A Window Into the Future: Modeling and Responding to the Disruptive Effects of Autonomous Vehicles
Where Are We Today?
Where Are We Today?

**THEN**
- Loyal to Mode
  - Tend to use just one option and rarely switch
- Perception of Limited Options
  - Personally-owned car often the default option

**NOW**
- Mobile Phone
  - Helps make choices, but each tool has its own app
- New Options
  - Many people use just one or two new options (ride-hailing, bike share) in addition to their primary mode
- Ride-Hailing
  - Car ownership separated from car use

**FUTURE**
- Mobility as a Service
  - Use mobile device to select among many options and seamlessly book and pay for them
- More New Options
  - Including innovative new private sector mobility tools
- Choose the Right Tool for the Right Trip
  - Based on better information about cost, time, and comfort
Where Are We Today?

- Average Weekday Person Trips per Capita for DC, MD, and VA
- 2009 vs. 2017 NHTS
Where Are We Today?

U.S. Public Transit Ridership
(millions of rides per month, 12-mo trailing average, major metros)

- Early 2000s Downturn and 9/11: -2.5%
- Great Financial Crisis Effect: -3.3%
- Uber and Lyft launch carpooling: -4.6%

Adapted from MetLife Investment Management, American Public Transportation Association
Note: Major metros include Boston, Chicago, Los Angeles, New York City, San Francisco, and Washington D.C.
Uncertainty in the Future

VMT per capita will be 10% to 20% above its 2004 peak, suggesting a need to accelerate transportation investment to keep pace with population growth.

Your Forecast

2040
15,350

Published Forecasts

17,100 VMT per capita
U.S. DOT

16,300 VMT per capita
Transportation Financing Commission

13,400 VMT per capita
U.S. Energy Administration

12,200 VMT per capita
Public Interest Research Group: High

8,200 VMT per capita
Public Interest Research Group: Low
Modeling AV Effects

2 Freeway Simulations

10 Regional Travel Demand Models
What do the Experts Say?

• Assembled a Delphi Panel of 27 leading transportation experts.
• Experts from academic institutions, public agencies, and technology firms.
• **Assumption** – A Level 4 AV will pick you up and drop you off closer to your destination.

• **Method** – Set terminal times to zero.
How did we model an AV Future?
Decrease Parking Costs

• **Assumption** – There will be better use of parking supply and lower parking costs with autonomous vehicles.

• **Method** – Cut model parking costs in half.
• **Assumption** – Because of the increased opportunity to engage in other activities while traveling to a destination, people will generally tolerate higher travel times than they do today.

• **Method** – Cut congested travel time in model skim tables in half.
How did we model an AV Future?
Increase Auto Availability

• **Assumption** – Automation and carsharing will allow travelers access to an auto trip whenever they need one.

• **Method** – Modify vehicle availability coefficients to eliminate zero auto households.
How did we model an AV Future?

Increase Freeway Capacity

• **Assumption** – Connected autonomous vehicles will be able to travel closer together, and at higher speeds. We expect that roadway capacity will increase first on Freeways and Expressways, then on major arterials.

• **Method** – Increased capacities on model freeways to 3,300 vehicles per hour per lane
How did we model an AV Future?

Increase Non-work Trips

• **Assumption** – People who are unable to drive today such as teenagers, the elderly, or people who lost their license will have the opportunity to make auto trips at their discretion rather than rely solely on walk/bike/transit modes or another driver.

• **Method** – Increased motorized non-work trip productions and attractions by 25%.
How did we model an AV Future?

Increase Auto Occupancies

• **Assumption** – Autonomous vehicles have a much higher likelihood of being shared than personally owned vehicles. The ride-sharing aspect pushes down the cost of the service and increases the likelihood of sharing.

• **Method** – Convert half of drive-alone vehicle trips to HOV 2 vehicle trips in trip tables for assignment.
Modeling Results

- VMT increased in all models (range of +8% to +68%) when assuming no regulatory requirement for ridesharing.
- If 50% of AV trips are shared, it would help mitigate the VMT increase but not fully offset it (range of +1% to +43%).
- The regulated ridesharing scenario would also substantially reduce vehicle delay but would increase the average trip length.
Modeling Results

• Total transit trips declined in all but one of the models tested by a range of -12% to -43%. The other model showed increased transit trips of 16%.
Research Findings: Chauffeur Experiment
(Harb et al., 2017)

- 13 San Francisco Bay Area subjects
- More auto travel
  - 76% increase in VMT
  - 22% of increased VMT were ghost trips
- Change in activity patterns
  - 94% increase in # longer trips (over 20 miles)
  - 80% increase in # evening trips (after 6 pm)
- Bimodal impact on miles walked
  - Half decreased (-28% on average), half increased (+49% on average)
- Virtually no biking, transit, TNC use in the sample

Cohorts: 4 Millennials, 4 Families, 5 Retirees

Retirees increase most
Consistent across cohorts
Prominent measures we tested include:

- **Pricing**
  Fees and user charges on low occupancy vehicle travel in the form of vehicle-mile charges and congestion pricing.

- **Shared-Ride Incentives**
  Pricing and added efficiencies and right-sized vehicles for pooled door-to-door travel, crowd-sourced microtransit, enhanced “mobility-as-a-service” options.

- **Goods Movement**
  Autonomous goods movement, local manufacture and 3D printing, optimized deliveries on right-sized vehicles.

- **Transit Enhancements**
  Autonomous transit vehicles to redeploy services in a more demand-responsive fashion to reduce passengers’ service access and wait times, speed up origin-to-destination travel times, and reduce fares.

- **New Technology Solutions**
  Drone deliveries and vertical-takeoff-landing (VTOL) transport, virtual reality as a substitute for travel, micromobility technology including e-bikes and scooters, and delivery bots.
Many of these countermeasures represent ambitious undertakings in terms of political will, cost and technology and call for early action in order to affect the trajectory of AV impacts, but the benefits appear to be significant in terms of counteracting potentially significant adverse impacts and turning them into favorable outcomes for mobility and environmental quality.
Thank you!