



# QUANTIFYING AUTOMATED TRAVEL DEMAND

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# roadmap.

- Why we did this?
- What we did?
- What we assumed?
- What happened?
- What do we do next?

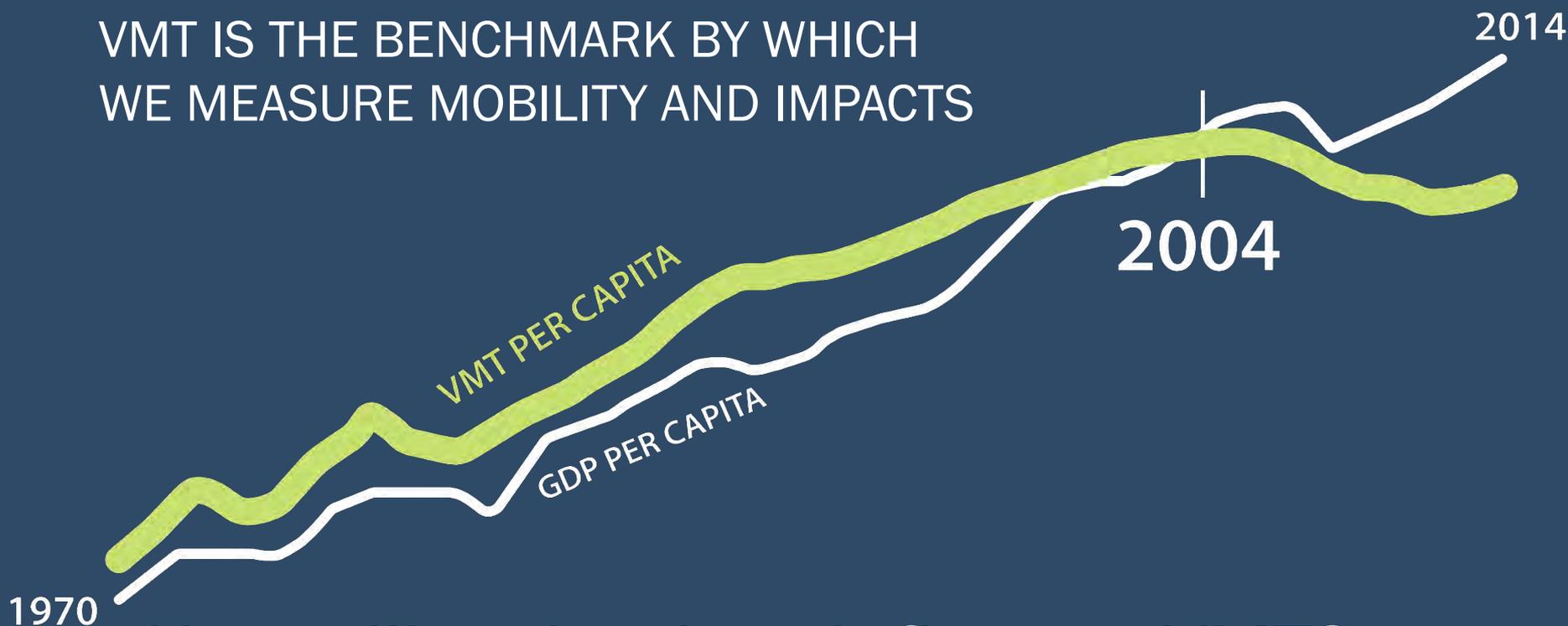


“Very smart people have very different opinions on the pace of implementation, market acceptance, and impacts of technology in transportation. But, folks are hungry for answers, and in the absence of information speculation is running rampant”

*Steven Polzin, University of South Florida*

**why** ■ WE DID THIS

VMT IS THE BENCHMARK BY WHICH WE MEASURE MOBILITY AND IMPACTS



How will technology influence VMT?

# why WE DID THIS



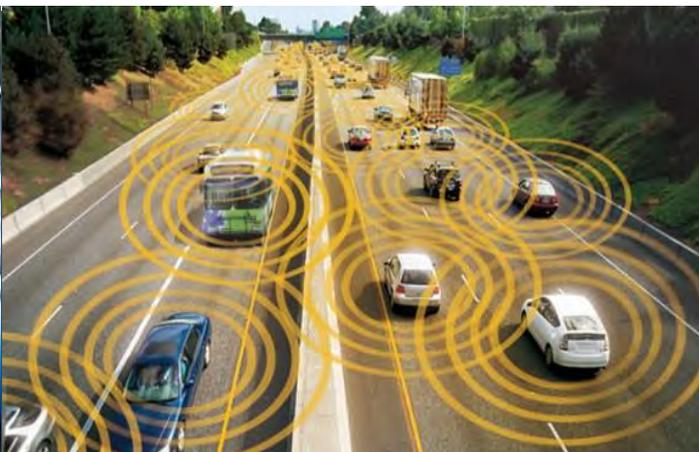
Here are some opinions.

Moving beyond opinions. Can we continue to estimate travel behavior with the tools we have when self-driving vehicles are ubiquitous?



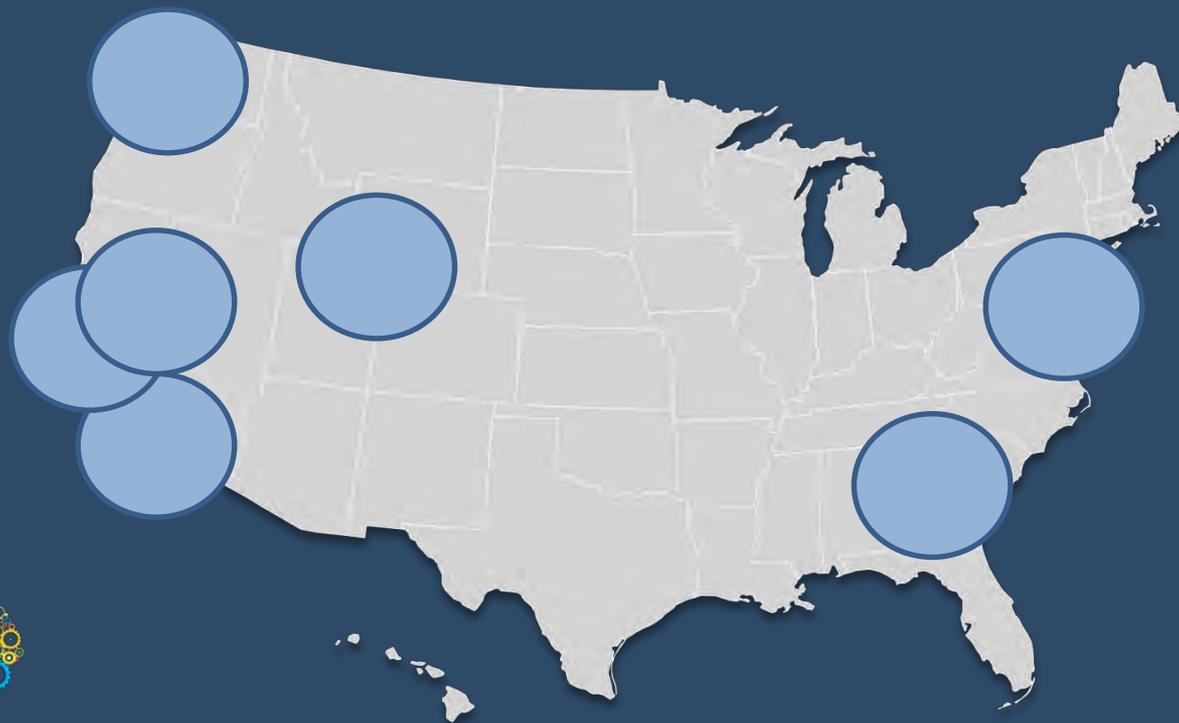
Gauge how sensitive our models currently are

Help our clients understand the uncertainty and make a more informed decision



# what WE DID

- Tested five regional models + two others
- Tested eight effects + cumulative effects

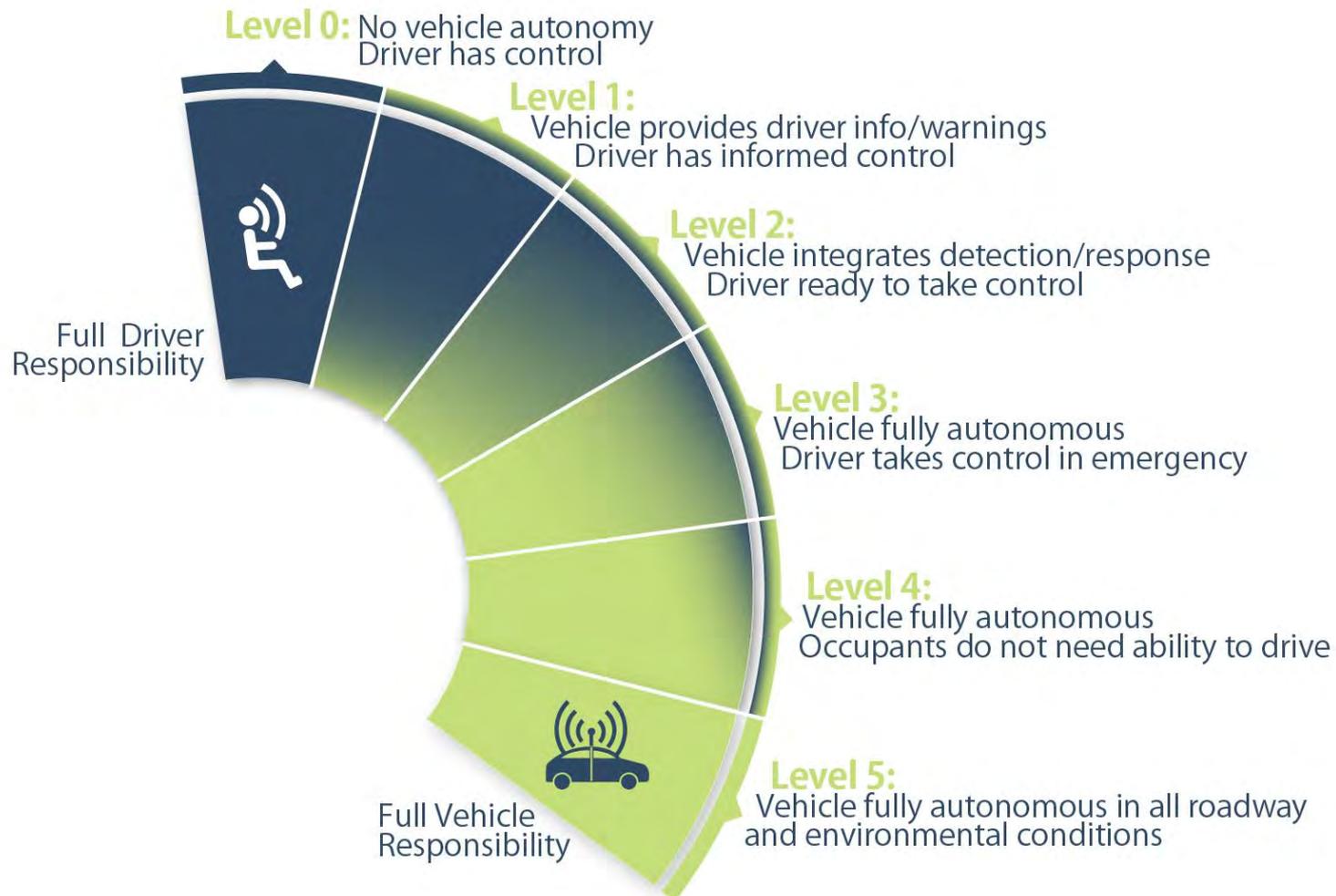


# what ARE WE DOING DIFFERENTLY

- Multiple models
- Broader range of results
- Variations across geographies
- Unbiased results

# what WE ASSUMED

- Assumed Level 5, 100% fleet mix



# what WE ASSUMED

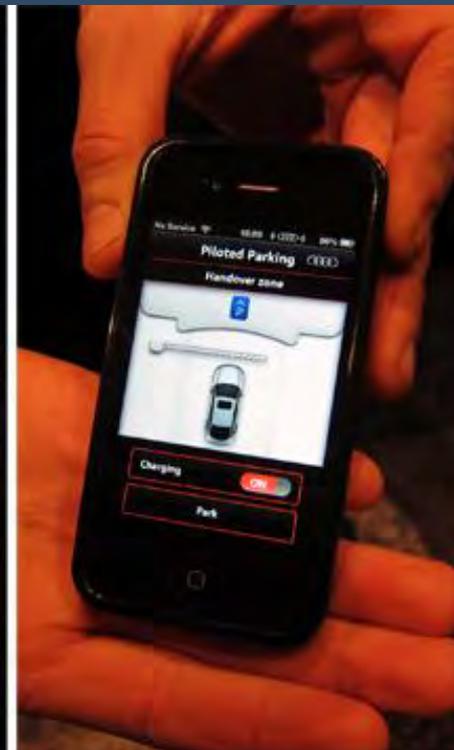
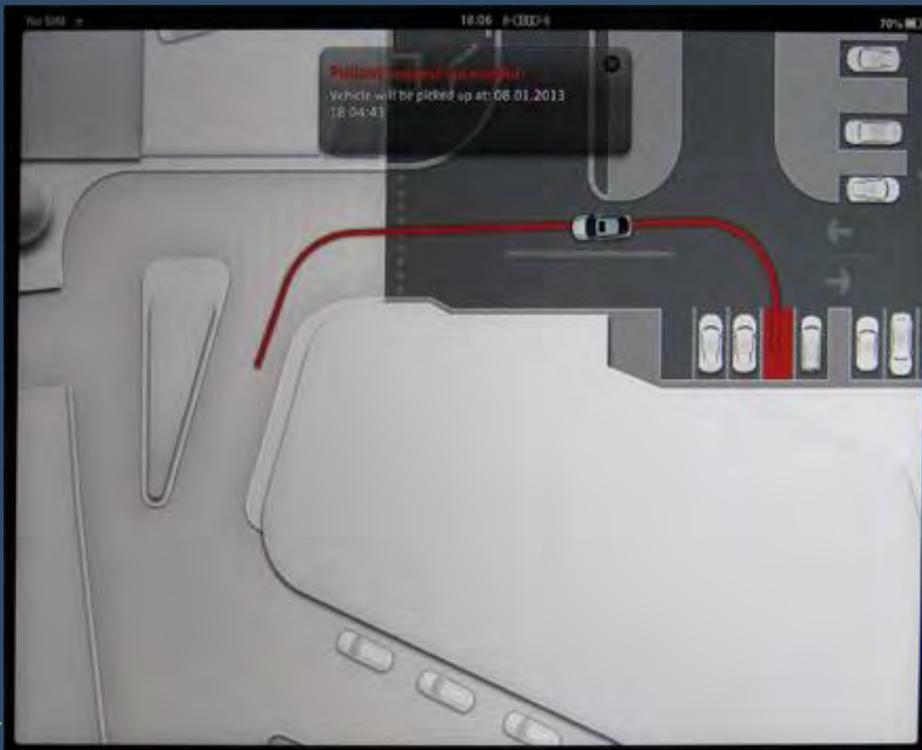
Model Input Assumption	No Regulation for Ridesharing	50% of AV Trips are Shared
Access Time		Set to 0
Vehicle Occupancy	Model Estimate	Half are Shared
Parking Costs		Halved
Lost Auto Time Impact		Halved
Auto Availability	All Households have Access to an Auto	
Freeway Lane Capacity		3,300 vphpl
Arterial Lane Capacity		Same as Today
Land Use Changes		None



# INDIVIDUAL TEST RESULTS

# Decrease Access Times

- Test – set access time for vehicles to zero
- Method – set highway terminal times = 0



# Decrease Access Times

- Test – set access time for vehicles to zero
- Expectation – some mode shift to auto

Measure	Mid-Atlantic Model	Mountain State Model	Bay Area Model	Calif. Central Valley Model	Southern Calif. Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	0.5%	-0.7%	1.4%	-5.8%	-	-	-
Vehicle Trip Growth	0.9%	0.0%	1.7%	0.1%	-	-	-
Transit Trip Growth	-15.3%	-4.3%	-10.4%	-14.9%	-	-	-

# Decrease Parking Costs

- Test – halve all auto trip parking costs (no capacity constraint)
- Method – halve highway parking costs in every area type



Image Source: Futureuta  
<http://futureuta.blogspot.com/2014/10/how-self-driving-cars-will-change-world.html>



Image Source: Arrowstreet Architects  
<http://www.arrowstreet.com/2016/03/the-self-driving-car-could-eliminate-the-parking-garage/>

# Decrease Parking Costs

- Test – halve all auto trip parking costs (no capacity constraint)
- Expectation – some mode shift to auto

Measure	Mid-Atlantic Model	Mountain State Model	Bay Area Model	Calif. Central Valley Model	Southern Calif. Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	1.1%	0.1%	1.0%	0.0%	-0.1%	14.6%	0.1%
Vehicle Trip Growth	2.8%	0.2%	0.4%	0.0%	1.0%	2.4%	0.1%
Transit Trip Growth	-7.0%	-5.0%	-3.2%	-0.3%	-1.0%	-11.5%	-4.1%

# Decrease Impact of Lost Auto Travel Time

- Test – halve perceived time spent in auto
- Method – modify skim tables to half congested time cost



Advertisement from 1957 for “America’s Independent Electric Light and Power Companies”



Image Source: Rinspeed. (2014). “Xchange”  
<http://www.rinspeed.eu/aktuelles.php?aid=14>

# Decrease Impact of Lost Auto Travel Time

- Test – halve perceived time spent in auto
- Expectation – significant mode shift to auto

Measure	Mid-Atlantic Model	Mountain State Model	Bay Area Model	Calif. Central Valley Model	Southern Calif. Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	25.8%	1.8%	39.3%	41.4%	-	1.4%	9.1%
Vehicle Trip Growth	4.5%	0.6%	3.7%	2.4%	-	0.0%	1.2%
Transit Trip Growth	-1.8%	-10.8%	0.3%	-18.9%	-	0.0%	-24.6%

# Increase Auto Availability

- Test – all households have access to at least one vehicle
- Method – modify vehicle availability coefficients to eliminate zero auto households



Image Source: BMW Blog

<http://www.bmwblog.com/2011/03/21/bmw-and-sixt-establish-drivenow-joint-venture-for-premium-car-sharing/>

# Increase Auto Availability

- Test – all households have access to at least one vehicle
- Expectation – those reliant on transit shift to auto

Measure	Mid-Atlantic Model	Mountain State Model	Bay Area Model	Calif. Central Valley Model	Southern Calif. Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	0.5%	0.7%	0.5%	0.7%	-	-	-
Vehicle Trip Growth	1.3%	1.1%	1.3%	2.8%	-	-	-
Transit Trip Growth	3.5%	-23.9%	-6.3%	-31.2%	-	-	-

# Increase Freeway Capacity

- Test – increase freeway capacity to 3,300 vphpl
- Method – modify roadway capacity reference file



Image Source: USDOT  
[http://www.its.dot.gov/communications/image\\_gallery/image14.htm](http://www.its.dot.gov/communications/image_gallery/image14.htm)

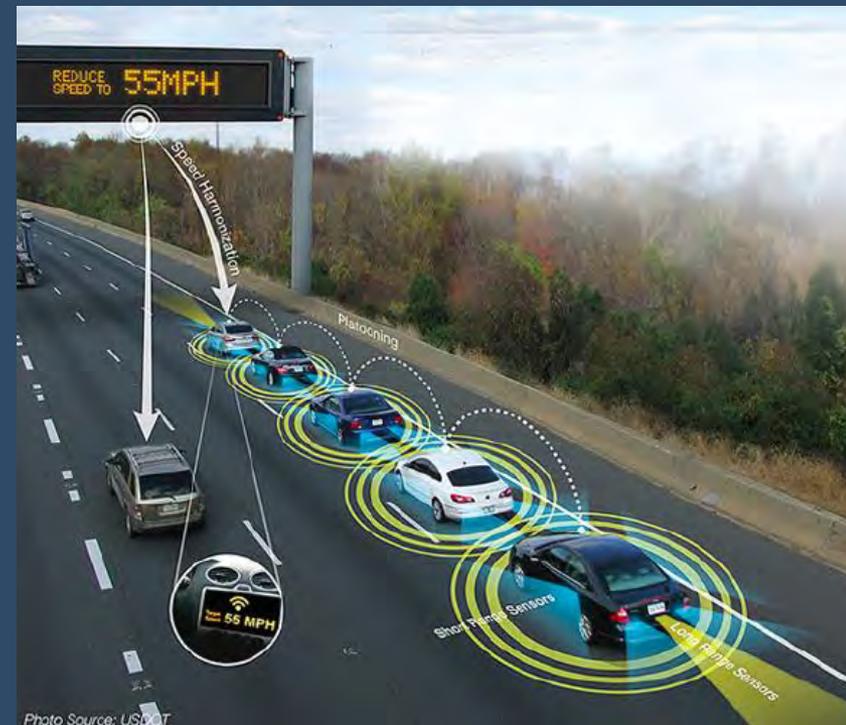


Image Source: USDOT  
[http://www.its.dot.gov/communications/image\\_gallery/image36.htm/](http://www.its.dot.gov/communications/image_gallery/image36.htm/)

# Increase Freeway Capacity

- Test – increase freeway capacity to 3,300 vphpl
- Expectation – longer trips; some mode shift to auto

Measure	Mid-Atlantic Model	Mountain State Model	Bay Area Model	Calif. Central Valley Model	Southern Calif. Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	4.5%	5.8%	-0.5%	3.6%	2.0%	3.6%	3.6%
Vehicle Trip Growth	0.0%	0.4%	0.0%	0.5%	1.0%	2.4%	0.8%
Transit Trip Growth	-3.6%	-0.7%	0.0%	-1.6%	1.0%	3.8%	-1.1%

# Increase Non-work Trips

- Test – increase non-work trip making by 25%
- Method – multiply motorized non-work productions and attractions by 1.25



Image Source: Taxi Intelligence  
<http://www.taxiintelligence.com/google-thinks-self-driving-cars-will-be-great-for-stranded-seniors-baby-boomers-want-mobility/>



Image Source: DVZ

<http://www.dvz.de/rubriken/logistik-verlader/single-view/nachricht/automobilwelt-erlebt-umbruch.html>

# Increase Nonwork Trips

- Test – increase non-work trip making by 25%
- Expectation – more auto and transit trips

Measure	Mid-Atlantic Model	Mountain State Regional Model	Bay Area Model	California Central Valley Model	Southern California Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	5.2%	7.5%	8.7%	15.5%	10.0%	-	-
Vehicle Trip Growth	13.2%	12.3%	15.1%	20.8%	15.0%	-	-
Transit Trip Growth	6.2%	9.2%	10.3%	10.1%	5.0%	-	-

# Increase Auto Occupancies

- Test – double average vehicle occupancy rate
- Method – Convert half of drive-alone vehicle trips to HOV 2 vehicle trips. Produce trip table inputs that are used for the assignment process.



Image Source: uber

<http://ubermovement.com/uberpool/>

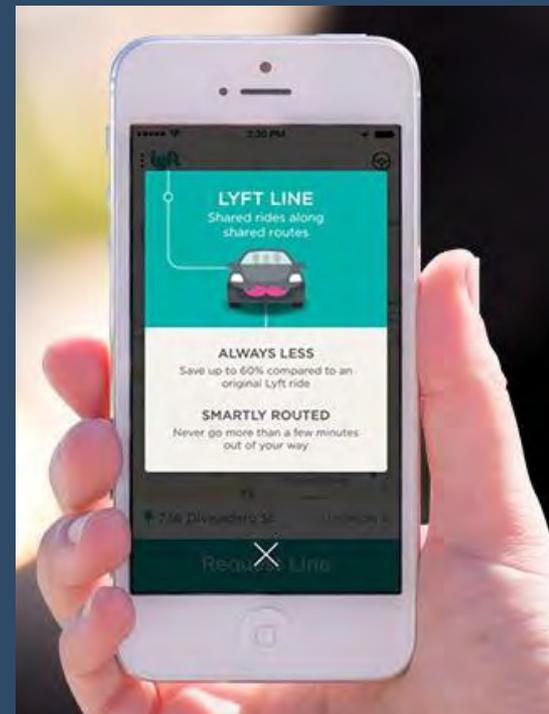


Image Source: Tech Crunch

<https://techcrunch.com/2014/08/06/lyft-line/>

# Increase Auto Occupancies

- Test – double average vehicle occupancy rate
- Expectation – fewer vehicles and less VMT

Measure	Mid-Atlantic Model	Mountain State Regional Model	Bay Area Model	California Central Valley Model	Southern California Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	-6.2%	-10.7%	-21.5%	-14.5%	-	-	-
Vehicle Trip Growth	-13.1%	-11.8%	-21.9%	-22.3%	-	-	-
Transit Trip Growth	-4.7%	0.0%	0.0%	0.0%	-	-	-

# Cumulative Effect (Private)

- Test – run 6 sensitivity tests together, no auto occupancy test
- Expectation – big increase to auto trips and VMT; transit mode shift

## PRIVATE OWNERSHIP TESTING RESULTS

Measure	Mid-Atlantic Model	Mountain State Regional Model	Bay Area Model	California Central Valley Model	Southern California Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	46.9%	16.5%	45.8%	67.6%	12.0%	19.6%	23.9%
Vehicle Trip Growth	24.6%	15.0%	19.4%	26.4%	16.0%	2.5%	2.6%
Transit Trip Growth	-26.0%	-38.9%	15.8%	-42.9%	5.0%	-7.7%	-42.4%

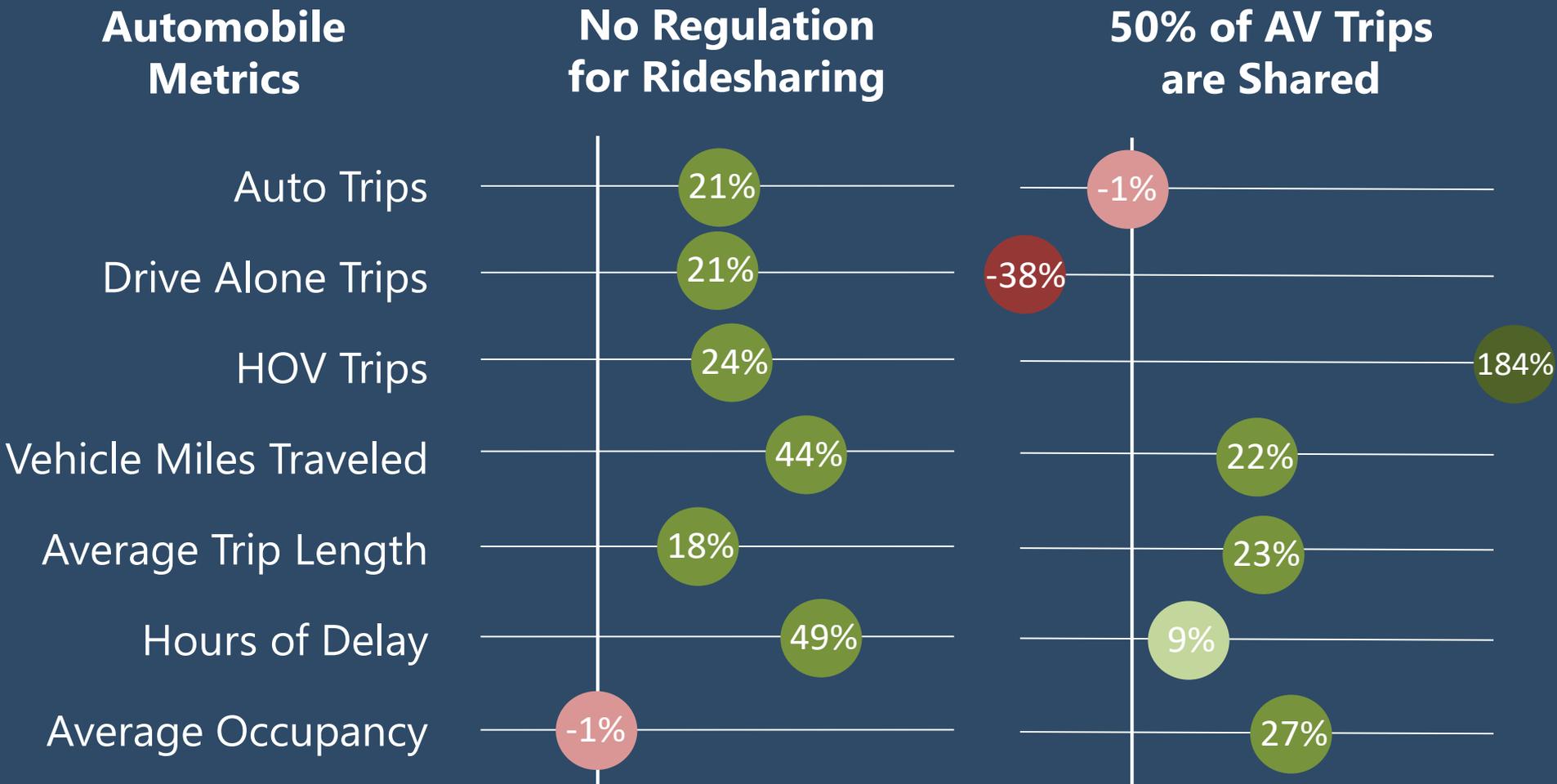
# Cumulative Effect (Shared)

- Test – run all 7 sensitivity tests together
- Expectation – less increase in VMT and auto trips compared to 6 test run

## SUBSCRIPTION/SHARED TESTING RESULTS

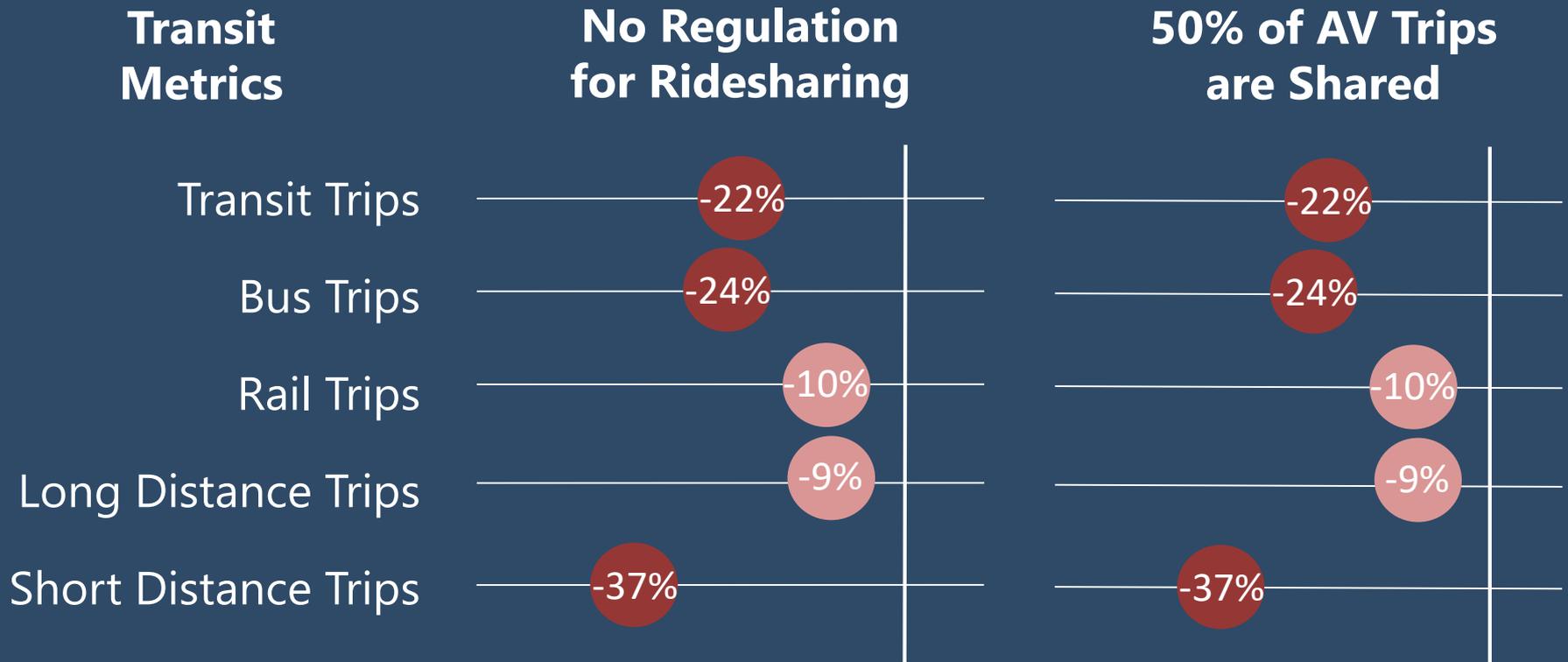
Measure	Mid-Atlantic Model	Mountain State Regional Model	Bay Area Model	California Central Valley Model	Southern California Model	Puget Sound Regional Council Model	Atlanta Regional Commission Model
VMT	26.7%	3.6%	16.3%	42.6%	-	-	-
Vehicle Trip Growth	5.2%	0.9%	-6.6%	-1.7%	-	-	-
Transit Trip Growth	-19.8%	-38.9%	15.8%	-42.9%	-	-	-

# what ■ HAPPENED



Study from University of Leeds projected as much as a **60% increase in VMT**

# what ■ HAPPENED



Study by the Atlanta Regional Commission predicted a decrease in public transit trips by as much as 42%

# what WERE THE KEY FINDINGS

- Future is uncertain and inevitably different
- Current tools are sensitive  
(but inconsistently so)
- Range of results generally consistent with professional expectations
- May lead to increase in VMT, decrease in transit ridership without regulation
- Models need to be refined

# what WE DID WITH DO WITH THE RESULTS

Shared results with those who maintain the models

They generally accepted the potential outcomes

Interested in “What would it take to offset the effects?”

# what ■ DO WE DO NEXT

- What would it take to offset the effects?
  - Congestion pricing
  - More convenient transit
  - Vehicle occupancy minimums
  - Expanded heavy rail systems

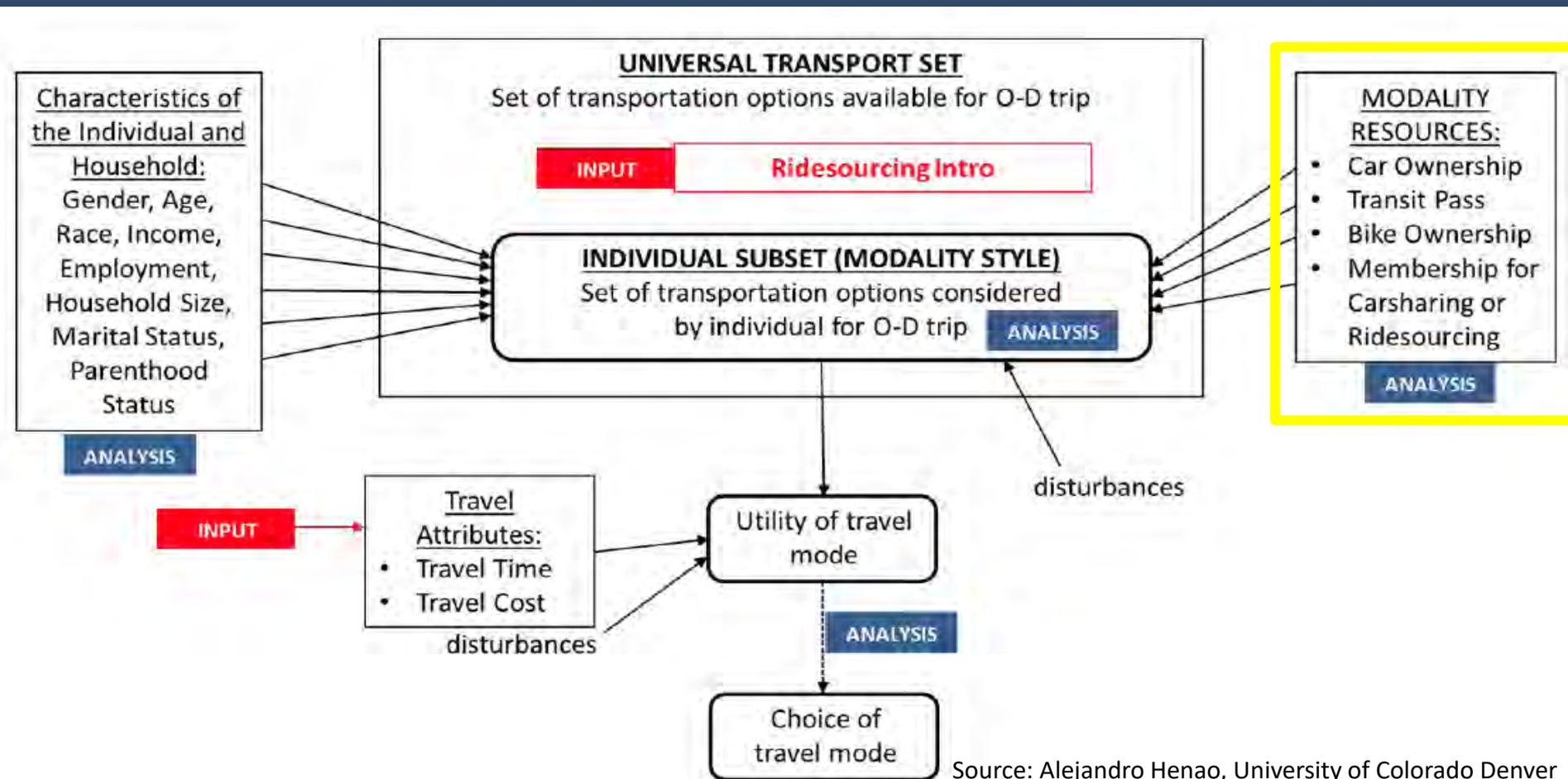


# what DO WE DO NEXT

- How might our models need to change?
  - Real-time congestion information
  - Modal consistency across trips/tours
  - Non-home-based travel linkage
  - Auto availability restrictions

# what ■ DO WE DO NEXT

## • New Travel Demand Framework?



# what DO WE DO NEXT

- Vehicle Ownership vs Access
  - Individual modes
  - PCE factors to account for AV level
- Household vs Individual Choice
- Land Use Changes
- Generating Trips without Traveling



INNOVATION BY

FEHR & PEERS