

Integrated Assessment of Low Carbon Transport at the National Level: Approach and Framework

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Workshop on:

Promoting Low Carbon Transport in India: *Expert Workshop on Indicators for Sustainable Transport*

Ahmedabad, August 29, 2011



Presentation Agenda

- 1. What do we mean by Low Carbon?**
- 2. Framing & Modeling of Sustainable Low Carbon Transport**
- 3. Methodology for the Assessment of National Low Carbon Transport Scenarios**
- 4. Sustainable Low Carbon Transport Scenario (integrating emerging technology and policy options)**
- 5. Conclusions**



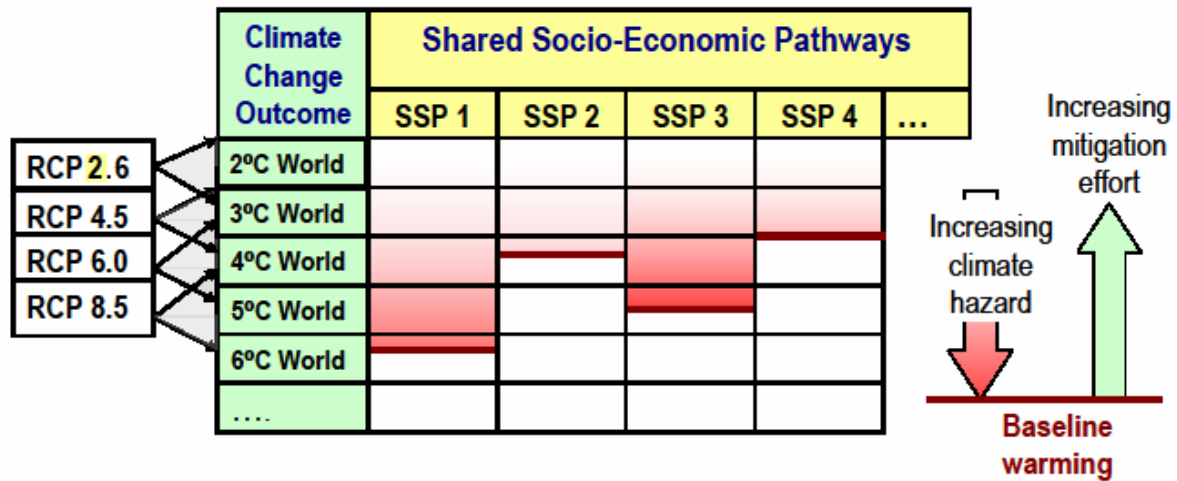
What do we mean by Low Carbon?

Global Climate Stabilization Target

Copenhagen and Cancun Agreements

2°C Temperature Stabilization Target

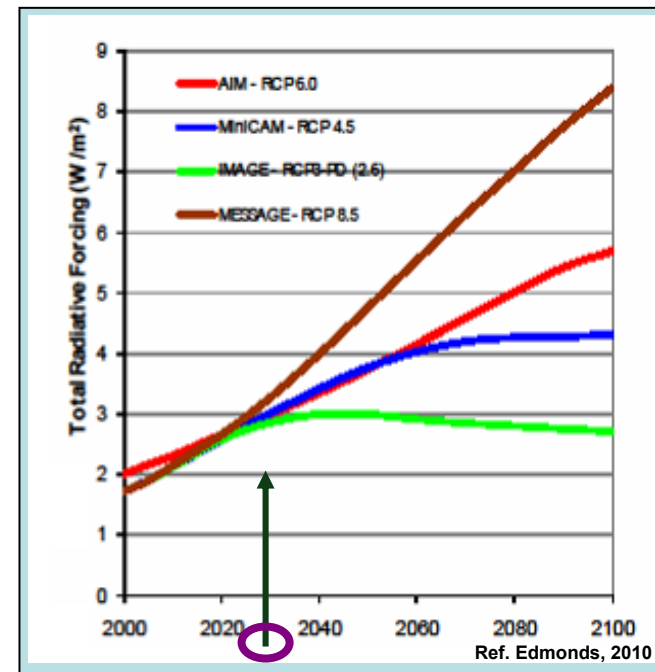
IPCC Representative Concentration Pathways (RCPs)



→ Cells contain information about mitigation, adaptation, residual climate impacts

Ref. Krieger et. al. 2010

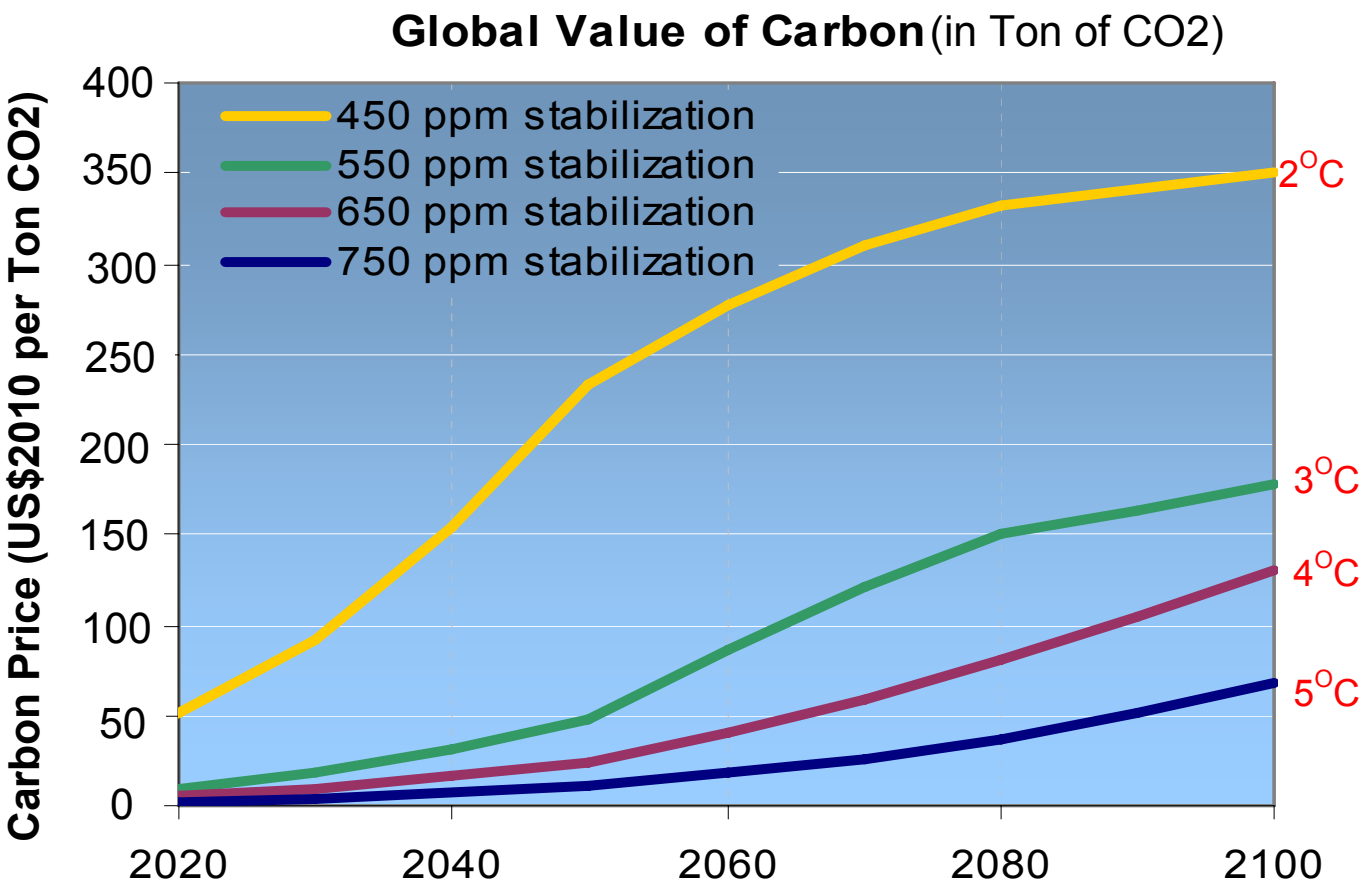
Emission Paths for RCPs



Available online (August 2011)
in 'Climatic Change', Springer



Global Carbon Price for GHG Concentration Stabilization Levels

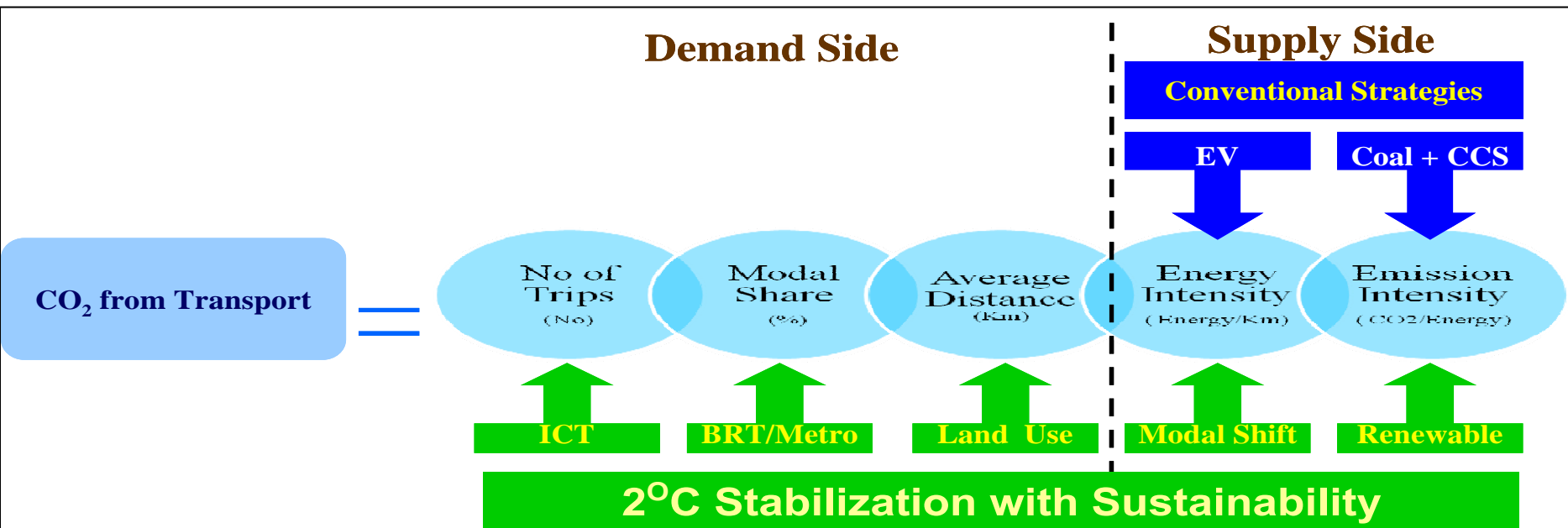


Framing & Modeling of Sustainable Low Carbon Transport



Transport and Sustainability Nexus

1. Inclusiveness
2. Co-benefits (by aligning 'development and climate' goals)
3. Long-term (Intergenerational) Perspective
 - Avoid Lock-ins (or irreversibility)
 - Social Discounting



Low Carbon Transport Framing (1): Mapping Transitions

- Demographic Transitions
 - Age, Gender, Urban/Rural, Education/Skills
- Income
 - Growth, Distribution
- Infrastructures
 - Modes, Investment, Ownership
- Technologies
 - Efficiencies, IPRs, Domestic vs. Foreign
- Governance / Institutions
 - Market Orientation, Global Interfaces, Effectiveness



Low Carbon Transport Framing (2): Economic Structure

Economic

- Income Distribution (Equity, Welfare)
- Cooperation vs. Competition
- Co-benefits; Discount Rate

Behavior

- Consumption (Awareness, Policies)
- Conservation (e.g. 3R)

Instruments

- Mix of Market vs. Non-Market
- Direct vs. Indirect



Low Carbon Transport Framing (3): Policies

Technology Policies (e.g.)

- Infrastructures
- Targeted R&D
- Domestic Clean Industry

Coordinate policies to gain co-benefits (e.g.)

- CO₂ and Air Quality
- Energy Security and Low Carbon Energy

Global Carbon Price vs. Social Value of Carbon

- Direct vs. Shadow Price
- Carbon Price and Discount Rates for Investments Proposals

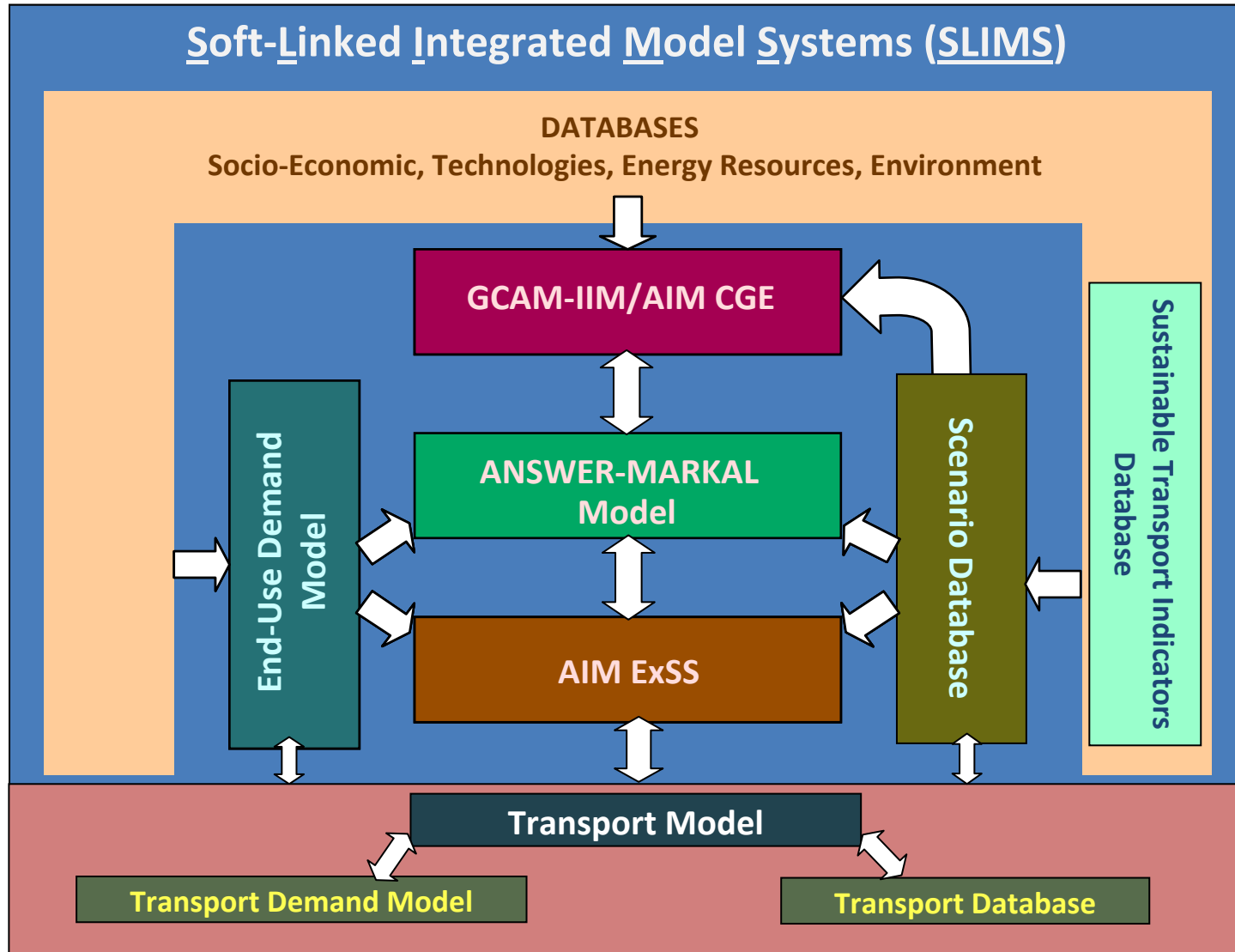


Low Carbon Transport Assessment Methodology

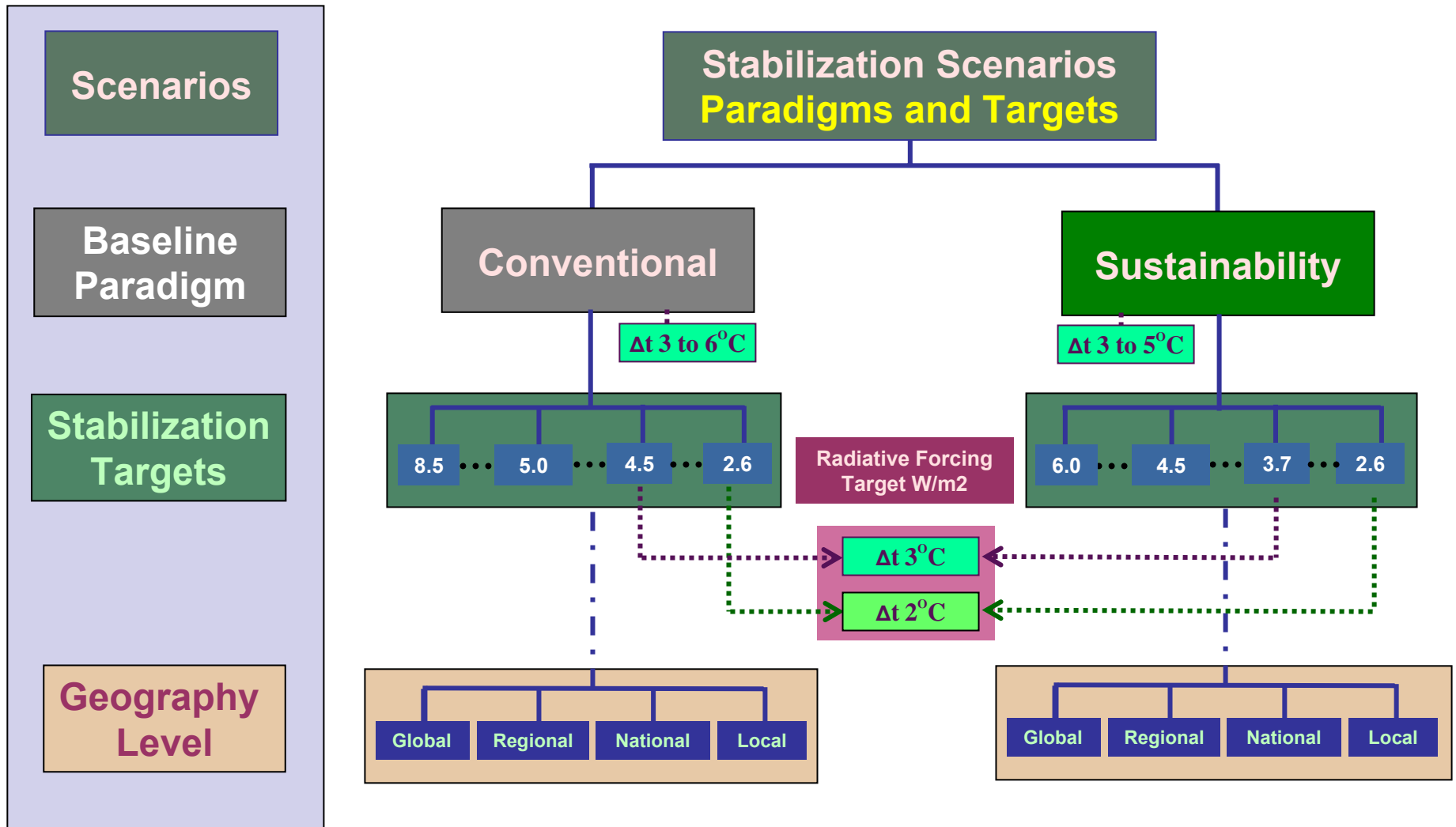
Scenarios and Modeling



Integrated Multi-Model Structure for Sustainable Low Carbon Transport

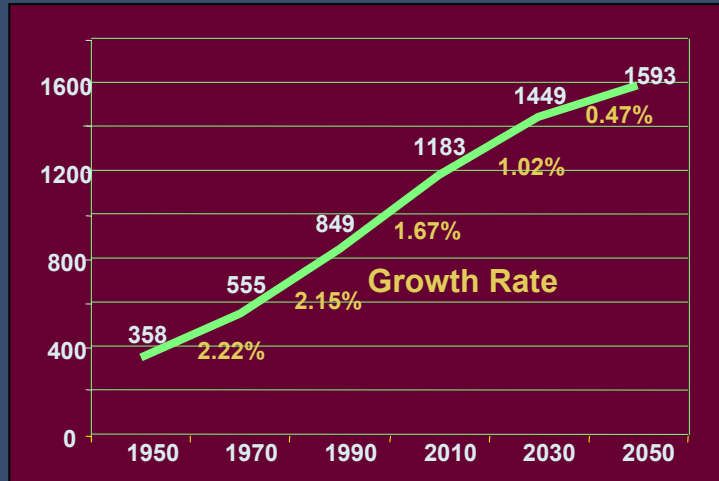


Climate Stabilization and Sustainability



Demographic Drivers

Population (Million)

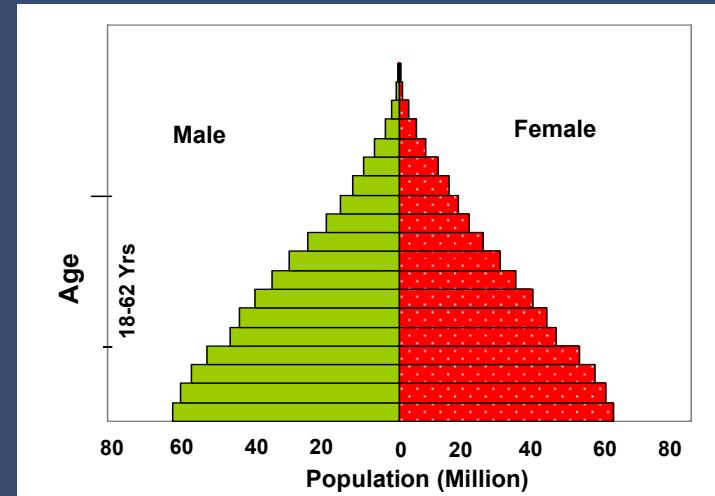


Labor Force (Million)



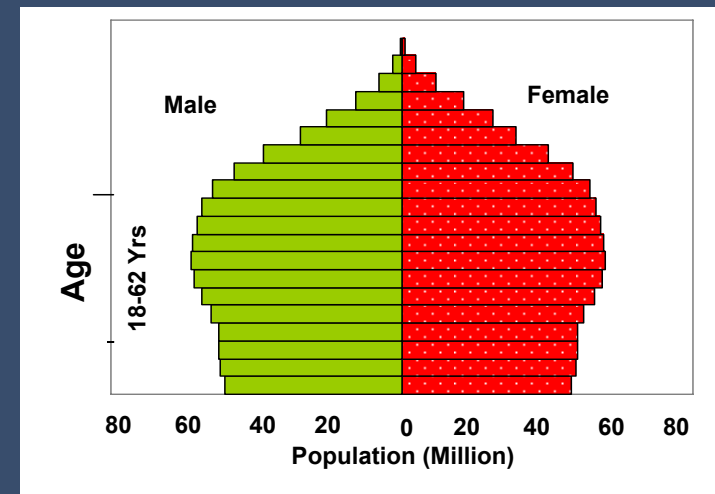
Year: 2000

Pop: 1021 Million



Year: 2050

Pop: 1593 Million



Drivers of Economic Growth

■ Human Capital

- High Labor Supply
- Increasing Education
- Migration (intra & inter county)

■ R&D

- Increasing Government/ Private Expenditure
- International Knowledge Flows
- R&D Collaborations

■ Technology

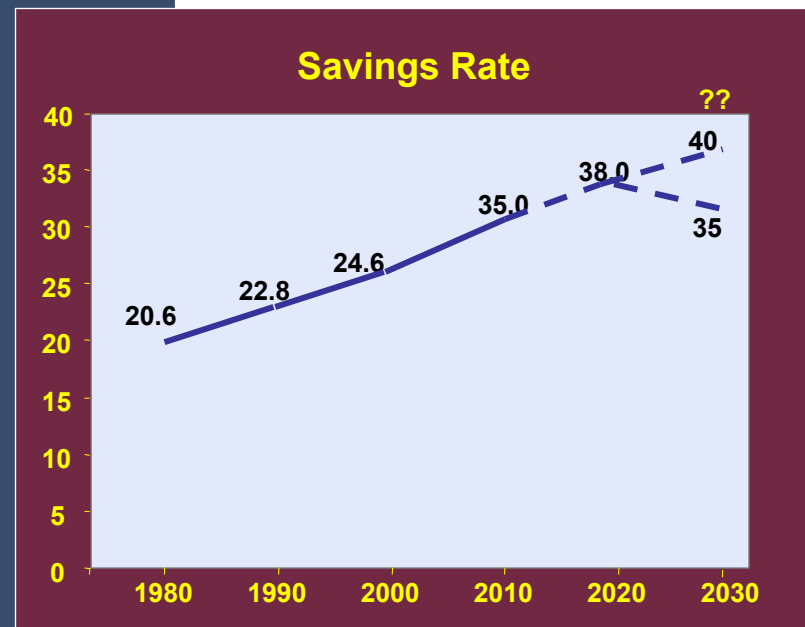
- Infrastructures
- Learning, transfers, deployment

■ Behavioral Changes

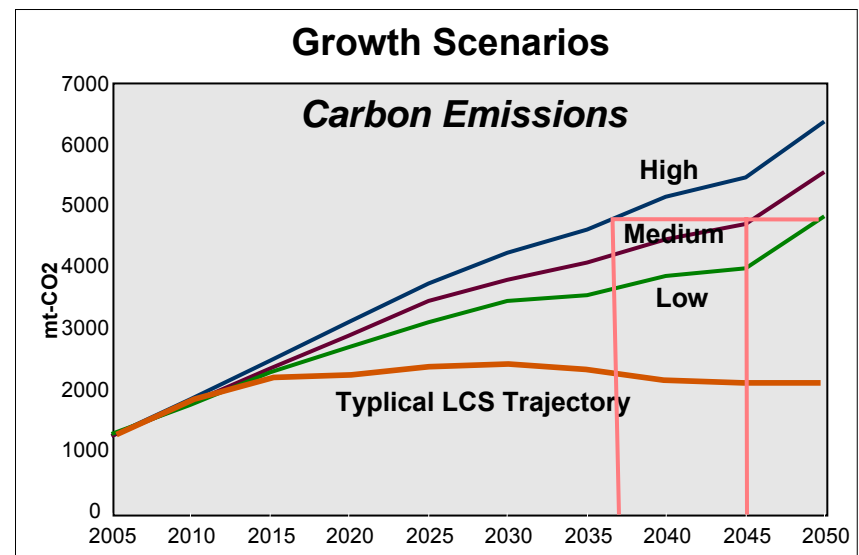
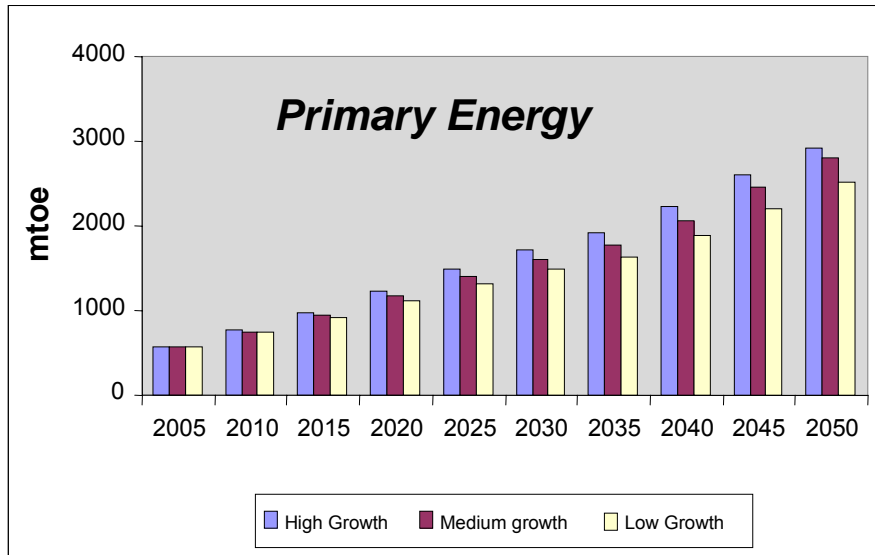
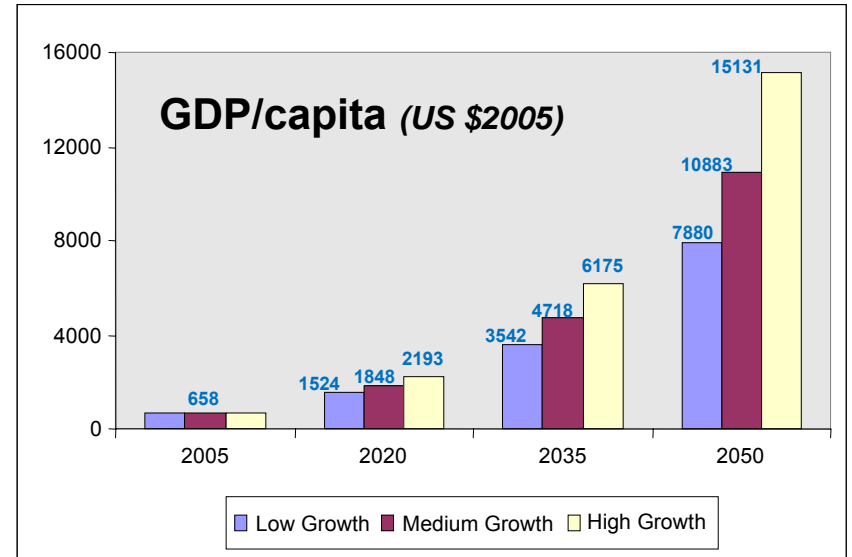
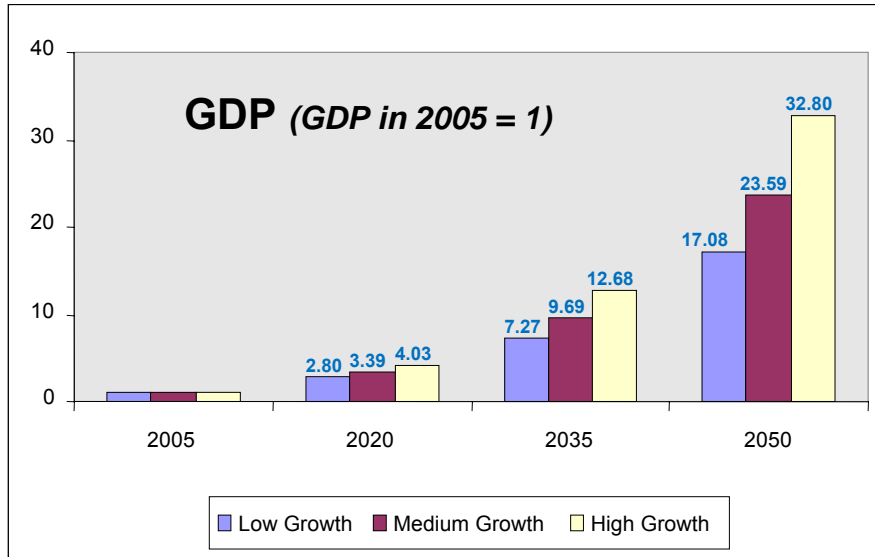
- High Savings Rate
- Changing Lifestyles

■ Governance

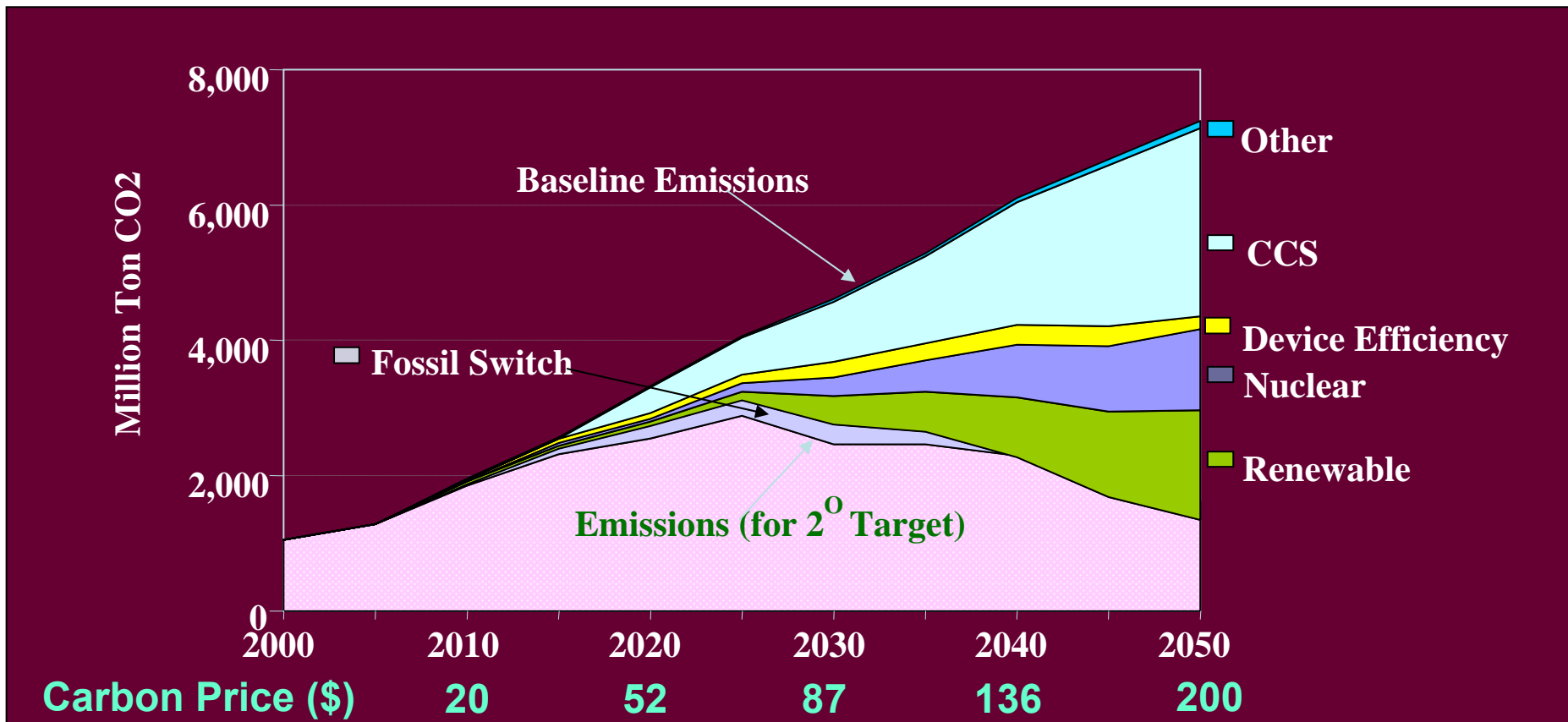
- Institutions
- Laws
- Policies



GDP, Energy, Emissions : Growth Scenarios



Mitigation Options: Conventional



Conventional Development + Carbon price

- High Carbon Price
- Climate Focused Technology Push
- Top-down/Supply-side actions

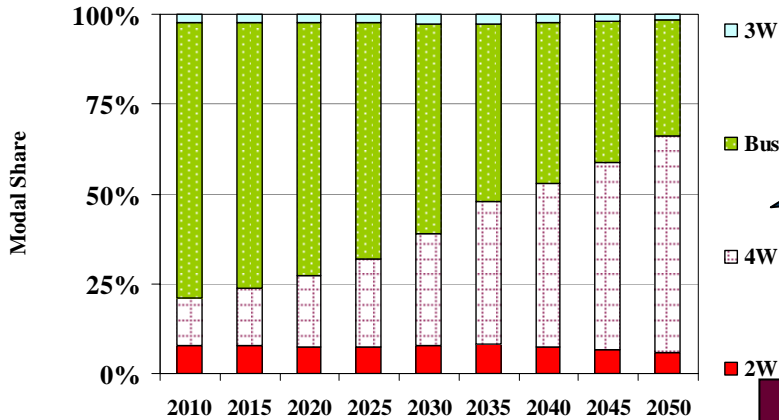
Technology Co-operation Areas

- Energy Efficiency (Immediate Target)
- Renewable (2020 Targets)
- Nuclear/CCS (Long-term Targets)



Future Scenario : Transport

Modal Split - Road

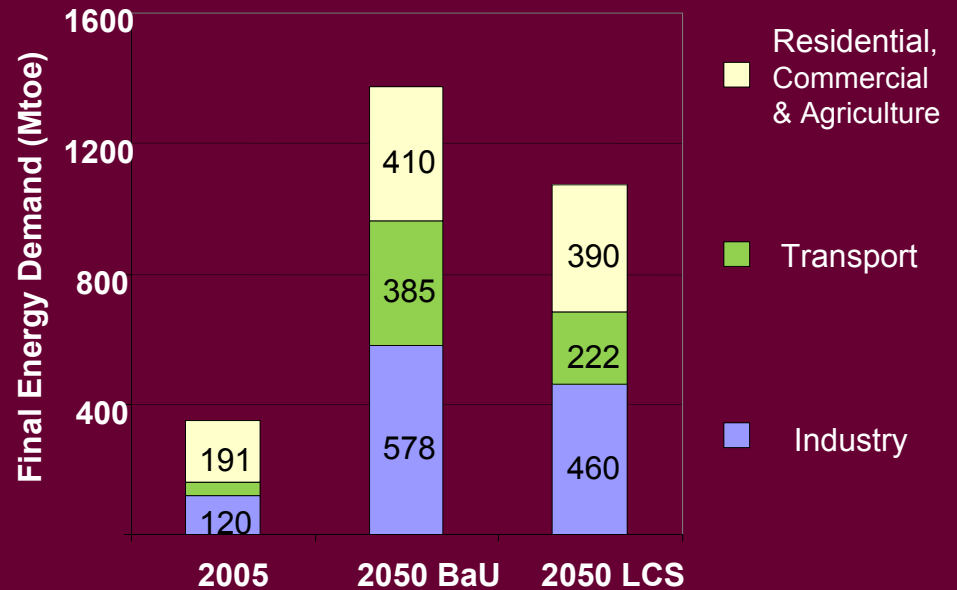


Modal Shift: Interaction of income effect and BAU transitions

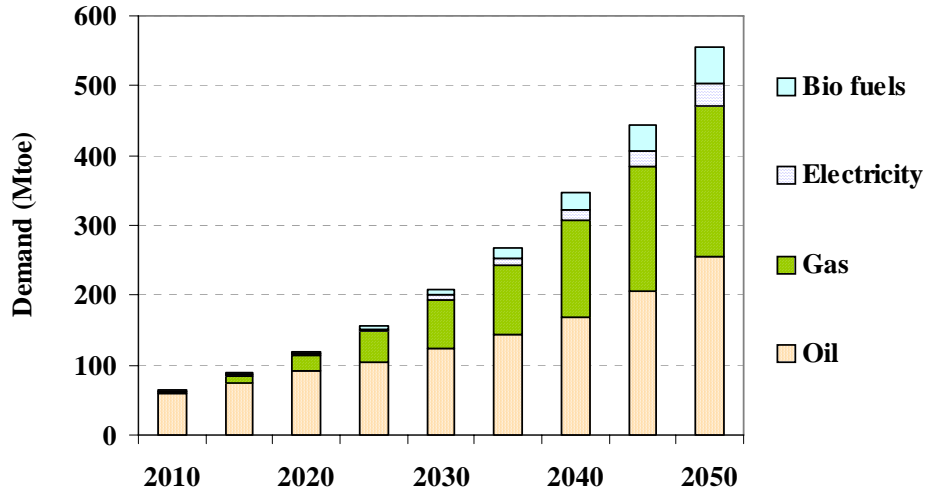
- Reduction in 2-Wheelers and 3-Wheelers
- Increase in Cars
- Shift to Bus (inter city movements)

Transport Energy Demand

- Increases under BAU scenario
- Modal Shift, Efficiency Improvements,
- Sustainable Transitions: Behavioural



Future Scenario: Transport



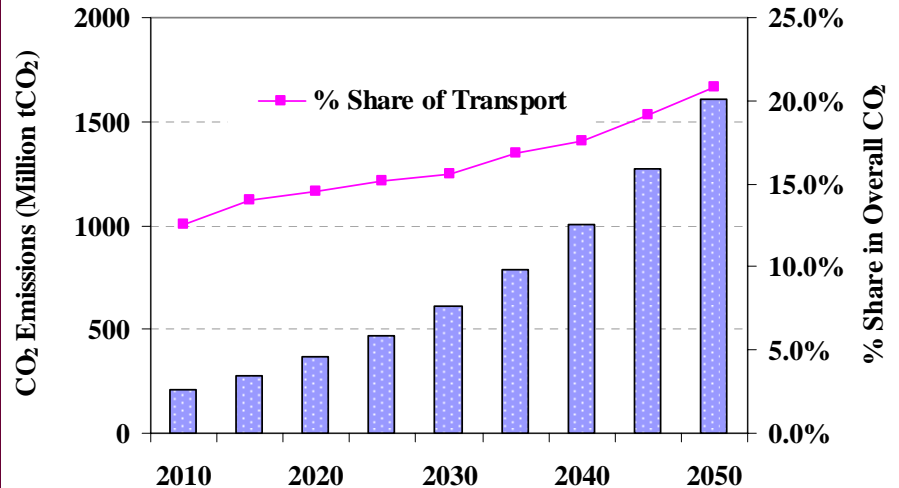
Changing Energy Mix

- Oil remains as dominant fuel
- Continuous penetration of natural gas
- Increase in electric vehicles
- Bio fuel usage (marginal)

Composition of energy demand from Transport

Increase in transport sector emissions

- Continuous rise in CO₂ emissions
- Transport emissions as a share of overall emissions also increases continuously



CO₂ Emissions from Transport



Low Carbon Transport:

Integrating Technology and Policy Options



Transport: Key Mitigation Options

- **Energy** : Efficiency, Electric Vehicles, Bio Fuels
- **Modal Shift**: Car Vs Bus/Transport , Rail Vs Road Freight
- **Infrastructure**: Inter city, Intra city, Freight Transport, Pipelines,
- **Soft Solutions**: Tele-commuting
- **Conservation/Behavioral**: Demand Reduction, Modal Shift
- **Planning**: Urban design, Locational Choices
- **End-of-pipe Solutions**: CCS

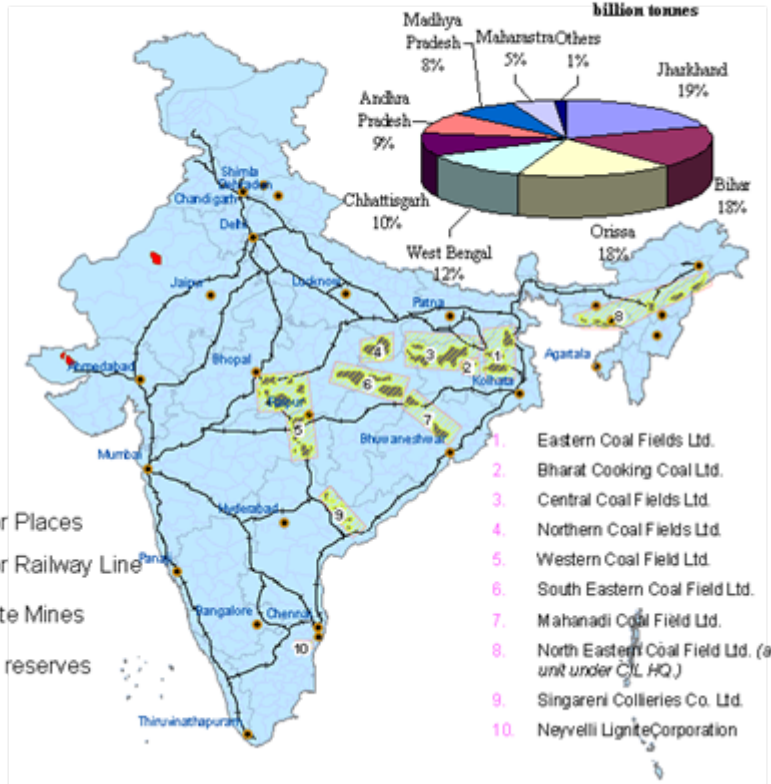


Infrastructures to Overcome Lock-ins

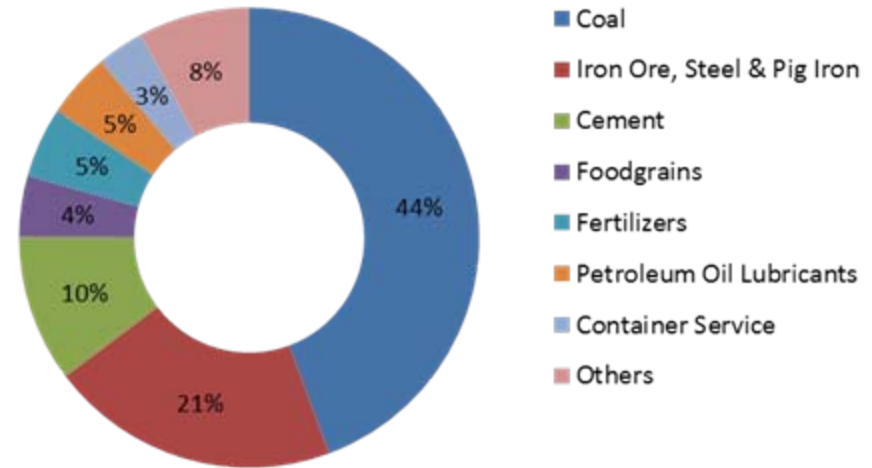
Coal by Wire

State Wise Coal Reserves

Total Proven Reserves 95.9 billion tonnes



Composition of Railway Freight Traffic (%): 2010

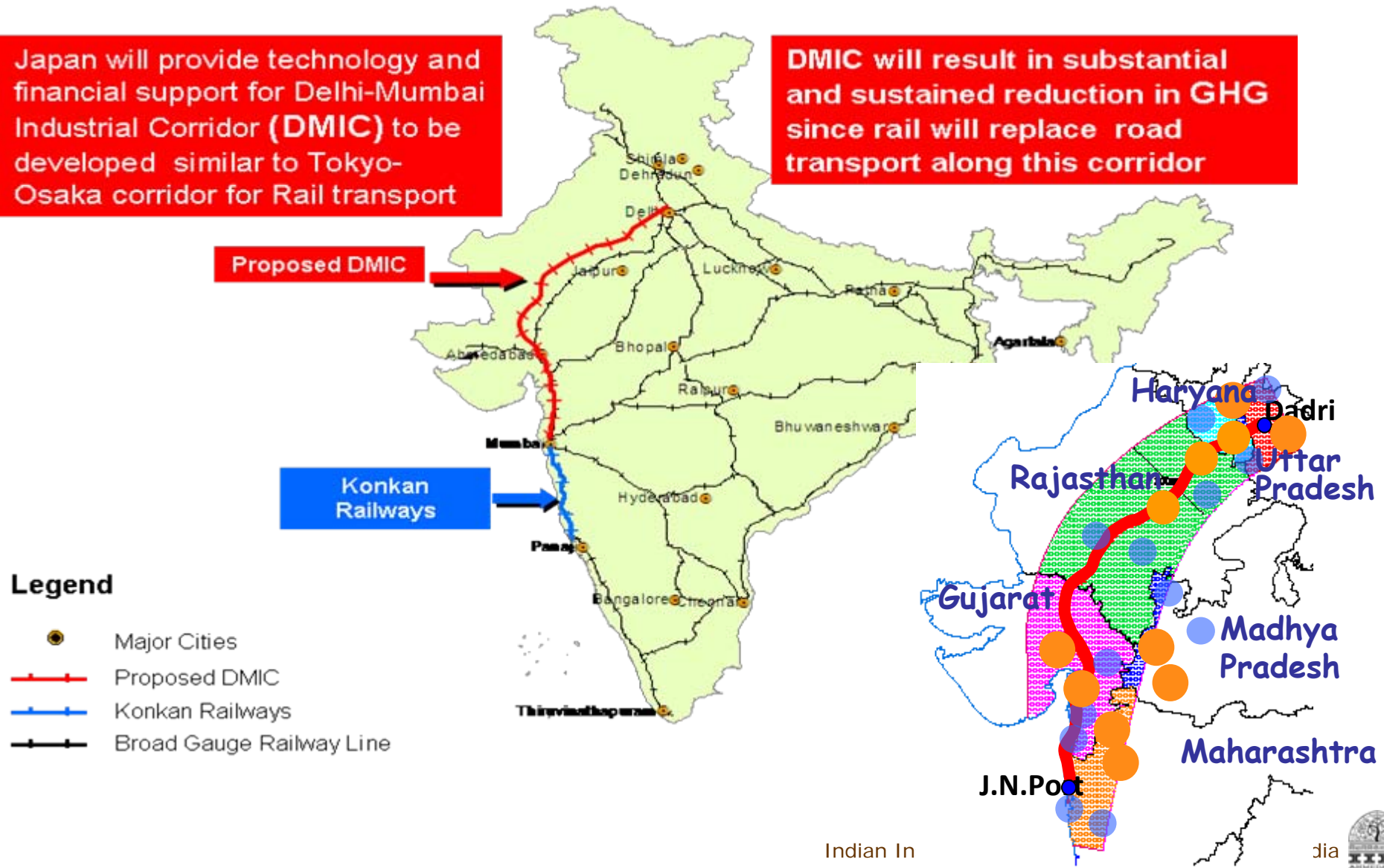


Infrastructures to Overcome Lock-ins

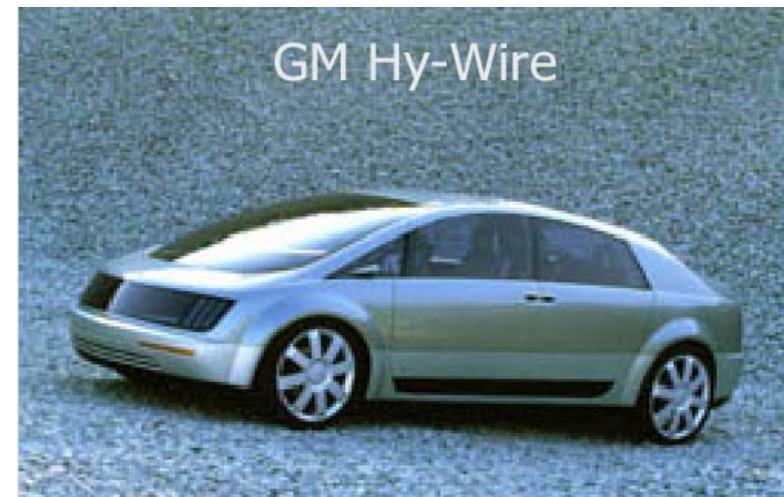
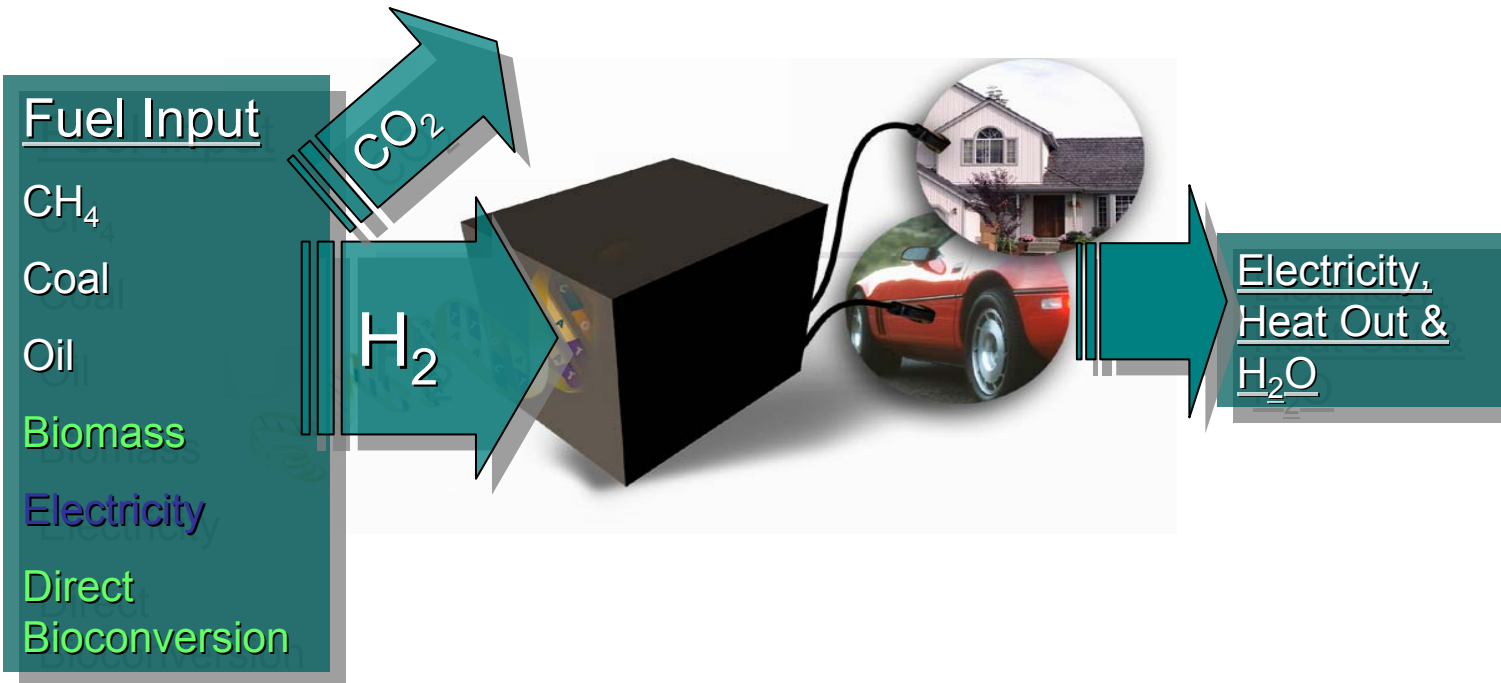
Train Corridors

Japan will provide technology and financial support for Delhi-Mumbai Industrial Corridor (DMIC) to be developed similar to Tokyo-Osaka corridor for Rail transport

DMIC will result in substantial and sustained reduction in GHG since rail will replace road transport along this corridor



Hydrogen as Energy Resource



Electric Cars

Zotye Auto: 5008EV



First EV bought by an individual

GM Chevy EV: Volt



FAW: Red Flag



Audi: E-tron



Mini E



BYD E6



BYD F6 DM



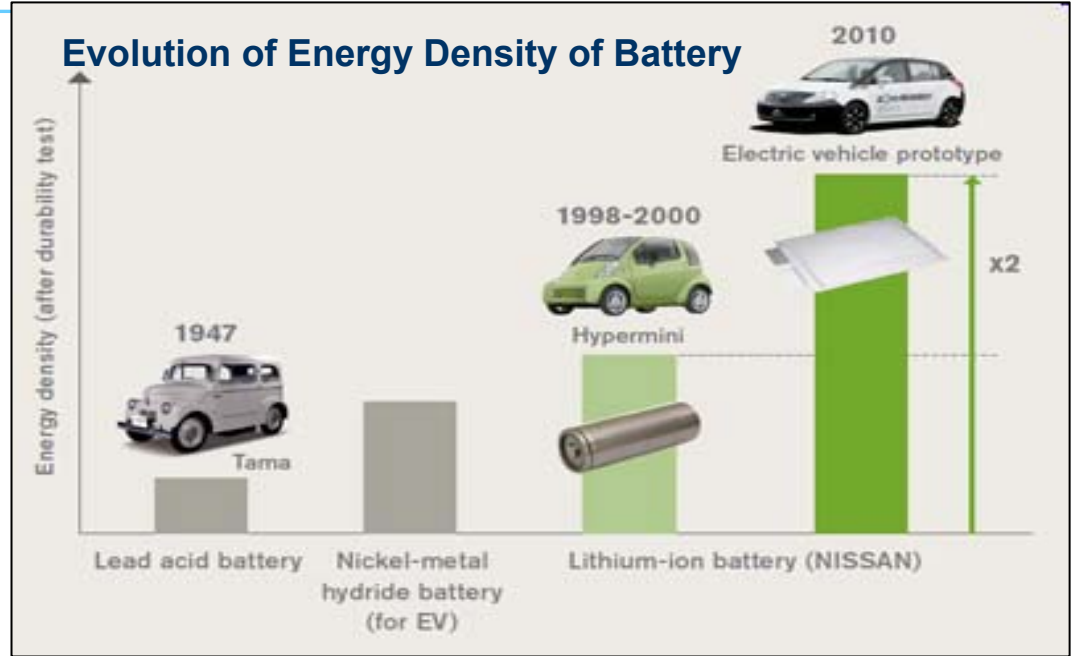
BYD F3R DM



Battery Charging Station in China



Nissan Leaf

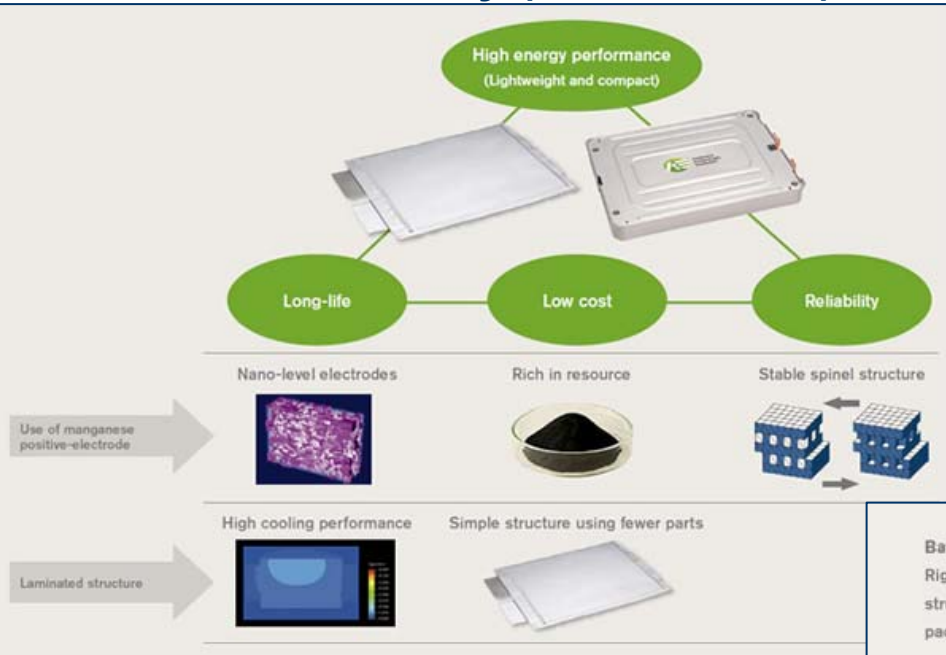


Nissan Leaf: Features

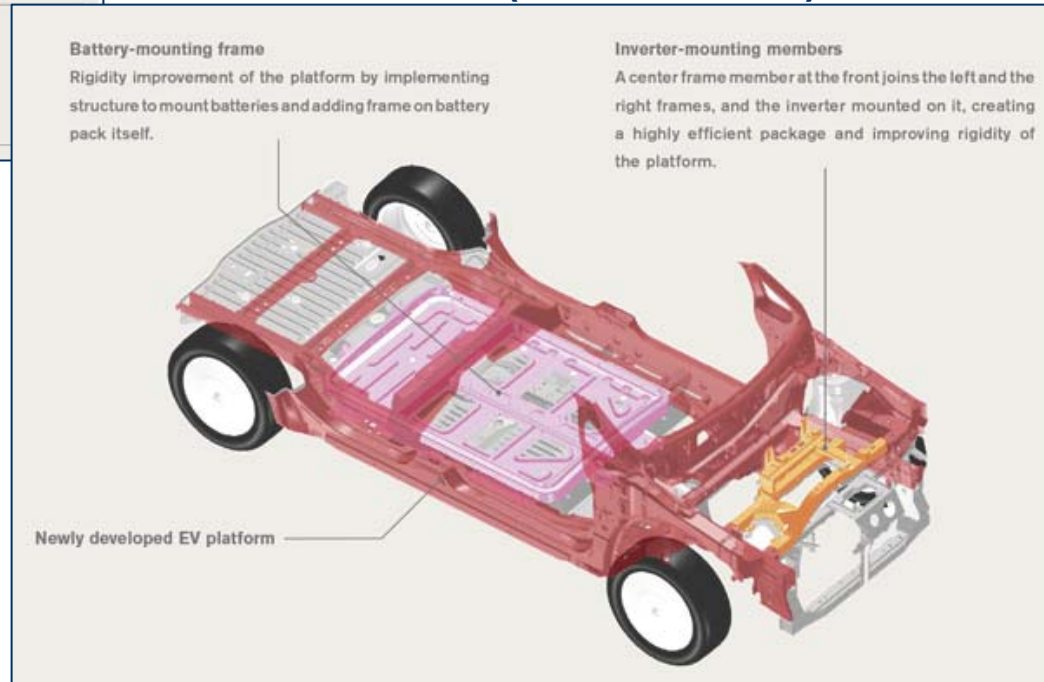
Seating capacity	5
Max speed	Over 140km/h (90mph)
Drive powertrain layout	Front motor, front drive
Battery	Laminated lithium-ion battery
Electric motor (power, torque)	High-response synchronous AC motor 80kW, 280Nm
Battery capacity/power	24kWh/Over 90kW
Crusing range	Over 160km (100miles, US LA4 mode)

Electric Vehicle Technologies

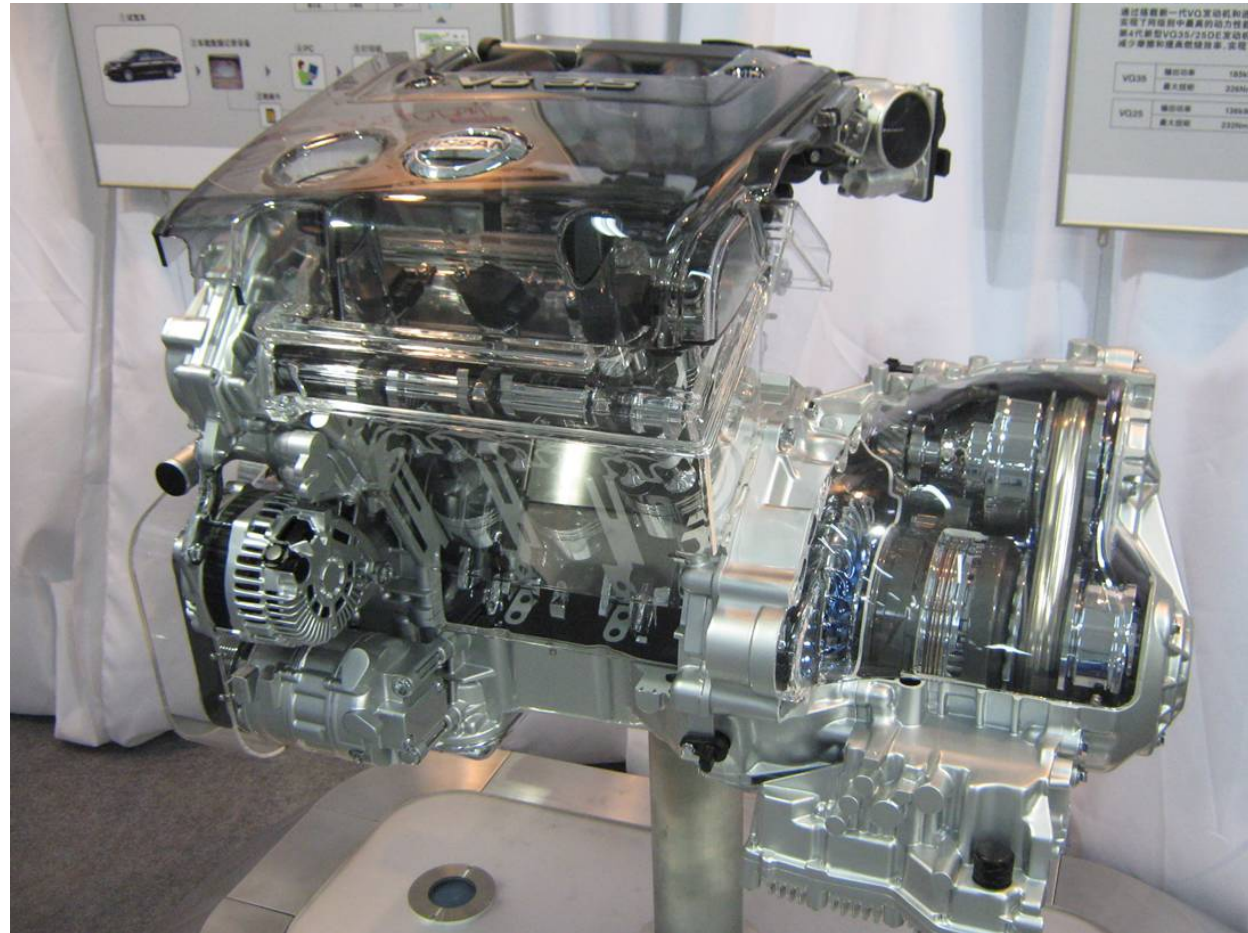
Lithium-ion Battery (Nissan: Leaf)



EV Platform (Nissan: Leaf)



Nissan Electric Car & Engine



Hydrogen Airplane Design





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- EU ETS (Aviation)
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Global airlines to get 212 million carbon certificates starting 2012

London, 7 March 2011: The European Commission has released the value for the historical aviation emissions which will be used to calculate the number of aviation allowances to be available from 2012.

Based on the average of annual historical aviation emissions for the period 2004-2006, the number of aviation allowances to be created in 2012 amounts to 212,892,052 tonnes (97% of historic aviation emissions), and the number of aviation allowances to be created each year from 2013 onwards amounts to 208,502,525 tonnes (95% of historic aviation emissions).

Allowance allocation as per the European Union shall be as follows-

- 82% = free allocation to aircraft operators
- 15% = auctioning
- 3% = allocated to a special reserve of new entrants into the market.

Way forward

Airlines are required to verify and report the emissions to their administering Member States by 31 March 2011. By that same date, airlines may also apply for free allocations of allowances based on 2010 activities. The benchmark decision for the free allocation by the EC will be published by 30 September 2011. By end September the EC will publish the emissions cap and the percentages of allowances to be: auctioned; given for free; and allocated to the special reserve.

Keywords: EU ETS, aviation, historical aviation emissions, European Commission, Allowances, Benchmark

To know more about EU Emission Trading Scheme (Aviation), please contact: prerna@climate-connect.co.uk

Carbon Markets EU ETS (Aviation) Groups:
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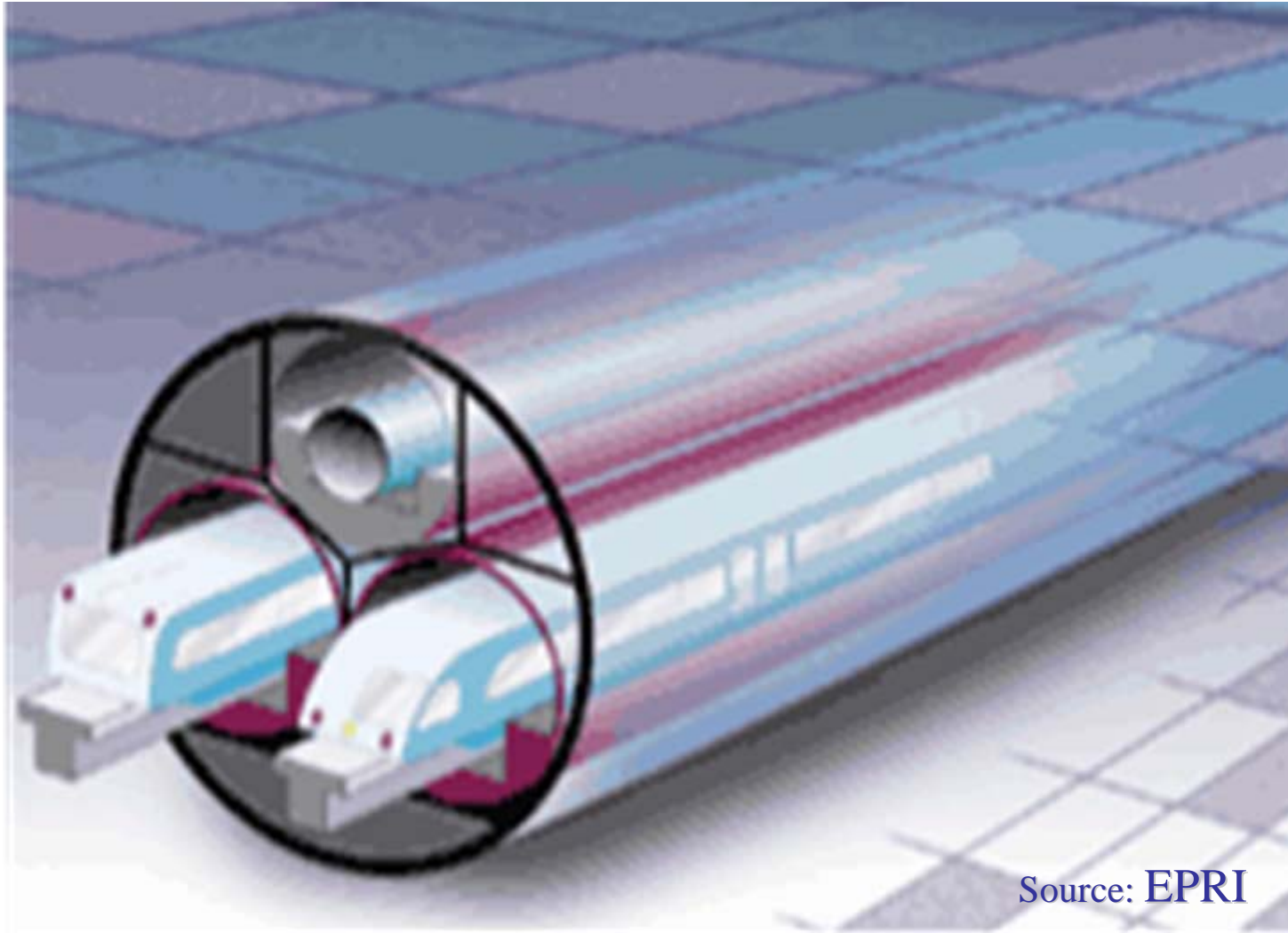
Carbon Markets

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Reports

- CDM EB 62 Meeting Highlights Sample.pdf
- CDM EB 61 Meeting Highlights Sample.pdf
- CDM EB 60 Meeting Highlights Sample.pdf
- Roadmap for Durban.pdf
- Japan Carbon Credit Flows.pdf
- CDM Highlights_13_27March to 3April 2011_Sample.pdf

Energy SuperGrid and MagLev Trains



LNG & CO₂ Transport



Sustainable Low Carbon Transport Scenarios



Copenhagen Commitments and Strategy

Copenhagen Commitments

- 20 to 25% Emissions Intensity Reduction from 2005 to 2020 (1.5 to 1.9% decoupling)
 - Per Capita Emissions Below OECD Average (for ever)

National Climate Change Action Plan

Implementation Strategy: 8 National Missions

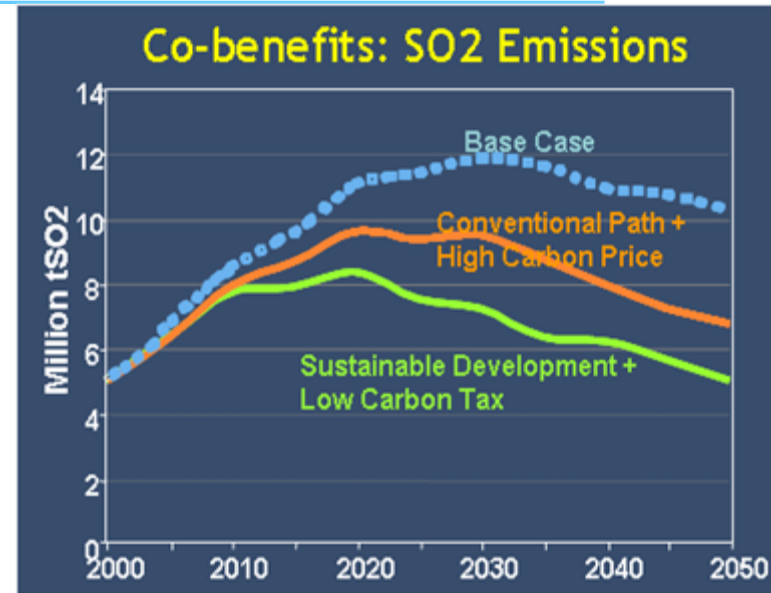
1. Solar Energy (22000 MW PV + Thermal by 2022)
2. Enhanced energy efficiency (10000 MW saving by 2012)
3. Sustainable habitat
4. Water Sector (20% water use efficiency improvement)
5. Sustaining the Himalayan eco-system
6. A “Green India” (6 Mil. Hectare Forestation; Forest cover from 23 to 33%)
7. Sustainable agriculture
8. Strategic knowledge for climate change



Co-benefits & Technology Choices

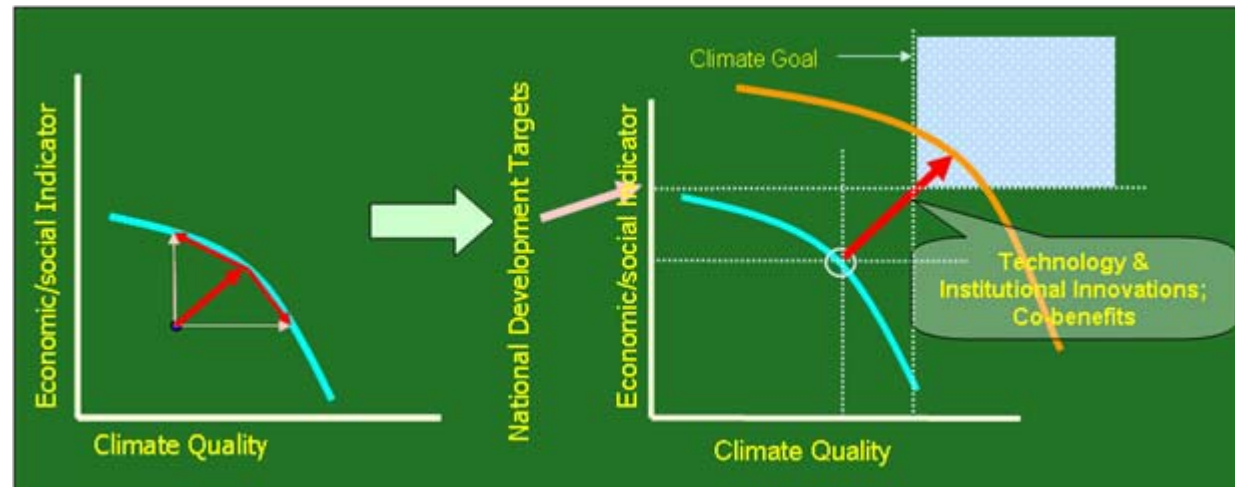
Technologies delivers multiple dividends

- In developing countries, significant opportunities exist for gaining co-benefits
- Technology Assessment should consider all costs and benefits



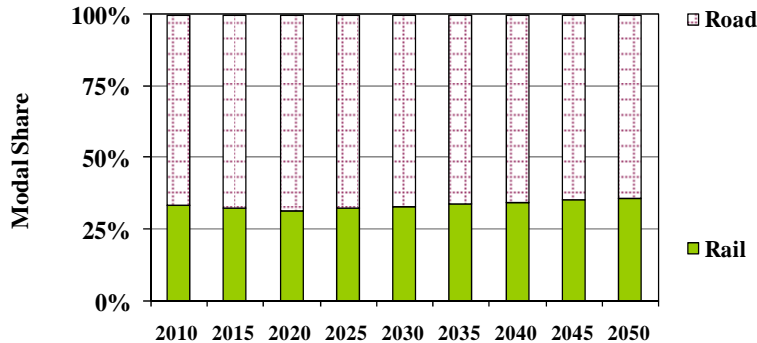
“For developing countries, the ‘good news’ is that their environment and natural resources policies are often so bad that there are reforms which would be both good for the economy and good for the environment.”

Joseph Stiglitz

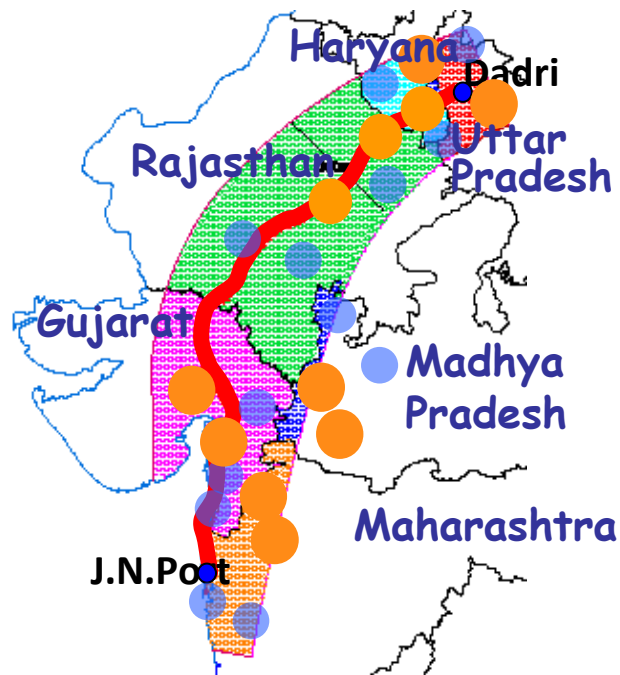


Co-benefits of Sustainable Freight Movement

Domestic Freight Traffic
(Billion TKM)



- Sustainable modal shift
- Efficient logistics
- Infrastructures investments
- Associated development



Technologies for Train Corridors

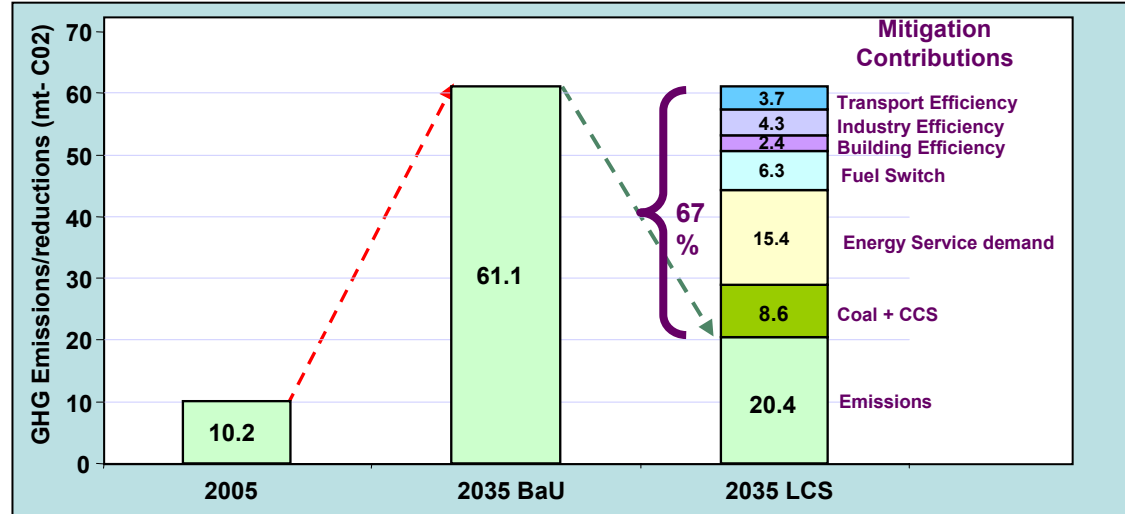
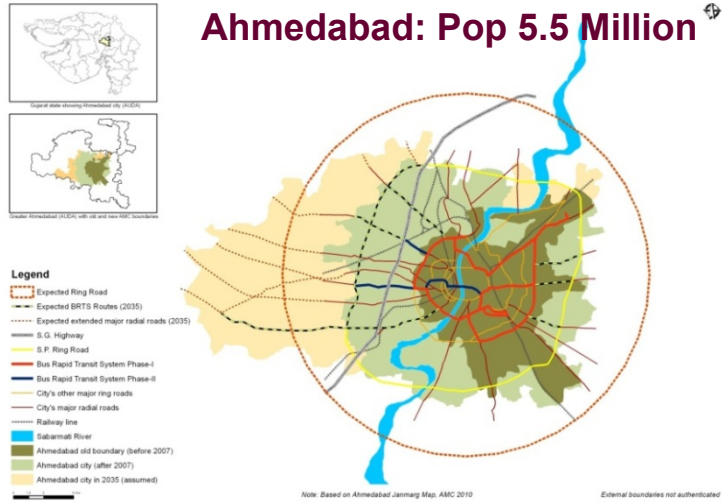
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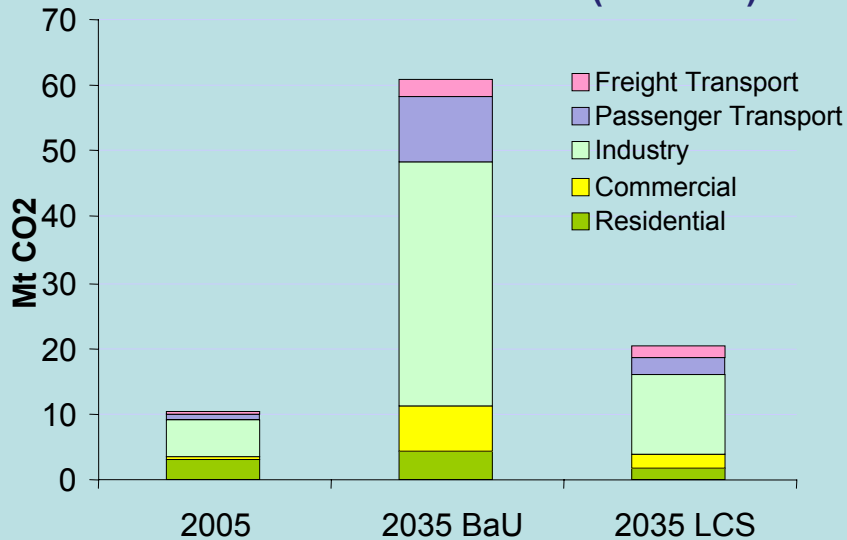


Co-benefits in City Planning: Ahmedabad

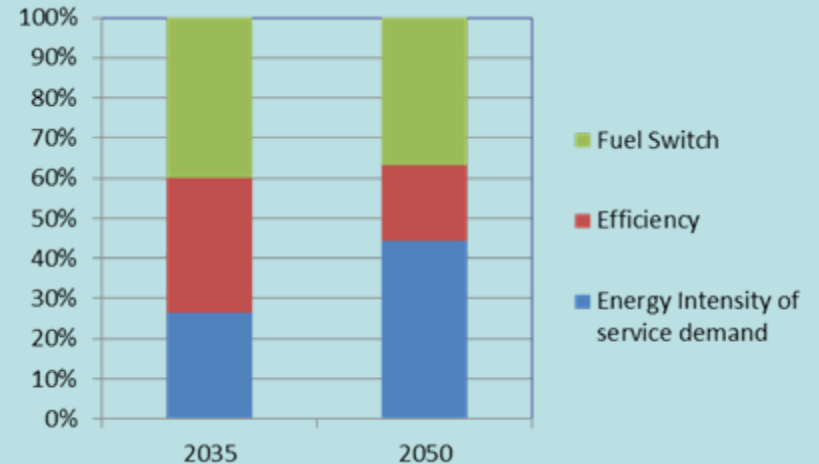
Ahmedabad: Pop 5.5 Million



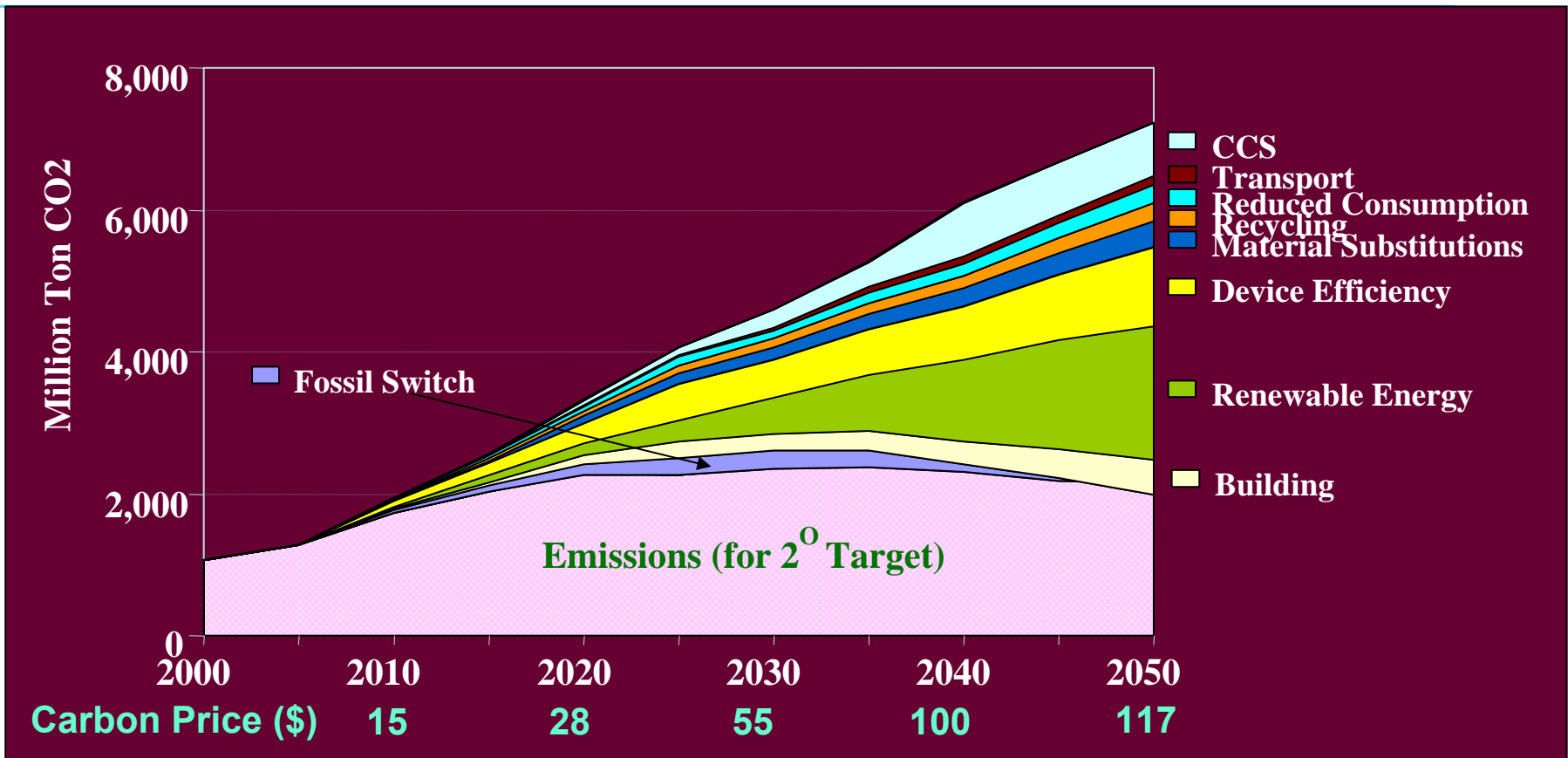
Sectoral CO2 Emissions (mt CO2)



Transport Sector Mitigation Options



Mitigation Options: Sustainability



Sustainability Approach: aligning climate and sustainable development actions

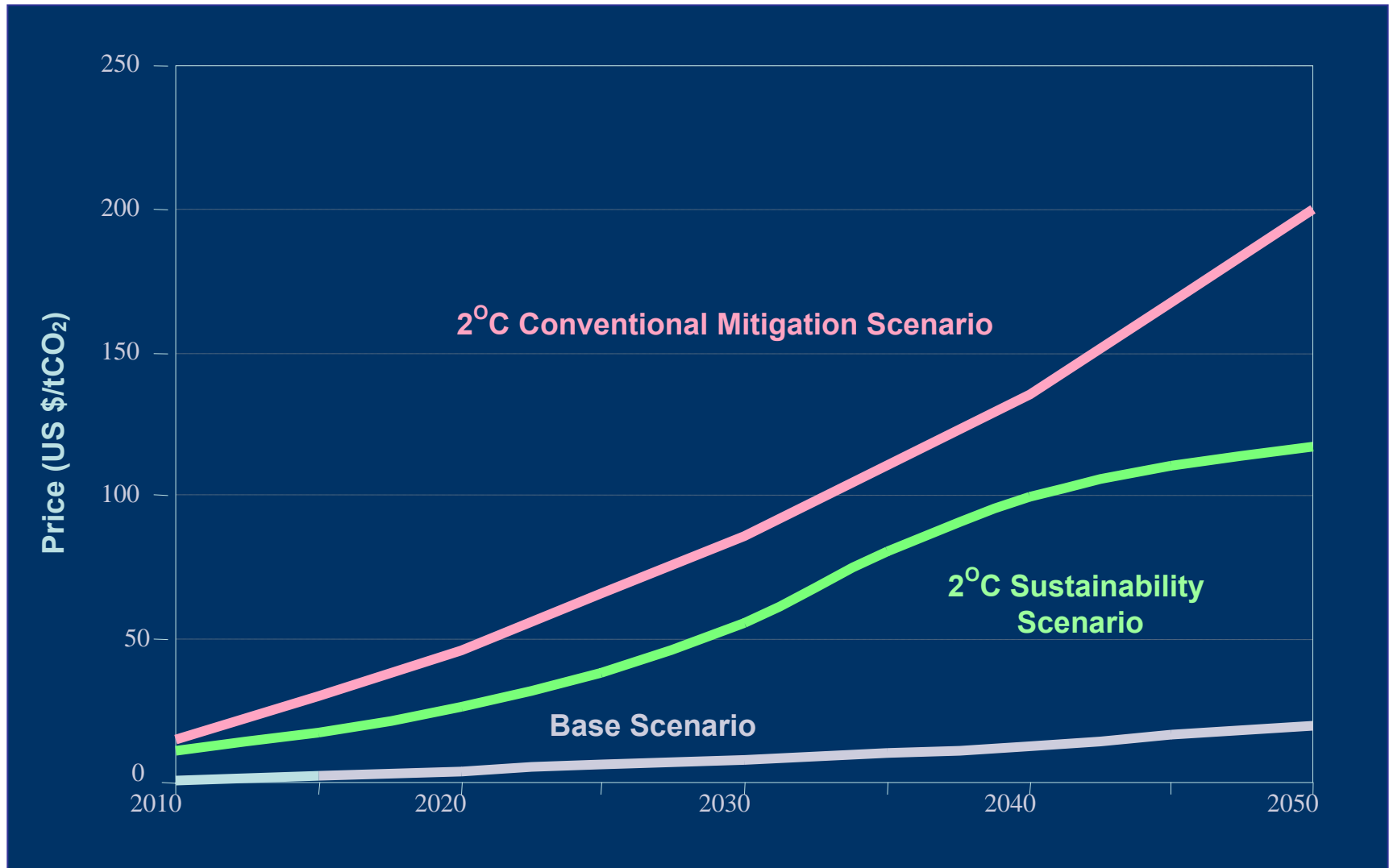
- Low Carbon Price
- Bottom-up/Demand-side actions
- Behavioural change
- Diverse Technology portfolio

Technology Co-operation Areas

- Transport Infrastructure Technologies
- 3R, Material Substitutes, Renewable Energy
- Process Technologies
- Urban Planning, Behavioral Changes



LCS with Lower Social Value of Carbon



Analysis with ANSWER-MARKAL Model



Conclusions

1. Low Carbon **Transitions** will reshape the transport landscape
2. Early actions in transport sector are key to avoiding **lock-ins**, gain **co-benefits** and reduce long-term costs of low carbon transitions
3. Conventional Low scenarios assessment **methodologies needs to be reframed** for Sustainable Low Carbon Transport Scenarios
4. **Diverse set of Indicators** are needed to assess co-benefits at Macro and Micro Levels





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“All I’m saying is NOW is the time to develop the technology to deflect an asteroid”

Thank you