A Policy Modeling Framework for Sustainable Urban Transport

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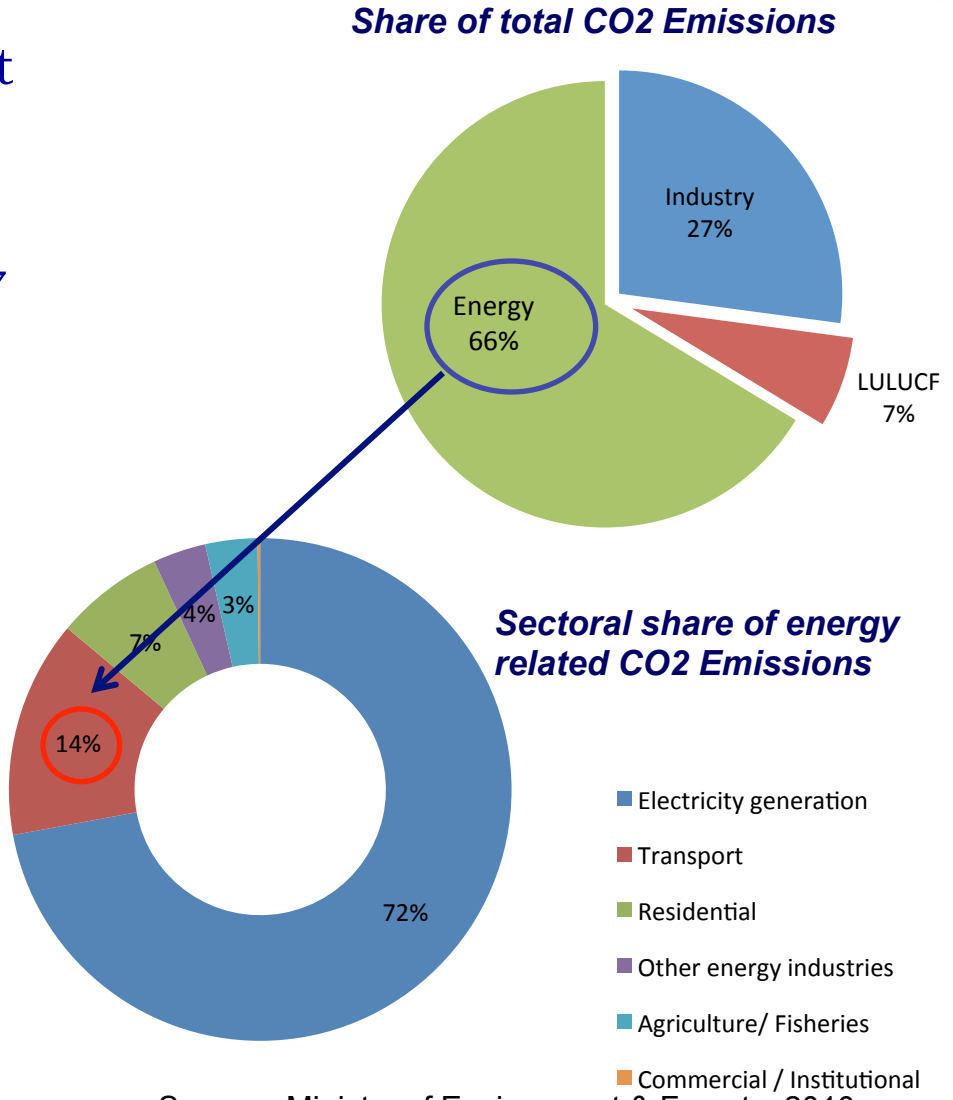
Stanford University

Overview

1. Context
2. Research Problem
3. Policy Framework
4. Preliminary results for pilot city

Emissions from transport : 2007

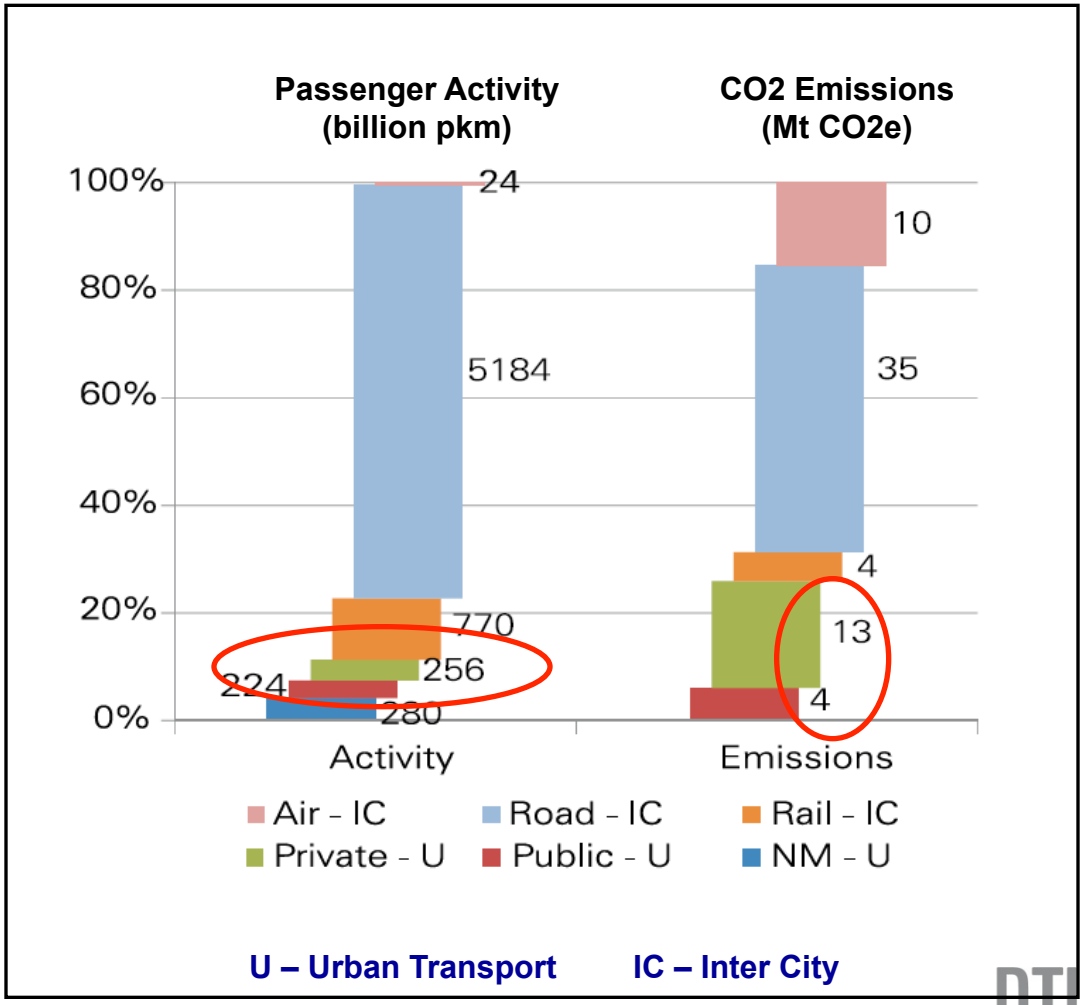
- Transport second largest contributor to CO_2 emissions from energy
- Freight accounted for 67 $MtCO_2$
- Passenger transport accounted for 66 $MtCO_2$



Source : Ministry of Environment & Forests, 2010

Passenger activity in 2007

- Demand for motorized urban transport is about 480 billion pkm.
- However accounted for 26% of CO_2 emissions from passenger transport
- High impacts on local air quality and health



Source : Planning Commission, 2011

National Policies

- National Action Plan on Climate Change
  - 8 Missions
  - National Mission on Sustainable Habitats
- Pledge to reduce emission intensity of GDP by 20-25% over 2005 level by 2020

- Jawaharlal Nehru National Urban Renewal Mission
  - Focused on creating urban infrastructures
  - **City Development Plans**
  - **Comprehensive Mobility Plans**
- Low carbon planning missing at city level

Research Problem

How to integrate climate change actions within the mobility plans of the city

1. What are national climate scenarios for transport sector?
2. How to make city plans consistent with macro economic assumptions at national level?
3. How to integrate technology transitions at national and city level?
4. How to make city mobility plans consistent with national climate scenarios?

Policy Framework for Sustainable Urban Transport

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Scenario at National Level

Macro Economic Module

Inputs
- GDP Projections India
- GDP Base year city
- City Development Plans
- National Development Plans

Outputs
- GDP Projections City Level
- Economic output from Household, Industry and Commercial sector
- Labour Input for different sectors

Model Framework
- I/O framework

Mobility Module

Inputs
- Economic output from Household, Industry and Commercial sector
- City Development Plans
- National Development Plans
- Labour input for different sectors

Outputs
- Demand for mobility
- Modal shares
- Infrastructure needs
- Traffic speed

Model Framework
- Land use transportation model

Economy Energy Environment Module

Inputs
- Demand for mobility
- Modal shares
- Infrastructure needs
- Technology assumptions

Outputs
- Energy Balances
- Emission of CO2, SO2, etc.
- Investments

Model Framework
- Energy System model

Sustainability Indicators : National / City Level

Economic
Per capita mobility, Average speed, per capita transport expenditures

Social
% of household budget on transport, Transit prices

Environmental
Per PKM energy use, per PKM CO2 emissions

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Climate Stabilization and Sustainability

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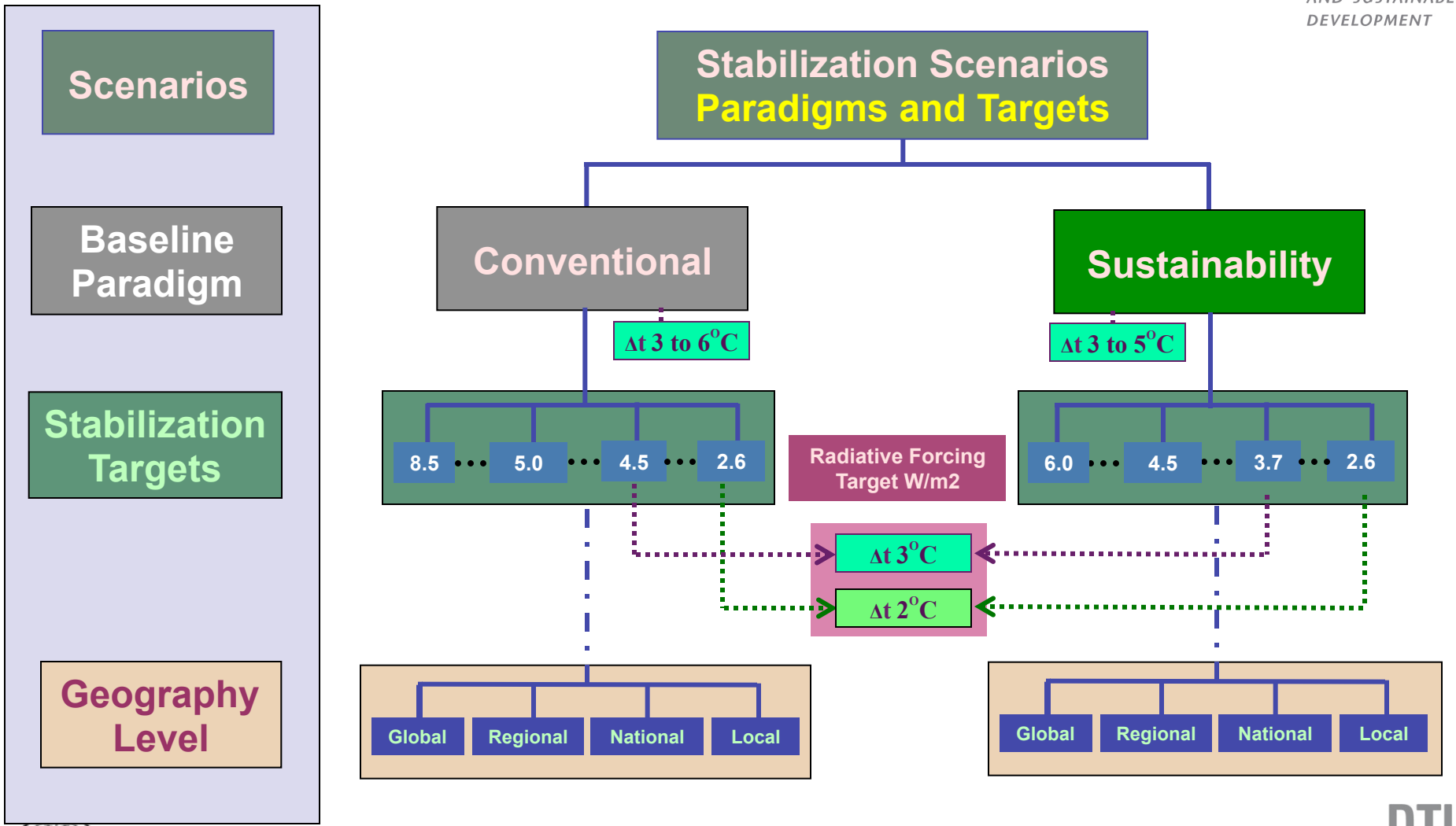

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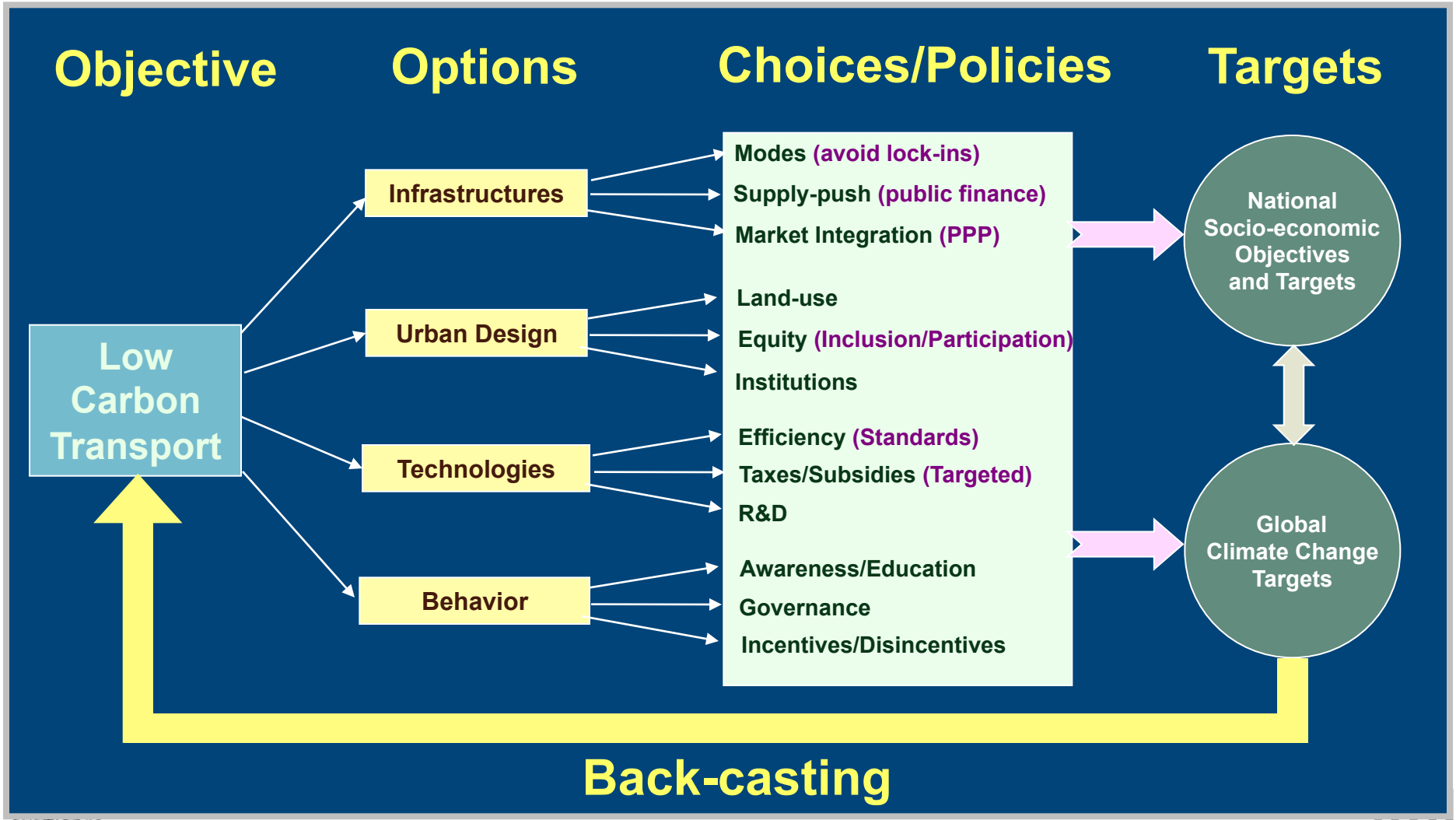
Sustainable Low Carbon Mobility Framework



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Results: National Scenarios

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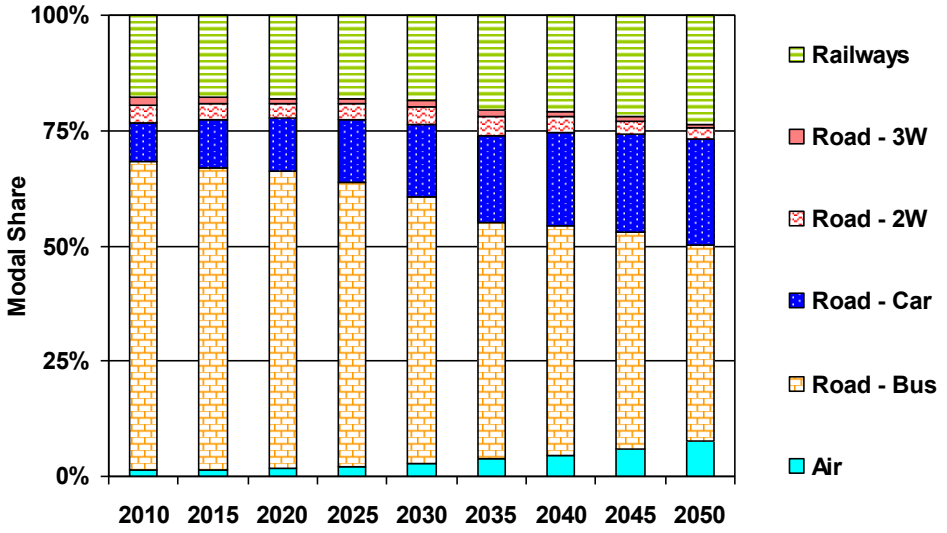
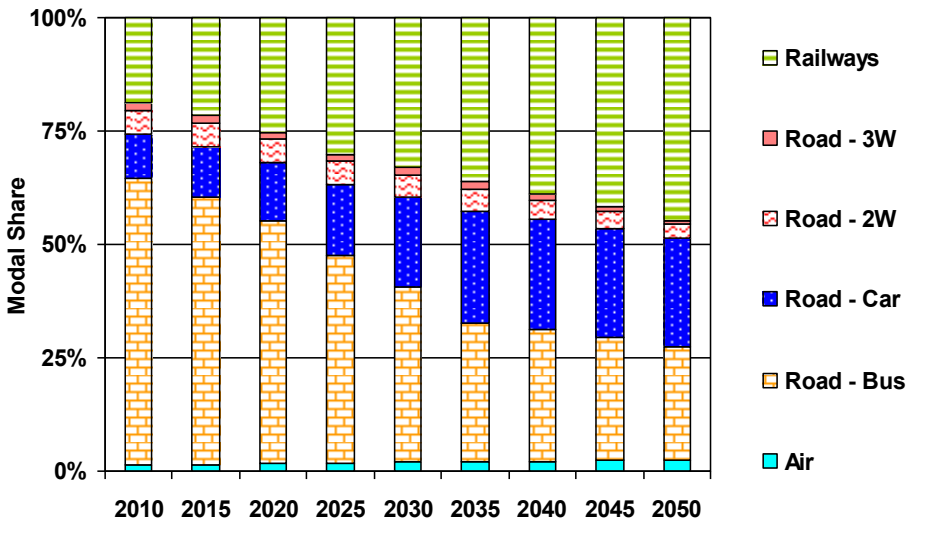
Passenger Transport Demand - Motorised

Base Case



4971	9770	13875	17051	20118	Billion pkms
16%	17%	20%	22%	22%	Urban Demand

450 ppm + Sustainability



4971	6297	8911	11920	15402	Billion pkms
16%	19%	22%	23%	22%	

Results : National Scenarios

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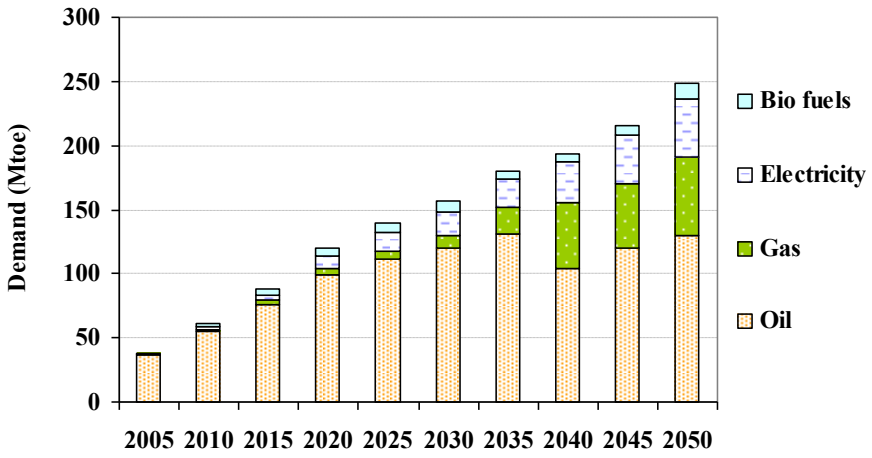
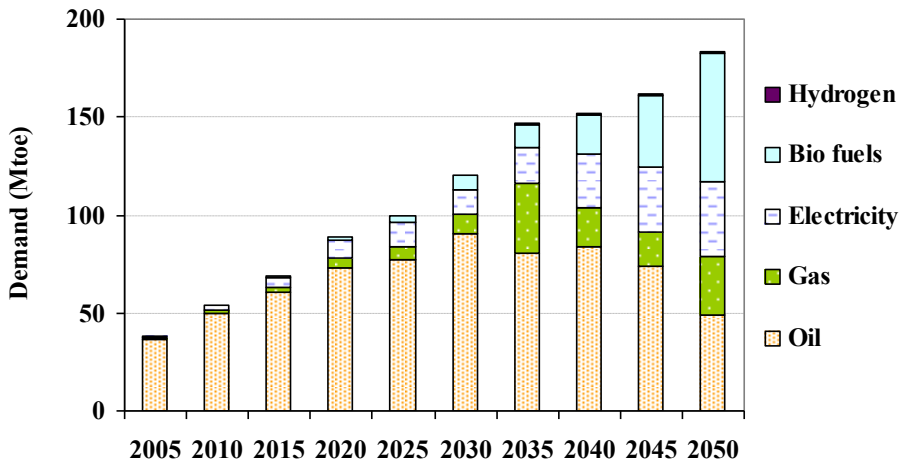
Transport Energy Demand : Base Case



Transport Energy Demand : 450 ppm + Sustainability Paradigm (ST)



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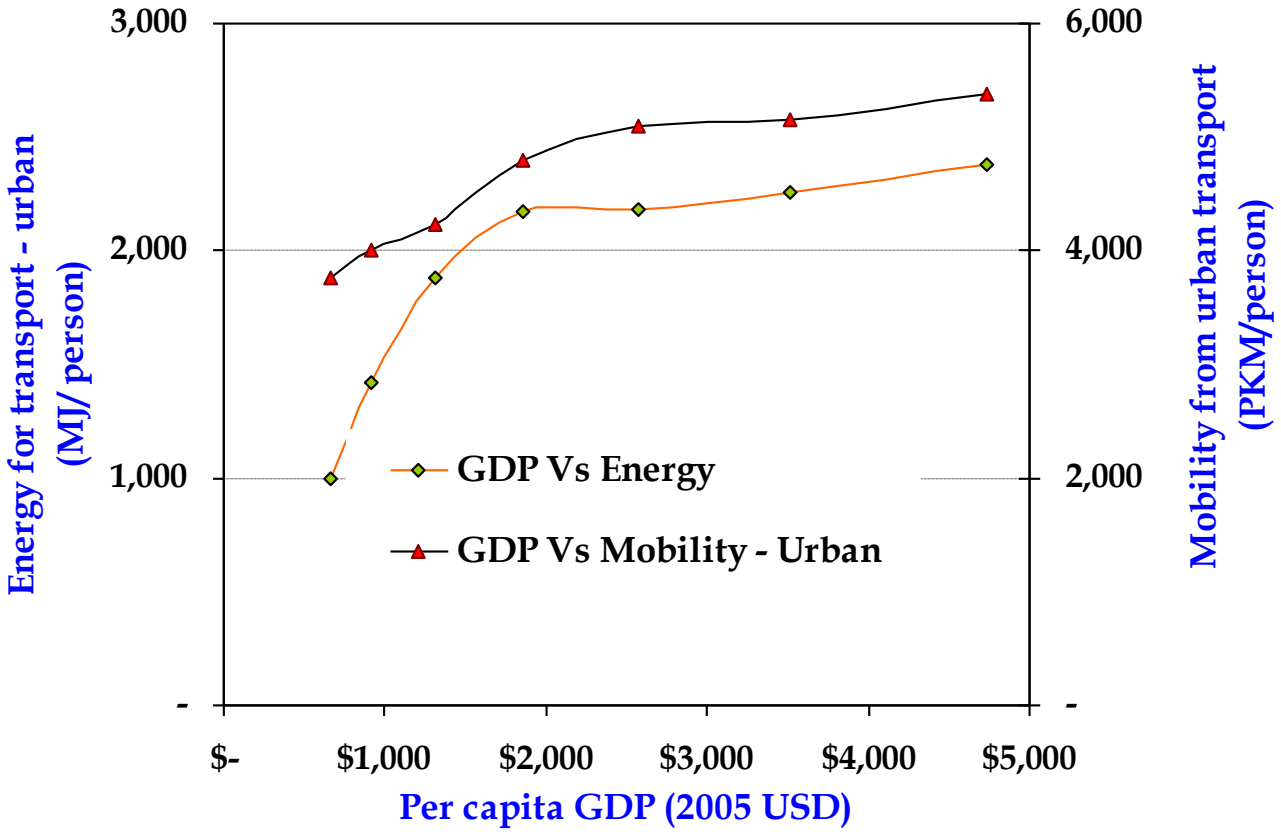
Indicators at National Level



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Results : City Level

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Results : Macro economic module

Macro Economic Module

Inputs
- GDP Projections India
- GDP Base year city
- City Development Plans
- Sectoral Development Plans

Outputs
- GDP Projections City Level
- Economic output from Household, Industry and Commercial sector
- Labour Input for different sectors

Model Framework
- I/O framework

Ahmedabad 2005

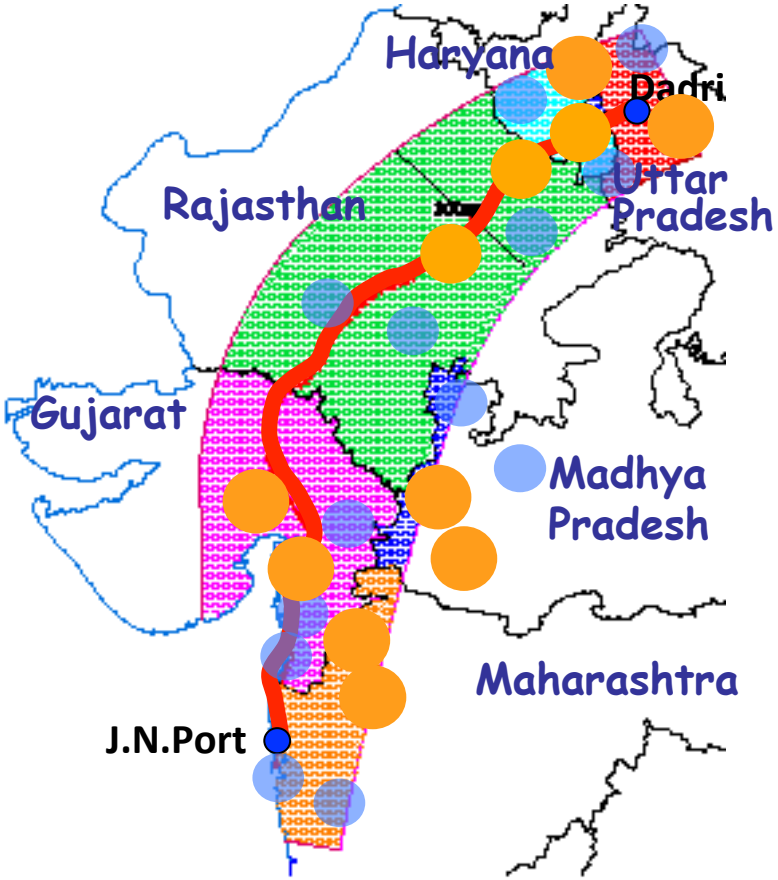
Billion INR					2005
	Agriculture	Manufacturing	Construction	Electricity & Water	Services
Total Input	5.85	261.36	17.45	6.58	38.33
Labour	9.3	51.44	11.32	2.66	94.95
Capital	2.32	12.86	2.83	0.66	23.74
Tax & Subsidy	-0.46	26.54	0.06	-0.81	-0.1
Total Output	17.01	352.2	31.66	9.09	156.92
Million Mandays	47	114	32	5	190

Ahmedabad 2035

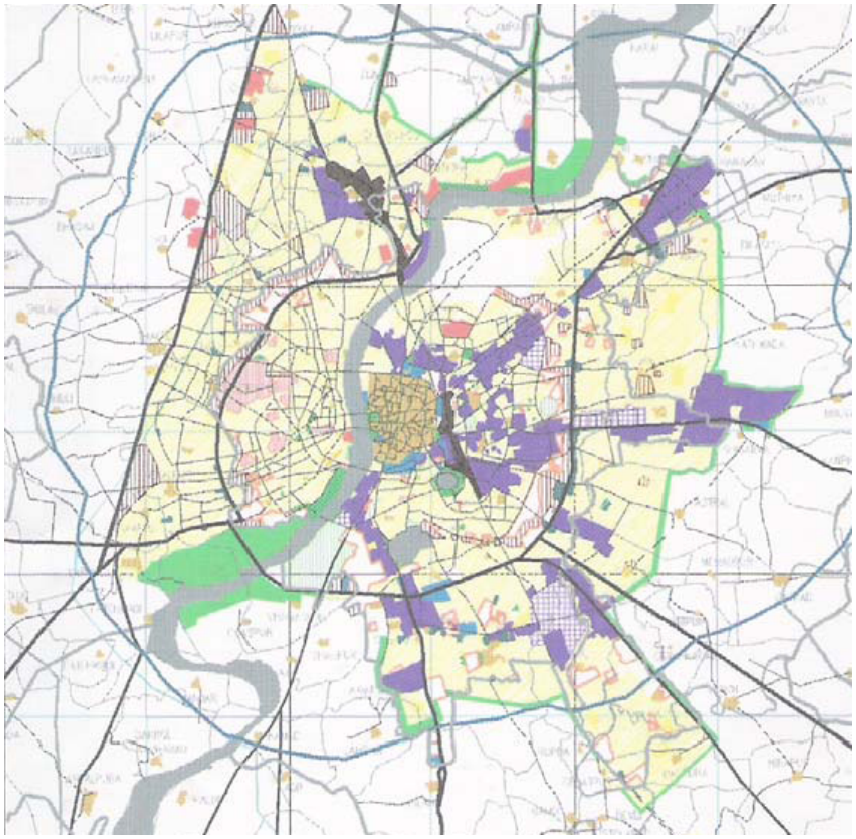
Billion INR					2035
	Agriculture	Manufacturing	Construction	Electricity & Water	Services
Total Input	39.54	2706.48	324.83	194.75	654.51
Labour	62.82	532.66	210.73	78.68	1621.16
Capital	15.7	133.17	52.68	19.67	405.29
Tax & Subsidy	-3.11	274.85	1.16	-24	-1.69
Total Output	114.95	3647.16	589.4	269.1	2679.27
Million Mandays	55	206	105	27	426

Some inputs : Mobility Module

DMIC Freight Corridor



Land Use Plan



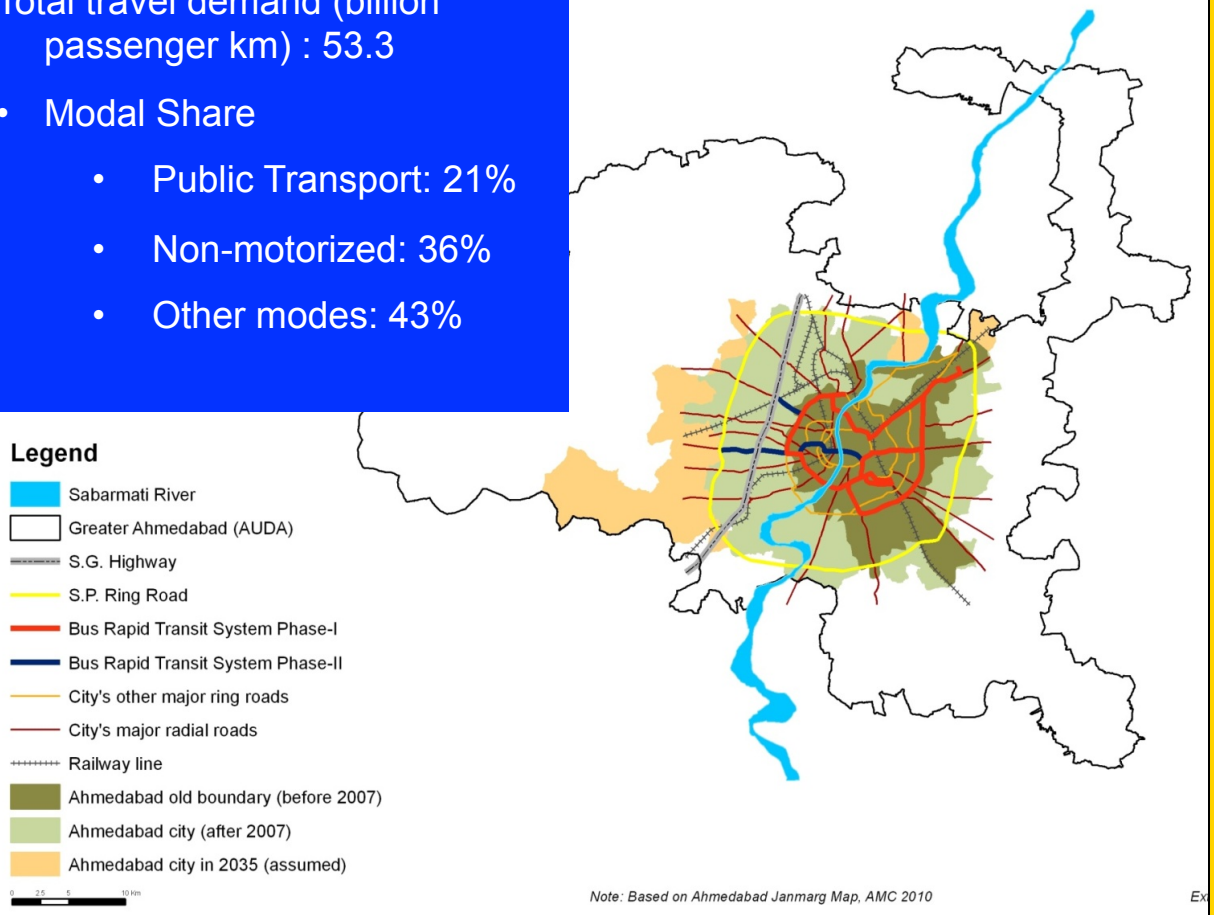
Source. City Development Plan for Ahmedabad

Results: Mobility Module

Ahmedabdad 2035

Total travel demand (billion passenger km) : 53.3

- Modal Share
  - Public Transport: 21%
  - Non-motorized: 36%
  - Other modes: 43%



Note: Based on Ahmedabad Janmarg Map, AMC 2010

Mobility Module

Inputs

- Economic output from Household, Industry and Commercial sector
- City Development Plans
- National Development Plans
- Labour input for different sectors

Outputs

- Demand for mobility
- Modal shares
- Infrastructure needs
- Traffic speed

Model Framework

- Land use transportation model

Results Base Case : Energy Environment Module

	Unit		2005	Base Case	2035
		India	Ahmedabad	India	Ahmedabad
End use demand					
Passenger transport demand	Billion pkm	3,499.16		15,059.89	
Out of which urban transport	Billion pkm	575.88	14.9	3,268.02	53.3
Outcomes					
Energy demand for transport - Urban passenger	Mtoe	7.59	0.20	39.02	0.64
CO2 Emissions for transport - Urban passenger	Million tCO2	21.67	0.54	138.55	2.26
Per capita indicators					
CO2 Emissions for transport - Urban passenger	tCO2/person	0.07	0.11	0.20	0.29
Passenger transport demand (Urban)	PKM/person	1,768.87	3,170.21	4,758.09	6,833.33
Efficiency indicators					
Energy intensity Passenger transport - Urban	toe/MillionPKM	13.18	13.29	11.94	11.94

LCS Ahmedabad: 2035

- Back casting approach
- % Reduction in CO2 emissions at national level made equal to reductions at the City Level
-
  - A - Reducing demand for transport (Urban design, behavioural change, information technology)

    From 53.3 Billion PKM to 32.07 Billion PKM
  - B – Shifting to sustainable modes (Improve infrastructures for public transport, non motorised transport)

    Modal Share PT increased to 50% from 21%. Increased PT with additional investments in footpath, cycle tracks to increase NMT share to 35%.
  - C – Improving of motorised transport (Efficient Technology, Infrastructures for cleaner fuels, behaviour change through incentives)

    Overall A+S+I result in reduction of demand for energy from 0.64 Mtoe to 0.26 Mtoe

Conclusions

1. Reduction in travel demand and modal switching require major changes in infrastructures and urban design.
2. Data availability
   - At national level: no separation for urban travel demand
   - at city level very inadequate, e.g, IO tables, Energy balances
3. More work required for
   - Integrating feed back in mobility module
   - On indicators
   - Quantification of co-benefits
   - User costs

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Thank You

Questions / Suggestions

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