Modeling Demographics and Emerging Technologies with ABMs

presented to

CATMUG

presented by

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CAMBRIDGE SYSTEMATICS

12/4/2019

Think Forward

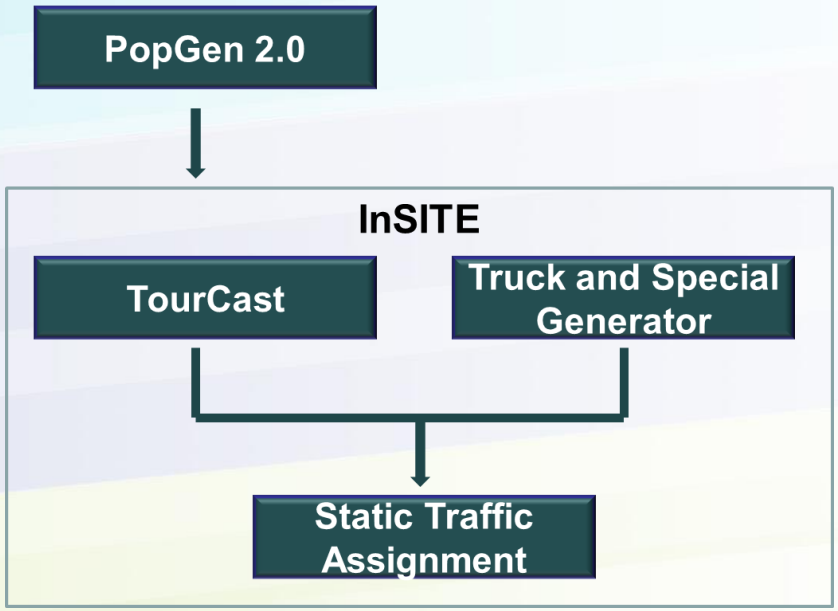
Introduction

- Activity-based models
  - » Tours as unit of travel
  - » Disaggregate
  - » Allows for new types of scenario testing
- Case studies
  - » Baltimore Metropolitan Council Activity Model
    - – Aging population scenario
  - » Southeast Florida Activity Model
    - – CAV scenario
    - – TNC scenario

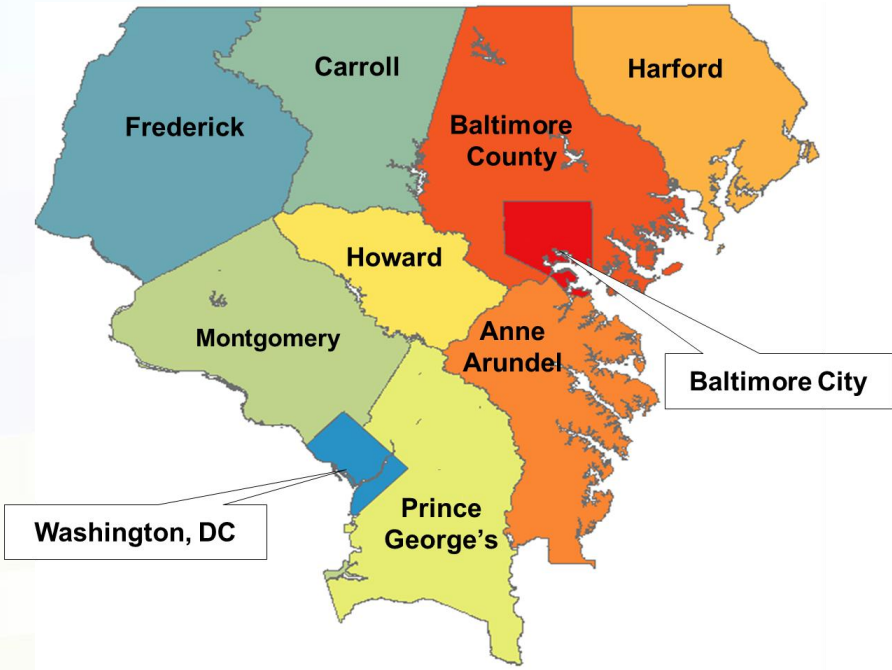
BALTIMORE ACTIVITY MODEL – CHANGING DEMOGRAPHICS

Baltimore ABM Background

Model Structure



Modeling Region



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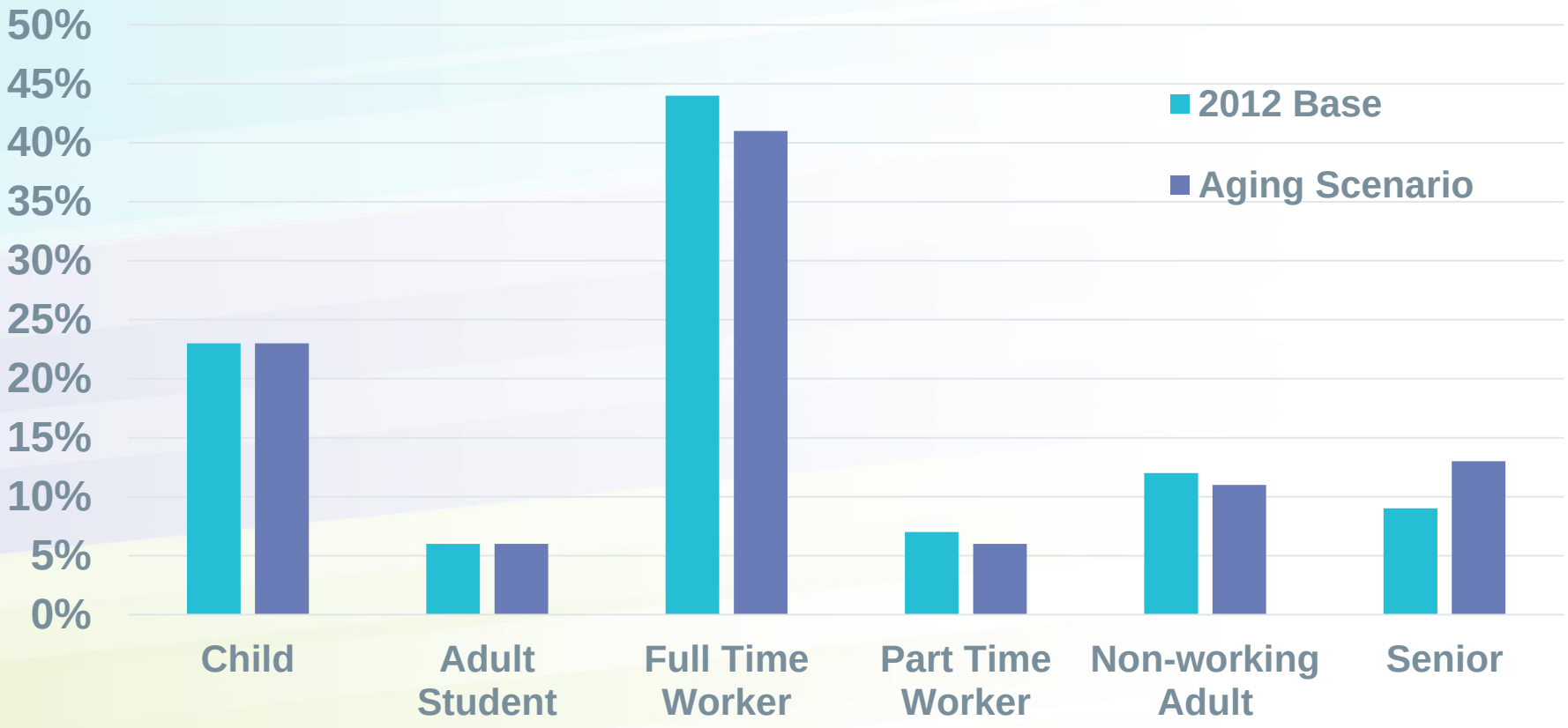
Aging Population Scenario

- How to create the synthetic population?
- Consistency with the base population
  - » Total population constant
  - » Total employment constant
- Adjust distribution of households ->

  30% increase in 1 or 2-person households with 1 or more retirees (age 65+)

Synthetic Population Summary



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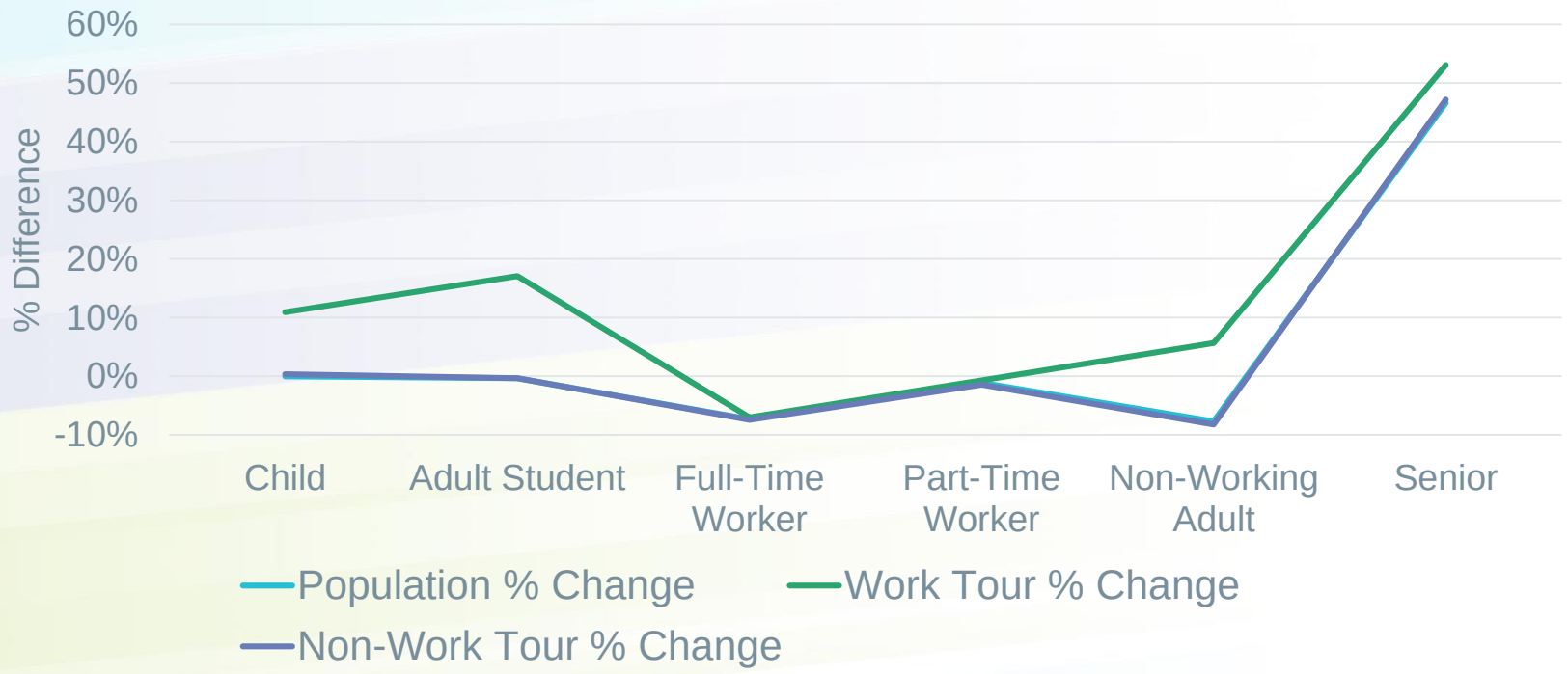
Change in Tours-Making

5.5% decrease in **work** tours

3.6% increase in **non-work** tours

1.0% decrease in **total** tour-making



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Tours by Mode

Tour Mode	Work Tours		Non-Mandatory Tours		Total Work & Non-Mandatory Tours	
	Base	Aging Population	Base	Aging Population	Base	Aging Population
Drive Alone	1,180,018	1,103,045	773,666	814,967	1,953,684	1,918,012
Shared Ride 2	310,406	291,050	411,185	429,098	721,591	720,148
Shared Ride 3	181,152	171,563	206,778	213,538	387,930	385,101
Transit-Walk	189,233	179,061	139,984	142,205	329,217	321,266
Transit-Auto	192,005	183,106	38,917	40,105	230,922	223,211
Walk	64,007	60,768	207,441	212,544	271,448	273,312
Bike	19,532	18,287	12,218	12,250	31,750	30,537

16,000 Fewer Transit Tours

VMT by Time of Day

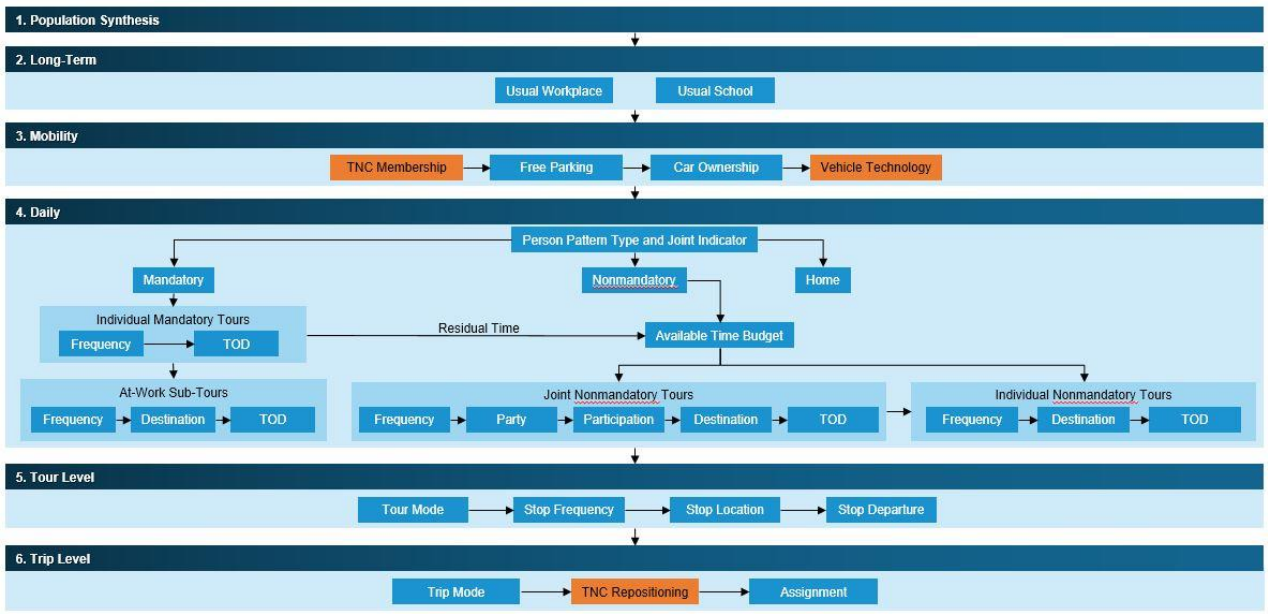
Geographic Area	Percentage Change in VMT as Percentage of Base Scenario VMT				
	AM	Midday	PM	Night	Total
Baltimore City	-3%	0%	-2%	-3%	-2%
Anne Arundel County	-4%	0%	-3%	-4%	-3%
Baltimore County	-3%	0%	-3%	-4%	-3%
Carroll County	-5%	0%	-4%	-4%	-3%
Harford County	-5%	-2%	-4%	-6%	-4%
Howard County	-4%	-1%	-4%	-6%	-3%
Baltimore Region	-4%	0%	-3%	-4%	-3%

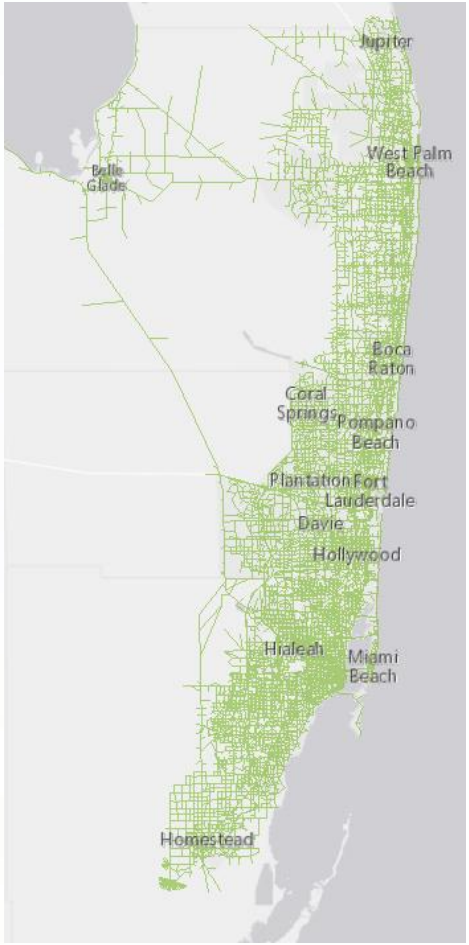
SOUTHEAST FLORIDA ACTIVITY MODEL –

CAV SCENARIO

SERPM Background

- Regional model for Southeast Florida
- 3 Counties
  - 2.1M Households, 5.5M Persons





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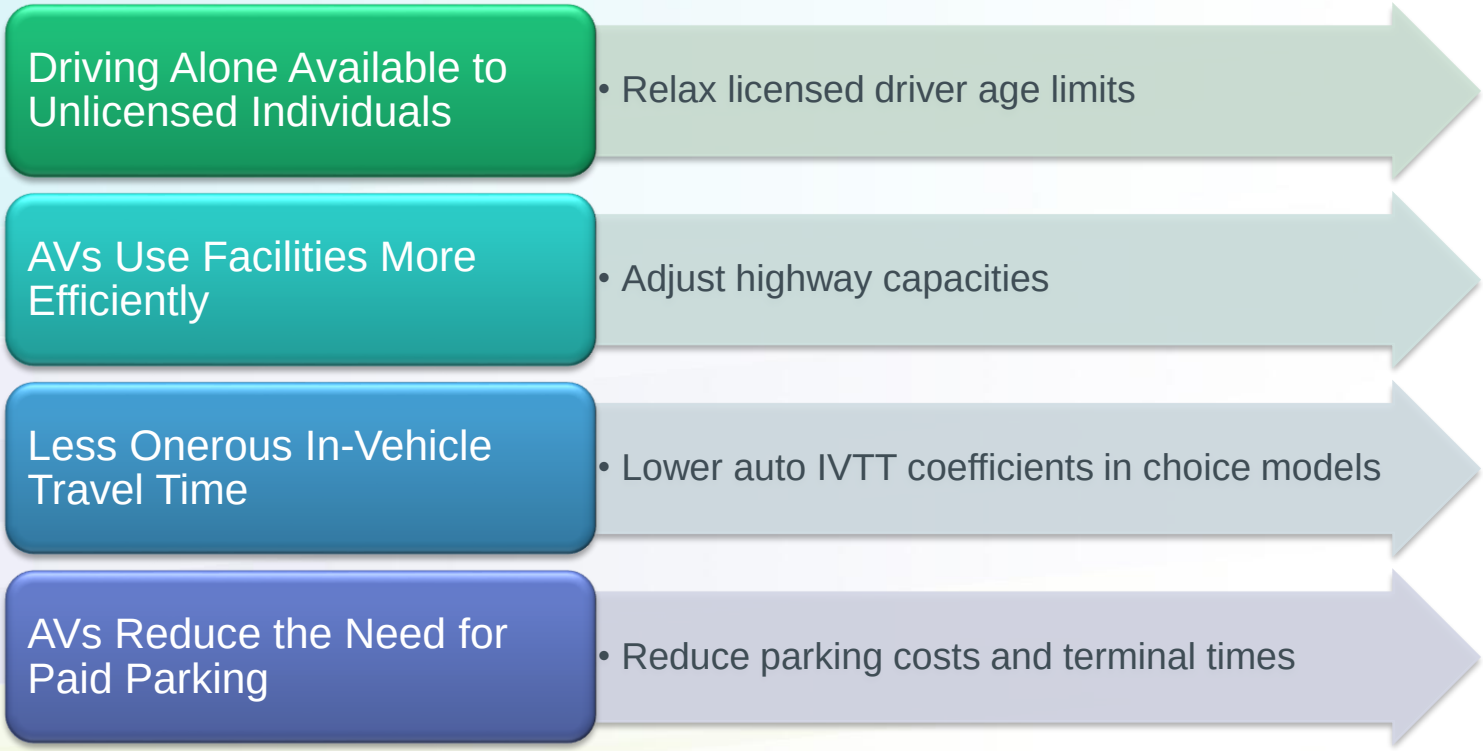
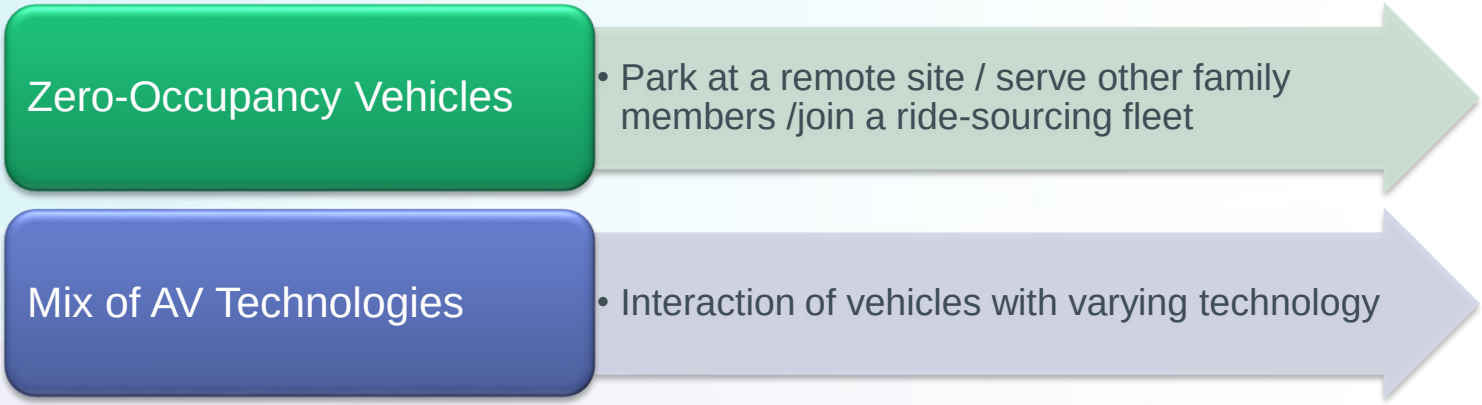
AV Technology – Scenario Development



AV Considerations NOT Included



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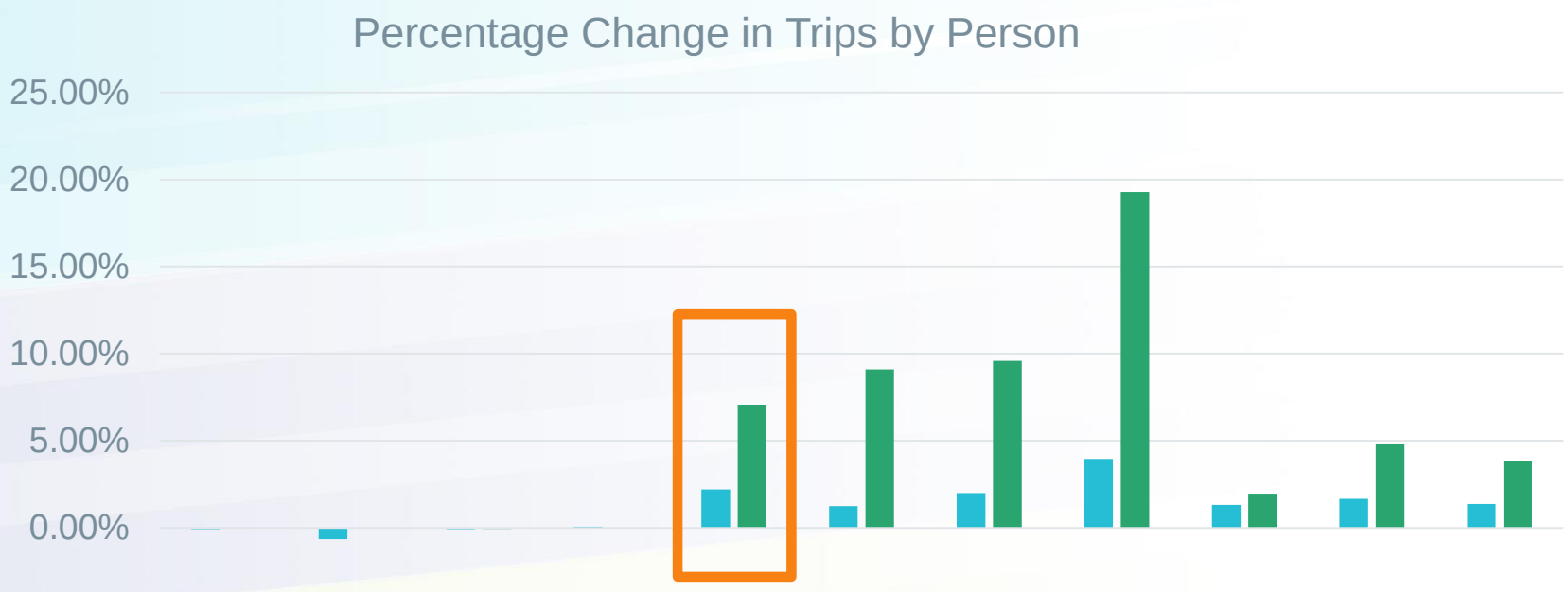
AV Technology Results – Trip-Making by Purpose



	Work	Work-Based	School	University	Escort	Maintenance	Shop	Eating Out	Visiting	Discretionary	Total
All Persons	-0.08%	-0.65%	-0.08%	0.06%	2.20%	1.25%	1.99%	3.96%	1.32%	1.66%	1.37%
Children 11-15	0.00%	0.00%	-0.05%	0.00%	7.06%	9.10%	9.59%	19.28%	1.97%	4.85%	3.81%

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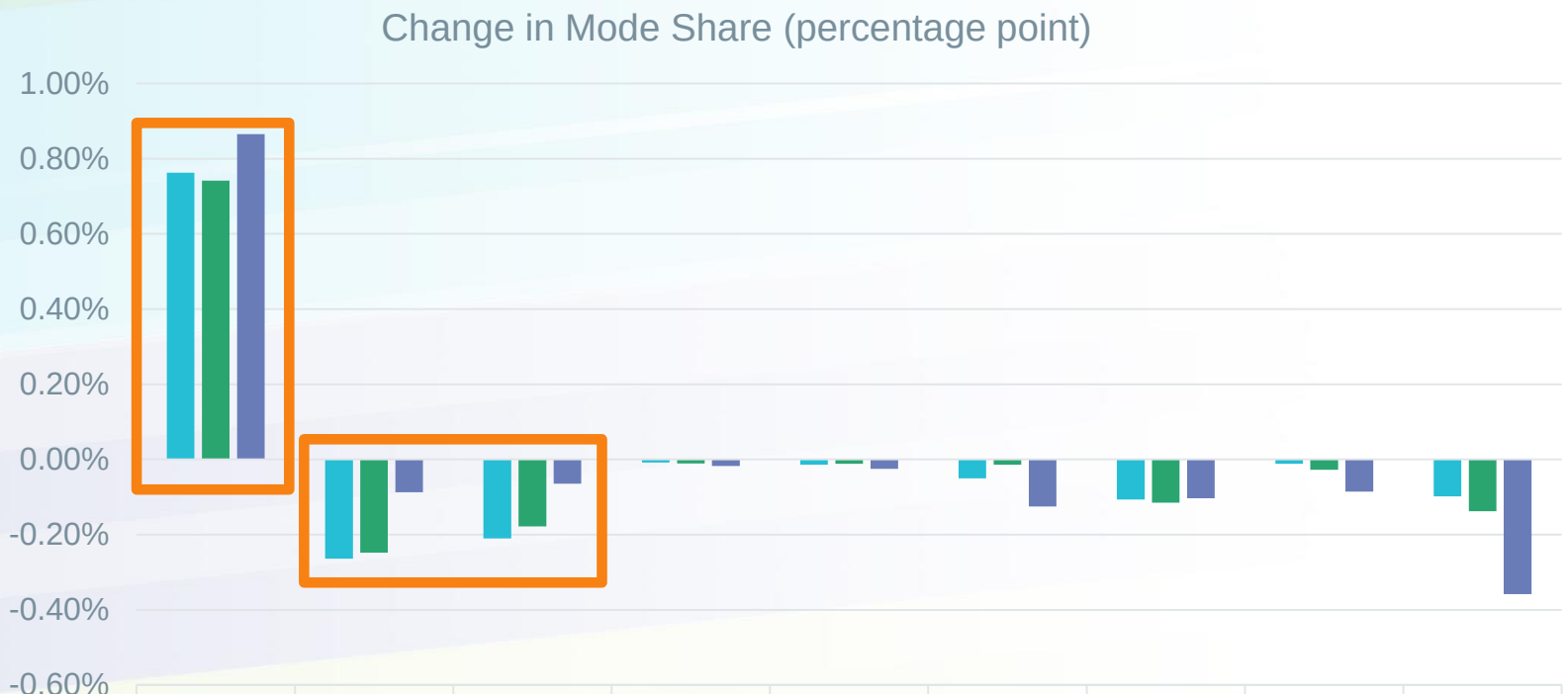
AV Technology Results – Mode Shares



	drive_alone	carpool_2	carpool_3	kissride	parkride	walktotransit	schoolbus	bike	Walk
Palm Beach	0.76%	-0.26%	-0.21%	-0.01%	-0.01%	-0.05%	-0.11%	-0.01%	-0.10%
Broward	0.74%	-0.25%	-0.18%	-0.01%	-0.01%	-0.01%	-0.12%	-0.03%	-0.14%
Miami-Dade	0.87%	-0.09%	-0.06%	-0.02%	-0.02%	-0.12%	-0.10%	-0.09%	-0.36%

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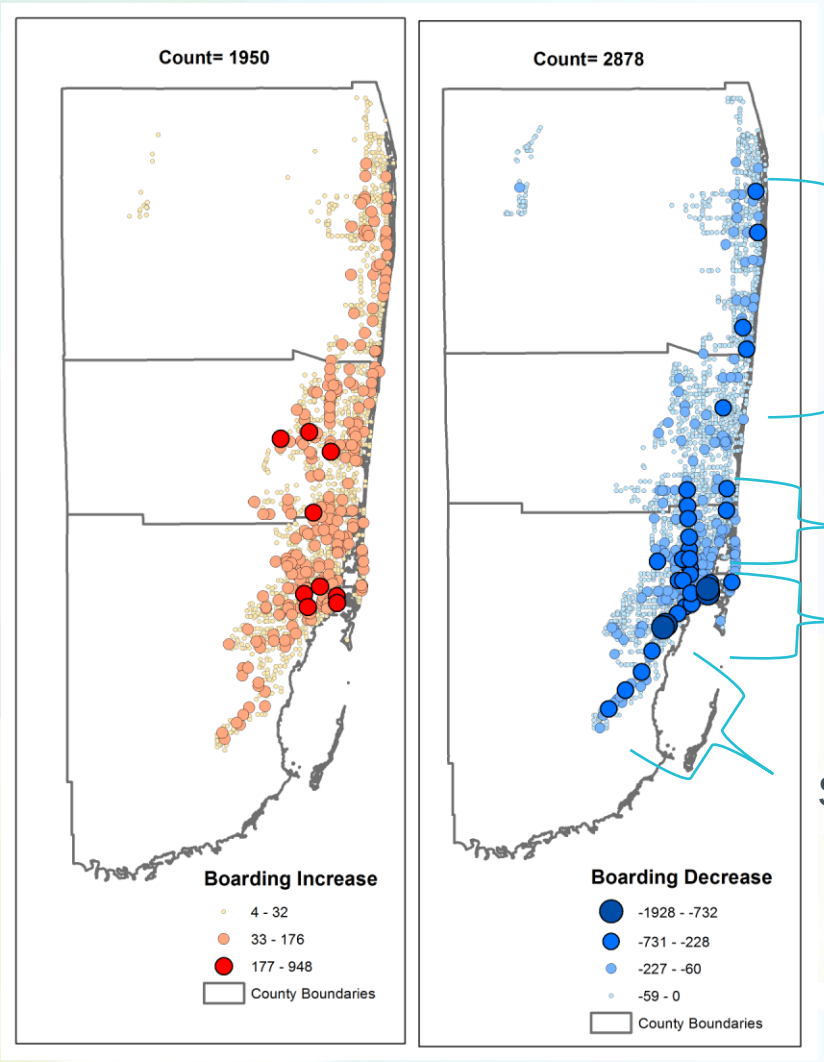
AV Technology Results – Transit Boardings



Tri-Rail Stations

BRT North Corridor

Metrorail

South Dade Transit Way

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AV Technology – Sensitivity Tests

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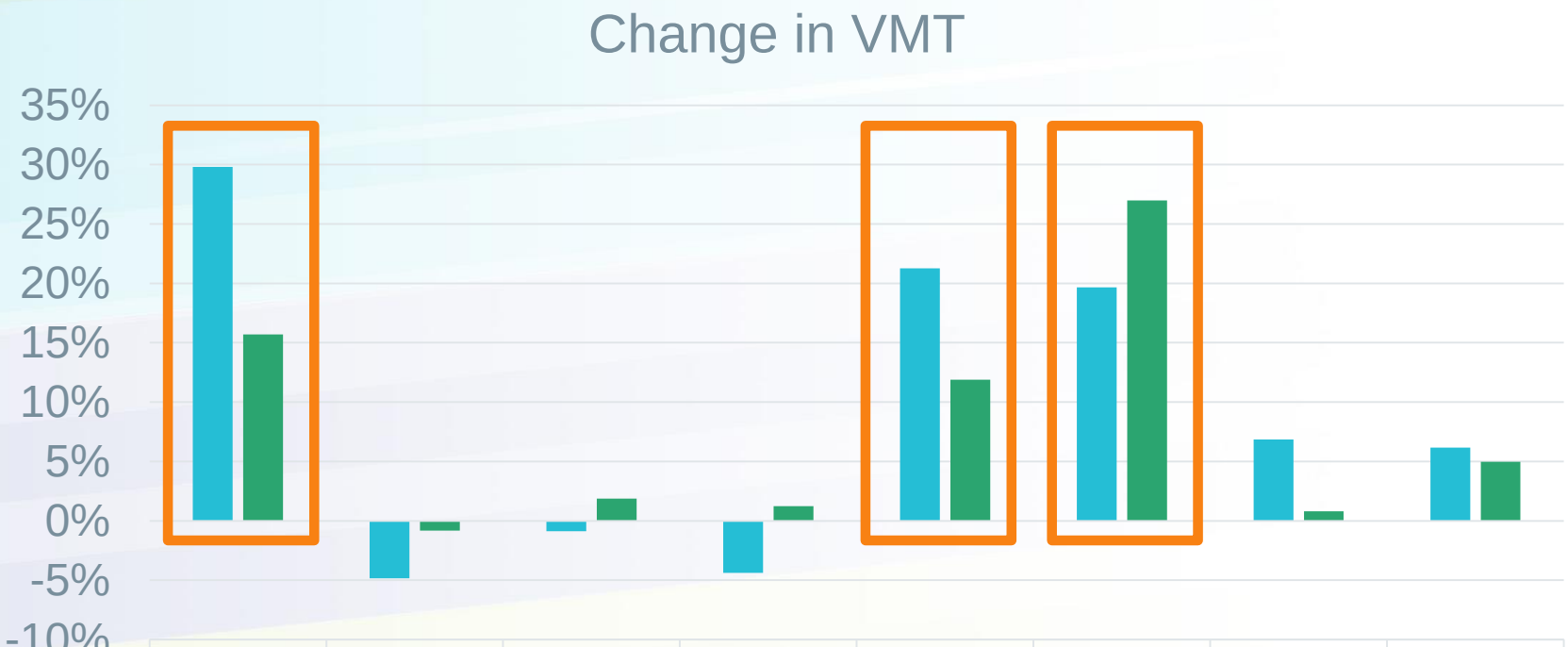
AV Technology Results – VMT



	Freeway	Uninterrupted Roadway	Higher Speed Interrupted Facility	Lower Speed and Collector Facility	Ramps	HOV Lanes	Toll Roads	Total
Peak	29.81%	-4.84%	-0.88%	-4.40%	21.25%	19.67%	6.85%	6.16%
Off-Peak	15.71%	-0.83%	1.86%	1.22%	11.89%	26.98%	0.81%	4.97%

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AV Technology Results – Summary

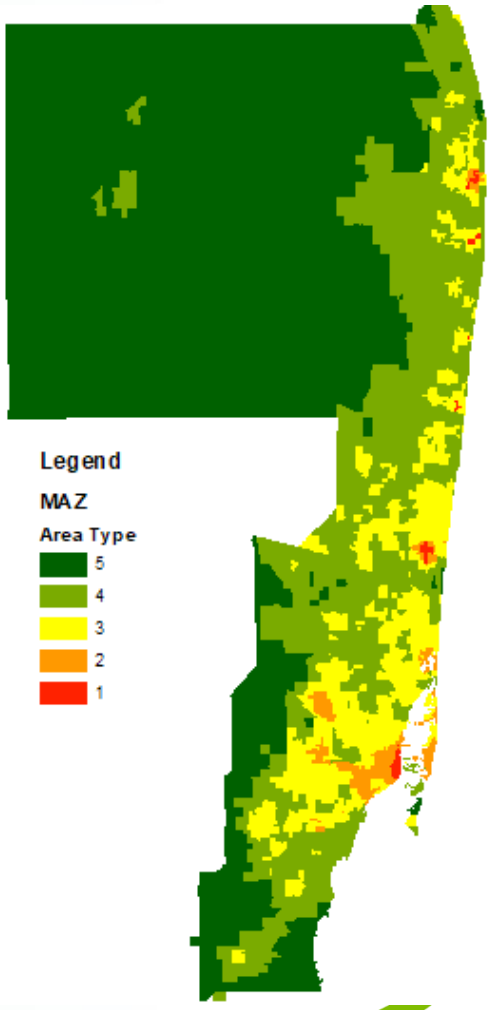
- Increases in trip making not always reasonable
  - » Escorting activities
  - » ABM offers better opportunity to account for this
- VMT changes were reasonable
- Transit
  - » Local bus mode deserves a second look
  - » Potential for micro-transit?
  - » Challenges to lower-frequency service
- Incorporating ZOVs would increase congestion

SOUTHEAST FLORIDA ACTIVITY MODEL –

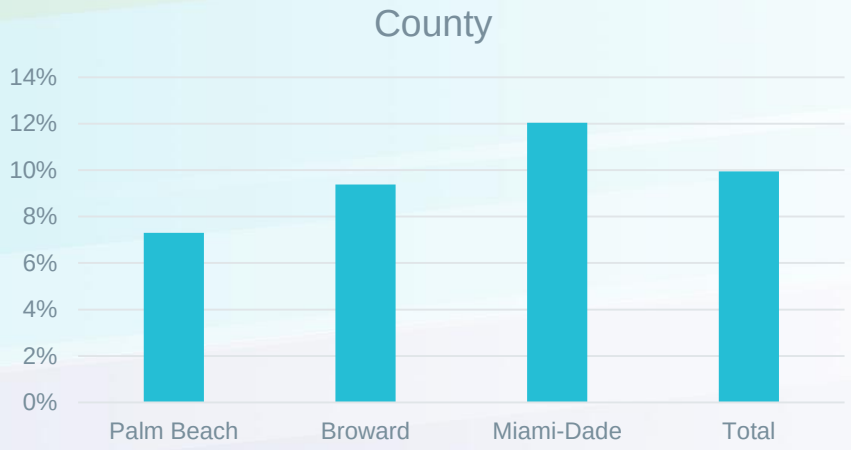
TNC SCENARIOS

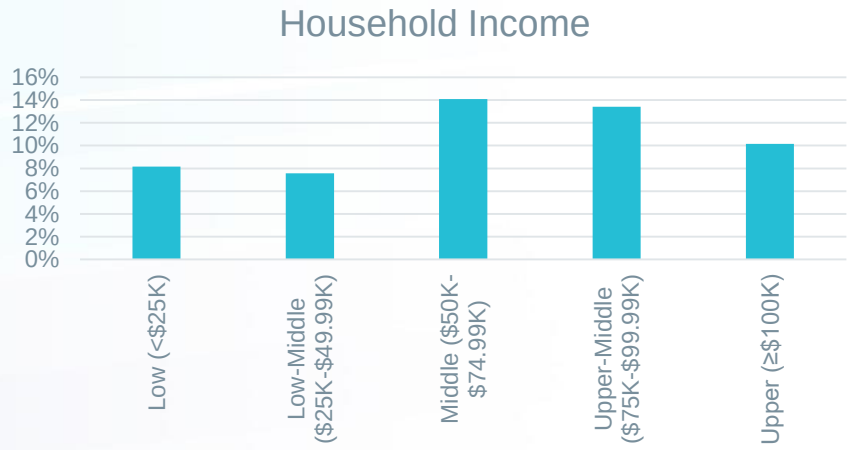
TNC – Scenario Development

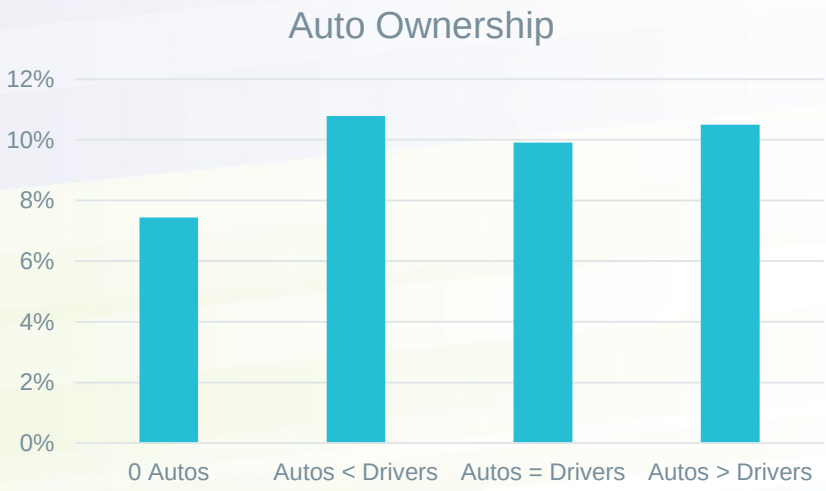
- TNC Membership Model
  - Reflects some travelers do NOT consider TNC as option
  - Varies across demographics: education, income, age, gender
  - TNC availability (**wait time by area type**)
- TNC mode alternatives
  - Wait time, fare, travel time
  - Shared service factors
- Repositioning to balance ODs
- Survey data for calibration/assumptions



Baseline TNC Membership







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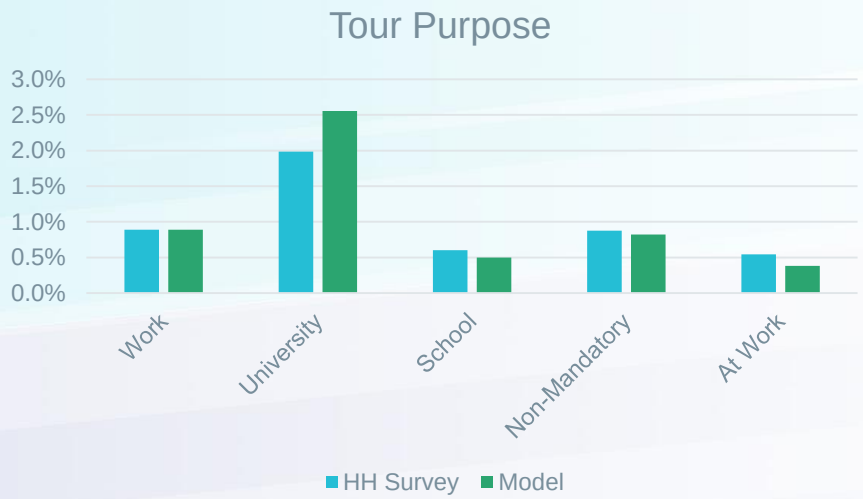
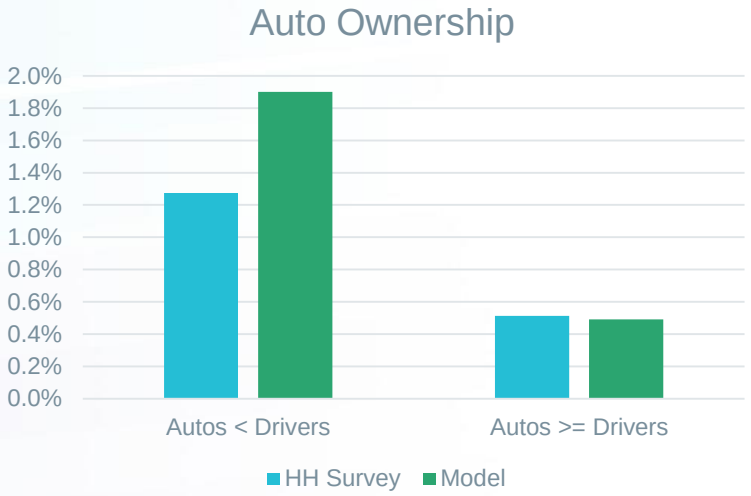
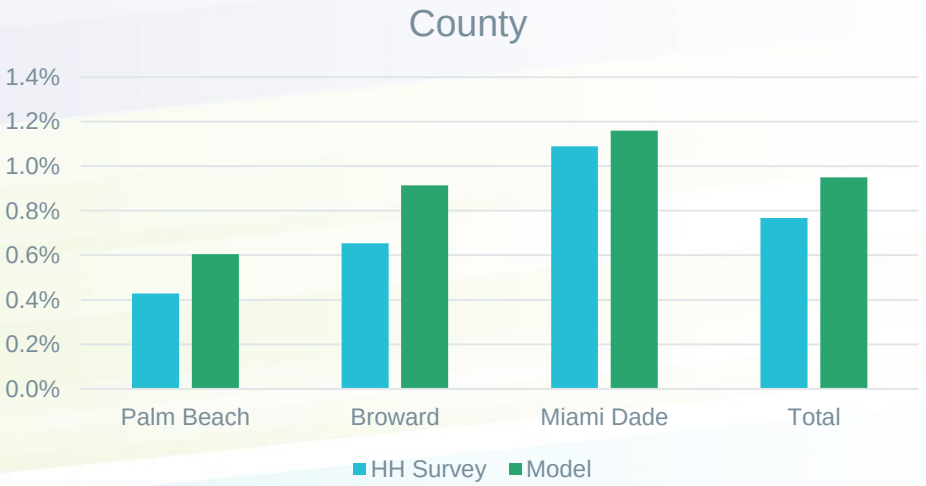
Baseline TNC Mode Share







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Baseline TNC Assignment

TNC passenger and repositioning trips

	Total Trips	Average Distance	VMT Ratio
Passenger	187,222	8.81	0.25
Repositioning	52,569	7.93	

VMT Changes over non-TNC Base

County	% Difference
Palm Beach	0.55%
Broward	0.61%
Miami-Dade	0.57%
All Groups	0.58%

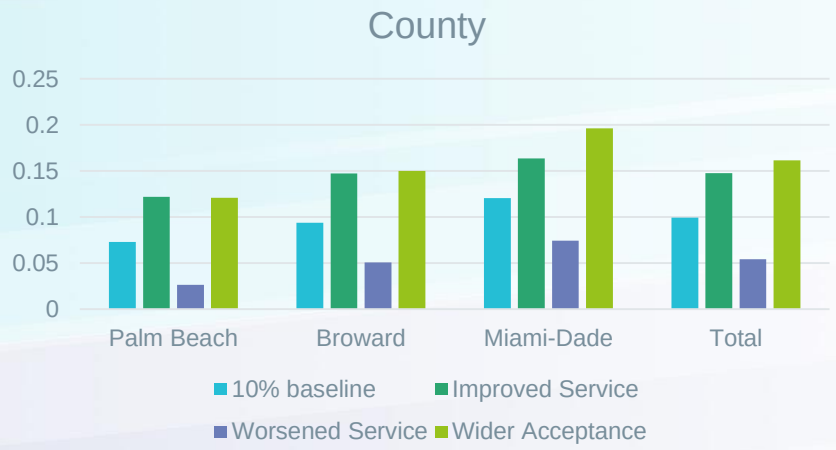
Transit changes over non-TNC Base

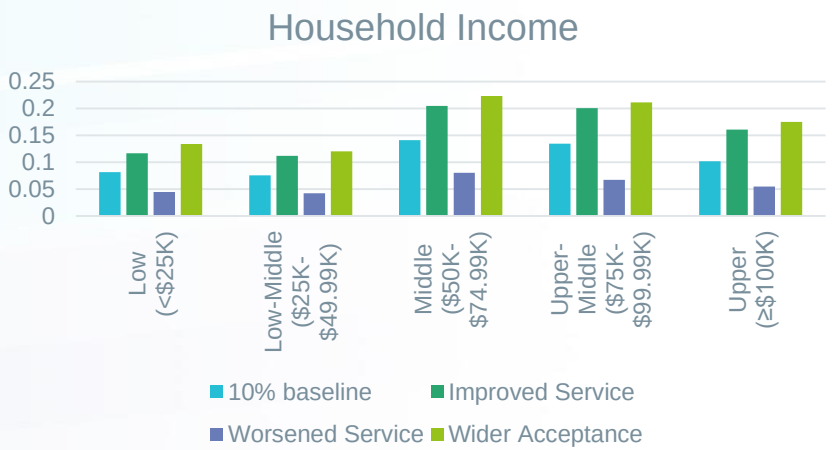
Operator	% Difference
Total Transit Boardings	-3.16%
Total Transit Linked Trips	-2.64%
Boardings / Linked Trip	-0.53%

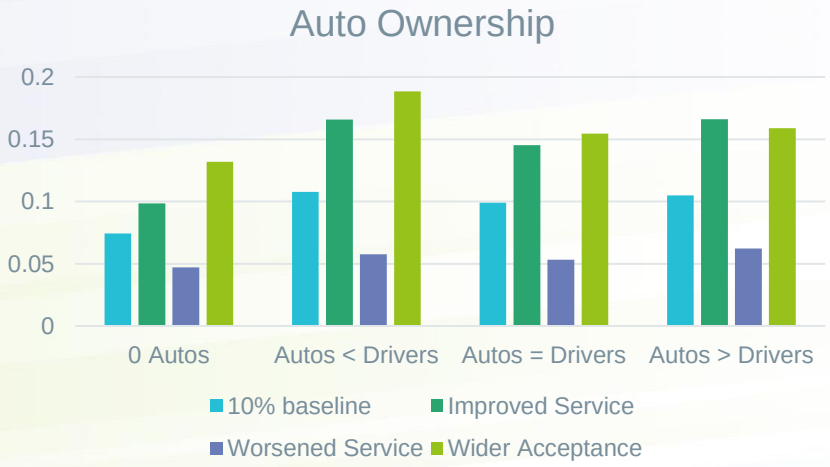
TNC Scenario Development

- Better service
  - Wait times 1.5-15 min (half)
  - Half fares
- Worse service
  - Wait times 6-60 min (double)
  - Double fares
- Wider adoption – remove preferences for **NOT** using TNC based on:
  - Gender
  - Education
  - Age
  - Keeping income and wait times

TNC Scenarios – Household TNC Membership







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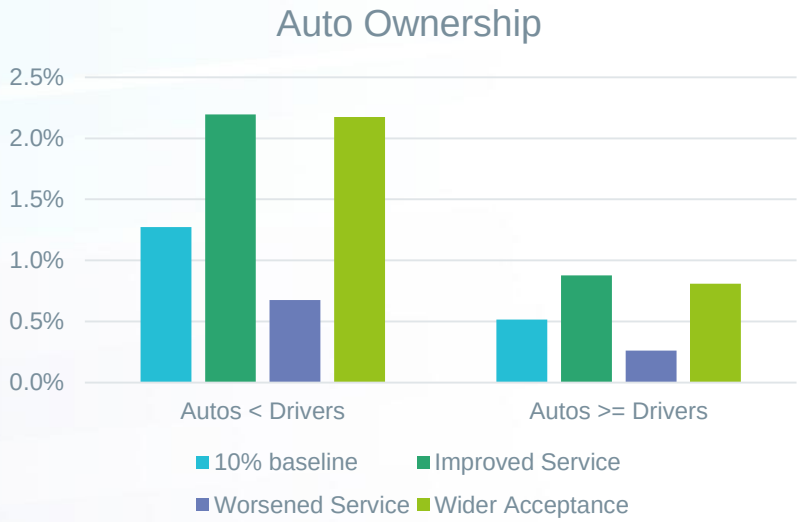
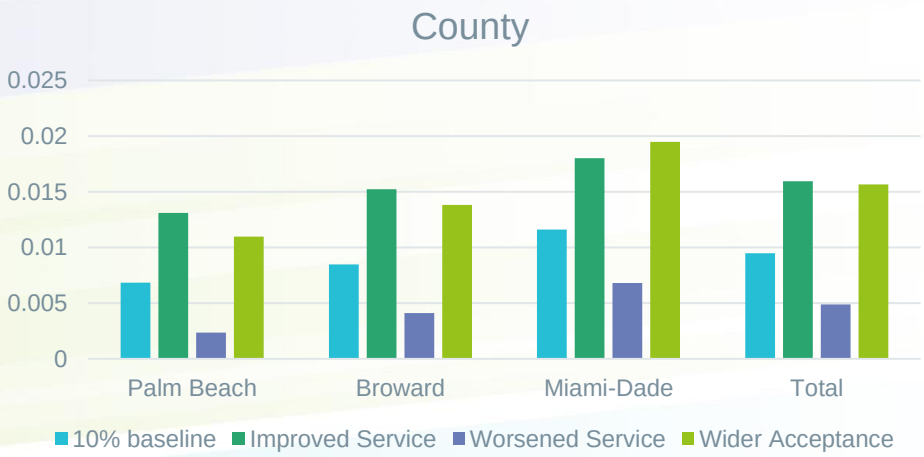
TNC Scenarios – Mode Shares





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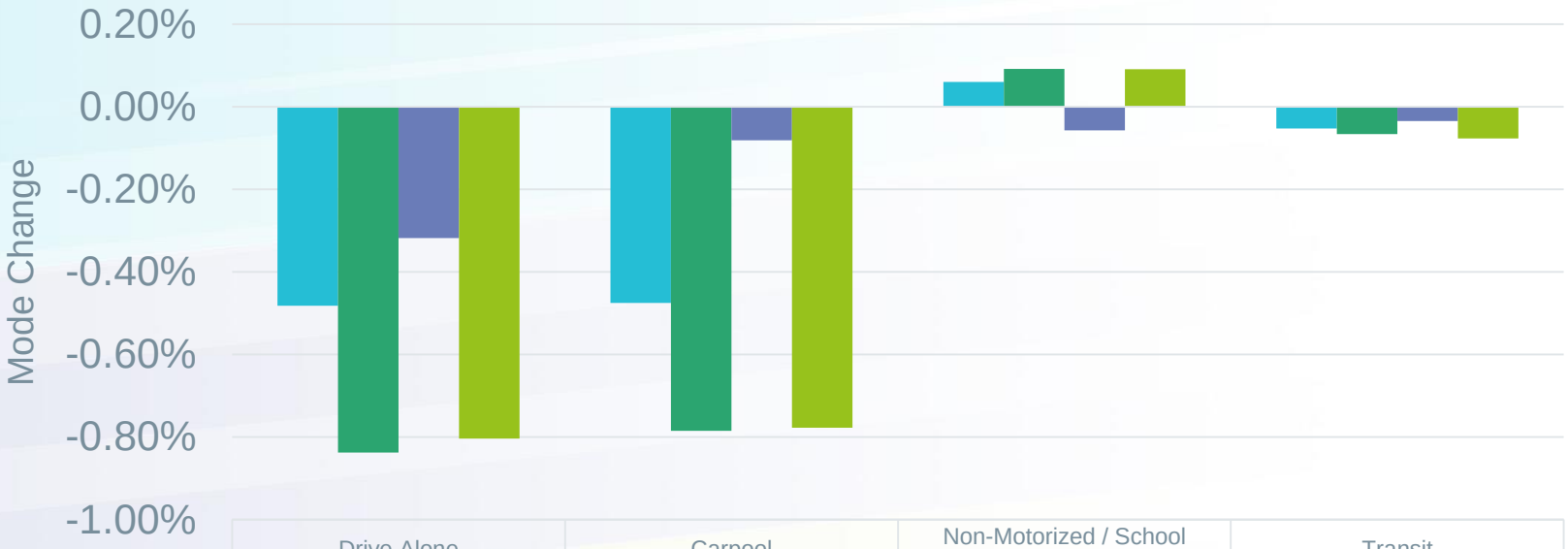
TNC Scenarios – Trip Mode Shift



	Drive Alone	Carpool	Non-Motorized / School Bus	Transit
10% baseline	-0.48%	-0.48%	0.06%	-0.05%
Improved Service	-0.84%	-0.78%	0.09%	-0.07%
Worsened Service	-0.32%	-0.08%	-0.06%	-0.03%
Wider Acceptance	-0.80%	-0.78%	0.09%	-0.08%

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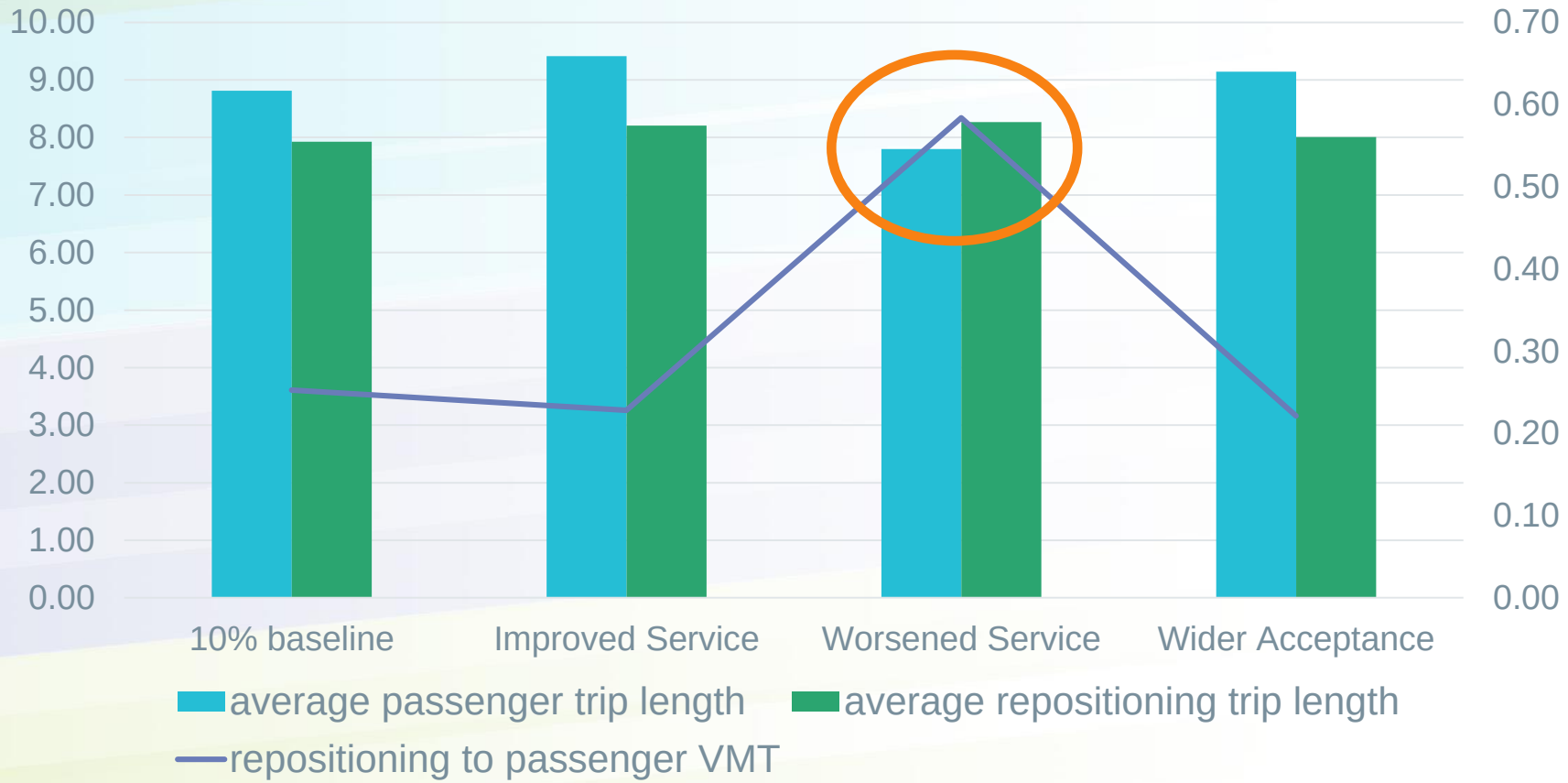
TNC Scenario Assignment



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TNC Scenarios Summary

- Wait times effective representation of use preferences (but needs better validation)
- ABM allows for segmenting TNC usage
  - E.g., across demographic segments
- Transit impact small
  - Drive access/egress transit utility improvement for households with TNC membership
- Next Steps
  - Testing policies to encourage shared mobility

Conclusions

- ABMs offer new areas for policy analysis
  - » Demographics
  - » Emerging technologies
- Scenario analysis guidelines
  - » Exploratory
  - » NOT predictive
  - » Assumptions should be explicit