Transportation Technology Services: Social and Environmental Impacts

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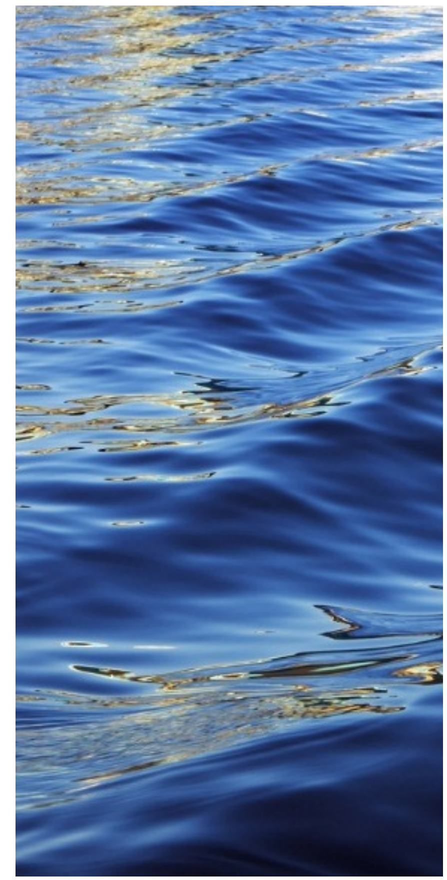

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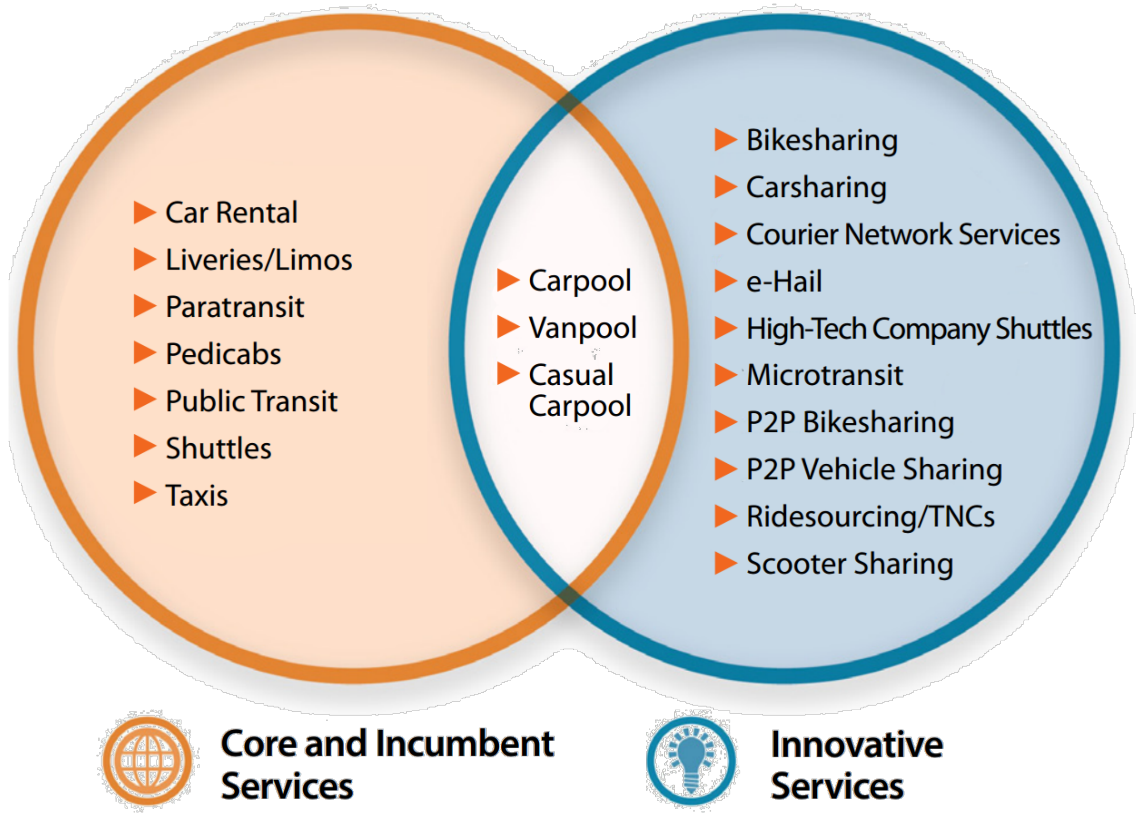
Overview

- Defining shared mobility and its impacts
- Scale and impacts of shared modes
- Recent declines in public transit use and key questions for public agencies
- Importance of data and research in evaluating shared mobility
- SAV developments
- Role of public policy and final thoughts
- Upcoming studies and current reports

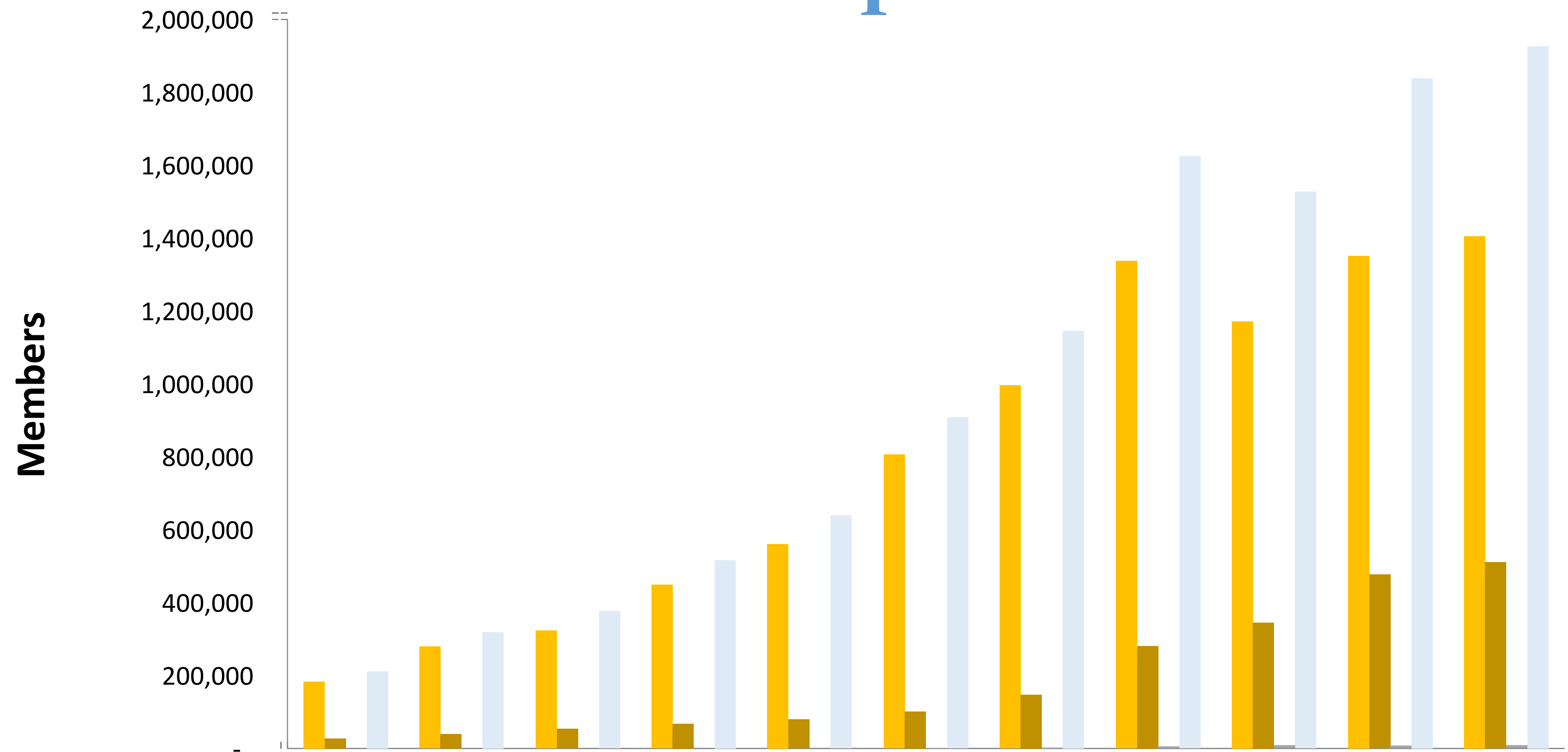
Defining Shared Mobility

Shared mobility—the shared use of a vehicle, bicycle, or other low-speed travel mode—is an innovative transportation strategy that enables users to have short-term access to a mode of transportation on an as-needed basis.



Shaheen et al., 2016

North American Carsharing Membership Growth



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 (Jan)
U.S. (n=21)	184,292	279,234	323,681	448,574	560,572	806,332	995,926	1,337,803	1,172,490	1,351,051	1,405,447
Canada (n=17)	26,878	39,664	53,916	67,526	78,856	101,502	147,794	281,675	344,403	477,528	511,654
Mexico (n=1)						750	2,654	6,174	9,639	9,275	10,127
North America (n=39)	211,170	318,898	377,597	516,100	639,428	908,584	1,146,37	1,625,65	1,526,53	1,837,85	1,927,22

Recent Study of One-Way Free-Floating Carsharing

Methodology:

- Online survey from ~9,500 North American car2go members residing in Calgary; San Diego; Seattle; Vancouver; and Washington, D.C.
- Activity data analysis

Martin and Shaheen, 2016

Recent Study of One-Way Carsharing

ONE-WAY CARSHARING IMPACTS

Member Vehicle Holdings

2% - 5%	sold a vehicle
1 - 3	vehicles sold per car2go vehicle
7% - 10%	postponed a vehicle purchase
4 - 9	vehicle acquisitions suppressed per car2go vehicle

1 car2go vehicle replaces 7-11 vehicles

or 28,000 vehicles across 5-city study

Reduction of VMT and GHG emissions

↓ 6% - 16%	Average reduction of VMT per car2go household
↓ 4% - 18%	Average reduction of GHG emissions per car2go household

Martin and Shaheen, 2016

Recent Study of One-Way Carsharing

City	Vehicles Sold	Vehicles Suppressed (foregone purchases)	Total Vehicles Removed per Carsharing Vehicle	Range of Vehicles Removed per Carsharing Vehicle	% Reduction in VMT by Car2go Hhd	% Reduction in GHGs by Car2go Hhd
Calgary, AB (n=1,498)	2	9	11	2 to 11	-6%	-4%
San Diego, CA (n=824)	1	6	7	1 to 7	-7%	-6%
Seattle, WA (n=2,887)	3	7	10	3 to 10	-10%	-10%
Vancouver, BC (n=1,010)	2	7	9	2 to 9	-16%	-15%
Washington, D.C. (n=1,127)	3	5	8	3 to 8	-16%	-18%

Martin and Shaheen, 2016

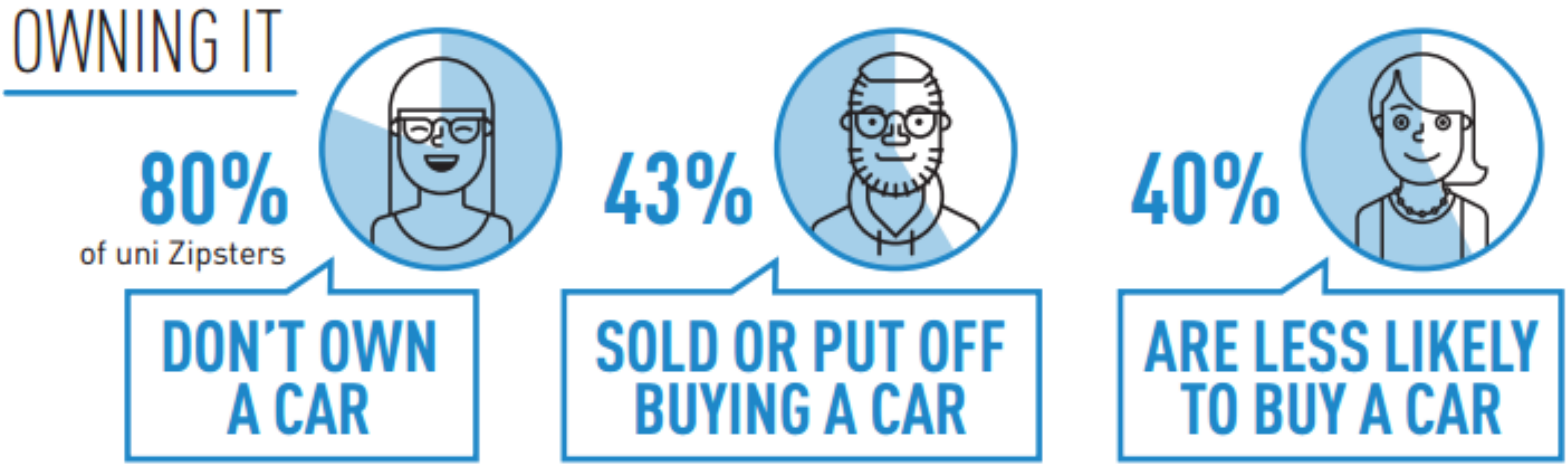
Recent Study of Zipcar's College/University Market: Fall 2016

- Survey design conducted as joint effort among TSRC UC Berkeley, Zipcar, and university representatives

- November 2015: online survey distributed via email by Zipcar to all North American Zipcar members
  - 534 North American universities. 31 universities in Canada and 503 in the U.S.
  - 27,781 respondents completed the survey
  - 10,040 complete responses by current college/university students, staff, or faculty

Stocker et al., 2016

Recent Study of Zipcar's College/University Market: Impacts



n=~10,000

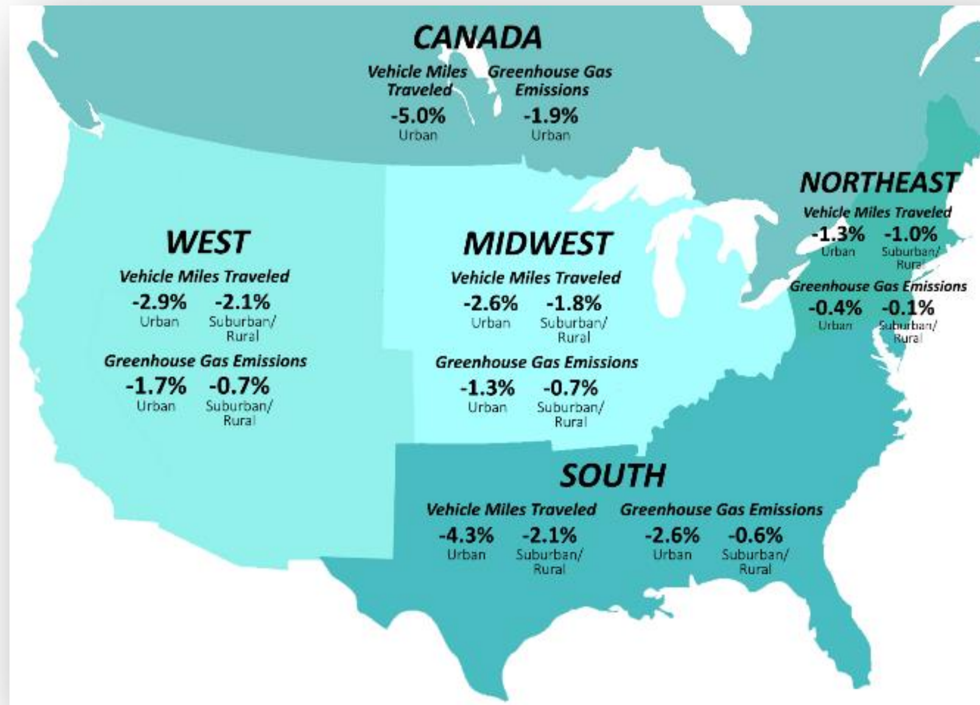
Impact on Vehicle Miles Traveled (VMT) and Greenhouse Gas (GHG) Emissions

-0.1% to -2.6%

Reduction of **GHG emissions**

-1% to -5%

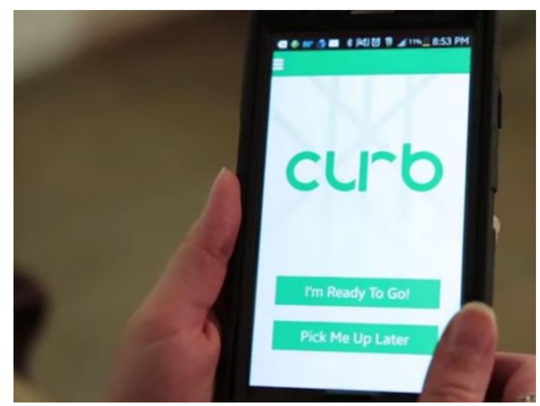
- Reduction of **VMT**
- VMT reductions are **greatest in urban land-use contexts**
- Members of **Southern and Canadian campuses** have the **greatest VMT reductions**



Stocker et al., 2016

Some Ridesourcing/E-Hail: Market Trends (Jan. 2016)

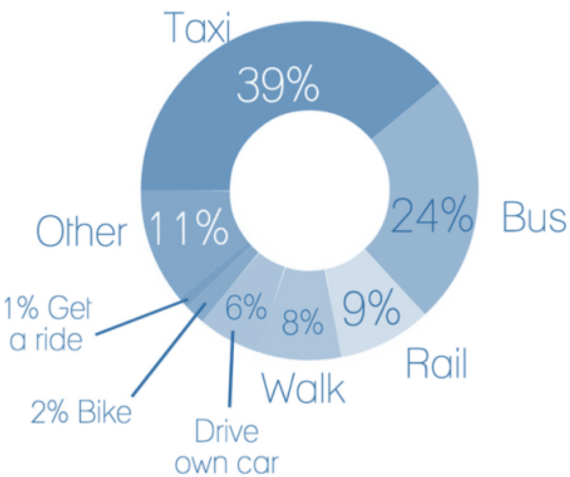
- Lyft: 195 cities; over 315,000 drivers
- Uber: 68 countries; over 360 cities; hundreds of thousands of drivers signing up globally per month
- Easy Taxi: 18 countries; 400 cities
- Curb by Verifone: 60 cities; 90 cab companies; 35,000+ taxis
- Flywheel: 6 cities; over 5,000 drivers
- TSRC study with NRDC, examining impacts of Uber and Lyft



Impacts of Ridesourcing in San Francisco: 2014

RIDESOURCING/TNC IMPACTS

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



n=380

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*

* 3% of study population would have actually driven

Worldwide and US Bikesharing: April 2016

Worldwide: **1,019 cities** with IT-based operating systems

- **1,324,530 bikes**
- 1,060,850 bikes in China (and 390 cities)

U.S.: **99 cities** with IT-based systems (61 programs)

- **~32,200 bikes**
- **3,400 stations**

In 2016, so far, 24 new programs began operating in world: 13 in China and 5 in US

Member Understanding: Five Bikesharing Cities Across Three Nations

Operator	City	Responses	Members (annual/seasonal)	Bikes	Stations
BIXI Montreal	Montreal	1102	49217	5000	400
BIXI Toronto	Toronto	1015	4185	1000	400
Nice Ride Minnesota	Minneapolis-St Paul	630	3500	1325	145
GreenBIKE SLC	Salt Lake City	72	N/A	65	12
EcoBici	Mexico City	3349	70100	3530	261
Total		6168			

© UC Berkeley, 2015

Impacts of North American Bikesharing

BIKESHARING IMPACTS

Bikesharing members in larger cities rode the bus less, attributable to reduced cost and faster travel associated with bikesharing.

Across all cities surveyed, increased bus use was attributed to bikesharing improving access to/from a bus line.

Rail usage increased in small cities (Minneapolis-St. Paul) and decreased in larger cities (Mexico City, Montreal, and Washington, DC) - all larger regions with denser rail networks. Shifts away from public transit in urban areas are often attributed to faster travel times and cost savings from bikesharing use.

5.5% sold or postponed a vehicle purchase

58% Increased cycling

50% of bikesharing members reduced personal auto usage

Shaheen et al. 2014

Shaheen et al., 2017

Microtransit Examples

- Fixed routes and fixed scheduling
  - Chariot, San Francisco
- Flexible routes and on-demand scheduling
  - Via: New York City, Chicago, Washington D.C.

Declines in Public Transit Ridership

UZA Name	Sum of 2015	Sum of 2016	Change
Seattle, WA	178,640,154	185,913,534	4.1%
Houston, TX	83,285,295	85,180,489	2.3%
Milwaukee, WI	40,610,851	41,476,982	2.1%
Detroit, MI	36,734,180	37,079,598	0.9%
New York-Newark, NY-NJ-CT	4,222,700,561	4,241,214,495	0.4%
San Francisco-Oakland, CA	454,952,418	454,996,256	0.0%
Boston, MA-NH-RI	403,464,723	402,554,159	-0.2%
Pittsburgh, PA	63,990,430	63,570,697	-0.7%
Denver-Aurora, CO	101,021,365	99,777,407	-1.2%
Portland, OR-WA	112,440,100	110,985,034	-1.3%
San Antonio, TX	37,983,886	37,290,201	-1.8%
Salt Lake City-West Valley City, UT	44,909,741	43,776,825	-2.5%
Minneapolis-St. Paul, MN-WI	96,636,368	93,716,857	-3.0%
Chicago, IL-IN	623,466,948	603,747,357	-3.2%
Urban Honolulu, HI	68,587,549	66,361,162	-3.2%
Las Vegas-Henderson, NV	72,044,767	69,420,973	-3.6%
Dallas-Fort Worth-Arlington, TX	75,998,371	72,137,725	-5.1%
Baltimore, MD	111,070,976	105,214,371	-5.3%
Atlanta, GA	141,154,134	132,925,293	-5.8%
Philadelphia, PA-NJ-DE-MD	369,644,085	346,276,496	-6.3%
Phoenix-Mesa, AZ	69,525,177	64,898,486	-6.7%
San Diego, CA	94,921,830	88,507,937	-6.8%
St. Louis, MO-IL	47,250,866	44,020,031	-6.8%
Cleveland, OH	46,844,074	43,507,057	-7.1%
Los Angeles-Long Beach-Anaheim, CA	619,459,557	572,589,716	-7.6%
San Jose, CA	44,718,244	40,763,554	-8.8%
Miami, FL	156,449,301	141,556,090	-9.5%
Washington, DC-VA-MD	441,222,366	396,260,838	-10.2%
Austin, TX	32,795,531	28,893,986	-11.9%
San Juan, PR	38,853,326	32,289,221	-16.9%

Increase

No Change

Decrease

NTD, 2017

Public Transit Ridership Declines

- Numerous studies documenting shifts to ridesourcing/TNCs predominantly from taxi and transit
- National survey (Reuters, 2017)
  - 68% use taxi less often
  - 38% use public transit less often
  - 21% use personal auto less often
- San Francisco (Rayle et al., 2014)
  - …. If ridesourcing were unavailable …..
    - 33% would have used public transit; 4% first-last mile
    - 7% would have used personal vehicle instead of TNC
    - 10% would have walked or biked
- Denver (Henao, 2016)
  - "For this trip, how would you have traveled if Lyft/Uber wasn't an option?
    - 22% Public transportation
    - 19% would have driven alone
    - 12% Would not have traveled

Shared Mobility and Public Transportation

More research and evaluations needed to study traveler behavior and elasticity of individual and combined variables

- Cost
- Fare type (e.g., pass, per trip, per mile) and stability (e.g., fixed vs. variable pricing)
- Temporal and spatial scale
- Convenience
- Travel time
- Wait time
- Number of modes
- Other factors

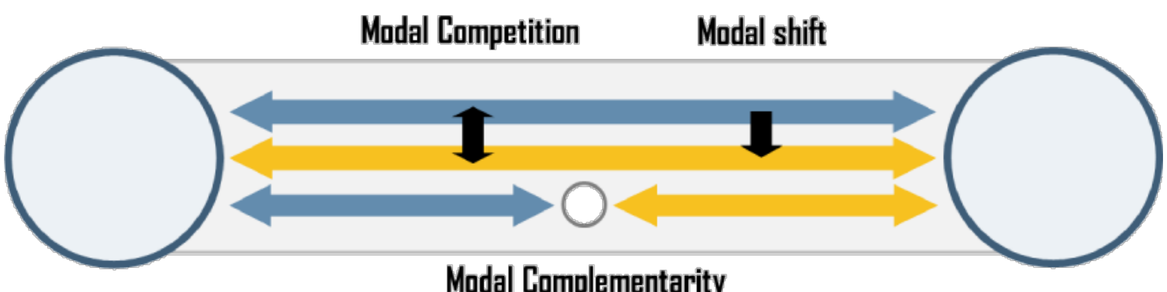


Image: Hofstra University

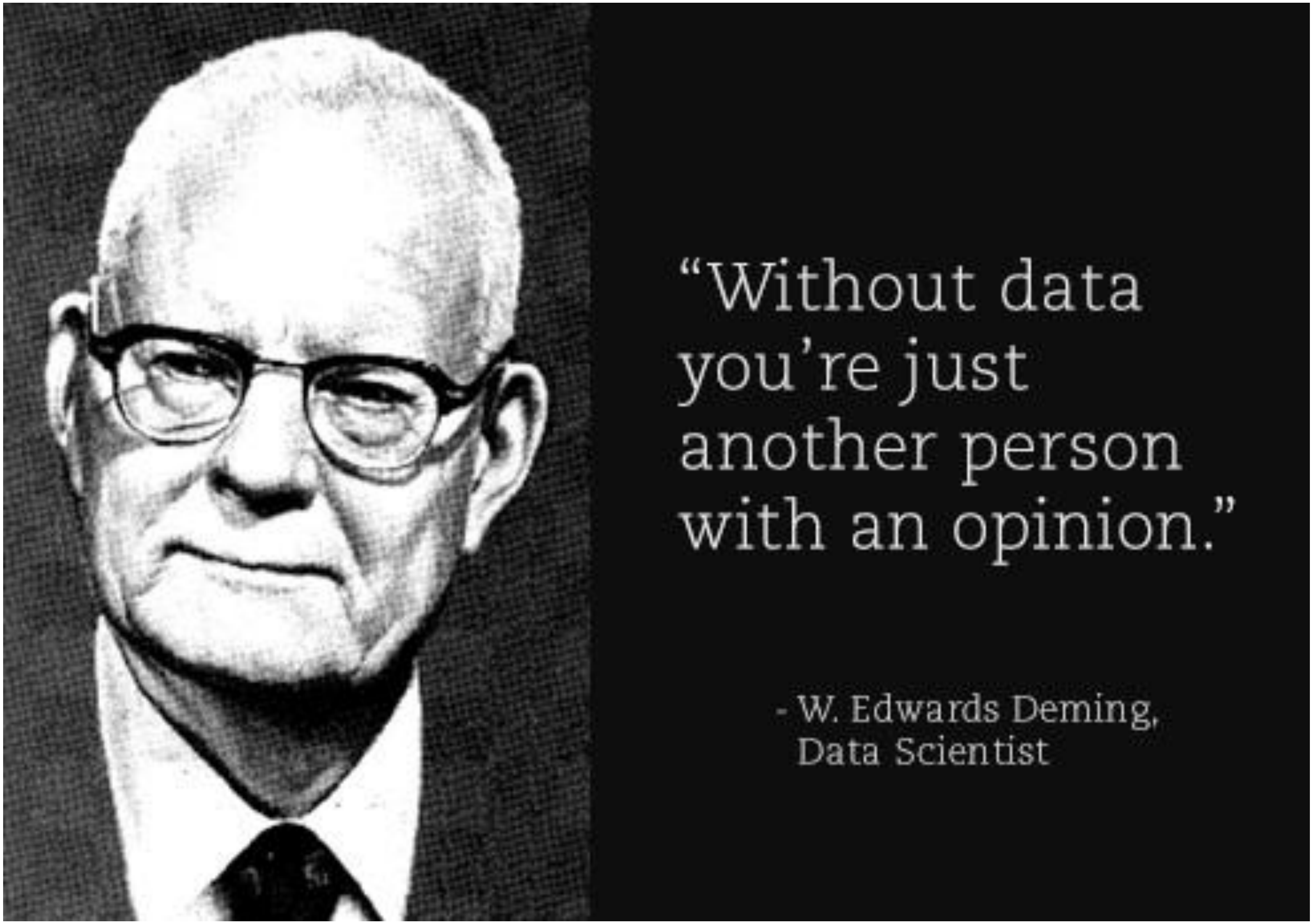
Key Questions for Public Transit

- When does shared mobility complement public transit and when does it compete?
  - How does it vary by mode & context?

- What factors influence complementarity vs. competition?
- How can shared mobility be used to enhance accessibility to areas without public transit service?
- How can shared mobility be used to improve efficiency and/or reduce service inefficiencies?
- How should public transportation respond to short-, mid-, and long-term changes? (e.g., shared mobility, AVs, SAVs, and other innovations)

Importance of Data and Research

- Need to develop data metrics, models, planning platforms, and methodologies to assess the economic and travel impacts of shared mobility
- Longitudinal tracking and forecasting of modal impacts (temporal/spatial scale)
- Develop ability for public agencies to forecast the economic and travel behavior impacts of shared modes/pilot projects and guide public policy development
- Developing policies that balance data sharing with privacy (user, private companies, and public agencies)
- Key for providing seamless multi-modal integration


"Without data you're just another person with an opinion."
- W. Edwards Deming,
Data Scientist

Evaluating Impacts of Pilots/Shared Mobility

Evaluation Hypothesis

- Based on project specific goals/target impacts

Performance Metrics

- Metrics established in line with project targets/hypotheses

Data Sources

- Based on performance metrics based and data collection plan

Analysis & Evaluation

- Quantitative & qualitative methods, such as surveys, focus groups, stakeholder interviews, and statistical and data analysis, and GIS analysis

Convergence

Electrification

Mobile Technologies

SECA

T. Papandreou, 2016

Shared Mobility

Automation

Shaheen, 2016

SAV Developments – Conventional Vehicle SAVs

All SAV pilots with conventional vehicles to date have a steering wheel in the vehicle and an engineer in the driver's seat for safety

Waymo

Example Pilot:

Early Rider Program, Phoenix, AZ

Uber

Example Pilot:

Pittsburgh, PA

NuTonomy

Example Pilot:

One North, Singapore

SAV Developments – Conventional Vehicle SAVs

Waymo Early Rider Program, Phoenix, AZ

- Alphabet's Waymo launched its Early Rider program in April 2017, inviting residents of certain areas of Phoenix, Arizona to ride in their autonomous vehicles
- After a trial period in Phoenix, Waymo plans to expand its fleet from 100 to 600 autonomous Fiat-Chrysler Pacifica Hybrid minivans

SAV Developments – Conventional Vehicle SAVs

Uber, Pittsburgh, PA

- In September 2016, Uber began a pilot in Pittsburgh, PA serving around 1,000 select Uber customers with four autonomous Ford Fusions
- There is a backup driver and engineer present in the front seats

SAV Developments – Conventional Vehicle SAVs

NuTonomy, One North Business Park, Singapore

- In August 2016, NuTonomy launched a public trial of their autonomous vehicles in a 1.5 square-mile section of Singapore, called One North
- NuTonomy partnered with Grab, the Southeast Asia-based ridesourcing company, and vehicles can be hailed via smartphone through Grab's platform

SAV Developments – Planned SAV Pilots

Low-Speed SAV Shuttle Pilots

EasyMile, Treasure Island, San Francisco Bay Area, CA

- EasyMile and the San Francisco County Transportation Authority are planning a pilot to serve first and last mile public transit trips on Treasure Island by 2020

Local Motors Olli, Miami Dade County, FL and Las Vegas, NV

- Local Motors' Olli has been tested in National Harbor, MD and has expansion plans to serve passengers in Miami and Las Vegas

SAV Developments – Planned SAV Pilots

Conventional Vehicle SAV Pilots

NuTonomy and Lyft, Boston, MA

- NuTonomy has been testing its AVs in the Seaport and Fort Point areas of Boston since April 2017
- In June 2017, Lyft and NuTonomy formed a partnership with plans to deploy a SAV pilot serving passengers sometime in the coming months

Delphi and Transdev, Normandy and Paris, France

- In June 2017, Delphi and Transdev announced that they will test AVs in Normandy and outside Paris in advance of building a commercial service starting in 2019, which could be deployed in other markets, including North America

Understanding the Impacts of Shared Mobility

- AVs, if **shared**, will begin to blur the lines between public and private transportation options

- SECA could help achieve **efficient and affordable public transportation** that improves **access to jobs and healthcare**

- Deployment opportunities for SECA in **first/last mile connections, underserved populations**, and **areas lacking quality public transit service**

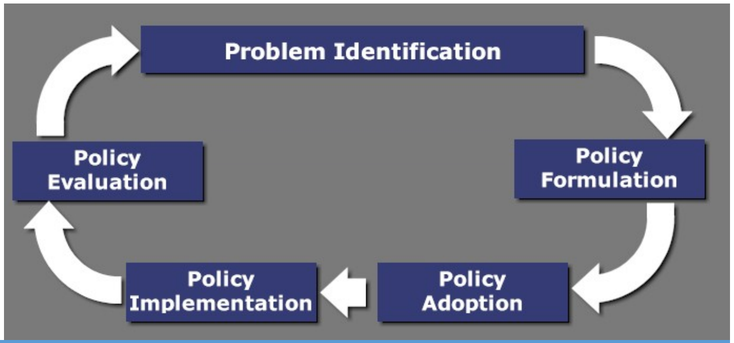
- **Cities and sites are different**, so SECA deployments need to be tailored to varying technical, social, and legal contexts

- **Pilot programs, enabled by public-private partnerships,** could encourage private shared services to adapt and expand functionality to meet the needs of public transit users

- **More research and informed policy needed**

Role of Public Policy

- Public agencies can **facilitate partnerships** between government and private sector
- Public agencies can engage in **public-public sharing of knowledge** and experience
- Governmental agencies could attract private sector partners by providing in-kind subsidies in exchange for meeting community goals
- Direct subsidies and taxes incentives should be coupled with case-specific evaluations that document positive social environmental impacts



Role of Public Policy

- **More pilots and evaluations needed to establish standards for estimating impacts and incorporating into modelling (e.g., SB743, SB375)**
- Rapid evolution and varying impacts of shared mobility services make developing general best practices difficult
- P**ublic sector needs proactive goal-based policy** instead of reactive mitigation-based policy
- Statewide data sharing requirements for all shared mobility operators would ensure fairness between providers

Future Shared Mobility Research

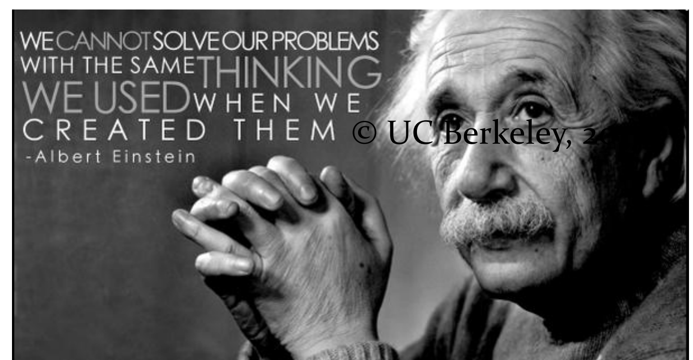
- North American and International Carsharing Market Outlooks (Summer/Fall 2017)
- Impacts Study of Lyft and Uber (Summer/Fall 2017)
  - Study will assess the impacts of travel behavior, vehicle ownership, VMT, modal shift, and GHG emissions
- P2P Carsharing Impact Study (Summer 2017)
- Bikesharing GHG Study (Fall 2017)

Future Shared Mobility Research (cont'd)

- U.S. Federal Highway Administration Studies of Mobility on Demand (Fall 2017)
- U.S. Federal Transit Administration Mobility on Demand Sandbox Independent Evaluation (2018-19)
  - $8 million funding for an array of mobility pilots with 11 partners (12 locations)
  - Booz Allen Hamilton and TSRC leading the independent evaluation for all sites
  - Measure project impacts and identify factors that may support or impede innovative transportation service models

Final Thoughts

- Change is now very fast, although may feel incremental; is disruption now a constant?
- Ultimately, will people care less about driving and more about connecting with media in vehicles?
- Future something we are creating now. We have ability to forecast what is coming and create preferred outcomes.
- Need more emphasis on social engineering (e.g., machine learning)
- Need more data and research understanding (e.g., pilots)



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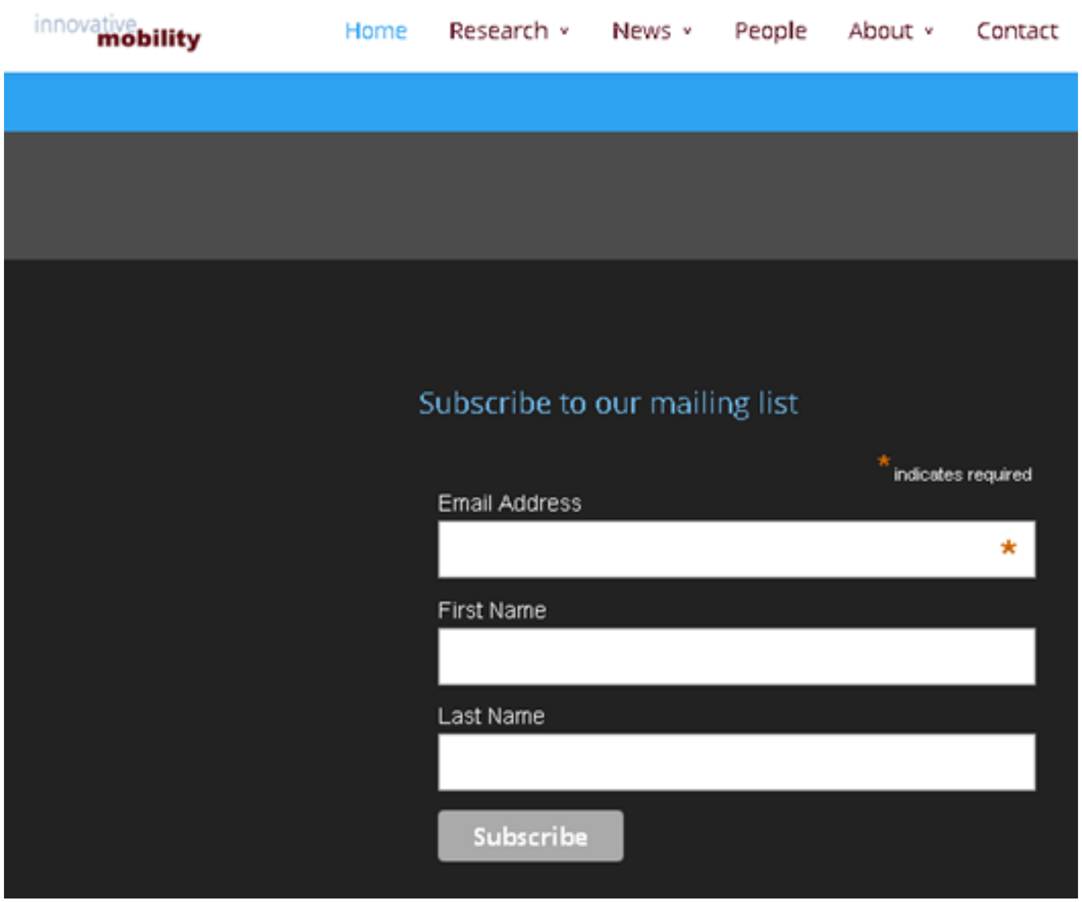

Last Week In Innovative Mobility
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TECHNOLOGY

NVIDIA and VW collaborate to apply artificial intelligence technology to broader transportation challenges. The organizations had previously partnered to develop driverless vehicles and will continue to use machine learning applications for urban traffic flow optimization.

RIDESOURCING

Uber and Yandex combine their Russian ridesourcing business. Both companies stated they would join forces in Russia, Armenia, Azerbaijan, Belarus, Georgia, and Kazakhstan to create a company that will operate in 127 cities. Russia's federal anti-monopoly regulatory body states the action would need approval as it potentially poses risk to competition.

APPS

TransLoc & Google

TransLoc and Google announce partnership to ensure accurate public transportation data are integrated into Google Maps. This partnership will allow TransLoc to manage larger volumes of real-time transit information for agencies and vastly improve access to public transit information for riders.

PUBLIC TRANSIT

Paris launches autonomous EV shuttle service pilot program. Two companies, Navya and Keolis, are partnering with the Parisian government to offer the service free of charge. The shuttles carry up to 15 people each and will operate three different daily routes. The pilot will run until at least December of this year.

BIKESHARING

Seattle allows private bikesharing on city streets, with as many as 10 companies planning to launch under the new program. Interested companies must roll out a minimum of 500 bikes and pay an operations fee to the city. This may lead to hundreds of thousands of dollars in public revenue. Helmet laws will still be enforced for users of the systems, but companies are not required to provide such helmets.

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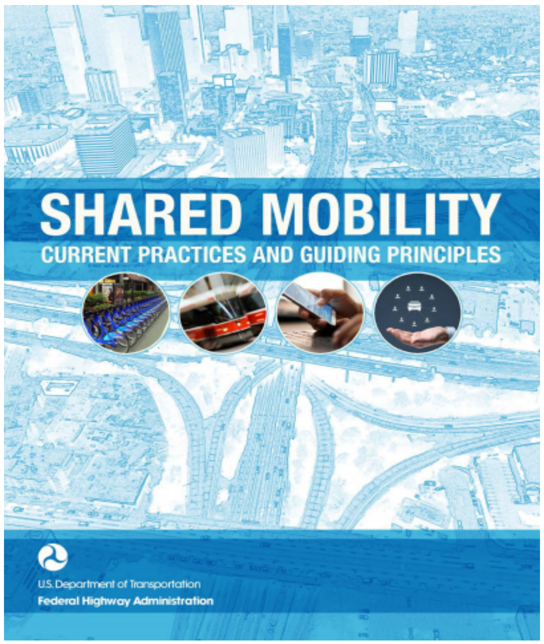
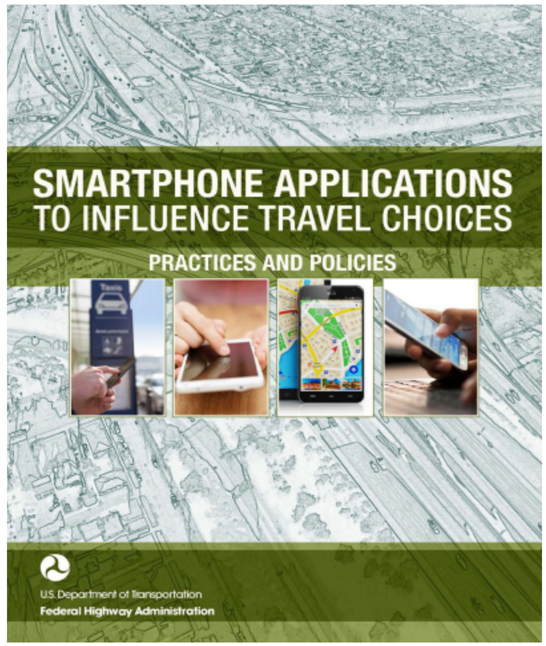
Recent Reports



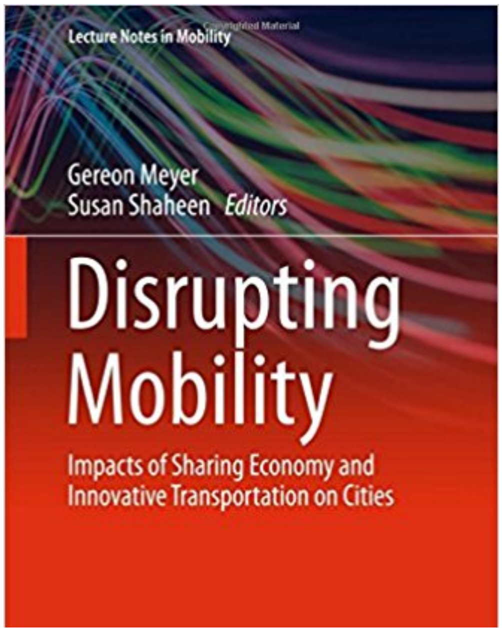
https://ops.fhwa.dot.gov/publications/fhwahop16022/fhwahop16022.pdf



https://ops.fhwa.dot.gov/publications/fhwahop16023/fhwahop16023.pdf

https://www.planning.org/publications/report/9107556/

Recent Book: Disrupting Mobility



Available at:

https://www.amazon.com/Disrupting-Mobility-Impacts-Innovative-Transportation/dp/3319516019

Acknowledgements

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