



Telematics and MOVES

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MOVES Review Work Group

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MOVES Activity Defaults

- MOVES default activity parameters are primarily nation wide averages.
- States are instructed to replace MOVES defaults with local data whenever possible.
- EPA uses MOVES defaults when detailed county-specific analysis is not practical.
- Telematics data will be used primarily to improve the default national averages.



Telematics Data

- Telematics refers to any technology that provides a continuous stream of vehicle activity data.
- Challenges include:
 - Providing privacy for vehicle owners.
 - Processing massive amounts of data.
 - Potential bias in self selecting samples.
- Opportunities include:
 - Detailed region-specific activity.
 - Extremely large samples.
- EPA is working with three telematics data sets: Verizon, NREL and CE-CERT.



Analysis Issues

- Screening to eliminate bad data.
- Identify and account for variations.
 - Which factors significantly affect results?
 - Are regional differences important?
 - Are seasonal differences necessary?
- Identify and account for potential vehicle selection bias.
 - Do samples include a sufficient number of seldom used and inactive vehicles?
- Some vehicles enter and leave the data collection during the sampling period.



Verizon Light-Duty Telematics

- Data collected for management of vehicles and fleets.
- Contracts with: State Farm, Mercedes-Benz and Volkswagen.
- Customers can consent to monitoring
 - Participants are offered incentives
- EPA purchased data from CA, CO, GA, IL & NJ.
 - Data spans August 2015 through August 2016.



Verizon Telematics Data

- Vehicle Information
 - Make, model, model year
 - Place of residence (zip code only)
- Trip Information
 - Date, time, length
 - Urban (MSA) or rural based on owner residence.
 - Vehicle/engine speed distribution summary
 - Load distribution summary
- Data is limited to 1996 and newer model year vehicles with on-board diagnostic capability.



Verizon Data Sample

State	Total Trips (Original)	Total Trips (Idle)*	Total Trips (Soak Time & Starts)*	%Trips**
California	1,958,858	1,886,947	1,761,184	90%
Colorado	5,644,374	5,390,417	4,977,334	88%
Georgia	15,457,392	14,654,336	13,465,865	87%
Illinois	12,955,252	12,318,387	11,448,257	88%
New Jersey	5,139,506	4,947,792	4,615,346	90%

*Only valid trips included in Idle analysis. Only valid trips with previous recorded valid trips included in start and soak analysis.

** Percent of total trips remaining after all screening (starts divided by original total).

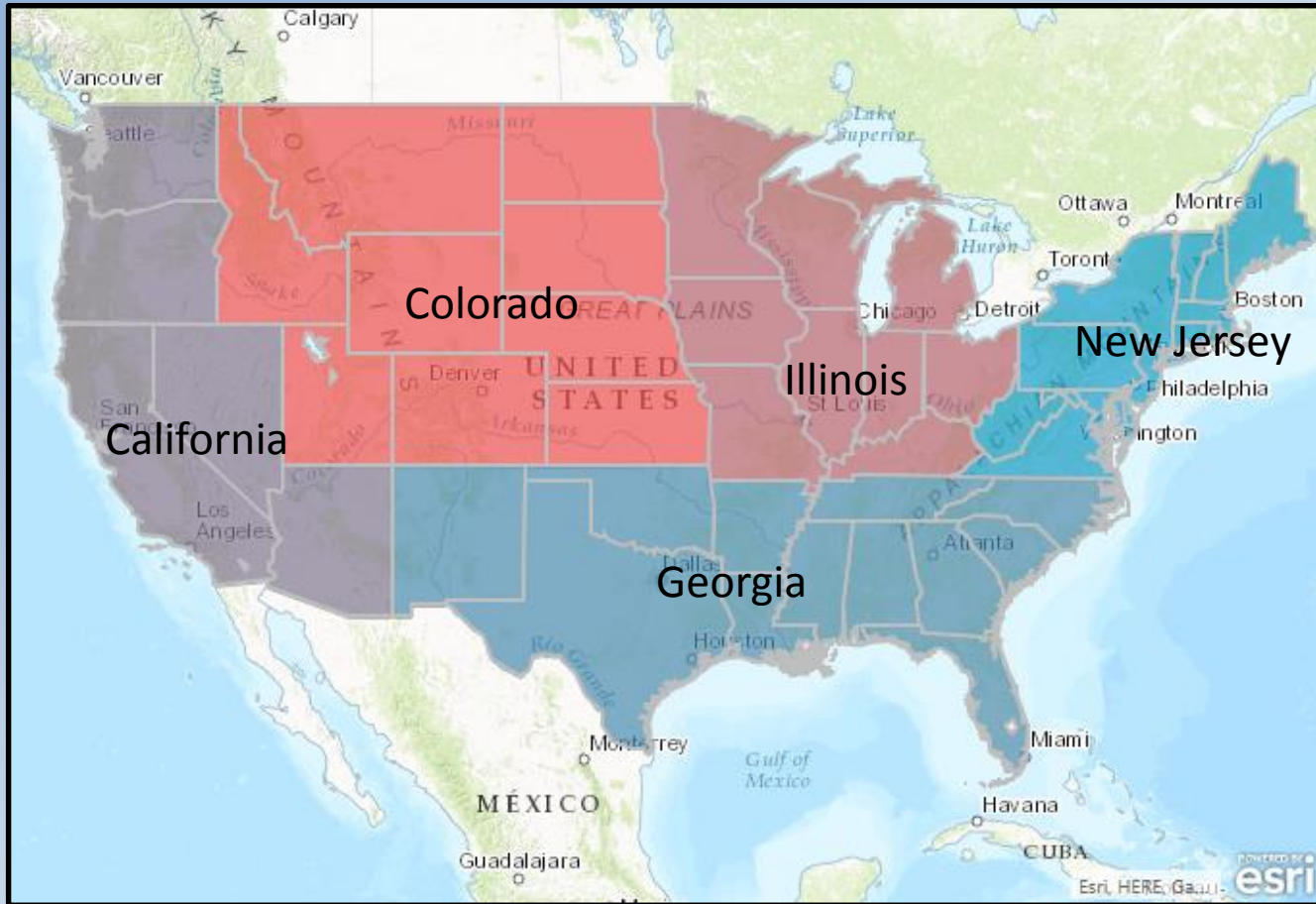


Target Analysis Variables

- Temporal allocation of vehicle miles traveled (VMT).
- Vehicle starts.
- Engine start soak time.
- Total idle time.



Proposed Default Regions for Weighting Light Duty Activity



With data from only 5 states, we associate them with nearby states to create (a) weighted national averages or (b) regional-specific values.

Alaska is associated with Colorado.
Hawaii, Puerto Rico and the Virgin Islands are associated with California.

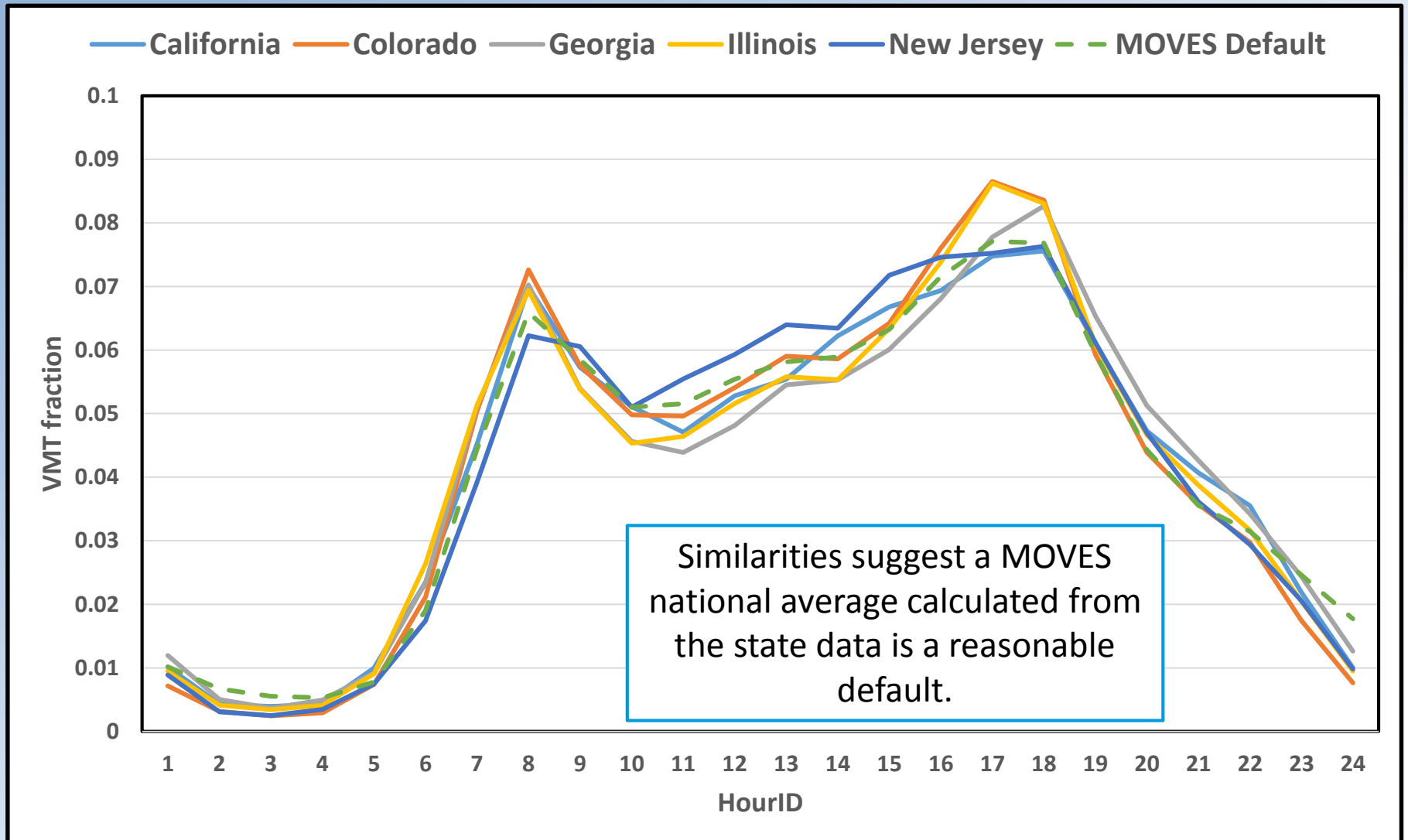


Hourly VMT Distribution

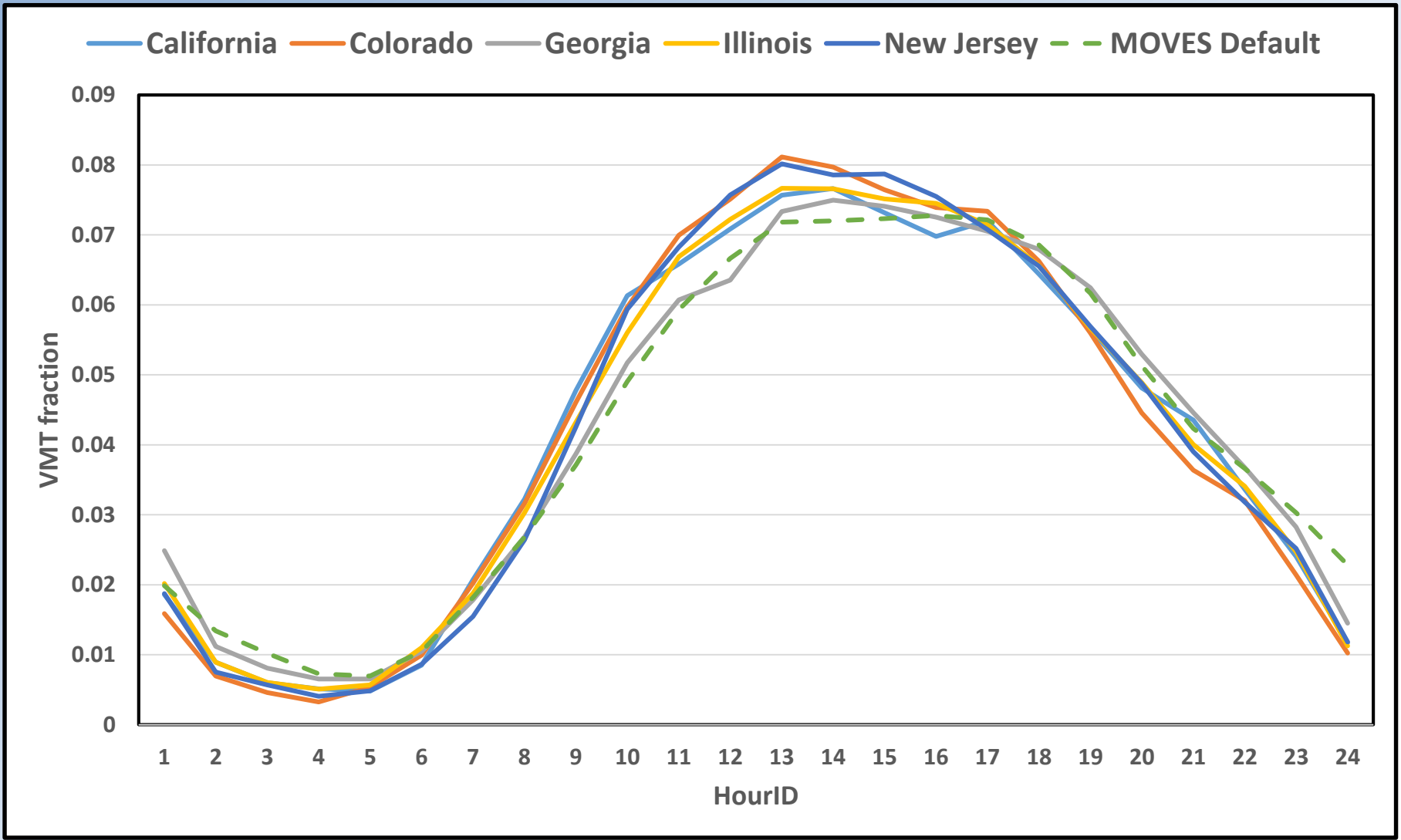
- MOVES assigns daily VMT to hours of the day using a distribution. The distribution can vary by:
 - Source Type
 - Day Type (Weekday or Weekend Day)
 - Road Type
- The default MOVES distributions do not currently vary by source type and the same distribution is used for both urban road types and both rural road types.
- Verizon “urban” includes only vehicles registered in MSA areas.



Verizon Hourly LDV Weekday Urban VMT Distribution



Verizon Hourly LDV Weekend Urban VMT Distribution



Vehicle Engine Starts

- MOVES2014 calculates the default number of starts per day per vehicle using trip information from a set of sampled instrumented vehicles distinguished by:
 - Source Type
 - Day Type (Weekday or Weekend Day)
- MOVES calculates the hourly distribution of starts from the trip information.
- MOVES2014 added the capability to add user-supplied:
 - Starts per day per vehicle.
 - Hourly start distribution.
 - Start adjustment for month of the year.

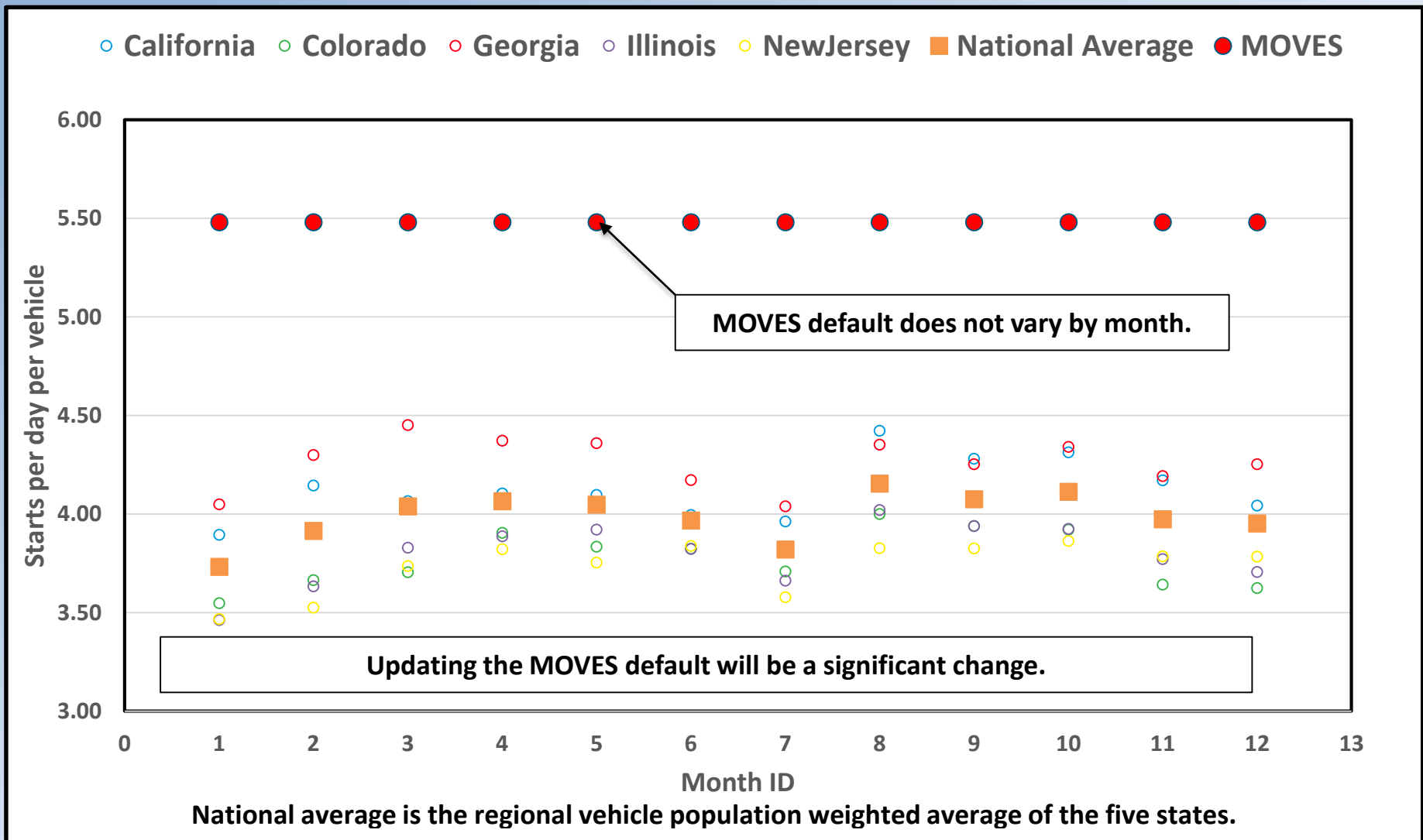


MOVES2014 Default Weekday Starts Per Day Per Vehicle

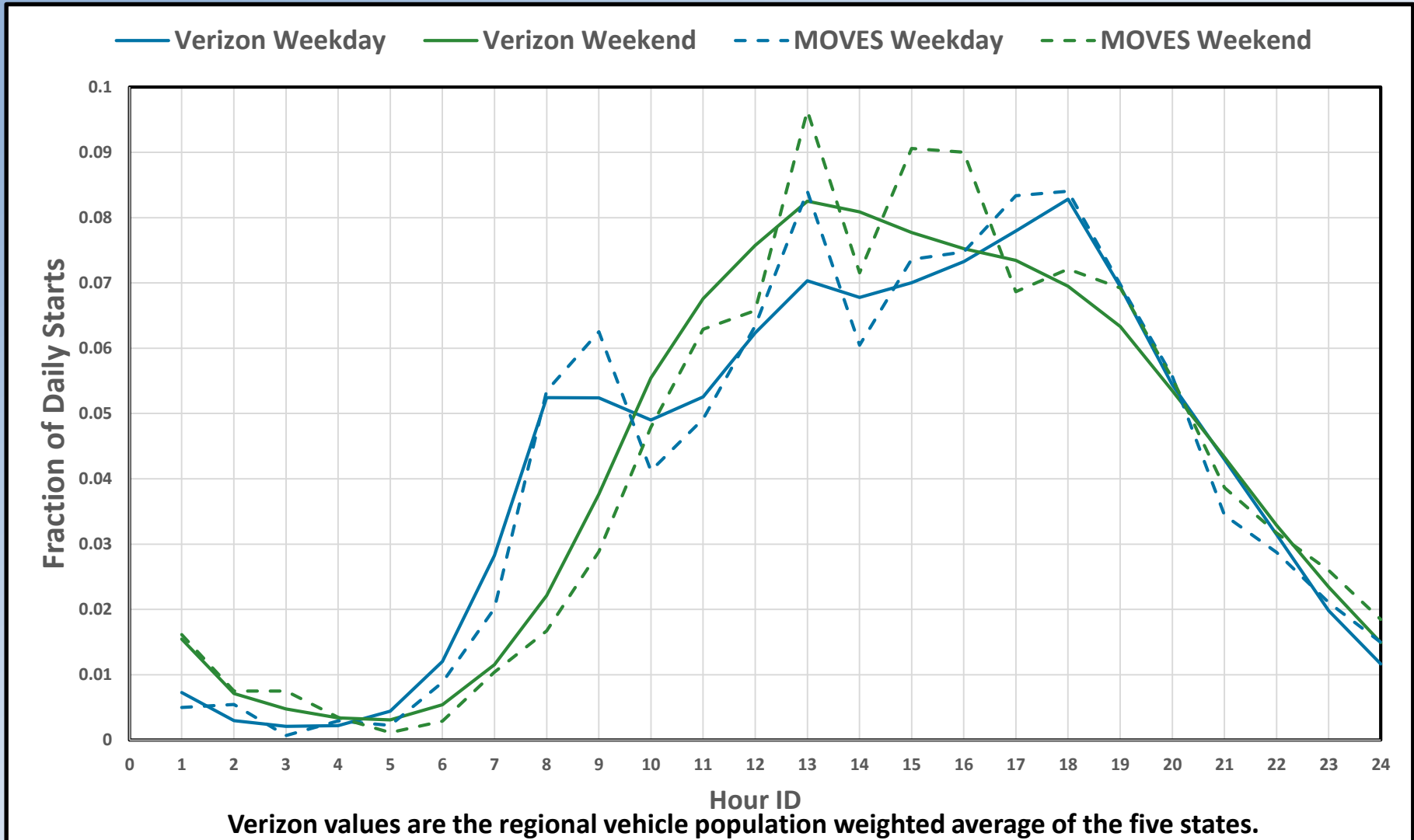
SourceTypeID	Description	Starts Per Day
11	Motorcycle	0.4
21	Passenger Car	5.5
31	Passenger Truck	5.5
32	Light Commercial Truck	6.0
41	Intercity Bus	2.7
42	Transit Bus	4.5
43	School Bus	5.6
51	Refuse Truck	3.4
52	Single Unit Short-haul Truck	6.7
53	Single Unit Long-haul Truck	4.2
54	Motor Home	0.5
61	Combination Short-haul Truck	5.4
62	Combination Long-haul Truck	3.8



Verizon Weekday LDV Starts Per Day Per Vehicle



Verizon National Average Temporal LDV Start Distributions



Soak Times in MOVES

- MOVES2014 calculates the default soak times using trip information from a set of sampled instrumented vehicles distinguished by:
 - Source Type
 - Day Type (Weekday or Weekend Day)
- In MOVES2014 these same soak times are used for calculations of evaporative emissions.

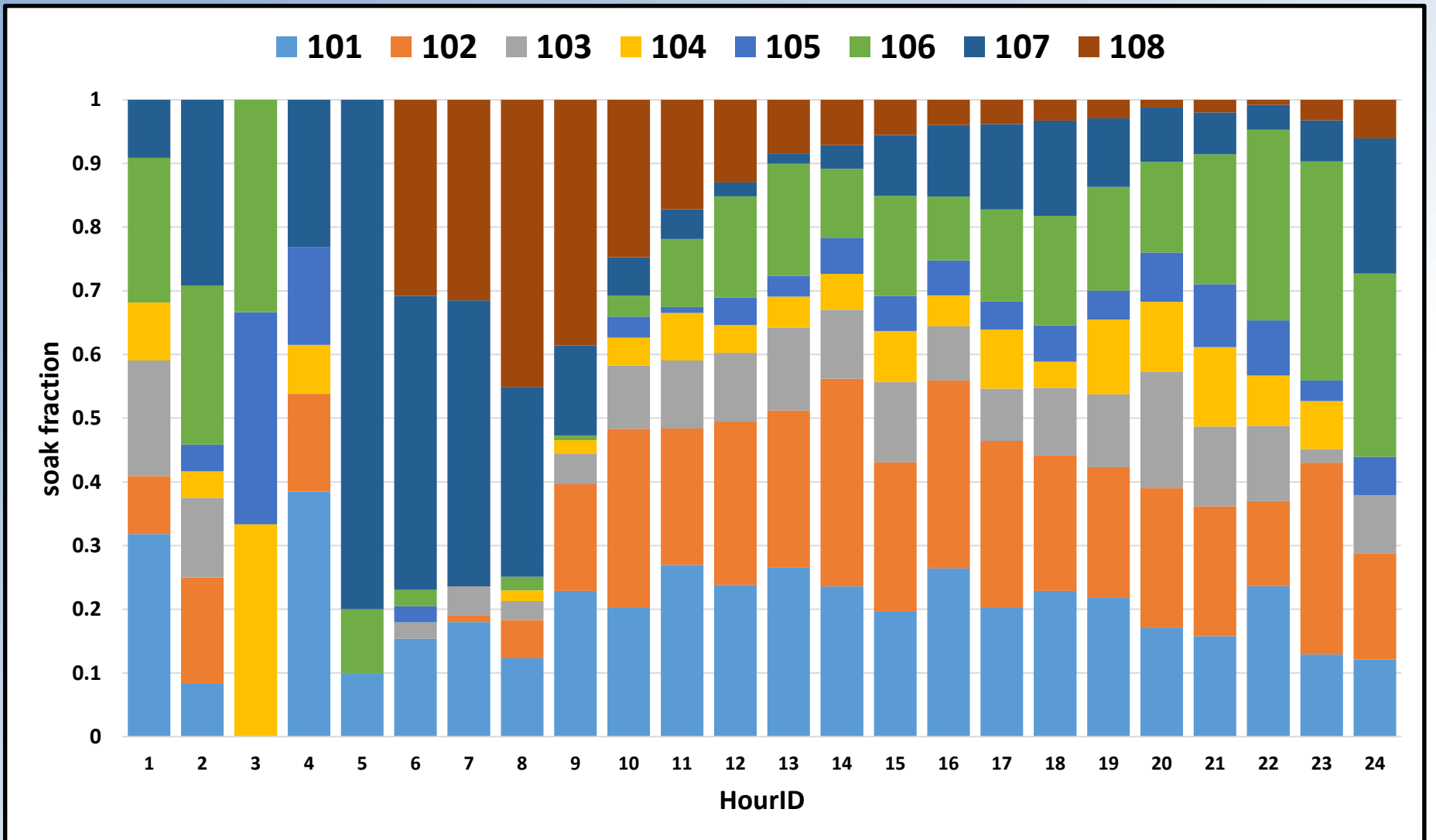


MOVES Engine Soak Bins

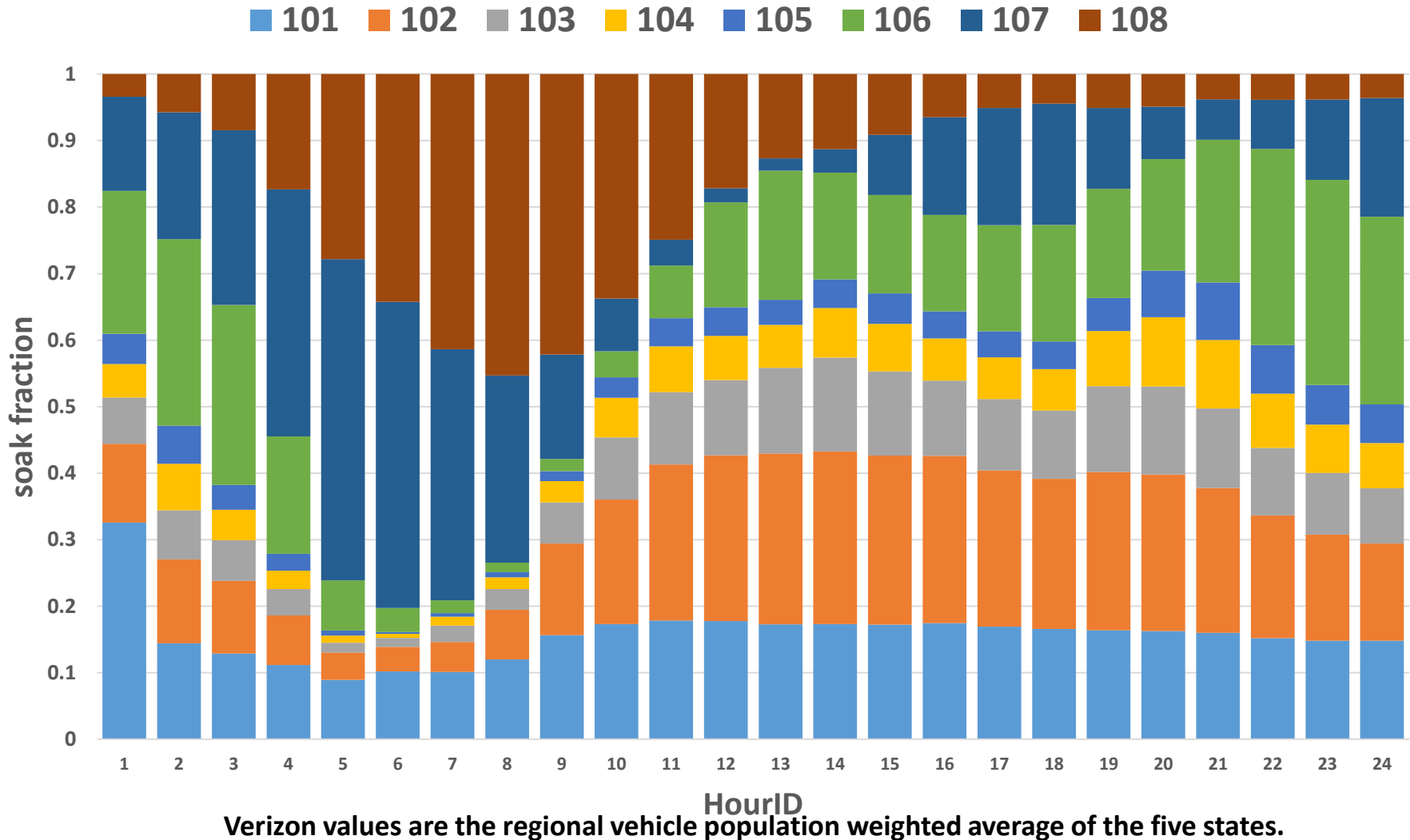
opModelID	Description
101	Soak Time < 6 minutes
102	6 minutes <= Soak Time < 30 minutes
103	30 minutes <= Soak Time < 60 minutes
104	60 minutes <= Soak Time < 90 minutes
105	90 minutes <= Soak Time < 120 minutes
106	120 minutes <= Soak Time < 360 minutes
107	360 minutes <= Soak Time < 720 minutes
108	720 minutes <= Soak Time



MOVES Average LDV Soak Time Distribution for Weekdays



Verizon National Average LDV Soak Time Distribution for Weekdays

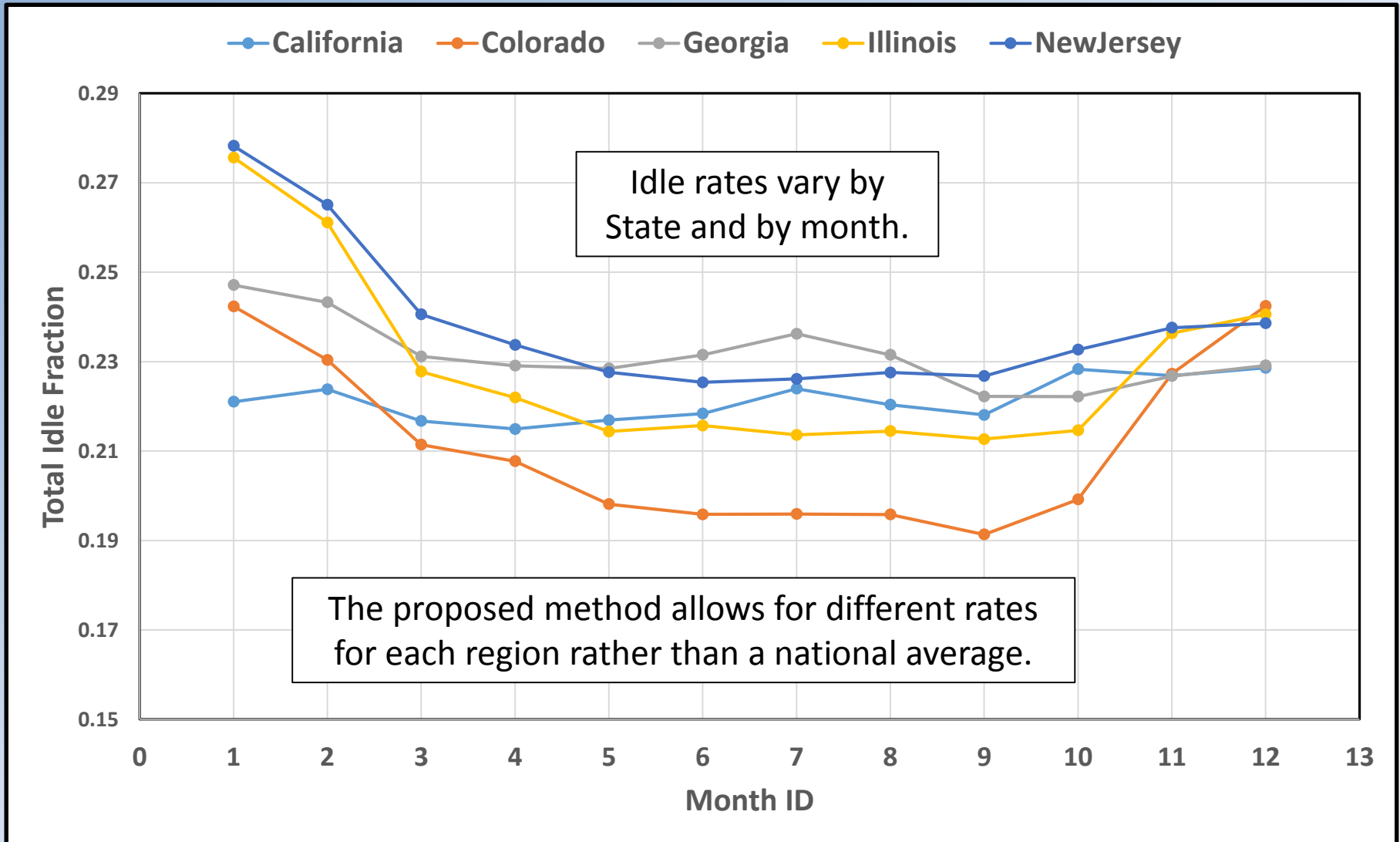


Engine Idle in MOVES

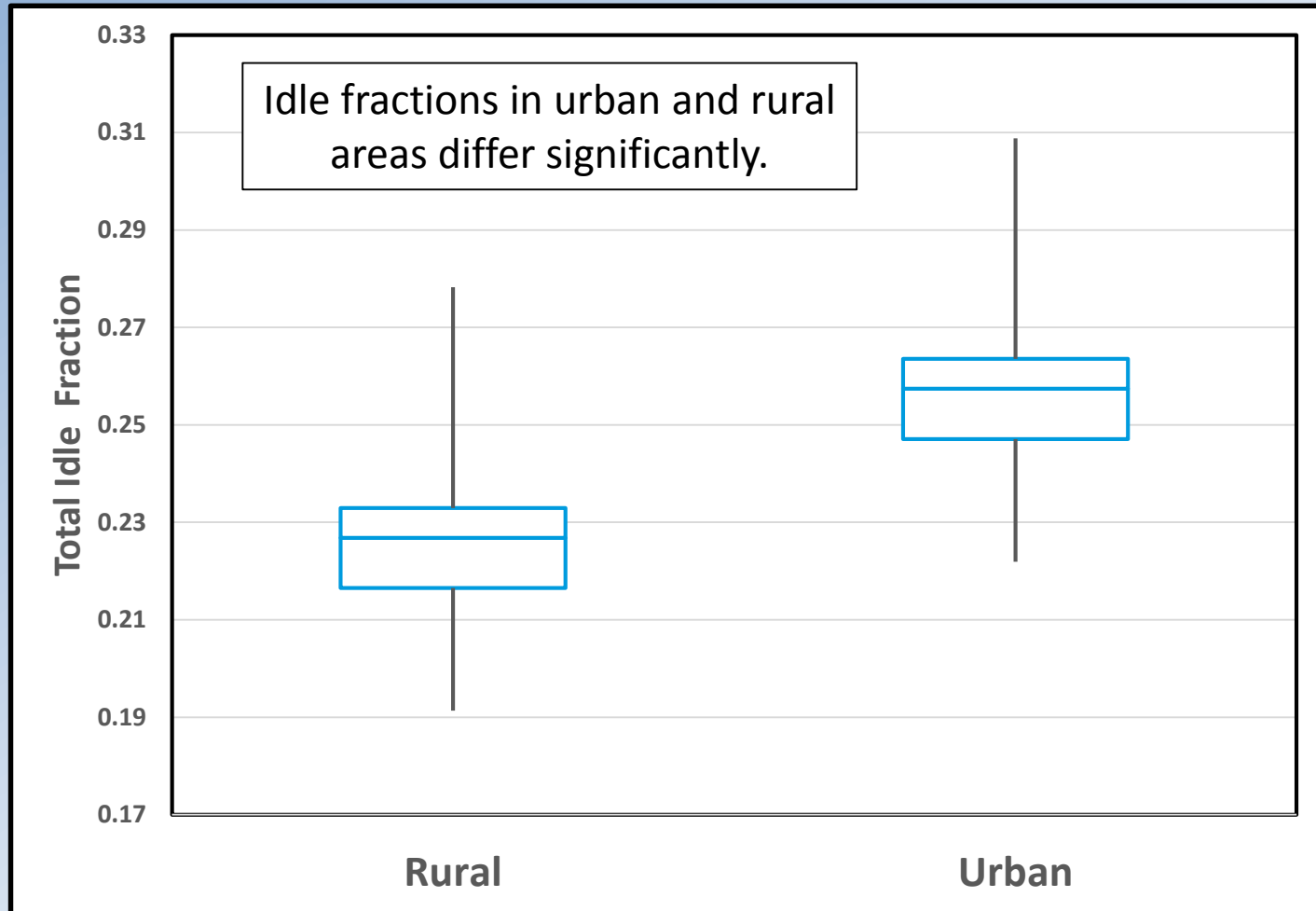
- Engine idle in MOVES only occurs during the driving schedules.
 - Idle varies by average speed.
 - Idle varies by road type.
- Telematics data demonstrates that total idle time included in the MOVES driving schedules is too low.
 - A proposal to better account for total idle time in MOVES was presented to the work group in March.



Total Weekday Urban LDV Idle Fraction



Verizon Five State Average Weekday Urban and Rural LDV Idle Fractions



“Urban” refers to data from counties within Metropolitan Statistical Areas.



Heavy Duty Telematics

- EPA has obtained telematics results from NREL and CE-CERT.
- Initial analysis of the data has begun.
- Results will be presented at a future meeting.
- The same questions of temporal distributions, idle time and engine starts will be evaluated.



NREL Heavy-Duty Telematics

- The National Renewable Energy Laboratory (NREL) operates the Fleet DNA clearinghouse of commercial fleet vehicle operating data
- The DNA data collects real-world vehicle operation data for medium- and heavy-duty commercial vehicles from a variety of vocations and locations

<https://www.nrel.gov/transportation/fleettest-fleet-dna.html>



NREL Vehicle Sample

Fleet DNA Vehicles Matching the MOVES Source Types									
MOVES				Vehicles with	Fuel			Powertrain	
sourceTypeID	Description	Vehicles	Electric	Engine RPM	Diesel	CNG	Propane	Conventional	Hybrid
42	Transit Buses	71	12	56	27	12	17	45	11
43	School Buses	256	0	11	7	2	2	11	0
51	Refuse Trucks	86	0	86	65	21	0	61	0
52	Single Unit Short-Haul	698	446	211	211	0	0	146	64
61	Combination Short-Haul	226	0	208	206	2	0	160	46
62	Combination Long-Haul	85	0	85	85	0	0	85	0

Analysis will only contain the conventional vehicles.

- Analysis sample:
 - Conventional powertrain trucks
 - With engine RPM data
 - Used to determine engine operation times.



NREL Engine Operation Data

Summary of NREL Data used for Starts and Idle Analysis				
Source Type	ID	Seconds of Data	Weekdays	Weekend
Transit Bus	42	17,369,566	339	62
School Bus	43	3,247,704	230	-
Refuse	51	26,466,050	1,097	40
Single Short Haul	52	68,602,358	3,080	508
Comb. Short Haul	61	174,818,257	4,567	956
Comb. Long Haul	62	208,262,098	3,877	1,300
Totals:		498,766,033	13,190	2,866
(Hours)		138,546		



CE-CERT Heavy-Duty Data

- University of California Riverside, Bourns College of Engineering – Center for Environmental Research and Technology (CE-CERT).
- Instrumented heavy-duty trucks selected by vocation from 19 different groups.
- Sampling was done second-by-second.
- All trucks were 2010 and newer model year.



CE-CERT Vehicle Sample

Source Type	SourceTypeID	Total Vehicles	Vehicle Miles Traveled	Days	Trips
Transit Bus	42	16	121,633.3	1,448.9	10,171
Refuse Truck	51	6	25,526.1	597.4	2,288
Single Short Haul	52	30	89,203.7	2,764.5	12,235
Single Long Haul	53	2	22,079.0	132.4	953
Comb. Short Haul	61	27	109,231.6	10,269.5	16,623
Comb. Long Haul	62	9	139,384.5	535.5	6,671
	Grand Total	90	507,058.3	15,748.1	48,941



Summary—Plans for MOVES

- Update default hourly VMT distributions for light duty cars and trucks based on national average Verizon data.
- Update default start frequency and soak distributions for light duty and heavy duty vehicles.
 - LD based on national average Verizon data.
 - HD tbd based on CE-CERT and NREL data.
- Add new idle approach (discussed in March)
 - LD defaults based on urban/rural region-specific Verizon data.
 - HD defaults tbd based on CE-CERT and NREL data.
- No update to activity for evap calculations.

