Activity-Based Model Future Mobility Experiments

Experiments with AV-Exclusive Facilities

presented by
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Outline

- Previous Work
- Scenario: AVs on HOTs
- Implementation
- Results
- Discussion

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

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

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AVs on HOTs Scenario Motivation

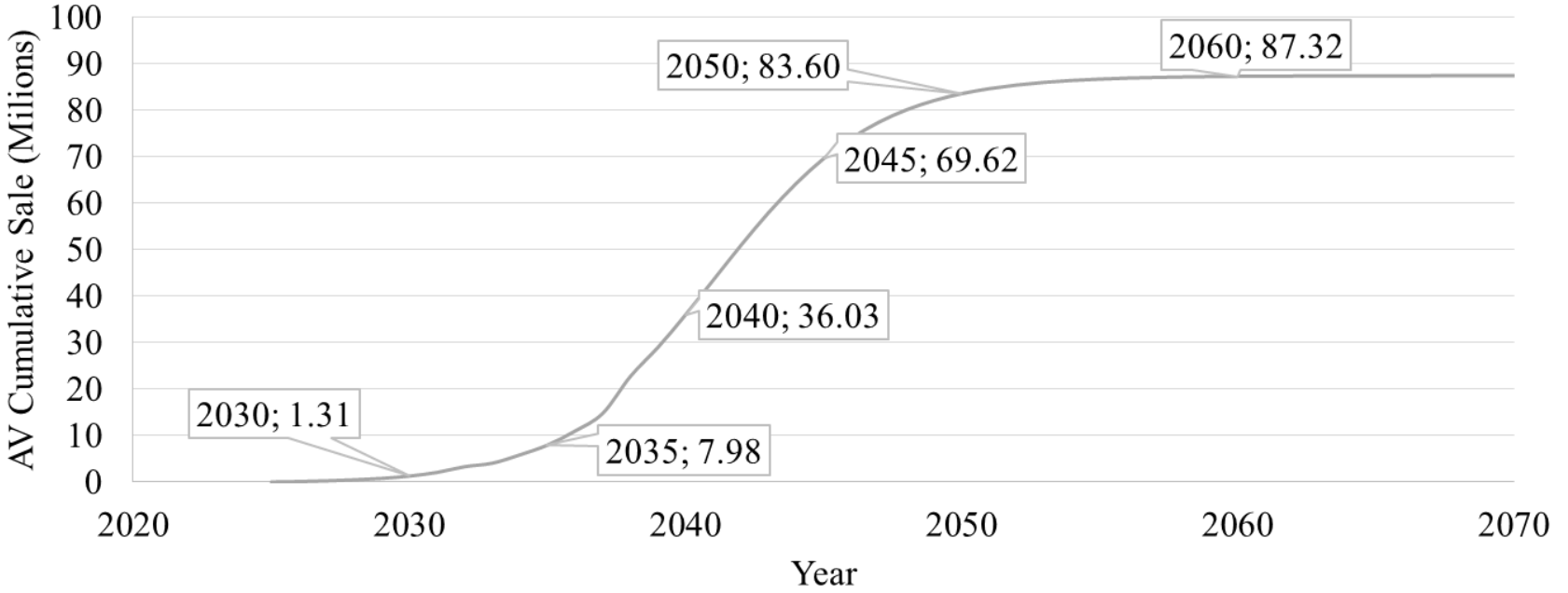
- Mixed fleet limits potential for capacity / speed improvements
  - Maybe even detrimental effects in the near term?
- If an exclusive facility could be dedicated to AVs, would that be a net benefit to the system?
- At what point?
  - Market penetration
  - Travel behavior shifts
  - Capacity increases

Autonomous Vehicles

Relevant Benefits

- **Use facilities more efficiently**
- **Less onerous in-vehicle travel time**
- **Reduce the need for paid parking**
- **Greater mobility for non-drivers**

Market Penetration Forecasts



Source: Lavasani, Jin and Du (2016), TRR No. 2597, pp. 67-74.

- Based on the Generalized Bass diffusion model
- Investigated previous penetration patterns for automobiles (from 1920 to 2014) and hybrid electrical vehicle
- Considered technology acceptance tastes through the usage of internet and cell phones from 2001 to 2014.

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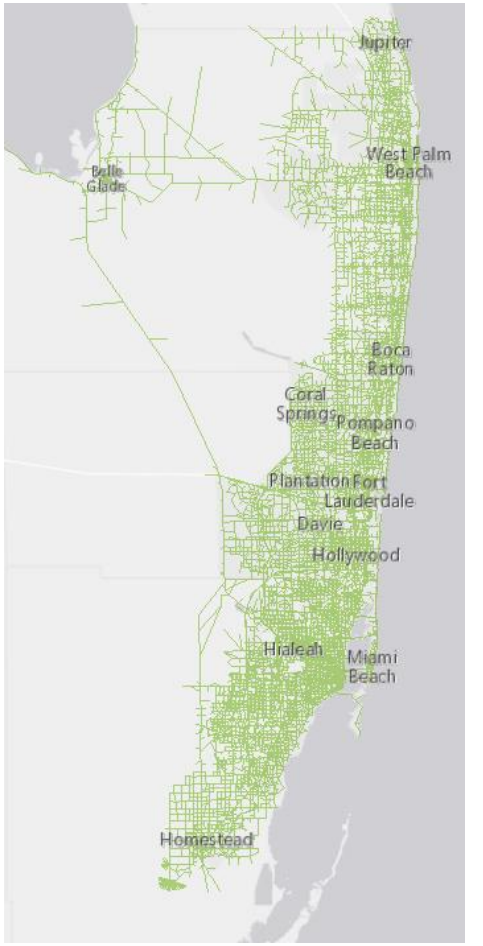
SERPM Overview

- Current model: SERPM 7.0
  - 2010 base / 2040 forecast
  - Activity-based model for residents
  - Tour-based model for visitors
  - Half-hour time periods (5AM – 12AM)
  - 5 Highway assignment Time periods
    - Auto occupancy; Pay / No Pay / HOV
  - 4 Transit assignment time periods
    - Access mode
- Represents 3 counties
  - 2.1M households and 5.5M persons
- SERPM 8.0 Model Update
  - New HH survey and Streetlight data
  - 2015 Base / 2045 Forecast



Implementation approach


- **Where available**: pivot off of existing model parameters or extend existing structures
- **Where not available**: introduce new terms and calibrate the model to reproduce scenario shares
- **Make changes incrementally** – examine results of demand and supply models
- 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

Auto Technology Component

- Household attributes
  - Household income <75k
  - Number of Vehicles in HH
- Spatial attributes
  - Intersection density
  - Population density
  - Retail density
- Person attributes
  - Long commute (>35 miles)
  - Education (Bachelors or higher)
  - Proportion of drivers under 30
  - Proportion of drivers age (Greater than 49)
  - Male driver in HH

Market Penetration Scenarios

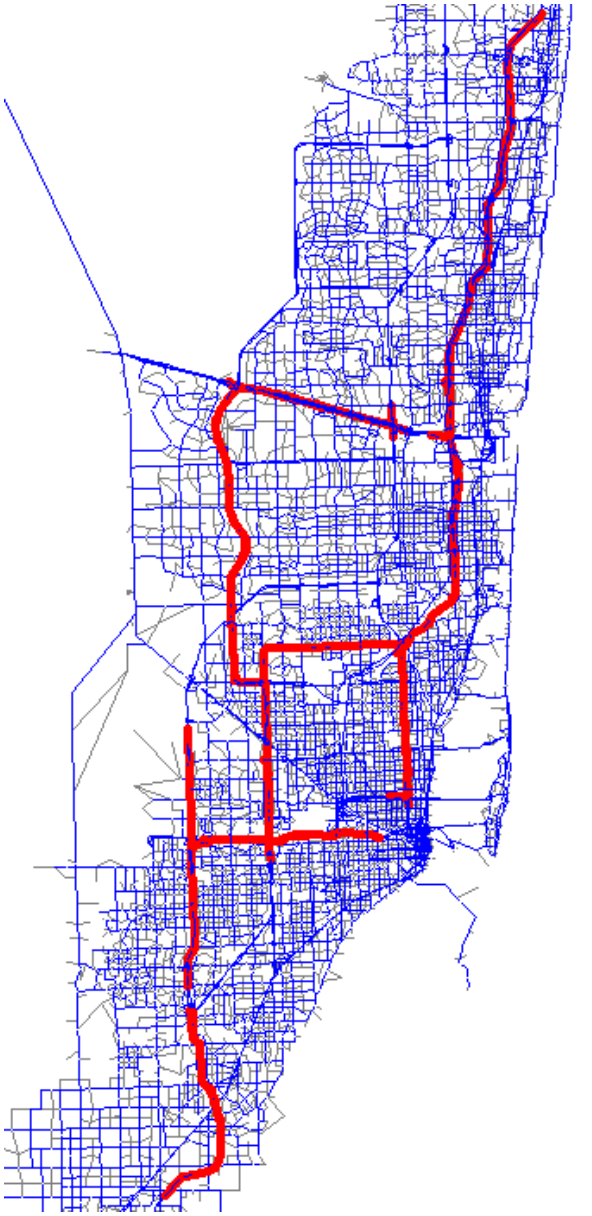
- Assumes earlier adoption by higher income households (>75K annually) and households with 3 or more vehicles.

Market Penetration	HH Income		HH Vehicle	
	<75K	>=75K	<3	>=3
10%	0%	100%	10%	90%
30%	20%	80%	20%	80%
50%	40%	60%	30%	70%
75%	45%	55%	40%	60%
90%	50%	50%	50%	50%

Total #HH	HH Income		HH Vehicle	
2,801,906	<75K	>=75K	<3	>=3
	1,855,857	946,049	2,412,337	389,569

Implementation Assumptions

- All HOT facilities become exclusive AV facilities
  - Maintain current toll rate
- All auto travel by persons in an AV household are by AVs
  - And the opposite is true for non-AV households
- ZOV operation is limited



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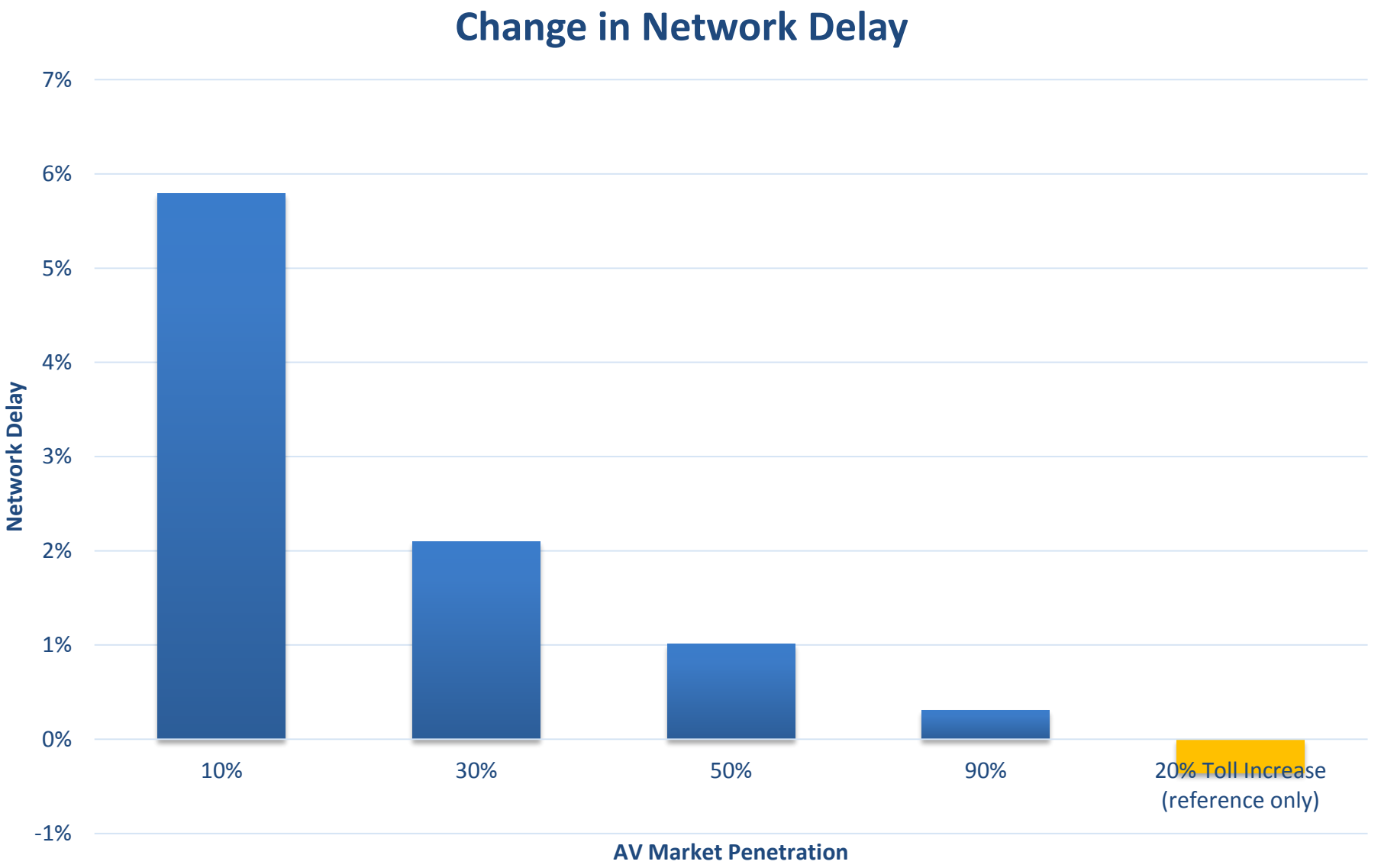
Scenarios Explored (to date)

AV Market Penetration	Underage Drivers	IVTT Sensitivity	Parking Costs	Managed Lane Capacity
10%	>=11 yrs can drive	10% reduction	20% reduction	90% increase
30%				
50%		50% reduction		
90%				

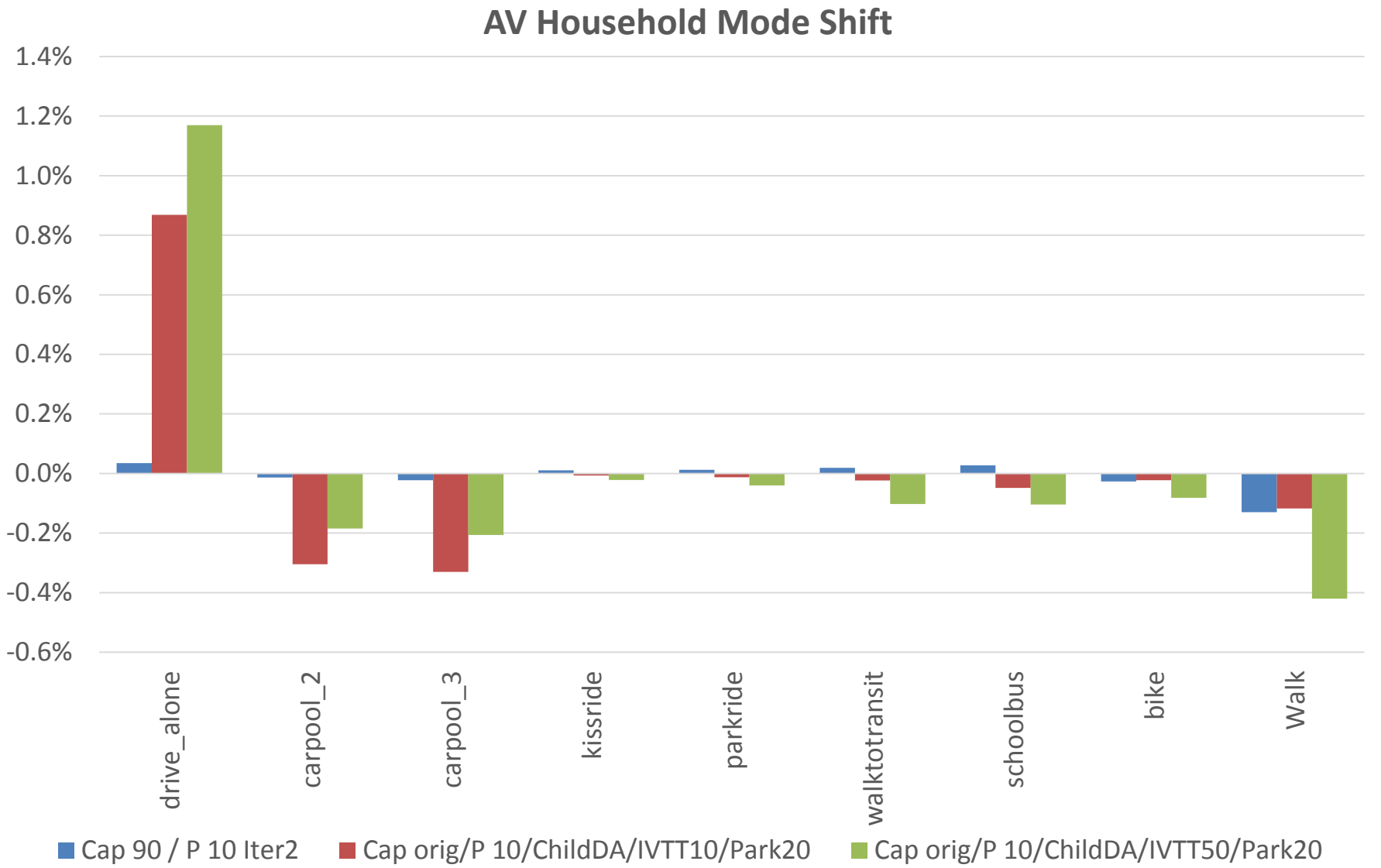
Metrics Reviewed


- **Mobility**: auto ownership, technology, transponder
- **Daily activity pattern**: tours by type, trip chaining, tour rates, intra-household coordinated travel, trips by type
- **Tour** location and time of day distributions
- **Mode choice** by income and region
- **Transit** ridership by submode, area type, region
- **Highway**: trip length; by facility type VMT, VHT, average speed, delay

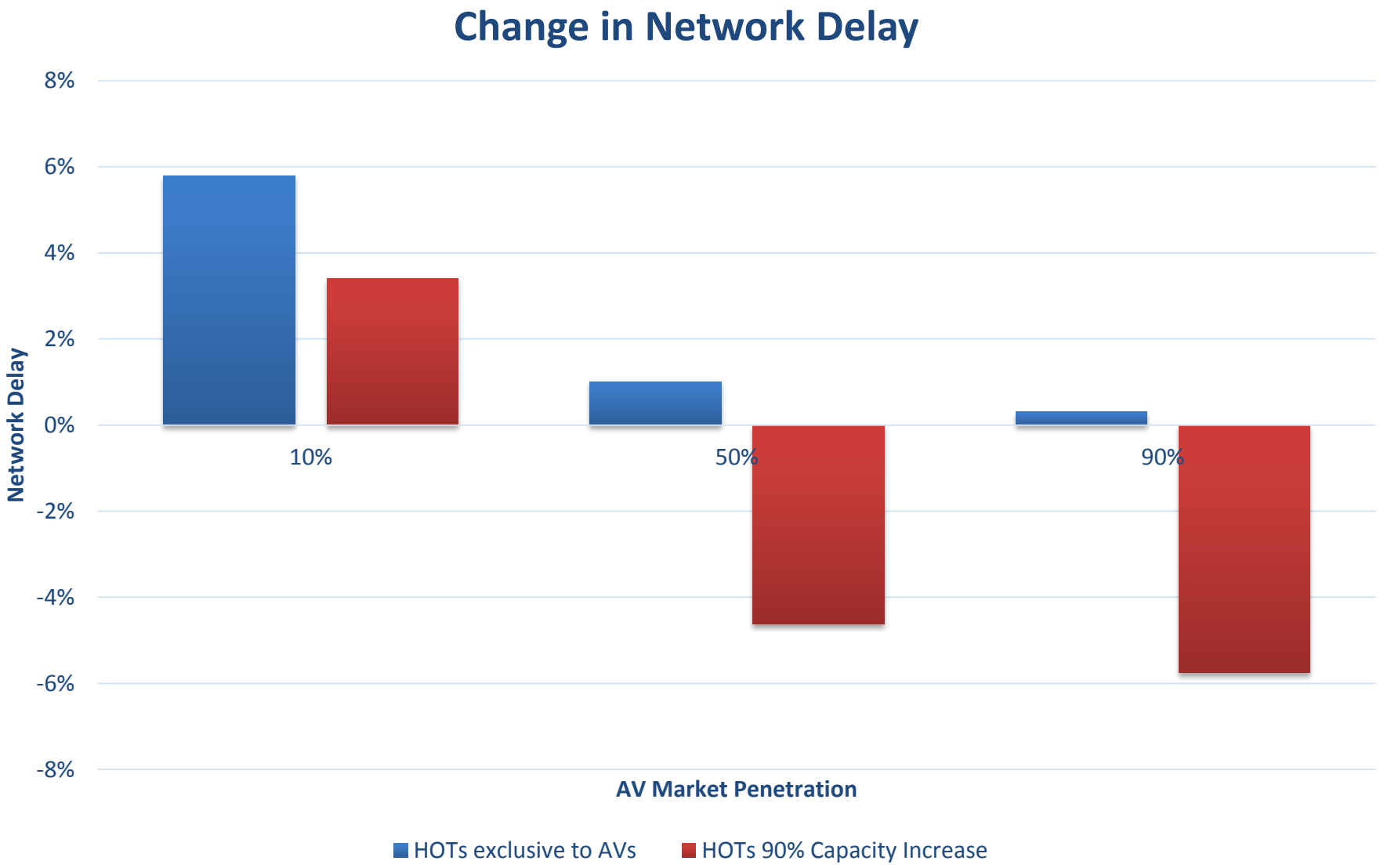
Highway Network: Exclusive HOTs



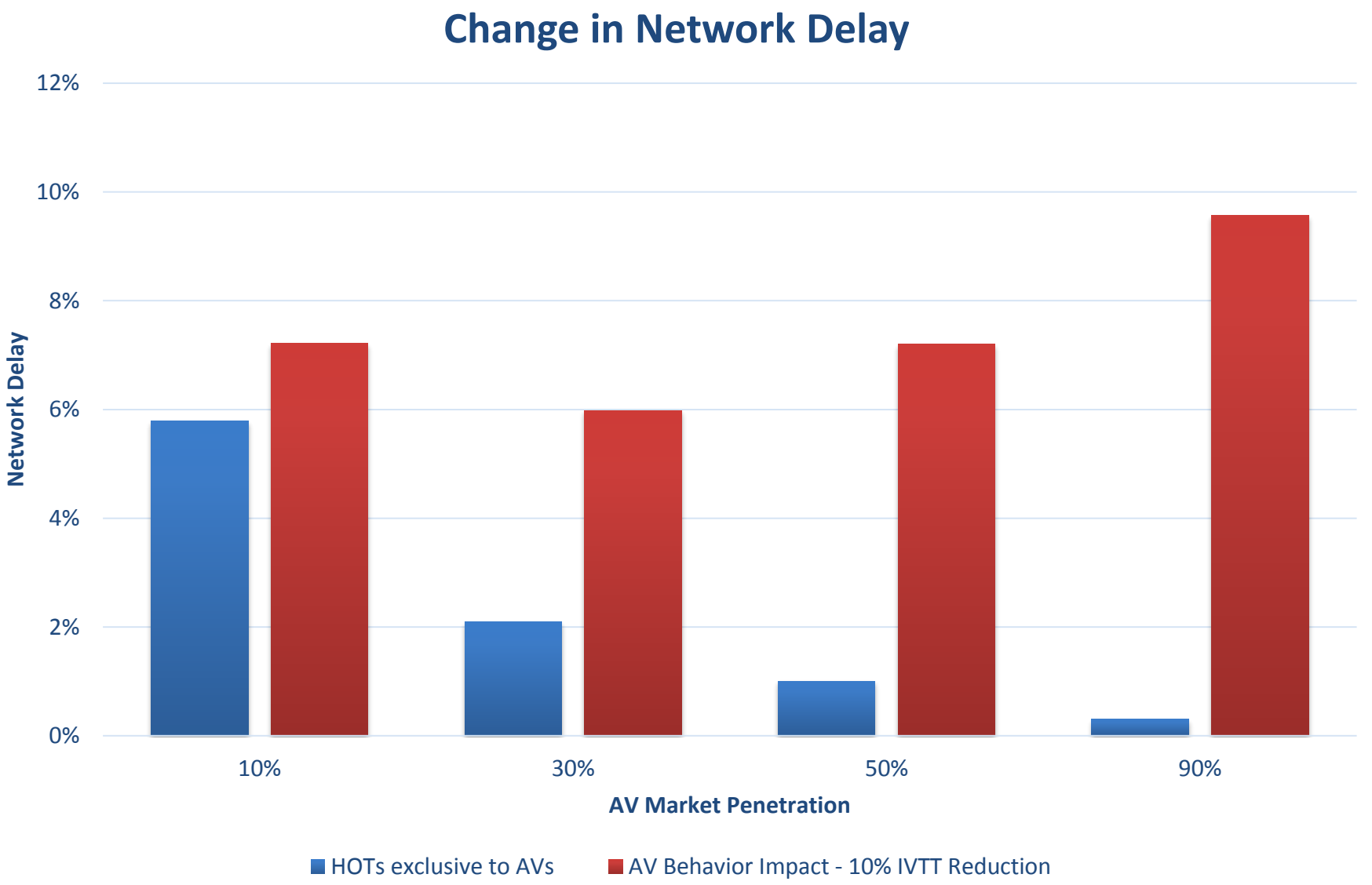
Impact of AVs on Travel Behavior



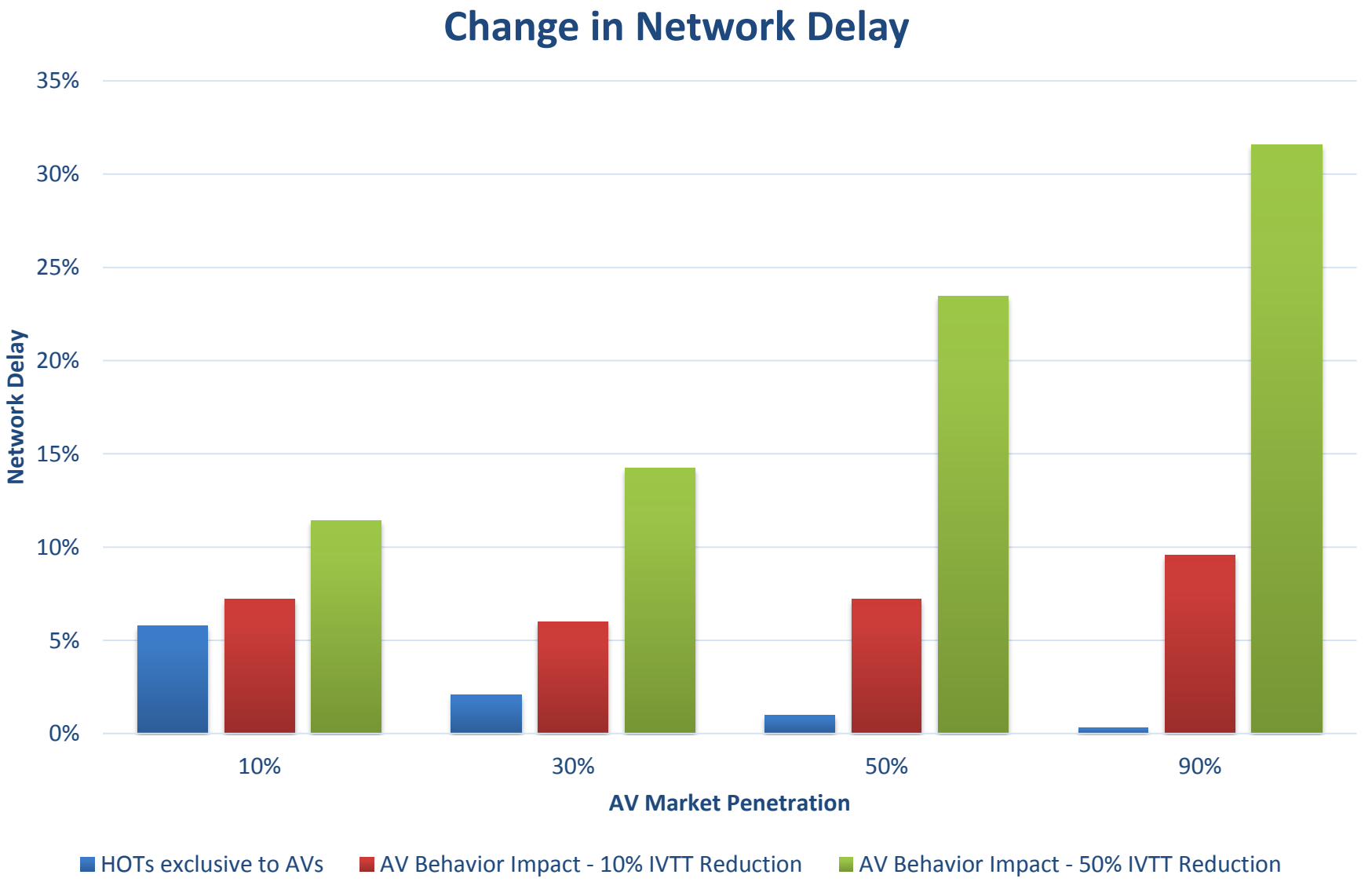
HOT Capacity Increase



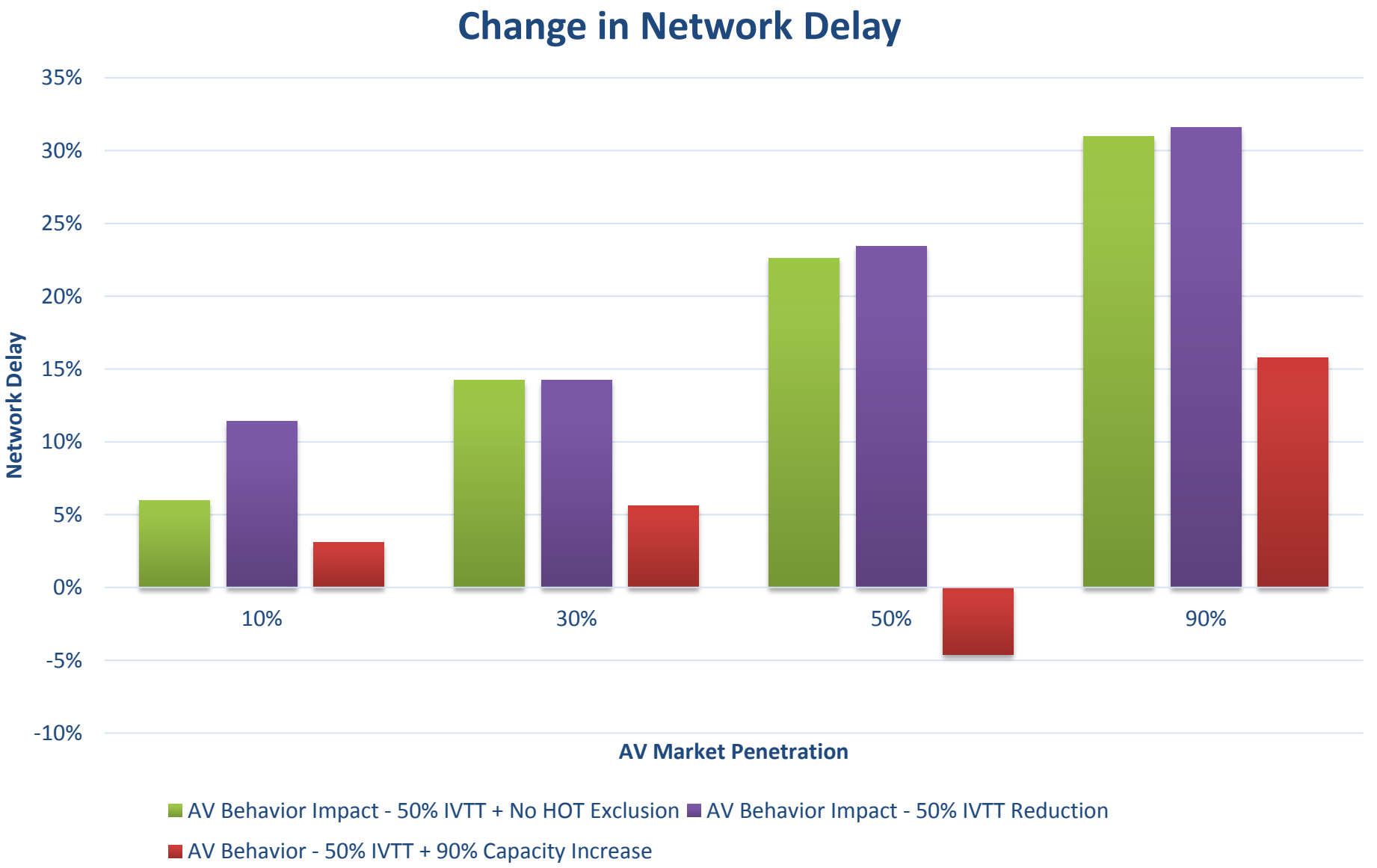
IVTT 10% Reduction



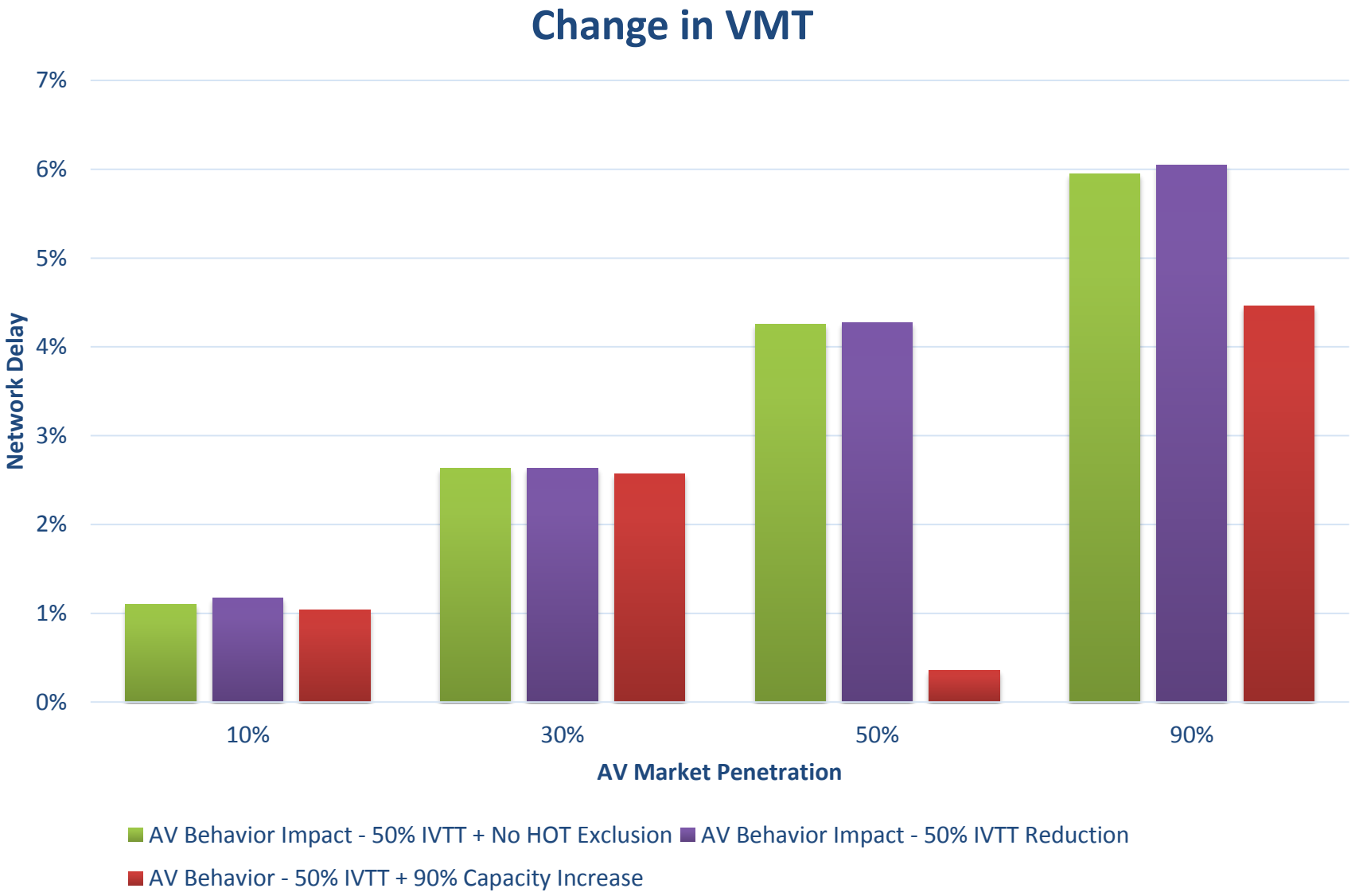
IVTT 10% and 50% Reduction



Cumulative and Exclusion



Cumulative and Exclusion - VMT



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Model Challenges/Lessons Learned

- Accessibility feedback
- Run time
  - Single iteration for exploratory analysis
  - Experiment design
- Complexity
  - Checklists!*

**The Checklist Manifesto, Atul Gawande*

Future Experiments


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Acknowledgements


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Questions?

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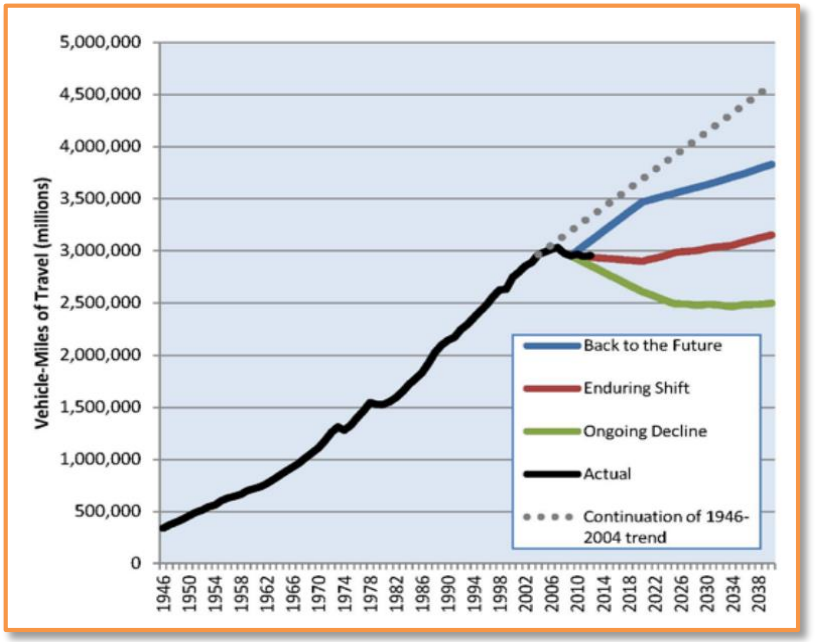
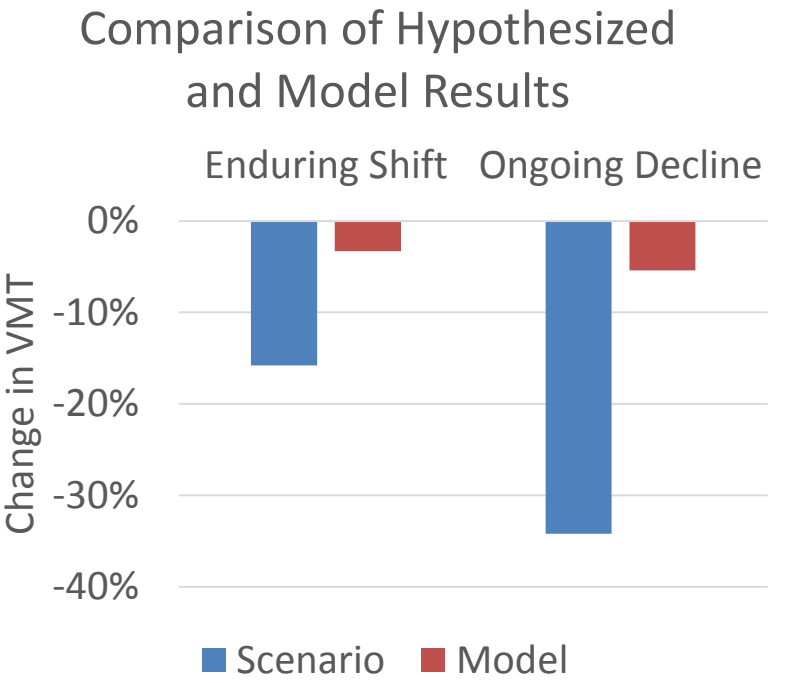
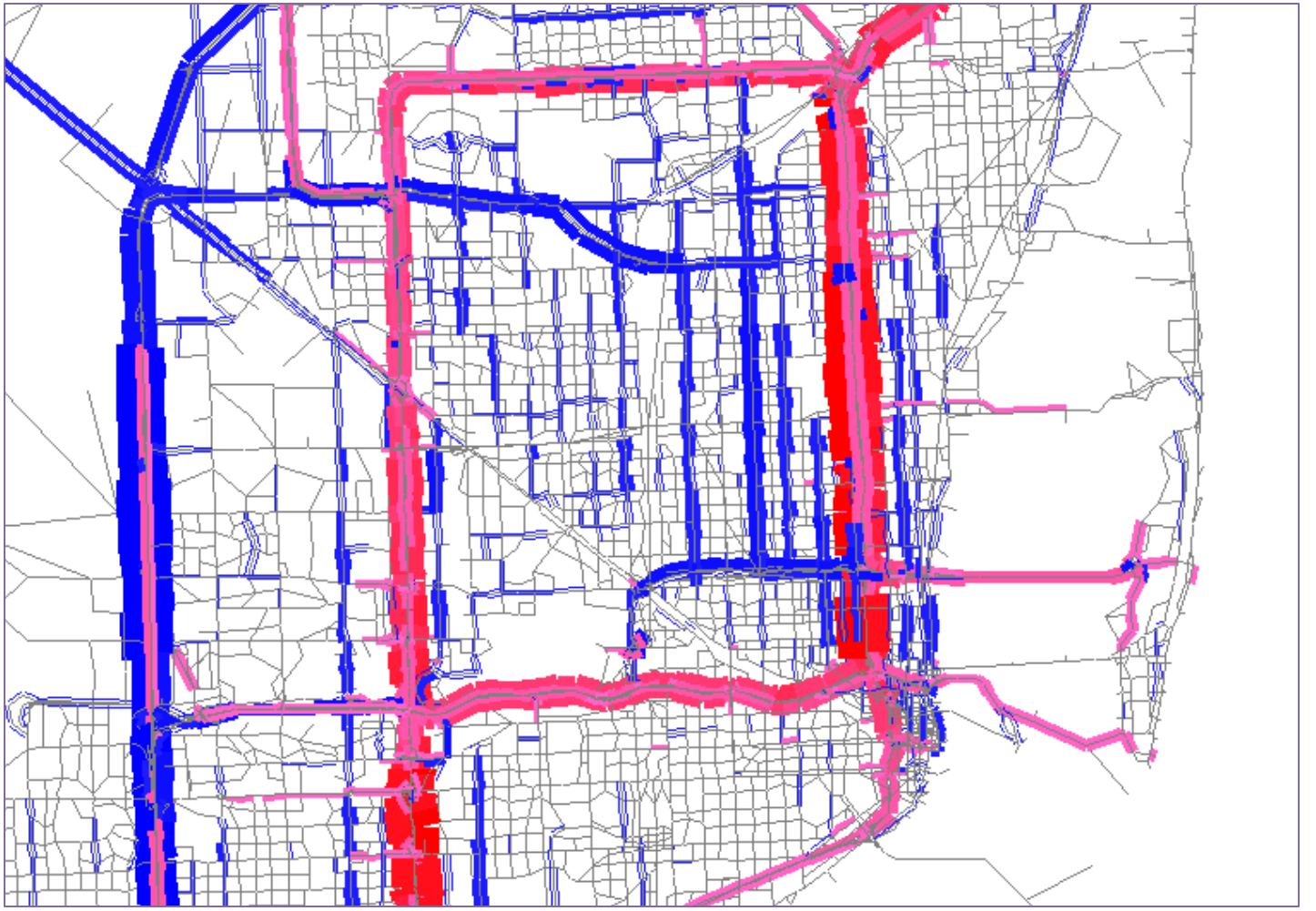
Other Scenarios

Millennials Scenario VMT Changes: Model vs. Futurist





AV Scenario: Change in Daily Volume



Highway capacity improvements shifted traffic to major facilities