Transformation of India's Transport Sector under global warming of 2°C and 1.5° C scenario

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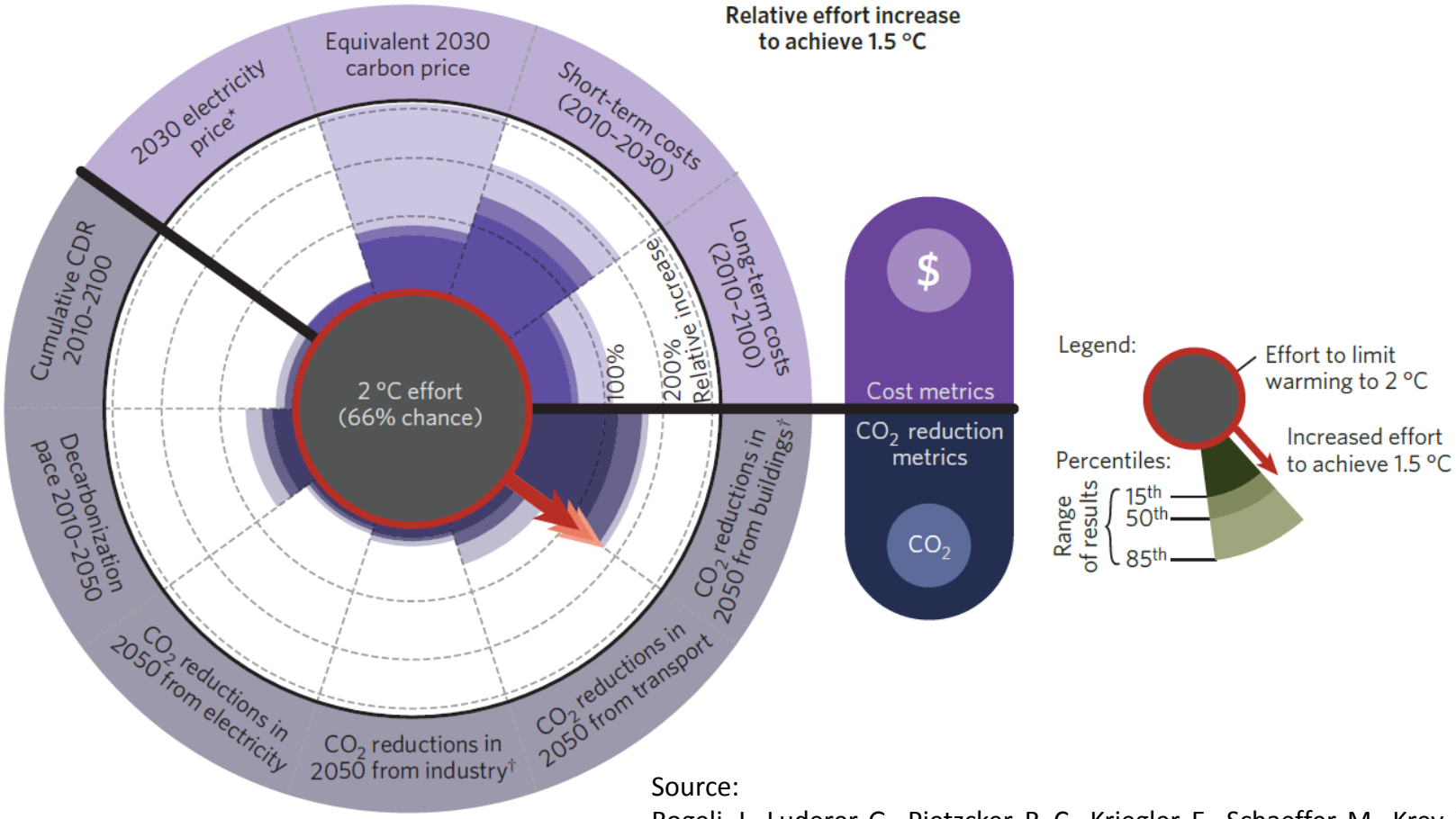
1.5°C and Efforts relative of 2°C



Source:
Rogelj, J., Luderer, G., Pietzcker, R. C., Kriegler, E., Schaeffer, M., Krey, V., & Riahi, K. 2015. Energy system transformations for limiting end-of-century warming to below 1.5 [deg]C. ***Nature Clim. Change***, 5(6): 519-527.

India's INDC

Overall Target : Reduction in CO_2 intensity by 33% - 35% in 2030 from the 2005 level

Transport related actions

Focus Area	Actions
Rail Transport	• Enhancing share of rail from 36 % to 45 % • Dedicated Freight Corridors to reduce 457 million tonnes of CO2 over a 30-year period
Coastal shipping & inland waterways	• implementation of a 1,620-km navigable channel for large commercial ships • waterway transportation grid connecting waterways to roads, railways, and ports. • to improve and augment capacity in India's ports, promoting efficient transportation of goods. • a 7,000 km road network along the coast to provide further connectivity to the ports.
Mass transit	• Urban transport to focus on moving people - investments in mass transit
Vehicle efficiency	• Efficiency targets for new cars • Improve fuel standards
Alternate Fuels and Vehicles	• Incentivizing hybrid and electric vehicles in the country • Promoting Biofuels

Scenarios

Strategies	NDC Scenario	2°C Scenario	1.5°C scenario
Climate Policies	Implementation of voluntary and supported actions aligned with NDC	Global carbon price consistent with 2 °C stabilisation	CO_2 emissions budget consistent with 1.5 °C scenario
Strategies that reduce or substitute urban passenger transport demand	Improvement of mass transit in cities, and overall mobility (Smart city and AMRUT missions).	Demand and modal mix changed relative to change in carbon prices	Demand and modal mix changed relative to change in carbon prices
Strategies that reduce or substitute Intercity passenger transport demand	• Investments in semi high speed rail corridors and high speed rail corridors. • Modal share of Rail increased to 30% by 2050	• Demand and modal mix changed relative to change in carbon prices. • High carbon prices incentivize rail electrification.	• Demand and modal mix changed relative to change in carbon prices. • High carbon prices incentivize rail electrification.
Strategies that reduce or substitute freight transport demand	• Integration of rail with coastal shipping & waterways • Implementation of dedicated freight corridors (DFC) shift freight to rail. • Modal share of Rail increased to 48% by 2050	Demand and modal mix same as NDC Scenario though high carbon prices create incentive to electrify rail.	Demand and modal mix same as NDC Scenario though high carbon prices create incentive to electrify rail.
Strategies that increase share of EVs	• Full duty exemption and half sales tax till 2025 • Increased investment in charging infrastructures.	Carbon Price facilitates cost competitiveness of EVs.	Carbon Price facilitates cost competitiveness of EVs.
Strategies that improve fuel economy	• Fuel consumption standards + additional constraint • Overall fuel economy for 4 wheelers below 4 lit/100 km	Carbon price facilitates cost competitiveness of fuel efficient vehicles	Carbon price facilitates cost competitiveness of fuel efficient vehicles

Methodology

- ANSWER MARKAL MODEL
- CO_2 Price and CO_2 Budget

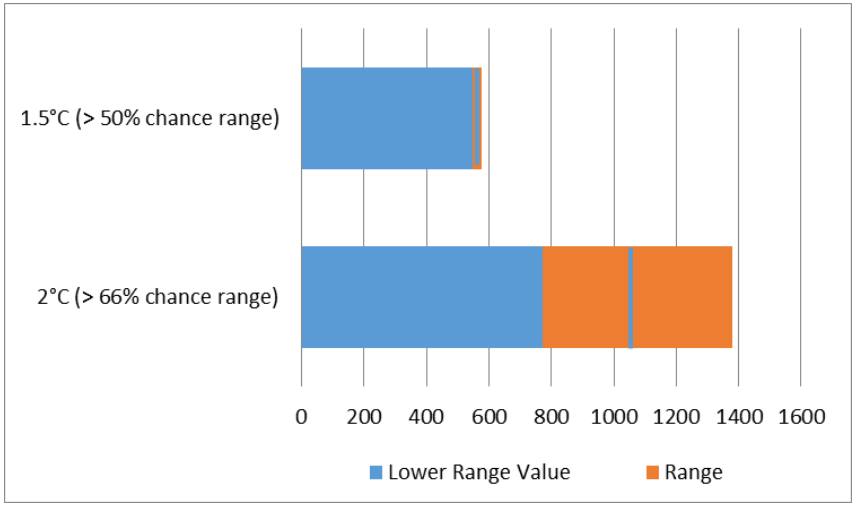
$$CO_2 Emissions India_{1.5^\circ C} = CO_2 Emissions India_{2^\circ C} \, x \left(\frac{CO_2 Emissions \, Global_{1.5^\circ C}}{CO_2 Emissions \, Global_{2^\circ C}} \right)$$

- Transport demand in 2°C and 1.5°C scenario

$$Demand \, Travel_{2^oC} = Demand \, Travel_{NDC} \, x \left(\frac{Fuel \, Price_{2^oC}}{Fuel \, Price_{NDC}} \right)^{\mu}$$

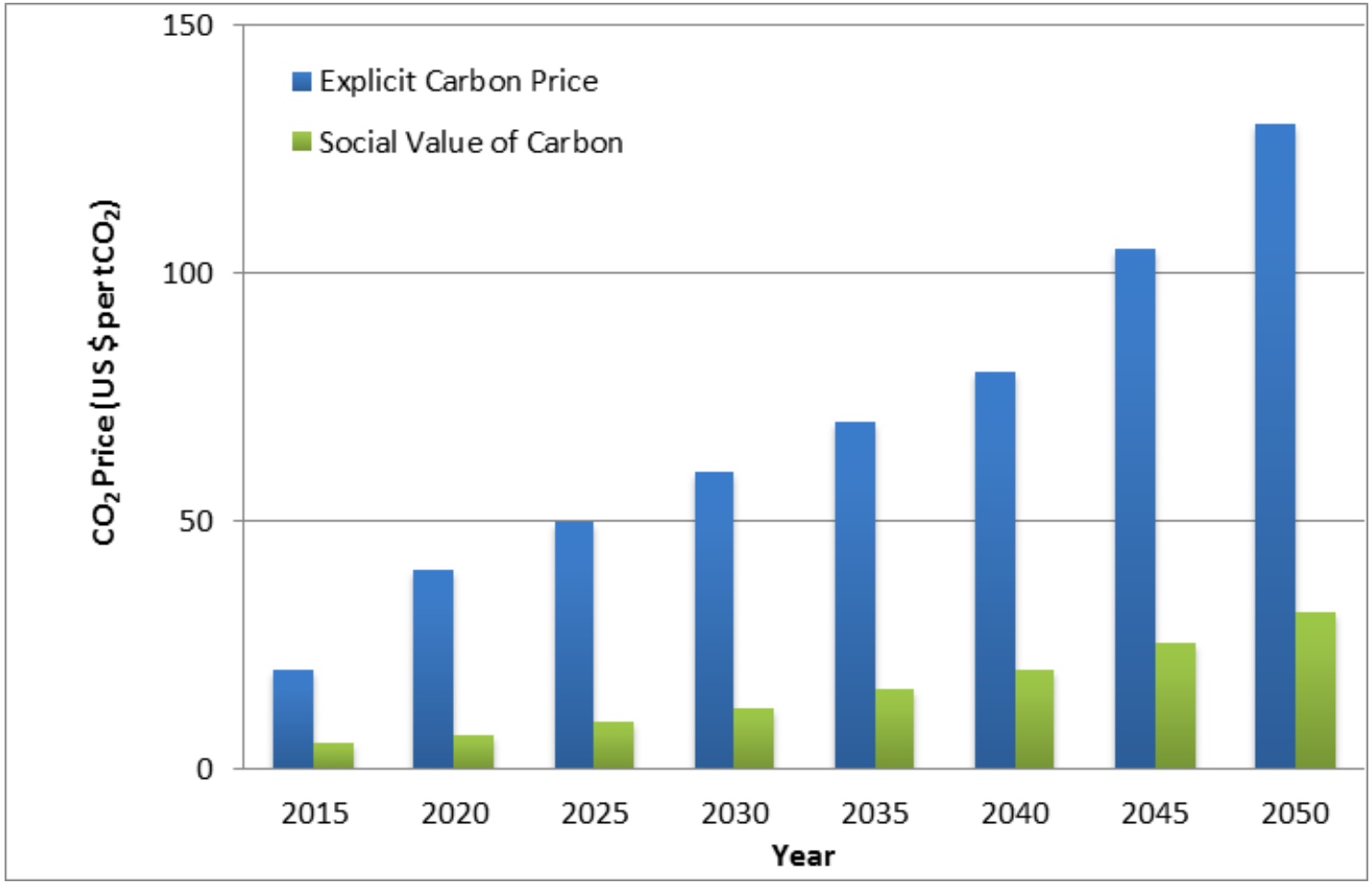
$$Demand \, Mode_{2^oC} = Demand \, Mode_{NDC} \times \left(\frac{CO_2 \, Price_{2^oC}}{CO_2 \, Price_{NDC}} \times \frac{CO_2 \, Intensity_{2^oC}}{CO_2 \, Intensity_{NDC}} \right)^{\mu}$$

Global CO_2 budgets ($GtCO_2$) for 2°C and 1.5°C scenario



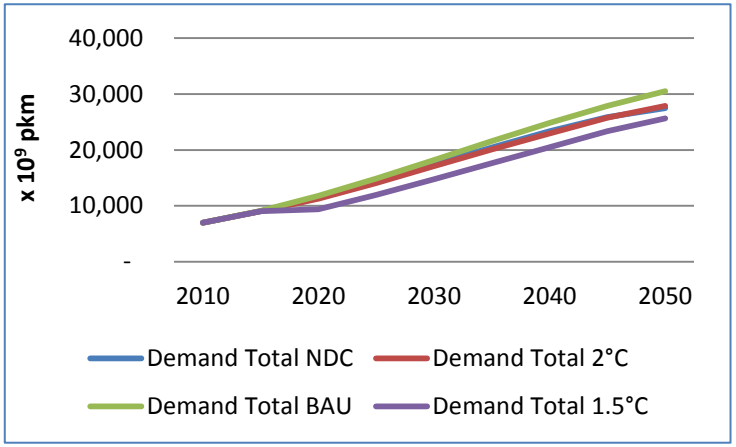
Source: UNEP (United Nations Environment Programme), 2016. The Emissions Gap Report 2016

Implcit carbon price: NDC Scenario

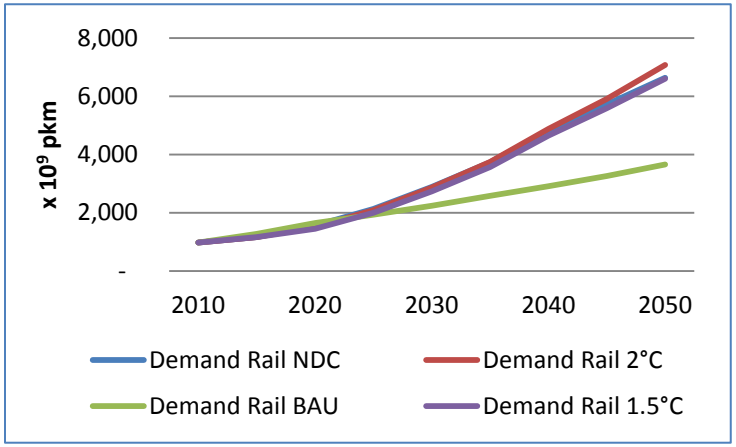


Passenger Demand

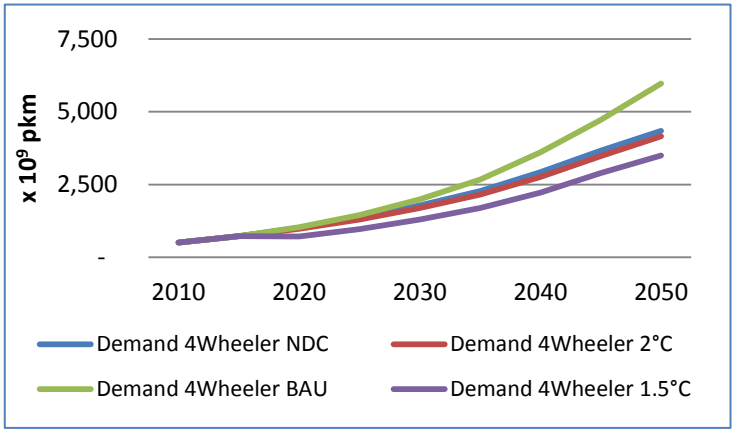
Overall



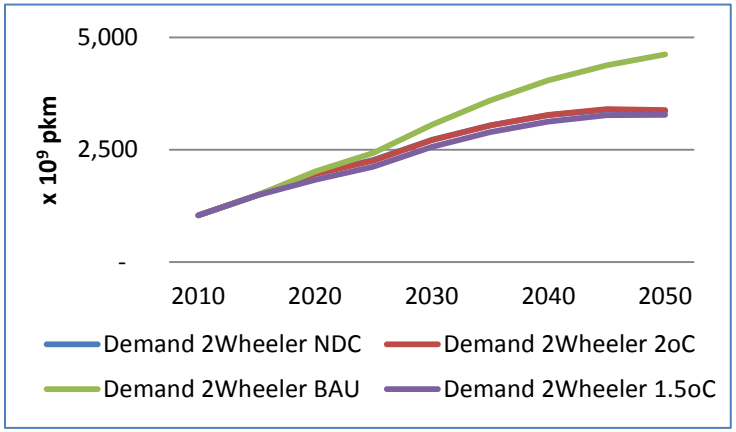
Rail



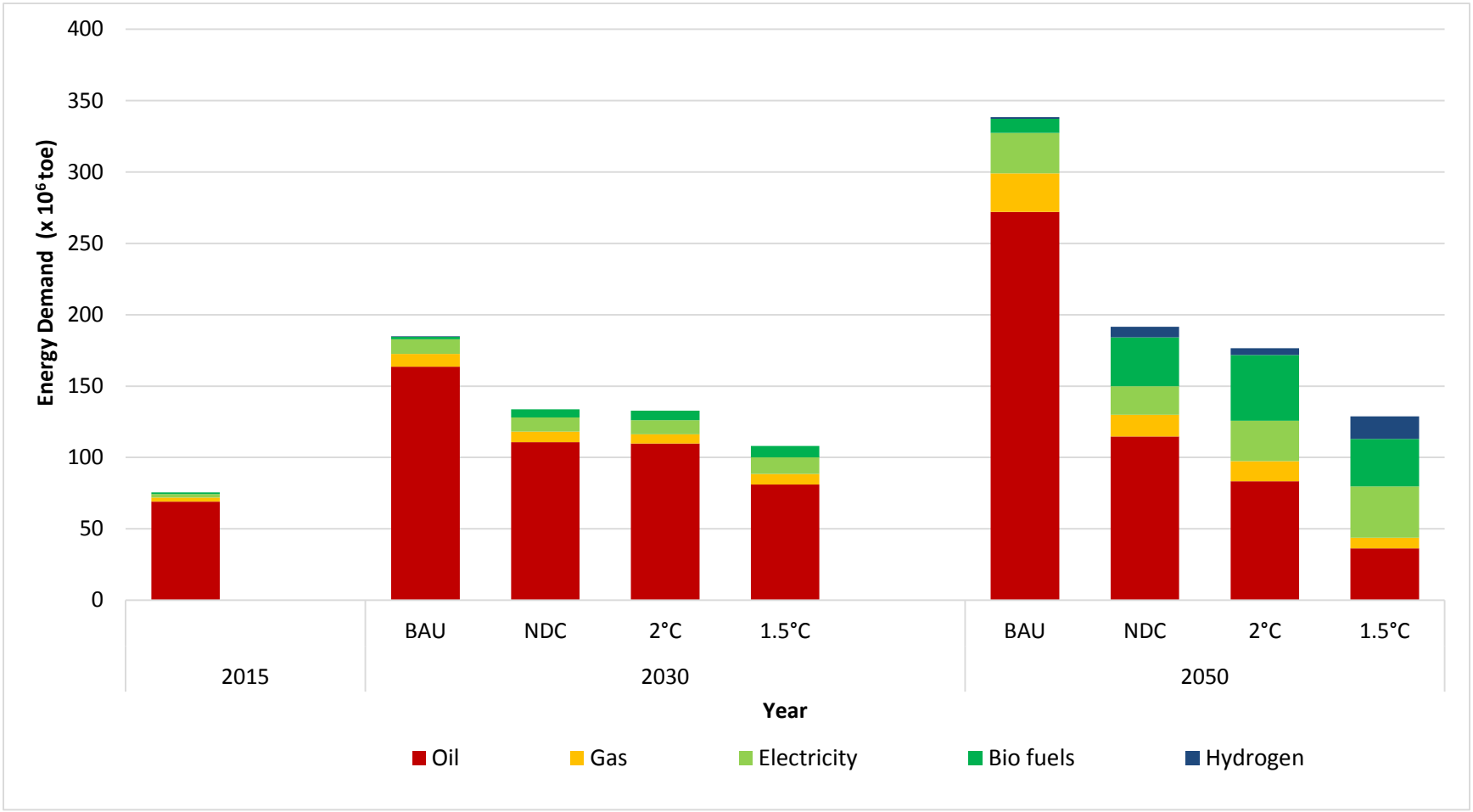
4 Wheeler



2 Wheeler

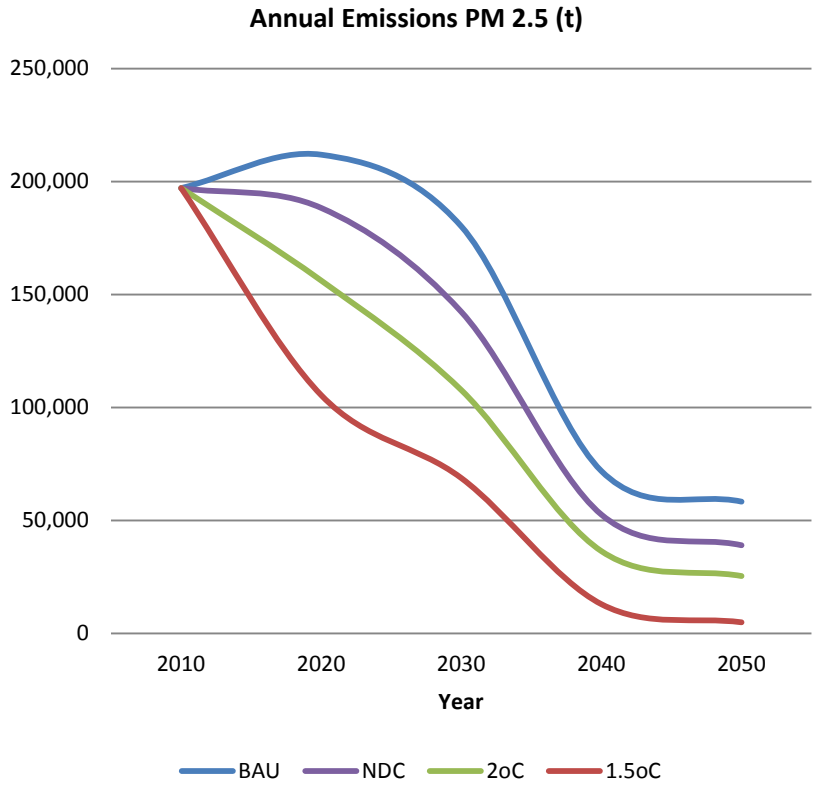


Results: Energy Mix

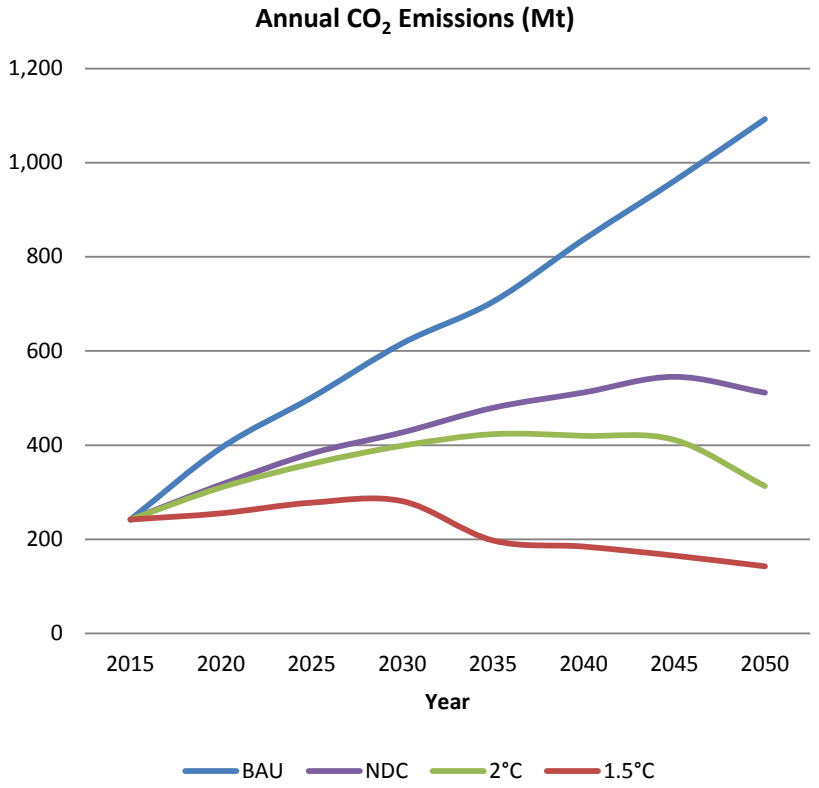


Results: Environment

PM 2.5



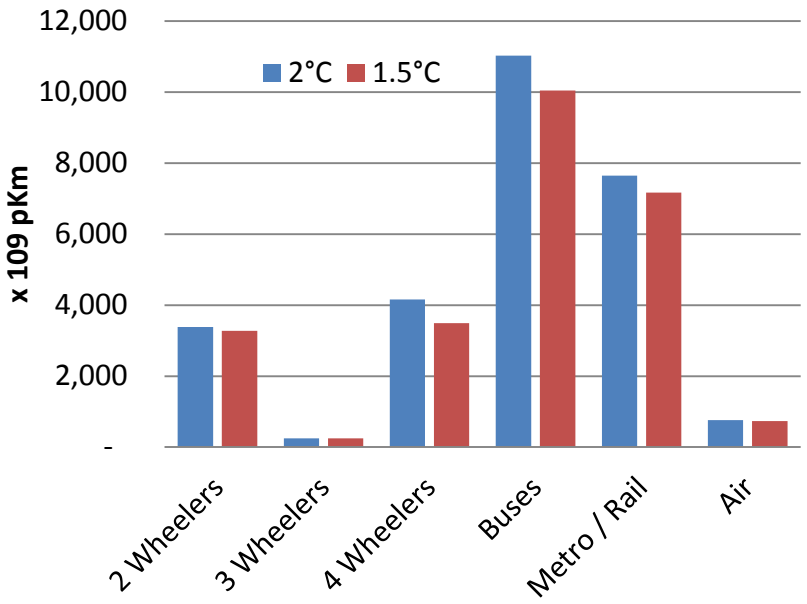
CO_2 Emissions



- NDC scenario itself achieves significant improvement in environment and CO_2 co-benefits

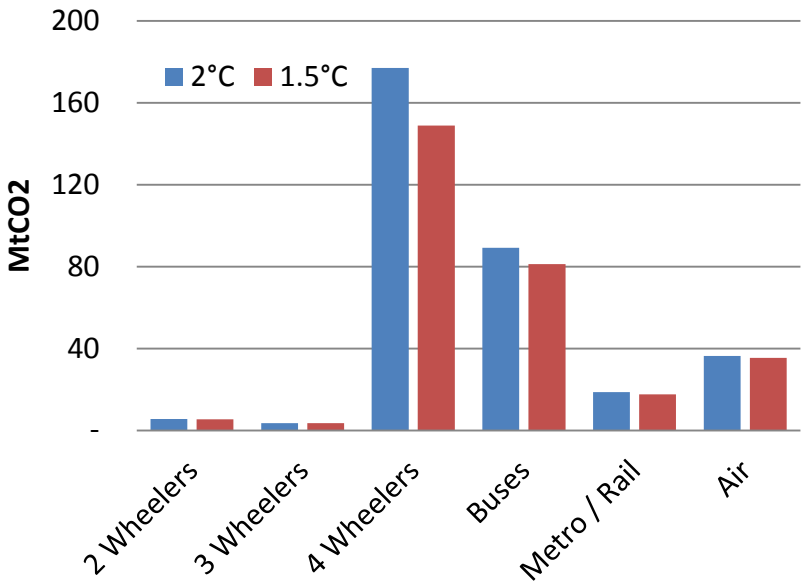
Decarbonisation due to demand reduction

Passenger Transport Demand in 2050



CO_2 Emissions in 2050*

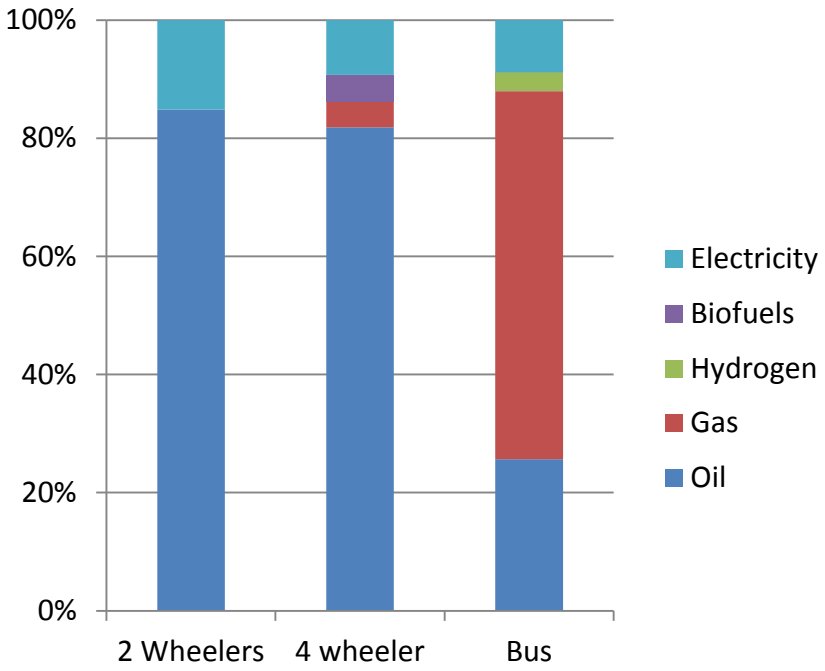
* without any fuel/tech change



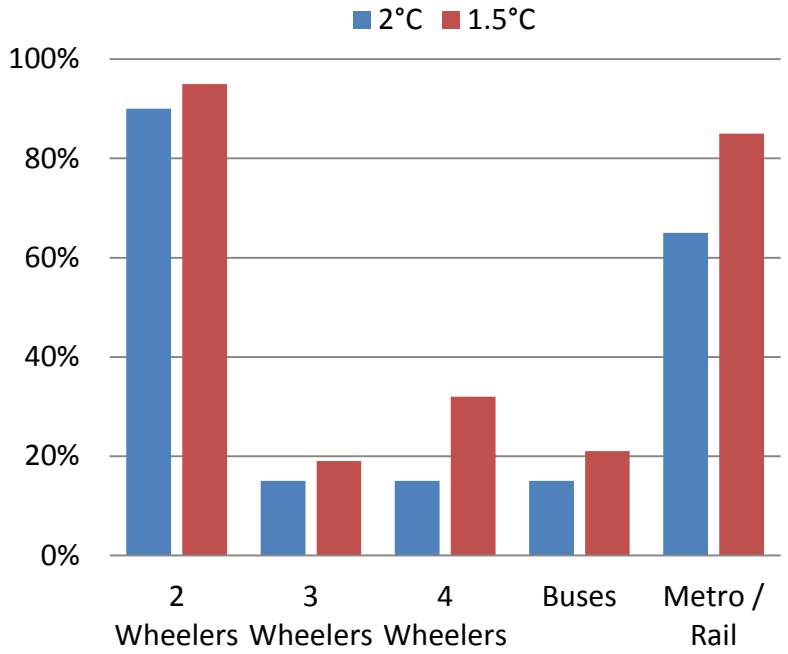
- **Overall** demand reduction is around 8.3% however reduction in CO_2 emissions is 12.6%
- Demand reduction and shift to sustainable modes would require integrated planning, and redirecting of investments

Technology Mix

Fuel Mix BAU Scenario: 2050



Share of Electric /H2 Vehicles



- **Deep decarbonisation would need a strong push towards electrification**

Electricity Decarbonisation

	2020	2025	2030	2035	2040	2045	2050
2°C	0.80	0.64	0.44	0.31	0.22	0.13	0.09
1.5°C	0.51	0.22	0.17	0.02	0.01	0.01	0.00

Conclusions

- India's NDC measures will improve sustainable development indicators and decoupling of CO_2 emissions compared to BAU.
- NDC alone however not sufficient to achieve Paris ambition.
- The transitions to global 2°C scenario will require policy support for clean transport technologies, electrification of transport and increased shift towards public transport
- Transition to low CO_2 intensity of electricity supply essential for decarbonisation of transport.
- The 1.5°C scenario is transformative and differentiates from other scenarios in the urgency and intensity of implementation.
- Deep decarbonisation would require redirecting of financing.