

# Updates to MOVES Vehicle Activity

FACA MOVES Review Workgroup

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The word "MOVES" is displayed in a stylized, metallic, three-dimensional font with a glowing effect, set against a dark, gradient background.

# Activity Update Overview

- **New 2011 base year.**
- **Average speed distributions.**
- **Monthly VMT fractions for motorcycles.**
- **Ramp average speeds.**
- **Heavy duty truck driving schedules.**
- **Multi-day diurnals.**
- **State provided data.**

## 2011 Base Year

- **1990 and 1999 are the base years currently available in MOVES2010.**
  - Calendar years 1991 through 1998 cannot be modeled using MOVES.
- **Vehicle populations and miles traveled are grown from the base years to other evaluation years using growth factors.**
- **Calendar years 1999 through 2011 are now historical years and no longer need projections.**

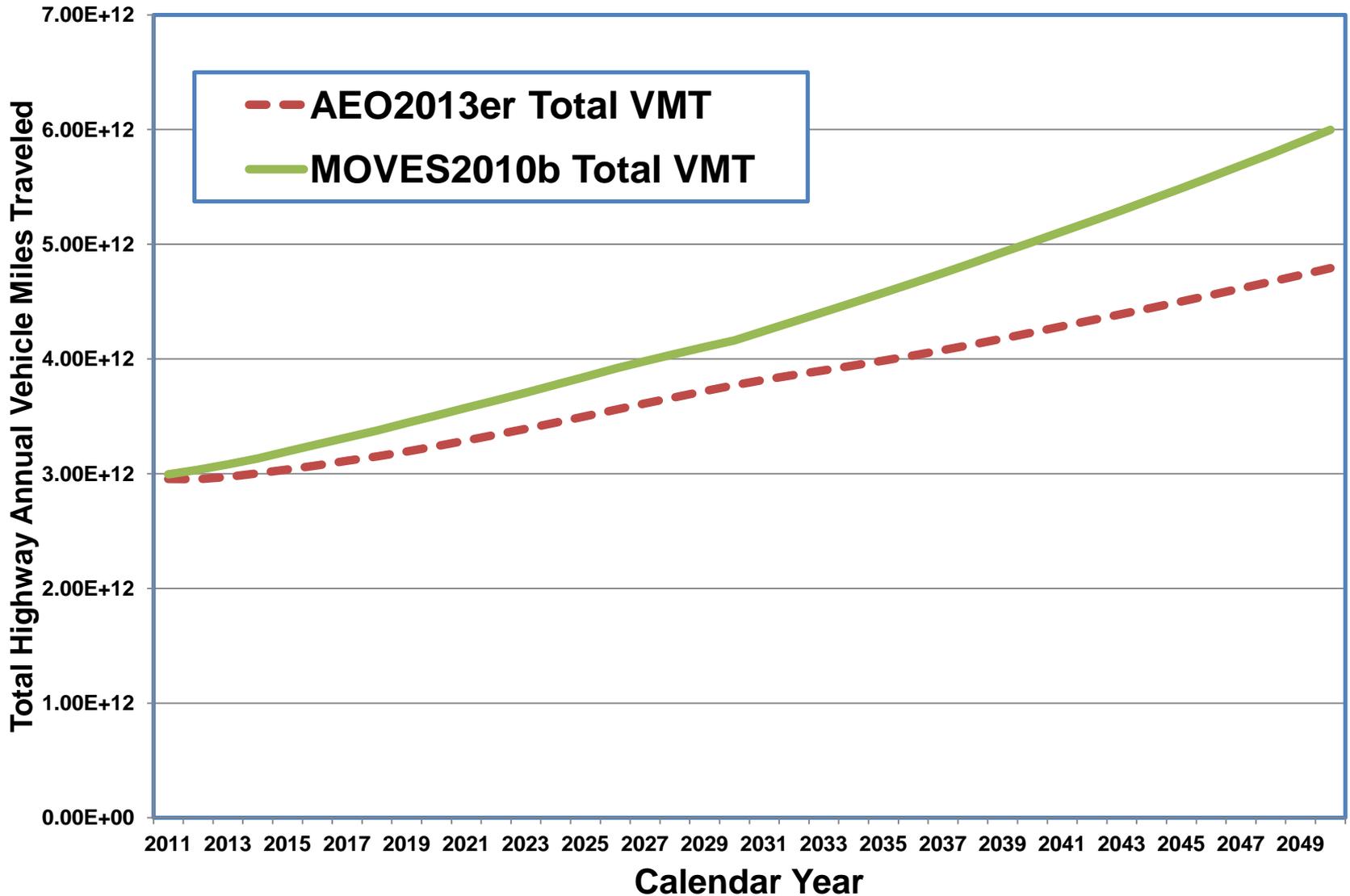
# Base Year Required Data

- **Annual vehicle miles traveled (VMT).**
  - By HPMS vehicle classes.
- **Vehicle populations.**
  - By MOVES source types.
- **Vehicle age distributions.**
  - By MOVES source types.

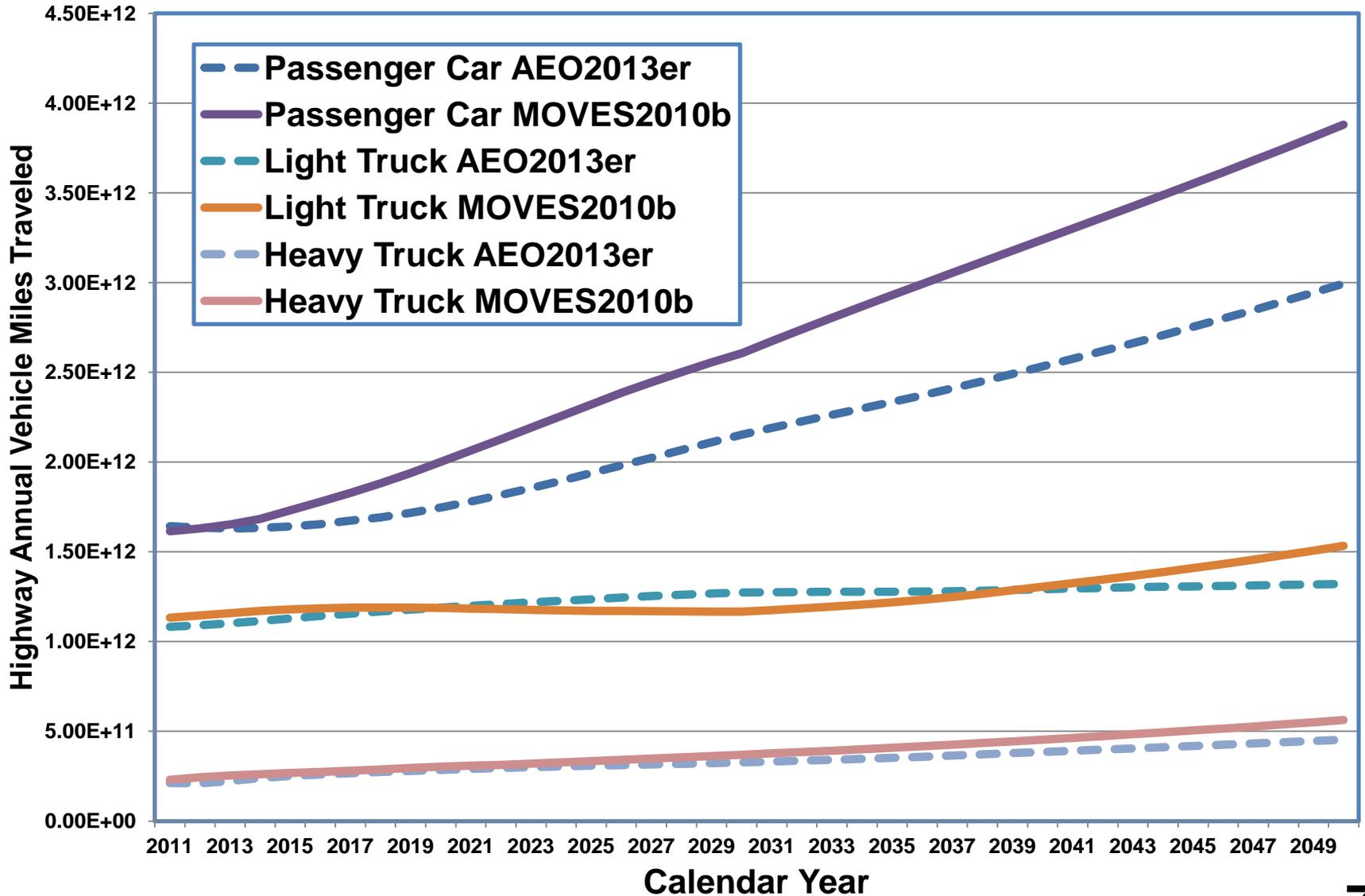
## VMT Data Sources

- **Historic vehicle miles traveled taken from Federal Highway Administration Highway Statistics.**
- **Projections taken from the US Energy Information Administration Annual Energy Outlook (AEO) early release.**

# Total Highway Vehicle Mileage Projections



# Highway Vehicle Mileage Projections by Vehicle Type



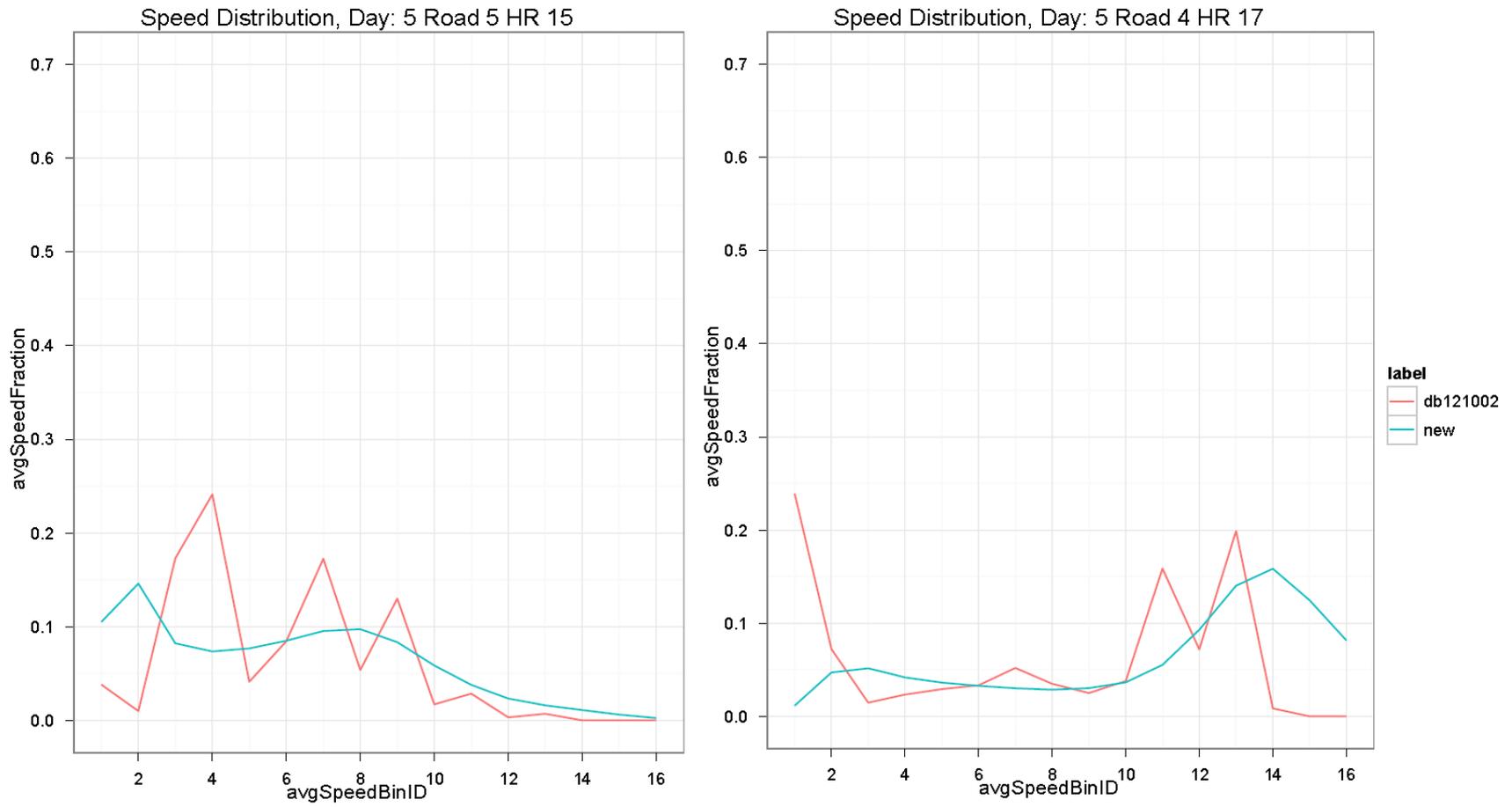
# Average Speed Distributions

- **Current average speed distributions are based on travel demand models from a 1999 analysis.**
- **Instrumented vehicles can provide more up-to-date and detailed vehicle behavior.**
- **EPA has purchased summary information from thousands of Tom-Tom GPS users which show average speeds by road type and hour of the day.**

# Calculating Average Speeds

- **GPS data stores time and location.**
- **Time and distance were calculated for each vehicle on individual roadway segments.**
- **The times and distances are summed over the roadway types for each hour of the day.**
- **Average speed (distance divided by time) is calculated from the time and distance sums.**

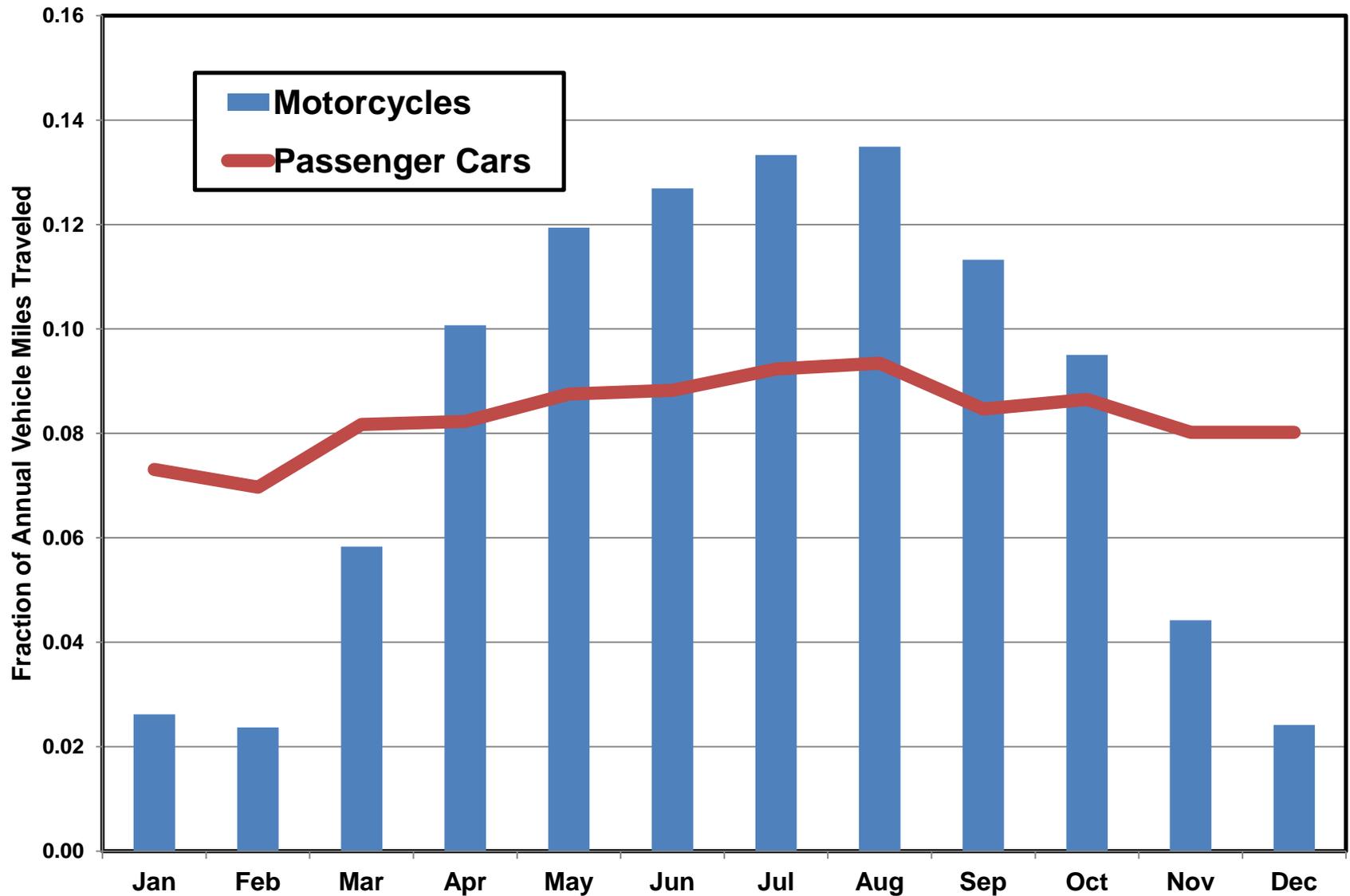
# Comparison of Example Average Speed Distributions



# Month VMT Fractions

- **Month VMT fractions account for season variation when distributing annual VMT to months.**
  - FHWA does not track motorcycle VMT separately.
  - Currently, passenger car month VMT fractions are used for motorcycles.
  - Motorcycle VMT is expected to vary significantly seasonally.
- **Bureau of Transportation (2010) crash statistics were used to develop seasonal allocations for motorcycle VMT.**

# Comparison of Passenger Car and Motorcycle Allocations

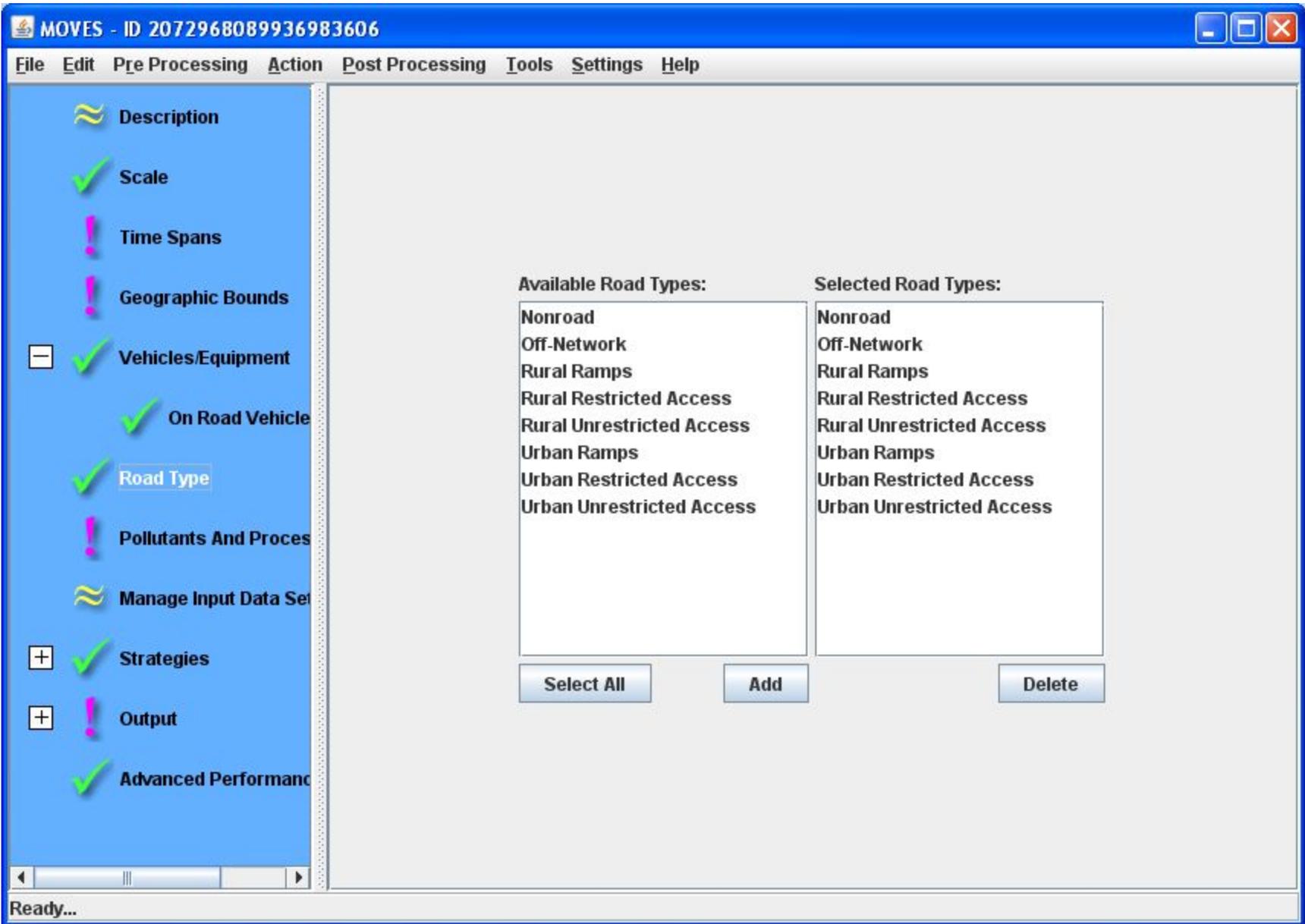


## Ramp Average Speeds

- **Urban and rural restricted access roads (freeways) have separate calculations for the impact of ramps on emissions.**
- **Currently a single average ramp speed is calculated from the average speed distribution for each road type.**
- **User input can adjust the default fraction of time vehicles spend on ramps.**
- **There is no separate ramp output.**

## New Ramp Output

- A separate ramp emissions calculation will now be done for each average speed bin.
- Each of the 16 average speed bins has a pre-determined operating mode distribution for ramps.
- Ramp emissions can now be reported separately in the output by road type and average speed bin.



# Heavy Duty Truck Driving Schedules

- Emissions are calculated for each of the 16 average speed bins using driving schedules.
- Where driving schedules are not available, operating mode distributions are interpolated.
- Operating modes are *\*not\** extrapolated. The nearest available schedule is used.
- Adding driving schedules at the low and high end will allow explicit calculation.

# Driving Schedule Map

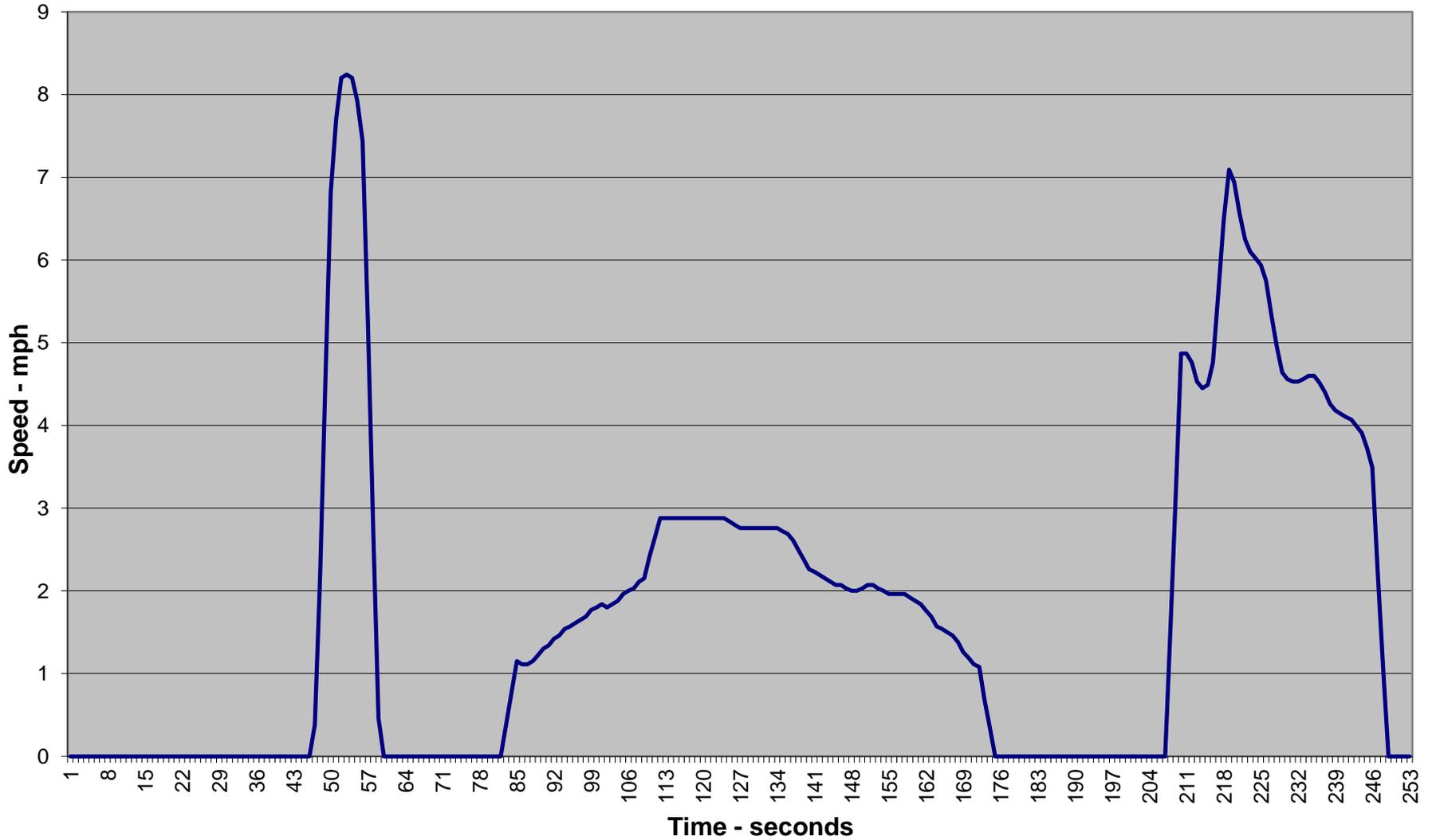
Source	Min Speed (mph)	0	2.5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
Type	Max Speed (mph)	2.5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	100
11	Motorcycle		Grey	Grey	Grey		Grey			Grey	Grey		Grey	Grey		Grey		
21	Passenger Car		Grey	Grey	Grey		Grey			Grey	Grey		Grey	Grey		Grey		
31	Passenger Truck		Grey	Grey	Grey		Grey			Grey	Grey		Grey	Grey		Grey		
32	Light Commercial Truck		Grey	Grey	Grey		Grey			Grey	Grey		Grey	Grey		Grey		
41	Intercity Bus	Orange	Orange	Orange			Grey			Grey		Grey	Grey			Grey		Orange
42	Transit Bus	Orange	Orange	Orange		Grey	Grey			Grey	Grey		Grey			Grey		Orange
43	School Bus	Orange	Orange	Orange		Grey	Grey			Grey	Grey		Grey			Grey		Orange
51	Refuse Truck		Grey	Grey			Grey			Grey	Grey				Grey	Grey		Orange
52	Single Unit Short-haul Truck	Orange		Grey				Grey		Grey		Grey	Grey			Grey		Orange
53	Single Unit Long-haul Truck	Orange		Grey				Grey		Grey		Grey	Grey			Grey		Orange
54	Motor Home	Orange		Grey				Grey		Grey		Grey	Grey			Grey		Orange
61	Combination Short-haul Truck	Orange	Orange				Grey			Grey	Grey				Grey	Grey		Orange
62	Combination Long-haul Truck	Orange	Orange				Grey			Grey	Grey				Grey	Grey		Orange

Orange boxes indicate areas without driving schedules that would require extrapolation. Grey squares indicate average speed bins without explicit driving schedules and require interpolations.

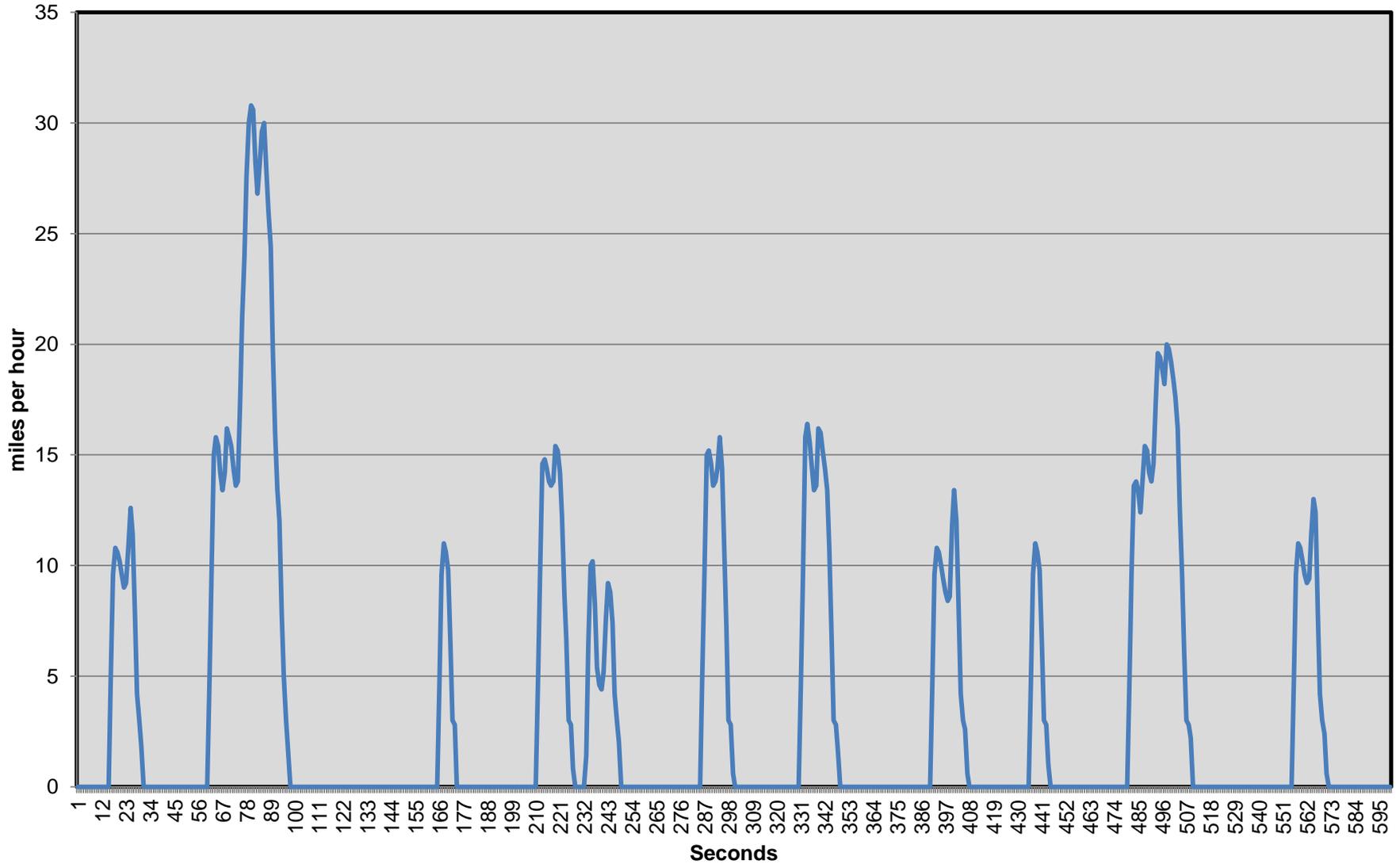
# New Driving Schedules

- **Modified HHDDT Creep Mode Cycle (1.8 mph).**
- **New York City Bus Cycle (3.7 mph).**
- **Washington Metro Area Transit Authority Bus Cycle (8.3 mph).**
- **Modified EPA HD High Speed Freeway Driving Schedule (76.7 mph).**
- **Modified EPA MD High Speed Freeway Driving Schedule (77.8 mph).**

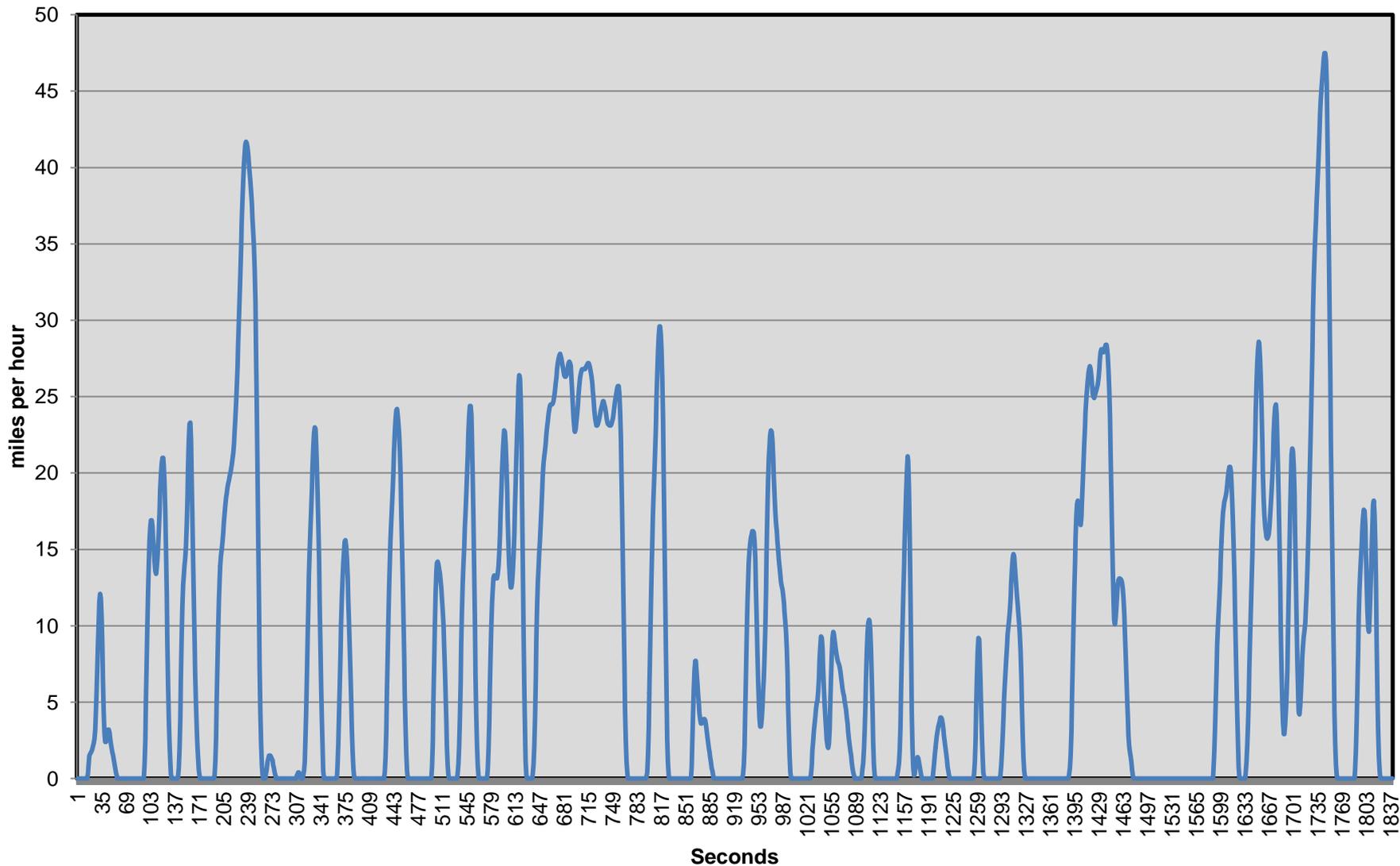
# Modified HHDDT Creep mode cycle (1.8 mph)



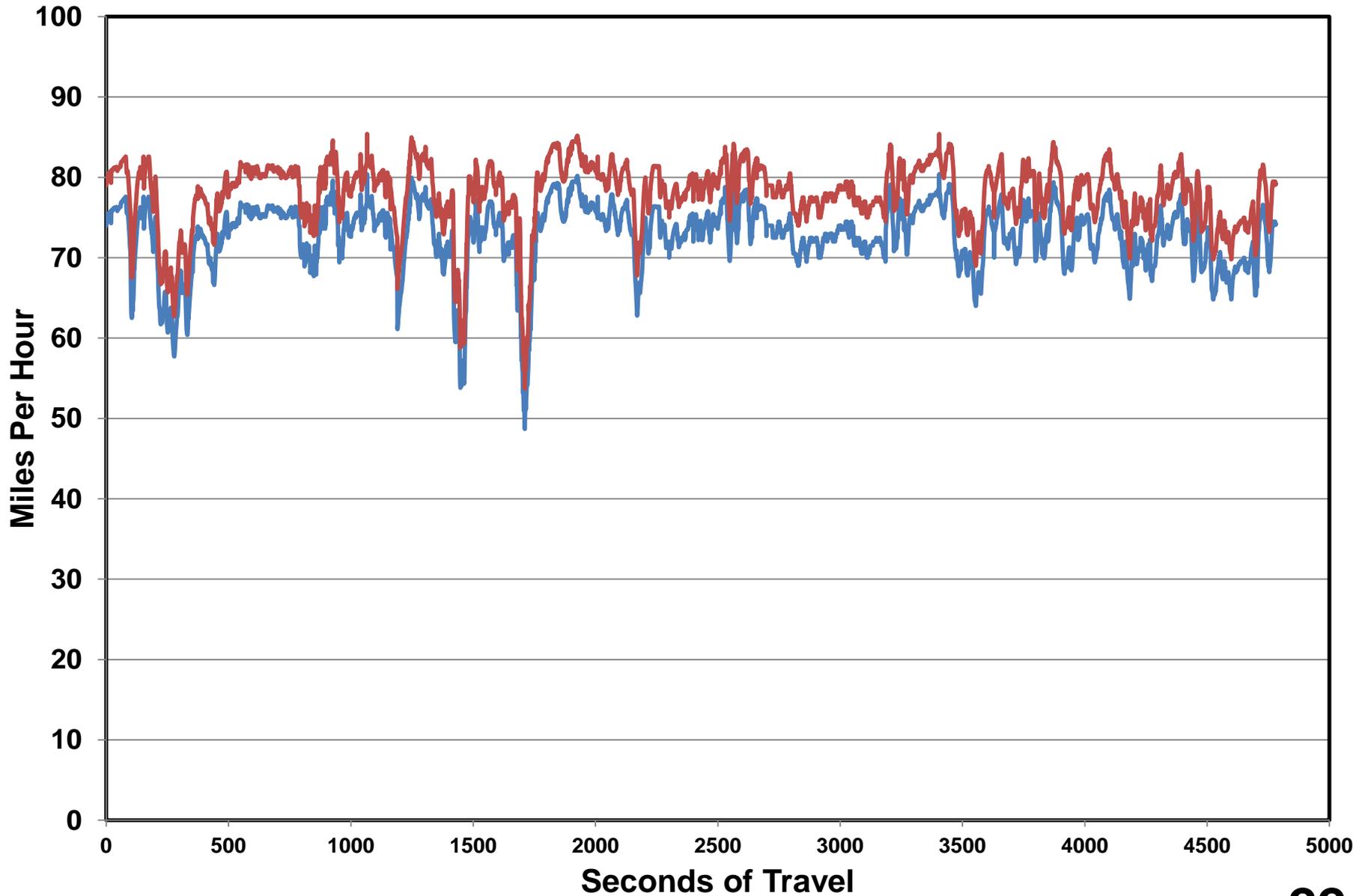
# New York City Bus Cycle (3.69 mph)



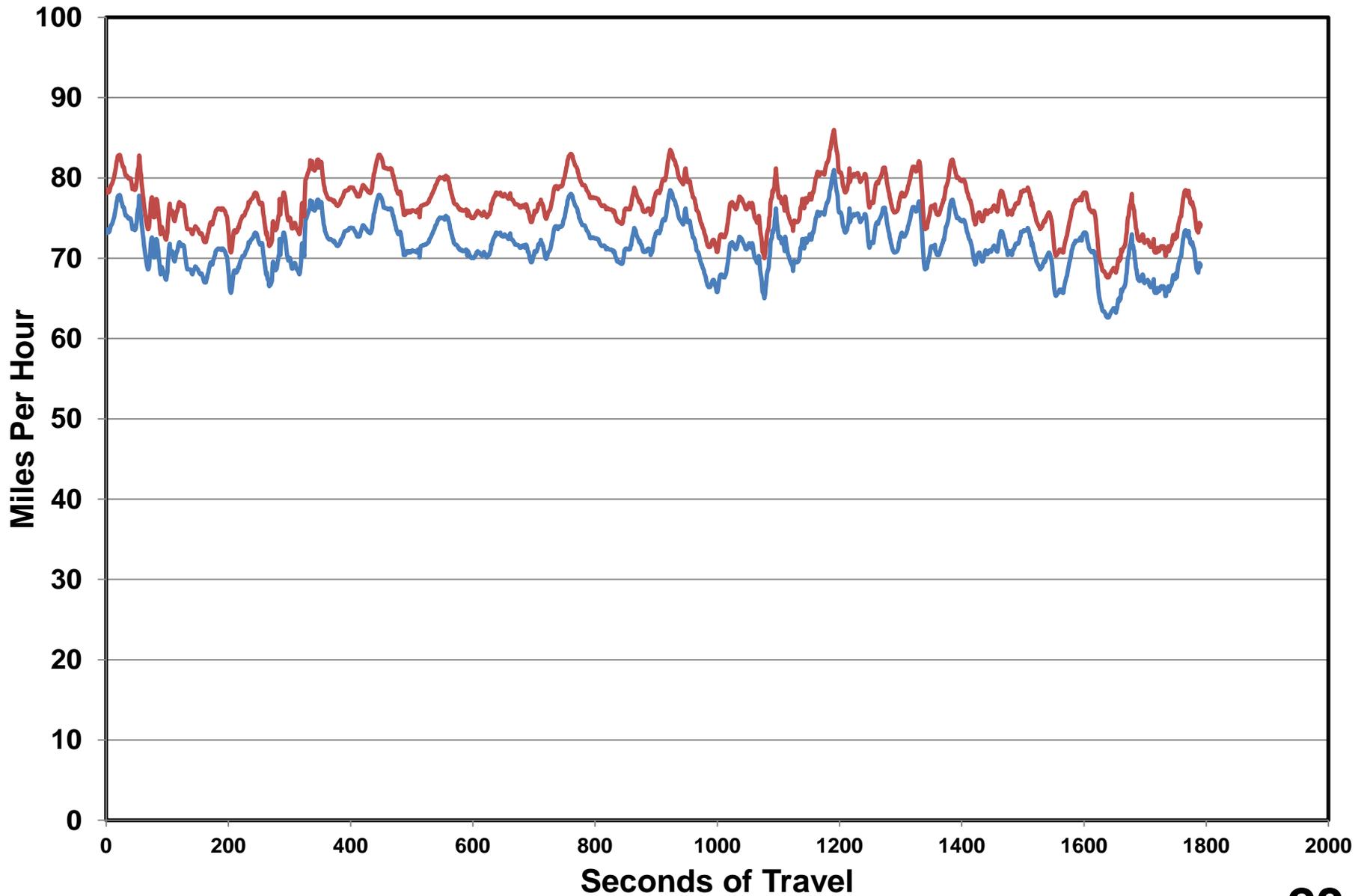
# Washington Metro Area Transit Authority Bus Cycle (8.3 mph)



# MD High Speed Freeway Driving Schedule (72.8 & 77.8 mph)



# HD High Speed Freeway Driving Schedule (71.7 mph & 76.7 mph)



## Multi-Day Diurnals

- Previous versions of MOVES assume only single day diurnal evaporative emissions.
- MOVES will now calculate emissions for vehicles which do not take trips for multiple days. This will affect evaporative emissions from parked cars.
- The recent Georgia Tech study suggests that at least 8% of passenger vehicles are not driven for at least 5 days at a time.

## Soak Distributions

- At the beginning of the day, all vehicles are beginning a new soak “day”.
- Each trip begins a new soaking period for vehicles.
- Vehicles which do not start during a day become “multi-day” diurnal vehicles passed on to the next day.
- The fraction of vehicles soaking 1, 2, 3, 4 and 5 or greater are determined from the vehicle trip samples contained in the MOVES database.

# Sample Vehicles

- **In MOVES, trip and soak time information is calculated from a table with a sample of vehicles.**
  - Any vehicles not taking trips in a particular hour of the day are soaking.
  - Some sample vehicles take no trips in a day are experiencing “multi-day” diurnals.
- **The number of vehicles not taking trips in the MOVES SampleVehicleDay table was increased to match the GA Tech result:**
  - 72 “no trip” Passenger cars added to 1,096 vehicles.
  - 28 “no trip” Passenger trucks added to 1,177 vehicles.

## State Provided Data

- **MOVES is designed to use county specific values provided by users.**
- **The 2011 National Emission Inventory project has collected 1,482 county specific databases from states containing county specific values.**
- **State supplied county databases are now being used for calculating national inventories in support of EPA rules.**
- **State supplied information can be used to update and validate default MOVES data.**

# Types of State Supplied Data

- Allocation of VMT to counties, road types and vehicle types.
- Vehicle populations and age distributions.
- Average speed distributions.
- Monthly and hourly VMT distributions.
- I/M and Stage II program descriptions and coverage.
- Local fuel program descriptions and coverage.

**Questions?**