Technical University of Denmark

Technologies for Urban Transport

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Technologies for Urban Transport

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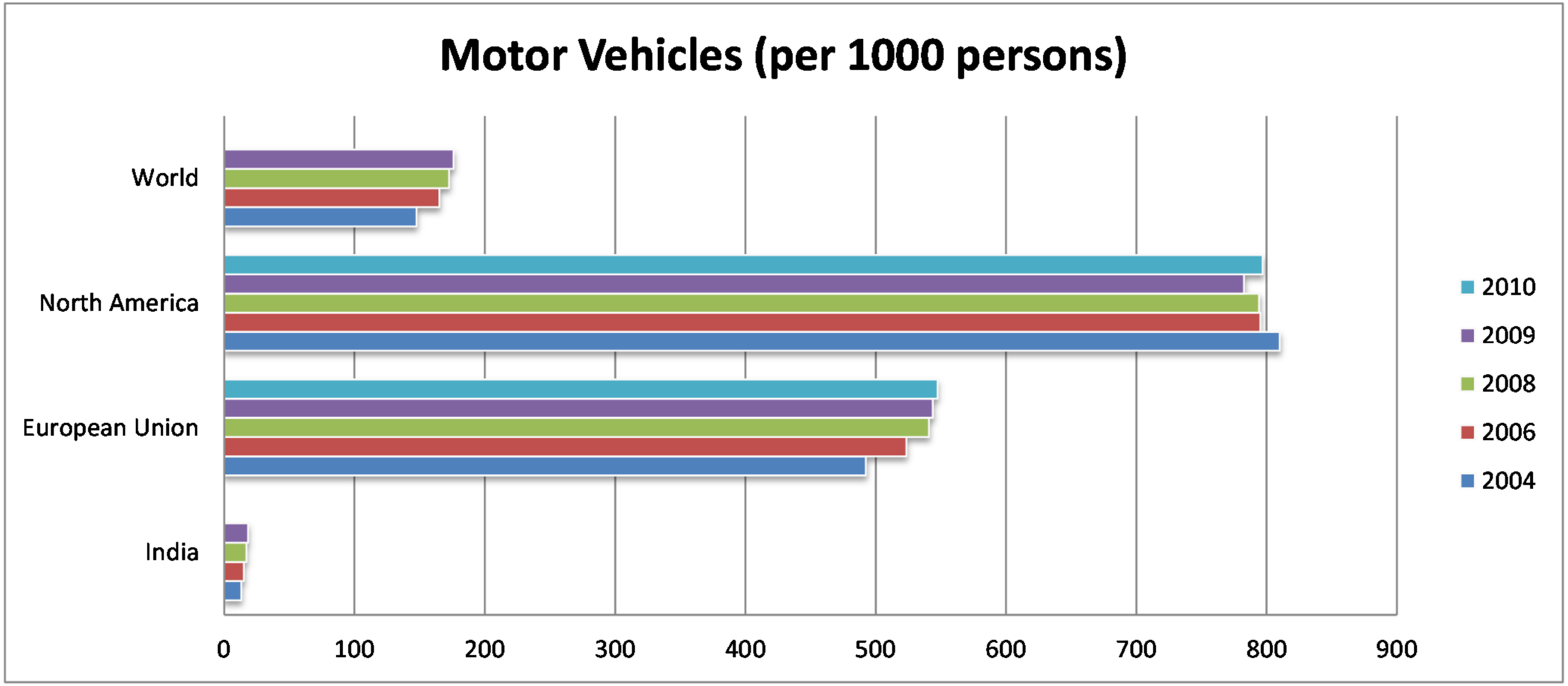
Contents

1. Trends of technological change
2. Scenarios : National
3. Conclusions

Trends for technological change

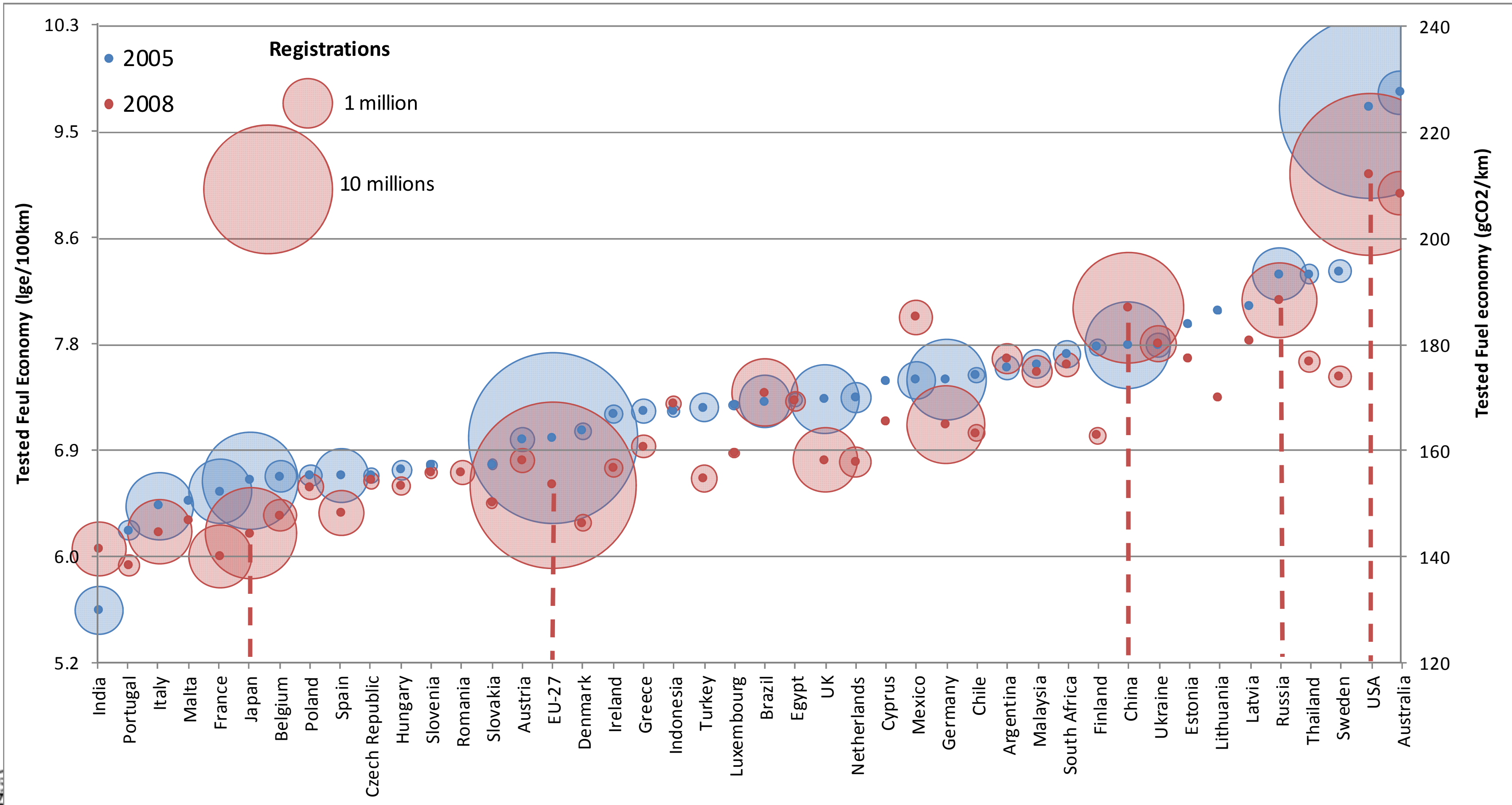
Motorisation

- India has very low motorisation but is increasing
- At similar income levels of motorisation can be different



Data Source: World Bank

Average Fuel Economy – Cross Country

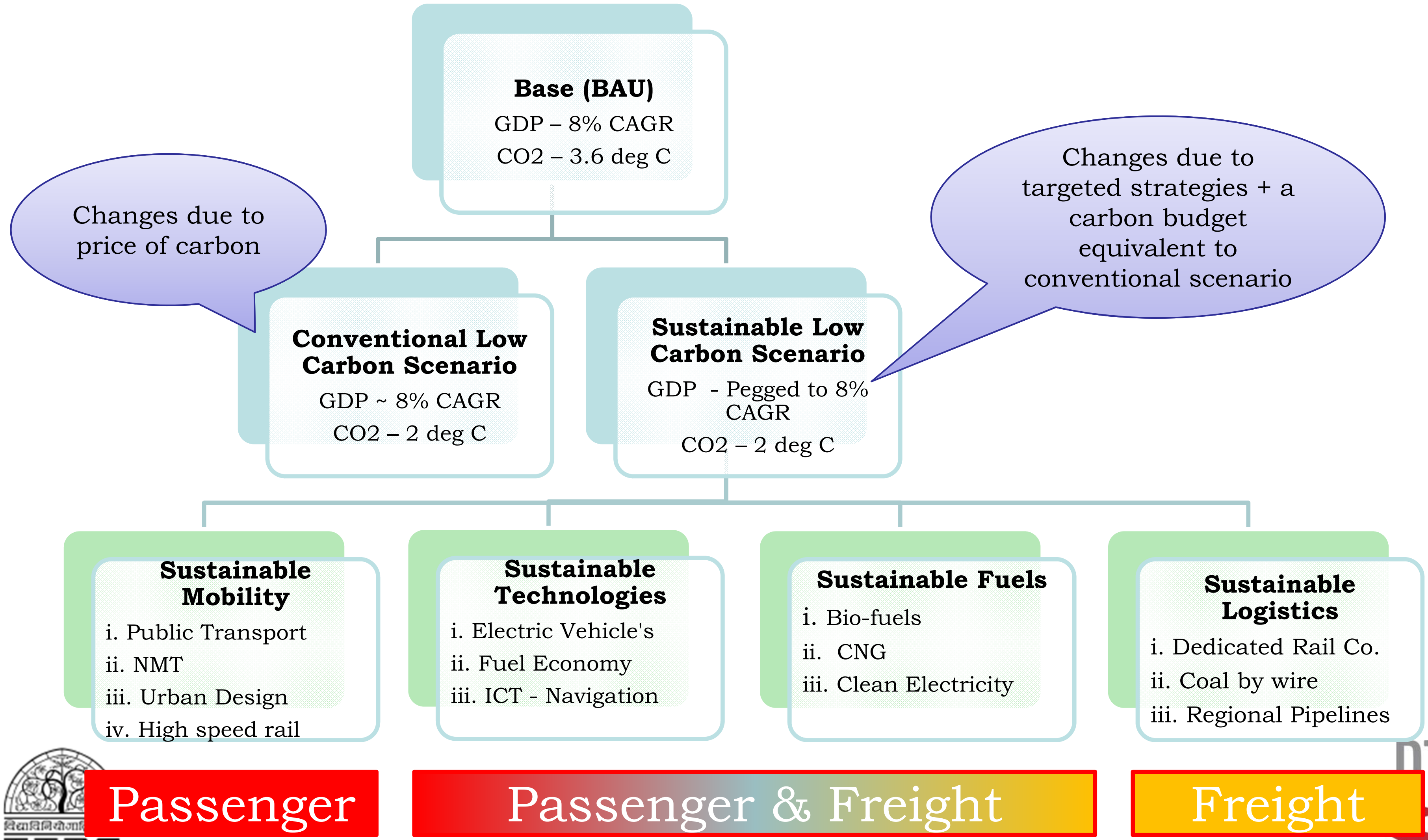


Source : Cuenot, F., and L. Fulton. 2011. International comparison of light-duty vehicle fuel economy and related characteristics. OECD/IEA, Paris.

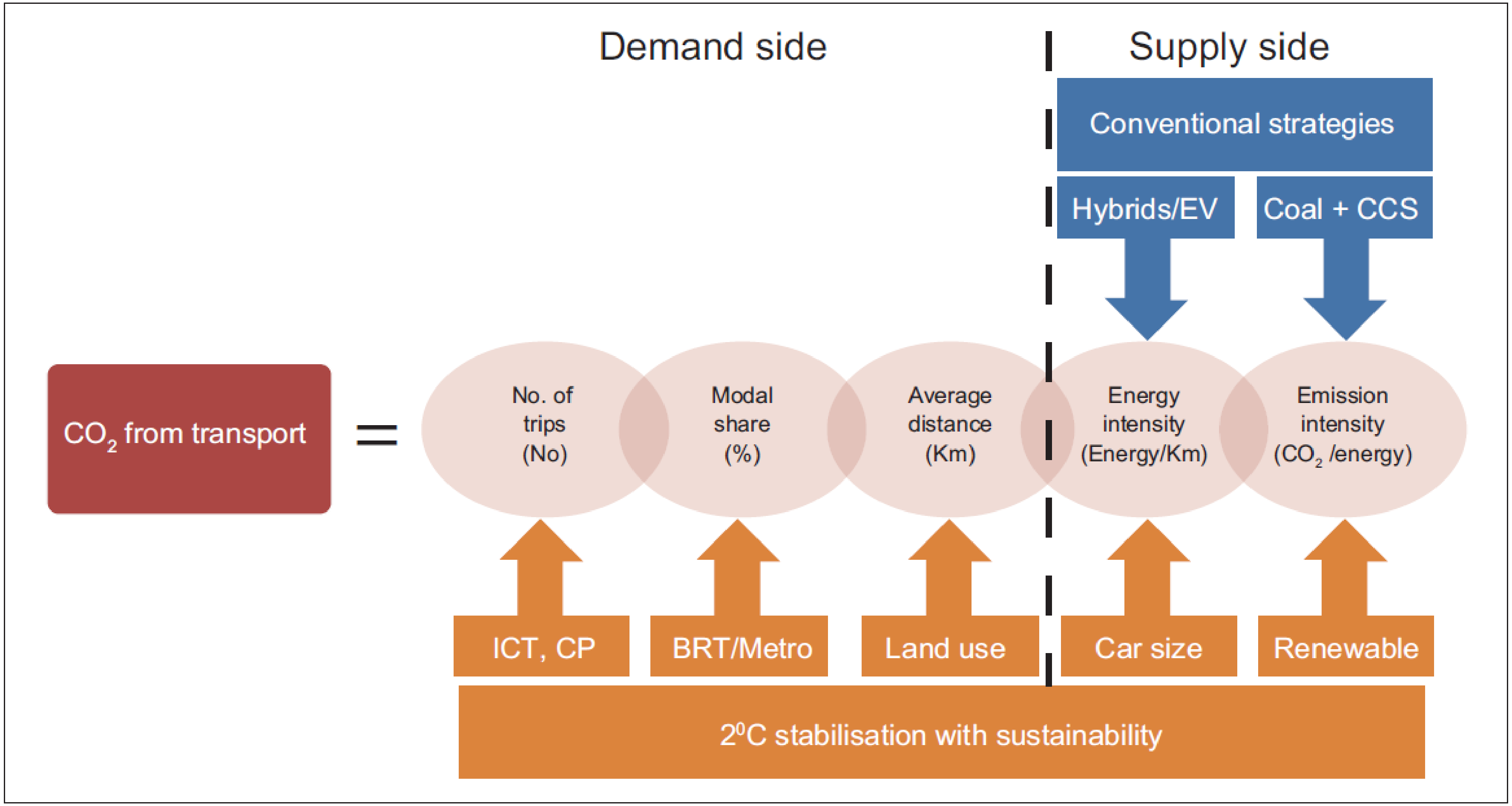
Technology Options

Scenarios : National

Architecture for Transport Scenarios



Emission Identity



Mass Transit Options

- Wide diversity in costs and emission reduction potentials
- Electricity based options become attractive in low carbon scenarios

	Bus Rapid Transit	Light Rail system	Metro
Capacity (passengers per line in one hour)	10,000 to 20,000 (Sometimes going to 40,000 Bogota BRT)	10,000 to 20,000	12,000 - 45,000 (Sometimes going upto to 80,000 Hong Kong Metro)
Costs (Million USD per km of length)**	5 to 27	13 to 40	27 to 330
Existing Networks in 2011** (km)	2139	15000	10000
CO2 per passenger ** (gCO2/pkm)	14 to 22	4 to 22	3 to 21
Typical Fuel	Diesel	Electricity	Electricity

** Data from IEA, 2012 Energy Technology Perspectives 2012

Alternative Drive Train Technologies

	Battery Electric vehicles	**Hybrid Gasoline**	**Plug in Hybrids**	**Fuel Cells**
Drive Range	100 - 160 km for cars, 60 km for 2 wheelers	Same as gasoline cars	20 - 50 km on battery alone, remaining using ICE	Same as gasoline cars
Drive Train	Electric Motor	Internal Combustion Engine	ICE, Electric Motor	Fuel Cell, Electric Motor
Existing Vehicles	120 Million Electric 2 wheelers in China,	More than 5.8 million vehicles globally sold till end of 2012		Few hundred globally
Energy consumption per pkm (w.r.t to a Gasoline engine) **	70-80% lower	11-22% lower	20-60% lower	55% - 70% lower
Typical Fuel	Electricity	Electricity / Gasoline /Diesel	Electricity / Gasoline /Diesel	Hydrogen

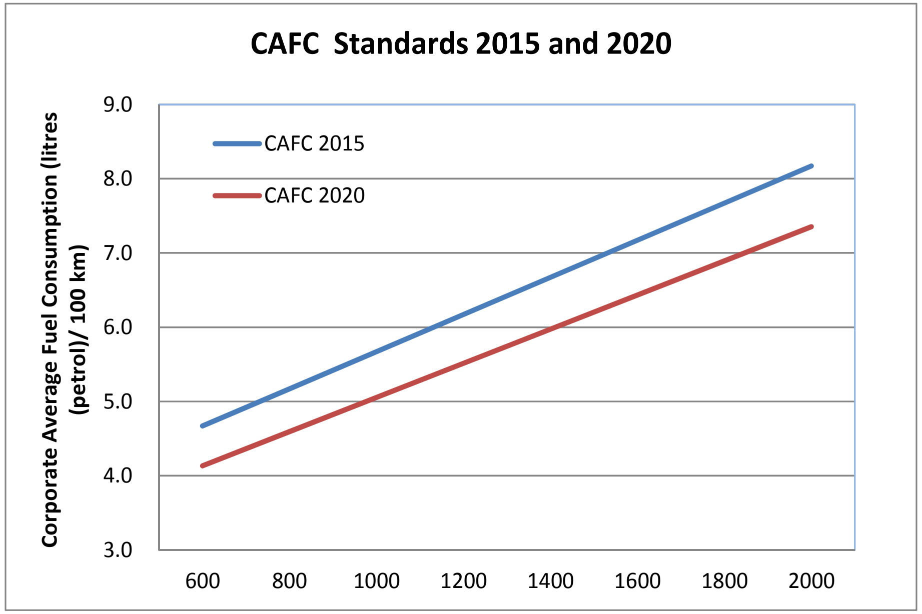
** IEA, 2009 Transport Energy & CO2; Kobayachi et. al., 2009 Energy efficiency technologies for road vehicles. Energy Efficiency 2, 125–137; Plotkin et. al., 2009 Multi-path transportation futures study : vehicle characterization and scenario analyses

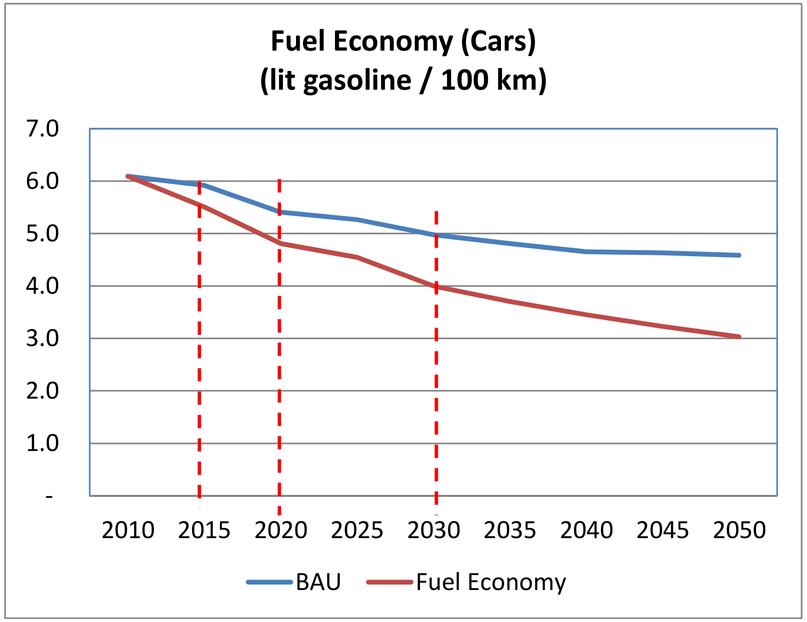
Scenario storylines: Fuel Economy

- **BAU Storyline - Fuel economy standards for 2015 and 2020 announced by BEE are implemented** by the government.
- **Increasing incomes** mean that an **increasing weightage for safety, reliability and comfort** from car buyers.
- Increasing preference for **medium size cars**

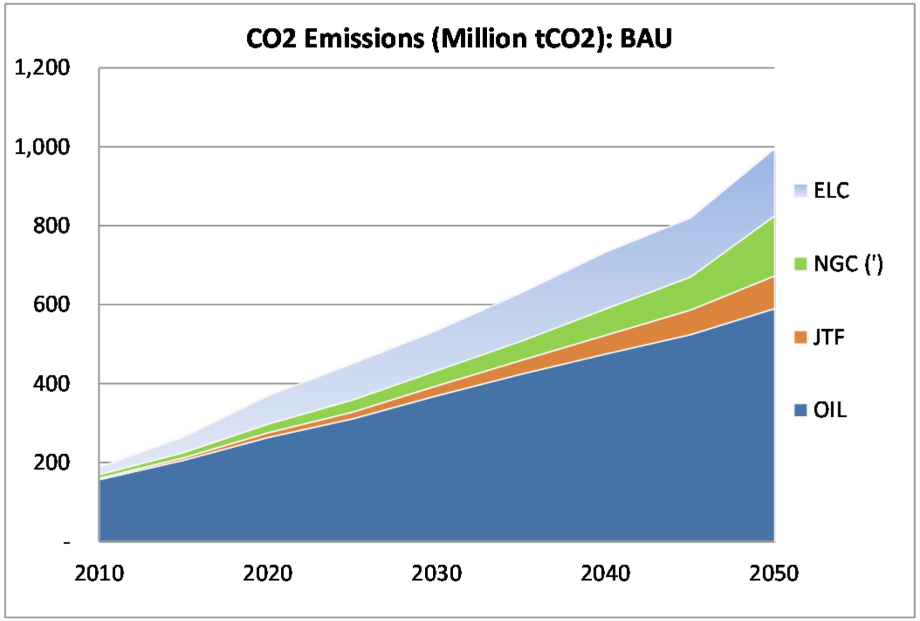
- **Fuel Economy storyline**
  - The vision of **4 lit / 100 km in 2030 according to GFEI**. The efficiencies can not be delivered by conventional drive train technologies and rather it is technologies such as **hybrids** which would be required for this scenario especially if vehicle weights increase. The improvements in engine technologies for cars also diffuse into 2 wheelers and buses

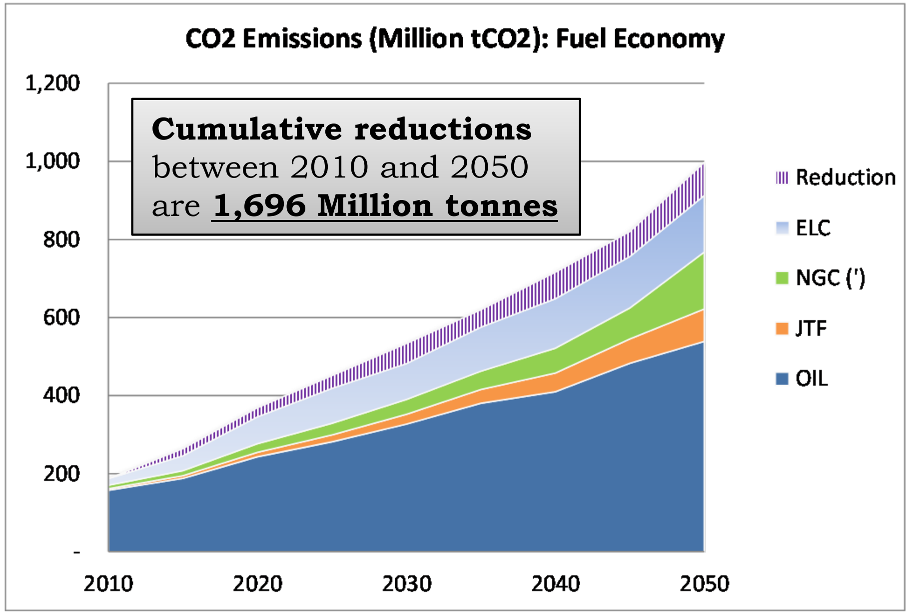
Fuel Efficiency: BAU and Fuel Economy





CO2 Emissions transport: BAU & BAU + Fuel Economy



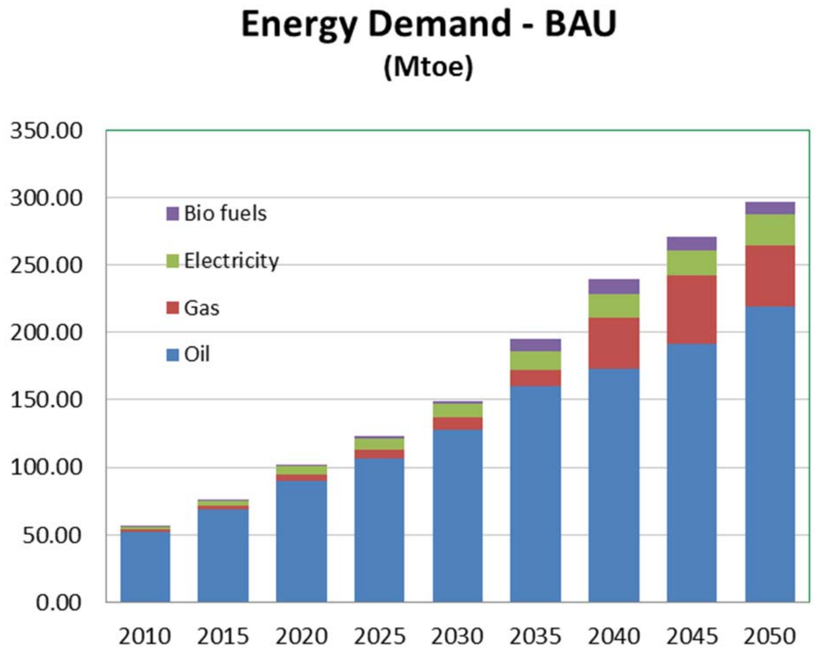


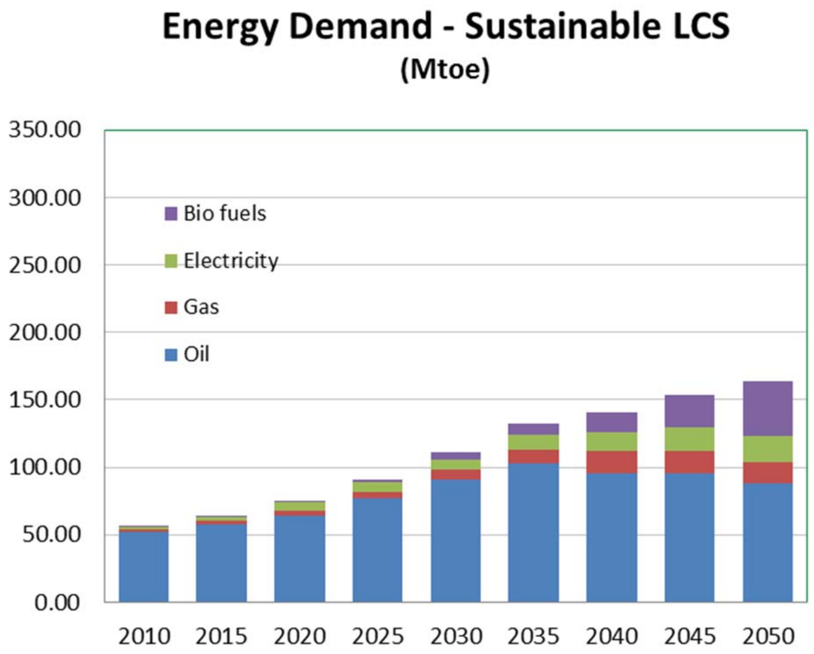
(*) Natural Gas emissions include both emissions from energy and fugitive emissions

Emission Intensity of Grid (Million tCO2/GWh)

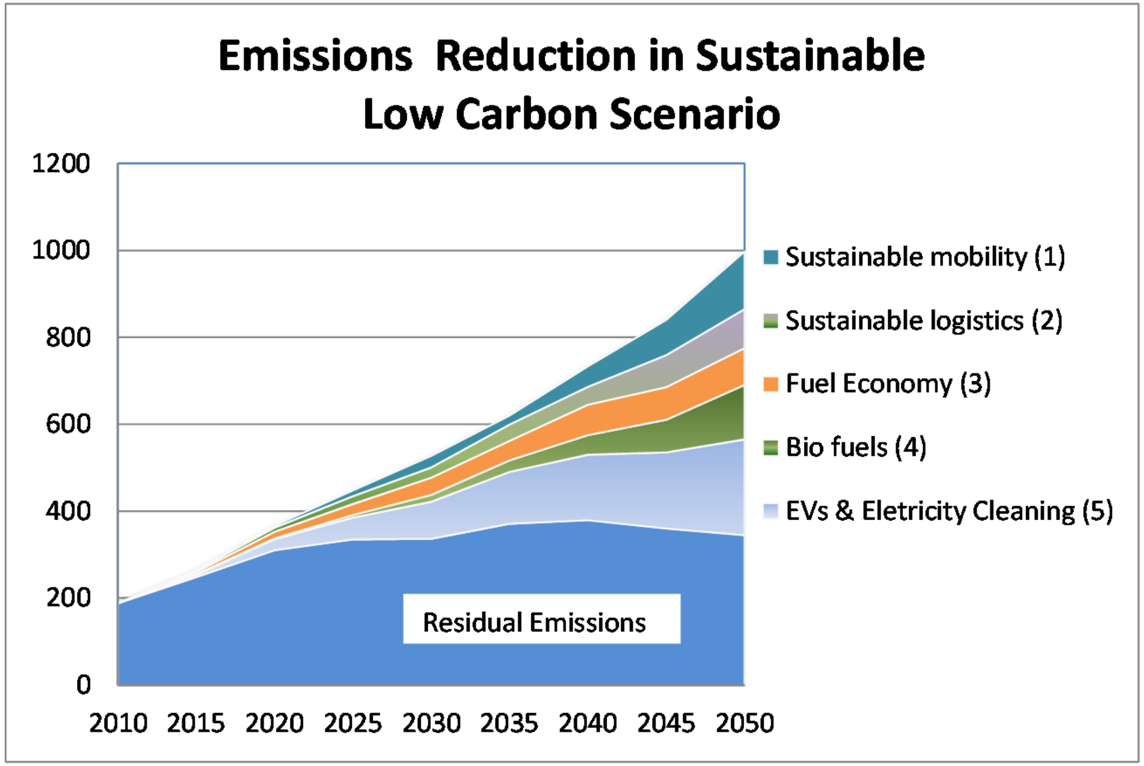
Scenario	2010	2020	2030	2040	2050
Base Case	0.99	0.94	0.86	0.74	0.69

Fuel Mix: BAU & LCS





Mitigation Wedges : Transport



Conclusions

1. Fuel Economy can deliver mitigation plus co-benefits for environment and energy security

2. Cleaning of electricity is crucial for a low carbon transport

3. Bio fuels are essential for a low carbon strategy

Thank You

Questions / Suggestions