

Overview

- ❑ Background
- ❑ Sensitivity Analyses
 - MOVES2010a – Regional Level
 - MOVES2010b – Project Level
 - MOVES2014 – Comparison with MOVES2010b National Level and Project Level
- ❑ Results
- ❑ Questions

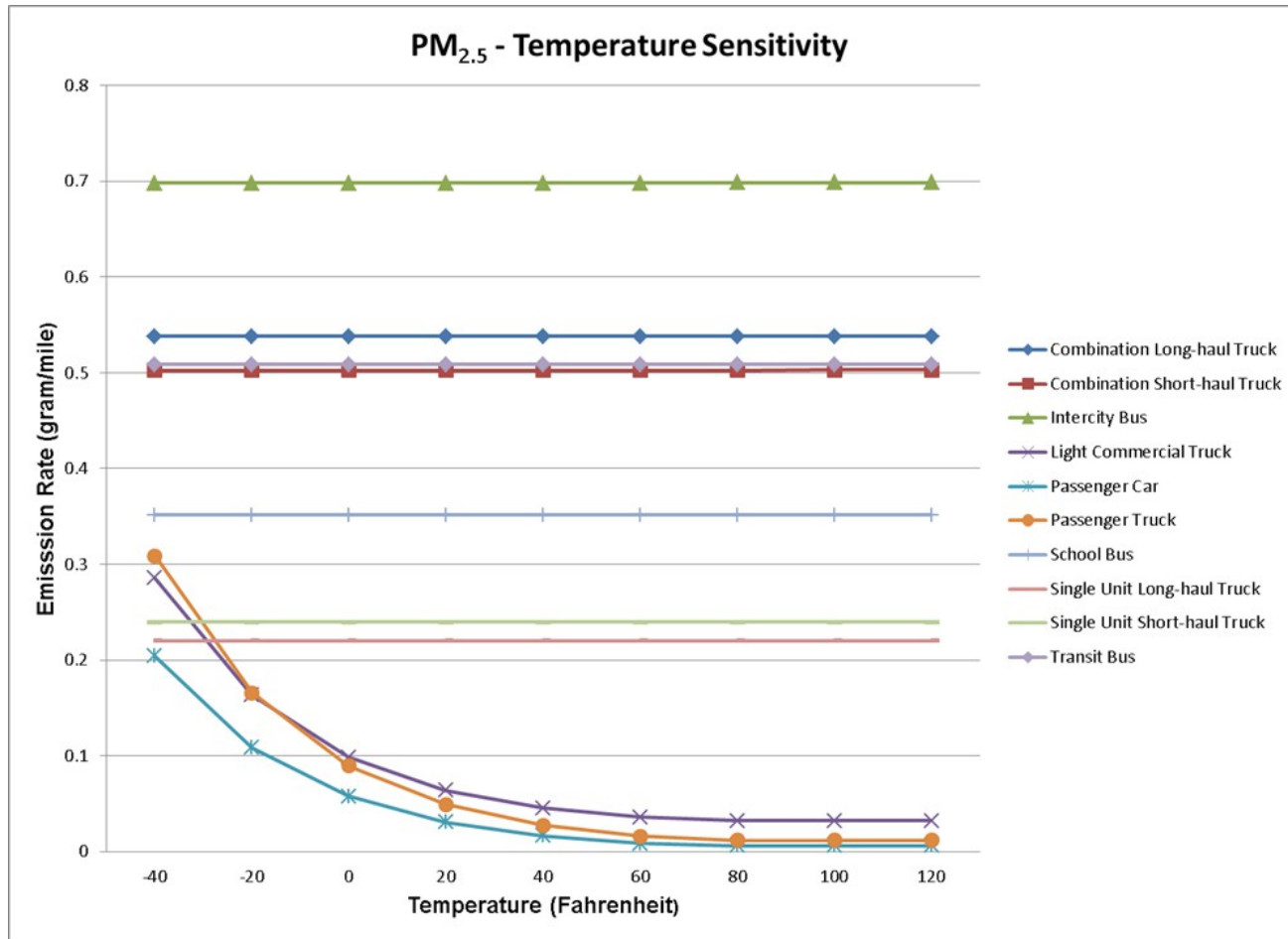
Background

- ❑ Sensitivity analyses sponsored by Federal Highway Administration (FHWA)
- ❑ MOVES2010a Regional Level Sensitivity Analysis
 - Report released in December of 2012
- ❑ MOVES2010b Project Level Sensitivity Analysis
 - Was a follow up analysis to MOVES2010a Regional Level Sensitivity Analysis
 - Completed March 2014
- ❑ MOVES 2014 Comparison with MOVES2010b
 - Conducted summer/fall of 2014
 - National Level and Project Level comparison

Regional Level Sensitivity Analysis

- ❑ MOVES2010a was utilized
- ❑ Parameters analyzed
 - Temperature
 - Running Emissions and Starts
 - Humidity
 - Year
 - Age Distribution
 - Average Speed Distribution

PM_{2.5} Temperature Sensitivity



Project Level Sensitivity Analysis

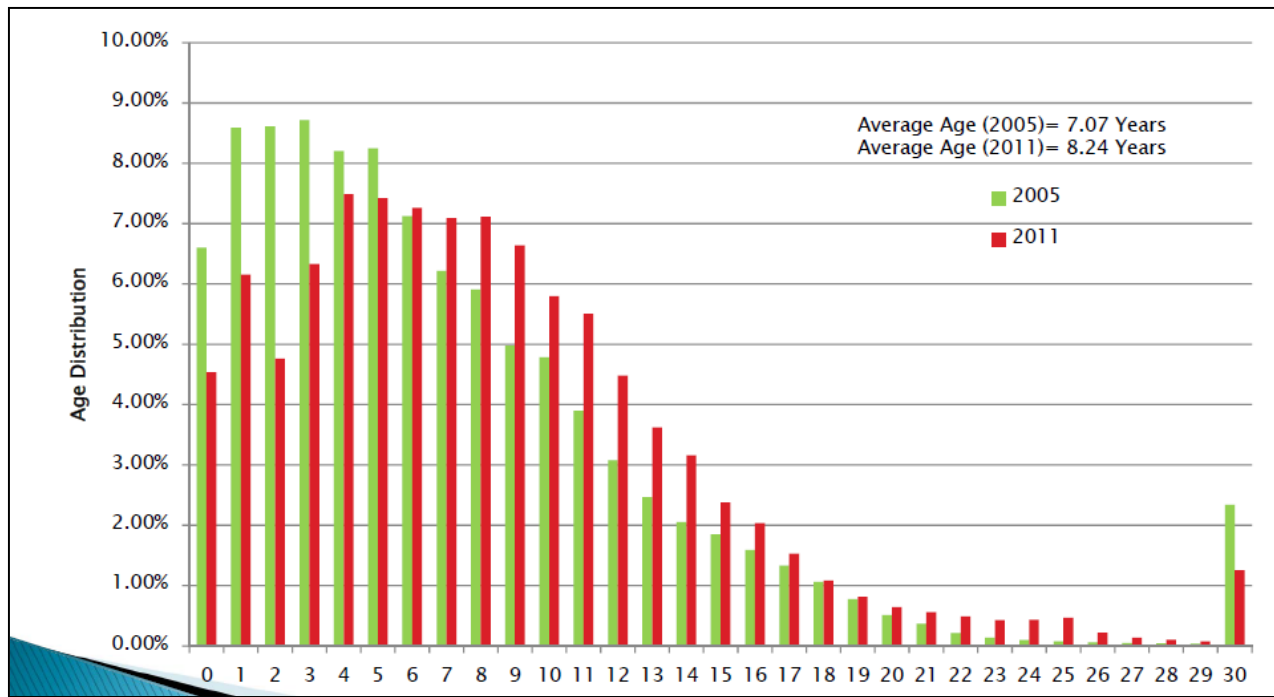
- ❑ MOVES2010b was utilized
- ❑ Parameters analyzed
 - Age Distribution
 - Fleet Mixture
 - Average Speed and Operating Mode Distribution Comparison

Age Distribution

- ❑ Age Distribution was analyzed for the Regional Level Sensitivity Analysis
- ❑ The Project Level Analysis applied more meaningful variations
 - Reached out to the Metropolitan Washington Council of Governments (MWCOCG) to obtain data.
- ❑ Analyzed multiple vehicle types
 - Passenger Cars
 - Transit Buses
 - Single Unit Trucks

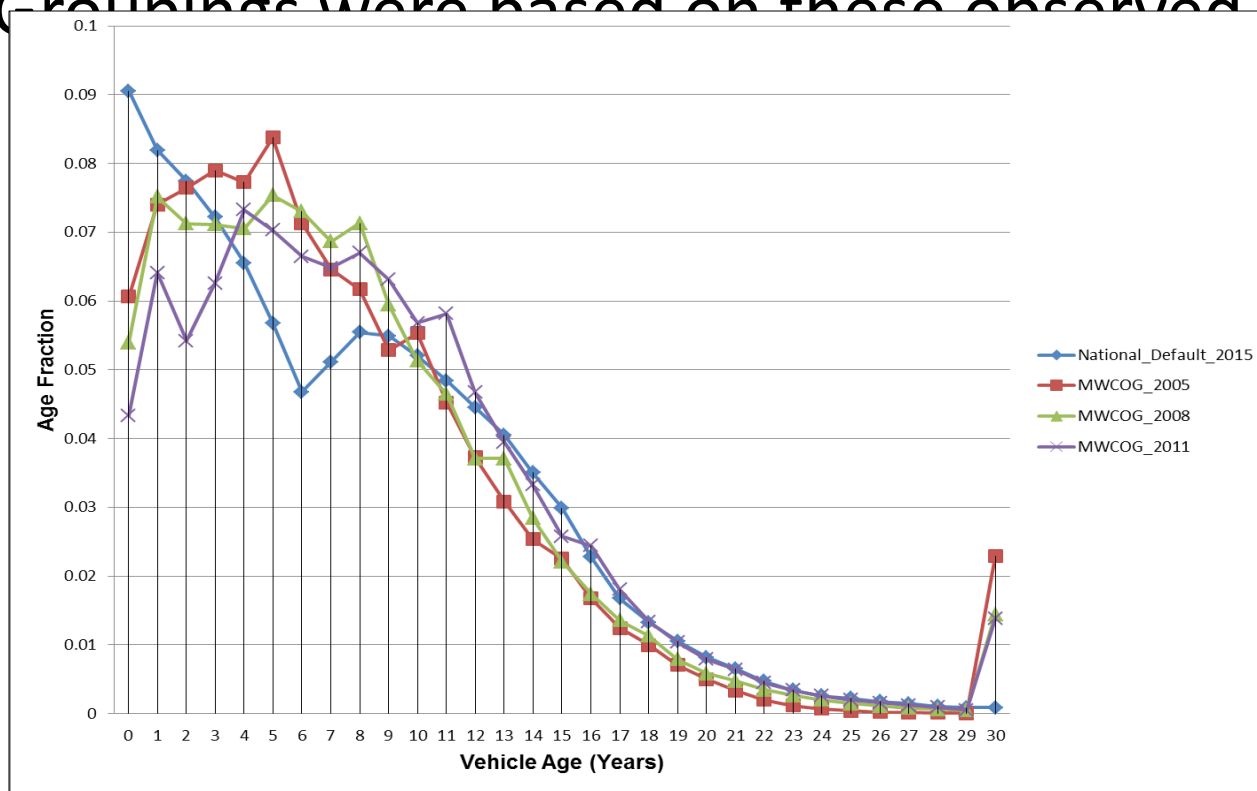
Age Distribution

- ❑ MWCOG provided data for 2005, 2008, and 2011
- ❑ The data showed the fleet aging throughout the years



Passenger Car Age Distribution Trends

- ❑ More variable for newer model years
- ❑ Less variable for latter years
- ❑ Age Groupings were based on these observed trends



Passenger Car Age Distribution

Groupings

- ❑ Passenger Cars were put into five age groups
- ❑ Five Scenarios were analyzed
- ❑ Scenario 1 has the least amount of variation based

upon the observed data

- ❑ Scenario 5 has the highest amount of variation based upon the observed data

Vehicle Age Range	Baseline Age Fractions	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
0-3 years	0.32	-5%	-10%	-20%	-30%	-45%
4-7 years	0.22	-2%	-5%	-7.50%	-10%	-20%
8-12 years	0.26	+5%	+10%	+20%	+30%	+50%
13-17 years	0.14	+4%	+8%	+15%	+20%	+30%
18-30 years	0.06	+2.5%	+5%	+7.5%	+10%	+25%
Average Vehicle Age	7.48	7.68	7.86	8.21	8.53	9.24

Passenger Car Age Distribution Results

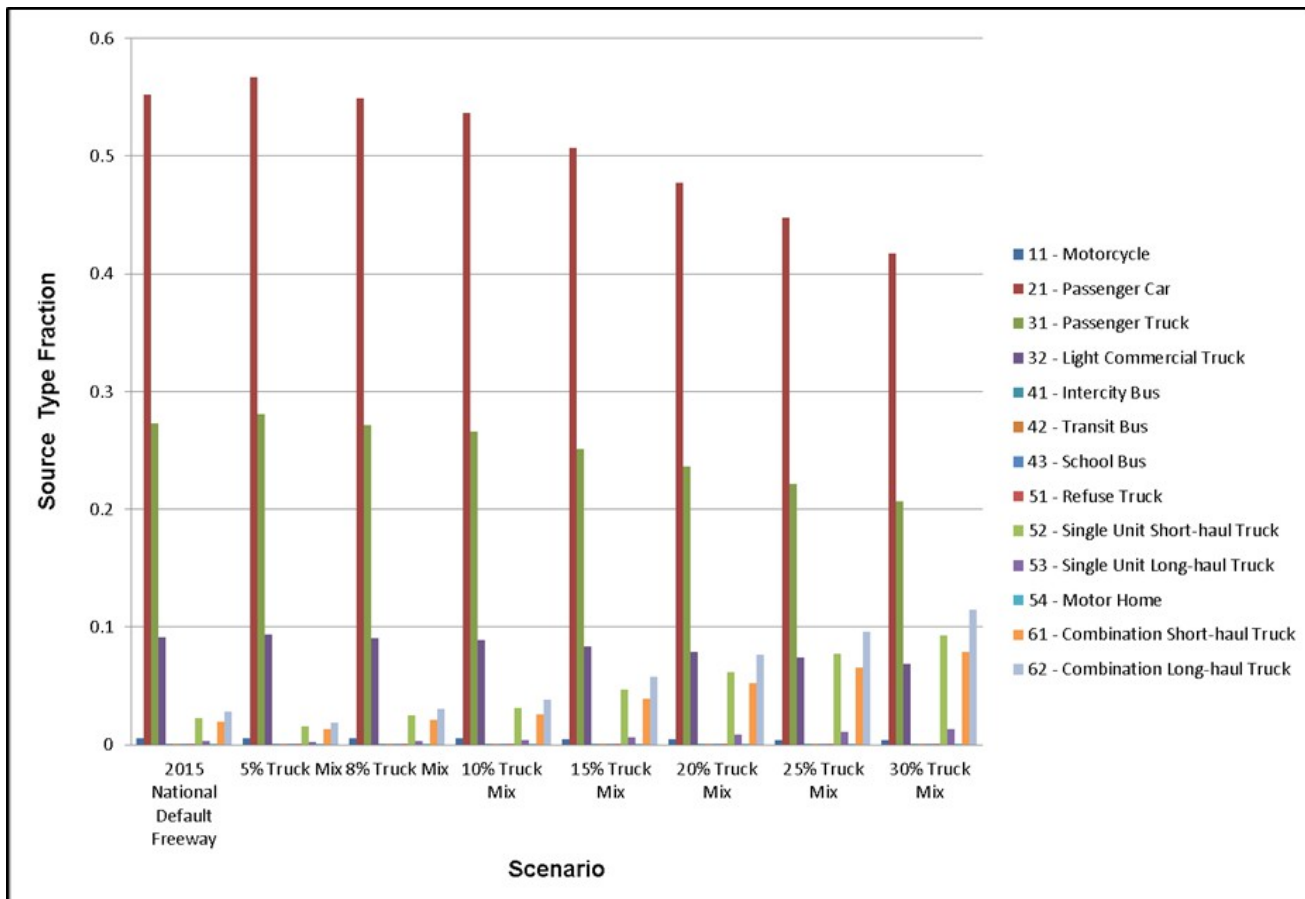
Source Type	Pollutant	Case	Average Age	Emission Rate (gram/vehicle-mile)	Percent Change
Passenger Car	CO	Baseline	7.48	1.484	-
		Scenario 1	7.68	1.516	2.15%
		Scenario 2	7.86	1.548	4.14%
		Scenario 3	8.21	1.604	7.49%
		Scenario 4	8.53	1.653	10.24%
		Scenario 5	9.24	1.776	16.47%
	NOX	Baseline	7.48	0.2929	-
		Scenario 1	7.68	0.3017	2.91%
		Scenario 2	7.86	0.3104	5.63%
		Scenario 3	8.21	0.3246	9.76%
		Scenario 4	8.53	0.3367	12.99%
		Scenario 5	9.24	0.3700	20.84%
	VOC	Baseline	7.48	0.0398	-
		Scenario 1	7.68	0.0409	2.88%
		Scenario 2	7.86	0.0421	5.56%
		Scenario 3	8.21	0.0439	9.51%
		Scenario 4	8.53	0.0455	12.62%
		Scenario 5	9.24	0.0502	20.78%
	PM2.5	Baseline	7.48	0.0067	-
		Scenario 1	7.68	0.0068	1.16%
		Scenario 2	7.86	0.0069	2.27%
Scenario 3		8.21	0.0070	4.01%	
Scenario 4		8.53	0.0071	5.56%	
Scenario 5		9.24	0.0075	9.94%	

Fleet Mix

- ❑ Analyzed five cases to determine how sensitive fleet can be a specific MOVES link
- ❑ The five cases include
 - Geographic area comparisons of fleet mix(Georgia Tech provided data)
 - Passenger Car to Passenger Truck ratio
 - Percent Truck Mix
 - Truck Type Mix
 - Transit Bus Mix

Percent Truck Mix Sensitivity

- Varied the truck mix while proportionally adjusting the other MOVES source types



Percent Truck Mix Results

Pollutant	Description	Emission Rate (gram/vehicle-mile)	Percent Change
NOX	Baseline_Highway	1.2006	-
	5% Truck Mix	1.0046	-16.33%
	8% Truck Mix	1.2464	3.82%
	10% Truck Mix	1.4077	17.25%
	15% Truck Mix	1.8108	50.83%
	20% Truck Mix	2.214	84.41%
	25% Truck Mix	2.6172	117.99%
	30% Truck Mix	3.0204	151.57%
PM2.5	Baseline_Highway	0.0342	-
	5% Truck Mix	0.0268	-21.55%
	8% Truck Mix	0.0359	5.04%
	10% Truck Mix	0.042	22.77%
	15% Truck Mix	0.0571	67.08%
	20% Truck Mix	0.0722	111.41%
	25% Truck Mix	0.0874	155.73%
	30% Truck Mix	0.1025	200.06%

Average Speed and Operating Mode Distribution Comparison

- ❑ Compared utilizing average speed for a link to a user defined operating mode distribution
 - When using average speed with MOVES, default drive schedules are applied
- ❑ Highway Capacity Manual (HCM) based drive schedules
- ❑ Georgia Tech provided operating mode distributions

Intersection Analysis

□ Intersection

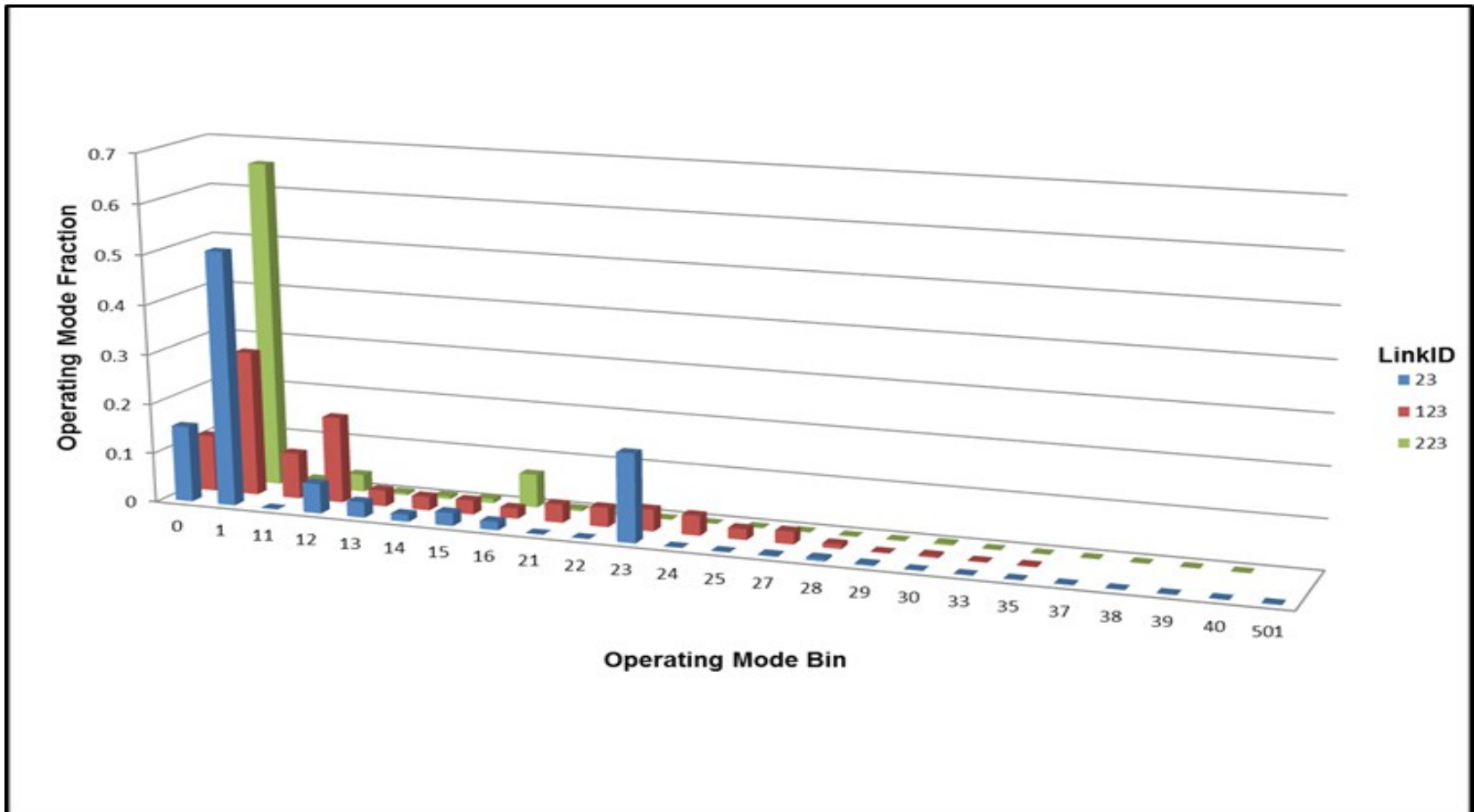
- 25 mph, 35 mph, 45 mph approach speeds
- LOS B,D, and E
- Consisted of approach, queue, and departure (acceleration) links

45 mph Scenario Intersection Data

Approach Speed (mph)	LOS	Signal Cycle Length (Seconds)	Yellow Time (seconds)	Green Time (seconds)	Red Time (seconds)	Vehicle Headway (seconds)	Deceleration Rate (mph/s)	Acceleration Rate (mph/s)	Volume per Cycle
45	B	55	4	10	41	14	-5	3	4
	D	95	4	23	68	10			9
	E	100	4	24	72	9			11

Operating Mode Distributions

45 mph Intersection Scenario – Queue Links LOS D Operating Mode Distributions



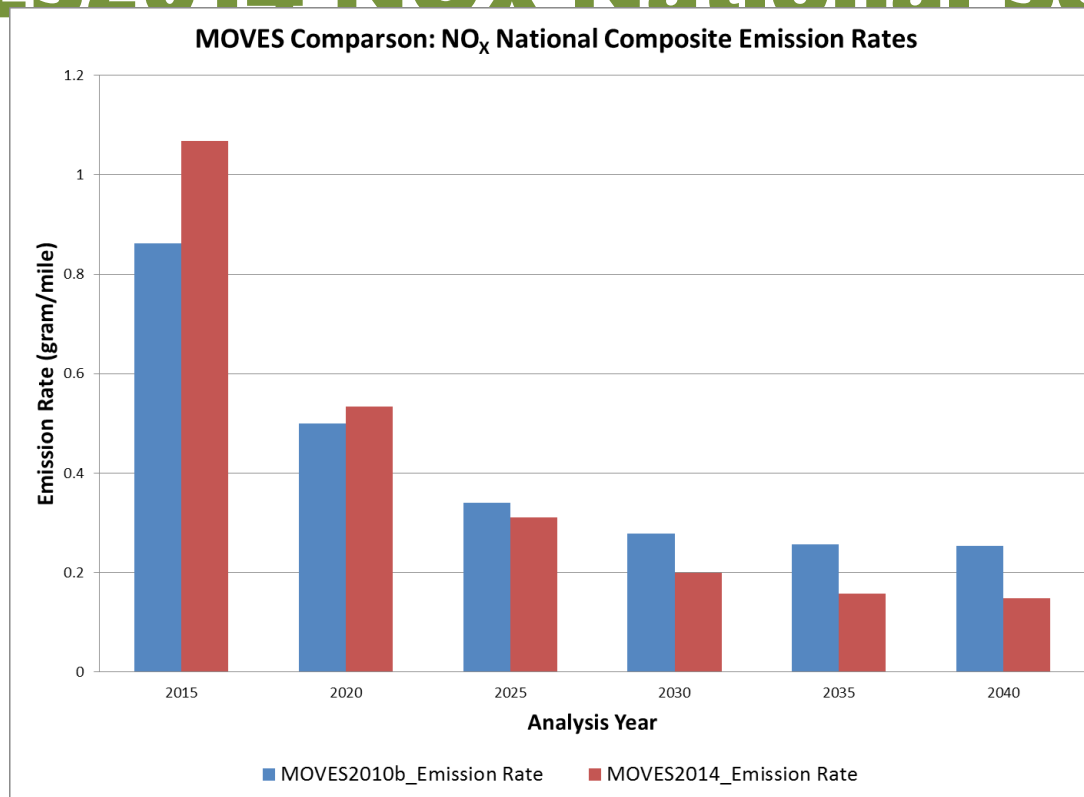
Intersection Results

Link Description	LinkID	Modeled Average Speed (mph)	Level of Service	CO Emission Rate (gram/veh-mile)	CO % Difference Compared to Average Speed	PM2.5 Emission Rate (gram/veh-mile)	PM2.5 % Difference Compared to Average Speed
Intersection Queue Link Average Speed	120	14.84	LOS B	3.135	-	0.0214	-
Intersection Queue Link HCM	20			1.555	-50.40%	0.01506	-29.62%
Intersection Queue Link GATech	220			1.644	-47.57%	0.0189	-11.72%
Intersection Queue Link Average Speed	123	13.24	LOS D	3.256	-	0.02276	-
Intersection Queue Link HCM	23			2.028	-37.71%	0.01679	-26.25%
Intersection Queue Link GATech	223			1.842	-43.41%	0.02118	-6.95%
Intersection Queue Link Average Speed	126	11.8	LOS E	3.393	-	0.02356	-
Intersection Queue Link HCM	26			2.345	-30.89%	0.01877	-20.32%
Intersection Queue Link GATech	226			2.067	-39.07%	0.02302	-2.27%

MOVES2014 Comparison

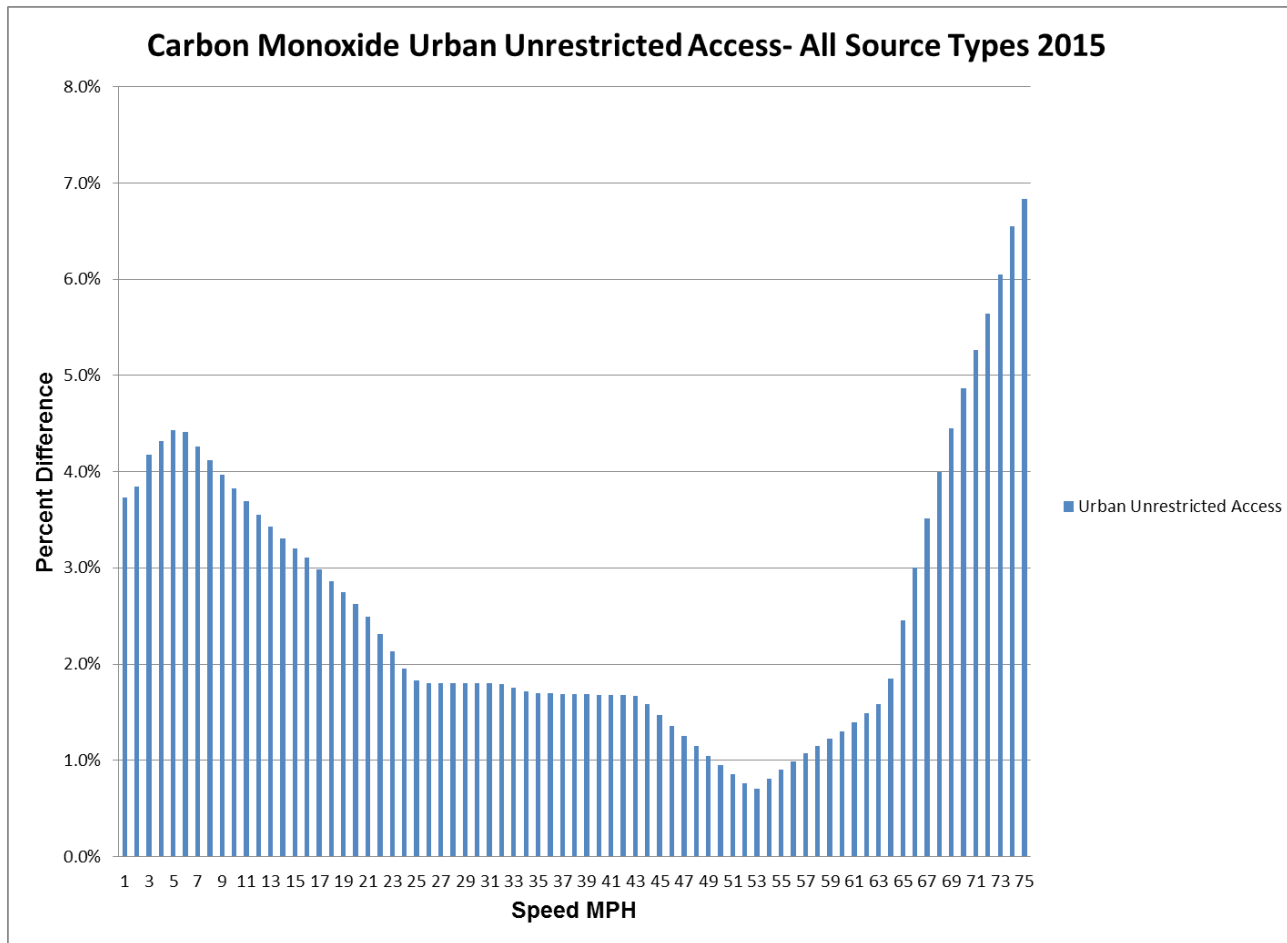
- ❑ MOVES2014 compared with MOVES2010b
- ❑ National Scale
 - Composite Emission Rates
 - Source Type Emission Rates
- ❑ Project Scale
 - Composite Emission Rates
 - Source Type Emission Rates

MOVES2014 NO_x National Scale

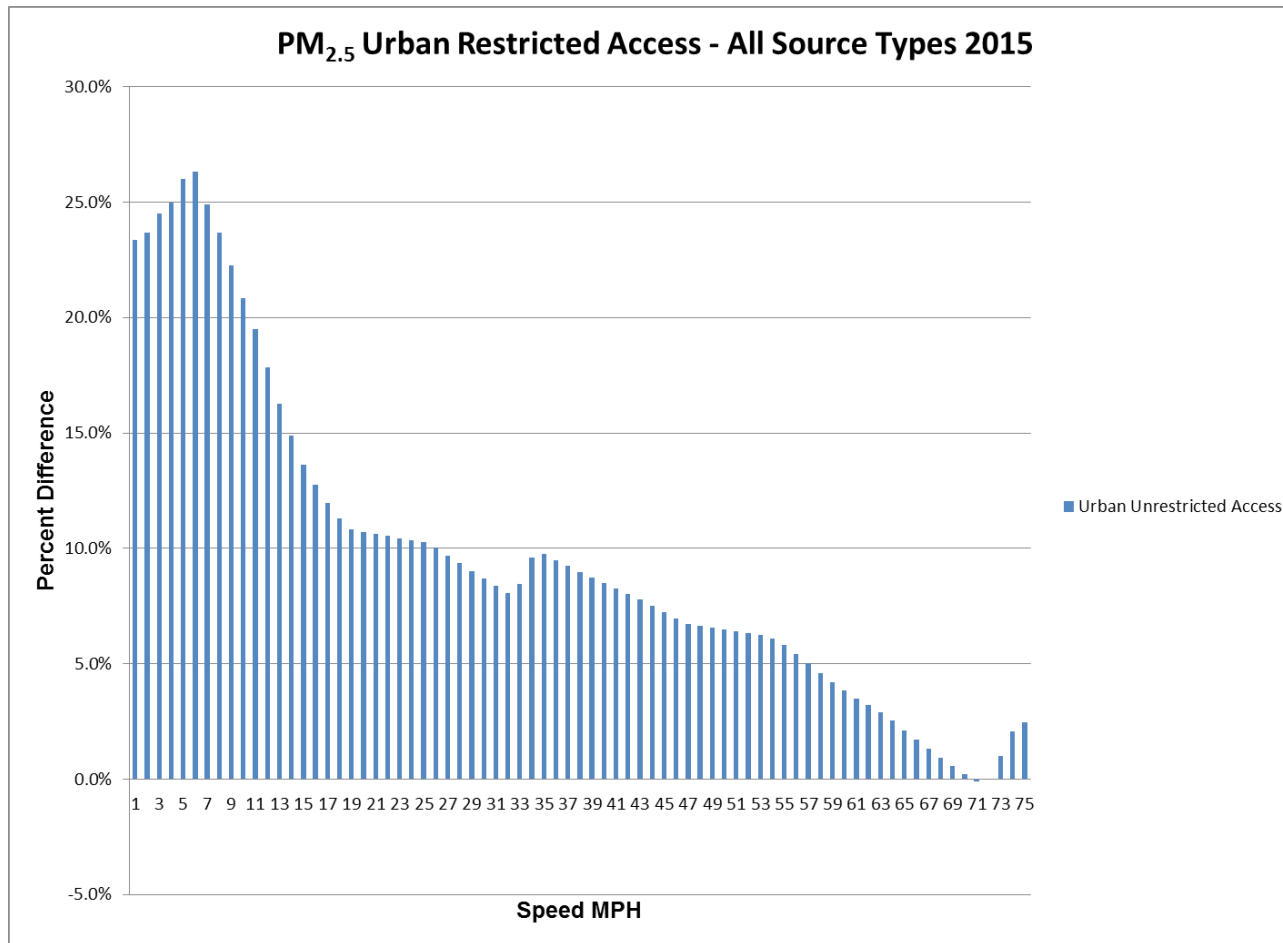


pollutantName	yearId	MOVES2010b Emission Rate (gram/mile)	MOVES 2014 Emission Rate (gram/mile)	MOVES2014 Percent Difference to MOVES2010b
Oxides of Nitrogen (NO _x)	2015	0.862	1.068	23.92%
	2020	0.500	0.533	6.58%
	2025	0.340	0.311	-8.56%
	2030	0.278	0.200	-28.10%
	2035	0.256	0.157	-38.59%
	2040	0.253	0.148	-41.52%

MOVES2014 Comparison to MOVES2010b Project Level



MOVES2014 Comparison to MOVES2010b Project Level



Questions?

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