m both side footpaths, signalized level crossing and sub-ways at mid-block	2 m wide cycle track with signalized crossing	Obstructed and discontinuous footpaths and bicycle tracks Designed widths do not meet standards. As in 2011 bicycle tracks to be removed to give space for motorized vehicles (TNN, 2011)
Pune	Continuous min. 1.5 m wide barrier free footpaths, with signalized raised zebra crossing	1.5m for cycle lanes and 2.5m for cycle tracks and free parking 60m from bus stops	Continuous footpaths; discontinuous bicycle tracks at certain patches, obstructions and lack of enforcement on using footpaths and cycle tracks by MV users
Surat	3 to 5m wide pedestrian activity areas & elevated mixed traffic lanes at mid-blocks	2m wide cycle tracks	
Jaipur	2m wide footpath with signalized crossing	2.5m wide cycle track with parking	No dedicated bicycle tracks and width of footpaths do not match the proposed width



Case Study 2: NMT in Indian Cities cont

Where is the space?

Nanded, Delhi existing corridors redesigned,no land acquisition.

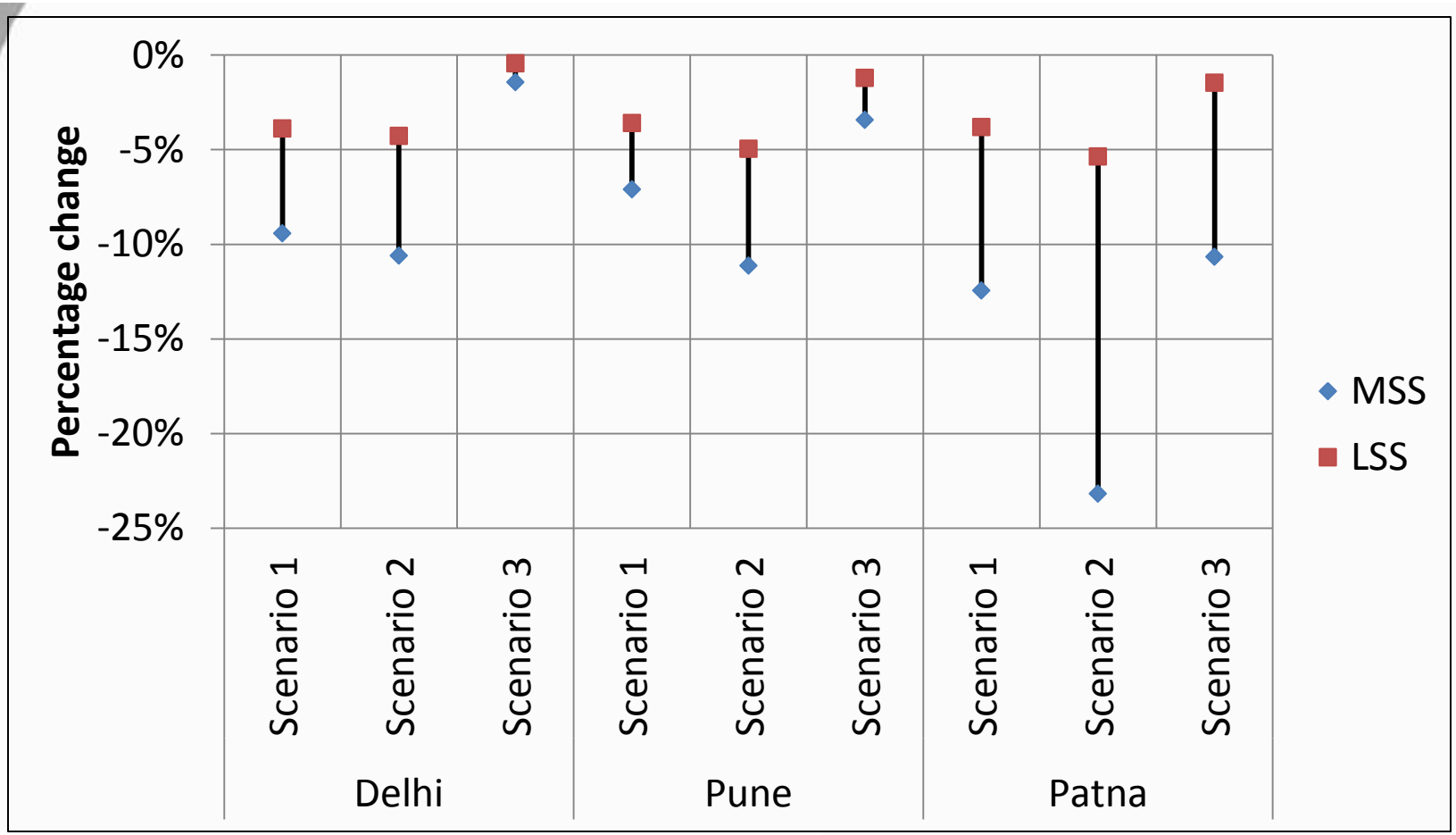
Will NMT users utilize the provided infrastructure?

No.of bicycle users increased by 70% in Delhi

Barriers in realizing the full benefits from NMT infrastructur in Delhi

Encroachedby Cars,twowheelers, constructionmaterials.

CO_2 Emissions in Maximum and Minimum Shift Scenario



- Maximum reduction in CO_2 is in Patna and least in Delhi.
- Need to emphasize on megacities to reduce maximum amount of Co2 emissions
- Need to focus on large cities to get maximum benefit

Scenario 1 Improving only bus infrastructure
Scenario 2 Improving both bus and NMT infrastructure
Scenario 3 Improving only NMT infrastructure