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Low Carbon Transport in India: Co-benefits and Risk Assessment

Shukla, Priyadarshi R ; Dhar, Subash; Chaturvedi, Vaibhav

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Low Carbon Transport in India: Co-benefits and Risk Assessment

Priyadarshi R Shukla

Subash Dhar

Vaibhav Chaturvedi

Sixth Annual Meeting of the IAMC

28 30 October 2013

Tsukuba, Japan

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Overview

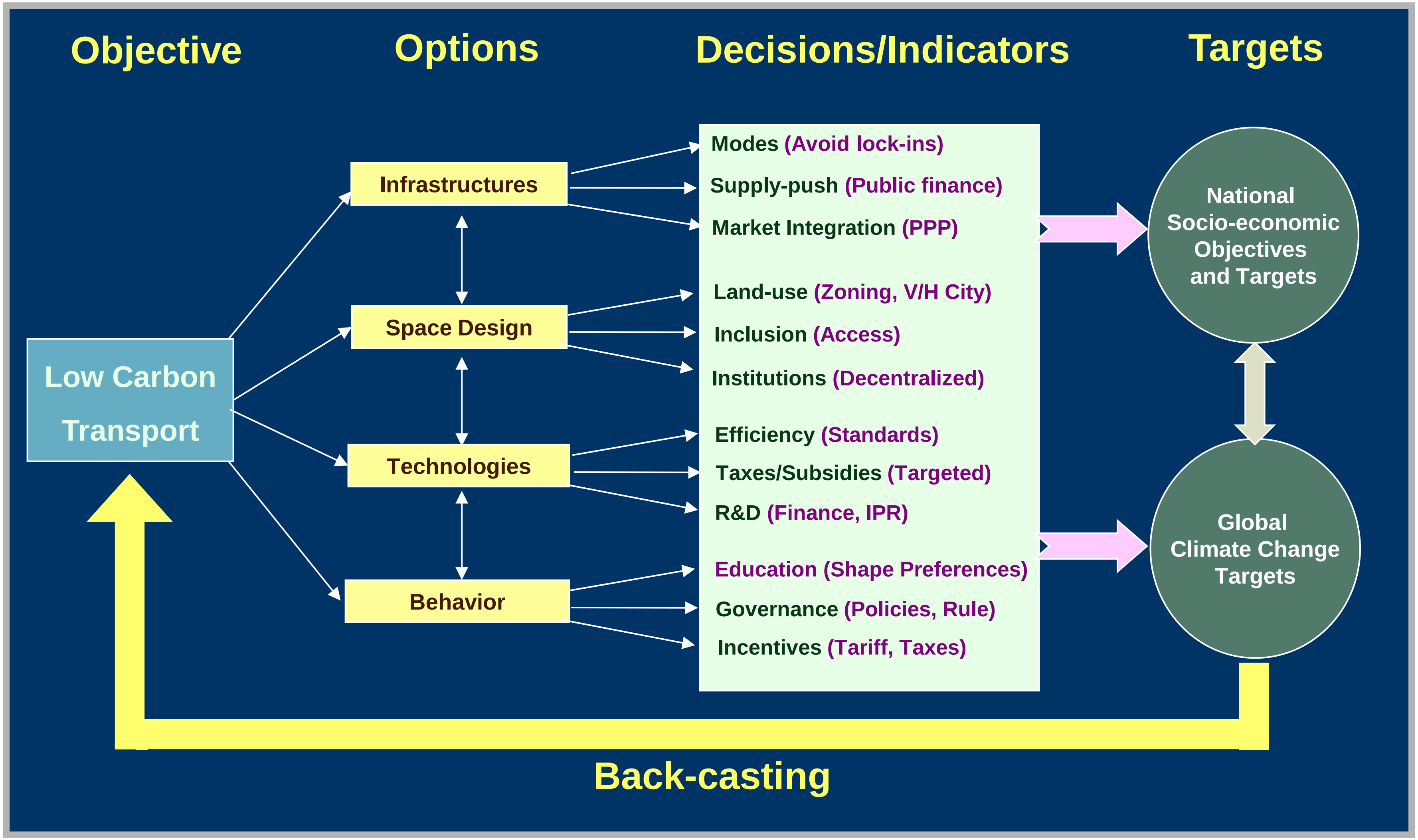
1. Sustainable Low Carbon Transport Assessment
   a. Concepts (Multiple objectives and related Targets)
   b. Assessment Framework (Back-casting)
   c. Model System (Soft-linked Top-down/Bottom-Up Model System)
2. Scenario storylines
   a. Business as Usual (BaU) Scenario
   b. Conventional Low Carbon Scenario
   c. Sustainable Low Carbon Scenario (some examples)
3. Results (with focus on Transport Sector)
4. Conclusions

Sustainable LC Society: Scenarios & Perspectives

Low Carbon and Inclusive Development

- Mapping Transitions (Storyline Drivers)
  i. Demographic (Gender/Age Profiles, Urban/Rural)
  ii. Income (Growth, Distribution)
  iii. Behavior (e.g. Consumption, Conservation)
  iv. Governance/Institutions (Conventional/Green)
- Economics (Multiple objectives, Targets)
  i. Cooperation (to vis-à-vis goals; e.g. energy access)
  ii. Co-benefits (e.g. energy security, AQ)
  iii. Directed finance (to meet national goals)
- Policies (Market and Non-Market Policies)
  i. Technology (Avoid Lock-ins): Infrastructures; Targeted R&D; IPR
  ii. Coordinated policies to gain co-benefits (e.g. CO_2 & Local Pollution)
  iii. Global carbon price/tax

Sustainable Low Carbon Mobility Framework



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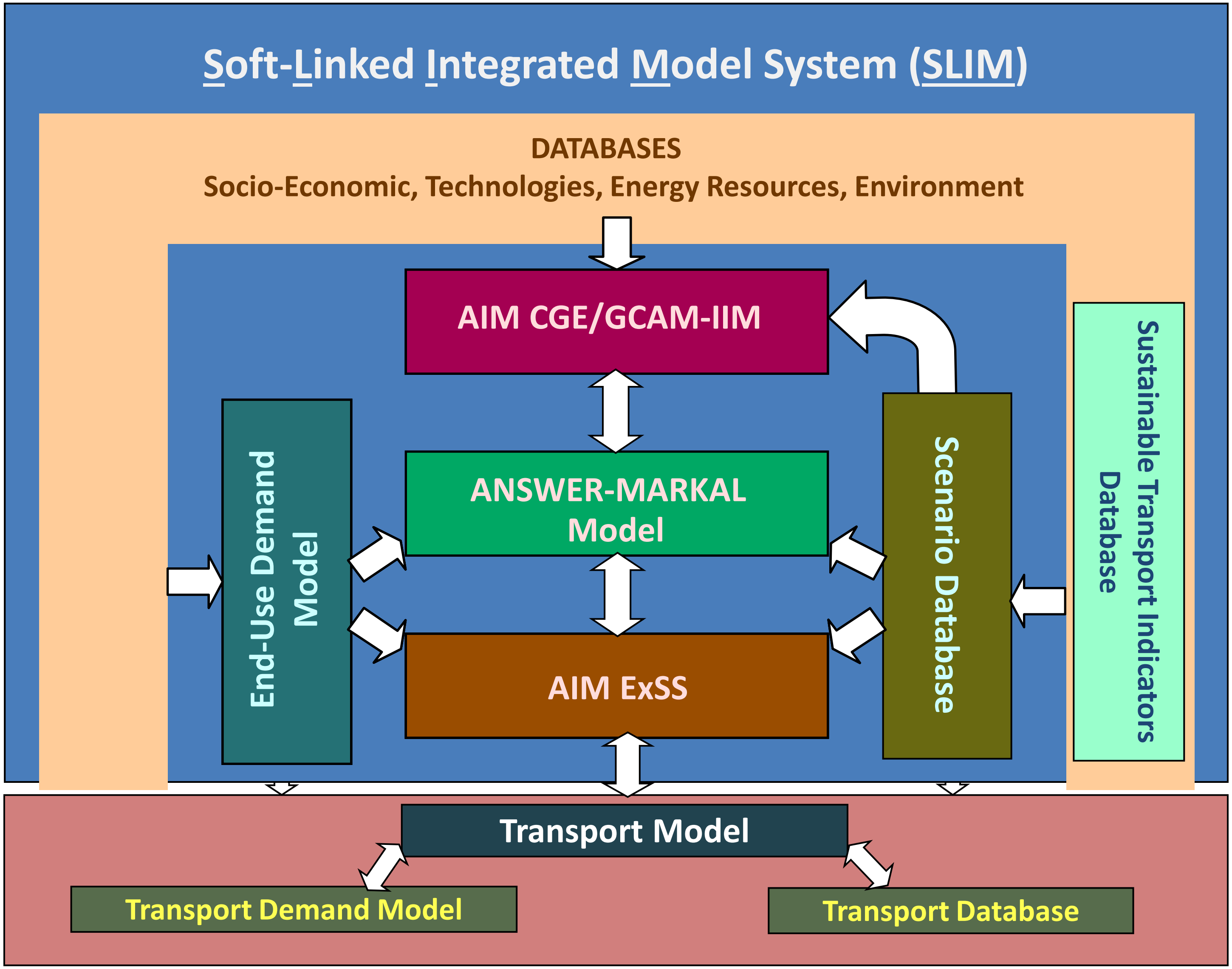
Soft-Linked Integrated Model

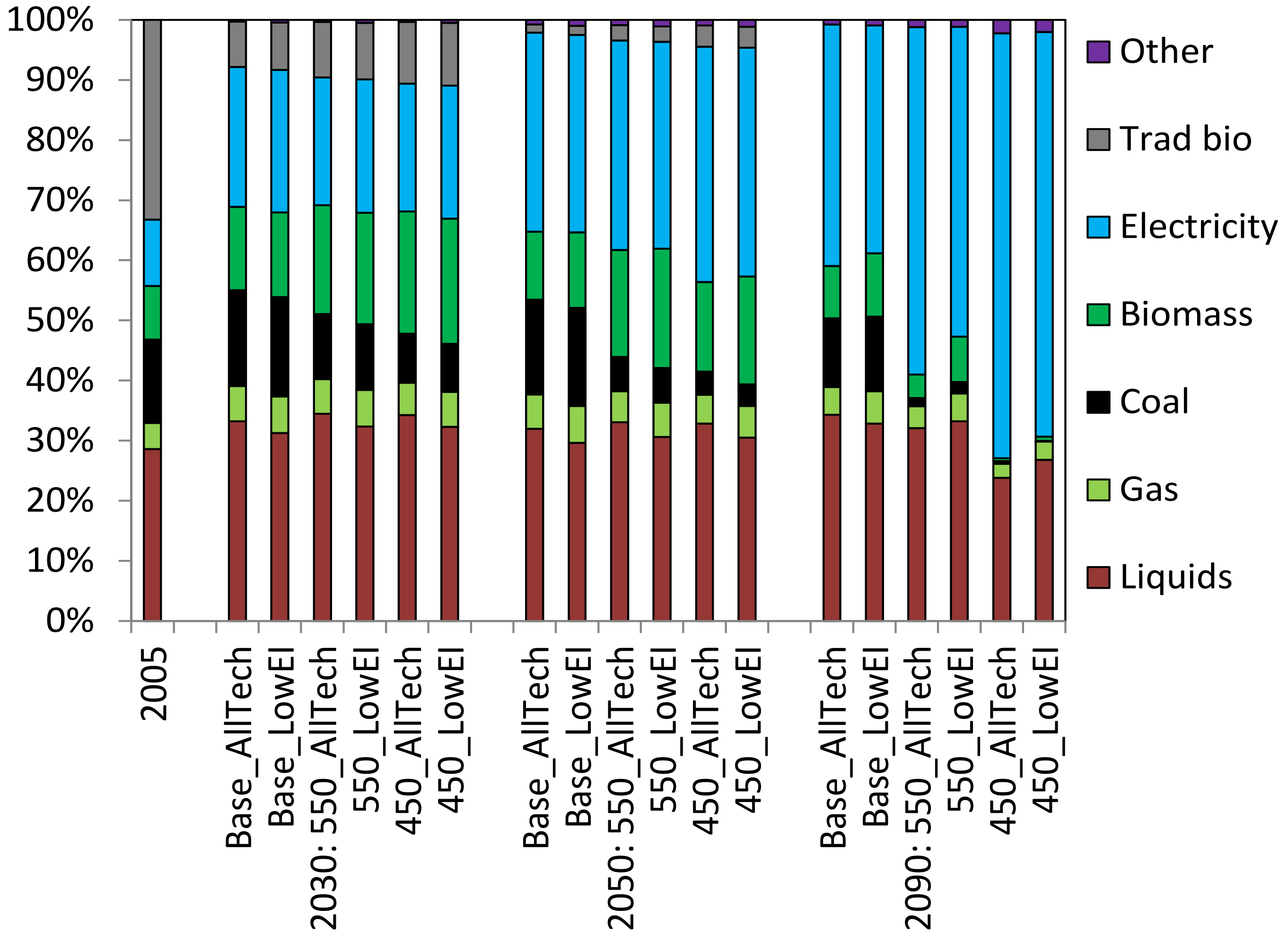


Scenario Descriptions: EMF27

Scenario Name	Description
Base_AllTech	**No** climate change mitigation policy scenario with **reference** assumptions for end use technology efficiencies.
Base_LowEI	**No** climate change mitigation policy scenario with **advance** assumptions for end use technology efficiencies for industry, transport and building sectors.
550_AllTech	Climate change mitigation policy scenario aiming at **3.7 W/m^2** radiative forcing stabilization by 2095 with **reference** assumptions for end use technology efficiencies. Overshoot before 2095 not allowed.
550_LowEI	Climate change mitigation policy scenario aiming at **3.7 W/m^2** radiative forcing stabilization by 2095 with **advance** assumptions for end use technology efficiencies. Overshoot before 2095 not allowed.
450_AllTech	Climate change mitigation policy scenario aiming at **2.6 W/m^2** radiative forcing stabilization by 2095 with **reference** assumptions for end use technology efficiencies. Overshoot before 2095 allowed.
450_LowEI	Climate change mitigation policy scenario aiming at **2.6 W/m^2** radiative forcing stabilization by 2095 with **advance** assumptions for end use technology efficiencies. Overshoot before 2095 allowed.

Ref: EMF27 Special Issue, Climatic Change, Sept. 2013

Final energy consumption by fuel: Effect of carbon tax versus end use efficiency



Ref: Chaturvedi and Shukla, EMF27 Special Issue, Climatic Change, Sept. 2013

Co-benefits of Energy Efficiency Improvements

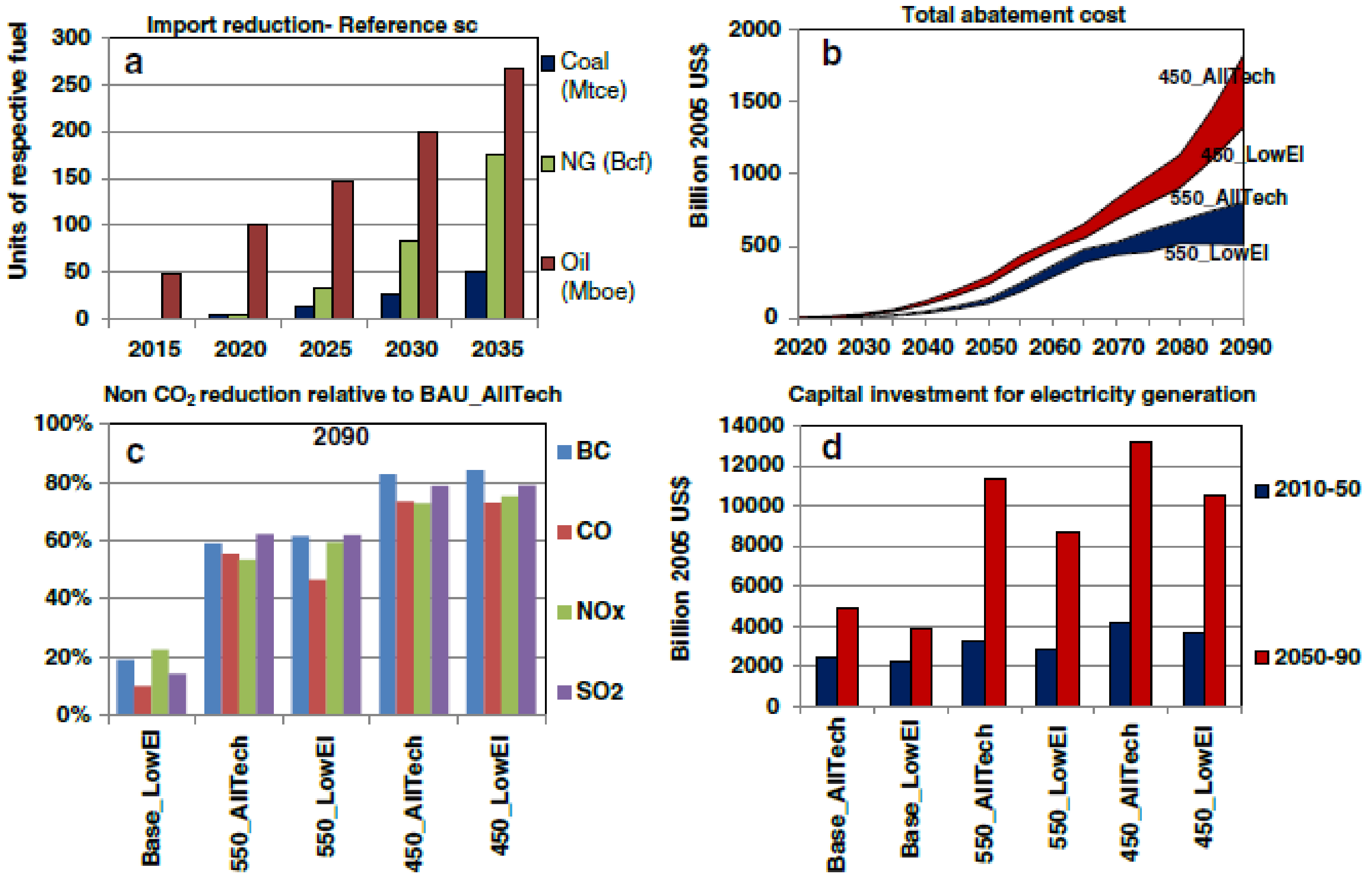


Fig. 2 Impact of enhanced end use energy efficiency policy on a) Import reduction under reference scenario b) Total abatement cost under climate policy c) Non CO2 reduction d) Capital investment for electricity generation

Ref: Chaturvedi and Shukla, EMF27 Special Issue, Climatic Change, Sept. 2013

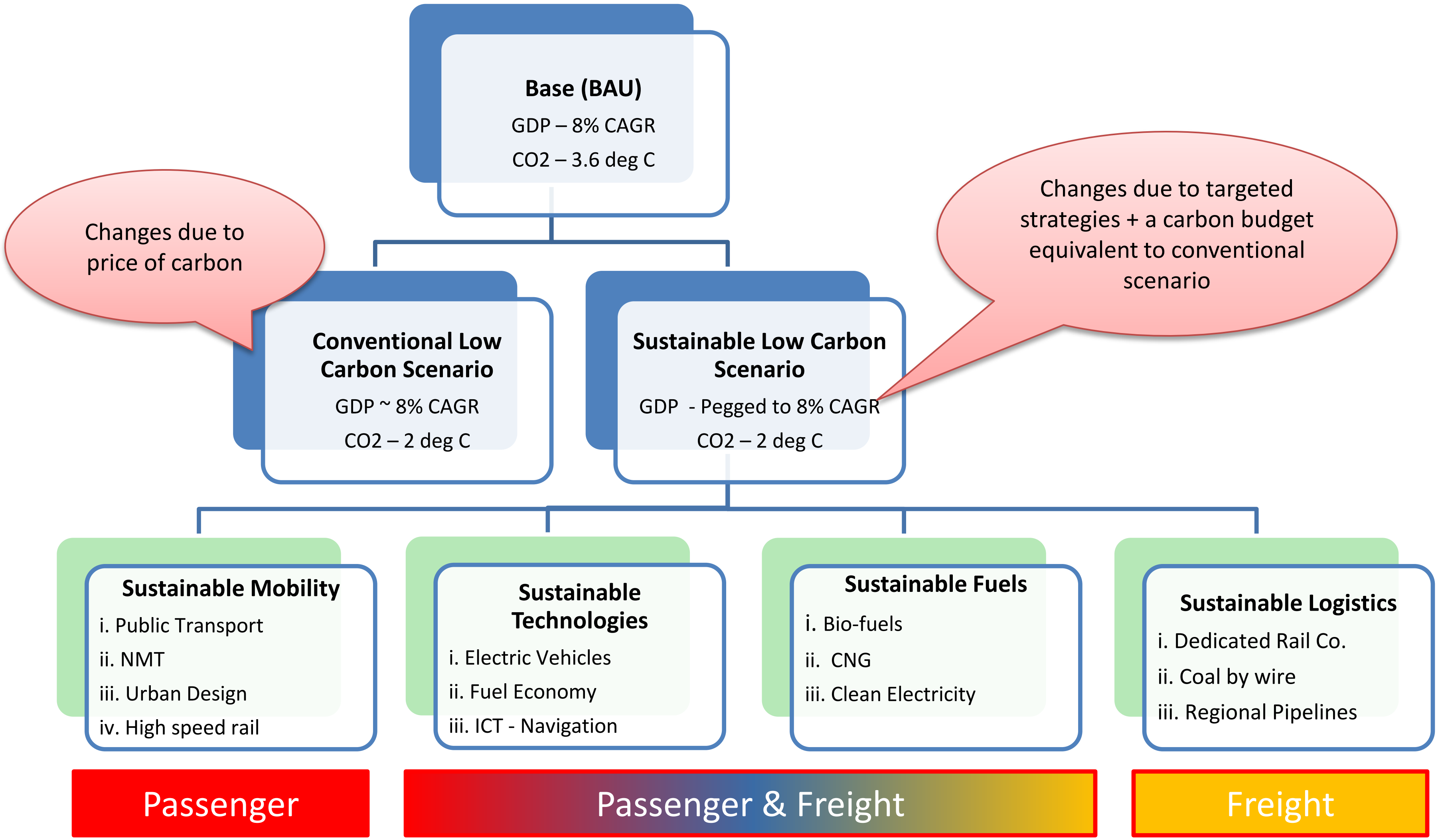
Scenario storylines

a. Business as Usual (BaU) Scenario

b. Conventional Low Carbon Scenario

c. Sustainable Low Carbon Scenario

Architecture for Transport Scenarios



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BAU & Conventional LCS Storylines

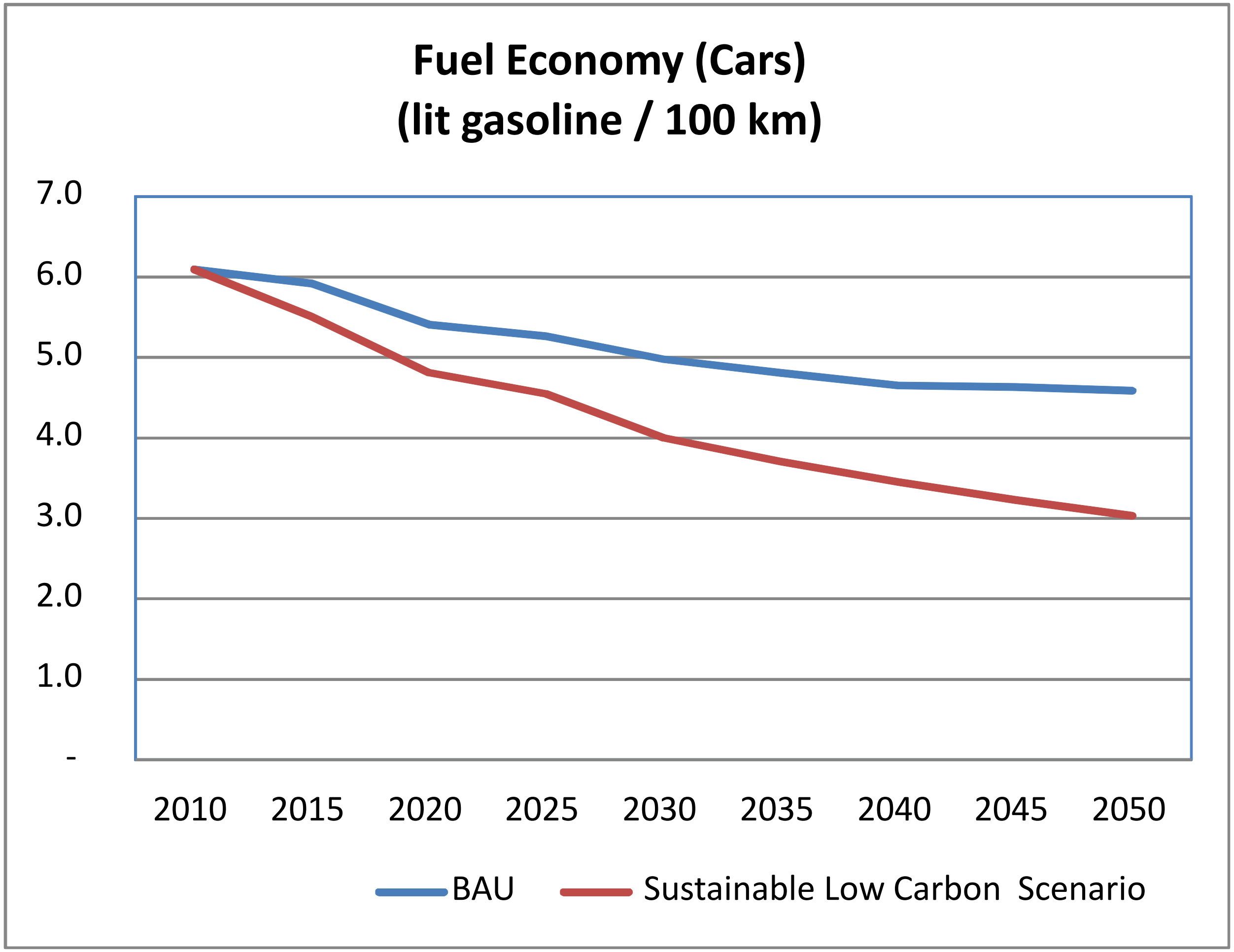
Business-as-Usual (BAU)

- GDP growth 8% between 2010 and 2030
- Population growth consistent with medium scenario of UN population projections
- Improvement in vehicle efficiencies consistent with policies (existing & proposed)
- Slow implementation of infrastructure projects (BRT; Freight Corridors, HST, etc.)

Conventional Low Carbon Scenario

- GDP, Demographic projections similar to BAU
- Policy and Institutional setting similar to BAU
- A global price corresponding to 2 deg C target
- Diffusion of more efficient vehicle technologies
- Clean up of electricity due to higher diffusion of renewables

Fuel Economy: BAU and Low Carbon



Sustainable Low Carbon Development Scenario Storyline

1) Sustainable Mobility in Cities (City Policies; Decisions and Investments)

- Enhanced NMT (**Non motorised transport**)
- Public Transport (PT): Improved access to **buses** (& para-transit), **BRT, Metro**
- Urban Design : Changes in **design, density and diversity**

2) Technology (National/Regional/Local Standards and Policies)

- ICT-Navigation, Electric Vehicles, Fuel Economy

3) Clean and Low Carbon Fuels (National Policies)

- CNG, Bio-fuels, Synfuels and Clean Electricity

4) Sustainable Logistics (National Policies)

- Intercity Passenger: faster inter city rail network (incl. High Speed Trains)
- Dedicated freight corridors , Pipelines, Coal by wire

In Addition:

1) General Sustainability Measures in All Sectors (e.g. 3R)

2) Same Cumulative Carbon Emissions as in Conventional Low Carbon Scenario

Sustainable Mobility Storyline

- Improved NMT (**Non motorised transport**)
- Public Transport (PT): Improved access to **buses** (& para-transit), **BRT, Metro**
- Urban Design : Changes in **design, density and diversity**
- Intercity : faster inter city rail connections (incl. **High Speed Trains**)
- Use of IT : e.g., **Video teleconferencing**, **websites** to facilitate car pooling , etc.

Sustainable Freight Storyline

- **Rail Freight**: **Dedicated freight corridors** (DFC), shift of fuels from **rail to pipelines**, etc
- **Ports & Inland Water ways**: Greater investments in small ports and water ways
- **Coal by Wire (CBW)**:
- **Regional Cooperation**: **International Gas pipelines, Electricity grids** reduce demand for coal

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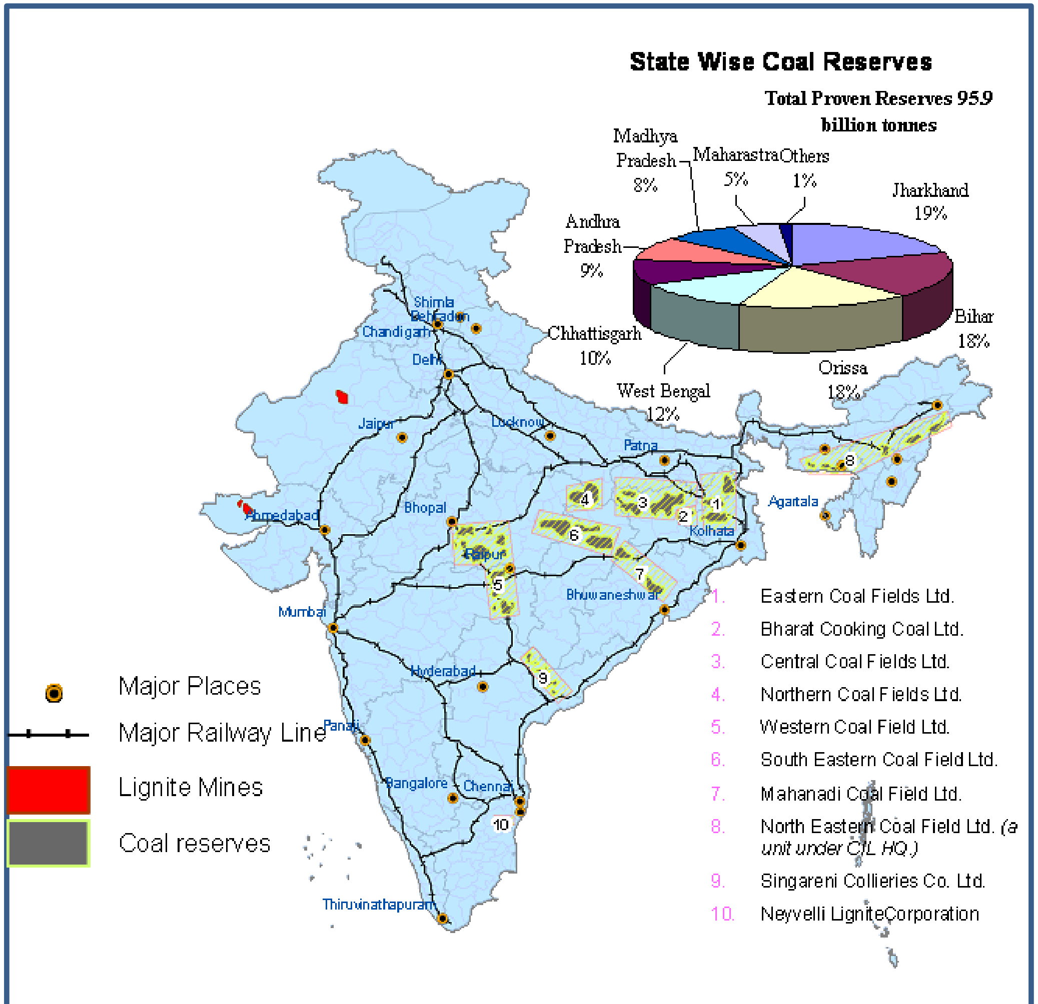
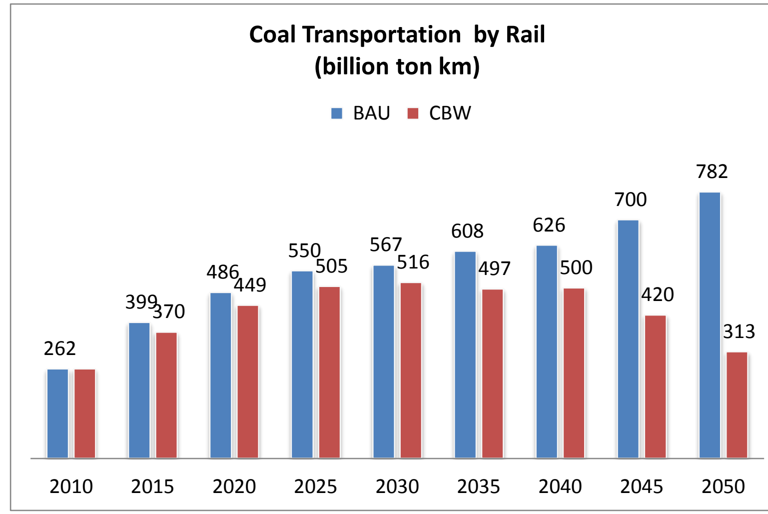
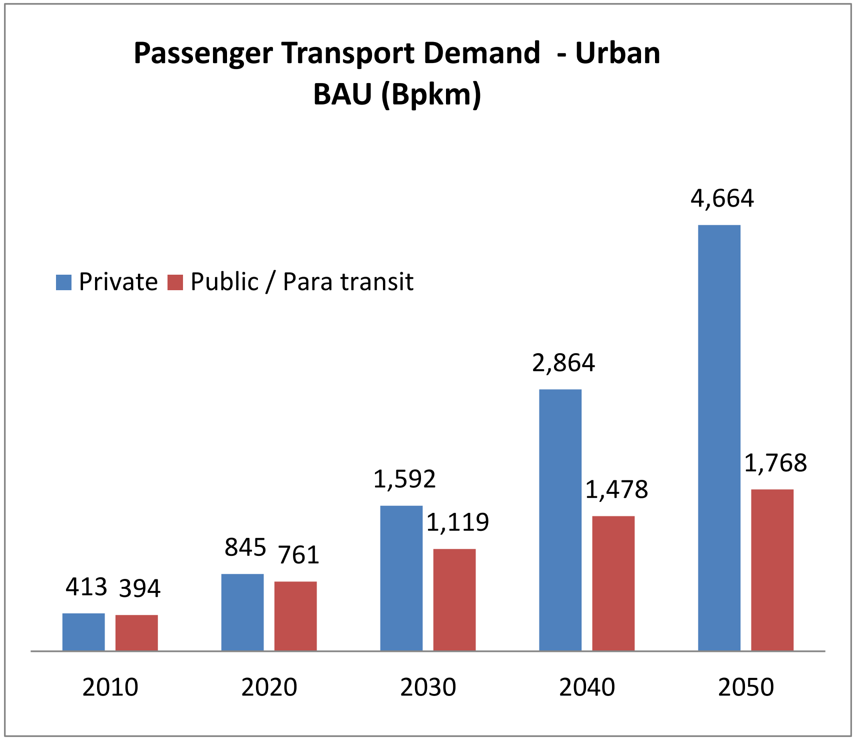
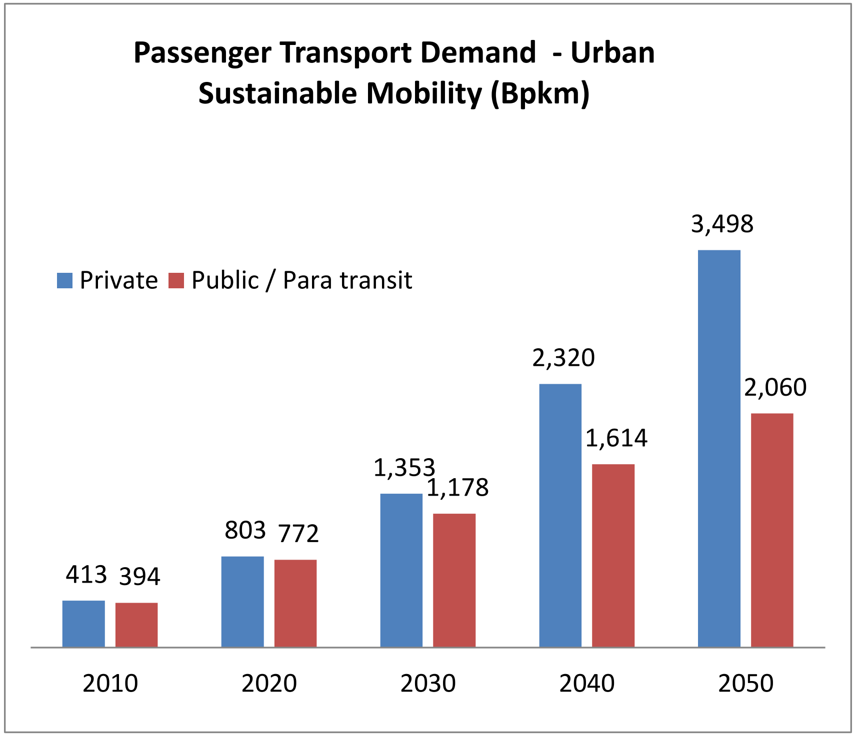
Infrastructure Alternatives: Coal by Wire





Demand for Urban Transport in BAU & Sustainable Mobility





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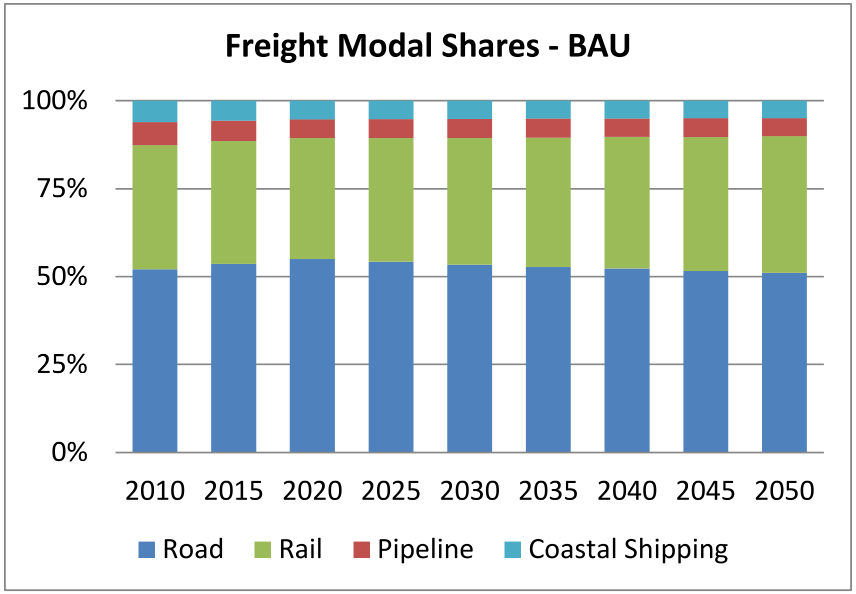
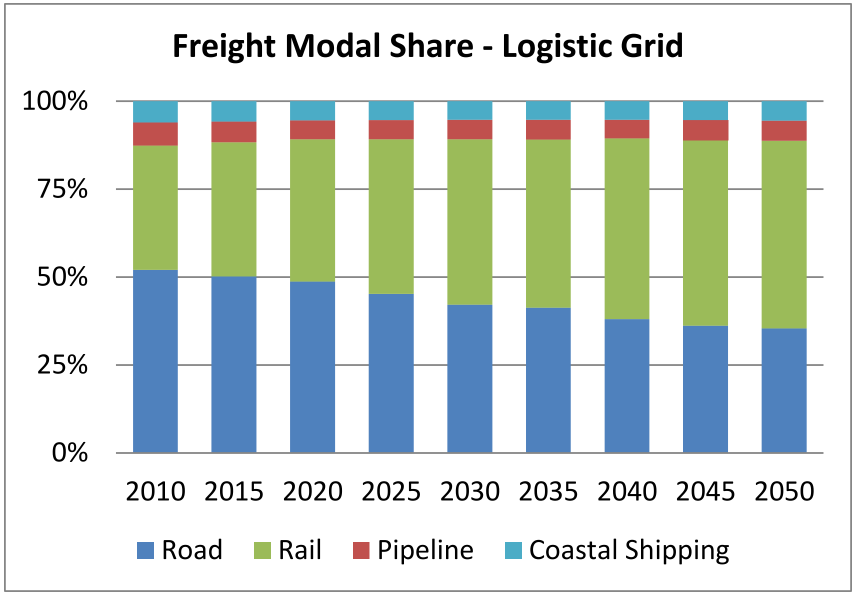
Modal Shares : Freight





Overall Freight Demand
2010 – 1771 btkm CAGR 2010-50* = 3.6%
2050 - 7341 btkm

Overall Freight Demand
2010 – 1771 btkm CAGR 2010-50 = 3.3%
2050 – 6558 btkm

(*) Absolute values from End Use Demand Model
CAGR harmonised between GCAM and MARKAL for BAU

Results

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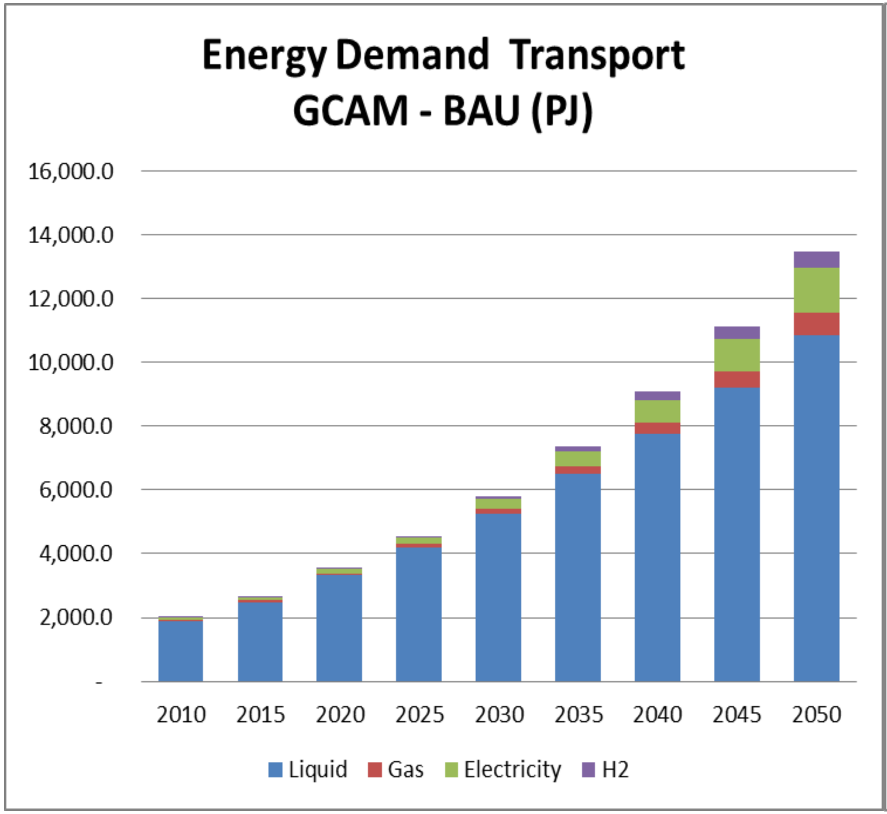
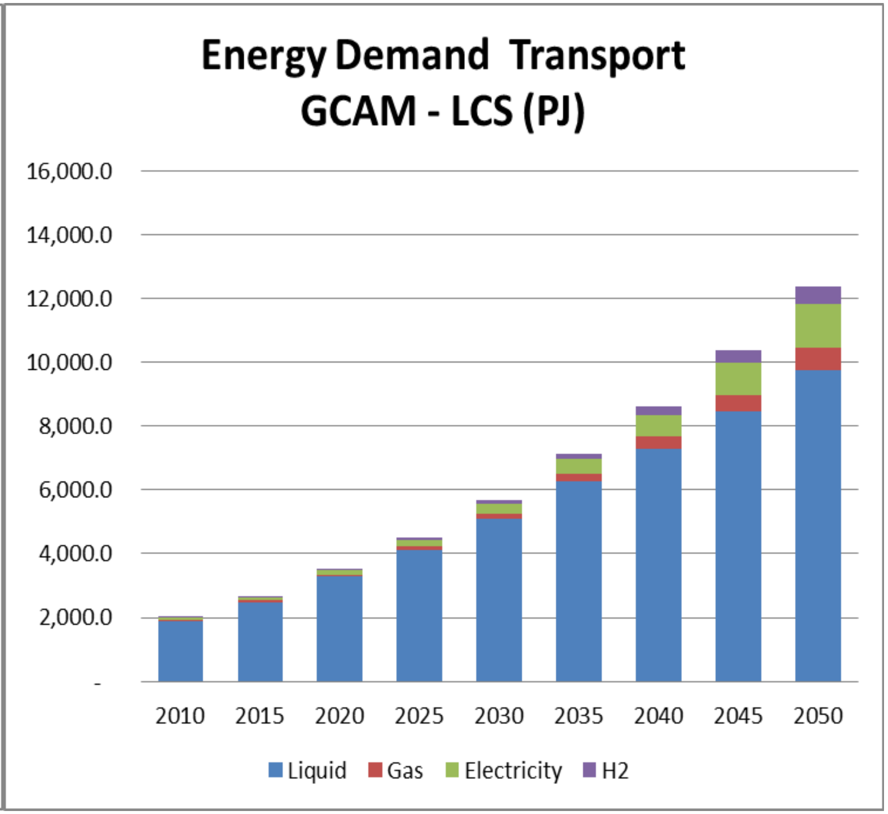
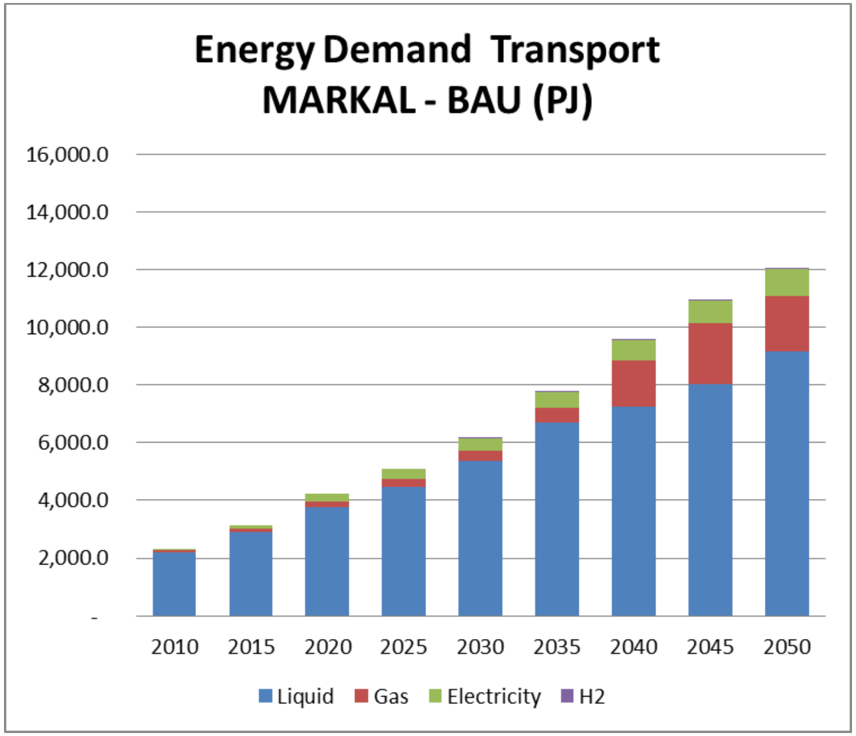
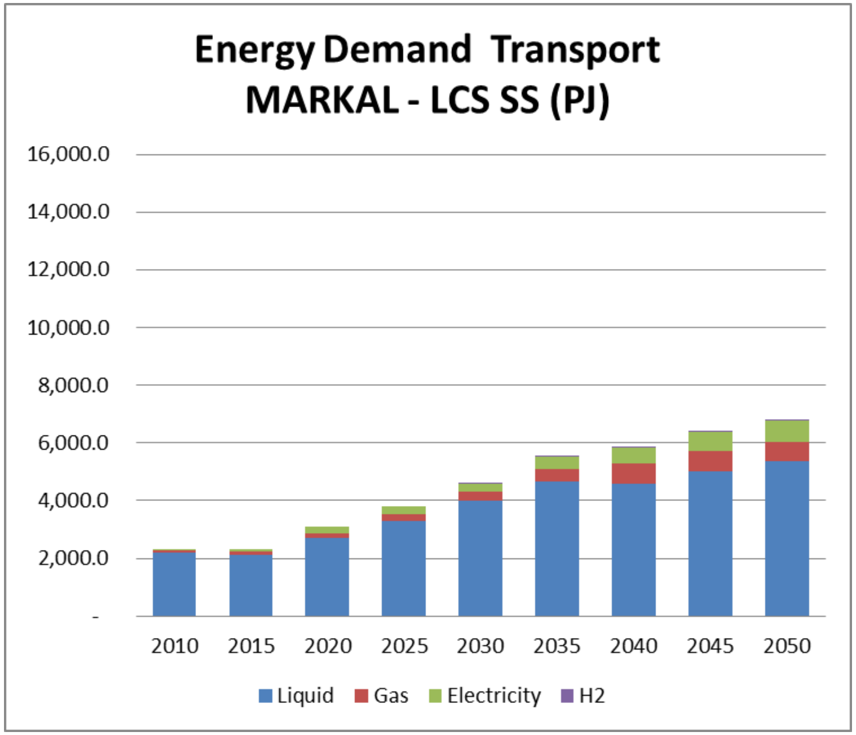
Energy Mix for Transport : GCAM





Energy Mix for Transport : MARKAL

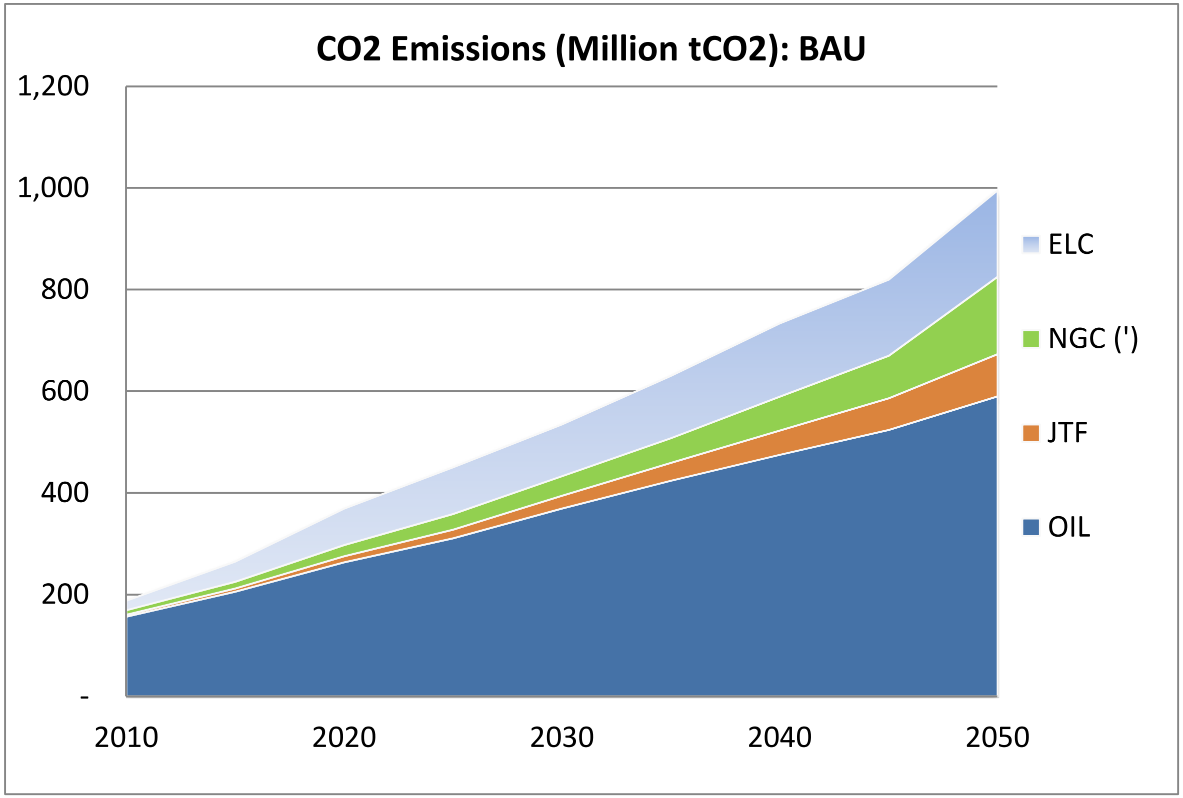




- MARKAL has stronger improvements in energy efficiency than GCAM reflecting the optimism of technology models
- Higher penetration of CNG vehicles.

- In LCS the overall demand for energy is getting almost halved
- Greater share of bio fuels in liquid fuels , 31% by 2050 (only 4% in BAU)

CO_2 Emissions: Transport BAU



(*) Natural Gas emissions include both emissions from energy and fugitive emissions

Emission Intensity of Grid (Million tCO2/GWh)

Scenario	2010	2020	2030	2040	2050
BAU	0.99	0.94	0.86	0.74	0.69

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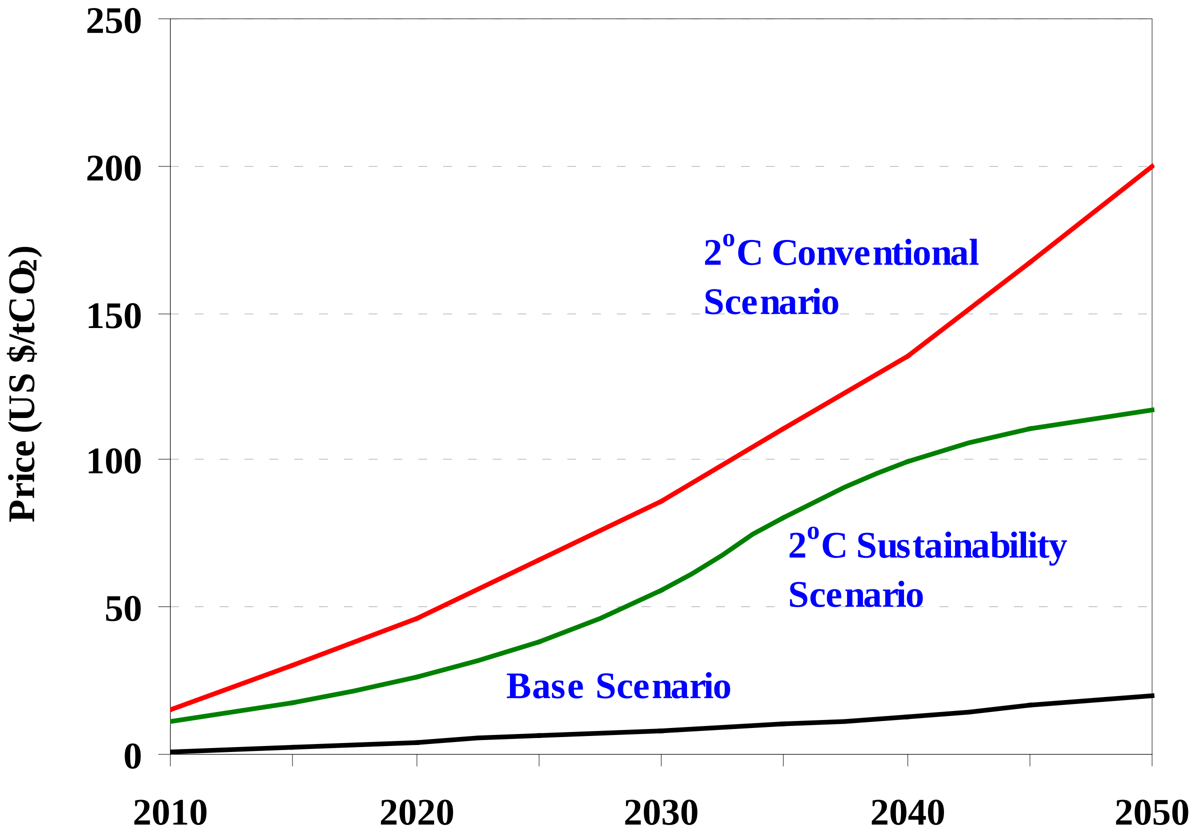
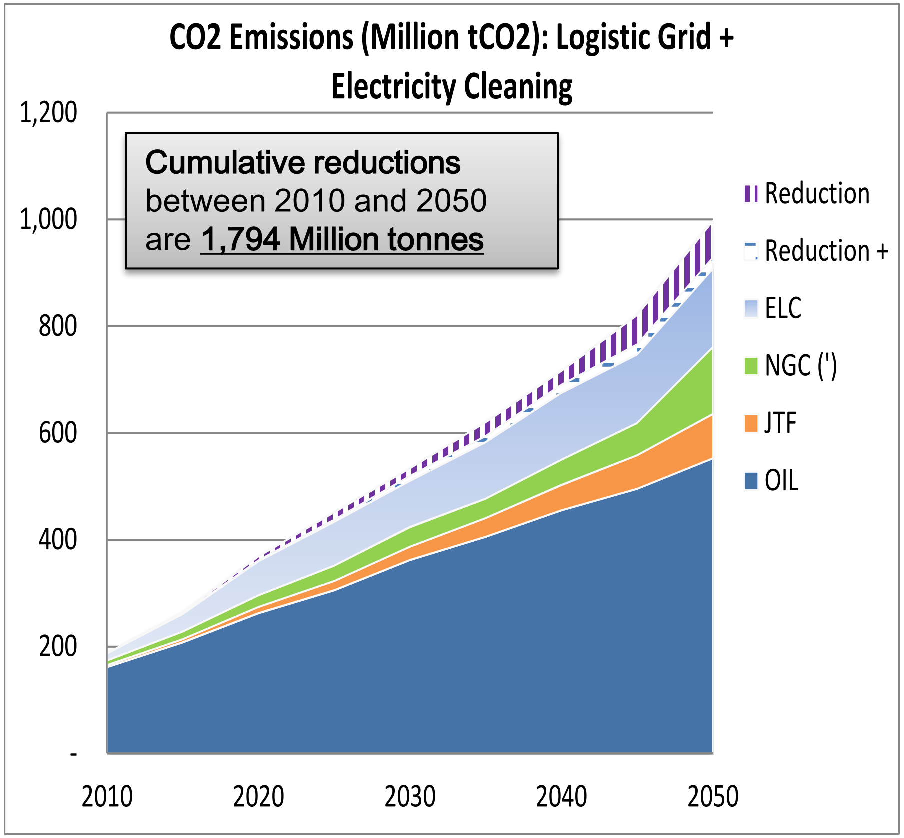
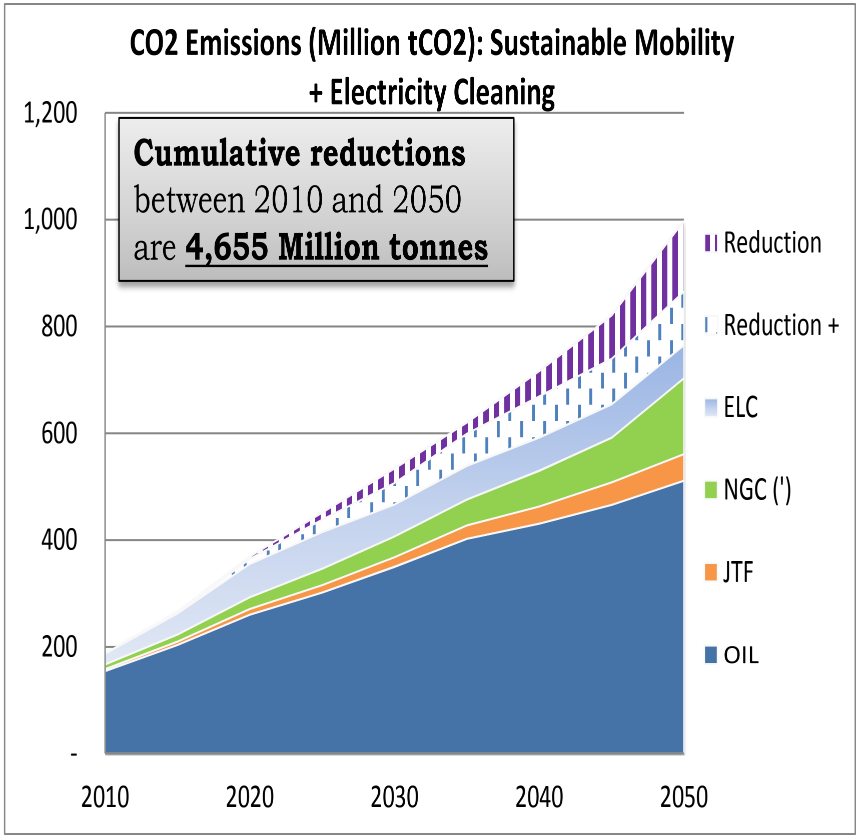
Carbon Tax Conventional & Social Cost of Carbon



CO_2 Reductions: Demand Strategies





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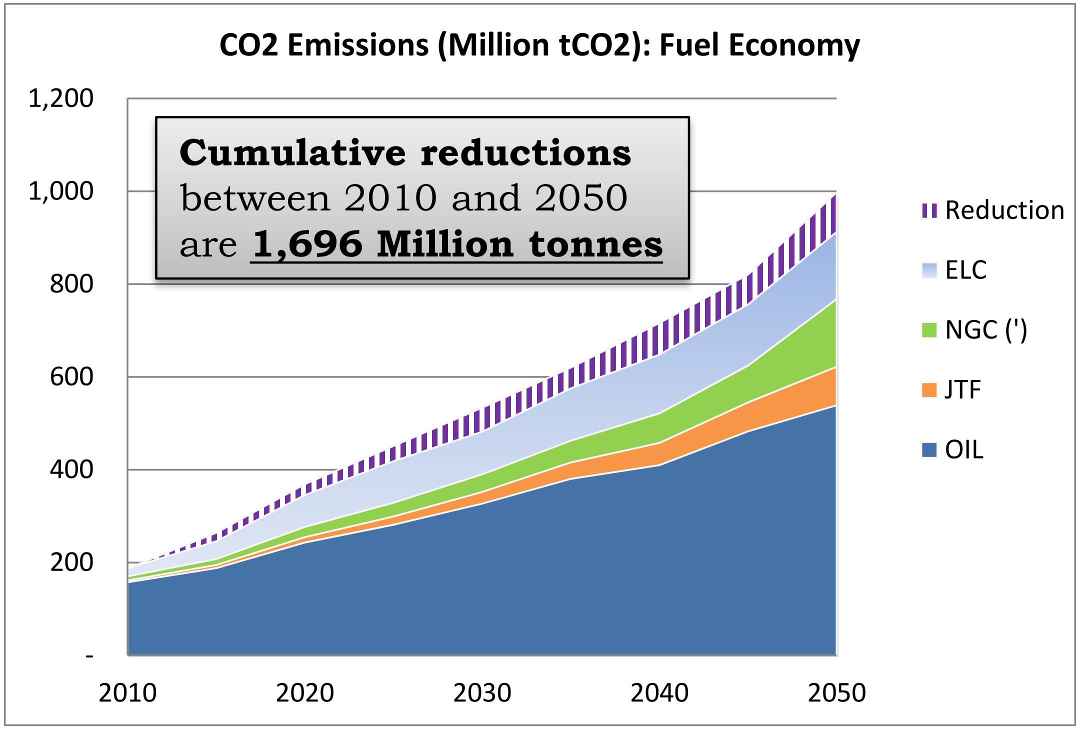
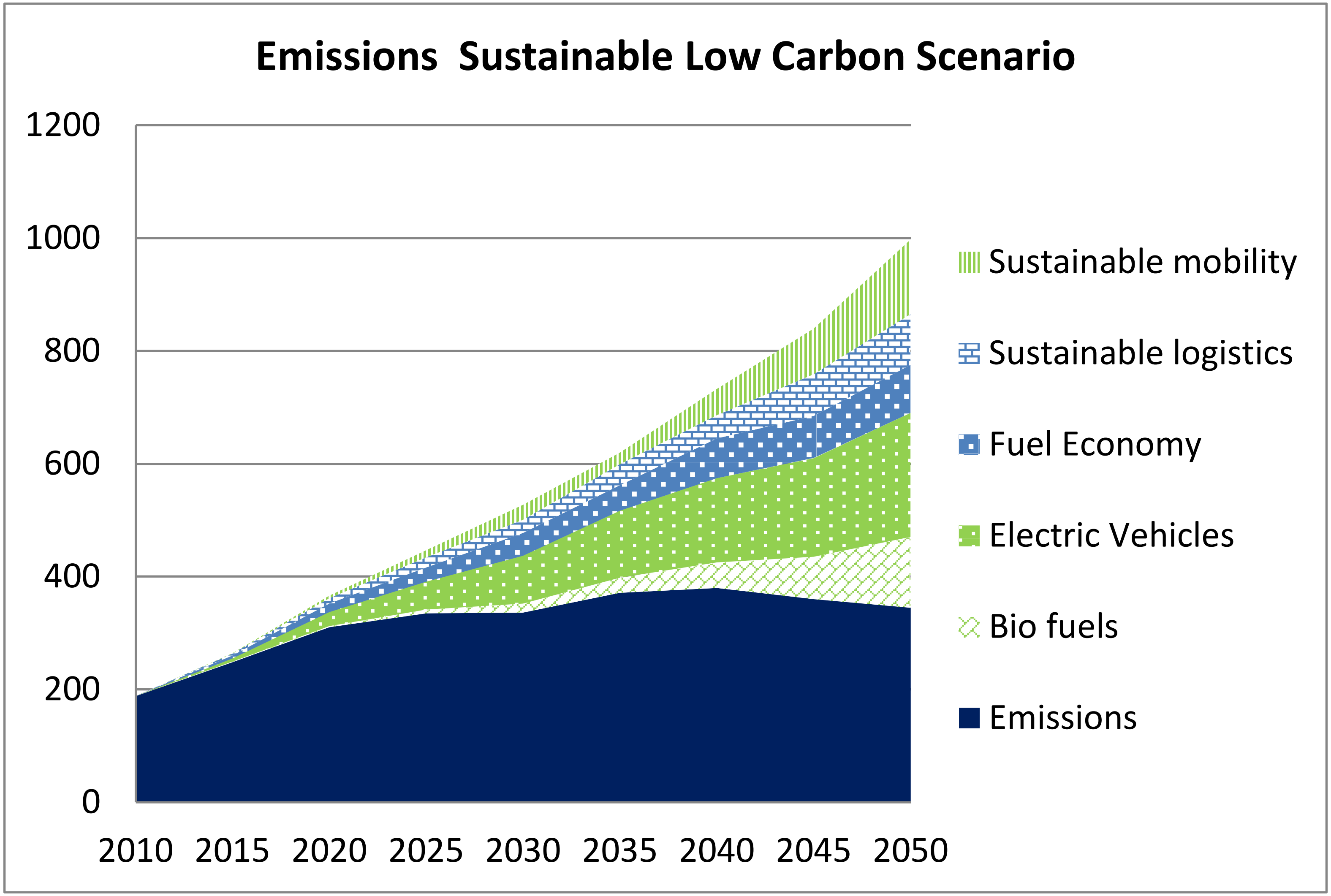
CO_2 Reductions: Supply-side Strategies



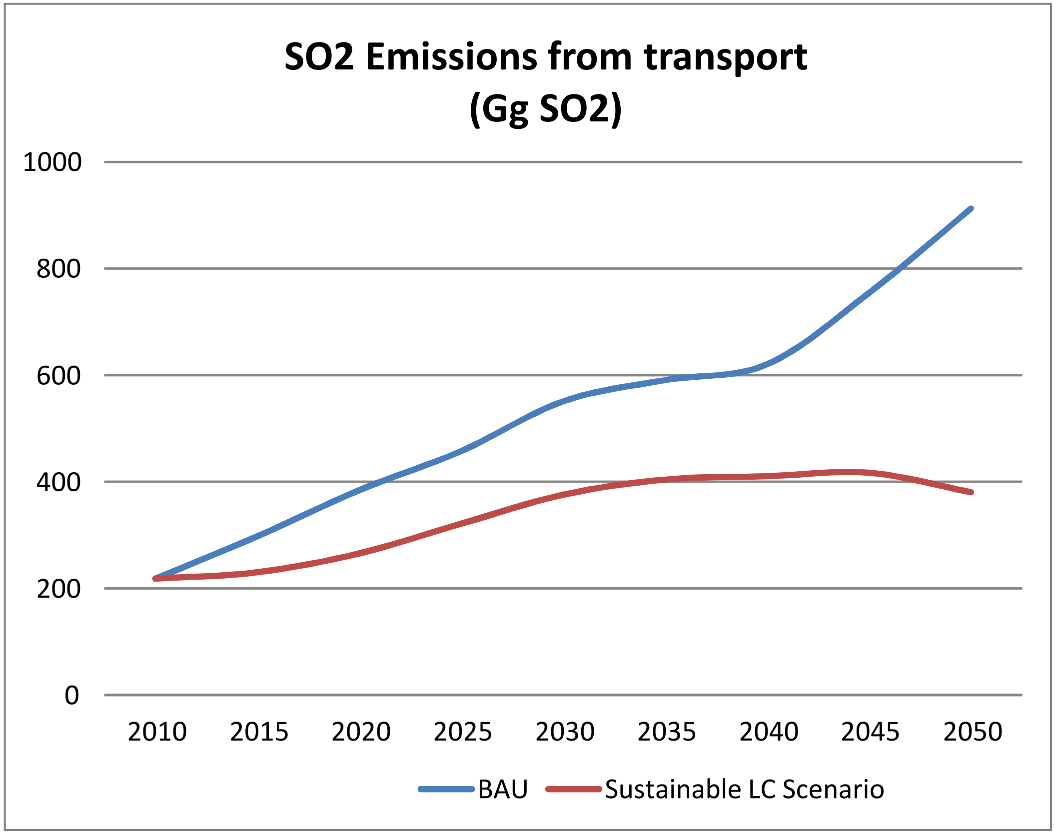
Other supply strategies

- Electric Vehicles
- Bio fuels
- Natural Gas

Overall CO_2 Reductions



SO2 Emissions



Conclusions

1. **Passenger transport:** Sustainable urban design, modal shift can contribute nearly a quarter of emissions reduction in freight transport, Facilitate non-motorized transport
2. **Freight transport:** Location decisions, Modal shift and regional energy market development can contribute a third of emissions reduction in freight transport.
3. **Vehicle Policies:** Fuel-Efficiency Standards, Remove fuel-subsidies, Environmental taxes have significant impact
4. **Fuel Mix:** Global carbon price influences significant change in the transport fuel mix including decarbonization of electricity
5. **Co-benefits:** Sustainable low carbon transport delivers significant co-benefits, e.g., reduced air pollution, energy security, energy access, etc.

Policy implementation costs should be compared vis-à-vis benefits

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Thank You

Project Website : www.unep.org/transport/lowcarbon

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