



UNIVERSITY OF CALIFORNIA *Berkeley*
Transportation Sustainability
RESEARCH CENTER

Impacts of the Ride-Sharing Economy

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University of California, Berkeley

Connected and Automated Vehicles –
What States Need to Know
Linthicum Heights, MD
June 22nd, 2016



7°C

07:51



Auto Pilot available
Hold both paddles to
activate

Macro Trends in Vehicle Miles Traveled

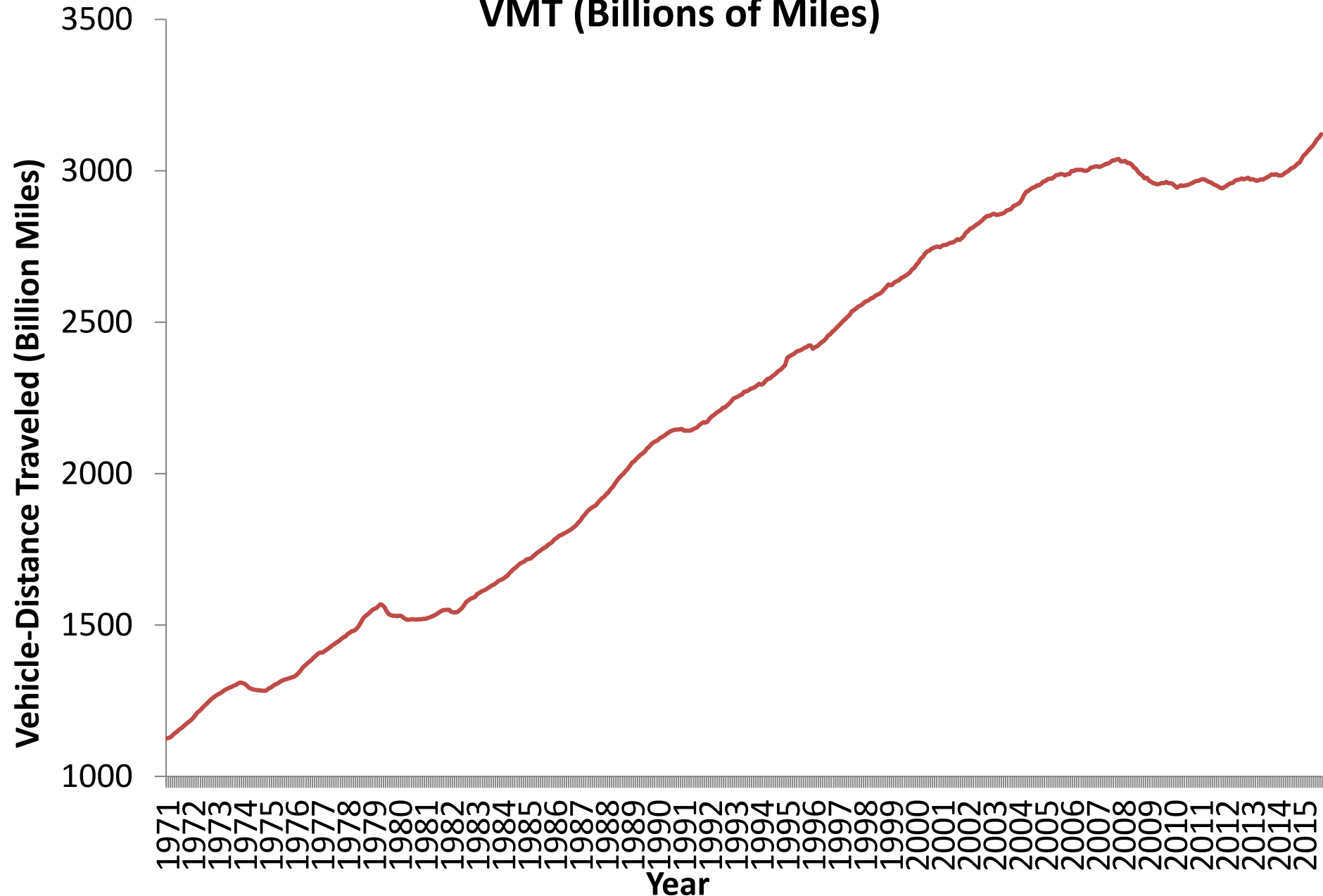


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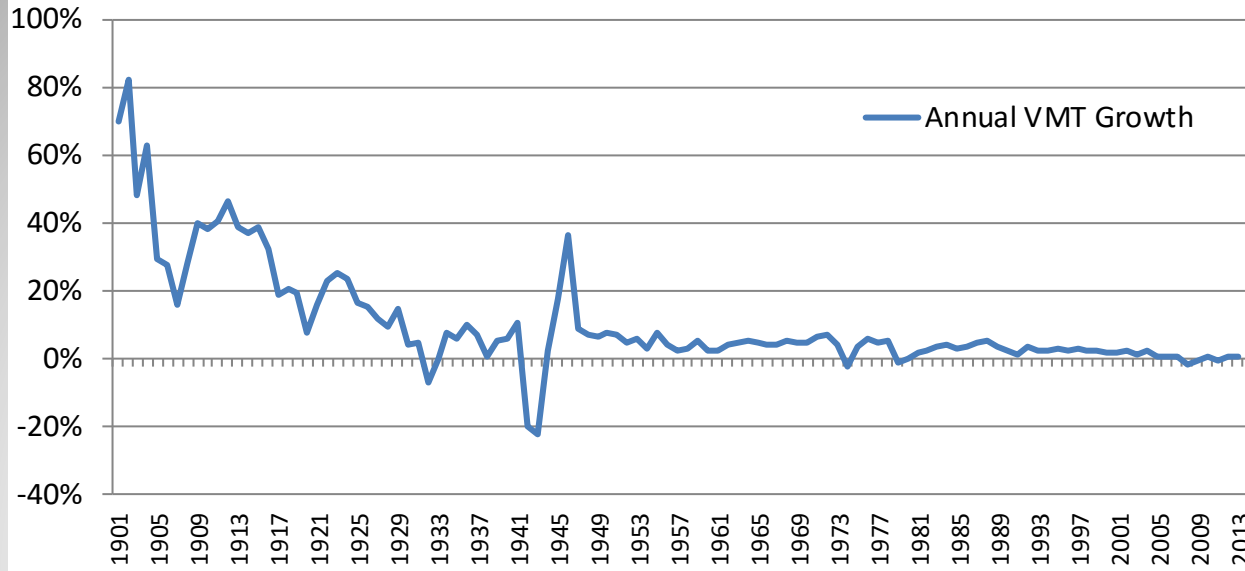
READY

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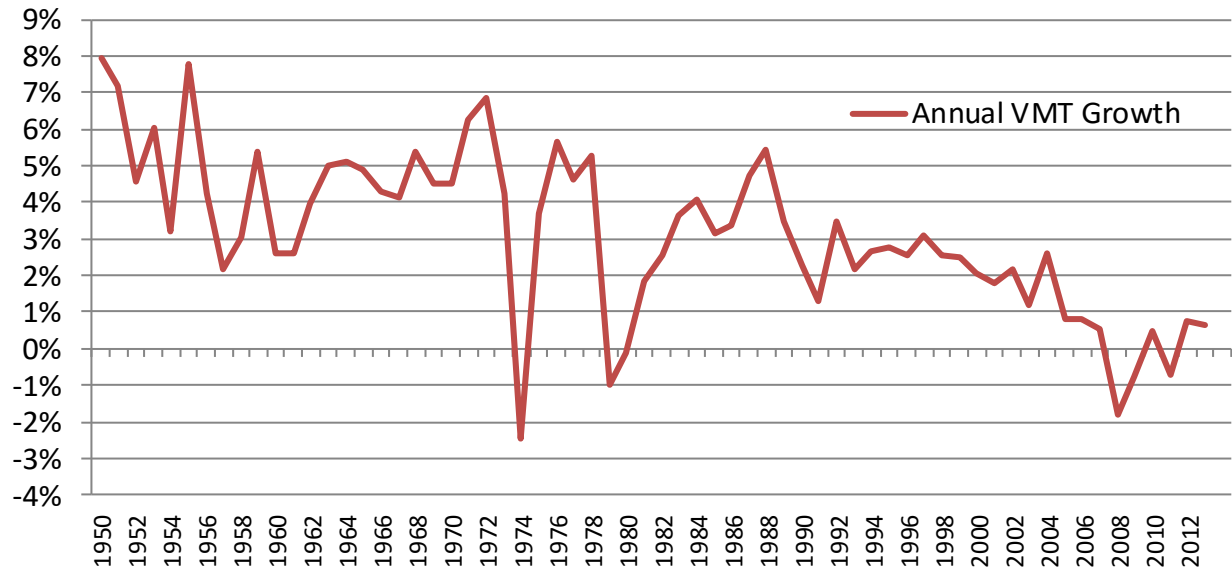
Moving 12-Month Total on ALL Roads - VMT (Billions of Miles)



**Annual VMT Growth in the United States
1901 to 2013**

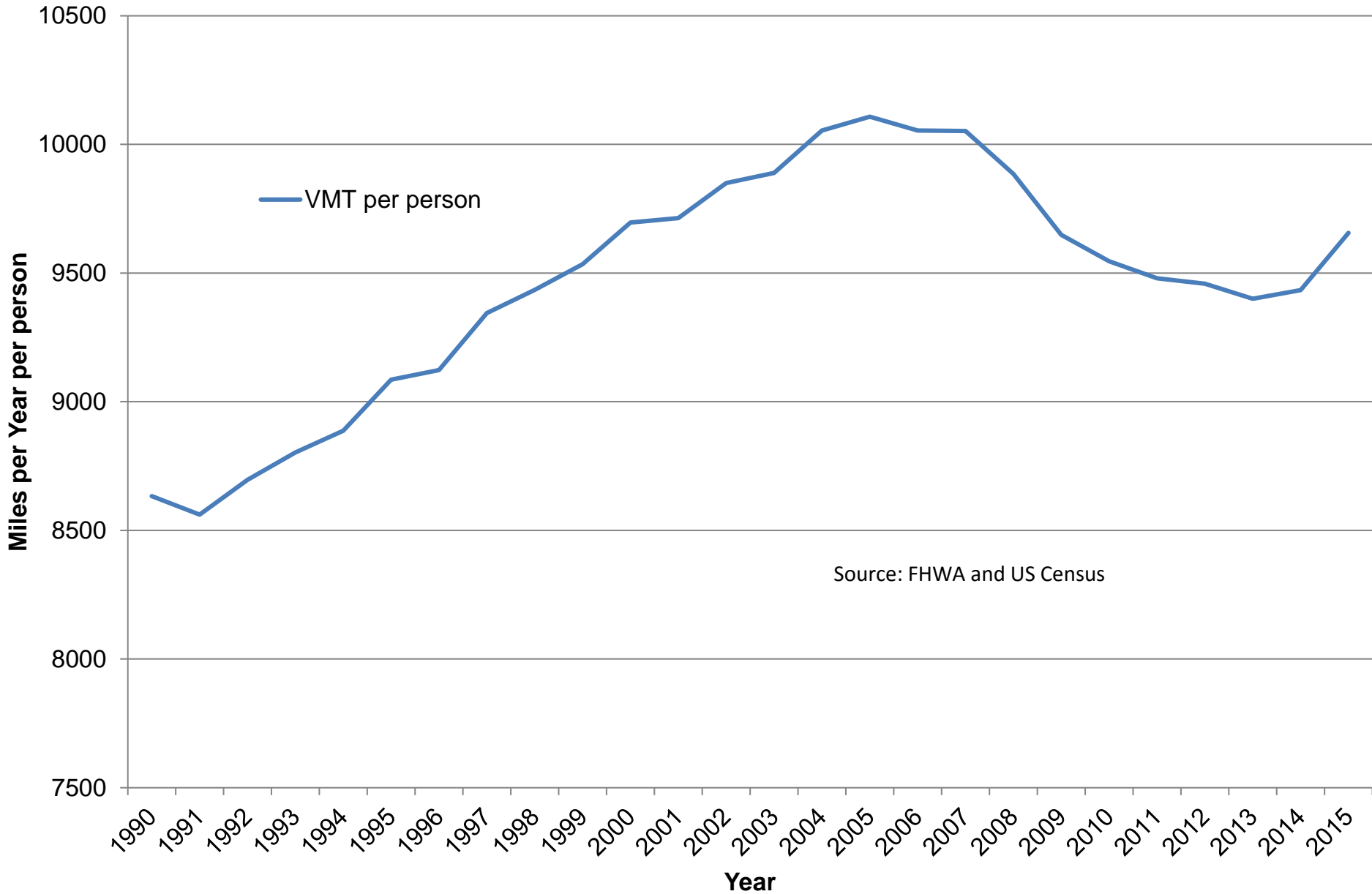


**Annual VMT Growth in the United States
1950 to 2013**



Vehicle Miles Traveled per Person in the United States

VMT and US Census Population Estimate for July of each Year



Automation and VMT?

- Will automation **increase** or **decrease** VMT?
- Scenario for Increased VMT
 - Personal cars can errands or return home empty, not park at the destination.
 - They drive with 0 occupants, adding to congestion, **which the owner does not experience.**
- Scenario for Decreased VMT
 - Autonomous vehicles are shared, easily accessible.
 - **People reduce personal vehicle ownership.**
 - There are fewer cars, personal driving goes down.



Shared Mobility



Shared Mobility Ecosystem

Carsharing

- Roundtrip
- One-Way
- Personal Vehicle Sharing (PVS)
 - P2P Carsharing
 - Hybrid P2P-Traditional Carsharing Model
 - P2P Marketplace
 - Fractional Ownership

Scooter Sharing

Bikesharing

- Public Bikesharing
- Closed Campus Bikesharing
- P2P Bikesharing

Alternative Transit Services

- Shuttles
- Microtransit

Ridesharing

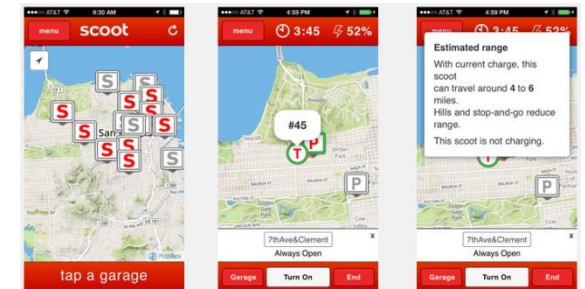
- Carpooling
- Vanpooling

On-Demand Ride Services

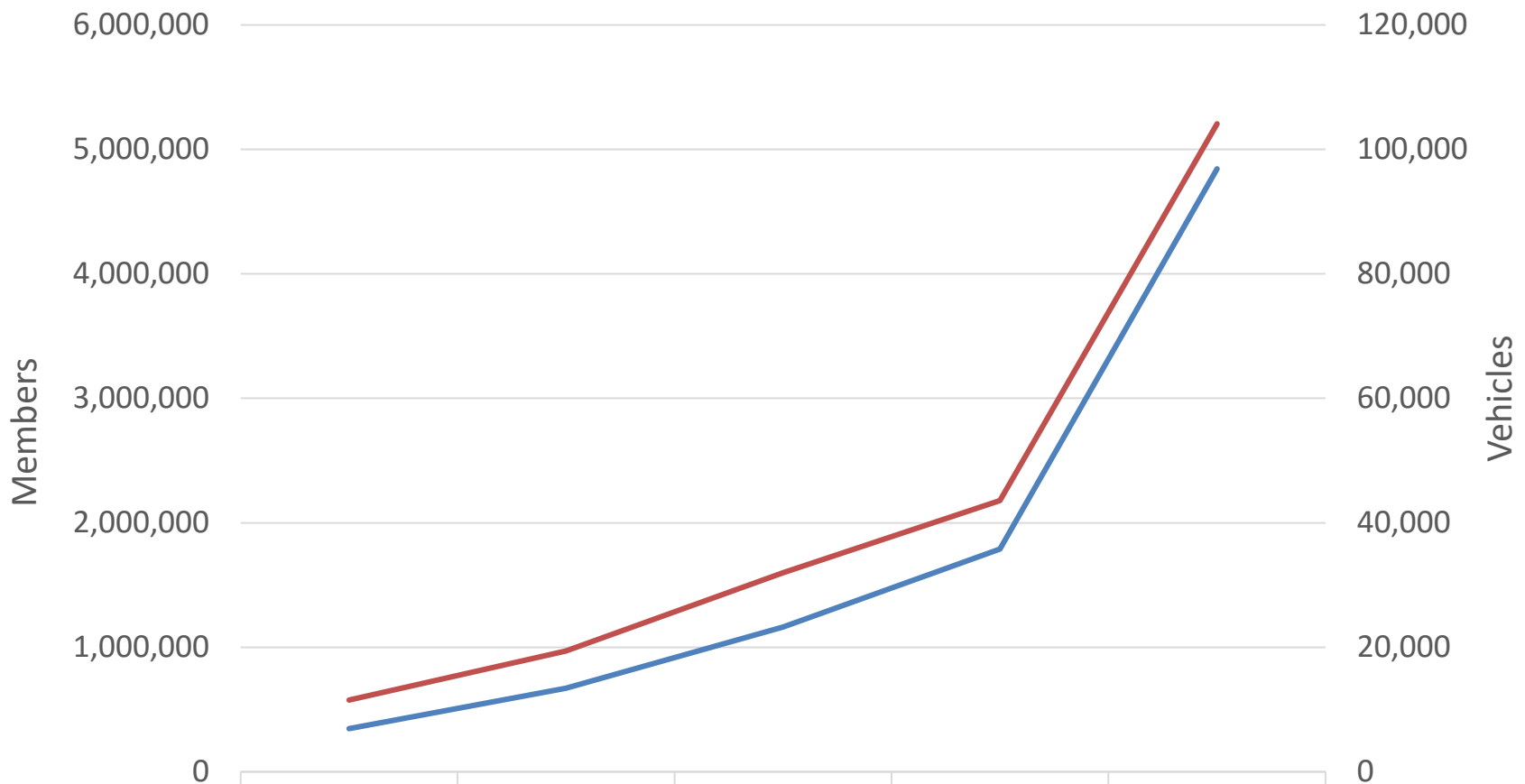
- Ridesourcing/TNCs
- Ridesplitting
- e-Hail

Courier Network Services (CNSs)

- P2P Delivery Services
- Paired On-Demand Passenger Ride and Courier Services



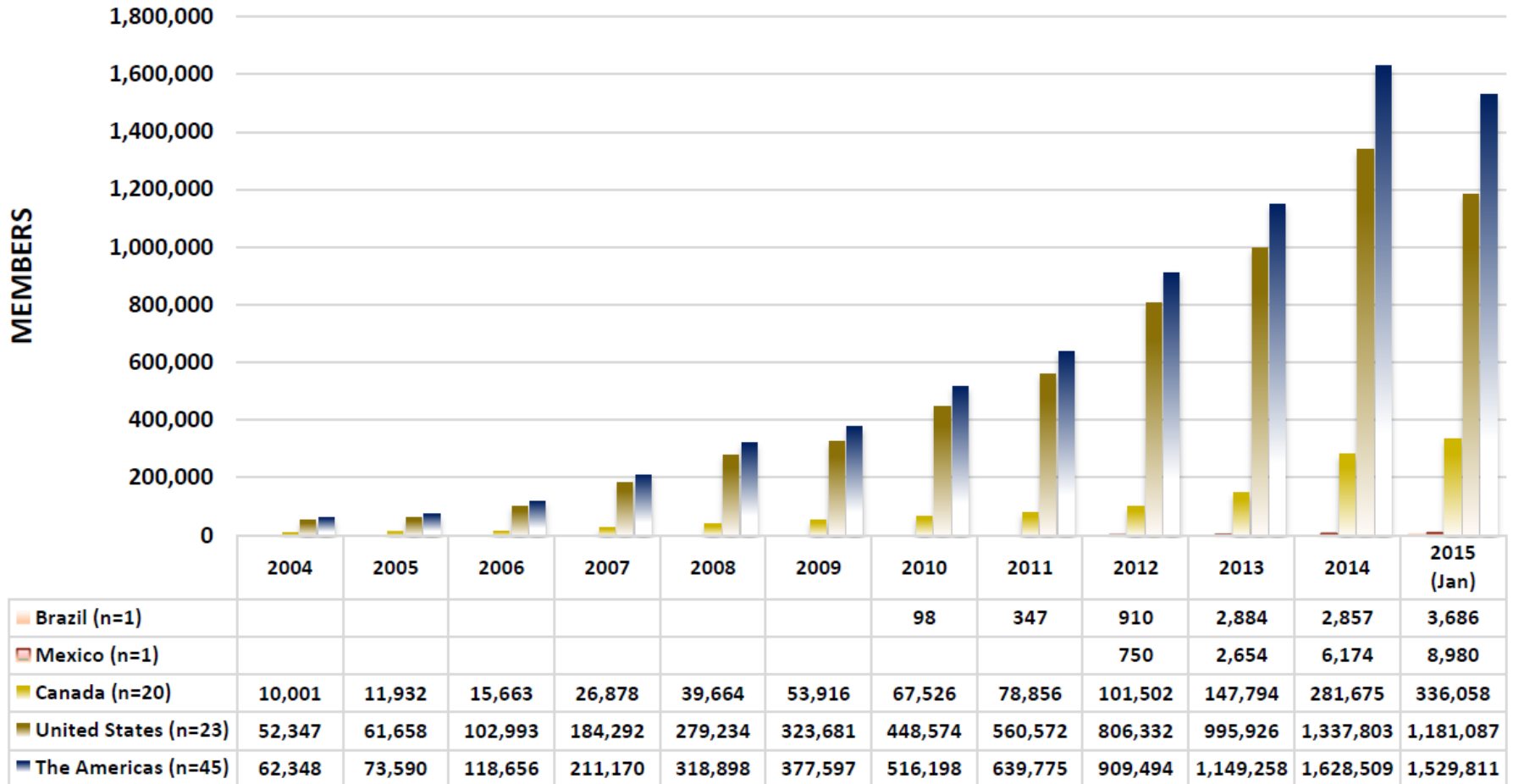
Growth of Worldwide Carsharing



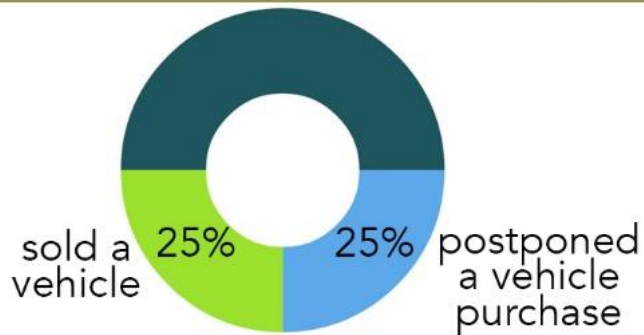
	2006	2008	2010	2012	2014
— Members	346,610	670,822	1,163,405	1,788,027	4,842,616
— Vehicles	11,501	19,403	31,967	43,554	104,125

Carsharing Growth

Member Growth in the Americas*



CARSHARING IMPACTS



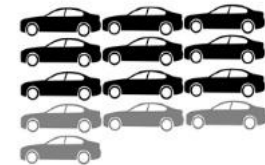
1 carsharing vehicle

replaces

9-13 vehicles



=



.58 - .84 metric tons

Reduction of GHG emissions per year for one household (mean observed and full impact)



34% - 41%

Reduction of GHG emissions per year for one household (mean observed and full impact)



27% - 43%

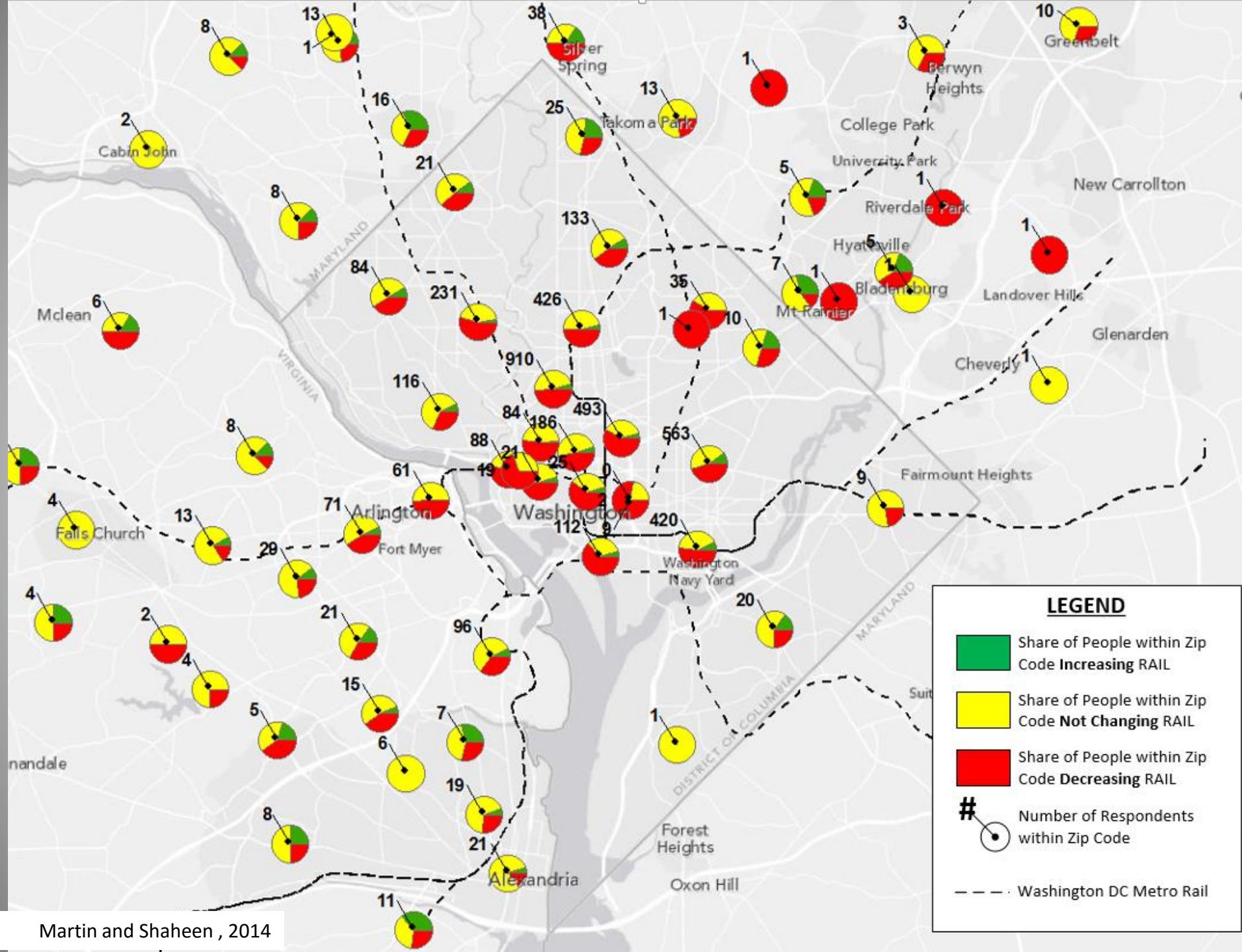
Reduction of VMT per year, considering vehicles sold and purchases postponed

More carsharing users increased their overall public transit and non-motorized modal use (including bus, rail, walking, bicycling, and carpooling) than decreased it.

- For every 5 members that use rail less, 4 use it more.
- For every 10 members that ride the bus less, 9 ride more.

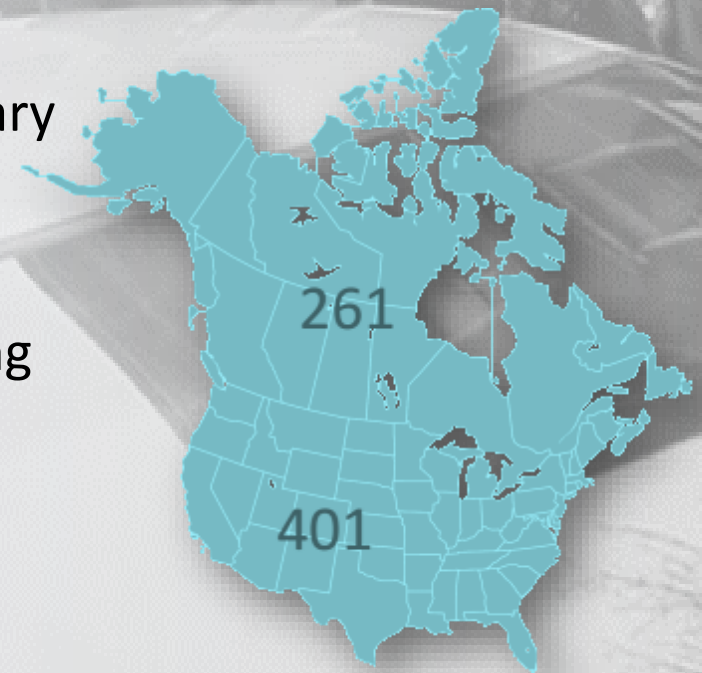
\$154 - \$435

Monthly household savings per US member after joining carsharing



Traditional Ridesharing

- **Carpooling and Vanpooling:** Travelers group into common trips by private auto/van.
- Differs from ridesourcing in that the primary motivation is collective cost savings.
- Long-term matching can still be challenging for carpooling and vanpooling.
- 662 ridematching services in the U.S. and Canada (24 span both countries).
- Traditional ridesharing most unequivocally reduces VMT.



Chan and Shaheen, 2011

For-Hire Vehicle Access Models

Ridesourcing/TNCs: Service that allows passengers to connect with and pay drivers who use their personal vehicles for trips facilitated through a mobile application

Street Hail:

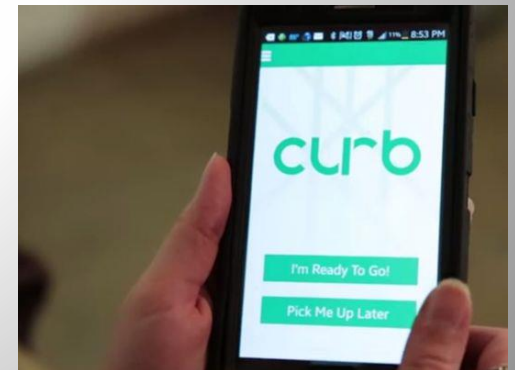
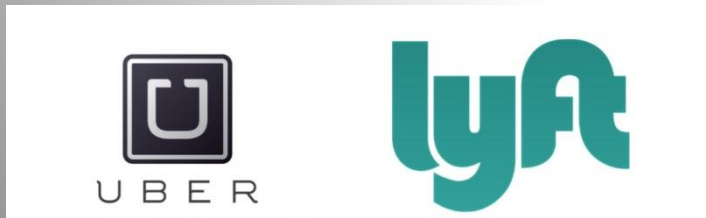
Hailed with a raised hand or by standing at a taxi stand or specified loading zone

E-Hail:

Hailed by dispatching a for-hire driver using a smartphone application

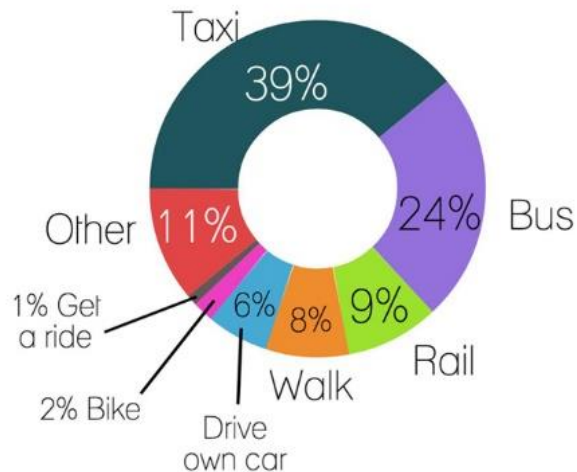
Some Ridesourcing/E-Hail: Market Trends

- Lyft: 150 cities; over 100,000 drivers (2015)
- Uber: 62 countries; 365 U.S. cities (2015); over 162,000 drivers in U.S. (early 2015)
- Flywheel: 6 cities, over 5,000 drivers
- Curb: 60 cities; 35,000 cabs
- Exact size unknown, but believed to be millions of users.



RIDESOURCING IMPACTS

How would you have made this trip if Uber/Lyft/Sidecar were not available?



92% would still have made this trip
8% induced travel effect

33% would have taken public transit (bus or rail)

4% named transit station as origin/destination,
suggesting some use ridesourcing to
access transit

20% avoided driving after drinking

Rayle et al, 2014

- Ridesourcing impacts on VMT are not known are currently a subject of intensive study.
- Study underway of the GHG and vehicle impacts of Uber and Lyft in the United States.
- Ridesourcing likely increases **driving, relative to carsharing**.
 - Vehicles that used to wait for the user, now drive to it.
 - But it also brings **scale and access** of shared mobility to a wider region than carsharing has.

7°C



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Automated Vehicles

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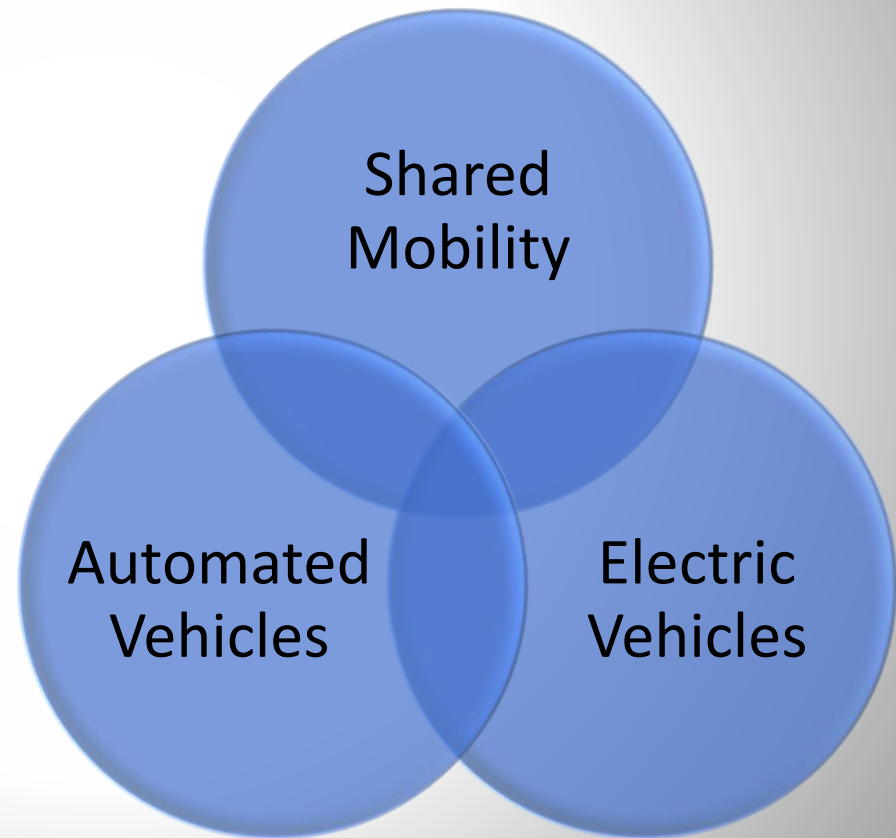


Benefits of Automated Vehicles

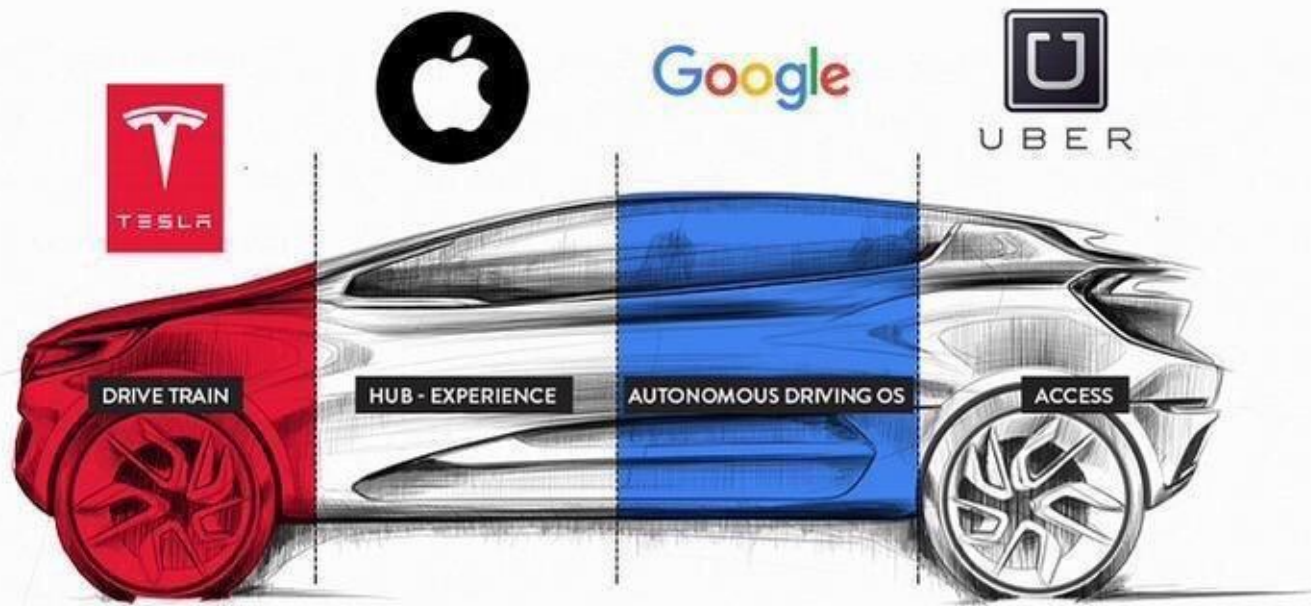
- Increased safety
 - More efficient road use
 - Increased driver productivity
 - Energy savings?
-
- Improved Dispatching
 - Improved Ease of Parking
 - Improved Ease of Refueling
 - Improved Mobility for populations unable to drive



Future: Confluence of Trends



Shaheen, 2015



VALUE CHAIN DISRUPTION

THIS IS YOUR CAR IN 2020

CAR SKETCH BY PRATHYUSH DEVADAS PRATHYUSHDEVADAS.WORDPRESS.COM

Potential Synergies with Carsharing

- AVs drive up to carsharing users, reducing access time.
- Self-parking, increase ease of use
- Self-fueling and self-recharging
- Decrease in operator insurance costs
- Provide easier first-and-last mile connections with major public transit corridors

Shared Mobility Services: Impacts

- Fagnant and Kockelman (2014) developed trip generation and distribution model, using agent based simulation.
- They find that shared automated vehicles (SAVs) have potential to mitigate environmental impacts of private auto travel.
- They find that a SAV may replace up to 11 private vehicles.

D.J. Fagnant, K.M. Kockelman / Transportation Research Part C 40 (2014) 1–13

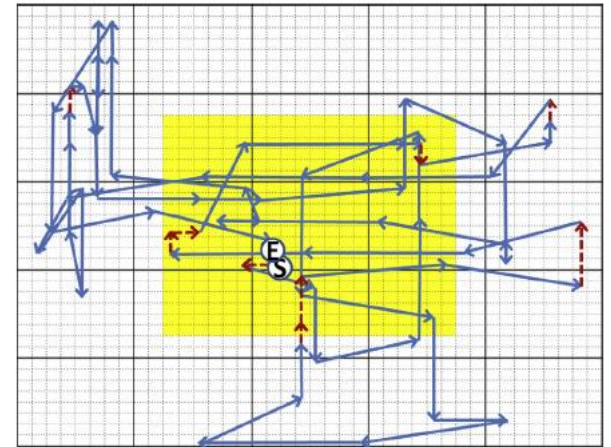


Fig. 5. Travel patterns and operation for an example SAV, 7 AM to noon.

Fagnant and Kockelman (2014)

Blurring Lines: More Convergence

Public Transit Services

Ridesourcing/TNCs



SIMILAR ATTRIBUTES



Michael Galczynski, 2015

Carsharing Services

Car Ownership / P2P Carsharing

The Future



Concept: Timothy Papandreu
Illustration: Kathleen Phu and
Audrey Koh

Concluding Remarks



- Shared mobility is historically used by:
 - Well educated, younger, living in urban areas
- How to scale this to other populations & land uses (accessibility, families, paratransit)?
- Today, shared mobility systems draw from all modes of transportation. Major reductions in VMT are derived from reductions in vehicle ownership and resulting behavioral change.
- Automation offers great promise to scale shared mobility. Shared mobility in turn may be the path where automation is the most benevolent in terms of VMT and emissions.
- Data and further research is critical to understanding innovative services.

Acknowledgements

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