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Electric Vehicle Scenarios for India

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Development and Mitigation Forum

27 January 2014

Cape Town, South Africa



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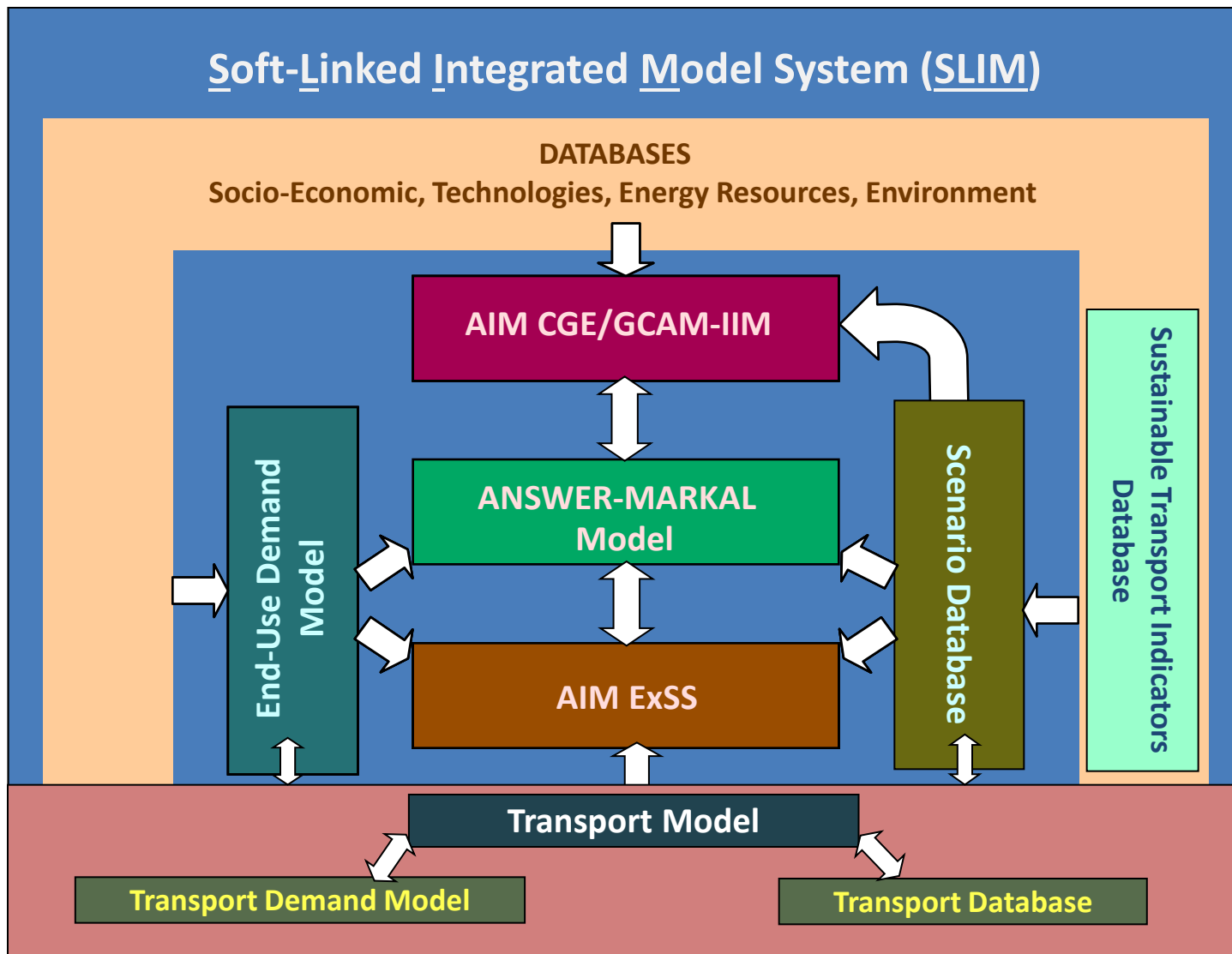
Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

based on a decision of the Parliament
of the Federal Republic of Germany

Presentation Agenda

1. Low Carbon National Transport Modeling Assessment
 - *Model System*
 - *Scenarios Architecture*
2. National Passenger Transport Demand
3. Sustainable Low Carbon Transport Scenario
 - *Energy Demand*
 - *CO₂ Emission Mitigation*
 - *Air Quality Co-benefits*
4. Electric Vehicle (EV) Scenarios
5. Conclusions

Soft-Linked Integrated Model System



Scenario Paradigm

Transport Scenarios

```
graph TD; A[Transport Scenarios] --> B[Baseline Scenario]; A --> C[Sustainable Low Carbon Transport]; C --> D[Avoid]; C --> E[Shift]; C --> F[Improve];
```

Baseline Scenario

GDP Growth rate -8% (2007-2032)

Sustainable Low Carbon Transport

GDP Growth rate -8% (2007-2032)

Avoid

Coal by wire
Urban Planning
Penetration of ICT technologies

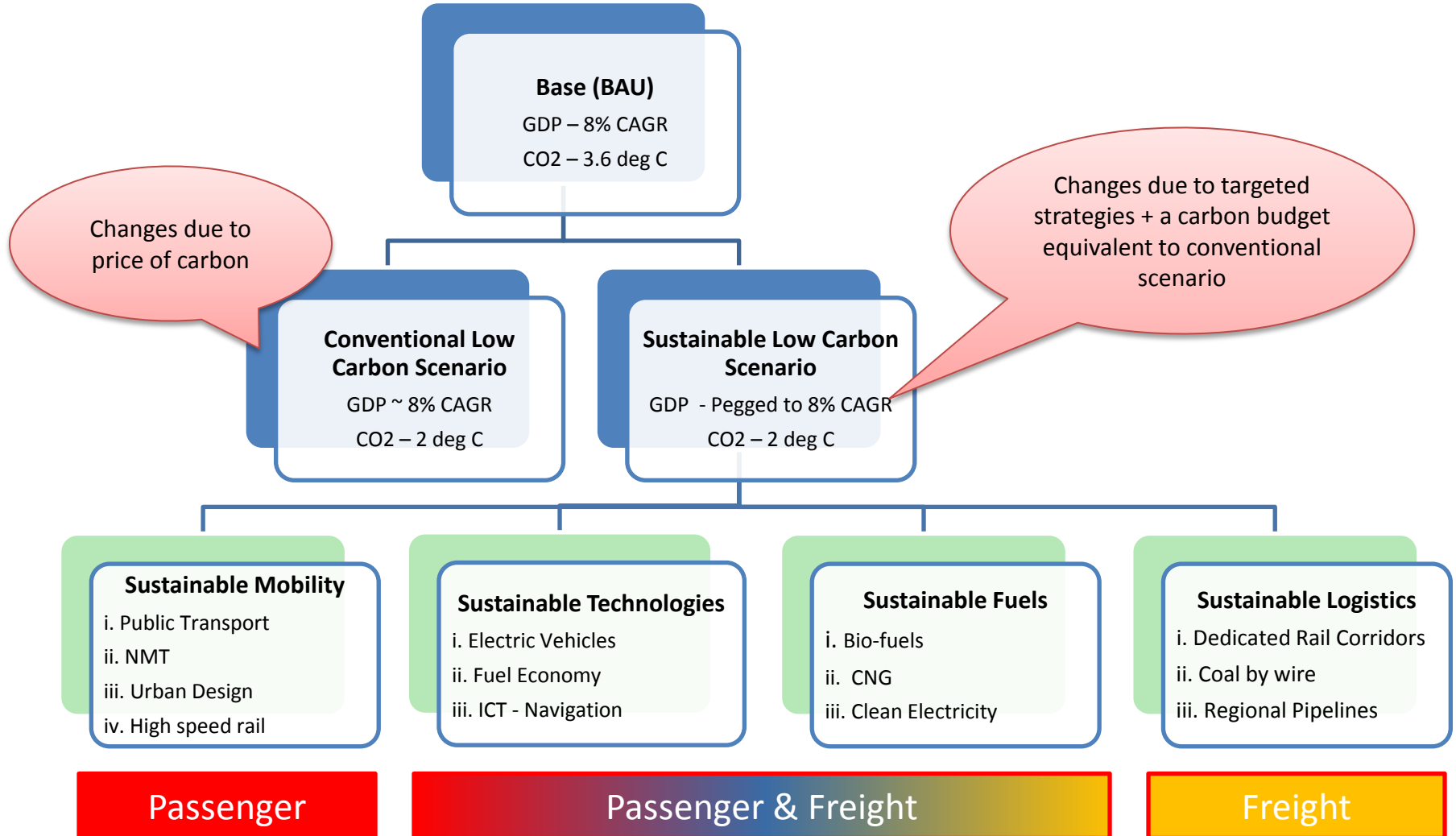
Shift

Investment in Mass transit Systems
Greater use of Pipelines

Improve

Vehicle Efficiency Improvement
Penetration of Electric Vehicles

Transport Scenarios Architecture



Sustainable Mobility Storyline

Non-Motorized Transport

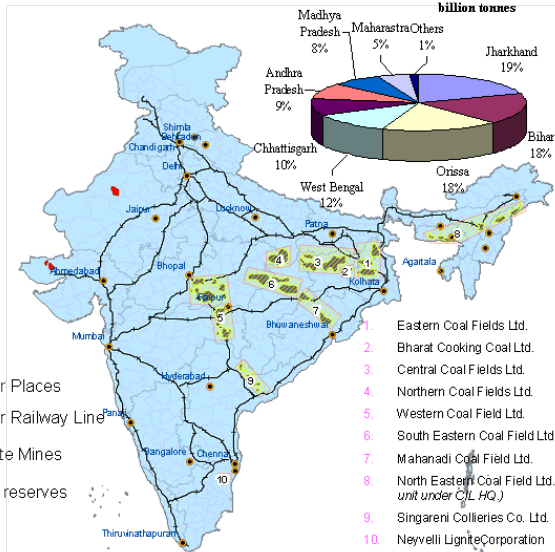


Pipe Transport

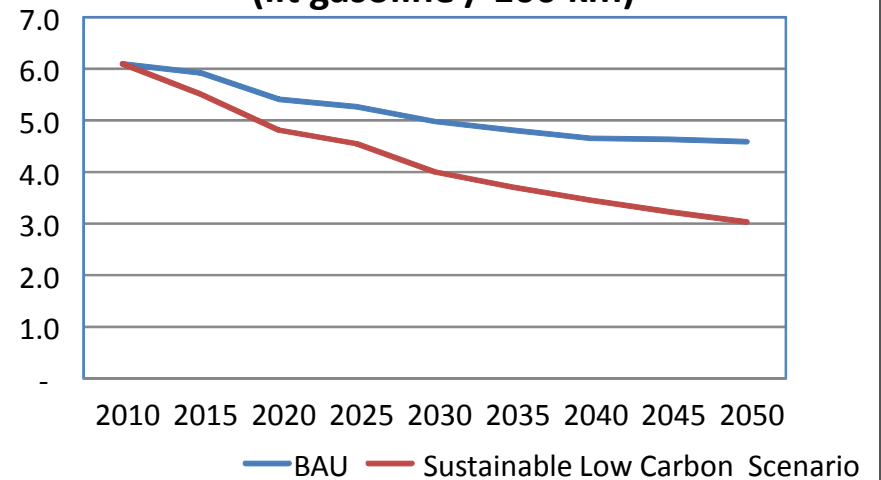


Coal-by-wire

State Wise Coal Reserves
Total Proven Reserves 95.9 billion tonnes



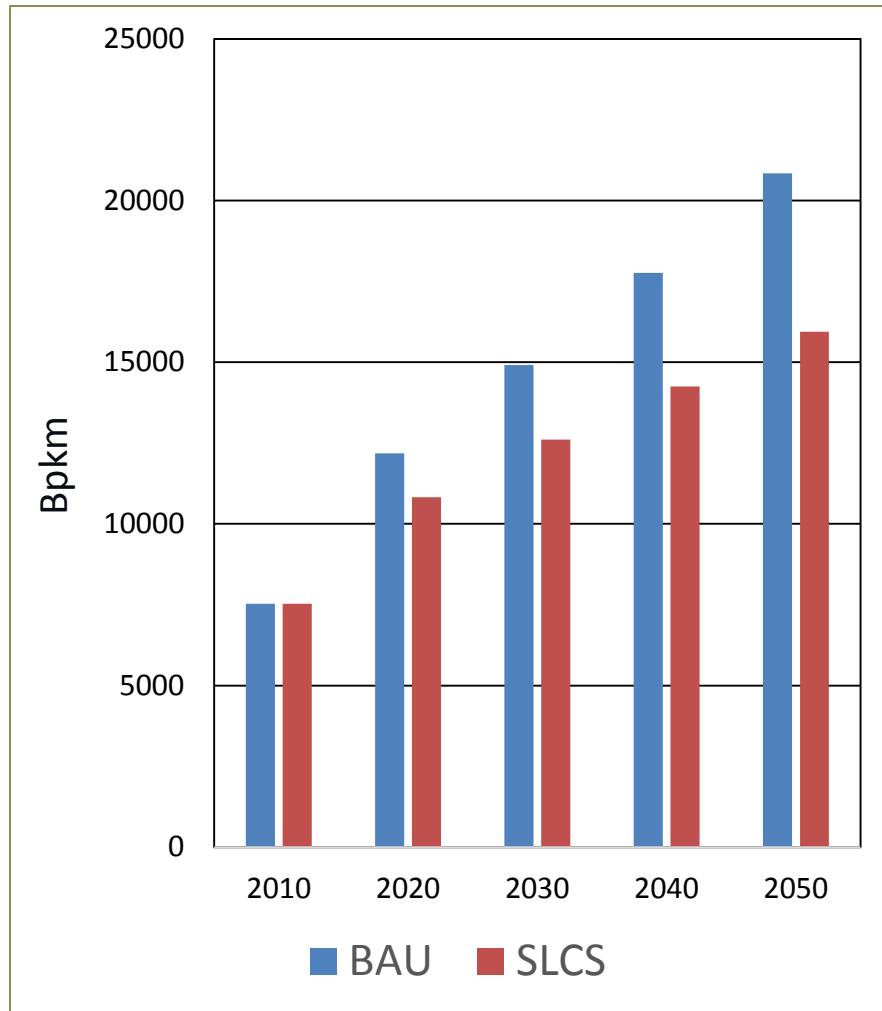
Fuel Economy (Cars) (lit gasoline / 100 km)



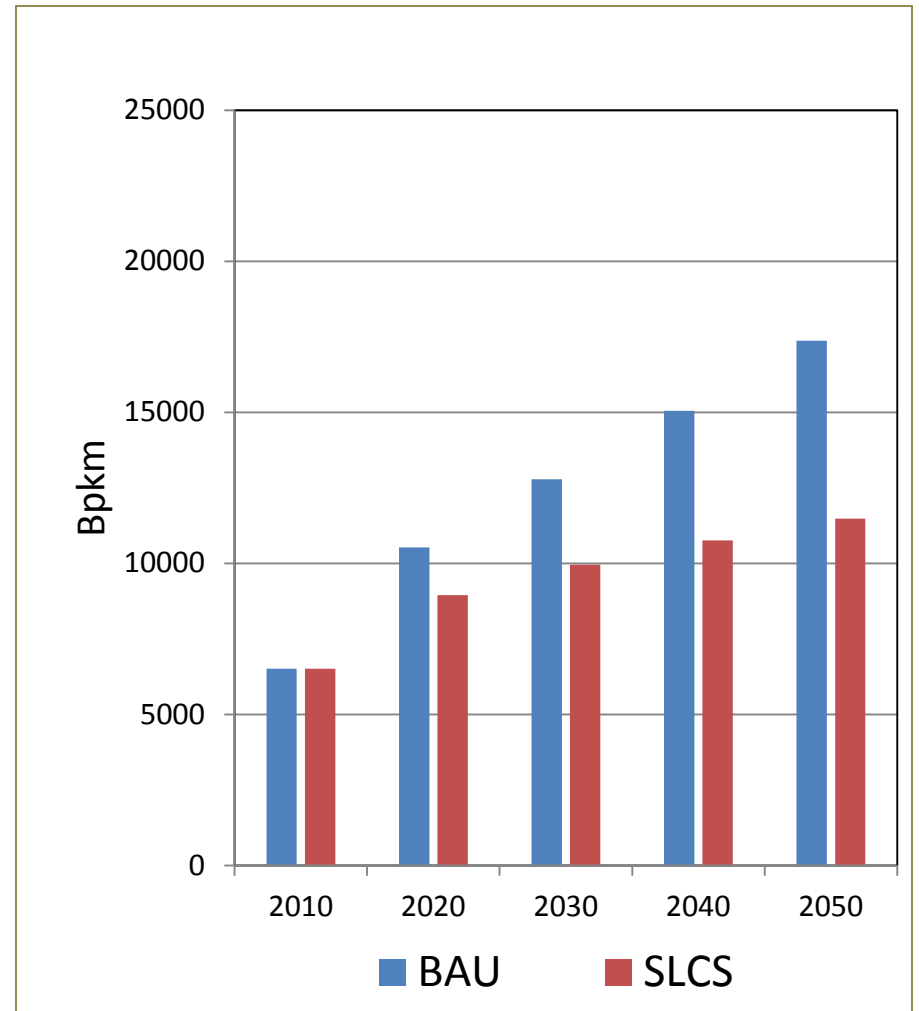
National Passenger Transport Demand in Scenarios

Passenger Transport Demand

BAU - Passenger Transport Demand

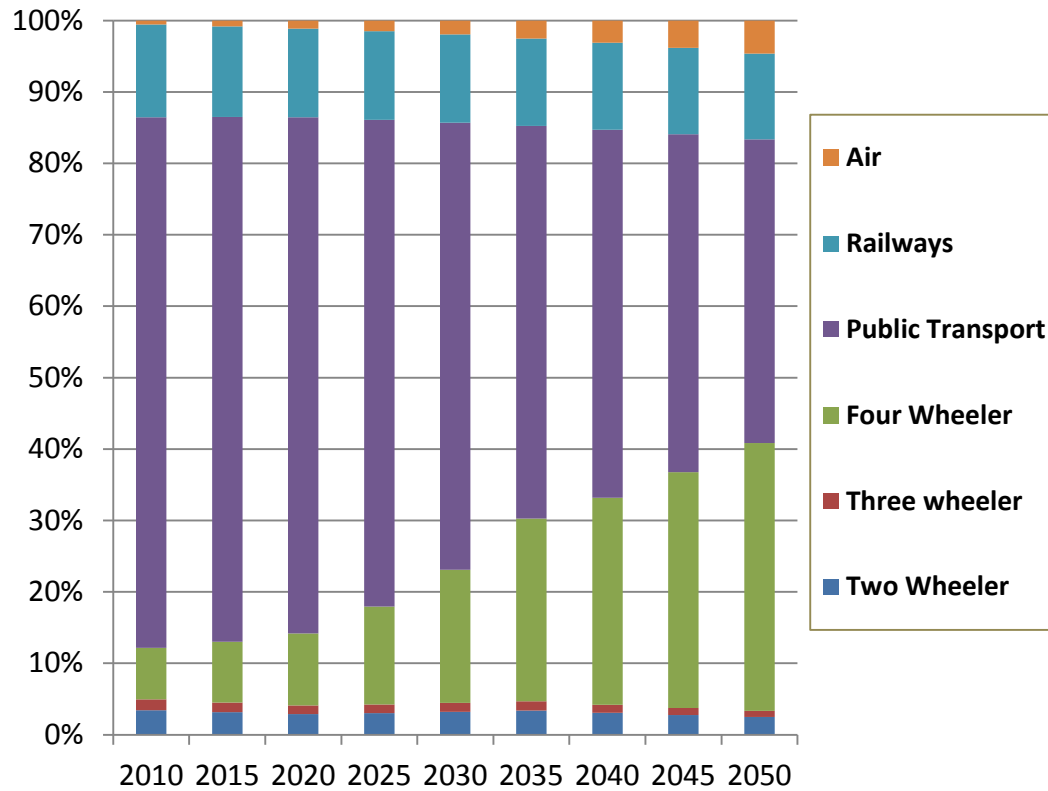


BAU - Road Passenger Transport Demand

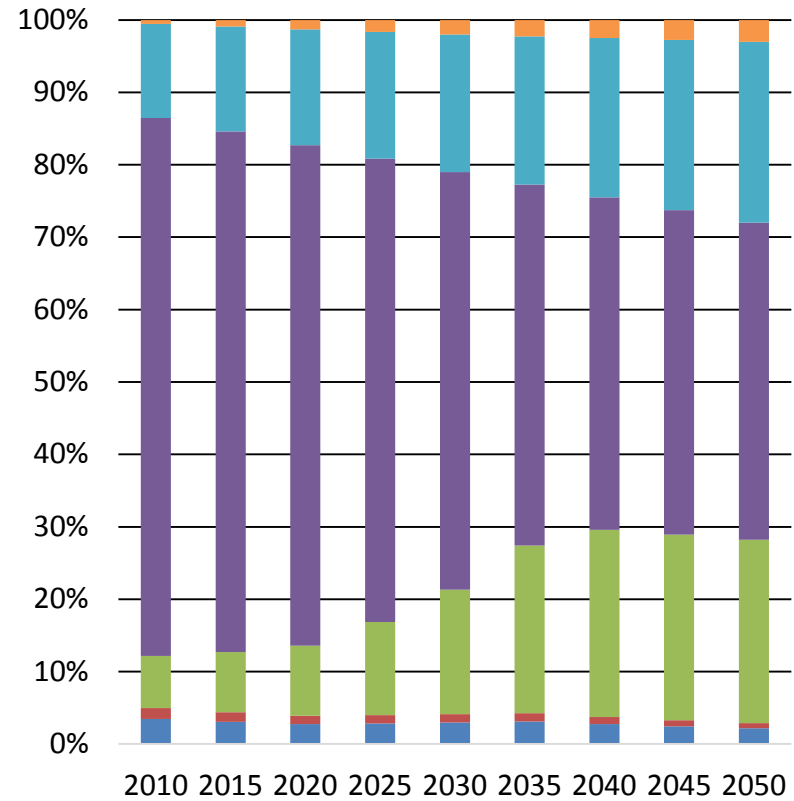


Modal Share of Passenger Transport

BAU Modal Share



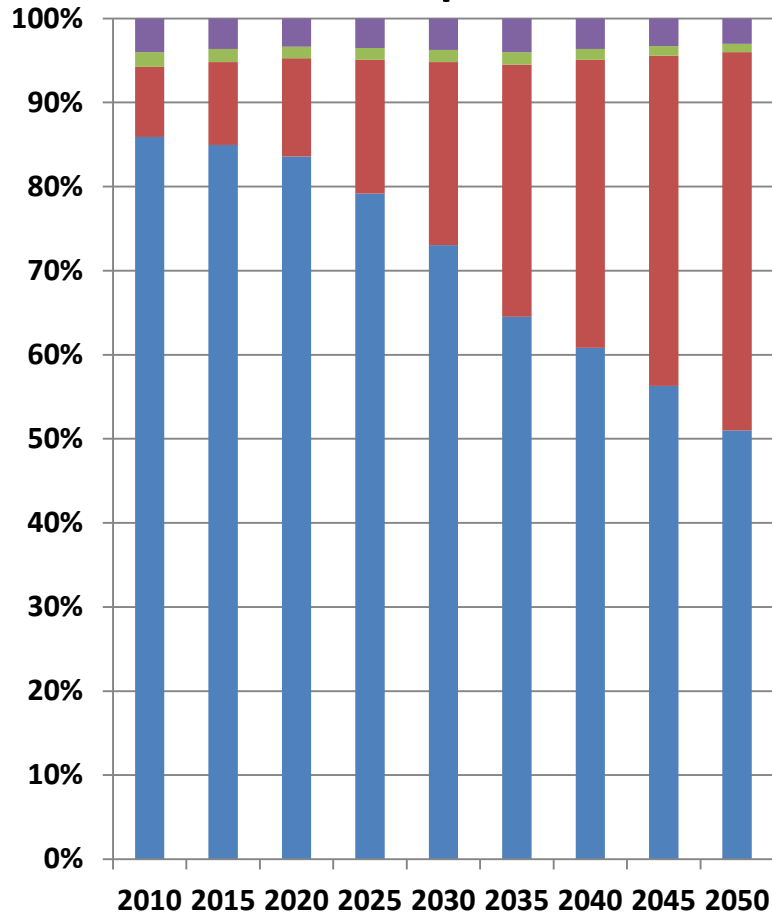
Sustainable Low Carbon Scenario Modal Share



Share in Road Passenger Transport

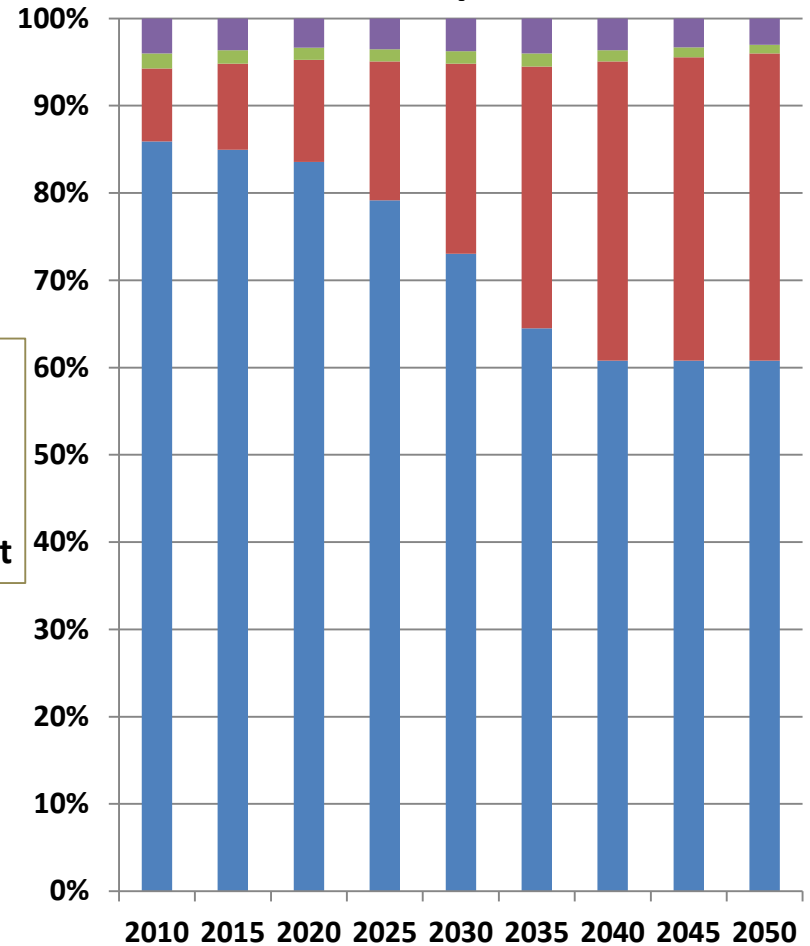
BAU

Road Transport Share



Sustainable Low Carbon Scenario

Road Transport Share

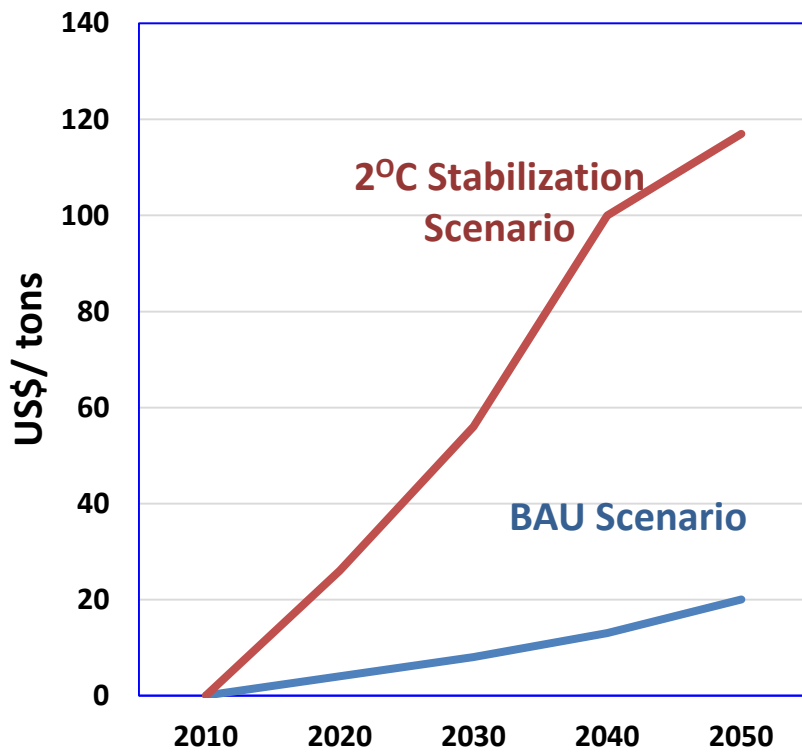


Sustainable Low Carbon Transport Scenario

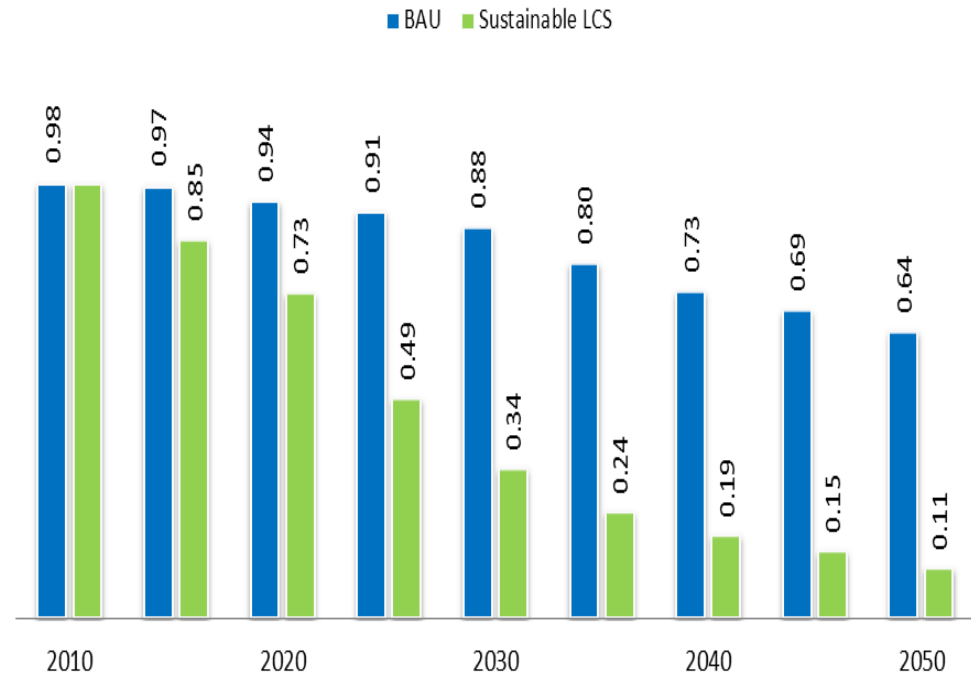
Results from Modeling Assessment

Low Carbon Electricity Transition

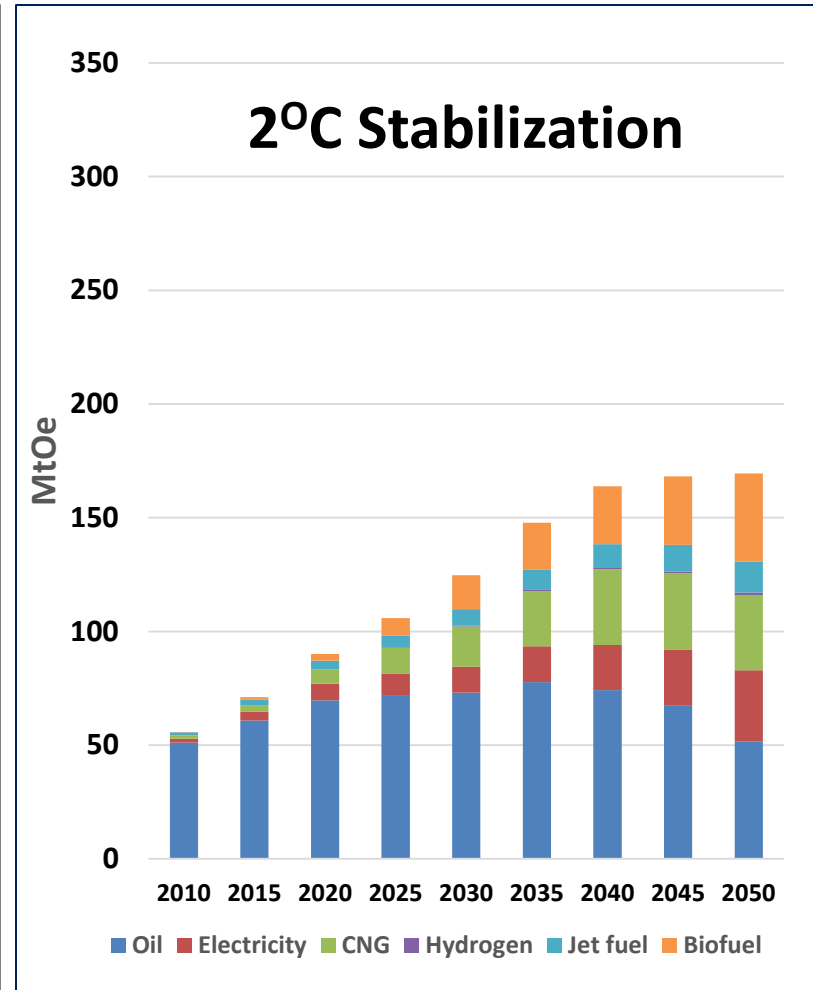
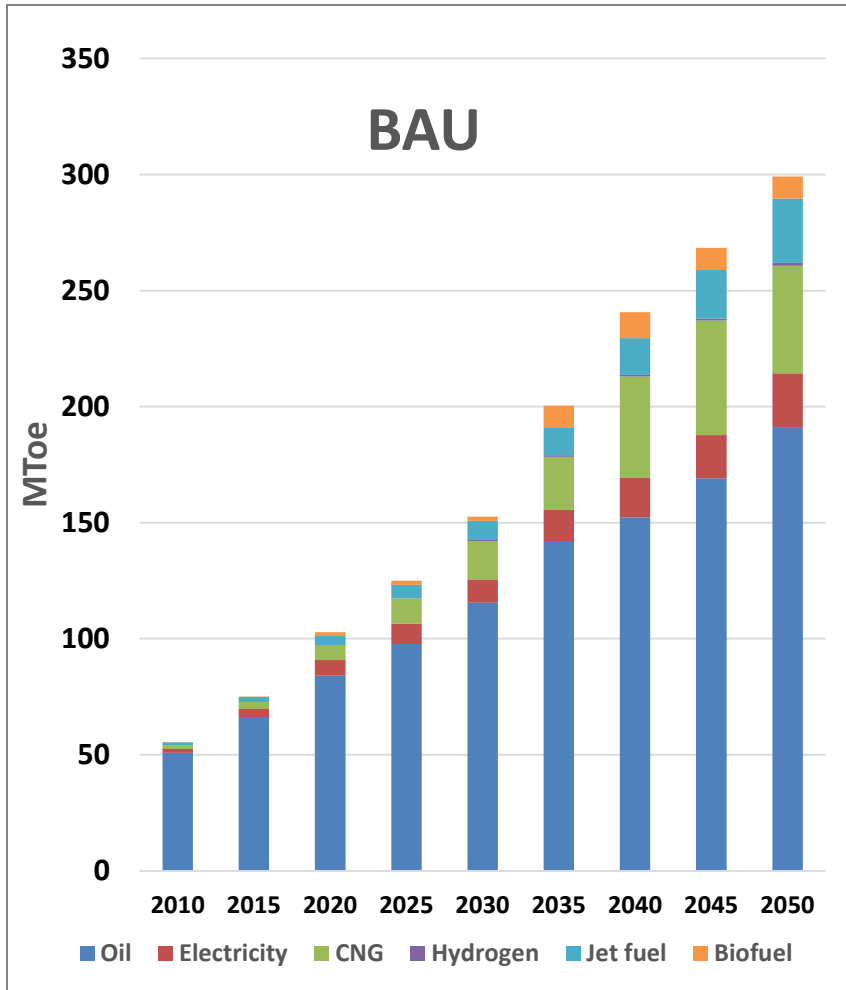
Carbon Price Trajectory



CO2 Intensity of Grid (tCO₂ / Mwh)

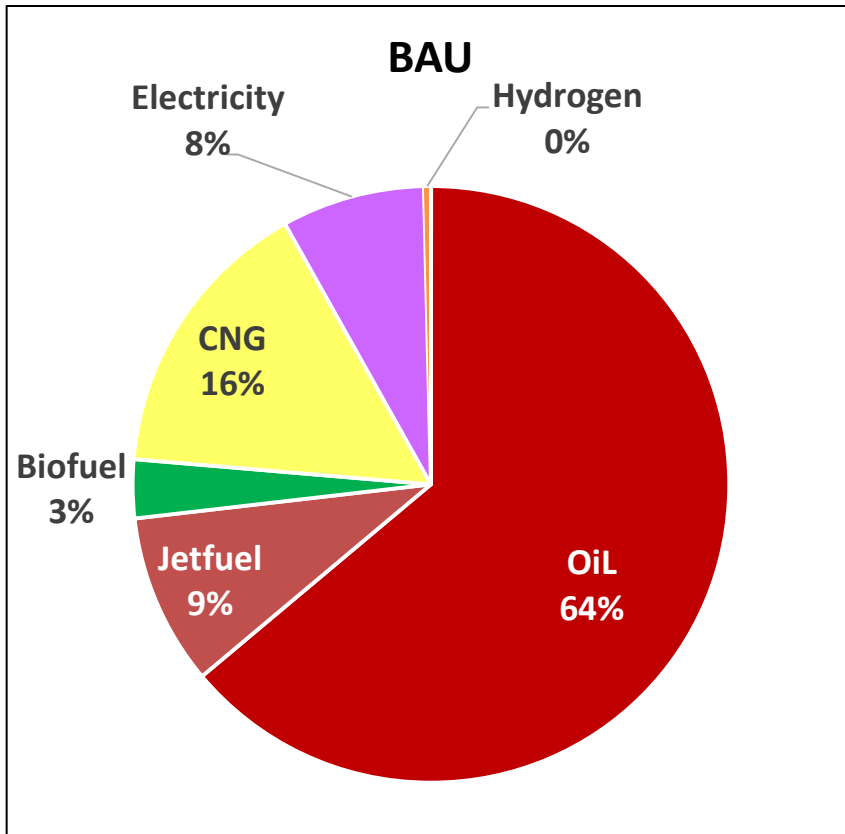


Energy Mix for Transport

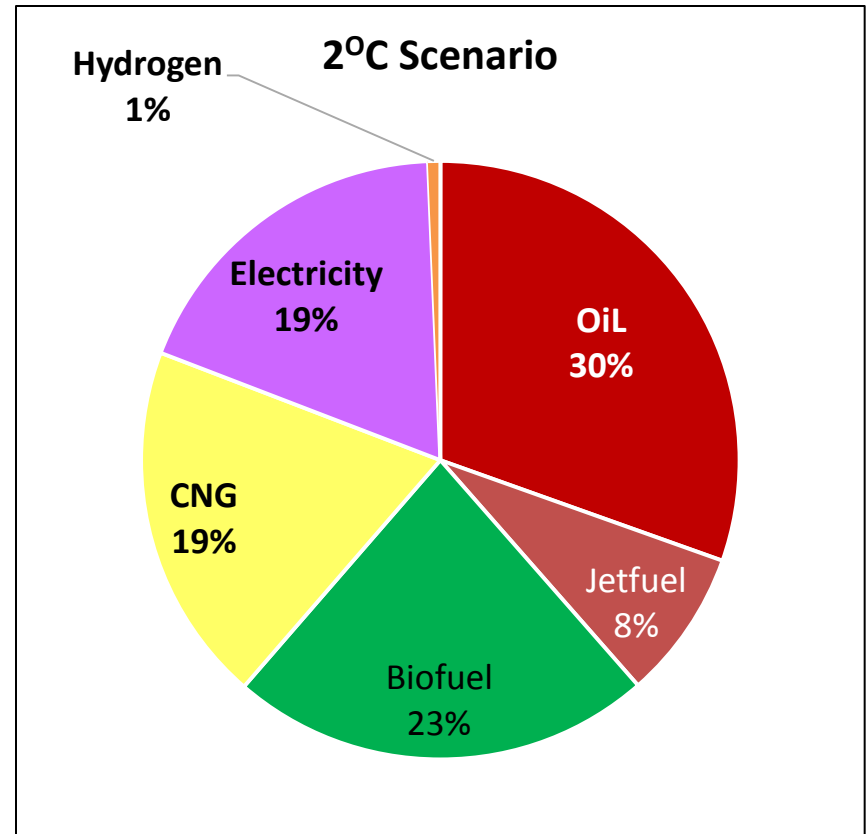


Transport Fuel Mix in 2050

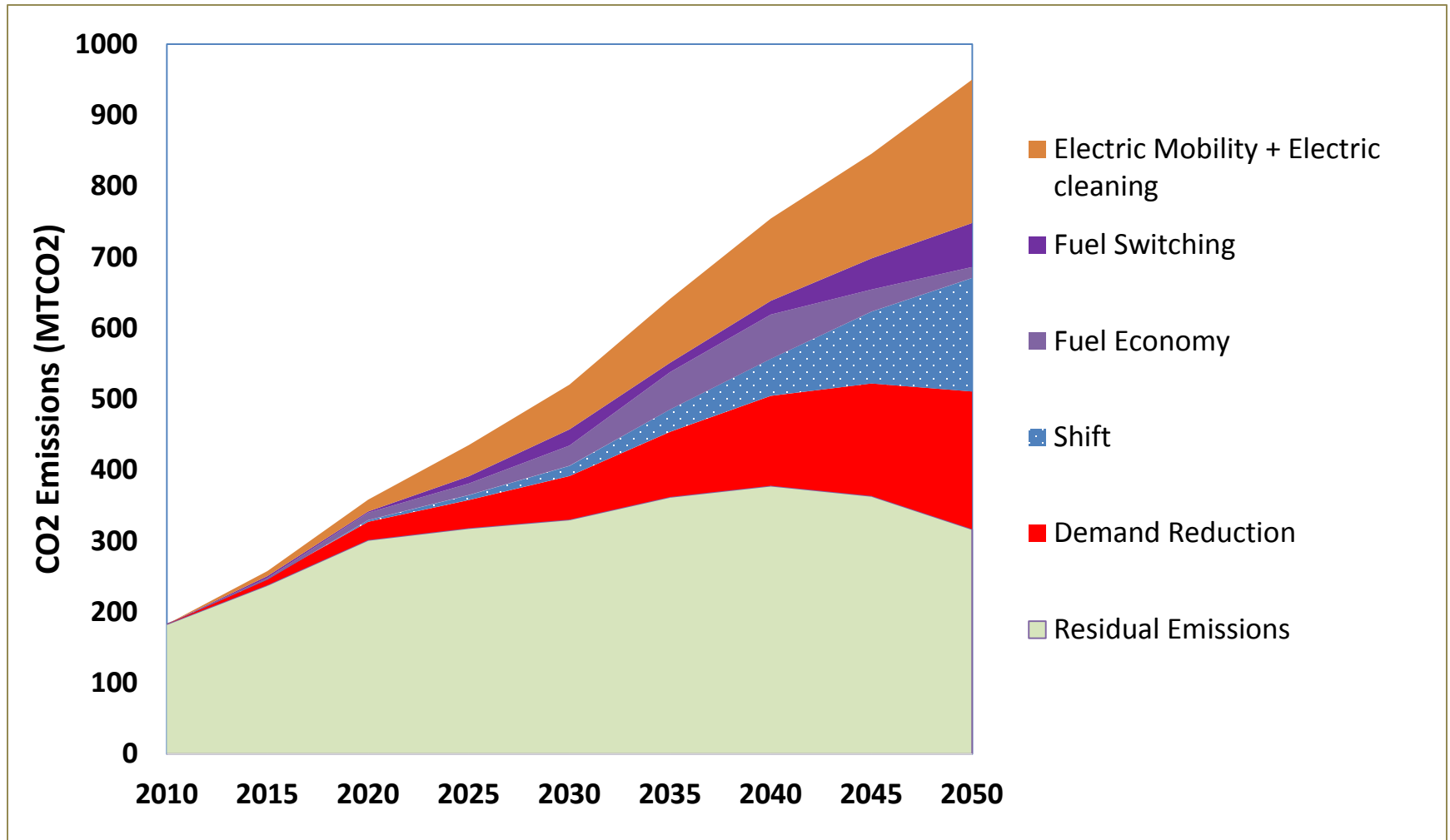
Transport Energy : 299 Mtoe



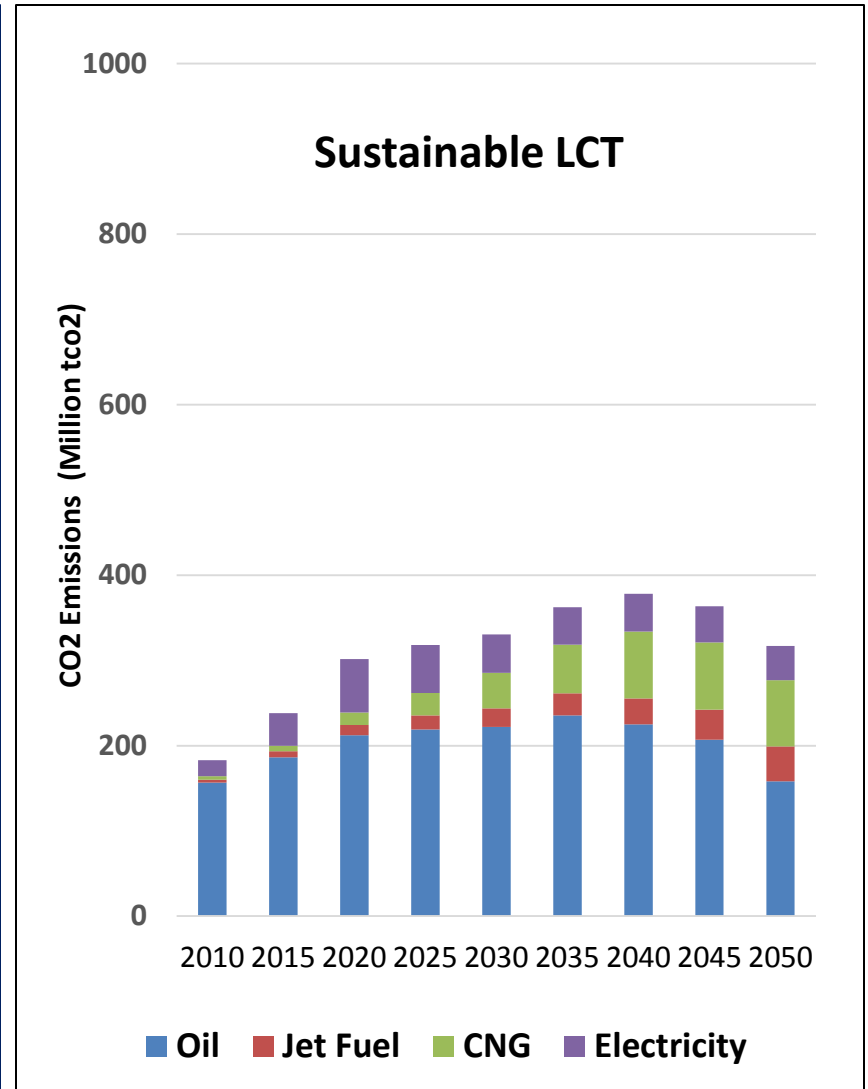
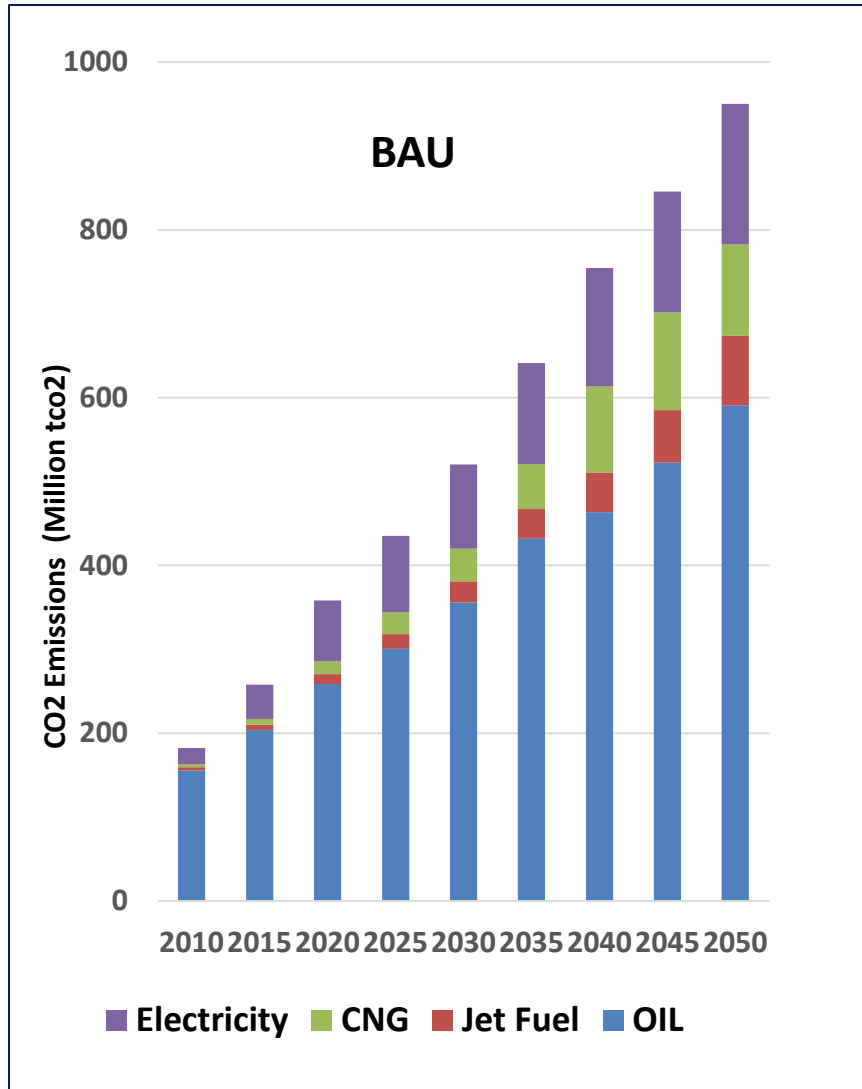
Transport: 169 Mtoe



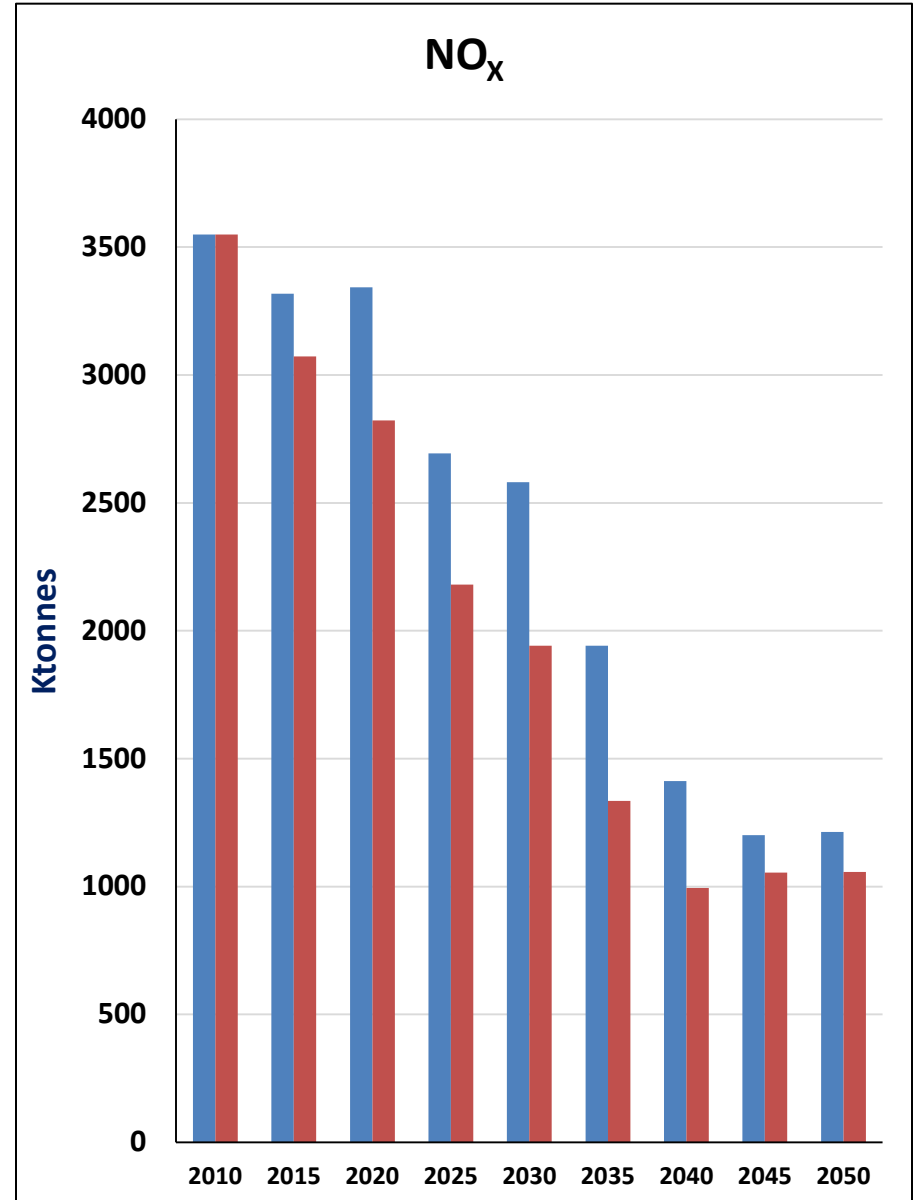
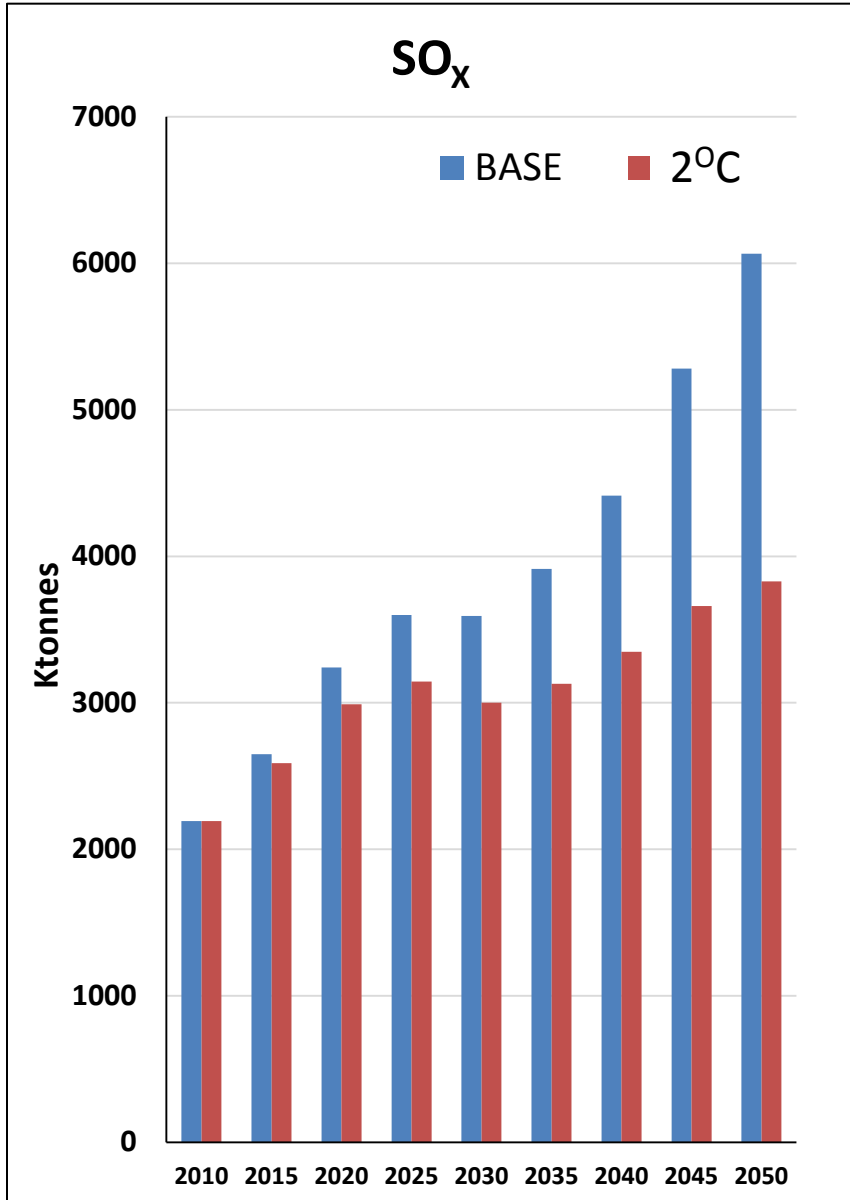
Contribution to CO2 Mitigation in Sustainable Low Carbon Transport Scenario



CO2 Emissions- Transport

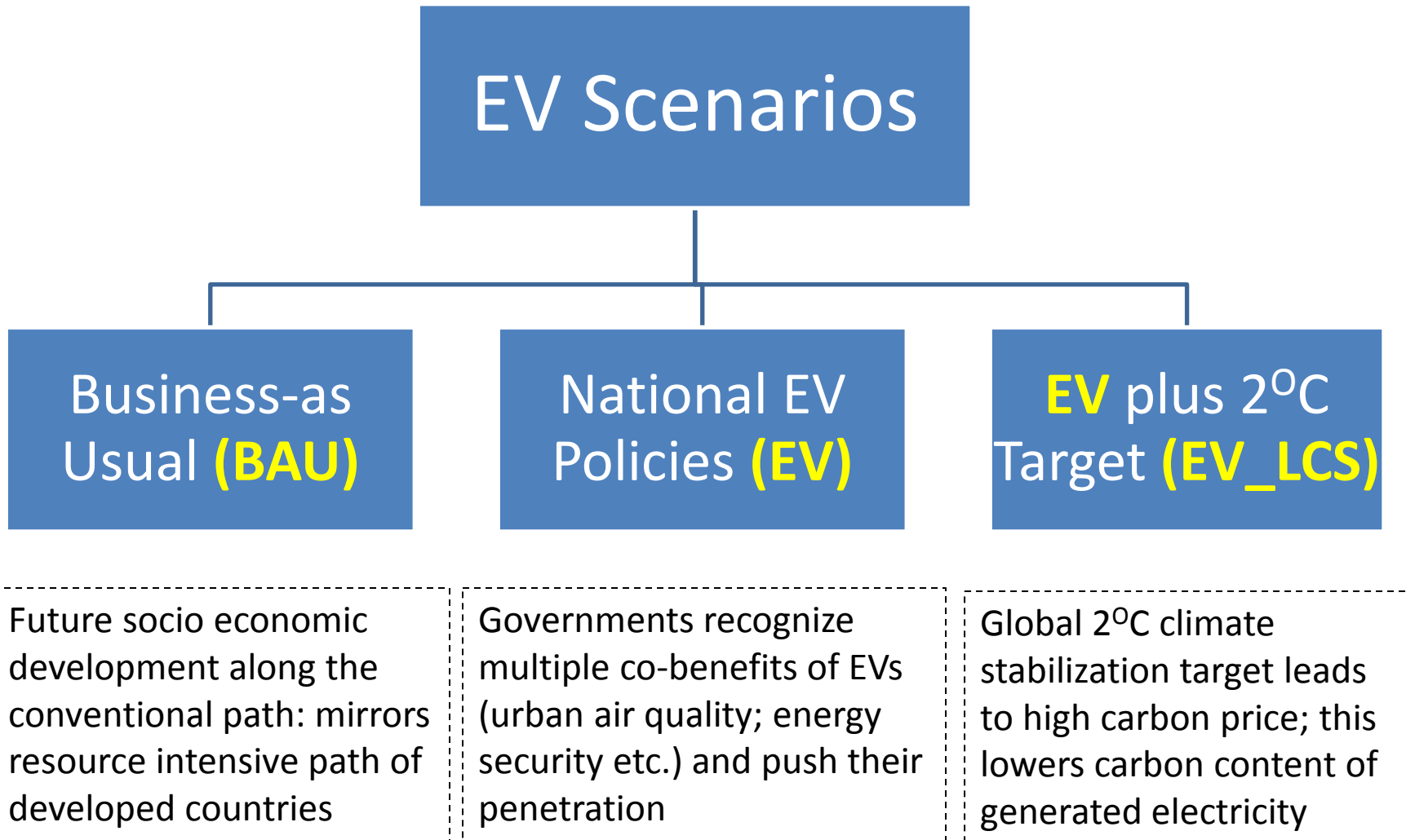


Air Quality Co-benefit



Electric Vehicle Scenarios

Electric Vehicles (EV) Scenarios



Scenarios Description: EV & EV_LCS

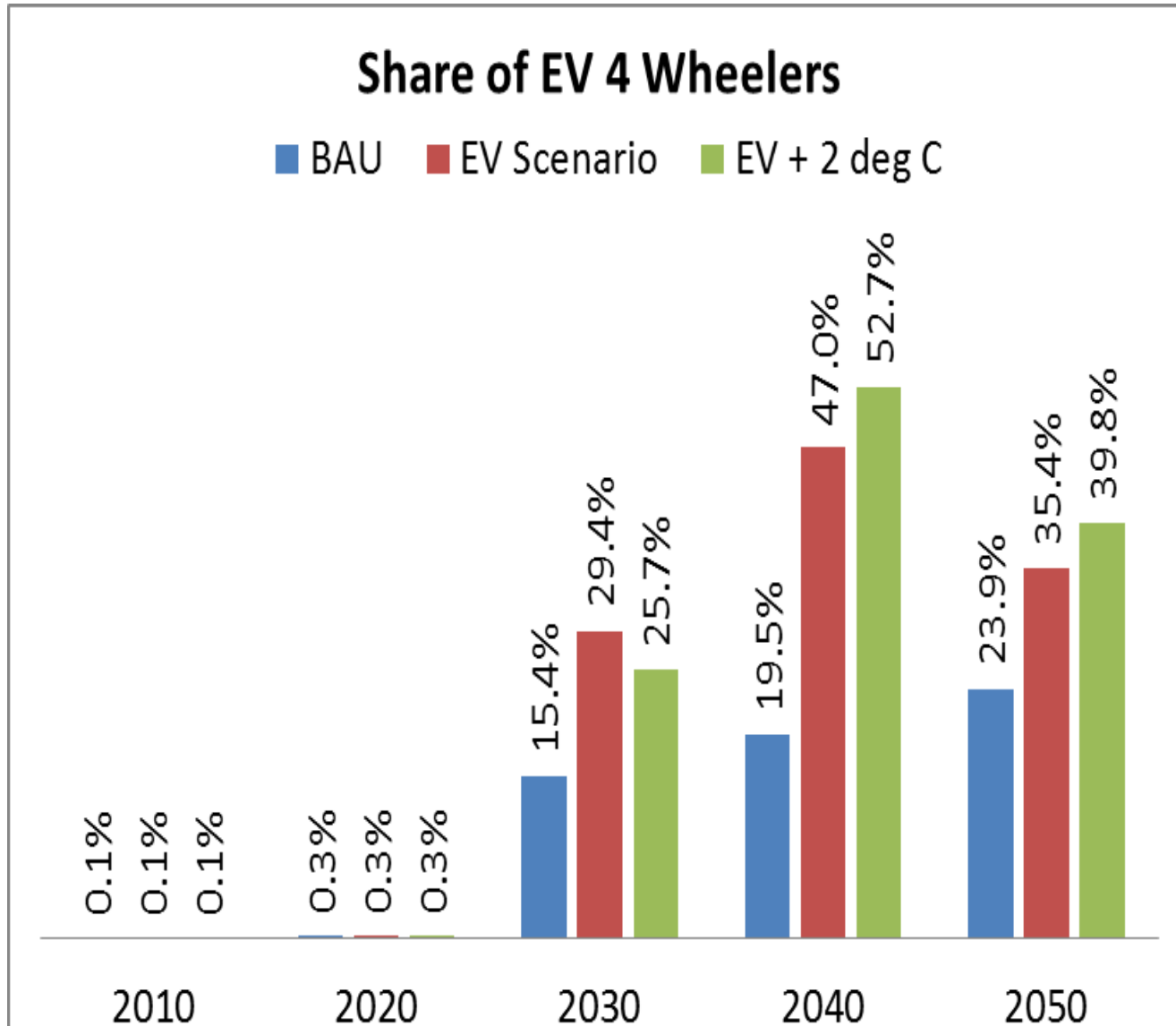
Electric Vehicle Scenario (EV): Assumptions

- Domestic policy supports: Direct capital subsidy, improved charging infrastructure, dedicated lanes, incentives for R&D in power train, batteries and smart grid technologies, quotas for EVs in urban public & goods transport
- Battery costs comes down to half of current costs in next 10-15 years: driven by advancements in battery technologies, improvements in battery capacities, declining component costs, and economies of scale in production
- Improved batteries with higher energy density will also help reduce weight of batteries: further pushing down EVs costs
- Limited range per charge put constraints on EVs penetration for urban transportation

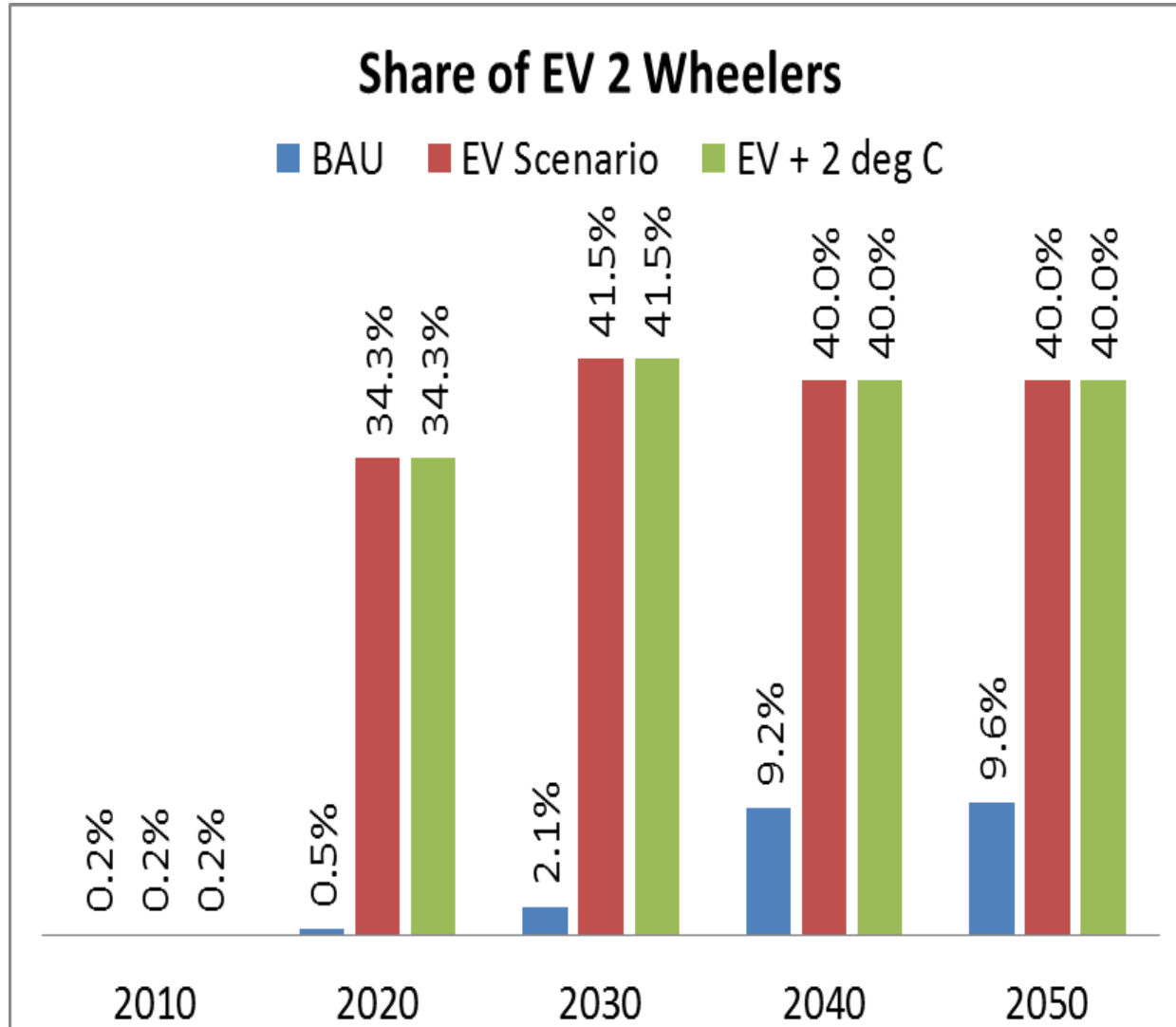
Electric Vehicle plus 2°C Scenario (EV_LCS): Assumptions

- Global 450 ppmv CO₂ equivalent concentration stabilization target
- Carbon Price rise: from US\$ 46/tonne CO₂ in 2020 to US\$ 200/tonne CO₂ in 2050 (based on outputs from IMAGE and MESSAGE models)

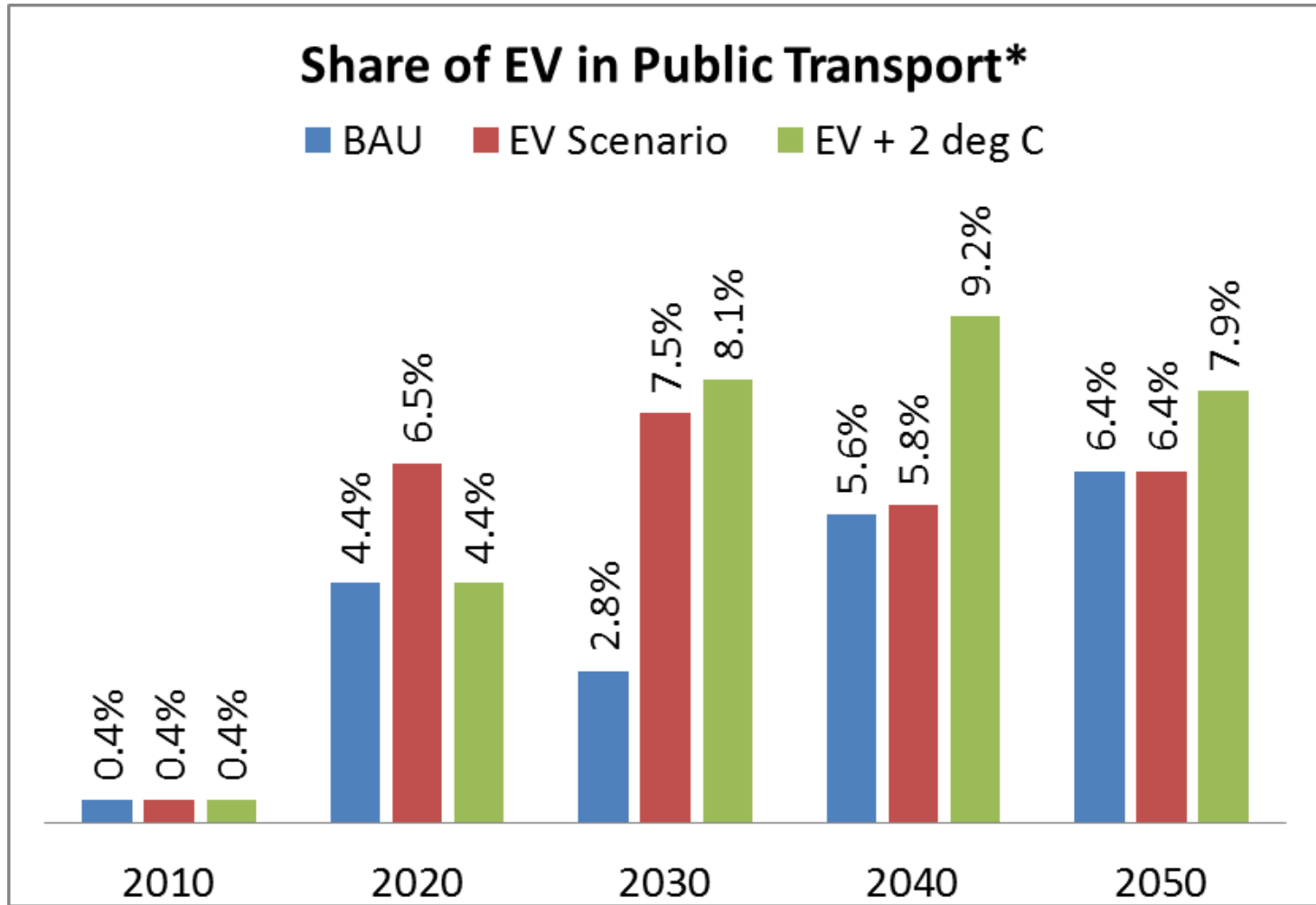
EV Share in Personal Motorised Transport



EV Share in Personal Motorised Transport



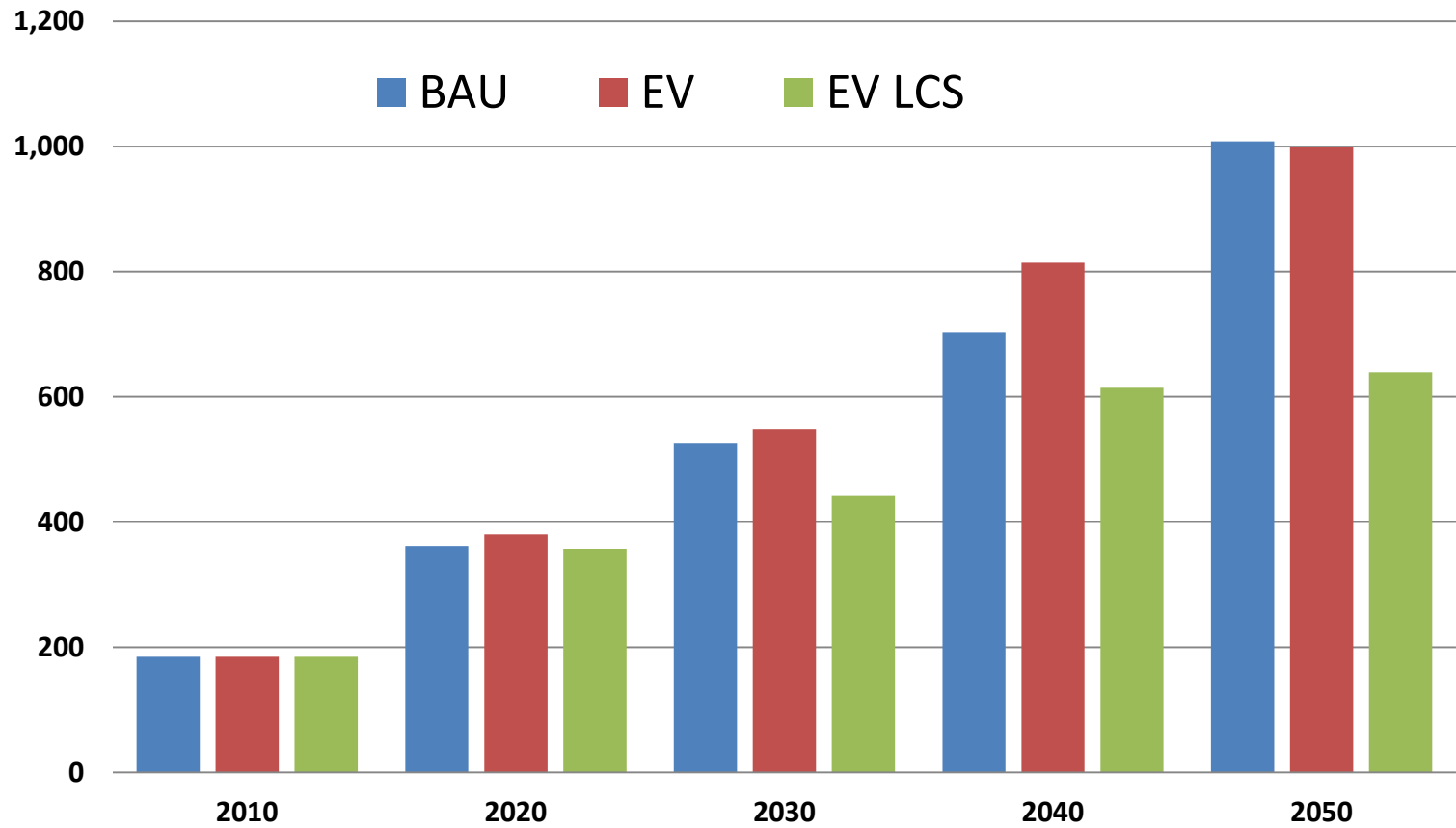
Share of EV for Public transport



(*) Excludes Demand for Passenger Transport met by Railways.

CO2 emissions: BAU, EV, EV_LCS

CO2 Emissions from Transport Sector
(Million tCO2)



Conclusions

- Under global 2°C stabilization policy, in 2050, India's:
 - Transport sector would mitigate 66% of BAU emissions
 - Transport Emissions will still be 60% above 2010 emissions
- The low carbon transition of transport sector is accompanied by sizable shift in fuels and technologies
- Low carbon transport transition shall deliver *Air Quality* and *Energy Security* co-benefits
- Electric Vehicles (EV) by themselves do not contribute to CO₂ mitigation; they may even increase emissions
- Under global 2°C stabilization policy, in India, EV contribute sizable mitigation, nearly 38% to the BAU transport emissions in 2050
- Early penetration of EV in India would come through 2-wheelers; this would create infrastructures that would facilitate larger vehicles.

Thank You

Low Carbon Transport Project Website :

www.unep.org/transport/lowcarbon



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