



CAMBRIDGE SYSTEMATICS

Think  Forward

Emerging Technology: AV Scenario Implementation and Model Results

presented to

*Florida Model Task Force:
Model Advancement Committee*

presented by

Cambridge Systematics, Inc.

Marty Milkovits

mmilkovits@camsys.com

September 15, 2016

Agenda

- Review Emerging Technology, Trends, and Travel Behavior Study Background and Objectives
- Scenarios Developed and Implementation Plan
- Modeling Methodology
- Autonomous Vehicle (AV) Scenario Implementation Details
- Autonomous Vehicle (AV) Scenario Results

Emerging Technology Trends and Scenarios

Background and Objectives

Background

- Models are applied to gauge the demands for and the sizes of new facilities
- Emerging technologies will disrupt travel behaviors.
- Three phases
 - Review of relevant literature
 - Identify key parameters and data needs
 - Compile regional, national trends, and discuss potential scenario testing



Objectives

- Compile information on emerging technologies from identified sources and case studies.
- Gather regional and national trends in a manner to support discussion of potential scenario testing.
- Provide definition to specific scenarios that could be tested with the SERPM 7 model to support policy analysis.
- The findings can be applied to test and shape policies in regional and MPO LRTPs to achieve their goals and objectives. It can also help to project more accurate demands for projects.
- Evaluate the SERPM 7 model's capability to test future scenarios and inform development of SERPM 8.

Scenarios Developed and Implementation Plan

Scenario Development

Identified Potential Scenarios for Modeling the Travel Behavior Impact of:

- Changing demographics
- Emerging technologies

Focused on How to Model in SERPM 7 ABM Environment

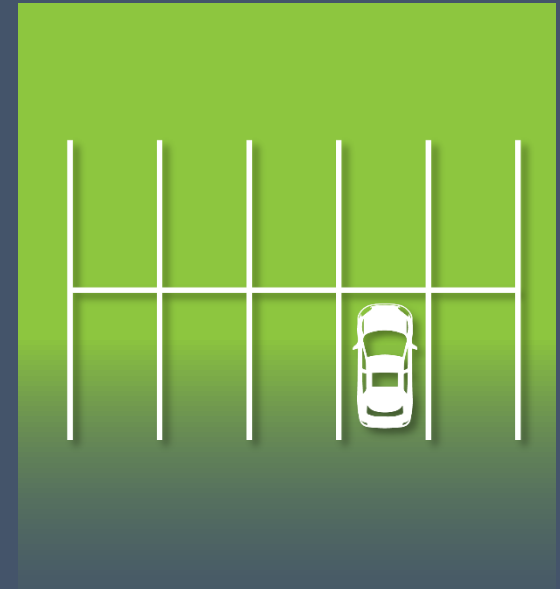
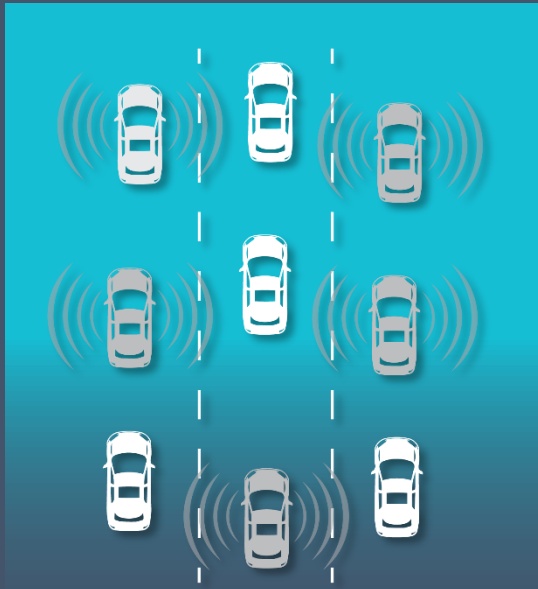
Six Scenarios

- Scenario 1 – Millennials Behave Differently
- Scenario 2 – New Transportation Services Reduce Need for Driving
- Scenario 3 – Emerging Technologies Enhance Transit Systems
- Scenario 4 – Managed Lanes Used Differently
- Scenario 5 – AV Technology Affects How People Travel
- Scenario 6 - Combined

Model Components

Model Group	Components
Complementary Models	Truck, visitor, special generators
Network Inputs	Speed, capacities, transit attributes
Population Synthesis	Synthetic person and household attributes and distributions
Long-Term Models	Usual activity locations (school and workplace)
Mobility	Vehicle availability
Daily	Activity plan
Tour Level	Tour timing, trip chaining, tour destination and mode choice
Trip Level	Trip mode choice
Assignment	Highway and transit

AV Technology Affects How People Travel



Scenario 5 – AV Technology Affects How People Travel

Driving Alone Available to Unlicensed Individuals

- Model assumes all individuals 16 or older can drive alone
- Relax assumption to 11 or older

AVs Use Facilities More Efficiently

- Freeway facility types – increase capacity by 80-100%
- Other facility types – increase capacity by 10-30%

Less Onerous In-Vehicle Travel Time

- Tour mode choice (all purposes and logsums)
- Reduce auto IVT coefficient by 5-10%

AVs Significantly Reduce the Need for Paid Parking

- Reduce parking costs by 20%
- Set maximum terminal time to 1 minute

Model Methodology

Stepwise implementation

- Each change made incrementally and model results examined
- Scenario management
 - » New versions of input and Utility Expression Calculator (UEC) files created
 - » Unique serpm_abm.properties file (Input\IN-2040R\) created to reference files and parameters for each scenario
- Single-pass model run
 - » Capacity increase scenarios seeded with skims from a full model run
- Full model run (speed feedback)
 - » Seeded skims used to reduce run time

Implementation Details and Impacts

Configuration Details

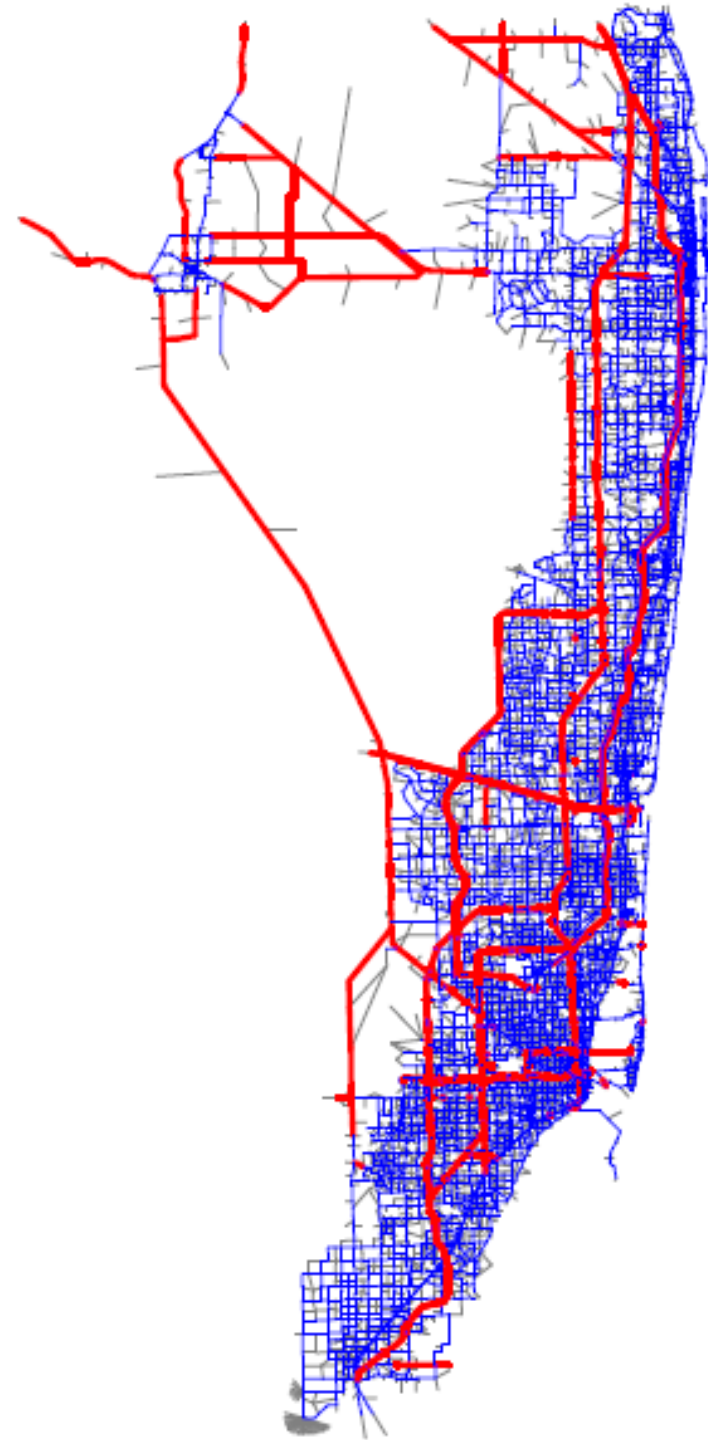
- SERPM 7.061
- CF2040: Adopted Cost Feasible LRTPs and Approved Projects
- Updated highway network with corrected facility types
- Corrected transit network building
- CTRamp binary built from source code dated 1/28/2016
- 25% demand sample rate

Driving alone available to unlicensed individuals

- Modified drive alone (toll and non-toll) and drive-transit availability constraint in mode choice UEC files within the serpm7\ctramp\uec folder
 - » TourModeChoice.xls
 - » TripModeChoice.xls
- Direct impact on Tour and Trip Mode Choice
- Logsum impact on destination choice
- No impact on visitor models or accessibilities

AVs Use Facilities More Efficiently

- Modified network capacity files (Input\IN-2040R\capcaltabs*.dbf) to specify capacity changes by facility type.
- Direct impact on:
 - » accessibilities
 - » destination choice
 - » mode choice
- Combined with unlicensed



Less Onerous In-Vehicle Travel Time

- Created an IVTT discount parameter (c_av_ivt_discount) and applied to the auto mode IVTT utility portion
 - » TourModeChoice.xls
 - » TripModeChoice.xls
 - » VisitorTourModeChoice.xls
 - » VisitorTripModeChoice.xls
- Direct impact on Tour and Trip Mode Choice
- Logsum impact on destination choice and accessibilities
- Combined with 80% highway / 10% other capacity increase and unlicensed

AVs Significantly Reduce the Need for Paid Parking

- Terminal times are not used in SERPM
- Parking costs reduced in the maz data file (Input\ABMTEMP\ctramp)
- Direct impact on Tour and Trip Mode Choice
- Logsum impact on destination choice and accessibilities
- Combined with 80% highway / 10% other capacity increase with IVTT 10% reduction and unlicensed

Results

Results Processing

- Step 1: copy output folder to repository of scenarios and give a unique name
- Step 2: run process in R that produces summaries and exports csv files with unique suffix to a results directory
- Step 3: identify scenarios on control tab in Excel and run macro to load summaries automatically using Data Connections

Update Links

	summary data suffix	Short name	Description
Reference Scenario	base	Base	Baseline with new network
Scenario 1	license	License	License restriction relaxed
Scenario 2	cap_80_10	Cap 80/10	Network capacity increase: 80% on freeways / 10% on local roads
Scenario 3	Cap_80_IVTT10	IVTT10	IVTT coefficient reduced by 10%, 80/10 network increases
Scenario 4	Parking	Parking	Parking Costs reduced by 20%, IVTT coefficient reduced by 10%, 80/10 network increases

Results Location Results
Demand Sample 25%

DAP - tours

Single pass

	%Change in Tours			
Tour Categories	License	Cap 80/10	IVTT10	Parking
MANDATORY	0.00%	0.07%	0.06%	0.05%
INDIVIDUAL_NON_MANDATORY	0.00%	0.43%	0.39%	0.39%
JOINT_NON_MANDATORY	0.00%	0.47%	0.90%	0.94%
AT_WORK	0.00%	-0.03%	0.04%	-0.03%
Total	0.00%	0.28%	0.28%	0.28%

Full run

	%Change in Tours			
Tour Categories	License	Cap 80/10	IVTT10	Parking
MANDATORY	-0.01%	0.04%	-0.03%	-0.02%
INDIVIDUAL_NON_MANDATORY	-0.03%	2.27%	2.09%	2.10%
JOINT_NON_MANDATORY	-0.04%	1.07%	1.42%	1.48%
AT_WORK	-0.10%	-0.55%	-0.59%	-0.65%
Total	-0.03%	1.21%	1.12%	1.13%

DAP – trips

All Persons

	%Change in Trips			
Trip Purpose	License	Cap 80/10	IVTT10	Parking
Work	-0.03%	0.00%	-0.07%	-0.08%
Work-Based	-0.10%	-0.55%	-0.59%	-0.65%
School	-0.01%	-0.05%	-0.09%	-0.08%
University	0.03%	0.02%	-0.03%	0.06%
Escort	0.03%	1.99%	2.23%	2.20%
Maintenance	-0.06%	1.20%	1.24%	1.25%
Shop	-0.17%	1.86%	1.98%	1.99%
Eating Out	0.00%	3.83%	4.02%	3.96%
Visiting	0.10%	1.31%	1.08%	1.32%
Discretionary	-0.01%	1.78%	1.66%	1.66%
Total	-0.04%	1.33%	1.36%	1.37%

Child 11-15

	%Change in Trips			
Trip Purpose	License	Cap 80/10	IVTT10	Parking
Work	-	-	-	-
Work-Based	-	-	-	-
School	0.01%	-0.04%	-0.06%	-0.05%
University	-	-	-	-
Escort	1.08%	5.76%	6.05%	7.06%
Maintenance	0.83%	9.54%	7.50%	9.10%
Shop	0.78%	10.02%	10.24%	9.59%
Eating Out	0.02%	19.82%	18.74%	19.28%
Visiting	2.08%	2.18%	1.89%	1.97%
Discretionary	-0.08%	4.75%	5.31%	4.85%
Total	0.29%	3.81%	3.71%	3.81%

Trip Mode Choice

<i>Region</i>	Change in Mode Share (percentage point)			
Trip Mode	License	Cap 80/10	IVTT10	Parking
drive_alone	0.7%	0.7%	0.8%	0.8%
carpool_2	-0.3%	-0.3%	-0.2%	-0.2%
carpool_3	-0.2%	-0.2%	-0.2%	-0.1%
kissride	-0.002%	-0.006%	-0.010%	-0.013%
parkride	0.001%	-0.008%	-0.015%	-0.018%
walktotransit	-0.005%	-0.002%	-0.054%	-0.072%
schoolbus	0.0%	-0.1%	-0.1%	-0.1%
bike	-0.02%	-0.02%	-0.04%	-0.05%
Walk	0.0%	-0.1%	-0.2%	-0.2%

% Change in Trips By Mode			
License	Cap 80/10	IVTT10	Parking
1.3%	2.7%	2.9%	3.0%
-1.6%	0.0%	0.3%	0.4%
-2.1%	-0.5%	-0.1%	0.0%
-2.5%	-5.2%	-9.8%	-12.2%
0.6%	-6.4%	-13.0%	-16.0%
-0.4%	1.2%	-2.2%	-3.4%
-2.4%	-3.3%	-3.9%	-4.0%
-1.2%	0.1%	-1.0%	-1.5%
-0.3%	0.8%	0.1%	-0.2%

<i>High Income (>\$100K)</i>	Change in Mode Share (percentage point)			
Trip Mode	License	Cap 80/10	IVTT10	Parking
drive_alone	0.8%	0.7%	0.9%	0.9%
carpool_2	-0.4%	-0.4%	-0.3%	-0.3%
carpool_3	-0.3%	-0.2%	-0.2%	-0.2%
kissride	-0.005%	-0.008%	-0.013%	-0.012%
parkride	0.002%	-0.009%	-0.017%	-0.019%
walktotransit	0.005%	0.007%	-0.046%	-0.055%
schoolbus	0.0%	-0.1%	-0.1%	-0.1%
bike	0.0%	0.0%	0.0%	-0.1%
Walk	-0.1%	0.0%	-0.1%	-0.2%

% Change in Trips By Mode			
License	Cap 80/10	IVTT10	Parking
1.4%	2.9%	3.2%	3.2%
-2.1%	-0.4%	-0.3%	-0.2%
-2.8%	-0.6%	-0.4%	0.0%
-6.4%	-8.9%	-15.6%	-13.9%
1.3%	-6.6%	-13.5%	-15.8%
0.4%	2.3%	-3.7%	-4.8%
-2.1%	-3.0%	-3.8%	-4.0%
-1.1%	0.5%	0.2%	-1.7%
-0.5%	1.3%	0.4%	0.1%

Highway Assignment

Peak	%Change in VMT			
	License	Cap 80/10	IVTT10	Parking
Freeway	0.00%	28.02%	29.81%	30.15%
Uninterrupted Roadway	10.04%	-6.36%	-4.84%	-5.25%
Higher Speed Interrupted Facility	-0.25%	-1.84%	-0.88%	-0.69%
Lower Speed and Collector Facility	0.16%	-5.65%	-4.40%	-3.83%
Ramps	-5.00%	19.95%	21.25%	20.99%
HOV Lanes	2.25%	17.96%	19.67%	19.93%
Toll Roads	2.84%	4.70%	6.85%	5.46%
Total	0.72%	4.77%	6.16%	6.11%
Off-Peak	%Change in VMT			
	License	Cap 80/10	IVTT10	Parking
Freeway	2.24%	13.83%	15.71%	15.45%
Uninterrupted Roadway	12.47%	-1.74%	-0.83%	-0.72%
Higher Speed Interrupted Facility	1.12%	0.99%	1.86%	1.81%
Lower Speed and Collector Facility	2.35%	0.32%	1.22%	1.35%
Ramps	-4.38%	10.64%	11.89%	11.59%
HOV Lanes	2.14%	25.72%	26.98%	27.38%
Toll Roads	1.33%	-0.60%	0.81%	0.70%
Total	1.84%	3.78%	4.97%	4.89%

Transit Assignment

	%Change			
Transit	License	Cap 80/10	IVTT10	Parking
Linked Trips (expanded)	-0.42%	0.39%	-3.23%	-4.60%
Unlinked Trips	-0.55%	0.06%	-3.73%	-5.22%
Transfer Rate	-0.13%	-0.33%	-0.52%	-0.65%

	%Change in Boardings			
Trip Mode	License	Cap 80/10	IVTT10	Parking
BRT	2.26%	-4.95%	-10.61%	-11.24%
Express	-1.24%	-5.30%	-9.26%	-10.67%
LocalBus	-0.25%	3.06%	-0.65%	-2.17%
Rail	-2.14%	-13.86%	-17.55%	-19.16%
Total	-0.55%	0.06%	-3.73%	-5.22%

	%Change in Boardings			
Area Type	License	Cap 80/10	IVTT10	Parking
CBD	-1.14%	-1.38%	-5.40%	-7.36%
Fringe	-0.32%	1.42%	-2.49%	-5.54%
OBD	-0.58%	-0.11%	-4.11%	-5.12%
Residential	-0.28%	0.02%	-2.84%	-3.49%
Rural	-3.10%	-10.00%	-9.52%	-3.10%
Total	-0.55%	0.06%	-3.73%	-5.22%

Other Scenarios

Next Steps

➤ Model specification for scenarios

Scenario		Level of Effort
1	Millennials Behave Differently	High: Population shift and new mobility terms are non-trivial
2	New Transportation Services	High: New mode, new terms in auto ownership
3	Emerging Technologies in Transit	High: New mode with transit egress
4	Managed Lanes	Low: network coding changes
5	AV Technology	Medium: mostly parameter changes, although should be done across range

➤ Testing scenarios and sharing results: volunteers?

Questions?

Acknowledgements

➤ FDOT District 4

- » Lois Bush
- » Shi-Chiang Li
- » Larry Hymowitz
- » Hui Zhao

➤ Cambridge Systematics

- » Jay Evans
- » Jingjing Zang
- » Kazi Ullah
- » Tom Rossi
- » Peter Haliburton
- » Peng Zhu

Thank you!

Mobility

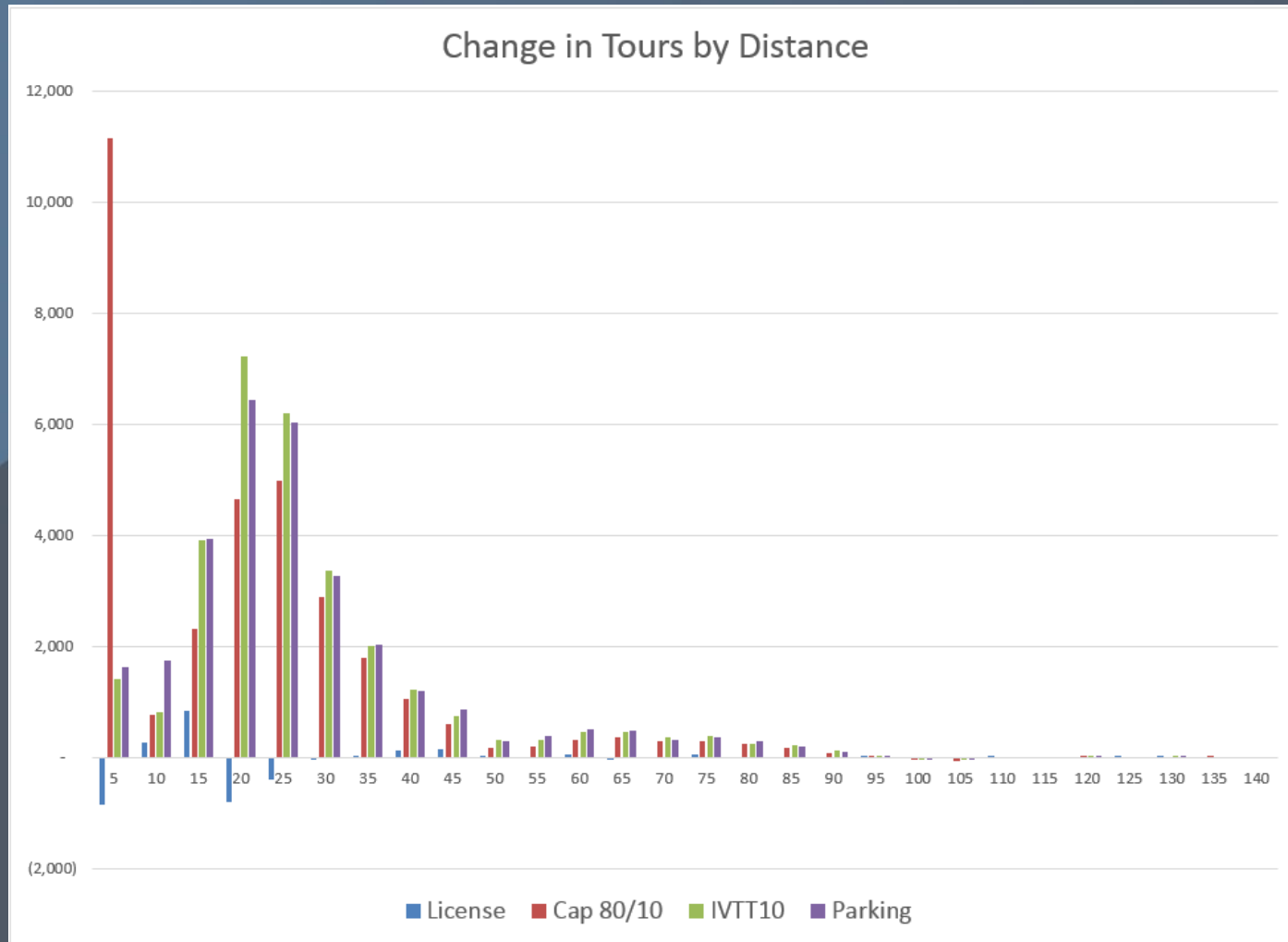
Single pass

	%Change in Auto Ownership Share			
Auto Ownership	License	Cap 80/10	IVTT10	Parking
0	0.00%	-0.13%	-0.13%	-0.14%
1	0.00%	-0.05%	-0.06%	-0.04%
2	0.00%	0.01%	0.01%	0.01%
3	0.00%	0.35%	0.40%	0.33%
4	0.00%	-0.02%	-0.03%	-0.06%

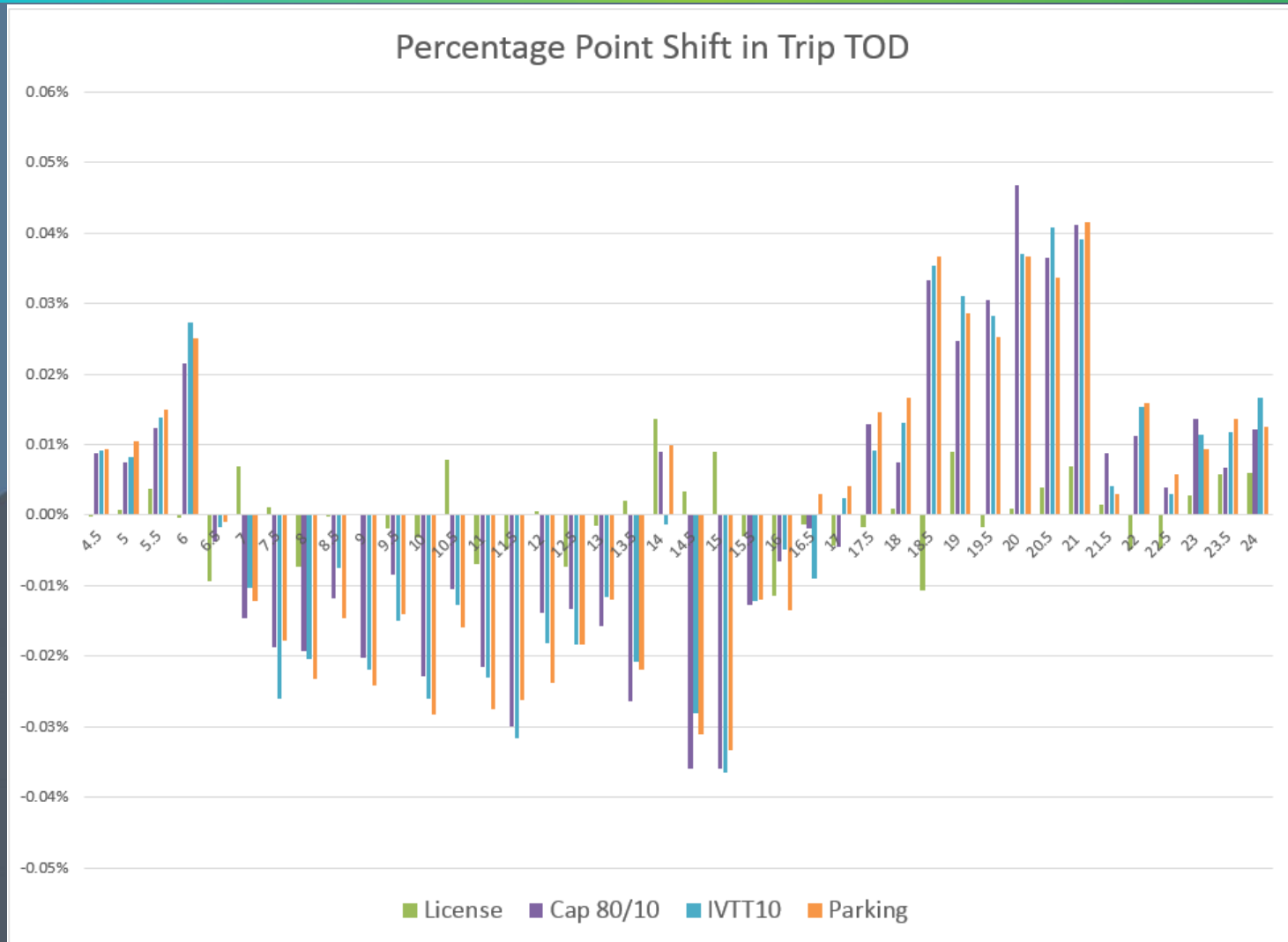
Full run

	%Change in Auto Ownership Share			
Auto Ownership	License	Cap 80/10	IVTT10	Parking
0	-0.03%	-0.60%	-0.60%	-0.61%
1	0.03%	0.10%	0.09%	0.12%
2	-0.05%	0.05%	0.08%	0.07%
3	0.09%	0.17%	0.18%	0.11%
4	-0.04%	-0.04%	-0.16%	-0.13%

Destination Choice



Trip Time of Day



Highway Assignment – Capacity Range

Peak	%Change in VMT			
	License	Cap 80/10	Cap 90/20	Cap 100/30
Freeway	0.00%	28.02%	30.53%	32.82%
Uninterrupted Roadway	10.04%	-6.36%	-7.23%	-8.53%
Higher Speed Interrupted Facility	-0.25%	-1.84%	-0.58%	0.68%
Lower Speed and Collector Facility	0.16%	-5.65%	-5.89%	-5.84%
Ramps	-5.00%	19.95%	21.24%	22.98%
HOV Lanes	2.25%	17.96%	19.10%	22.96%
Toll Roads	2.84%	4.70%	0.74%	-0.48%
Total	0.72%	4.77%	5.05%	5.83%
Off-Peak	%Change in VMT			
	License	Cap 80/10	Cap 90/20	Cap 100/30
Freeway	2.24%	13.83%	13.29%	14.69%
Uninterrupted Roadway	12.47%	-1.74%	-3.51%	-2.78%
Higher Speed Interrupted Facility	1.12%	0.99%	0.42%	1.73%
Lower Speed and Collector Facility	2.35%	0.32%	-1.32%	-0.05%
Ramps	-4.38%	10.64%	10.87%	12.24%
HOV Lanes	2.14%	25.72%	28.45%	33.80%
Toll Roads	1.33%	-0.60%	-0.05%	-1.04%
Total	1.84%	3.78%	3.31%	4.27%