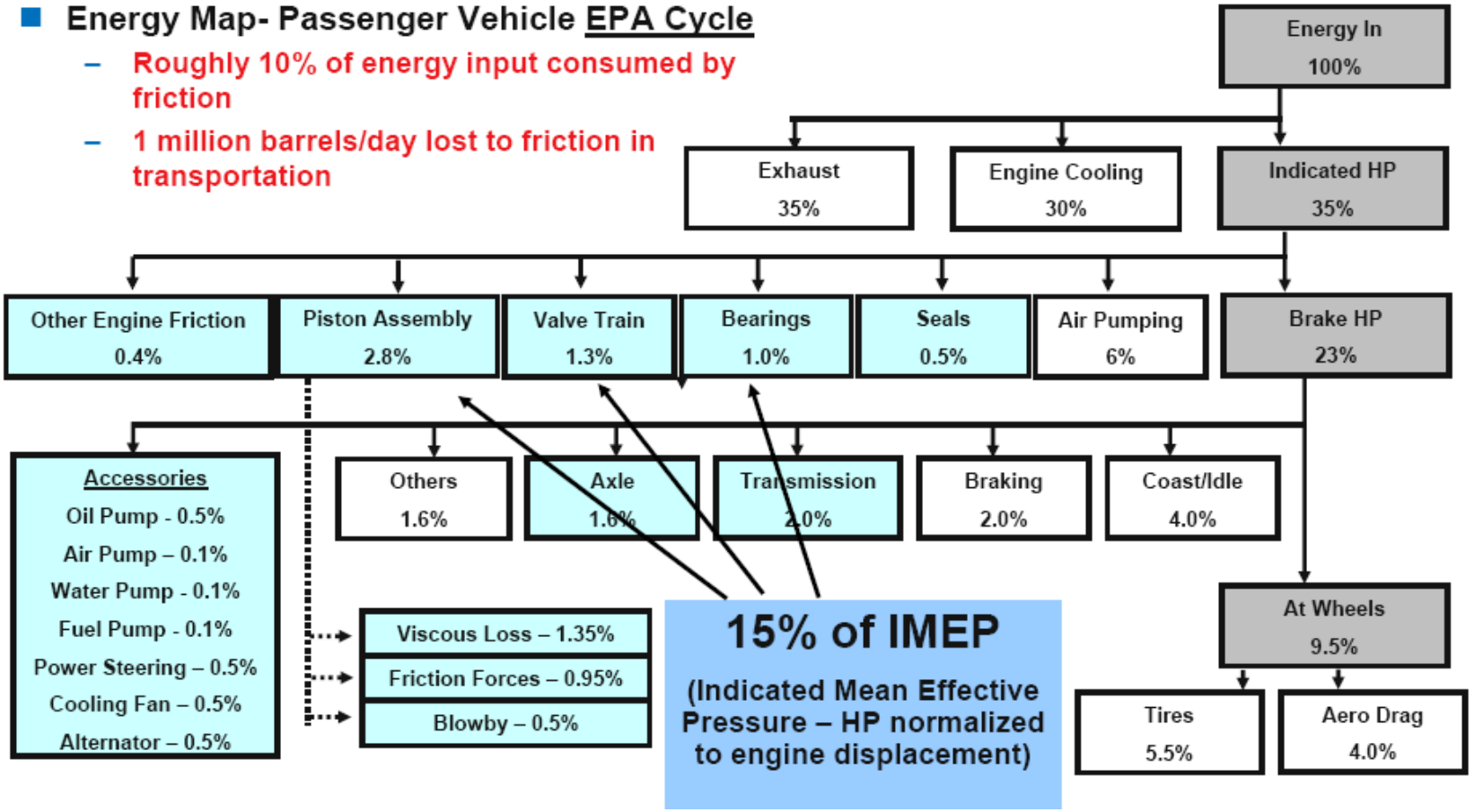
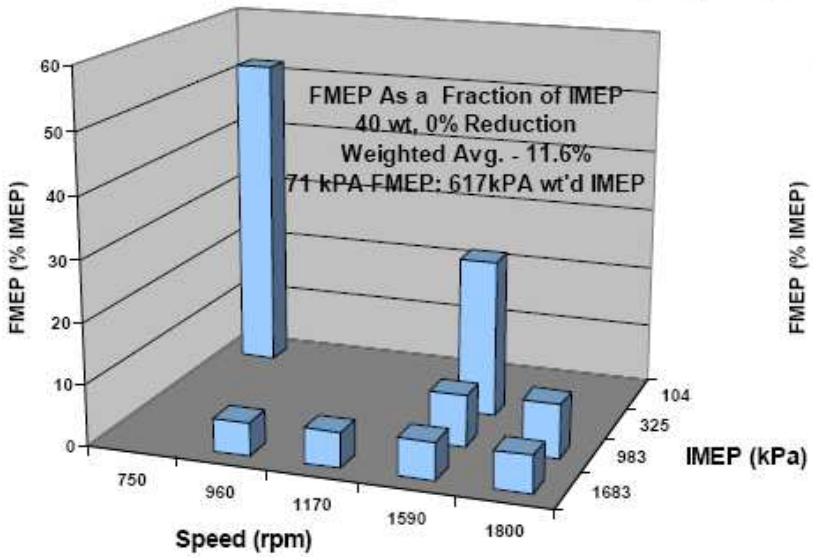
How Much of the 10-11 MBBL/day of Petroleum Used for On-Road Vehicles is Lost to Friction? - More Energy is Lost to Friction Than is Delivered to the Wheels

- **Energy Map- Passenger Vehicle EPA Cycle**
  - Roughly 10% of energy input consumed by friction
  - 1 million barrels/day lost to friction in transportation



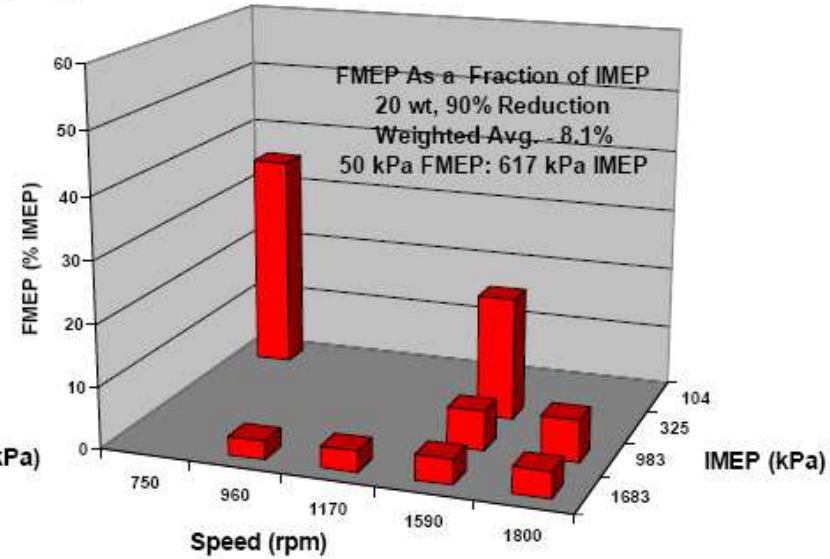
Friction Losses are Greatest (Relative to Engine Power) at Low Speeds and High Loads - Forward-Predictive Modeling

- Under idle conditions, over 50 % of energy consumed to overcome friction (boundary and viscous) - pumping losses account for the balance



40 Weight Oil

71 kPa FMEP compared to 617 kPa IMEP



20 Weight Oil, 90% Reduction in Boundary Friction

50 kPa FMEP compared to 617 kPa IMEP

30 % reduction in FMEP (71 to 50 kPa)

21 kPa reduction in FMEP represents 3.5% of IMEP - or an increase of 3.5% in fuel economy