Sustainable mobility approaches for low carbon development: Implications for energy demand and CO_2 emissions

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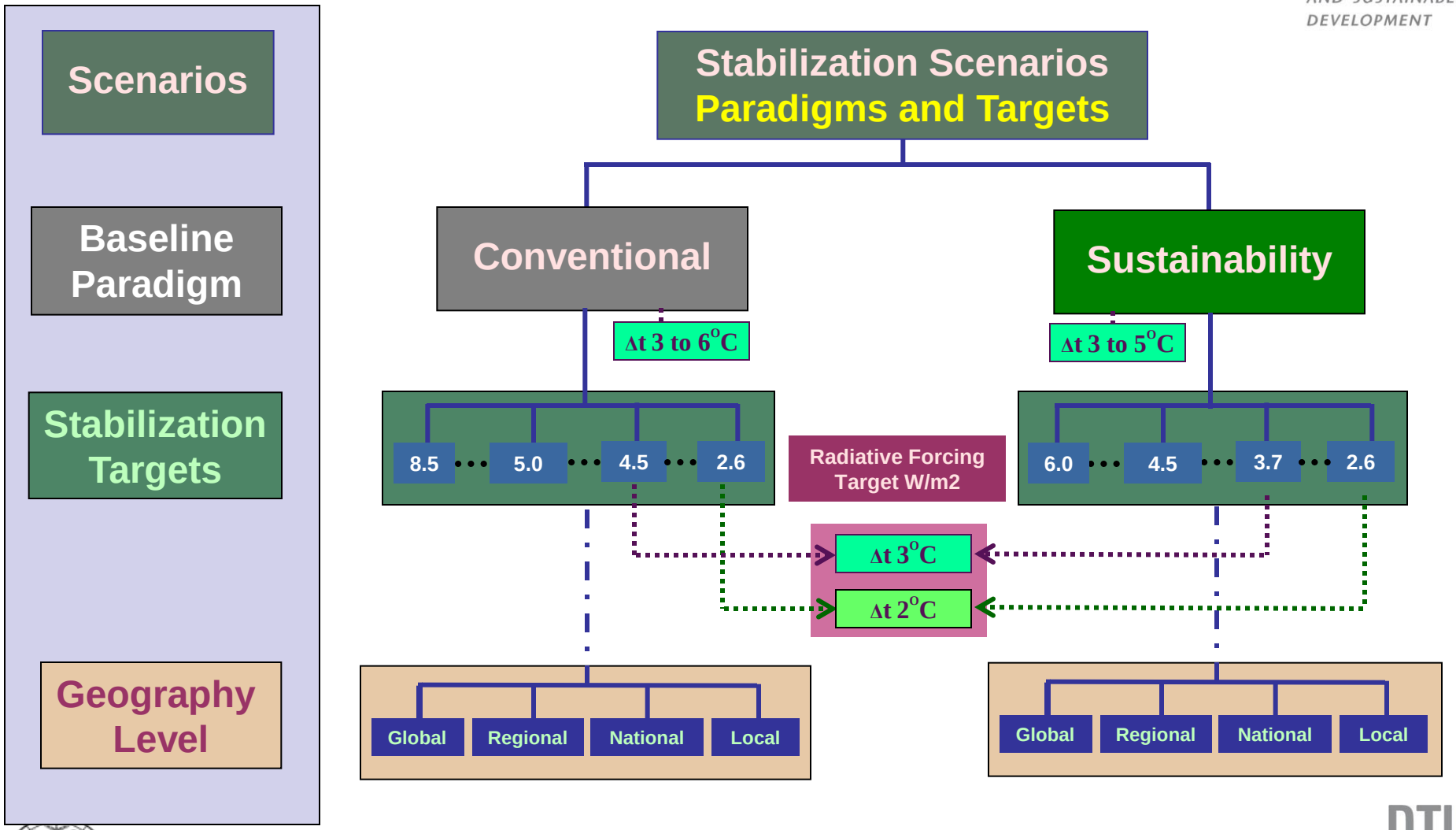
Delhi

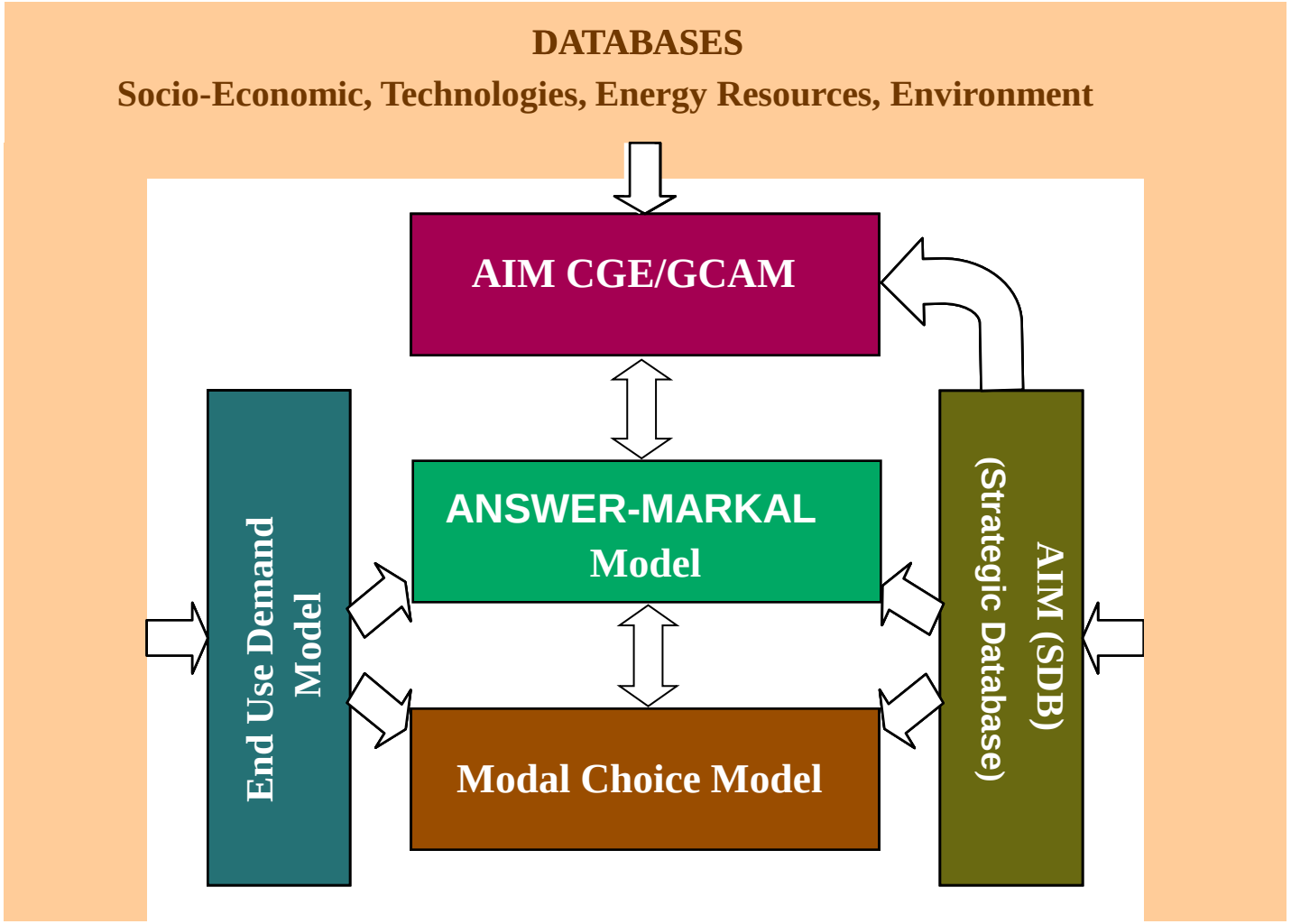
Overview

1. Scenario Architecture overall
2. Model Framework
3. Overall reductions at national level
4. Scenario Architecture for Transport Sector
5. Results based on a step wise approach
6. Overall reductions from transport sector
7. Conclusions

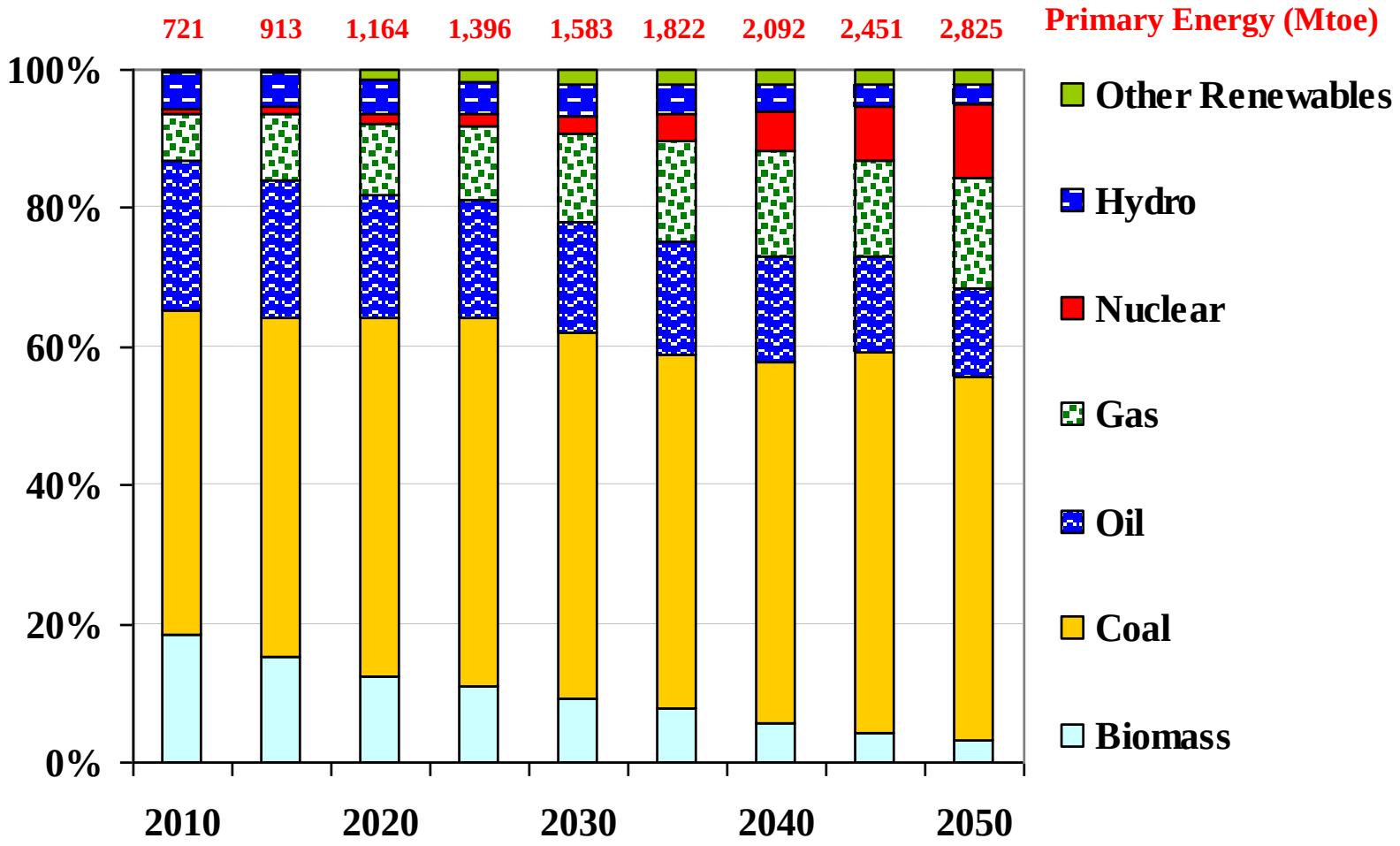
Climate Stabilization and Sustainability



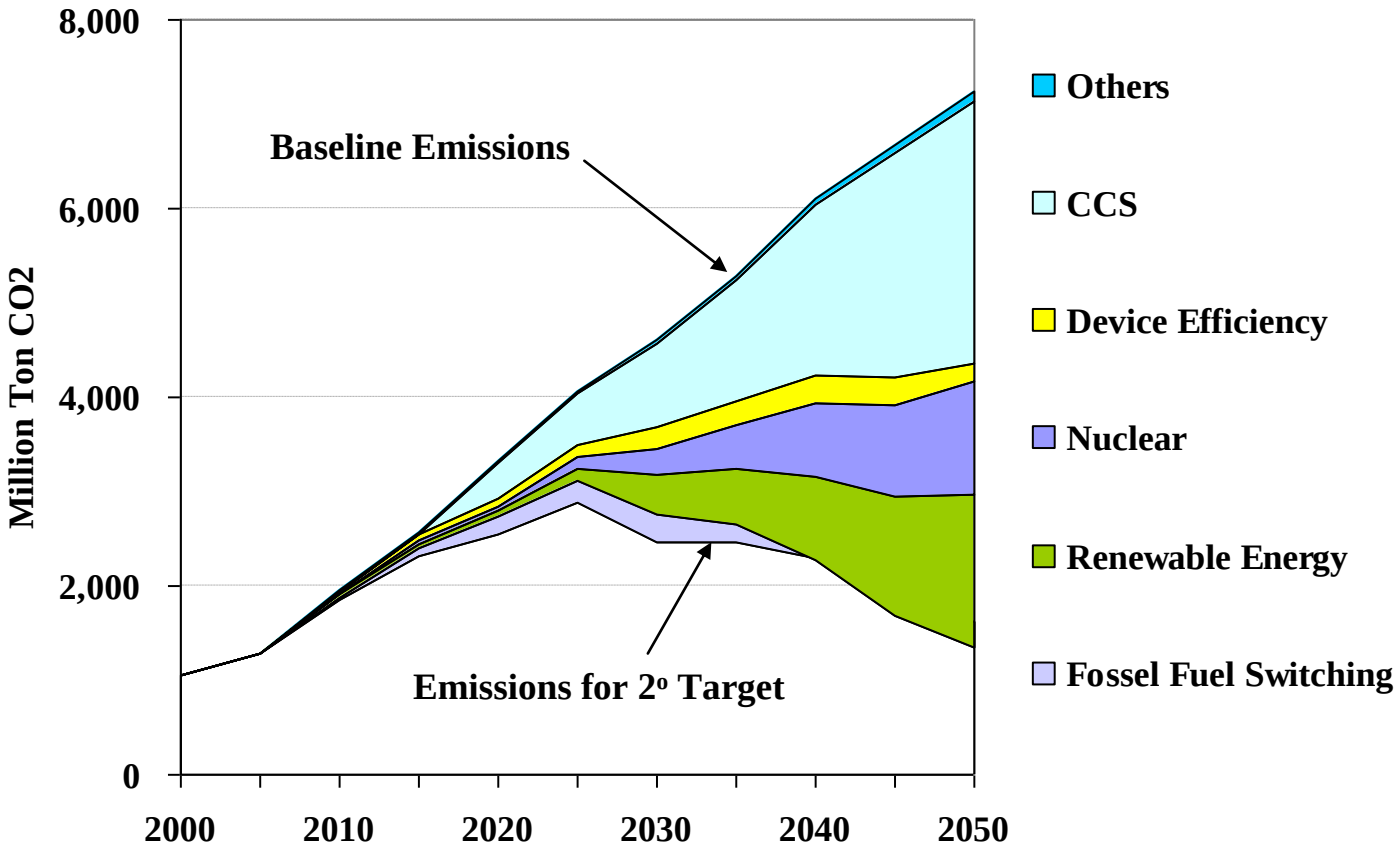
Integrated Modeling Framework



Primary Energy Transitions: BAU

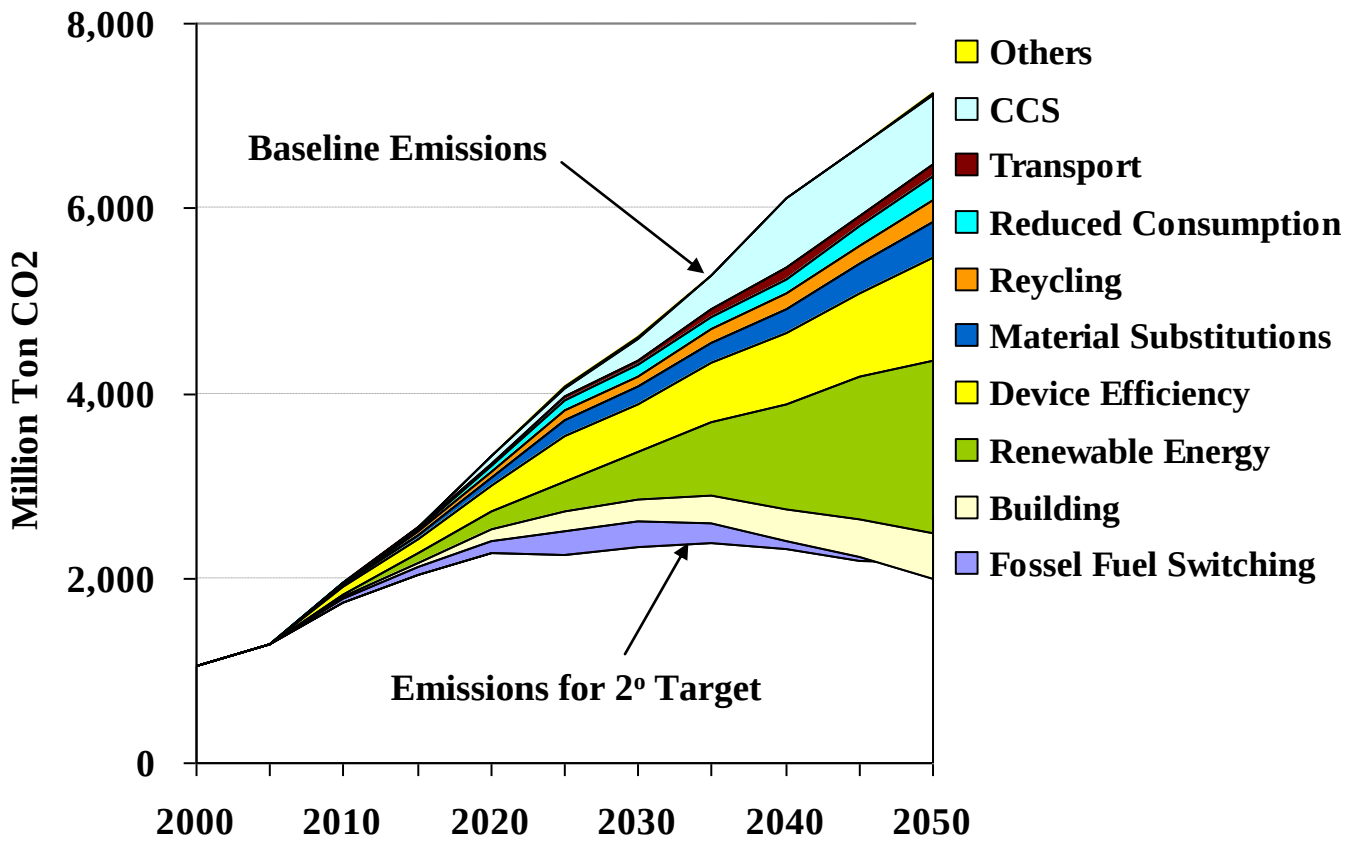


CO_2 Reduction: Conventional Scenario



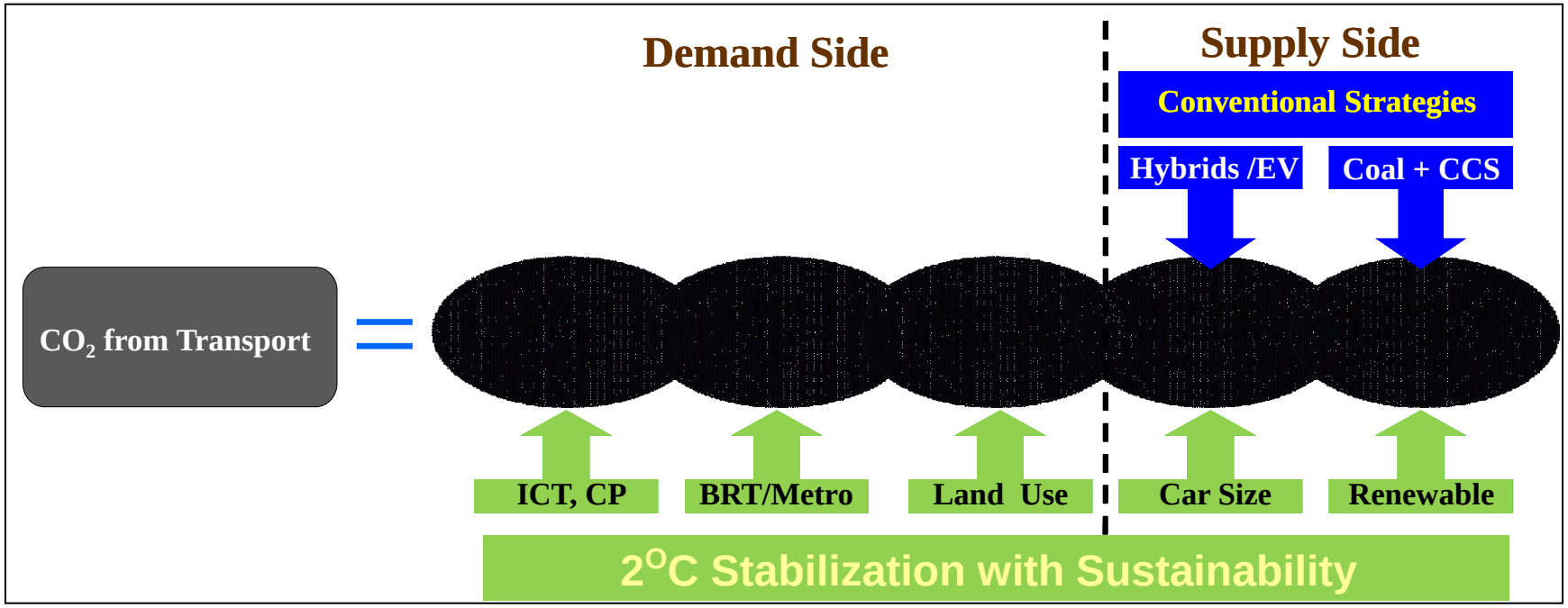
Carbon Price	20	52	87	136	200
(US $/tCO2)					

CO_2 Reduction: Sustainable Scenario



Carbon Price (US $/tCO2)	15	28	55	100	117

Emission Identity



Demand Side Strategies

- Number of Trips – Reduce through
  - ICT –Information & Communication Technology
  - CP – Car pooling
- Modal Shares – Shift
  - Investing in public transport infrastructures e.g., BRT, Buses and Metros
  - Investing in NMT infrastructures
  - Urban Planning which facilitates NMT and Public transport
  - Investing in rail infrastructures for goods & passenger
  - Coal by wire
- Average Distance or Trip lengths – Reduce through
  - Urban Planning

Supply Side Strategies

- Energy Intensity – Reduce (toe/pkm or tkm)
  - Conventional strategies – More efficient technologies e.g., Hybrids , Electric Vehicles
  - Sustainable strategies – Car Size, Car Pooling
- CO_2 Intensity – Reduce ($kgCO_2$/tpkm)
  - Conventional strategies – Electrification + CCS
  - Sustainable strategies – Bio Fuels, Renewable electricity

Architecture for Transport Scenarios

Base (BAU)
GDP – 8% CAGR
CO2 – 650 ppm
Endogeneous Technological Change

Changes due to price of carbon

Conventional Low Carbon Scenario
GDP ~ 8% CAGR
CO2 – 450 ppm

Sustainable Low Carbon Scenario
GDP - Pegged to 8% CAGR
CO2 – 450 ppm

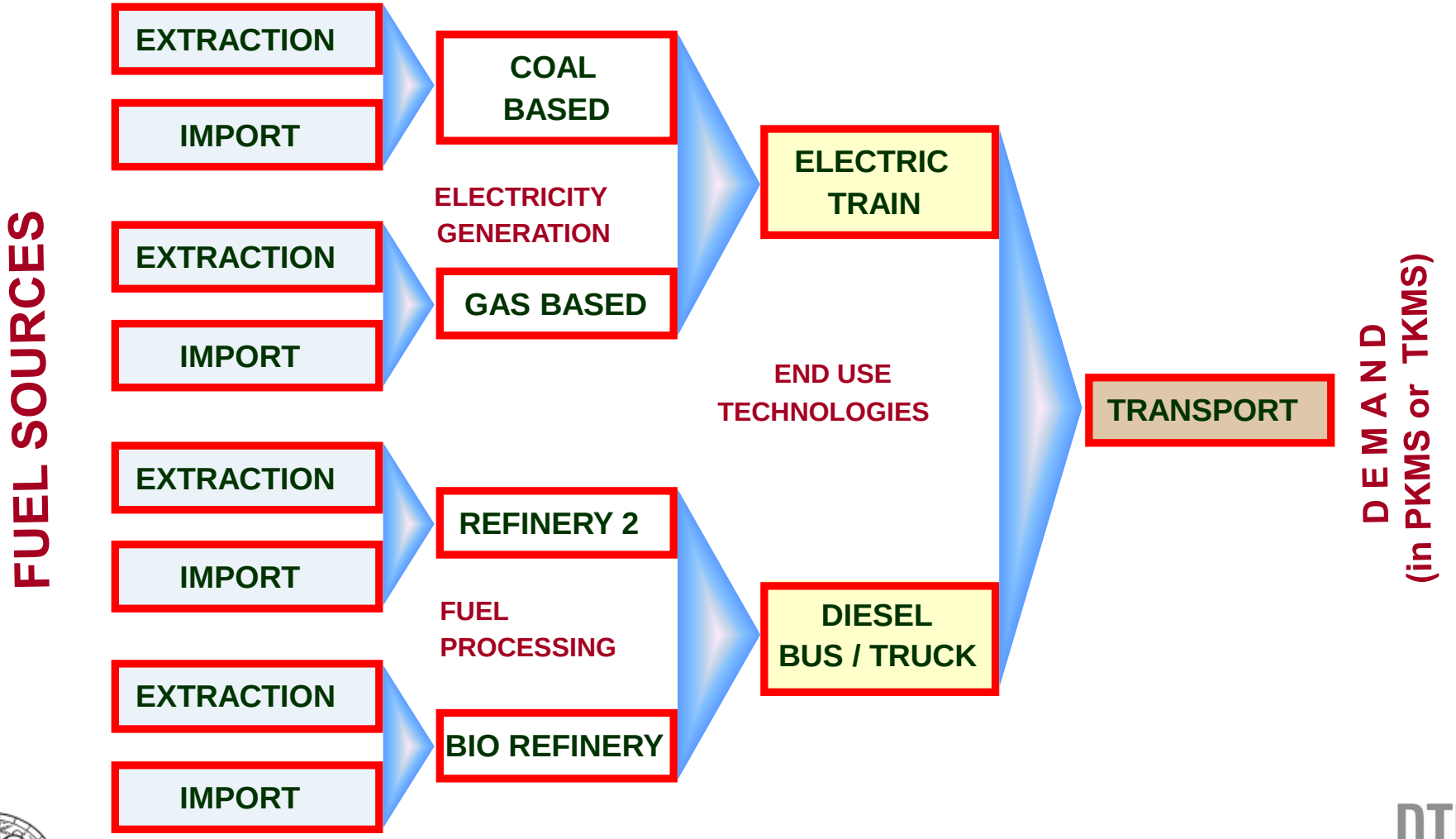
Changes due to targeted strategies + a carbon budget equivalent to conventional scenario

Sustainable Mobility
i. Public Transport
ii. NMT
iii. Urban Design
iv. Coal by Wire /Rail Corridors

Sustainable Technologies
i. Electric Vehicles
ii. Hybrids

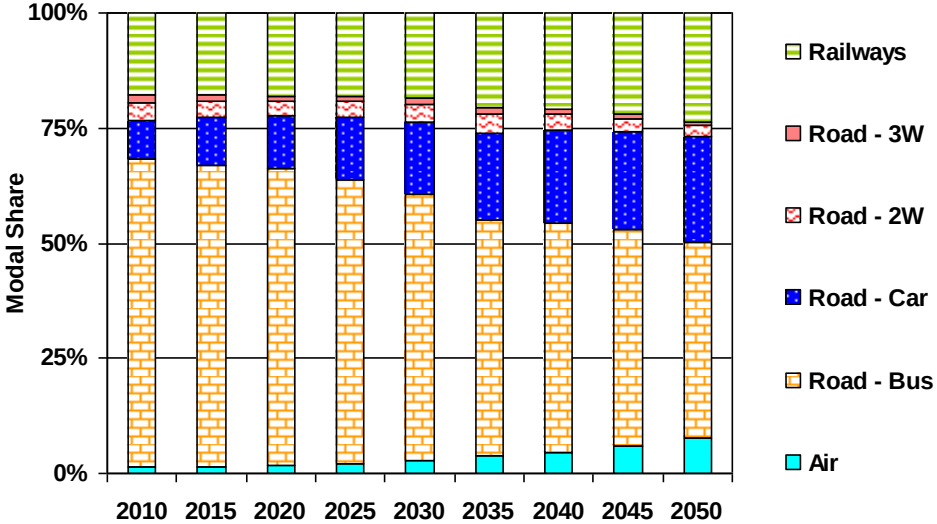
Sustainable Energy
i. Bio-fuels
ii. CNG

Typical Reference Energy System



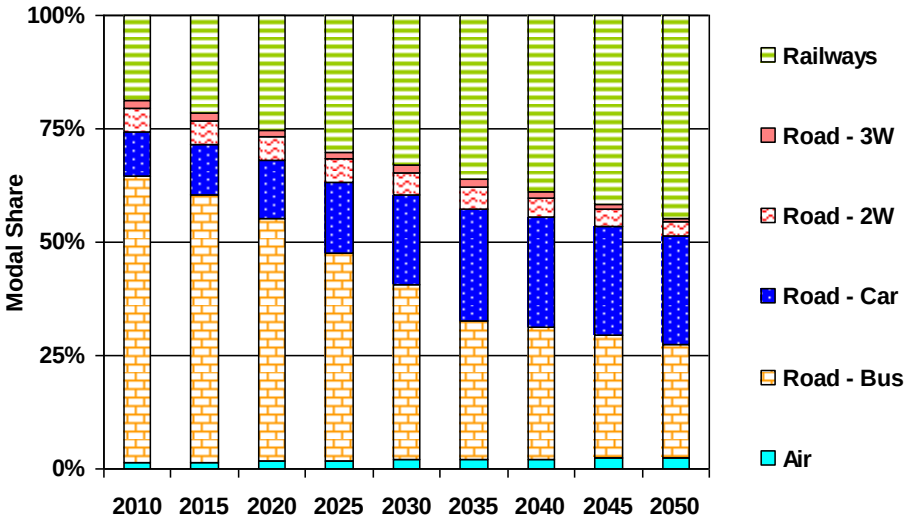
Passenger Transport Demand - Motorised

Base Case



4971 9770 13875 17051 20118 Billion pkms

Sustainability



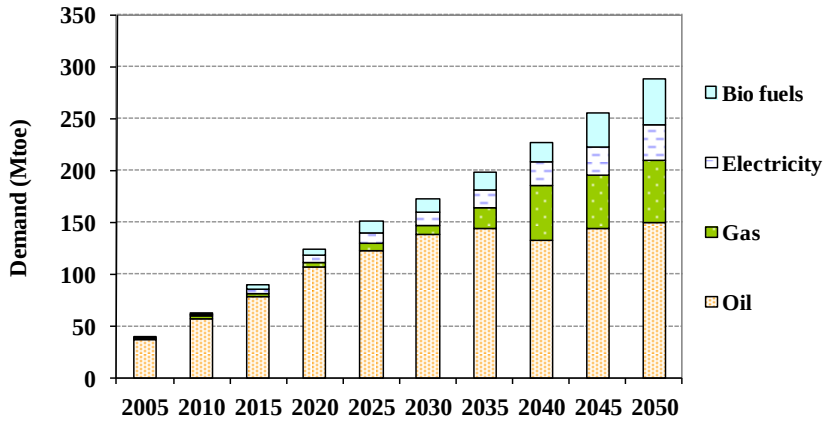
4971 6297 8911 11920 15402 Billion pkms

Using Enduse demand model and modal choice model

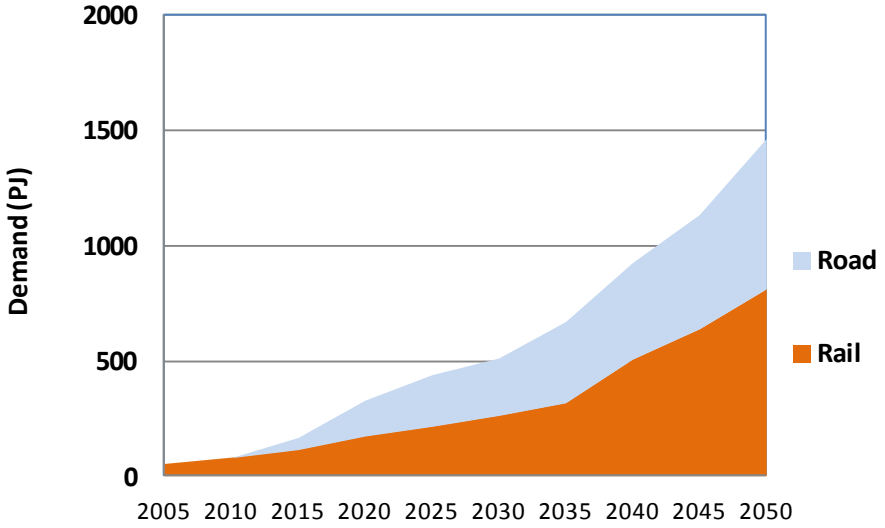
Similar transitions for freight

Energy Demand: Base Case

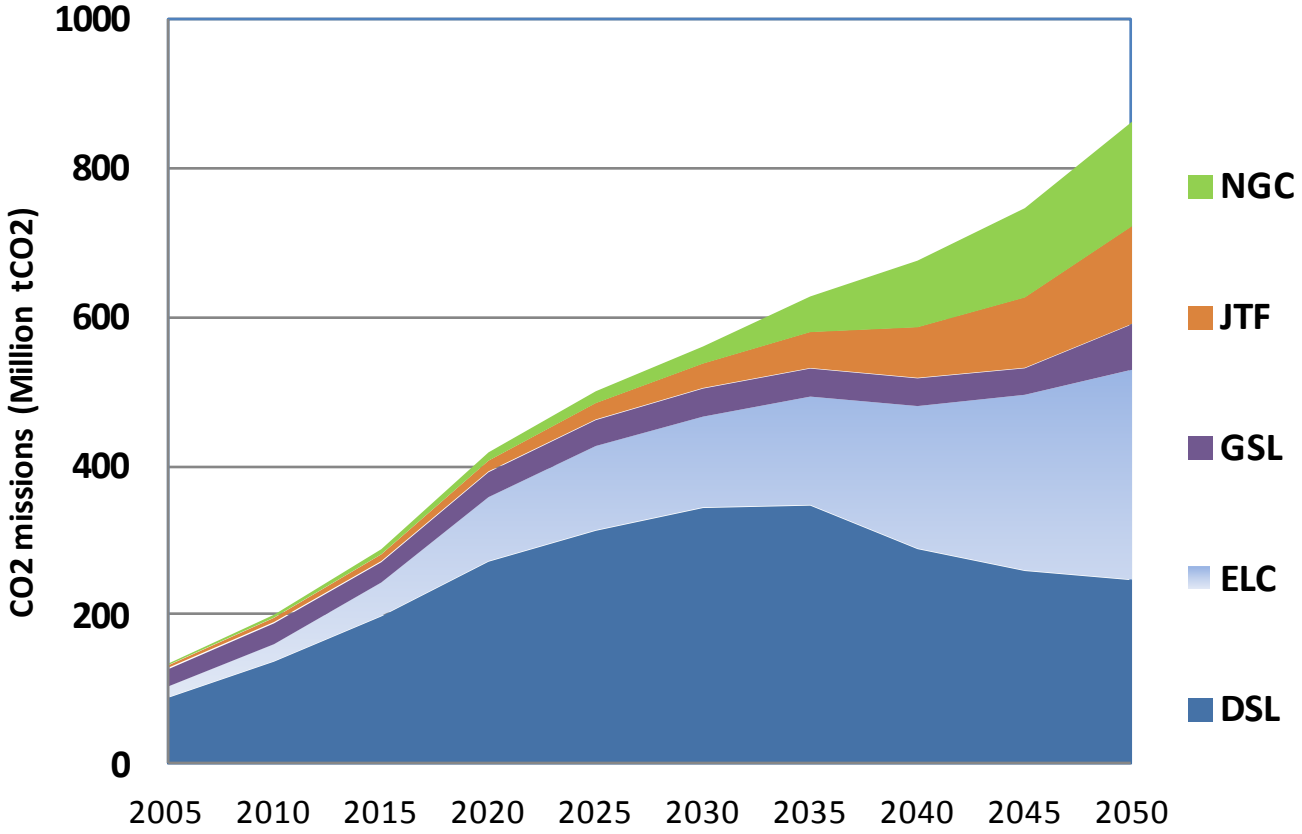
Transport Energy Demand : Base Case



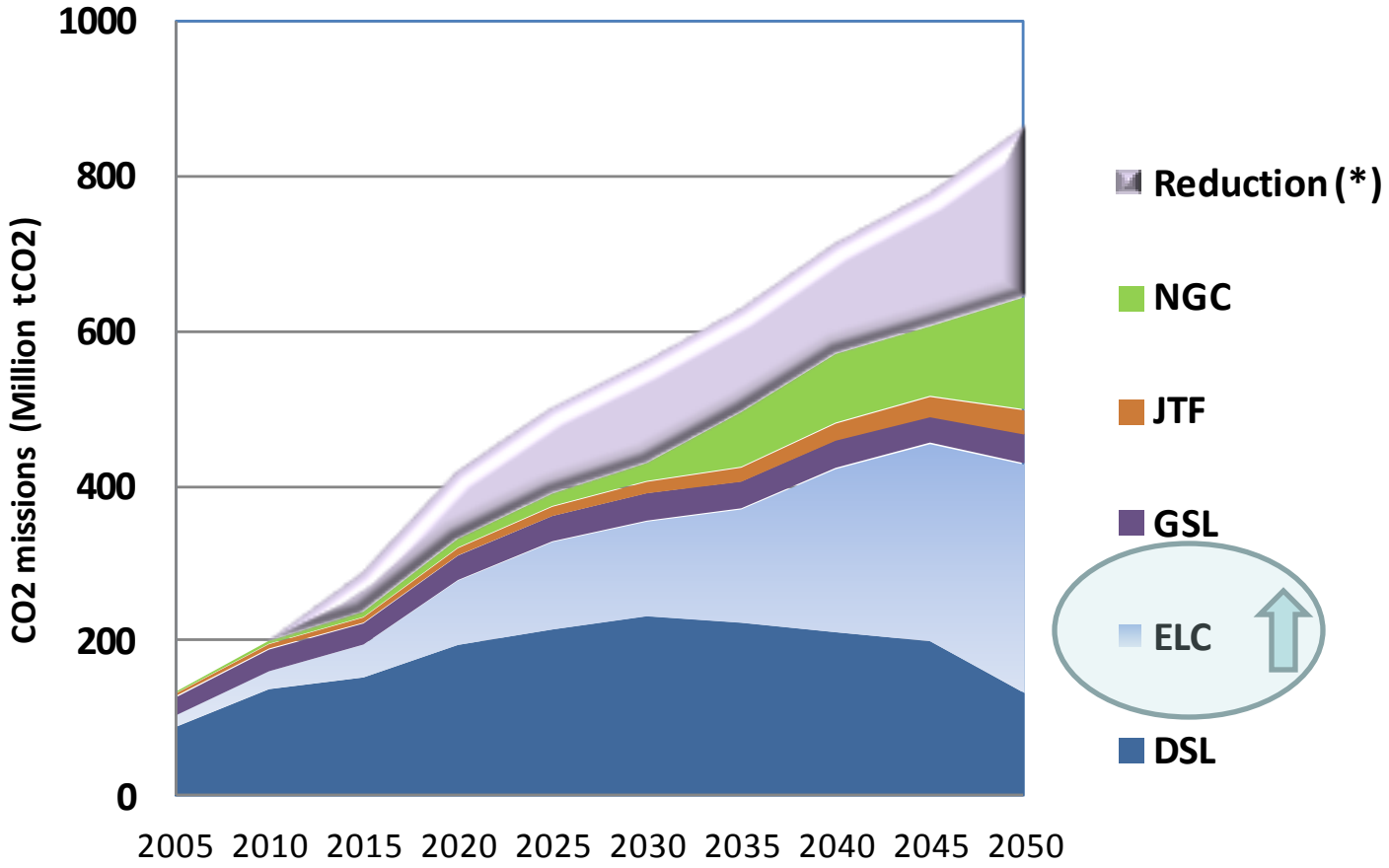
Transport Electricity Demand : Base Case



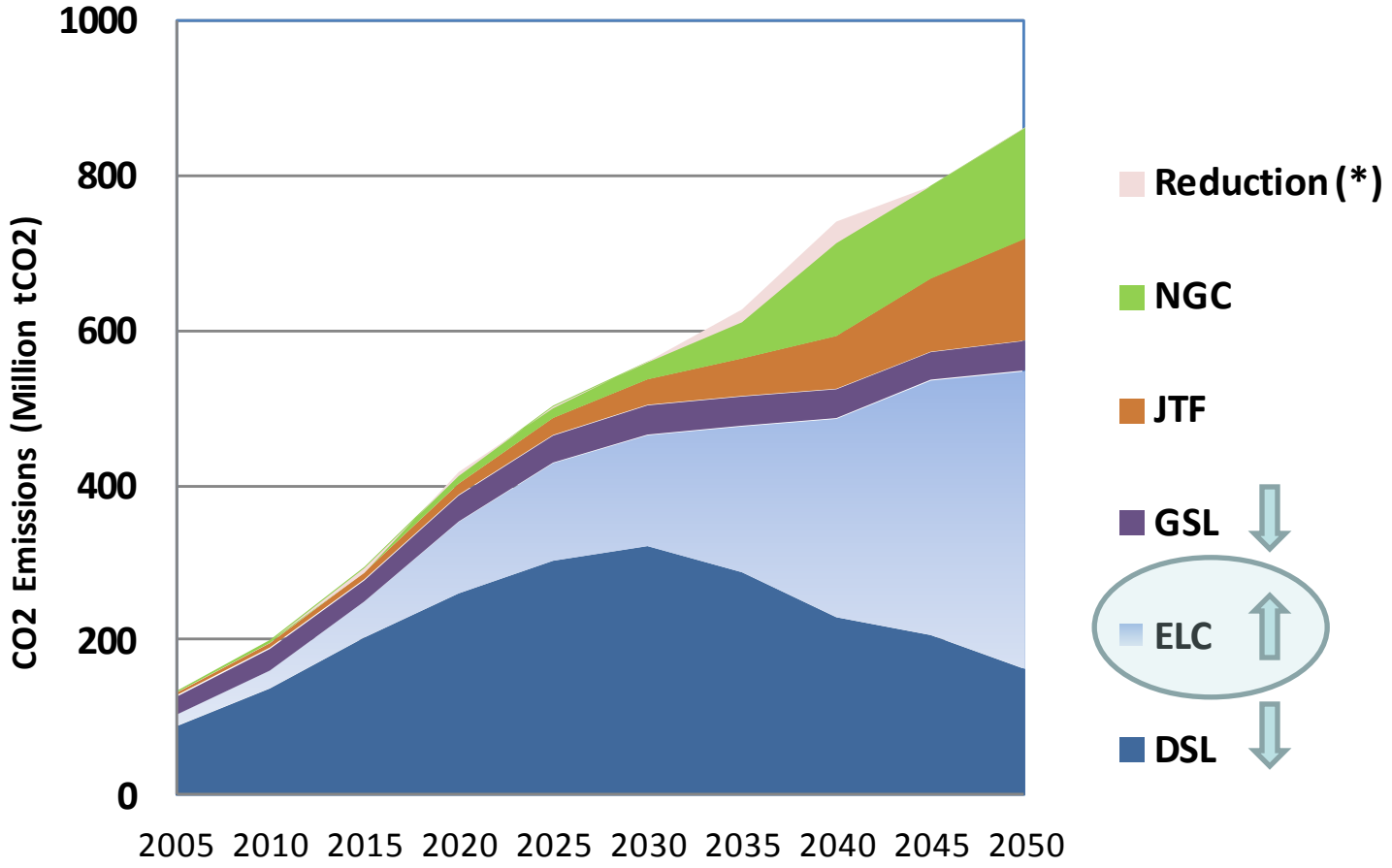
CO2 Emissions – Base Case



Mobility Measures - Strategy

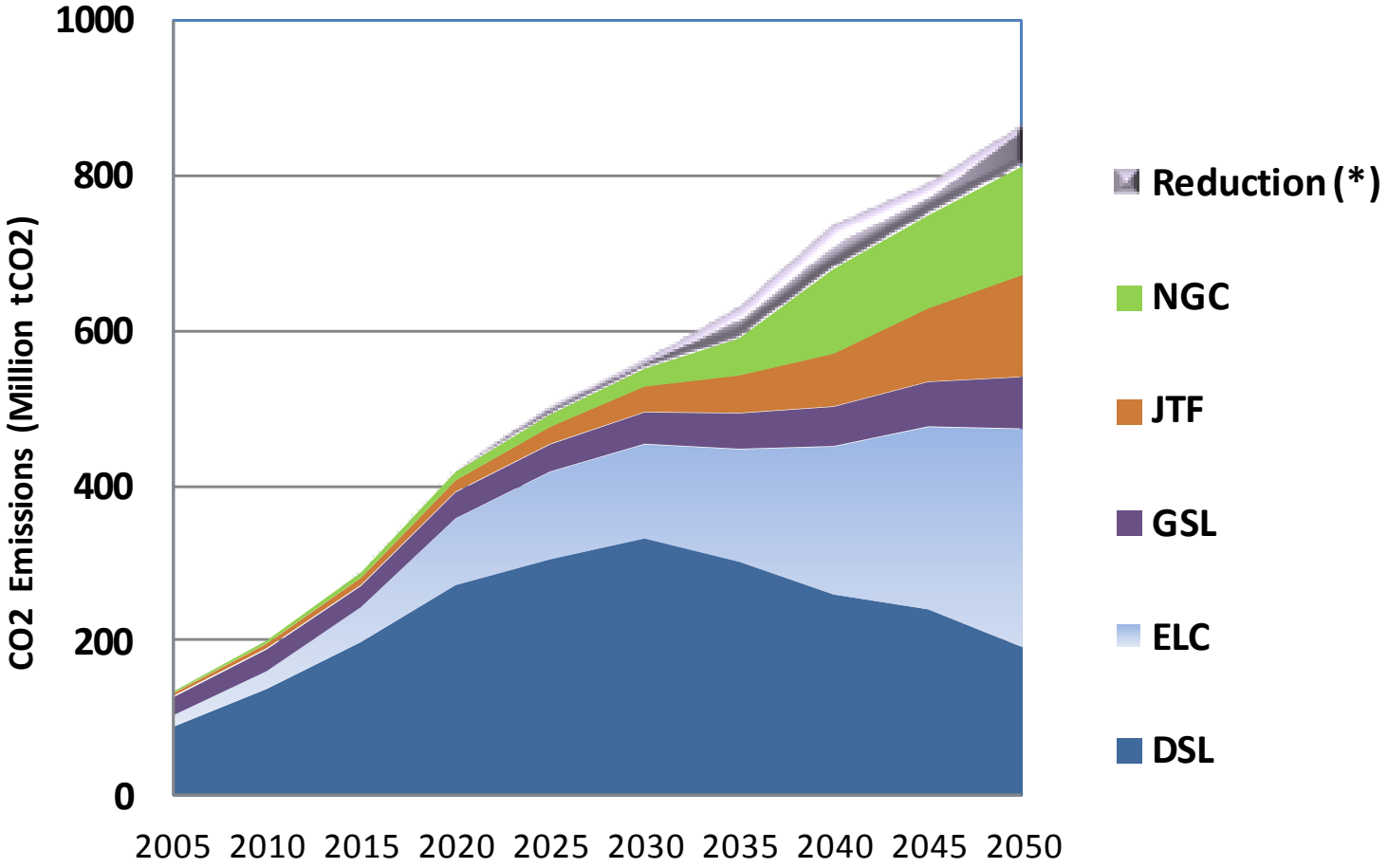


Electric Vehicle (EV) - Strategy

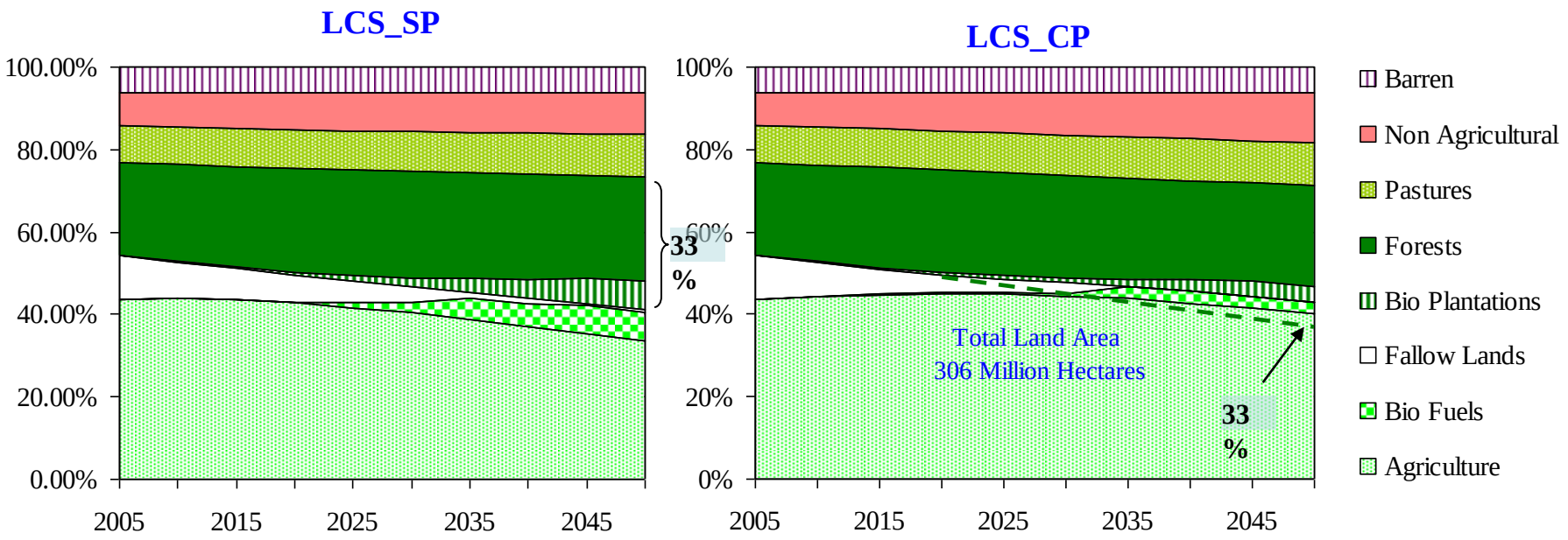


* In many years we see an increase and not a reduction

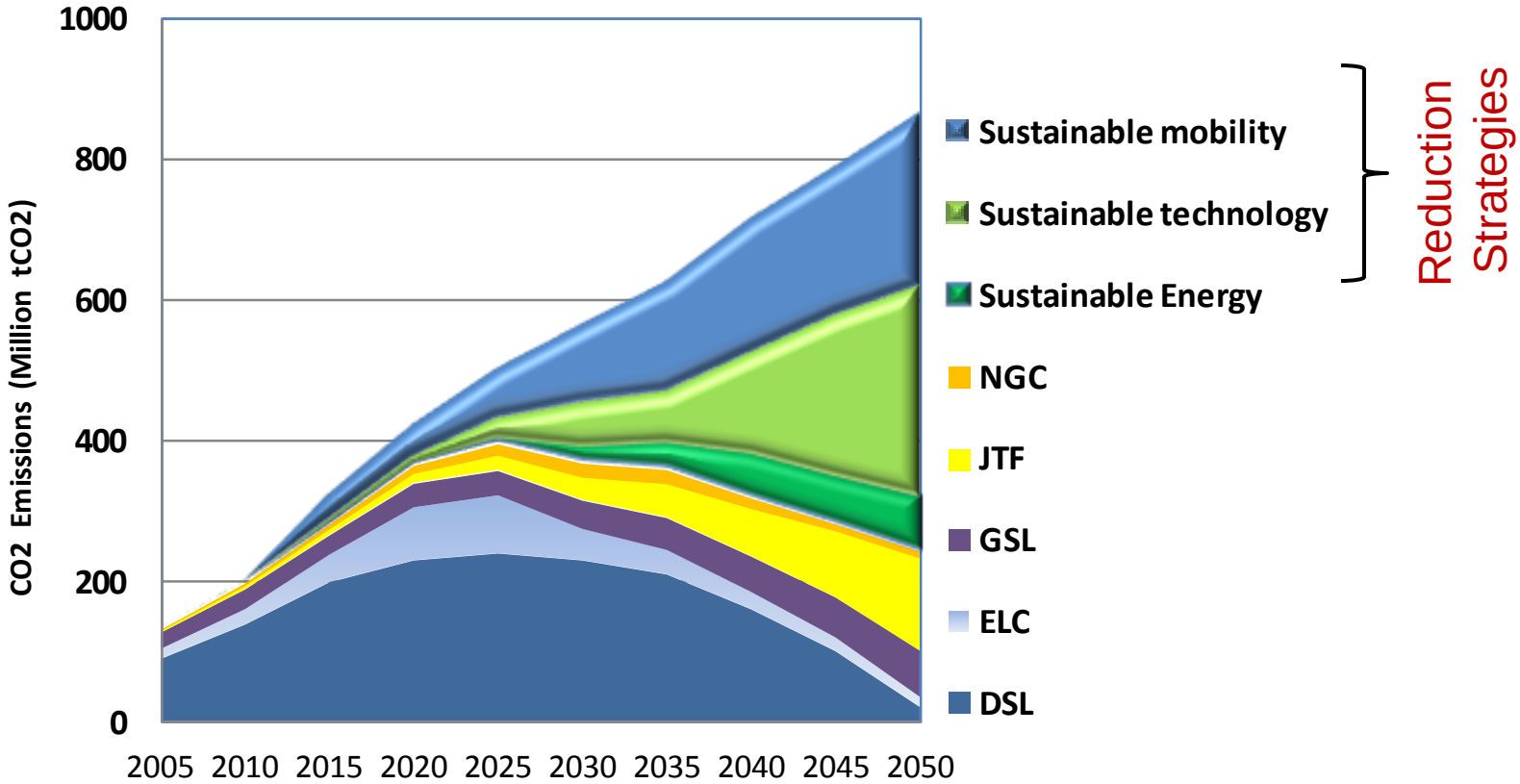
Bio fuels strategy



Land Use transformations



Overall Reduction: Sustainable Low Carbon Scenario



Emission Intensity of Grid (Million tCO2/GWh)

Scenario	2010	2015	2020	2025	2030	2035	2040	2045	2050
Base Case	0.99	0.85	0.73	0.49	0.34	0.24	0.19	0.15	0.11
Low Carbon Scenario	0.99	0.96	0.94	0.93	0.86	0.78	0.74	0.75	0.69

Conclusions

1. Mobility strategy will require major changes in infrastructures and urban design.
2. Mobility strategy can deliver substantial reductions in CO_2 and these will be greatly enhanced in a sustainable low carbon world
3. Electric vehicles would need a sustainable low carbon world to deliver CO_2 benefits
4. Bio fuels deployment limited by land availability

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Thank You

Questions / Suggestions

IIM AHMEDABAD

DTU