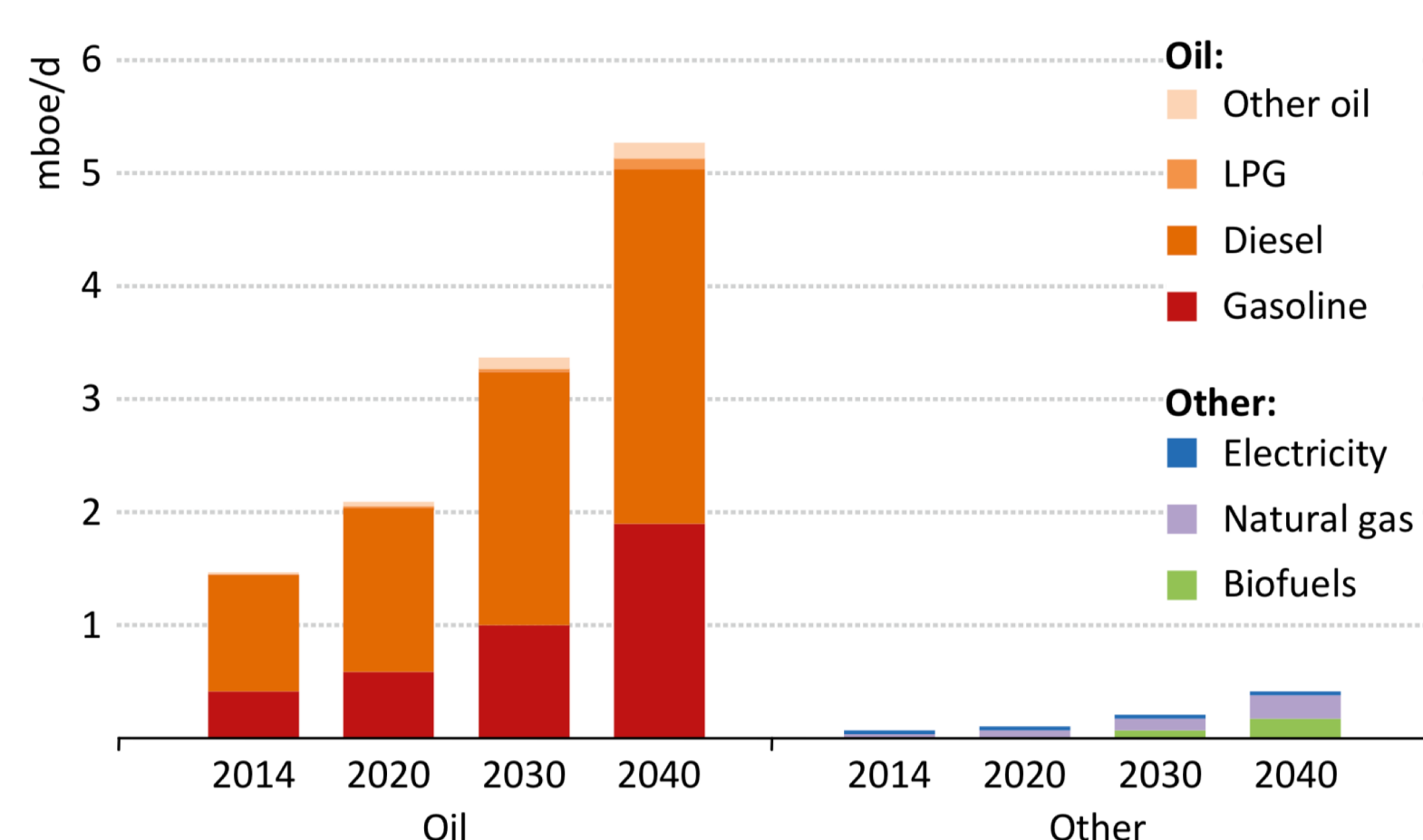


Motivation and Initial Research Questions

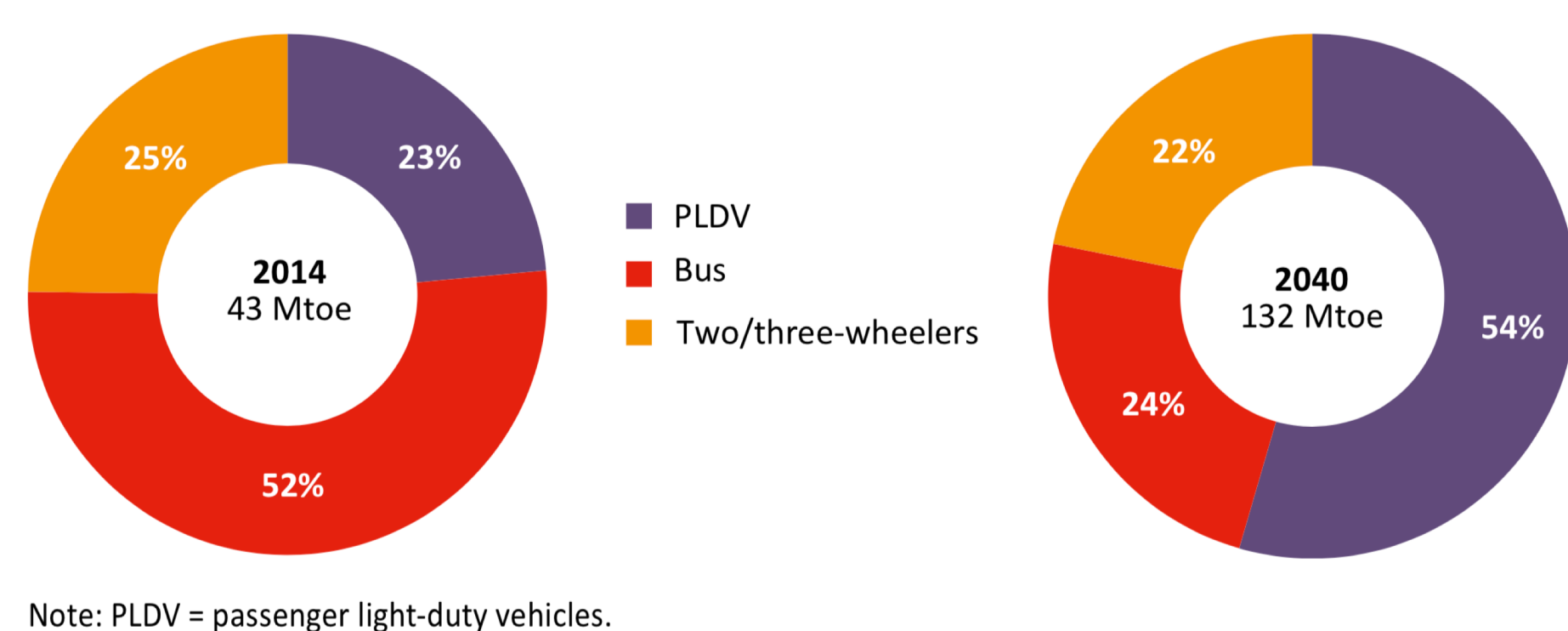
- ✓ Potential for improvement and associated benefits are huge: RMI Scenario says 1 transportation can avoid 1 gigaton of carbon dioxide emissions between 2017 and 2030, and \$60 billion in annual petrol/diesel costs in 2030
- ✓ Electrification is welcome, but new policies scenarios show majority of increased demand will be met by Oil.
- ✓ Diesel and Gasoline maintain their current dominance.
- ✓ As expected from many rapidly emerging countries, majority of growth is expected from the passenger LDVs
- How does current passenger transportation sector pan out?
- How does the passenger LDV fleet characteristics look like in terms of GHG emissions, fuel economy, utilization etc.
- How do these vehicles compare in terms of historic performance with vehicles from other countries?
- What policies are in place in India? What targets? Transition programs?

Passenger Light Duty Vehicles in India: Scenarios and Comparisons

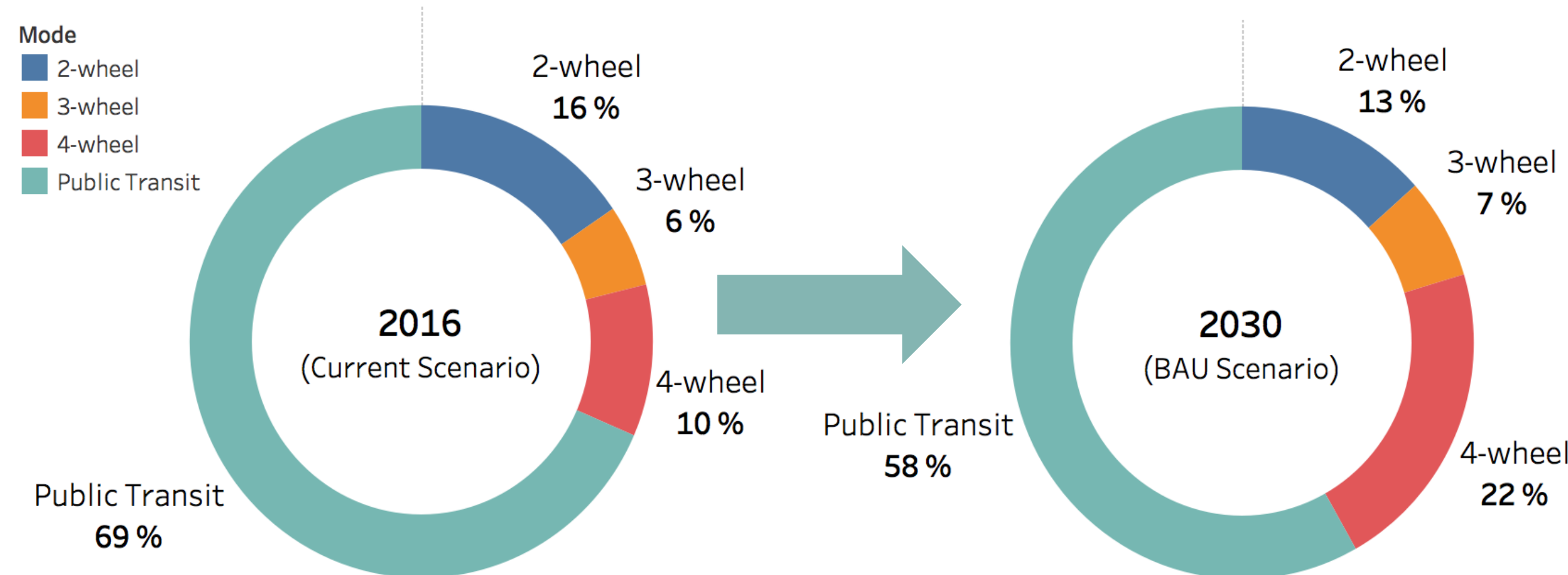
Transport fuel demand change (2014 and 2040)



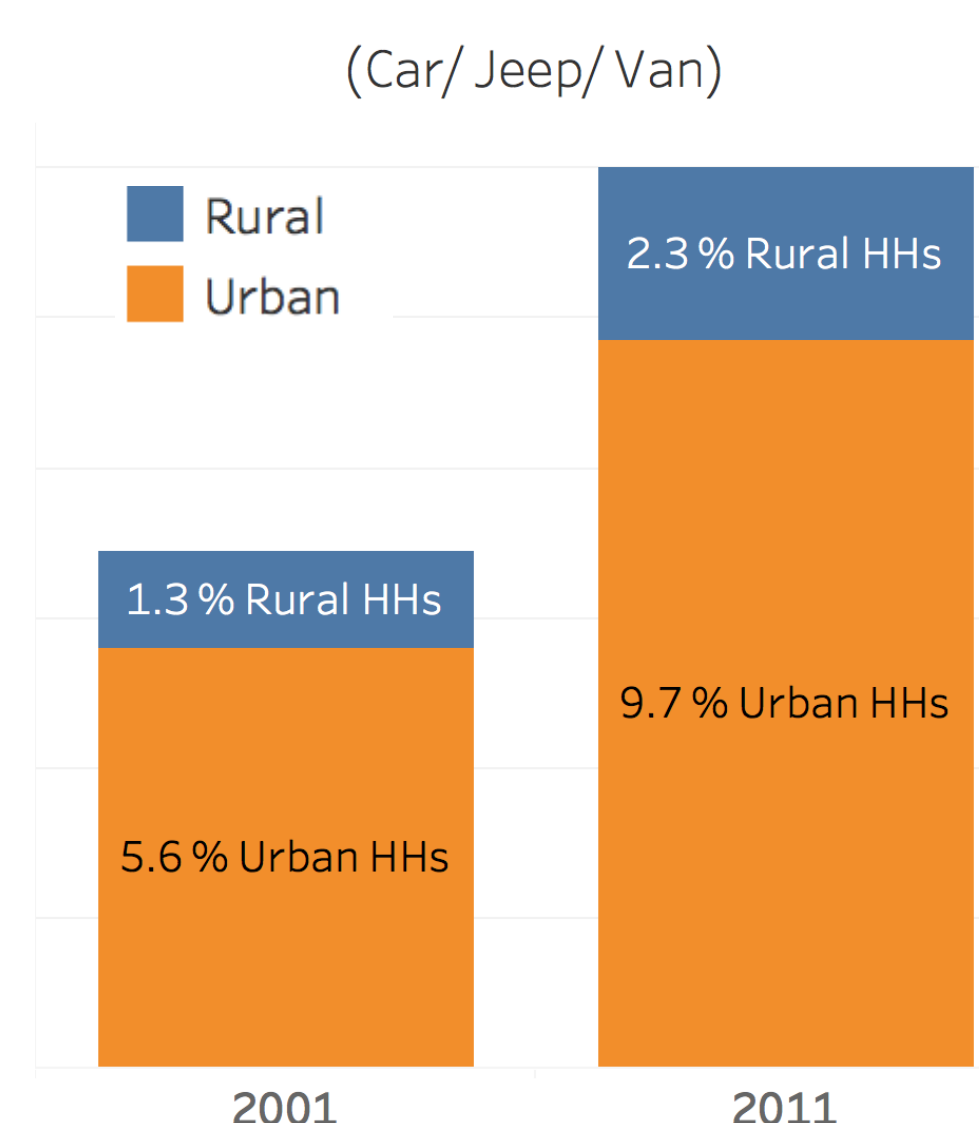
Road fuel demand change for personal transport (2014 and 2040)



Modal Split (%) with respect to billion passenger kilometers



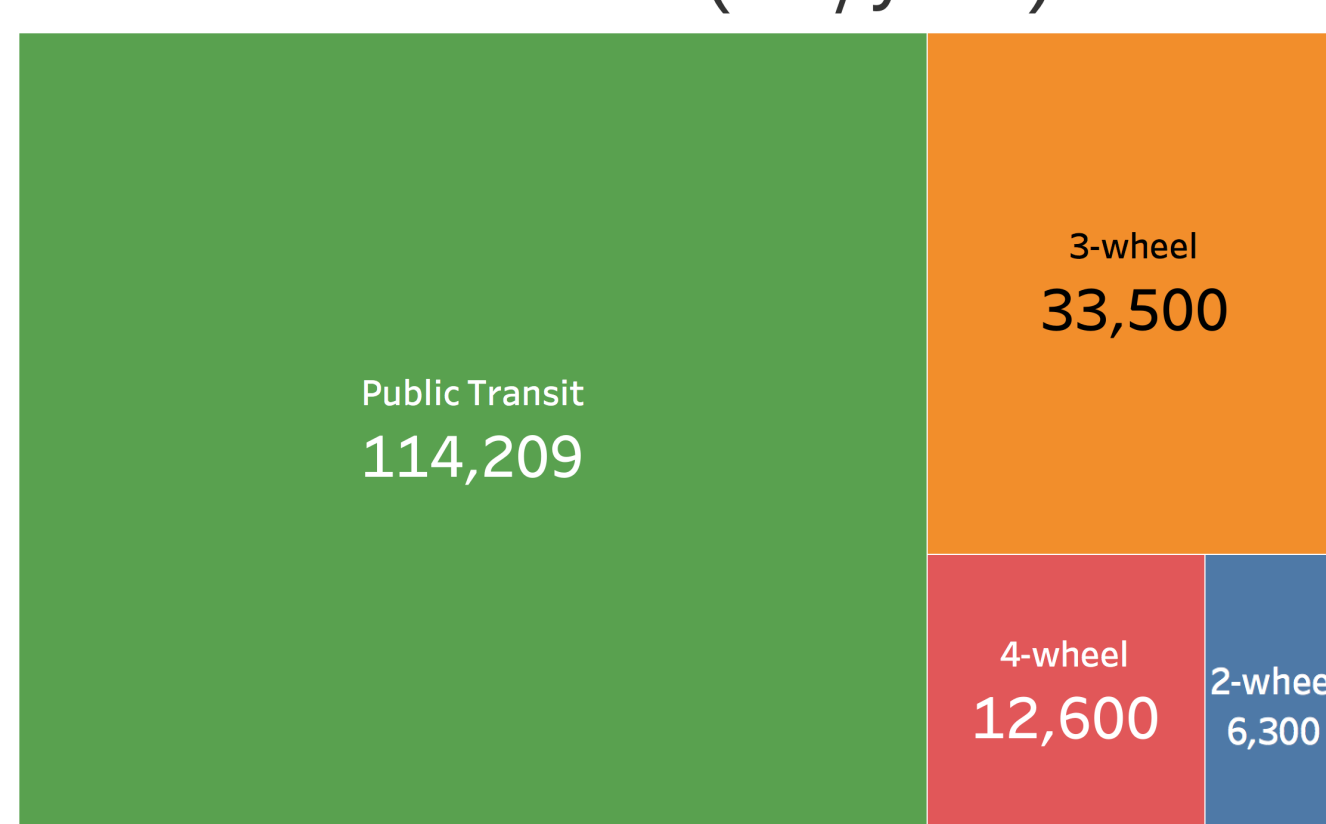
% of households with 4-wheeler



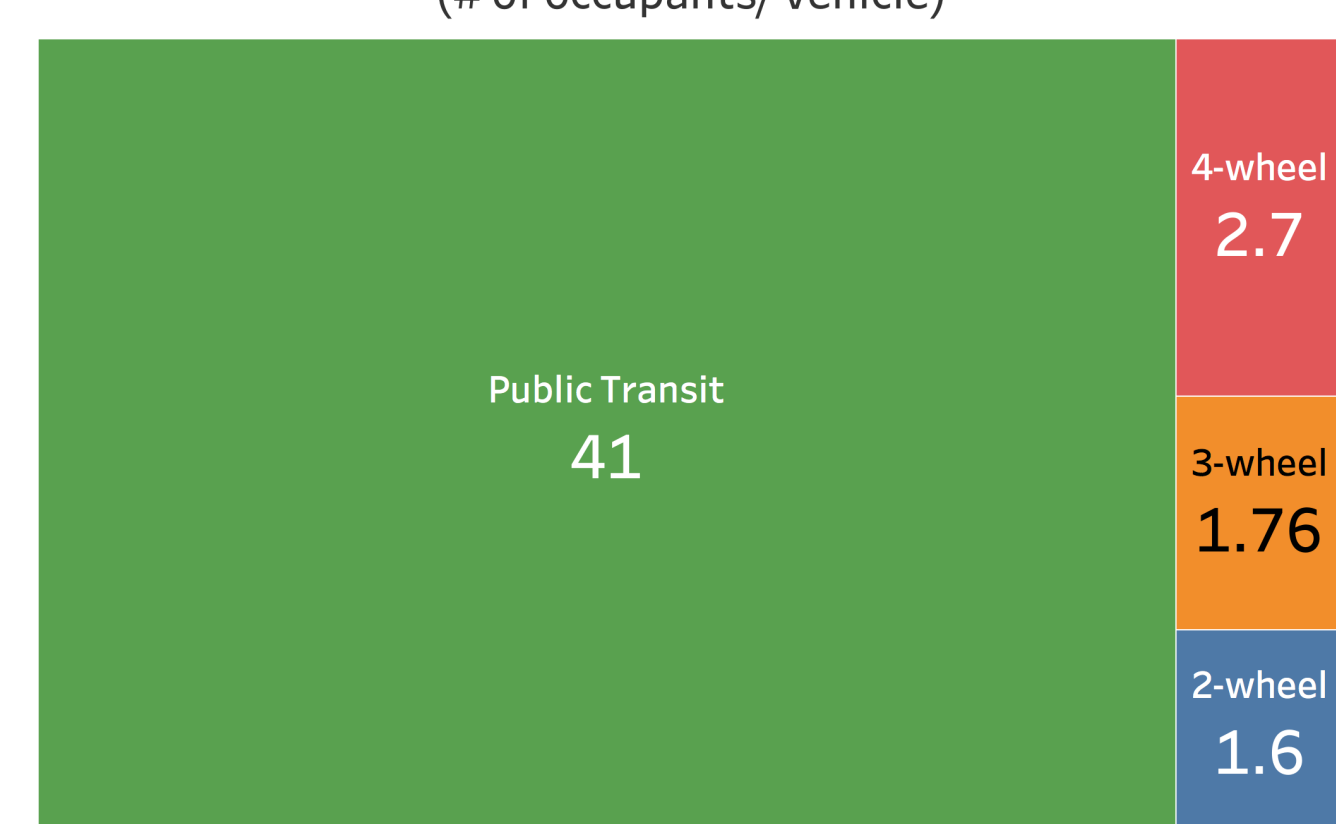
- Apart from having big share of Non-motorized mode of transport, India is known for large number of 2-wheelers
- If we focus on 4 wheeled passenger LDVs, % passenger miles traveled is significant now and will be even more in future overtaking the 2 wheelers and 3 wheelers combined considering BAU (Business As Usual scenario- RMI and NITI Aayog Report 2017)
- LDVs are doing well in terms of Specific Energy Consumption which is explained by better utilization and relative higher occupancy of the vehicles.

Comparing passenger LDVs with other motorized modes

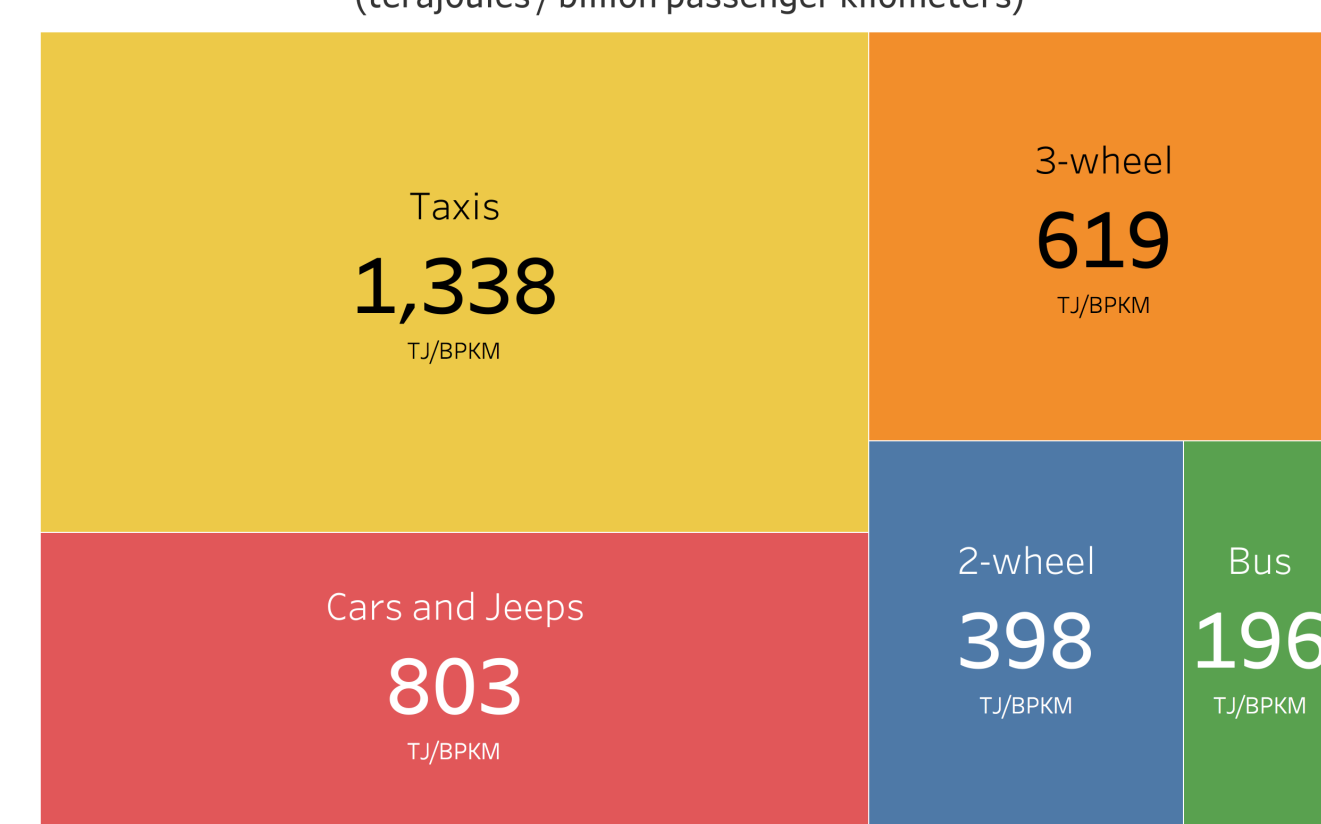
Utilization (km/year)



Occupancy by mode (# of occupants/vehicle)

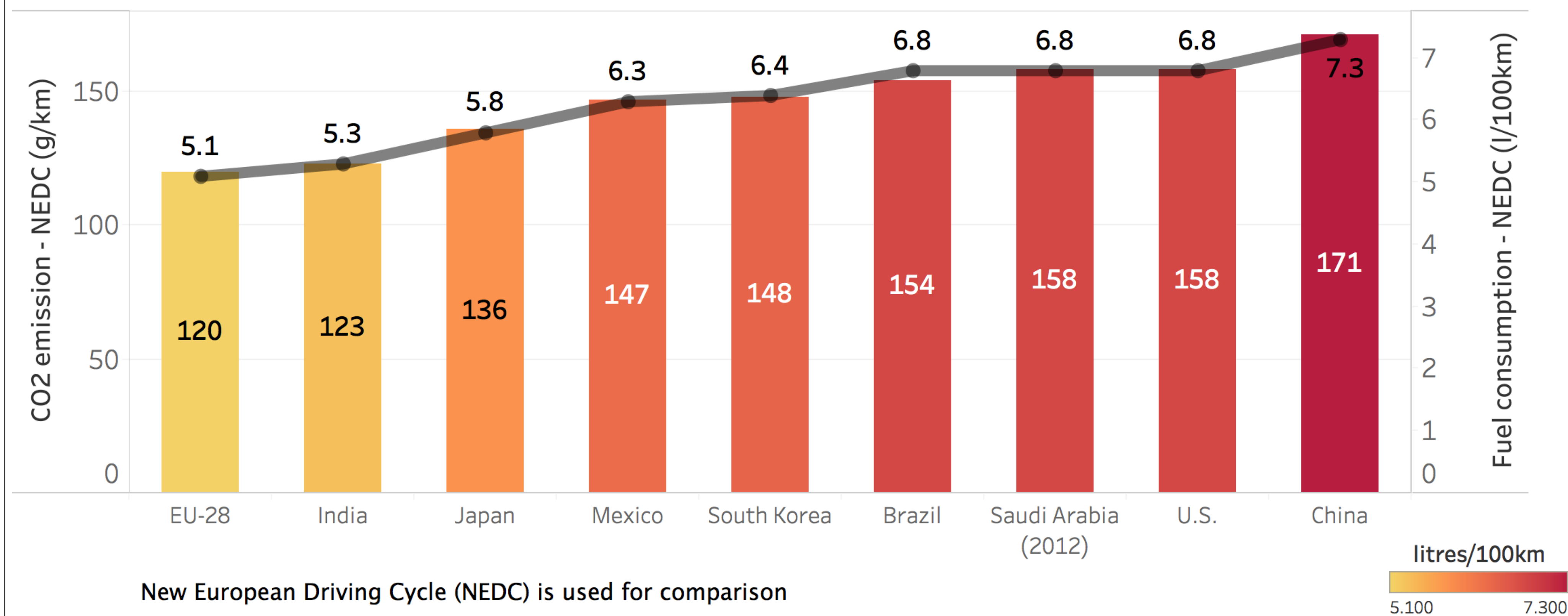


Specific Energy Consumption (terajoules / billion passenger kilometers)



Assessing Indian Passenger Car Fleet

Emission Intensity and Fuel consumption values of Passenger Cars



- ICCT came up with a methodology to compare values in major countries, using a common test cycle (NEDC)
- Though there are gaps in the actual real world numbers and test cycle results, it's a good way to compare
- India's car fleet is fuel efficient and less carbon intensive, needs to keep following stricter regulations.

Historic Performance

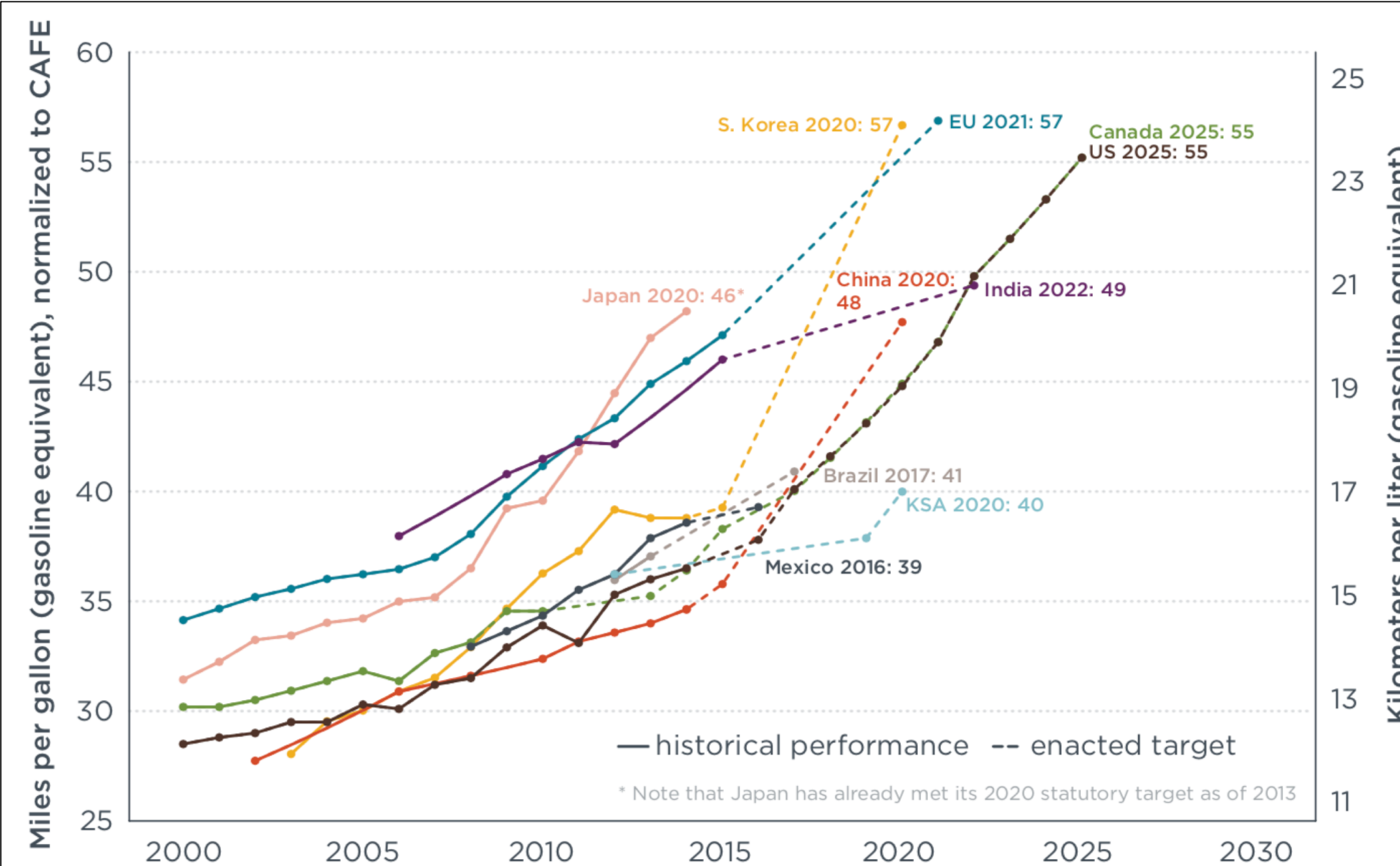


Figure 4. Historical fleet CO₂ emissions performance and current standards (mpg normalized to U.S. CAFE test cycles) for passenger cars

- **BSES (Bharat Stage Emission Standards)** : Regulates vehicular pollution emissions
 - Regulates pollutants HC, CO, NO_x, and PM to all new vehicles (nationwide since April 2017)
 - Leapfrogged: BS VI standards will be applied, skipping V, to all new vehicles nationwide starting in April 2020
- **CAFC (Corporate Average Fuel Consumption)** : Regulates fuel economy, Similar to CAFÉ
 - Considers sale weighted average FE for all car manufacturers; 130 gCO₂/km in April 2017 & 113 gCO₂/km in April 2022, equivalent to a nominal percent reduction of 13% over this period.
- **Electrification programs**: No official policy. Goal of 100% EV sales reduced to initial 30% 2030
 - FAME scheme extended which provides subsidies to the hybrid and electric vehicles.
 - City regulators are planning and/or already buying electric vehicle fleets (buses, auto-rickshaws)

Policies in place

Although the authority of the Indian government to set vehicle emissions standards was codified in 1988, it was in 2003 that India implemented the Bharat standards, which parallel the Euro standards. India currently applies the equivalent of Euro 4/IV to new light-duty, heavy-duty, and two- and three-wheeled vehicles, and will introduce the equivalent of Euro VI for all new on-road vehicles in 2020. Previous Bharat standards were introduced earlier in select major cities. India has also adopted nationwide fuel efficiency standards for light-duty vehicles called CAFC (Corporate Average Fuel Consumption). Recently multiple ZEV schemes have come up both at national, state and city level.

Next steps and research questions added

- Analyze consumer behavior of the purchasers and users of fuel efficient and battery-electric cars
- To what extent Indian consumers' preference for low cost car affect the market. Is it the most important market signal which drives the auto industry to improve fuel economy? Even more than regulatory policies?
- Comparing real world numbers (economy and emissions intensity) with lab results to find if the comparison we did here make sense. And Compliance?
- Checking effectiveness of current policies to support electrification of the LDVs.