

The 18th AIM International Workshop

Sustainable Low Carbon Transport Scenario for India

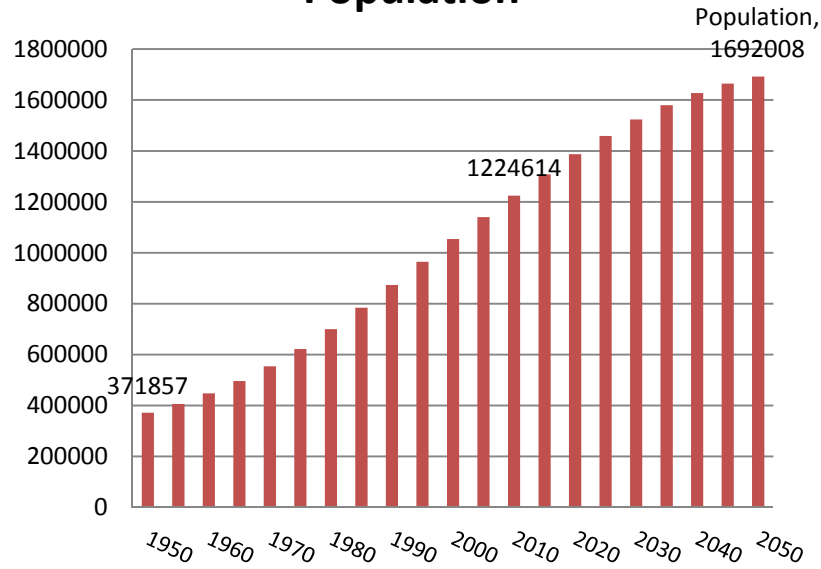
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Ahmedabad, India

Flow of the Presentation

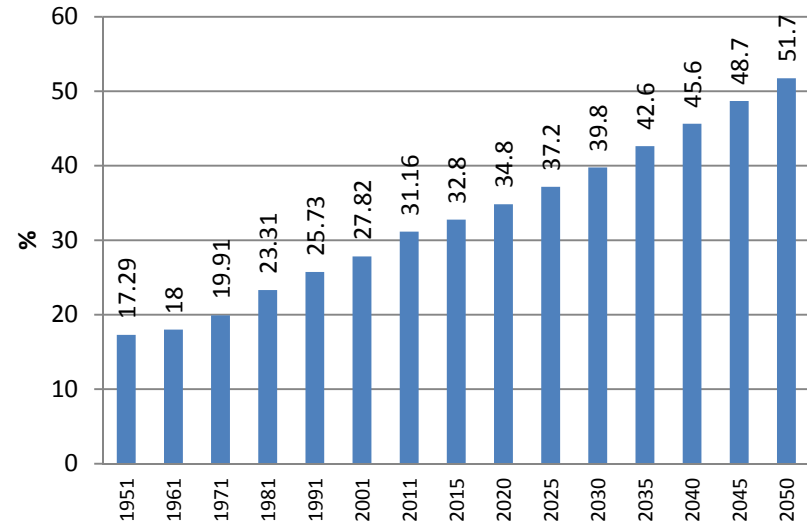
1. Basic Information about the target region
2. Contribution of Transport to India's total CO₂ emissions
3. Objectives
4. Strategies for Sustainable Low Carbon Transport
5. Scenario assumptions
6. Results

India: Demographics and Economic Growth

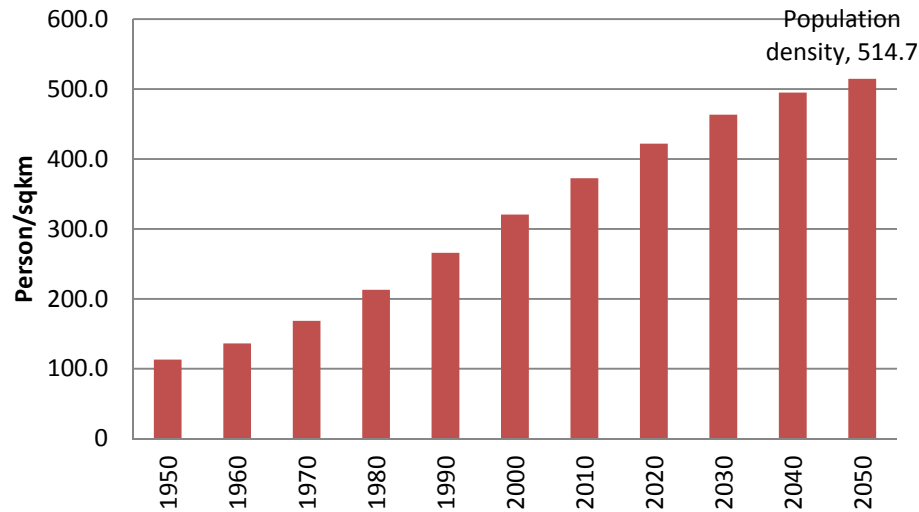
Population



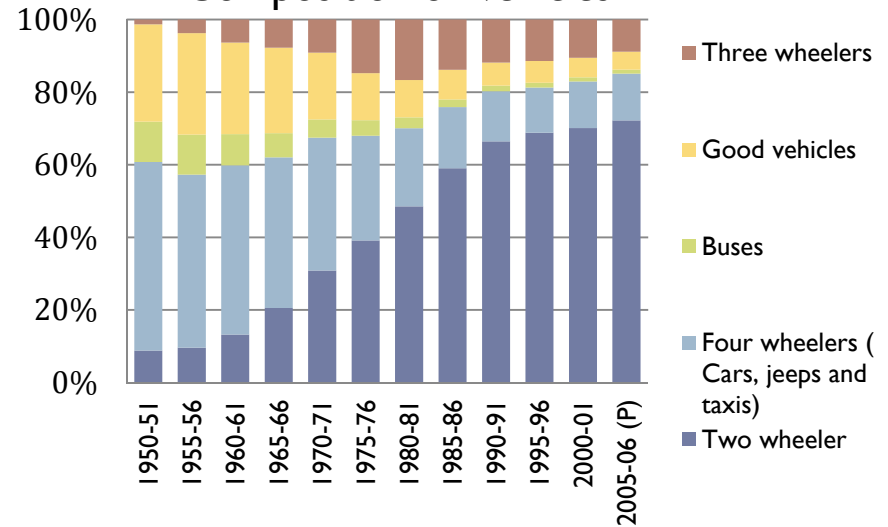
Urbanisation : %



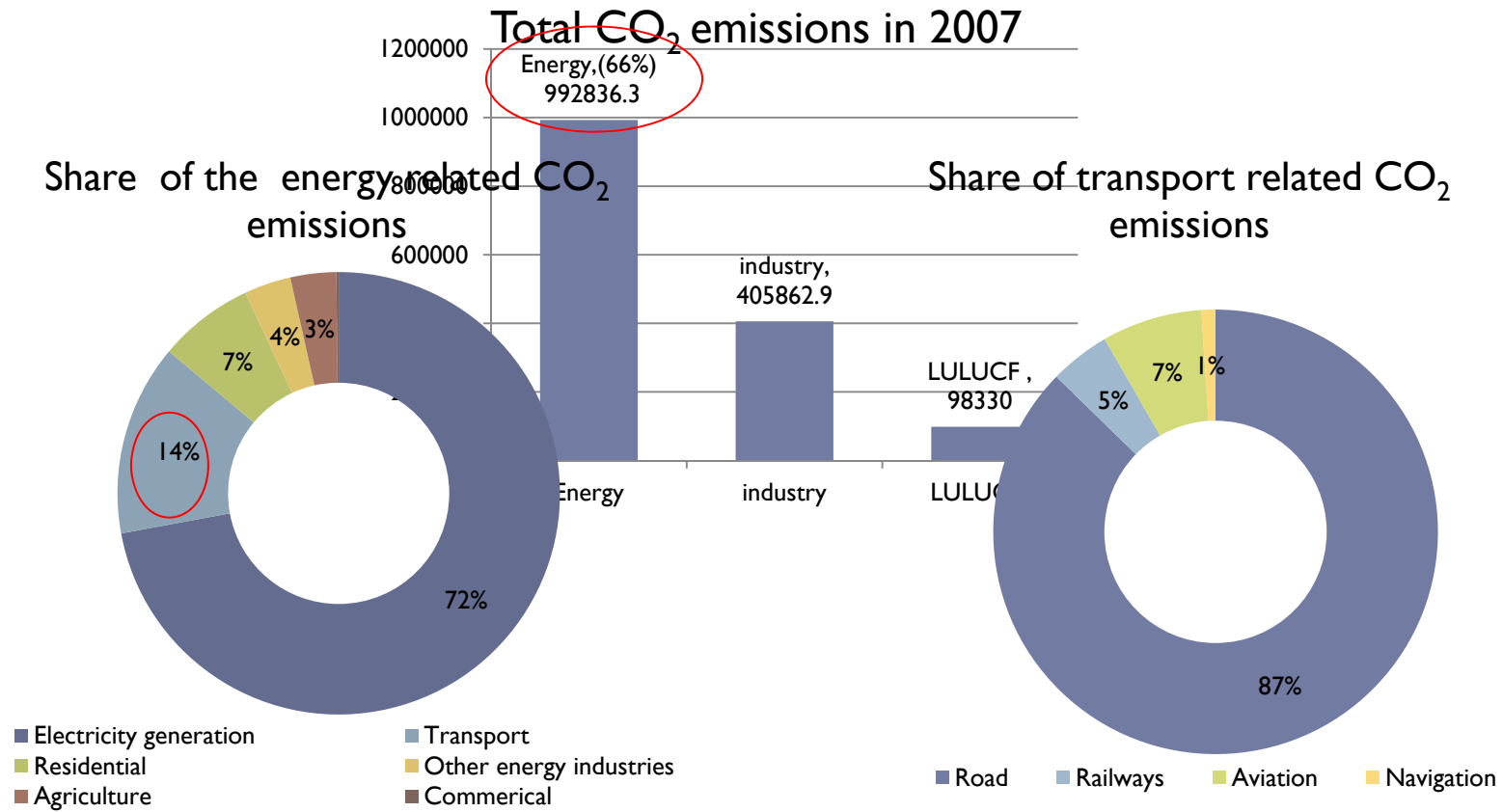
Population density



Composition of Vehicles



Contribution of Transport to India's total CO₂ emissions



Source : MOEF(2010)

Objectives

- Assess long-term transitions of the national transport system under low carbon stabilization scenarios
- Long term emission trajectories using different demand and supply side strategies under different scenarios

Strategies for Sustainable Low Carbon Transport

Demand side strategies

- Sustainable mobility :
 - Reducing the number of trips : shifting to ICT technologies i.e. video conferencing, online shopping
 - Reducing the average travel distance: by improving land-use planning

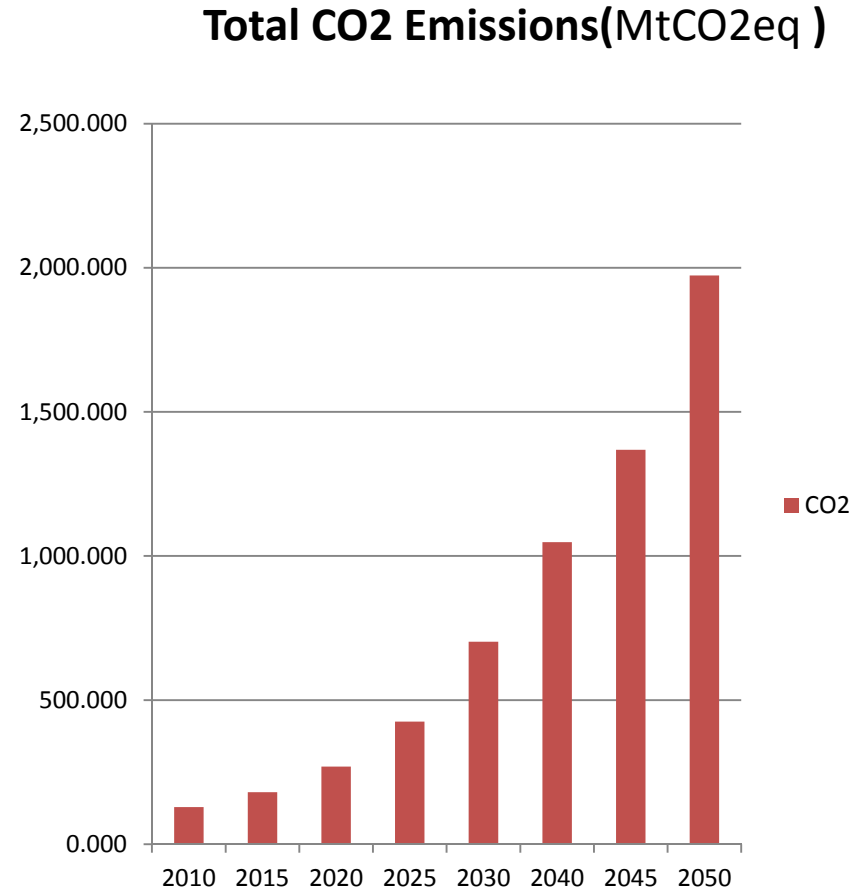
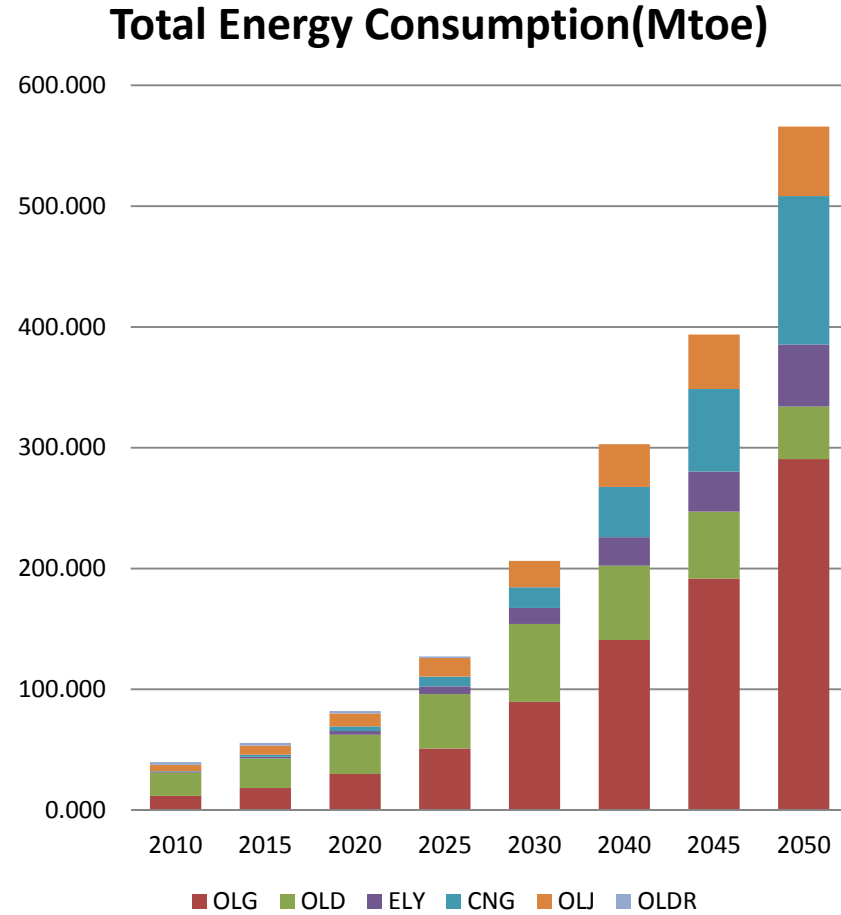
Supply Side strategies

- Sustainable energy : Cleaner fuels (bio-fuels, renewable electricity)
- Sustainable technologies : reducing car size
- Increasing the modal share of less energy intensive mode like railways, public transport & NMT

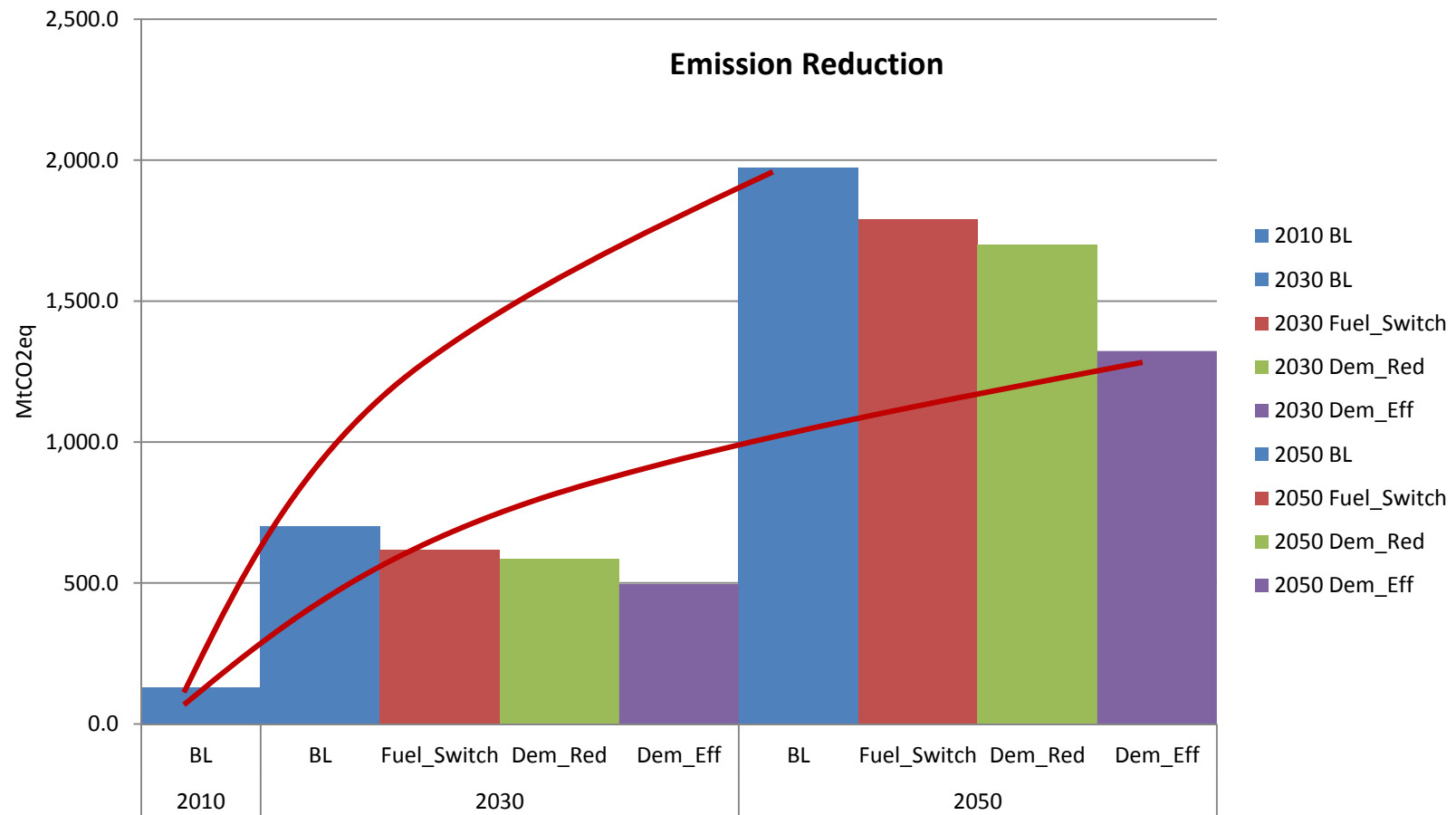
Scenario assumptions

Scenario	Key Drivers	Critical parameters
Sustainable Low carbon transport Scenario	Shift from fossil fuels, high share of mass transit system, Sectoral demand, Energy efficiency	Transport demand (↓) , Efficiency improvement (↑) , penetration of renewable technologies(↑) fuel consumption(↓) ,
Climate Centric Scenario	Carbon tax, strong global environmental concerns, rate of technological change, access to global technologies , technology transfer	Early penetration of advanced and clean technologies, technology development rate (↑)

Business As Usual Scenario

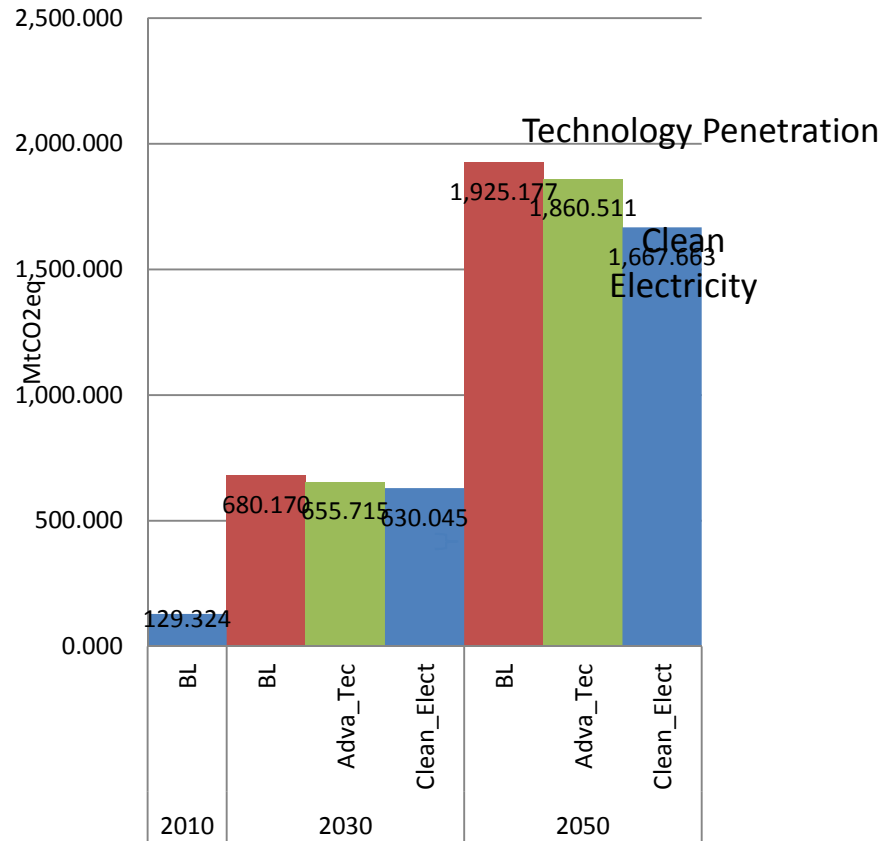


Sustainable Low Carbon Transport Scenario

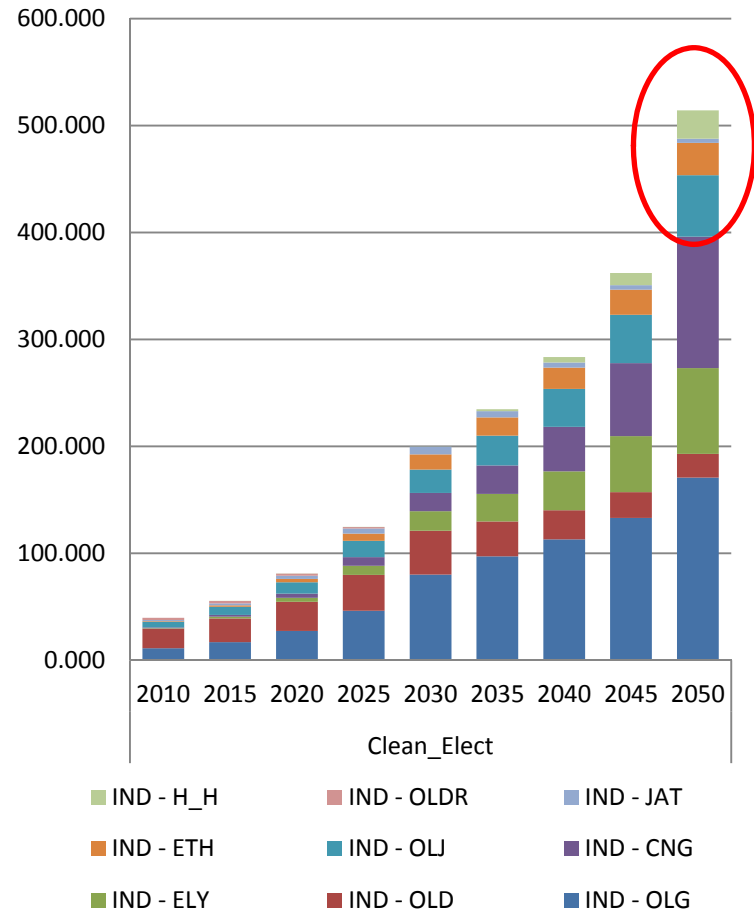


Climate Centric Scenario

Total CO2 Emissions(MtCO2eq)



Total Energy Consumption(Mtoe)



Low Carbon Scenario in Transport Sector at Bhopal

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Basic information of country and city

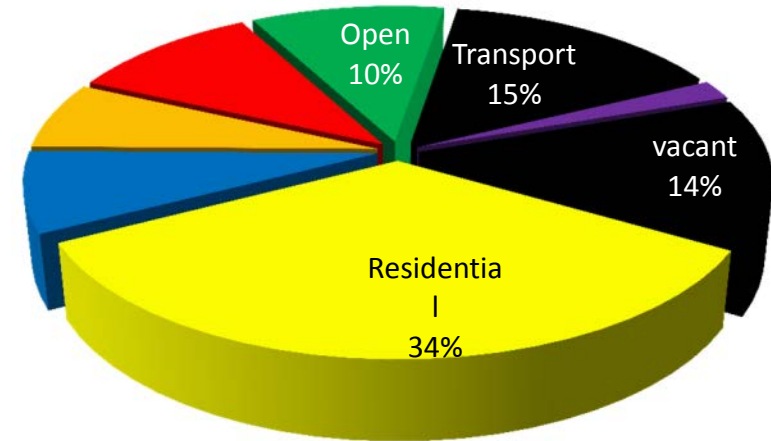
Population of India
- in year 2011
1.22 billion

Population of
Madhya Pradesh in
year 2011
7,25,97,565

Population of
Bhopal Census
2011
23,68,145

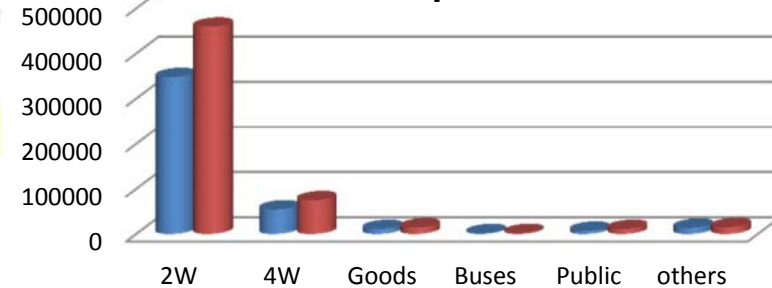


Area of District 2,772 km².



Land Use distribution in Bhopal

Vehicular Growth in Bhopal



Vehicular population in Bhopal

Bhopal - Urban Agglomeration	Year 2005
Two- wheelers	347571.00
Autos/ Tempo	10127.00
Cars/Taxi	37455.00
Buses	8294.00
Goods Carriages	9854.00
Tractors/ Others	14675.00
Total	427976.00

Population

Municipal Corporation	Total Population		Decadal Growth Rate
	2001	1991	
Indore	1474968	1091674	35.11
Bhopal	1437354	1062771	35.25
Jabalpur	932484	741927	25.68
Gwalior	827026	690765	19.73

Source: Census of India, 2001, 1991

Objectives of the study

In the developing countries Study at Local level are important for fast growing cities with multiplying demand.

To develop Local level detailed model for urban and rural context to incorporate the local factors and lifestyle for precise results.

AIM/Enduse model is applied for projections in Transport Sector and Residential Sector for Urban and Rural Areas in Bhopal

Workshop was a learning of application of model in understanding the role of Emission tax, Energy tax, discount rate for return and shares of technologies to develop Scenarios to achieve for Low Carbon Societies.

Assumptions

Services in Transport Sector

Gas - 1 CO2
 Region - 2
 Sector - 2
 Service - 4
 Energy - 17
 Device - 75

Service	Region	Sector	Unit	2005	2020	2030
TRF	BhopalR	TRANS_R	MTKm	103.12	78.283	58.153
TRP	BhopalR	TRANS_R	MPKm	646.99	491.114	364.827
TUF	BhopalU	TRANS_U	MTKm	154.67	419.697	629.913
TUP	BhopalU	TRANS_U	MPKm	2587.95	7022.407	10539.75

Assumption : future energy price (Lakh Rs./GJ)

Assumption : future emissions) MtCO2eq

	2005	2020	2030	2005	2020	2030
ANM	0.0000000001	0.00000000011	0.0	0.0	0.0	0.0
DSL	850.0	1020.0	1173.0	73143.0	73143.0	73143.0
ELC	860.0	1032.0	1186.8	68053.5	68053.5	68053.5
GSL	900.0	1080.0	1242.0			
HVO	800.0	960.0	1104.0	75721.5	75721.5	75721.5
HYD	0.0000000001	0.0	0.0	0.0	0.0	0.0
LPG	410.0	492.0	565.8	53100.0	53100.0	53100.0
LSC	45.0	54.0	62.1	92708.0	92708.0	92708.0
LSHS	900.0	1080.0	1242.0	77125.0	77125.0	77125.0
MAN	0.0000000001	0.0	0.0	0.0	0.0	0.0
NGA	90.0	108.0	124.2	52050.0	52050.0	52050.0
NUF	2000.0	2400.0	2760.0	0.0	0.0	0.0
OIL	100.0	120.0	138.0	72600.0	72600.0	72600.0
SKO	700.0	840.0	966.0	68200.0	68200.0	68200.0
SOL	0.0000000001	0.0	0.0	0.0	0.0	0.0
WIN	0.0000000001	0.0	0.0	0.0	0.0	0.0

Transport Urban Passenger Existing Technology

CODE	REGION	SECTOR	STOCK	SERVICE	UNIT	OUTPUT QUANTITY	ENERGY1	UNIT	QTY	ENERGY 2	UNIT	QUANTITY
T2EU	BhopalU	TRANS_U	344.017	TUP	MPKkm	0.020075	GSL	GJ	0.3311	HVO	GJ	0.0003
T3EU	BhopalU	TRANS_U	52.794	TUP	MPKkm	0.0292	GSL	GJ	0.551833	HVO	GJ	0.0005
T3HU	BhopalU	TRANS_U	35.196	TUP	MPKkm	0.1095	ELC	GJ	0.367889	GSL	GJ	0.5733
T3NU	BhopalU	TRANS_U	1	TUP	MPKkm	0.1095	DSL	GJ	0.735778	HVO	GJ	0
T4DU	BhopalU	TRANS_U	54.795	TUP	MPKkm	0.0365	DSL	GJ	1.095111	HVO	GJ	0.0003
T4OPU	BhopalU	TRANS_U	7.07	TUP	MPKkm	0.0365	LPG	GJ	0.0602	NGA	GJ	0.3554
T4PU	BhopalU	TRANS_U	56.562	TUP	MPKkm	0.0365	GSL	GJ	0.735778	HVO	GJ	0.001
TACU	BhopalU	TRANS_U	35.17	TUP	MPKkm	0.00365	ANM	GJ	1.82			
TBYU	BhopalU	TRANS_U	115.164	TUP	MPKkm	0.005475	MAN	GJ	0.672			
TCCU	BhopalU	TRANS_U	0	TUP	MPKkm	0.146	NGA	GJ	0.22575	NGA	GJ	0.7975
TCEDU	BhopalU	TRANS_U	103.622	TUP	MPKkm	0.146	DSL	GJ	0.328533	HVO	GJ	0.0003
TCEPU	BhopalU	TRANS_U	459.595	TUP	MPKkm	0.09125	DSL	GJ	0.2464			
TTDP	BhopalU	TRANS_U	0.782	TUP	MPKkm	146	DSL	GJ	0.2416			
TTEP	BhopalU	TRANS_U	3.126	TUP	MPKkm	182.5	ELC	GJ	0.1167			
TWPU	BhopalU	TRANS_U	406.05	TUP	MPKkm	0.00292	MAN	GJ	0.336			

Transport Urban Freight Existing Technology

CODE	REGION	SECTOR	STOCK	SERVICE	UNIT	OUTPUT QUANTITY	ENERGY1	UNIT	QTY	ENERGY 2	UNIT	QUANTITY
T3FAU	BhopalU	TRANS_U	10.827	TUF	MTKkm	0.009125	GSL	GJ	16.42667	HVO	GJ	0.0005
T3FTU	BhopalU	TRANS_U	18.561	TUF	MTKkm	0.0073	DSL	GJ	6.570667	HVO	GJ	0.0005
TCEFU	BhopalU	TRANS_U	1	TUF	MTKkm	0.001825	DSL	GJ	3.285333	HVO	GJ	0
TCFU	BhopalU	TRANS_U	1	TUF	MTKkm	0.00365	DSL	GJ	2.628267	HVO	GJ	0
TTDG	BhopalU	TRANS_U	1.547	TUF	MTKkm	0.01825	DSL	GJ	0.1586			
TTEG	BhopalU	TRANS_U	4.64	TUF	MTKkm	0.0219	ELC	GJ	0.0512			
TTHU	BhopalU	TRANS_U	12.374	TUF	MTKkm	0.00011	MAN	GJ	3.36			
TTUU	BhopalU	TRANS_U	23.201	TUF	MTKkm	0.001825	DSL	GJ	3.285333			

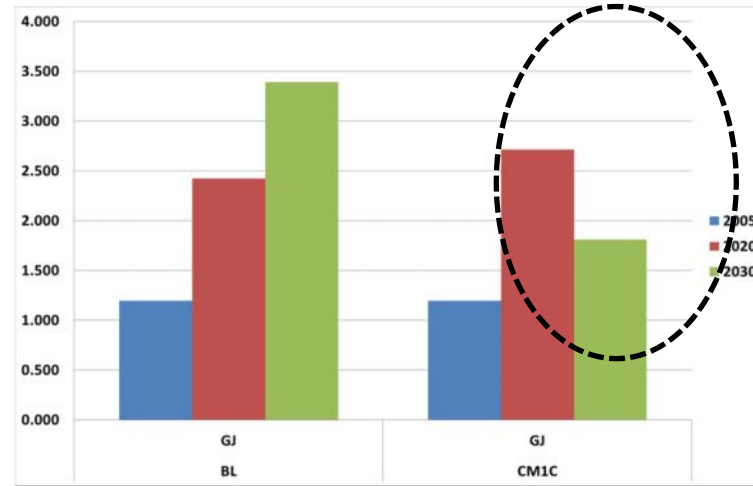
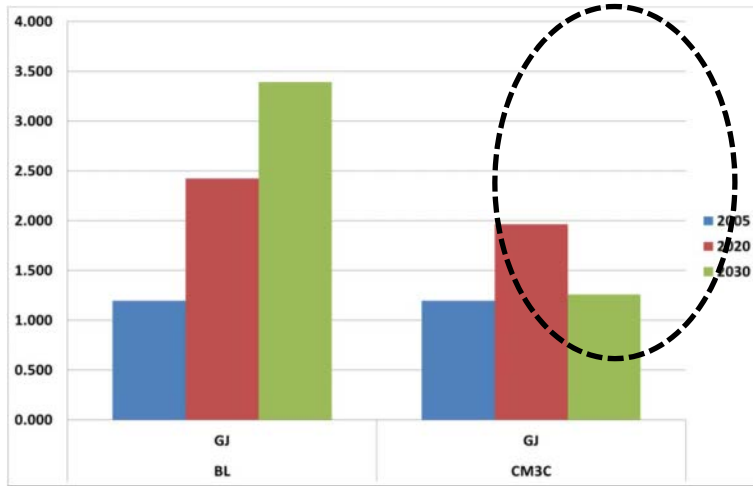
Transport Urban Passenger Future Technology

CODE	REGION	LIFE	COST	OPT COST	SECTOR	SERVICE	OUTPUT UNIT	QUANTIT Y	ENERGY 1	UNIT	QTY	ENERGY 2	UNI T	QUANTIT Y
T2HU	2-wheeler future 4 stroke	15	800	37	TRANS_U	TUP	MPKkm	0.0219	GSL	GJ	0.275917	HVO	GJ	0.0003
T2NEU	2-wheeler future Electric	15	200	47	TRANS_U	TUP	MPKkm	0.0146	ELC	GJ	0.275917			
T4DNU	Diesel Car New	20	1200	60	TRANS_U	TUP	MPKkm	0.0365	DSL	GJ	0.730074	HVO	GJ	0.0003
T4EU	Electric Car	20	1900	40	TRANS_U	TUP	MPKkm	0.01825	ELC	GJ	0.36			
T4HU	Hybrid Car	20	2400	60	TRANS_U	TUP	MPKkm	0.020075	ELC	GJ	0.073578	GSL	GJ	0.7493
T4OPU	LPG/CNG/NGA Car	20	1300	60	TRANS_U	TUP	MPKkm	0.0365	LPG	GJ	0.0602	NGA	GJ	0.3554
T4PNU	Petrol Car New	20	1100	20	TRANS_U	TUP	MPKkm	0.0438	GSL	GJ	0.613148	HVO	GJ	0.0009
T4SU	Solar Car	20	1800	30	TRANS_U	TUP	MPKkm	0.0146	SOL	GJ	0.36			
TCEU	HCV Electric Bus	20	150	18	TRANS_U	TUP	MPKkm	0.146	ELC	GJ	0.2025			
TCHU	MCV Hybrid	15	400	35	TRANS_U	TUP	MPKkm	0.00365	DSL	GJ	0.016555	NGA	GJ	0.046
TCNHU	HCV New Diesel Bus	20	110	9	TRANS_U	TUP	MPKkm	0.146	DSL	GJ	0.19712	HVO	GJ	0.0003
TCNPU	MCV diesel New Passenger	15	200	20	TRANS_U	TUP	MPKkm	0.09125	DSL	GJ	0.19712			

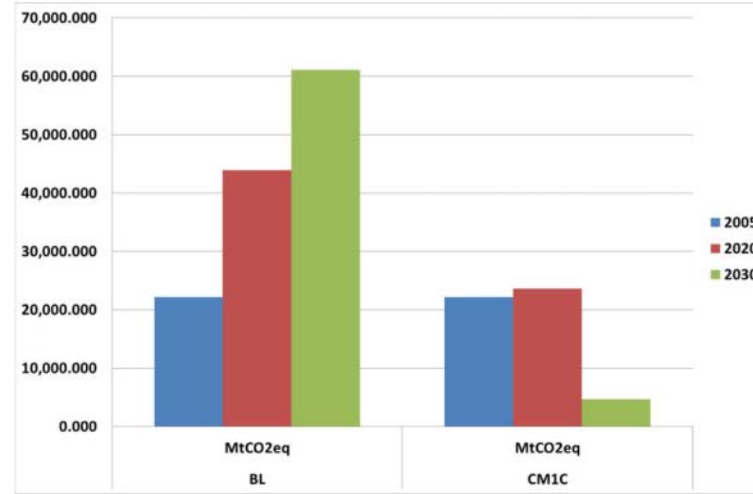
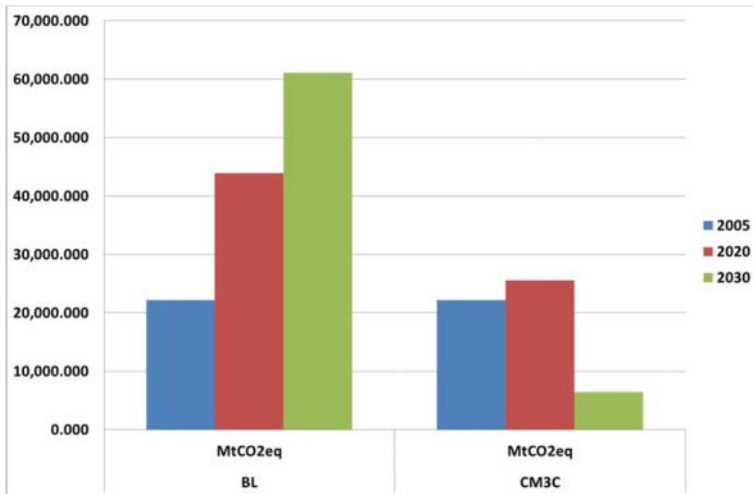
Transport Urban Freight Future Technology

CODE	REGION	LIFE	COST	OPT COST	SECTOR	SERVICE	OUTPUT UNIT	QUANTITY	ENERGY1	UNIT	QTY	ENERGY 2	UNIT	QUANTITY
T3FANU	3WFreight Auto New 4 stroke	15	800	37	TRANS_U	TUF	MTKkm	0.0073	GSL	GJ	10.95111	HVO	GJ	0.0003
T3FTNU	3WFreight Tempo New	15	1200	65	TRANS_U	TUF	MTKkm	0.009125	DSL	GJ	4.928	HVO	GJ	0.0005
TCNFU	MCV diesel New Freight	15	1500	35	TRANS_U	TUF	MTKkm	0.001825	DSL	GJ	2.464	HVO	GJ	0.0005

Change in Energy Demand And Emission in Free and Controlled Scenario



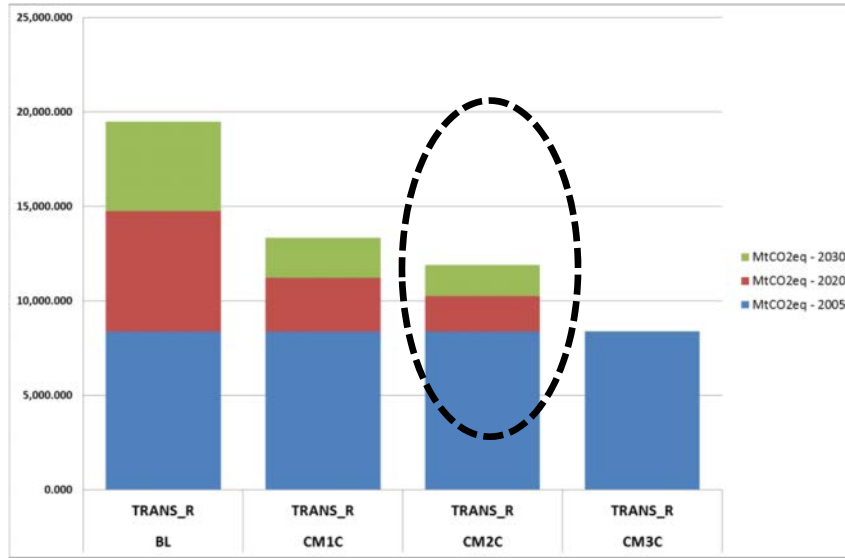
Energy Demand is increased



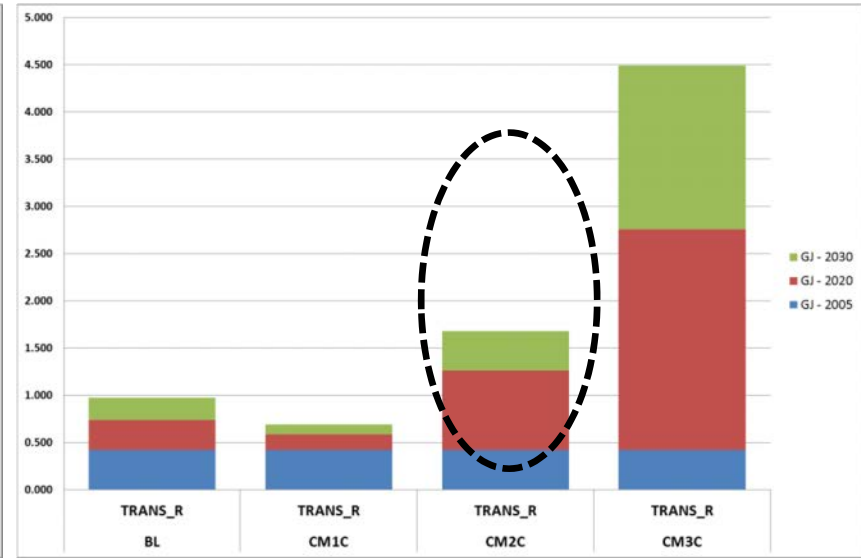
Free Scenario – the technology selection is free, high taxes

Controlled Scenario – the technology share is limited, no taxes

Energy Demand and Emission in different scenarios

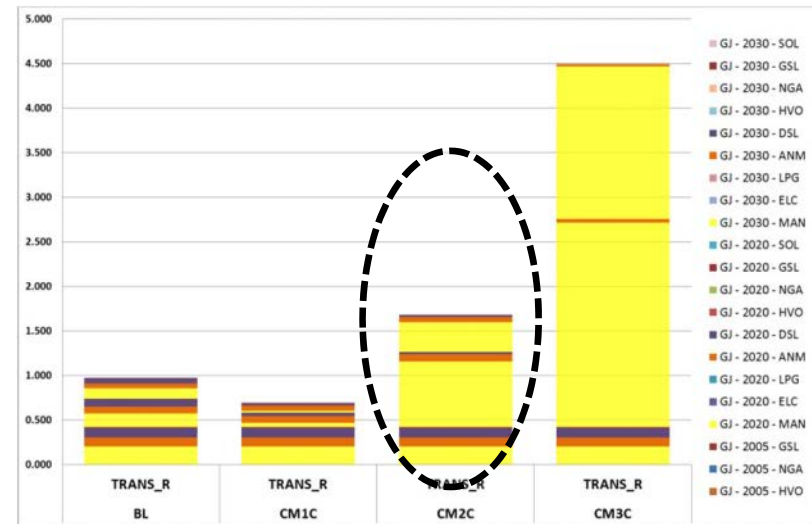


Emissions

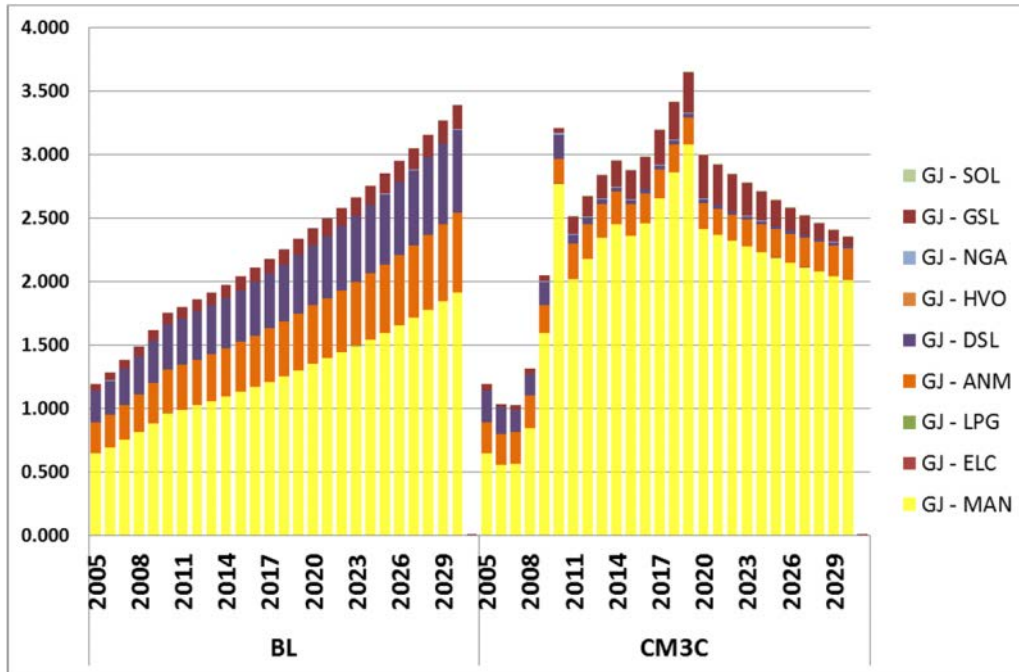


Energy Demand

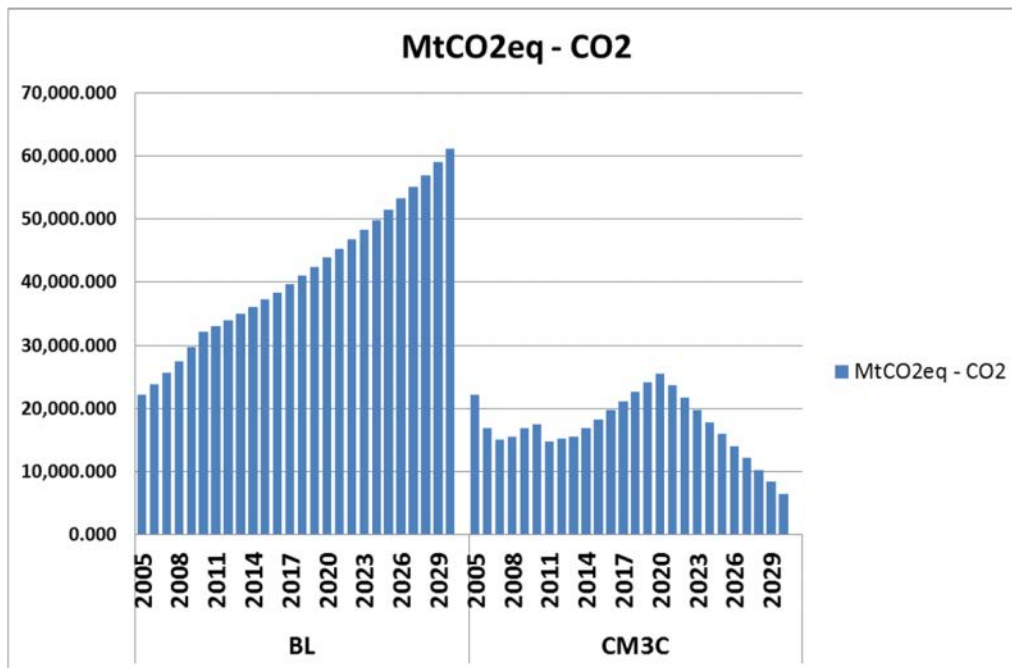
CASE NAME	EMS_TAX	ENE_TAX	RATE
BL	T0	T0	5%
CM1C	T0	T0	5%
CM2C	T200	T30	20%
CM3C	T200	T30	33%



Energy Share

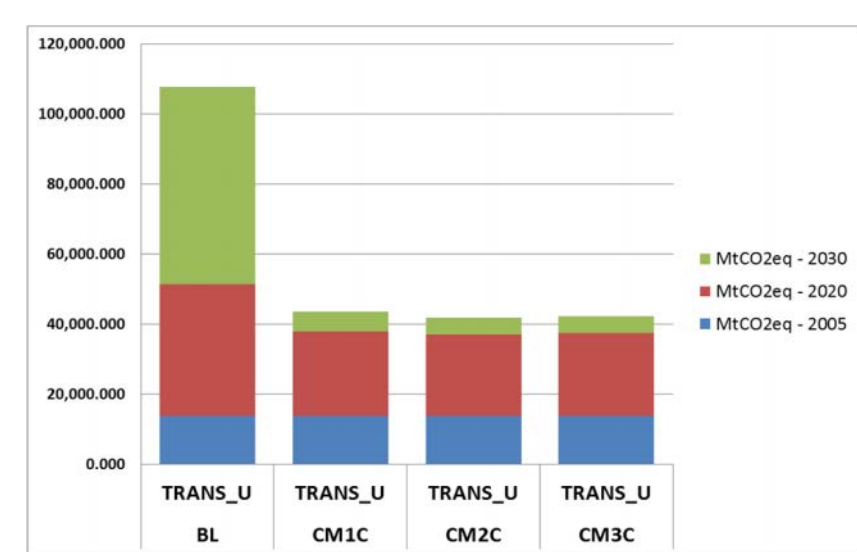
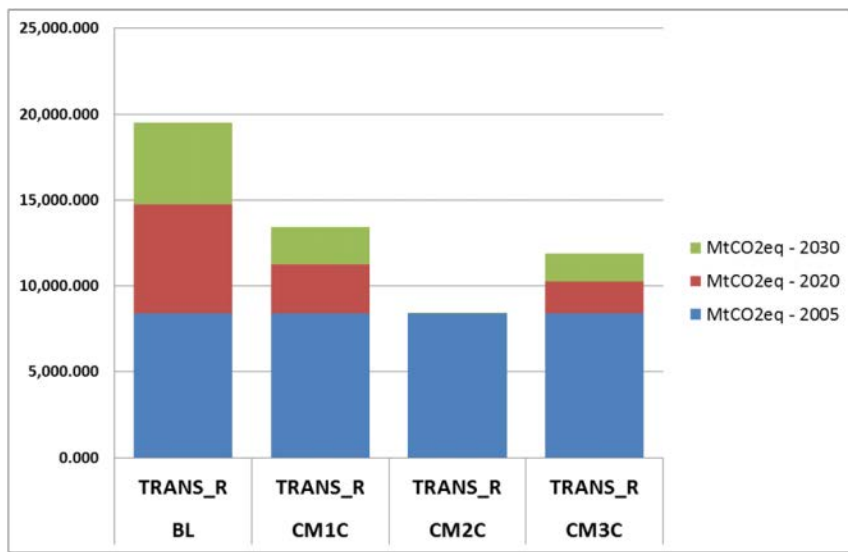
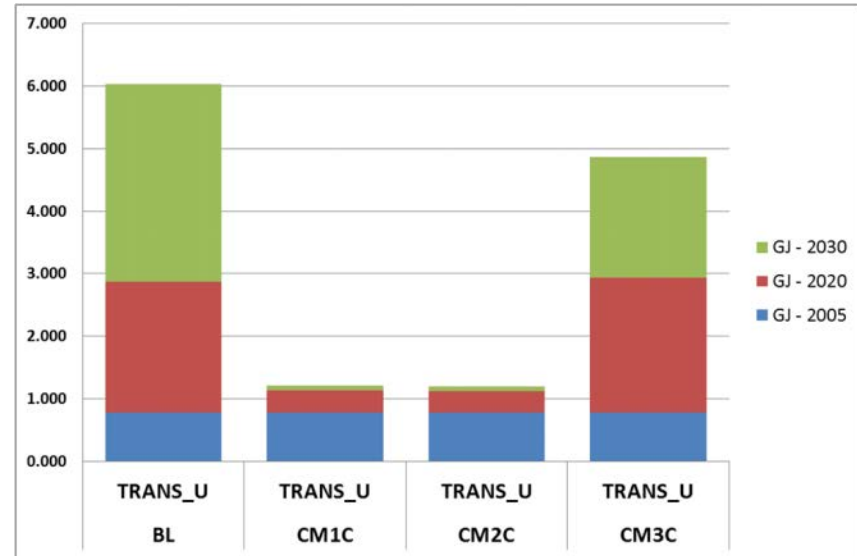
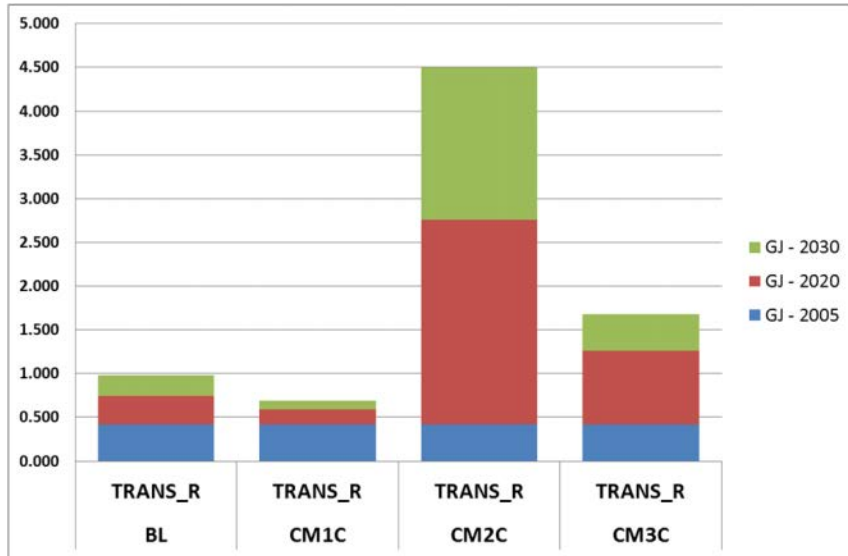


More Human energy is used due to heavy emission tax



Emissions are reduced

Sector wise Energy Demand and Emission



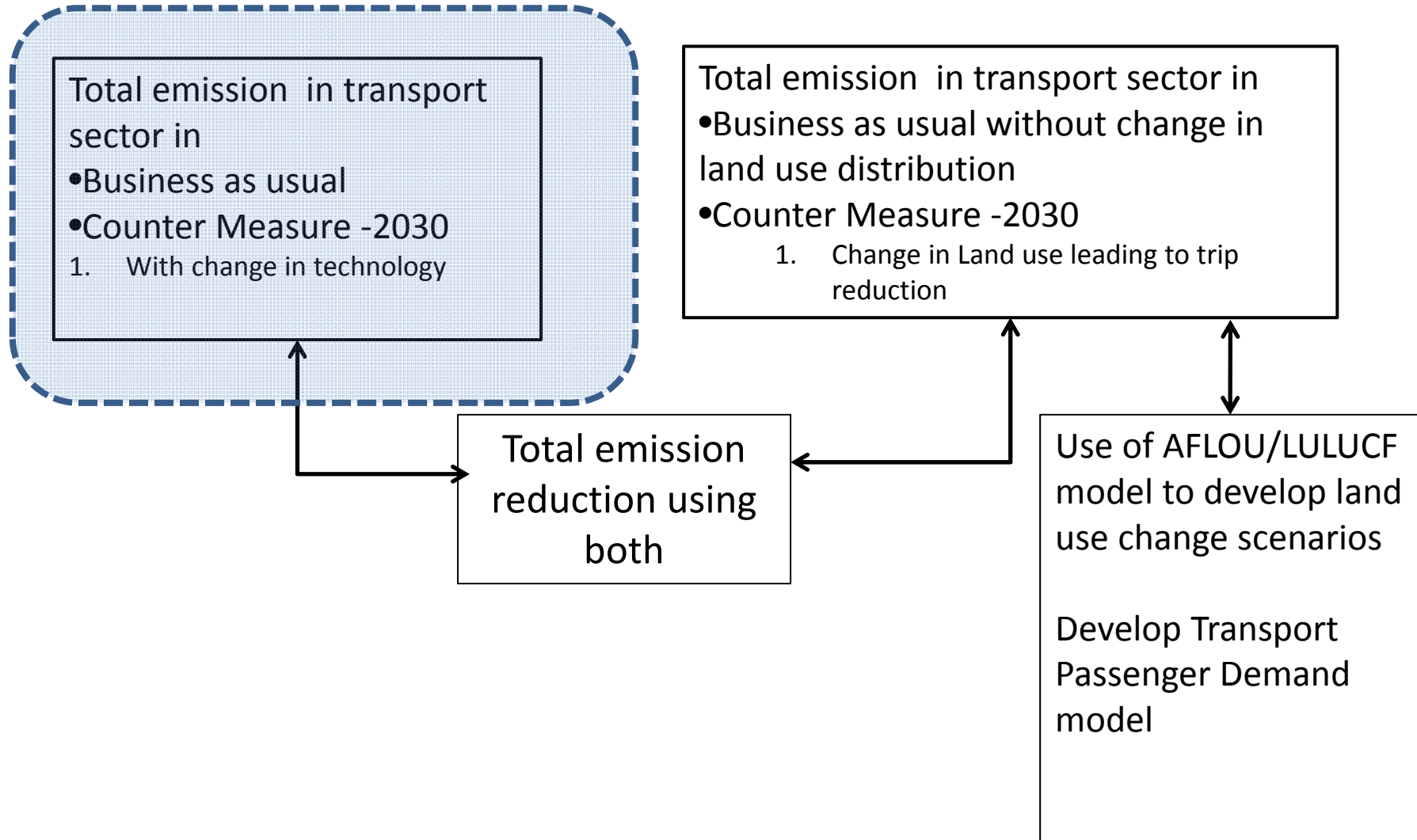
Rural

Urban

ENERGY EMISSION

Develop low carbon scenario for Bhopal in transport sector

Assess the change in amount of trip generated due to change in land use



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Thank You