**Variability in Vehicle Energy Use and Emissions Based on Cycle Average Speed and Vehicle Specific Power**

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Since 2008, we have collected data on the energy use and emissions of over 200 light duty gasoline vehicles using Portable Emission Measurement Systems. Each vehicle was measured for approximately 12,000 seconds of driving on a predetermined 110 mile path that includes four roundtrip routes and posted speed limits ranging from 25 mph to 70 mph. From these data, we have developed models of vehicle fuel use and CO2, CO, HC, and NO emission rates based on vehicle specific power (VSP) and the operating mode (OpMode) bins used in the EPA MOVES model. From these data, we are able to quantify over 800 round-trip driving cycles. We compare tailpipe exhaust emission models developed based on 14 VSP modes to those developed based on the EPA OpModes in terms of comparability in predicting cycle average emission rates. The 14 mode VSP modeling approach produces cycle average emission rates highly comparable to those of the EPA OpMode approach. We assess real-world trends in cycle average emission rates as function of cycle average speed and vehicle emission standards. The results illustrate that fuel use and CO2 emission rates are sensitive to cycle average speed but also depend on the frequency distribution of VSP. On average, NO emission rates of Tier 3 vehicles are much lower than for Tier 2 vehicles, which in turn are much lower than for Tier 3 vehicles, and the NO emission rates tend to have less relative sensitivity to cycle average speed than CO2 emission rates. Although Tier 2 and Tier 3 vehicles have lower CO emission rates than Tier 1 vehicles, the CO emission rates of Tier 2 and Tier 3 vehicles are similar to each other. Furthermore, for Tier 2 and Tier 3 vehicles, CO emission rates are far more sensitive to the distribution of VSP than to cycle average speed. These results indicate the real-world effectiveness of Federal emission regulations and the variability in real world emissions related to power demand and driving cycles. Implications of variability in emission rates for emission hotspots and exposure to traffic-related air pollution are briefly discussed.