The Impact of New Mobility Services on the Automotive Industry

CAR
CENTER FOR AUTOMOTIVE RESEARCH

August 2016

CENTER FOR AUTOMOTIVE RESEARCH

3005 Boardwalk, Suite 200
Ann Arbor, Michigan 48108
734-662-1287
www.cargroup.org

Emerging trends in mobility technology, such as the rise of ridehailing and carsharing services, have led many industry analysts to offer their views on how these trends will affect the automotive industry in the United States. The reports stemming from these efforts have resulted in highly conflicting visions of the future, ranging from a dramatic decline in vehicle sales to a windfall in revenue and profits.

Faced with this cloudy picture, researchers at the Center for Automotive Research decided to weigh in with their own analysis, one that is rooted in our cumulative knowledge of travel behavior, consumer preferences, and the operational characteristics of new mobility services.

Our analysis, based on sound data and detailed in this report, sheds light on what we believe are likely future directions. We welcome feedback on this effort and will continue to refine our viewpoint as technology, society, and service offerings continue to evolve.

The Impact of New Mobility Services on the Automotive Industry

This report was produced and published by the Center for Automotive Research (CAR). It was prepared primarily by CAR researchers Adela Spulber and Eric Paul Dennis, with guidance and input from Richard Wallace, Director, Transportation Systems Analysis. CAR researcher Michael Schultz provided data analysis and forecasts critical to the overall effort.

August 2016

Table of Contents

List of Figures and Tables iii
Introduction 1
Types of New Mobility Services 3
Ridehailing 3
Ridesharing 4
Carsharing 5
Bikesharing 6
Microtransit 6
Mobility-as-a-Service 7
Shared Autonomous Vehicles 7
Key Trends in Transportation Choices 8
Push Forces for New Mobility 8
State of Transportation in the United States 11
Target Users and Markets of New Mobility Services 14
Effect of New Mobility Services on Transportation 18
State of New Mobility Industry and Potential Growth 22
Ridehailing 22
Ridesharing 24
Carsharing 25
Bikesharing 27
Implications for the Automotive Industry 29
New Markets and Opportunities for Automakers 29
Cost Comparisons between NMS and Private Vehicle 32
Effect on Light Vehicle Sales 36
Broader Impacts and Policy Considerations 39
Conclusions 41
Notes and References 43

List of Figures and Tables

Figure 1: Enablers and Push Forces Driving the Rise of New Mobility Services 2
Figure 2: Ideal Use Cases for Different Modes of Transportation 3
Figure 3: Annual County Population Growth, by Density 9
Figure 4: Light Vehicle Sales (Vehicles/1,000 people) 10
Figure 5: Usual Means of Transportation to Work 12
Figure 6: Average Vehicle Miles Traveled in the United States, 1970-2015 (FHWA) 13
Figure 7: Active Uber Driver-Partners in the United States 15
Figure 8: Use of Ridehailing by U.S. Adults 17
Figure 9: Alternative Transportation Mode Users Would Take if Their First Choice Was Unavailable 19
Figure 10: Changes in Personal Travel Behavior Since Using New Mobility Services 19
Figure 11: Business Expenses for Ground Transportation in the United States 20
Figure 12: Active Uber Drivers by Service 23
Figure 13: Carsharing: 1998 - 2015 Historic Growth and 2016-2021 Projections in the United States 26
Figure 14: Carsharing: 2006 - 2014 Historic Growth and 2015-2021 Projections in Three Regional Markets 27
Figure 15: Growth of Bikesharing Programs in the World 28
Figure 16: Growth of Bikesharing Programs in the United States 28
Figure 17: Automakers and New Mobility Companies: Examples of Partnerships and Investments 31
Figure 18: Annual Transportation Costs: Carsharing v. Private Vehicle (City Level) 33
Figure 19: Annual Transportation Costs: Carsharing v. Private Vehicle (National Averages) 34
Figure 20: Annual Transportation Costs: Ridehailing v. Private Vehicle (City Level) 35
Figure 21: Annual Transportation Costs: Ridehailing v. Private Vehicle (National Averages) 36

Table 1: Comparison of Uber and Lyft 4
Table 2: Overview of BlaBlaCar 5
Table 3: Comparison of Zipcar and car2go 6
Table 4: Key Factors Affecting Travel Behavior 8
Table 5: Guidelines for Where Carsharing Succeeds 14
Table 6: Characteristics of Carsharing Markets 16
Table 7: Percent of U.S. Residents That Have Used Ridehailing (Uber or Lyft) 17
Table 8: Potential for New Mobility Services to Increase or Decrease VMT 21
Table 9: Number of Private Vehicles Replaced by One Shared Car, 2021 Projections 37
Table 10: Net Loss of New and Used Vehicle Sales Due to Carsharing, 2010 to 2021 38

Introduction

The concept of *mobility* is increasingly being adopted by planners, policymakers, and industry to describe the systems that allow people to move about their world. This shift in language—from *transportation* to *mobility*—represents a shift in thinking about how a transportation system is best designed and managed. While *transportation* is a system-centric concept, *mobility* is a user-centric concept—recognizing that transportation products and services must be responsive to the needs, habits, and preferences of travelers and society.

Numerous new passenger transportation options, collectively called *new mobility services* (NMS), have been developing for the past fifteen years. They strive to fulfill as much as possible all users' needs of movement and access to places, goods, and people, in a holistic and systemic way.

New mobility services are transportation solutions enabled by emerging technologies and wireless connectivity that allow for more convenient, efficient, and flexible travel. Carsharing, ridehailing, ridesharing, microtransit, bikesharing, and mobility-as-a-service are among the most noteworthy new mobility services currently being developed. Each has its own business model and underlying service characteristics.

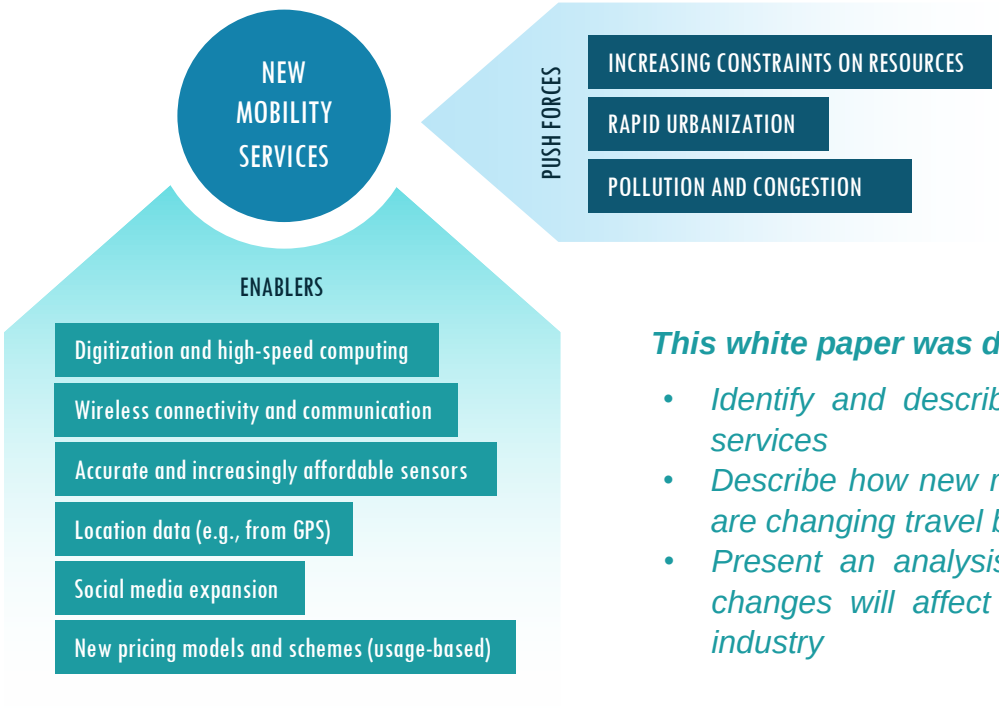
The concept of shared-use mobility, which is at the center of new mobility services (NMS), enables users to have access to transportation modes (vehicle, bicycle, motorbike, etc.) for a short-term and on an as-needed basis. NMS provide transportation as an on-demand service, with mobility as the core commodity promoting choice in transportation mode and encouraging multimodal connectivity and system interoperability.[1] New mobility services often blur the lines between public and private transportation, and between what is shared and what is owned.

NMS have emerged due to a variety of enablers and push forces (see Figure 1); the former make NMS technically possible, while the latter make them advantageous. The enablers are advances in technology, such as wireless communication and accurate GPS location. The push forces include rapid urbanization, pollution, and congestion, and these are just a few factors that have prompted this wave of innovation in transportation.

To shed light on how NMS will affect the automotive industry, CAR researchers investigated a wide range of research on the characteristics of NMS and how they affect travel behavior, demographic and other societal trends, and developed some of its forecasts. This report presents CAR's findings and approach in detail. The focus of the analysis is on the United States, but international comparisons are made to explain the broader impact of new mobility services, as well as to distinguish how NMS might have different effects in the United States compared to other places.

We expect to show that NMS likely are not the catalyst of a **mobility revolution** that will bring about disruptive and profound change in travel behavior. NMS, bringing new business models, products, and services, will not supplant the automotive industry in the medium term. Rather, our findings suggest that NMS are contributing to a **mobility evolution.** Worldwide, they are part of an incremental change in travel behavior, especially in urban areas, towards a multimodal system that is less car-centric. This gradual change will allow traditional transportation players – automakers in particular – to adapt and maintain their market positions, despite the increasing diversification of the transportation sector.

Figure 1: Enablers and Push Forces Driving the Rise of New Mobility Services



This white paper was developed to:

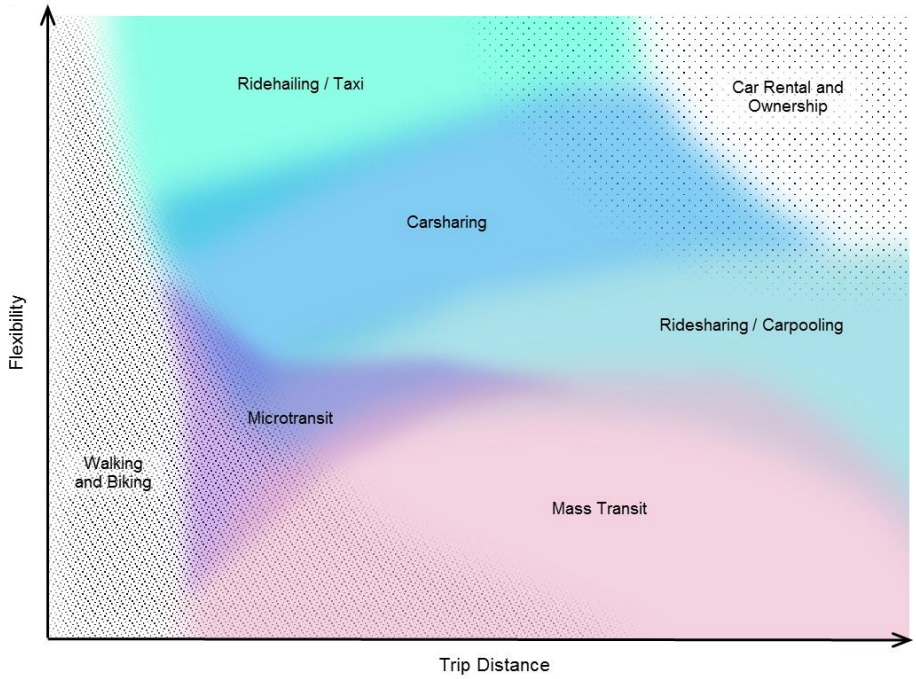
- *Identify and describe new mobility services*
- *Describe how new mobility services are changing travel behaviors*
- *Present an analysis of how those changes will affect the automotive industry*

This report is organized into several distinct sections. First, it describes and characterizes the various types of new mobility services that exist, clarifying the different service offerings and business models that are being pursued. Second, it presents important trends in transportation and travel behavior, as well as demographic trends. Third, it examines opportunities for growth in the market for mobility services—what exists today will not necessarily be the market options in the future. Fourth, based on integration of these sections, it presents an analysis of how CAR researchers foresee NMS affecting the automotive industry, followed by analysis of even broader policy implications and overall conclusions.

Types of New Mobility Services

New mobility services have been characterized as more reliable, predictable, efficient, convenient, accessible, and seamlessly connected compared to established means of transportation, as well as offering easier options for payment. NMS, such as ridehailing and carsharing, also contribute to reduced demand for parking, pollution, and congestion, as well as provide energy savings and transportation costs savings for users. Each of these NMS fits a specific niche, but they also partially overlap with one another and with established means of transportation (see Figure 2). Which service is best for a given trip depends on trip distance and the amount of flexibility (time, destinations available) that the traveler has available for the trip.[2]

Figure 2: Ideal Use Cases for Different Modes of Transportation



Ridehailing

Ridehailing services rely on smartphone apps to connect paying passengers with drivers who provide rides (for a fee) in their private vehicles. Transportation Network Companies (TNCs) design and operate these online platforms. Most TNCs function as digital marketplaces that link self-employed drivers with customers and collect a fee for making the connection. TNCs have deployed a variety of operating models, partnering with drivers holding a commercial driver's license or just a normal driver's license.

Ridehailing started in the late 2000s in the United States and is now available in most of the world. The biggest TNC is Uber (present on all continents), followed by regional players such as Lyft (United

States), Didi (China), Ola (India), Haxi (Europe), and Gett (Europe). Conceptually, ridehailing is distinct from ridesharing. The term ridesharing indicates that drivers share a destination with their passengers, but the distinction between ridehailing (provided by TNCs) and ridesharing is becoming less and less clear. TNCs have launched several services that offer clients the option of sharing a ride with others, so-called "ridesplitting" services. Uber has UberPOOL and UberHop, while Lyft has LyftLine. Nevertheless, these are not properly ridesharing services, because driver still do not share a destination with their passengers and operate much like a taxi driver.

TNCs have also been experimenting with actual ridesharing services (for example, UberCOMMUTE, Uber's Destinations feature, Lyft Driver Destination, Lyft Carpool) that allow the drivers to input their destinations and then accept ride requests from people wanting to go along the same route as the driver.

Table 1: Comparison of Uber and Lyft

Company	**Uber**	**Lyft**
Active Since	2009	2012
Passengers	8 million passengers worldwide[3]	2.8 million passengers[4]
Active Drivers	450,000 drivers in the United States[5] and more than one million worldwide	315,000 drivers in the United States.[6]
Geographic Availability	200 U.S. cities. More than 450 cities in 75 countries worldwide.[7]	200 U.S. cities[8] - operates only in the United States

Ridesharing

Ridesharing is a type of carpooling that uses private vehicles, arranging shared rides on short notice between travelers with a common origin and/or destination. This service can be dedicated to short- or long-distance trips. Travelers share trip costs through these ridesharing platforms that charge a fee for making the connection.

Carpooling has existed for decades, but real-time ridesharing started in the mid-2000s. Ridesharing is less popular than carsharing in the United States, and so far Europe is the biggest market for this type of service. The largest operator is BlaBlaCar, a long-distance ridesharing platform present in Europe and South America (see Table 2). In the United States, several small players offer platforms for enabling peer-to-peer ridesharing (mostly short-distance) or organizing real-time carpooling or vanpooling; these include vRide and Commutr. As another example, Waze (owned by Google) launched a ridesharing pilot project in May 2016 with several companies in the Bay Area. By using a dedicated app called Waze Rider, more than 25,000 employees will be able to request a ride from other Waze users who share similar commutes. Drivers can choose whether or not to approve that request in the original Waze app. Riders pay drivers a suggested amount based on the standard rate set by the Internal Revenue Service (IRS) — 54 cents per mile.

Table 2: Overview of BlaBlaCar

Company	**BlaBlaCar**
Active Since	2006
Members	25 million members
Rides	10 million people transported / trimester
Geographic Availability	22 countries in Europe and South America.
Business Model	Long-distance peer-to-peer

Carsharing

Carsharing is a short-term car rental, often by the hour. Electronic systems allow customers unattended access to the vehicles. Gasoline and insurance are included in this type of service. These characteristics distinguish carsharing from traditional car rental. In the last few years, however, the distinction between the two models is increasingly blurred, especially as car rental has become more similar to carsharing.

Business models:

- *Round-trip carsharing— must have a reservation with beginning and end time; vehicle must be returned to its home station*
    - *Peer to Peer (P2P) - private individuals own the fleet.*
    - *Business carsharing – companies own the fleet, station-based.*
    - *Corporate carsharing – corporate fleets with carsharing technology (telematics and online scheduling).*
- *Flexible carsharing — one way/on demand services*
    - *Free floating – vehicles can be parked on the street in any legal parking space in the "home area".*
    - *Station-based – vehicles can be parked only in designated garages, parking lots or at electric vehicle charging stations.*

Carsharing is available in 26 countries spread across North and South America, Europe, Asia, and Oceania. The biggest carsharing market is Europe, home to more than two million members and nearly 60,000 vehicles in service in 2014. North America ranks second, with more than 1.6 million members and nearly 25,000 vehicles as of 2014.[9]

The first carsharing programs in North America started in 1994. As of January 2015, 23 carsharing programs were operating in the United States[10] (excluding peer-to-peer), slightly less than half of which were for-profit services. Contrary to the situation in Europe, flexible carsharing is less common than round-trip carsharing in the United States. The largest programs are operated by car rental companies and vehicle manufacturers. In January 2015, U.S. carsharing programs amounted to 16,700 vehicles and 1.2 million members.[11] The three largest operators, Zipcar, car2go (see Table 3), and Enterprise CarShare, support almost 96 percent of the membership.

Table 3: Comparison of Zipcar and car2go

Company	*Zipcar*	*car2go*
Owner	Owned by Avis Budget Group	Owned by Daimler
Active Since	2000	2008
Members	950,000 members worldwide	1,566,000 members worldwide[12]
Geographic Availability	Over 50 major metro areas, 500 college campuses, and 50 airports in Europe and North America.	Over 30 cities in Europe, North America and China.
Rental Model	Station-based, mostly round-trip.	Free-floating, one-way.

Bikesharing

Bikesharing is a system that provides free or affordable access to bicycles for short-distance trips, mostly in urban areas.

Bicycle-sharing models

- *Community Bike programs - organized mostly by local community groups or non-profit organizations*
- *Smart Bike programs – implemented by government agencies, sometimes in a public–private partnership*

Bikesharing systems are available in almost 1,000 cities worldwide,[13] especially in China, Italy, and Spain. The systems with the highest number of shared bicycles are located in Paris, London, Changshu, New York, and Barcelona.[14] As of October 2015, the United States was home to about 30,700 shared bikes at 3,300 stations across 70 systems, covering 104 U.S. cities.[15] The largest U.S. programs are in Washington, D.C.; Minneapolis; and Boston.[16] Some of the biggest operators of bikesharing in the United States. are Motivate, DecoBike, and Zagster. The majority of bikesharing systems are point-to-point, or one-way.

Microtransit

Microtransit is a wide category encompassing various private transit services that use small buses and develop flexible routes or schedules (or both) based on customer demand. Microtransit bridges the gap between single-user transportation and fixed-route public transit and resembles current route-deviation services.

Microtransit operates in a similar manner to jitney service, New York's informal dollar vans, or city-operated paratransit services. What sets it apart are wireless connectivity and data analytics. Better data on mobility patterns and wide smartphone access have made flexible, on-demand transit more convenient for the users and more profitable for providers. A few microtransit companies started operating in the United States around 2010: Bridj (Boston, Washington, and Kansas City), Chariot (San Francisco), and Via (New York, Chicago). A few operators, such as Leap Transit (San Francisco) and Kutsuplus (Finland), have suspended service after a brief operating period.

Mobility-as-a-Service

Mobility-as-a-Service (MaaS) is a mobility distribution model in which a person's transportation needs are met over one interface and are offered by a service provider. In general, multiple transportation options (mass transit, carsharing, ridehailing, etc.) are bundled, an integrated solution is presented to the user through a smartphone app, and service is paid for through a single account.

The goal of MaaS is to provide end-to-end transportation by linking different transportation modes and making better use of the existing transportation options in a given area. Transportation aggregators like Google Maps and the Bay Area's 511 website are precursors of MaaS. Mobility-as-a-service was first conceptualized in Europe and a Pan-European MaaS Alliance was formally unveiled at the 2015 ITS World Congress. The MaaS Alliance is an umbrella for several projects aimed at developing MaaS business models and payment options.

In general, European initiatives are more advanced than their American counterparts. Pilot projects such as UbiGo (Sweden) and MaaS (Finland) were deployed in 2014-2015. Following their success, they are aiming at providing travel packages (monthly subscription or usage-based) in Gothenburg and Helsinki in 2016 or 2017.

In the United States, companies like TransLoc, Xerox, and moovel N.A. are developing transportation aggregator apps, including employee commute benefits, and are developing partnerships with local authorities. Since late 2015 to early 2016, Xerox has been testing its Seamless Transportation solution in Valence, France, and its Mobility Marketplace in Los Angeles and Denver. RideScout, which merged in 2016 with GlobeSherpa to form moovel N.A. LLC, has tailor-made solutions in more than 70 cities in the United States and Canada, that approach the concept of MaaS.

Shared Autonomous Vehicles

Shared autonomous vehicles are fully self-driving (fully automated or autonomous) vehicles that do not require human drivers; human input is needed only to provide information regarding the origin and destination of the trip.

The working concept is that shared autonomous vehicles (SAVs) can be summoned by customers using mobile phone applications, much like ridehailing services are accessed through TNCs. Several automotive manufacturers (Volvo, GM, Ford, Mercedes, etc.), technology companies (Google, EasyMile, Apple), and new mobility companies (Uber, Lyft, Zipcar) currently are working on the development of shared autonomous vehicles. Most forecasts expect SAVs to be available for the public beginning with 2020-2025, first on enclosed perimeters (campuses, airports, etc.) and then on city roads.

Key Trends in Transportation Choices

The introduction and adoption of new mobility services is related to several broad trends, such as rapid urbanization, economic growth, increasing road congestion, increasing pollution from the transportation sector, and changing mobility preferences.

The uneven prevalence of these trends across the globe and within the United Stated implies that the potential for NMS to disrupt transportation, and the automotive industry with it, is similarly variable. NMS are being increasingly used in the largest and densest cities, as well as, to a lesser extent, smaller urban areas and inner suburbs. New mobility services are far less adapted to sprawling and sparsely populated areas, where a majority of the United States population lives and where the convenience of driving one's own car is greater than the appeal of NMS. Overall, the transportation choices U.S. residents make will be transformed by new mobility solutions to a lesser extent than in other parts of the world. The U.S. automotive market is relatively less vulnerable to disruptive NMS services than are other markets.

Push Forces for New Mobility

The impacts of new mobility services on the transportation sector are largely determined by their interaction with the factors affecting travel behavior (Table 4) and the evolution of these factors over the last few years. Recent and long term evolutions of a few factors affecting travel behavior are acting as push factors for new mobility services.

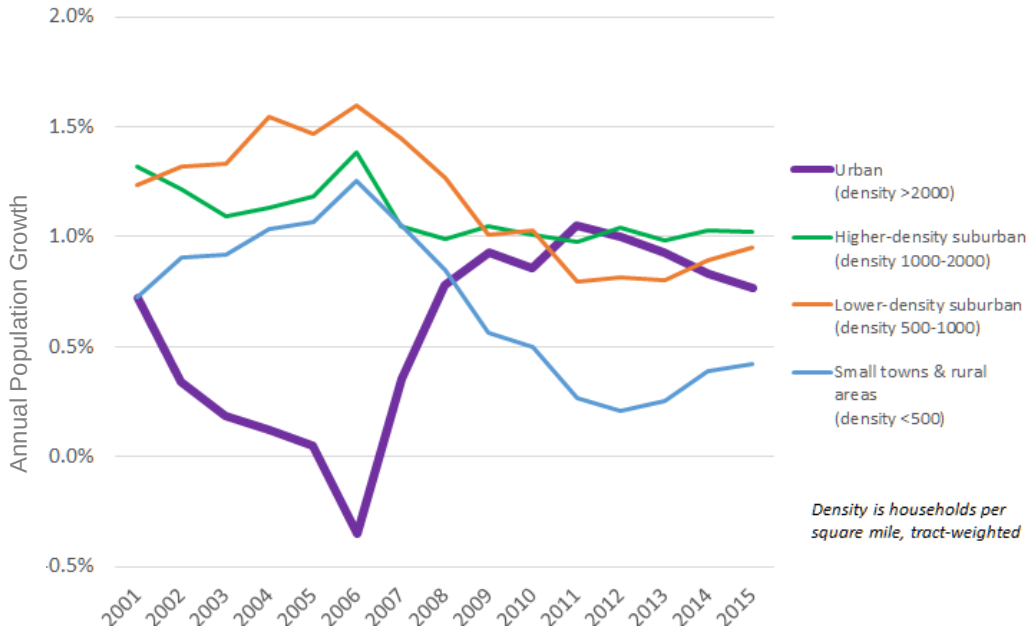
Table 4: Key Factors Affecting Travel Behavior

Demographic Trends	**User Preferences**
• Population age structure • Population growth and density • Licensed drivers	• Social preferences for mobility • Preferences for residence • Telework and work commute
Transportation Options	**Transportation Costs**
• Available means of transportation: private vehicle, mass transit, ridehailing, taxi, carsharing, car rental, ridesharing, carpooling, bicycle, bikesharing, walking	• Fuel prices, transit fares • Vehicle ownership costs • Toll and parking prices • Road congestion
Infrastructure and Planning	**Macrofactors**
• Land zoning and development trends • Public investment • Traffic management systems	• Economic growth • Employment and income • Global warming and pollution

Population Growth and Density

Worldwide, the most important demographic trends include rapid urbanization, the expansion of megacities, and densification. The U.S. situation, however, is different, because low-density development and urban sprawl is dominant (see Figure 3). In recent decades, American urban areas and downtowns have made a significant recovery in terms of population, development, and job growth. Between 2007 and 2015, there was a rebound in urban growth, when population growth in urban counties[17] grew more rapidly than in suburbs and exurbs; however, urban this urban revival has slowed since 2015, and suburban county populations are once again growing faster than urban ones.[18]

Figure 3: Annual County Population Growth, by Density



Source: U.S. Bureau of Census data, graphics by Jed Kolko

The stronger population growth in the suburbs will have a direct impact on the adoption of new mobility services, especially of those that are particularly suited for dense urban areas. More specifically, carsharing, ridesharing, and transportation network companies might not be so disruptive, because the fabric of the United States is likely to remain dominated by a suburb pattern, for which new mobility services are not particularly adapted.

User Preferences

The growing preference for urban living, biking and walking can contribute to a decrease in personal vehicle use. Residential choice can be used to understand travel preferences. There is an increasing demand to live and work in urban walkable areas. The choice to live in a downtown area or a suburban subdivision includes some consideration of the transportation options available in those areas. Accordingly, people move into the city partly because they want to walk, bike, or use transit more than they want to drive.

Increasingly, home owners, renters and businesses attach an increasing economic value to walkability and dense urban areas. This is why home prices increased 50 percent faster in urban centers[19] and office space in walkable urban areas has a 74 percent price-per-square-foot premium compared to rents for office

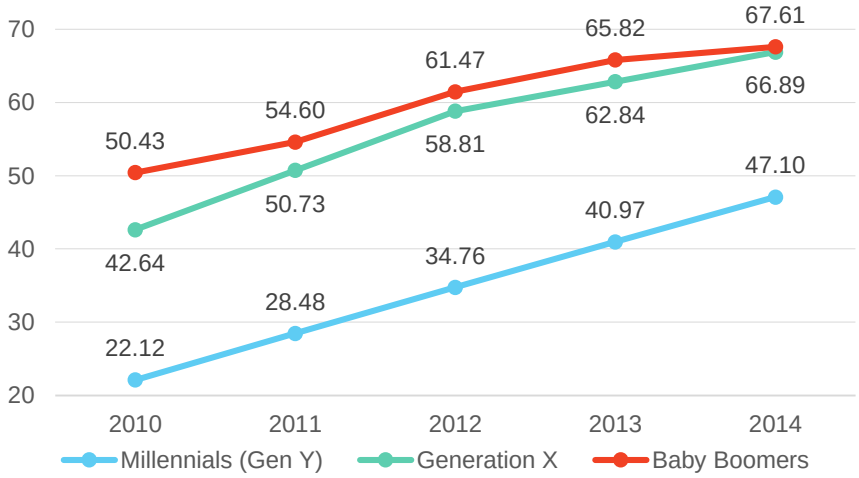
space in suburban business parks.[20] All in all, an increased desirability for areas that are dense, walkable, and have public transit leads to a decrease in interest for a car-centric lifestyle, which may have a positive impact on new mobility services and possibly a negative one on vehicle sales.

In reaction to the preference for urban lifestyle, recent land and transportation planning efforts, whether in urban or suburban settings, have put an increasing emphasis on rendering neighborhoods more walkable, building complete streets and expanding bike lanes. In addition, part of the planning community strives to reduce the need for physical movement through higher urban densities, transit oriented design, increased access to services and goods, all of which contribute to reducing the energy intensity and congestion of urban mobility.

Population Age Structure

Millennials and, to some extent, Baby Boomers will be the driving forces of the adoption of new mobility services. Changes involving these two demographic categories will likely increase demand for new mobility services. Millennials now represent the biggest cohort of the American population.[21] This generation is more urban than its predecessors and has increased as a proportion of residents in the center of nearly every city in the country, while falling as a proportion across all other areas.[22] Millennials are also less car-focused than previous generations, more likely to use public transit, bike or walk, and have led a broader shift in transportation behaviors among Americans (see Figure 4). Millennials are the early-adopters of most of the new mobility services, from carsharing, ridesharing, bikesharing. They also are more open to connected and automated vehicles, as well as less polluting vehicles. The preference Millennials appear to have for the urban living, will reinforce the spread of these services, which are particularly suited for dense urban areas.

Figure 4: Light Vehicle Sales (Vehicles/1,000 people)



Source: U.S. Bureau of Census and J.D. Power data

In 2014, a typical Millennial was about 30% less likely to buy a car than someone from older generations.[23] In addition, today's younger generation buys fewer cars than young people did ten years ago. For example, in 2003, 25 out of 100 persons in their mid-thirties took auto loans. In 2015, only about 17 out of 100 people in the same age group did so. The only age group that was more likely to take an auto loan in 2015 that in 2003 were people over 65 or older. [24] Factors that can help explain why

Millennials are less likely to buy automobiles include: gasoline prices, student debt, credit history, interest rates, and travel preferences.

Baby Boomers primarily live in suburbs. As they get older, driving becomes more of a challenge for them because of age-related health issues. The mobility challenges that an aging Baby Boomer generation will have in a suburban setting means that this cohort will have increasing needs for alternative mobility services, whether they are ridehailing, semi-flexible route shuttles, multimodal solutions (especially innovative last-mile solutions), or shared autonomous vehicles.

Licensed Drivers

For the last 30 years, the percentage of licensed drivers has been dropping in all age groups, though the United States maintains one of the highest rates in the world. The decline is steeper for the younger population, but it is present even among the older age groups. For 16-to-44-year-olds, there has been a continuous decrease since 1983. The percentage of licensed drivers among 45-to-69-year-olds started decreasing in 2008. Finally, the number of drivers 70 years and older has also been decreasing since 2011.[25]

Transportation Options and Costs

Changing preferences and macro-factors are not enough to change travel behavior, because behavior strongly depends on available options. Public transit networks, walkable and bikeable roads, along with the new mobility services, cover only a limited part of the United States. Only 55 percent of American households reported that they have access to public transportation service.[26] Europe is a different situation, where a growing number of municipalities implement policies that discourage driving in city-centers to curb pollution and congestion. Also, a bigger share of the European population lives in areas covered by a public transit network. Another important element is the cost of transportation. The costs of owning and using a vehicle are relatively lower in the United States than in other countries, which is an important factor in the preference for a private vehicle.

However, in recent years, there has been an increase in the number of new transit projects across the United States for bus rapid transit, street cars, and busses. There has also been a strong effort to move towards smart transit solutions for traffic management, real-time location of transit assets, and new ticketing solutions integrating smartphones and credit cards, smart cards, etc. Part of the planning community believes that as population density in urban areas increases and daily-routine destinations become more accessible through walking, biking or transit, a personally-owned car that sits idle more than 95% of the time will become a less desirable and economically-feasible business model for personal mobility.

State of Transportation in the United States

In contrast with countries in Europe and Asia, in the United States private vehicles have a far larger modal share than other options and retain a dominant place in the transportation system.

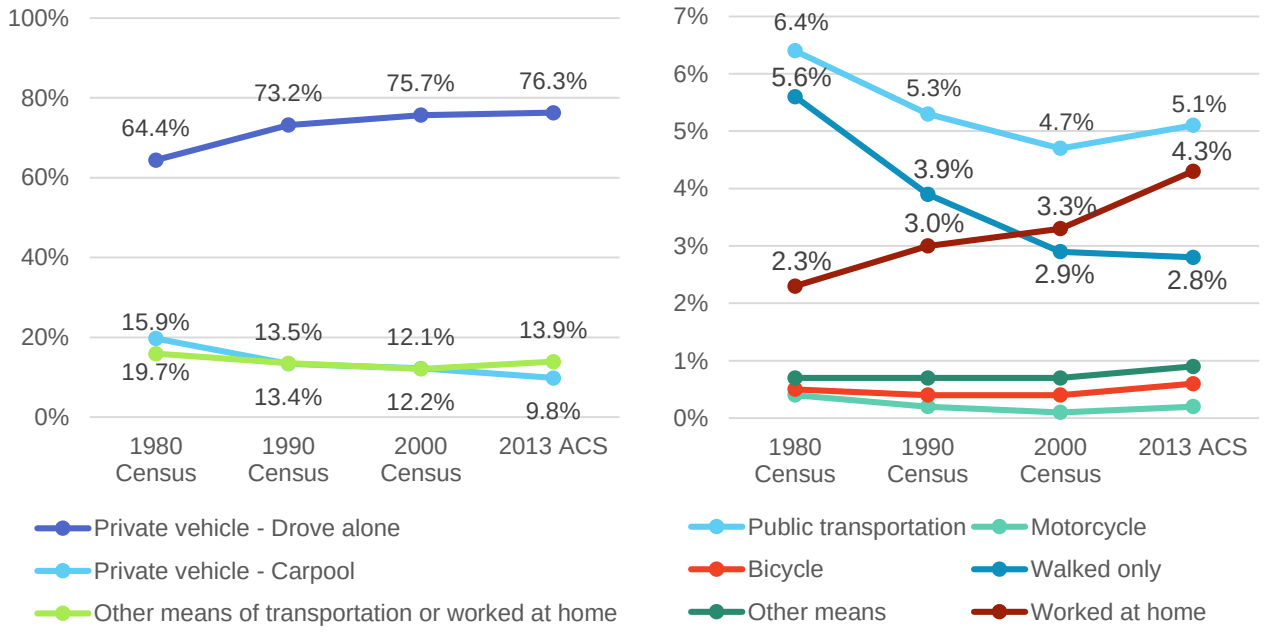
In 2013, 76.3 percent of Americans commuted to work by driving alone, and this share has been increasing over the years (see Figure 5). This is why the United States has one of the highest ratios of

vehicles per capita, fourth-place worldwide after three microstates, San Marino, Monaco, and Lichtenstein. Since 2008, however, this number has stopped growing and is now slowly declining, settling at just under 0.8 in 2013.

In 25 years, the share of people that carpool was divided in half. Carpooling dropped from 19.7 percent in 1980 to 9.8 in 2013. In addition, the average vehicle occupancy has also dropped for all trip purposes, from 1.9 passengers in 1997 to 1.7 in 2009. This is partly explained by the low costs of owning and operating a single occupancy vehicle. The United States has some of the lowest costs of driving in the world. Low gas prices combined with higher wages makes driving in the United States very affordable. A gallon of gas costs just 1.8 percent of the average daily wage; in European countries, it is between 5 and 20 percent.[27] Moreover, driving to work alone is partly facilitated by employer subsidized parking and highway expansion policies that make HOV lanes less attractive. Additionally, changes in the job market made carpooling less relevant. Jobs are less concentrated that they have been in the past, work schedules are more flexible, and teleworking is increasing.

The use of public transit is highly concentrated in the United States within a few dense metropolitan areas. Only 5.1 percent of workers commuted by public transit. Despite the dominant place of the private vehicle, public transportation and bicycles have seen an increase in use since 2000. This trend is likely to continue in coming years.

Figure 5: Usual Means of Transportation to Work

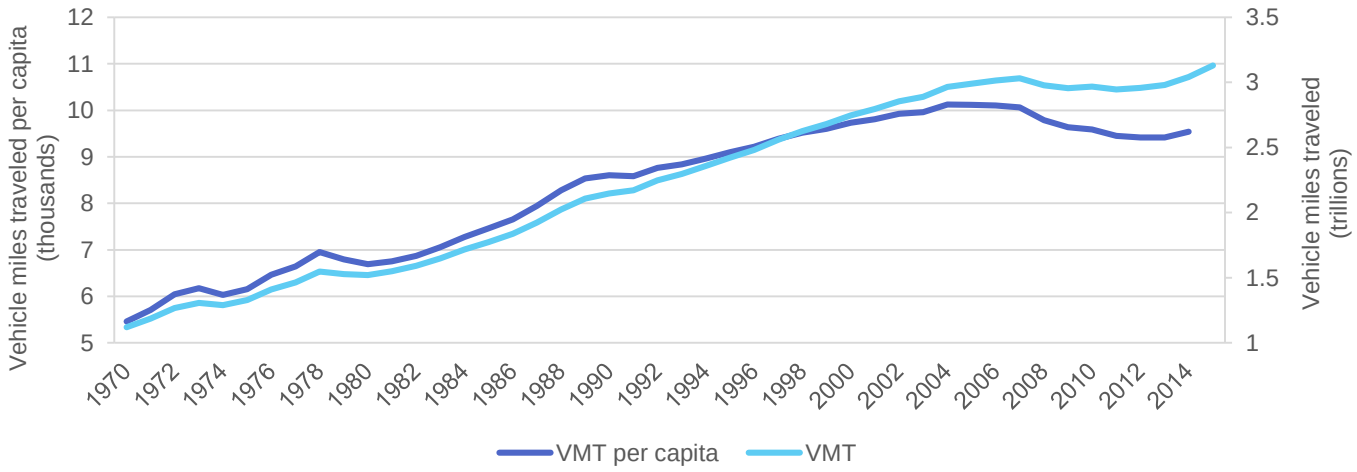


Younger population groups are driving less[28] and use public transit more than other generations, especially in dense metropolitan areas with robust public transit networks. For example, in the San Francisco metro area, the share of 16-24 year-olds who drove to work fell from 71 percent in 2006 to 64.8 percent in 2014.[29] While in San Francisco, Boston, and Seattle, all age groups registered similar driving declines, in other urban metro areas the sharpest declines were among the younger generation. In the Chicago, Dallas, and Minneapolis regions, the share of young people driving to work decreased sharply, even as those of other age categories remained stable or even increased.

Peak car travel happened ten years ago.

After the United States experienced "peak car travel" in 2005, the number of vehicle miles traveled (VMT) per capita started falling, and the drop accelerated during the Great Recession that begun in 2008 (see Figure 6). The lowest point was reached in the first months of 2014. After mid-2014, VMT per capita started increasing again, and in 2015 this number reached the same level as in 2001, roughly 9,500 miles. A new peak might yet be achieved in the next few years. Although vehicle miles traveled were on a downward trend, the average commute time has not stopped increasing and reached 25.8 minutes in 2013.

Figure 6: Average Vehicle Miles Traveled in the United States, 1970-2015 (FHWA)



Millennials are driving less than previous generations. A 2009 and 2001 VMT per capita comparison reveals that, while decreases have been made across the board, the most substantial declines are between the ages of 20 to 40, a range that overlaps with Millennials. Overall, because of long term trends with high inertia, it is unlikely that the dominant place of the private vehicle in the transportation landscape of the United States will be significantly challenged by new mobility services in the medium term.

Target Users and Markets of New Mobility Services

New mobility services are growing in areas with specific characteristics and many of their first adopters share a set of distinctive demographic traits.

Geographic Availability and Target Markets

Overall, new mobility services work best in denser and walkable urban areas with good public transportation networks. New mobility services are not used as a sole means of transportation, but instead are used in combination with other ones, especially public transit.

New mobility services are and will be used more intensively in areas with good public transit, but just occasionally in areas with little or no public transit; in such areas, new mobility services might be used for specific purposes, such as to or from an airport. In areas with low public transit coverage, a personal vehicle remains the dominant mode of transportation, thereby limiting the demand for hailing an Uber or renting a Zipcar.

In addition to the factors mentioned above, carsharing programs are most likely to succeed in areas with higher than average density and mixed land uses (see Table 5 for details). In addition, programs work best in areas where there are a great variety of potential uses for carsharing.[30] Peer-to-peer or non-profit carsharing programs can serve less dense residential areas than commercial carsharing programs, because profit is not a priority.

Table 5: Guidelines for Where Carsharing Succeeds[31]

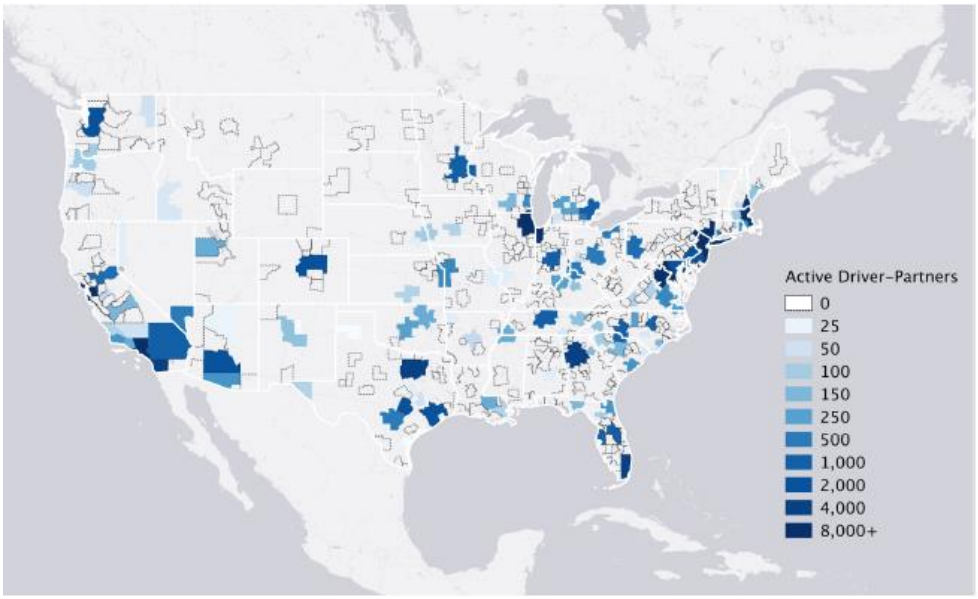
Demographics	
One-person households	minimum 30%
Work Commute Mode	
Drive alone	maximum 55%
Walk	minimum 5%
Vehicle Ownership	
Households with 0 vehicle	10% - 15%
Households with 0 or 1 vehicle	60% or more
Neighborhood Characteristics	
Housing units per acre	5 or more
Source: TCRP (2005)	

Carsharing programs are now available in most large U.S. cities. Zipcar is in 46 of the 50 largest U.S. metropolitan areas (in terms of public transit ridership), and car2go is in nine out of the 50. Zipcar has also targeted university campuses and airports, both of which are viable market areas for carsharing.

Ridehailing operator Uber is making most of its revenue in a few big U.S. cities (New York City, San Francisco, Chicago, Washington D.C. and Los Angeles), according to 2014 revenue data (see Figure 7). At the end of 2014, the fastest growing cities in terms of Uber driver-partners were Miami, Austin, and

Houston.[32] Ridesharing services also are available in suburban areas, but they are less profitable in these areas.

Figure 7: Active Uber Driver-Partners in the United States



The map indicates the number of Uber driver-partners who took at least four trips in November 2014, by Census Metropolitan Statistical Areas
Source: Hall and Krueger (2015)

For bikesharing systems, connections to the public transit network are a key factor of success. In April 2016, 77 percent of the 3,378 bike-share stations in the United States are within a block's distance of public transportation.[33] These connections extend the transit network by offering ways of reaching places with public transit and a way for reaching destinations not served by transit. Bikesharing is most feasible in core urban centers, but may also be viable near suburban points of interest (commercial centers, office parks). Finally, bikesharing is dependent on the quality of the bike/road infrastructure. The Midwest and the West have higher biking rates than the Northeast and the South.[34] Climatic factors (such as excessive cold, heat, and rain), however, have very little impact on the prevalence of biking.[35]

Ridesharing has the most potential along commuting corridors in denser areas. Inner-ring suburbs (10 to 15 miles outside the urban core) have a high ridesharing potential as well. These areas have a higher concentration of workers with similar commutes, headed either to the downtown areas or suburban office parks.[36]

Finally, Mobility-as-a-Service solutions have the potential to be implemented and grow in most cities that offer at least two or three transportation modes (public transit, bikesharing, ridehailing/taxi, carsharing, microtransit).

Profile of New Mobility Services Users

The users of new mobility services are mostly urban dwellers and have higher income and educational attainment levels than average. They are also less likely to own a vehicle and rely more heavily on public transportation, especially for the work commute.

The average NMS users own 1.05 cars per household,[37] compared to the national average of 2.06.[38] Overall, a third of U.S. Millennials are interested in or already using new mobility services.[39] The target demographic for carsharing programs are younger than average, with a median age of 35 years.[40] They are also urban dwellers with relatively high education levels (83 percent of carsharing members hold at least a Bachelor's degree[41]), as well as college students and faculty. They rely more heavily than the general population on public transit and other transportation options,[42] and have a low vehicle ownership rate (0.47 vehicles per household for carsharing users, compared to the U.S. average of 2.1 vehicles).[43] See Table 6 for details. In addition, people that occasionally need a second car or a specific type of vehicle (a truck, for example) and business travelers are also more likely to consider becoming carsharing members.[44]

Table 6: Characteristics of Carsharing Markets

Characteristics	Neighborhoods with access to carsharing	Regional Average
Demographics		
One-person households	51.8%	27.2%
Households with children	12.5%	32.4%
Rental households	71.5%	39.6%
Households earning more than $100,000	18.2%	17.9%
Persons with Bachelor's degree or higher	54.6%	34.0%
Means of Transportation to Work		
Drive alone	33.0%	69.4%
Carpool	6.6%	11.6%
Public transit	30.8%	8.8%
Bicycle	2.1%	0.8%
Walking	21.9%	4.4%
Vehicle Ownership		
Households with no vehicle	40.0%	11.3%
Average vehicles per household	0.84	1.66
Neighborhood Characteristics		
Housing units per acre	21.7	
Source: TCRP (2005)		

Ridehailing users are generally younger, with a median age of 33 years. Ridehailing use is also more concentrated among urban dwellers and those with higher levels of income and educational attainment (see Table 7). More than half of frequent (daily or weekly) ridehailing customers take public transit daily or weekly, and almost two thirds of them own a car. Conversely, two in five less frequent ridesharing users are frequent transit users, and four in five of them own a car.[45]

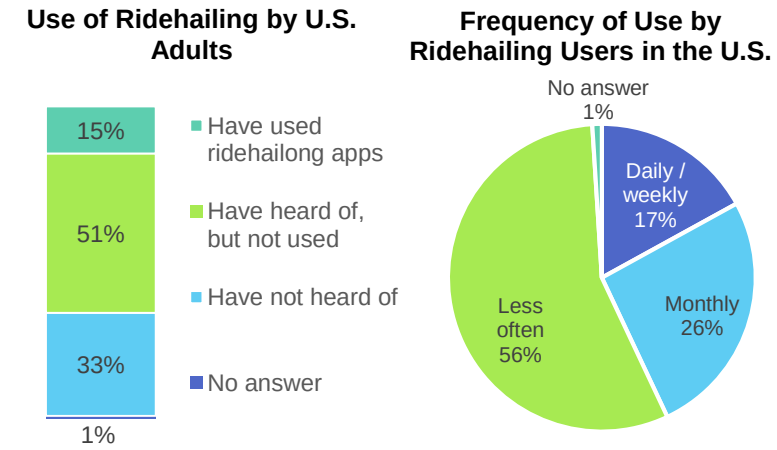
Table 7: Percent of U.S. Residents That Have Used Ridehailing (Uber or Lyft)

	Demographic	Percent
Population	All U.S. adults	15
Age	18-29 years	28
	30-49 years	19
	50-64 years	8
	65+ years	4
Education	H.S. graduate or less	6
	Some college	15
	College graduate	29
Personal Income	Less than $30,000	10
	$30,000-$74,999	13
	$75,000+	6
Residence Area	Urban	21
	Suburban	15
	Rural	3

Source: Pew Research Center (2016)

Survey results indicate that 15 percent of U.S. adults have used ridehailing services and that three percent of Americans use ridehailing services on a daily or weekly basis (see Figure 8). In addition, frequent ridehailing users tend to use public transit, walk, ride a bicycle, and take a taxi more than non-users.[46]

Figure 8: Use of Ridehailing by U.S. Adults



Source: Pew Research Center (2016)

A 2013 survey (n=618) analyzed the socio-demographic characteristics and usage patterns of members of the ridesharing program BlaBlaCar in France. The respondents tended to be younger (around 30 years old) and more educated than the national population, though their income level is roughly similar to that of the general population. Students and individuals that use the BlaBlaCar for work trips employ it more frequently. The findings suggest some equity balancing effects, which may be unique to this shared mobility mode. Notably, users with a lower income level are more likely to be passengers, while higher income users use carpooling mainly as drivers.[47]

Effect of New Mobility Services on Transportation

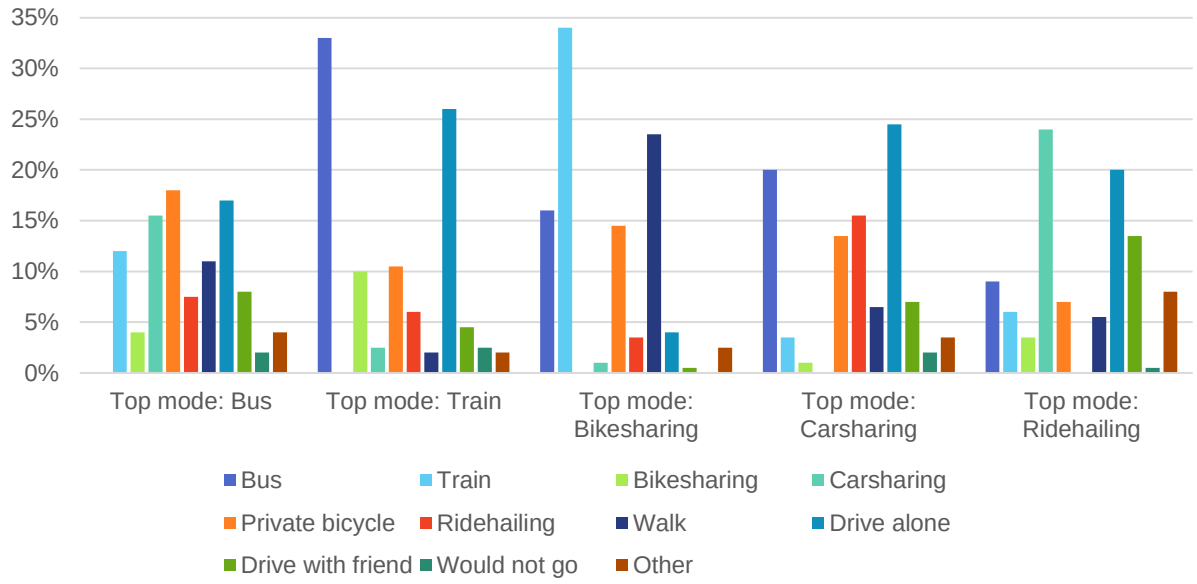
New mobility services are changing the transportation sector, either by providing entirely new mobility solutions or by reshaping traditional transportation means with technology (ridesharing with carpooling, microtransit with bus shuttles). As a result, there is more diversity in terms of transportation solutions and a greater offer of individual mobility, as opposed to collective mobility (public transit). NMS are having a transformative effect on many cities by increasing transportation accessibility. From the point of view of the user, NMS contribute to a shift from one solution to every mobility need, the privately owned vehicle, to many custom solutions.

Modal Shift Linked to The Use of New Mobility Services

Overall, the growth of new mobility services has been associated with a decrease in the use of private cars and an increase in public transit use; however, some people also prefer NMS over public transit in certain circumstances. For example, research indicates that people prefer carsharing or ridehailing to public transit, if the transit trip takes longer or requires several changes. [48] In total, new mobility services substitute for more private vehicle trips than for public transit trips.

New mobility services substitute more private vehicle trips than public transit trips, with variations according to each mode of transportation. For example, almost a third of carsharing users say they would drive a car or drive with a friend, but only 23 percent would take public transit, if carsharing was not available. Over a third of ridehailing users would switch to a private vehicle (driven alone or with a friend), and 15 percent to public transit. Finally, half of bikesharing users would take public transit if bikesharing was not available. See Figure 9 for details.

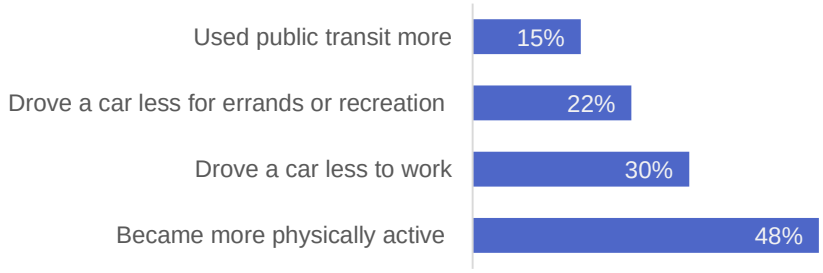
Figure 9: Alternative Transportation Mode Users Would Take if Their First Choice Was Unavailable



Source: Shared-Use Mobility Center (2016)

A growing body of research shows that the more people use NMS, the more likely they are to take public transit, use and own fewer cars. A recent survey showed that as a result of using new mobility services, 30 percent of the respondents drove a car less to work, 22 percent drove a car less for errands and recreation, and 15 percent used public transit more (see Figure 10).[49] Other surveys show that, for carsharing specifically, more users increased their use of public transit and non-motorized modes than decreased it.[50]

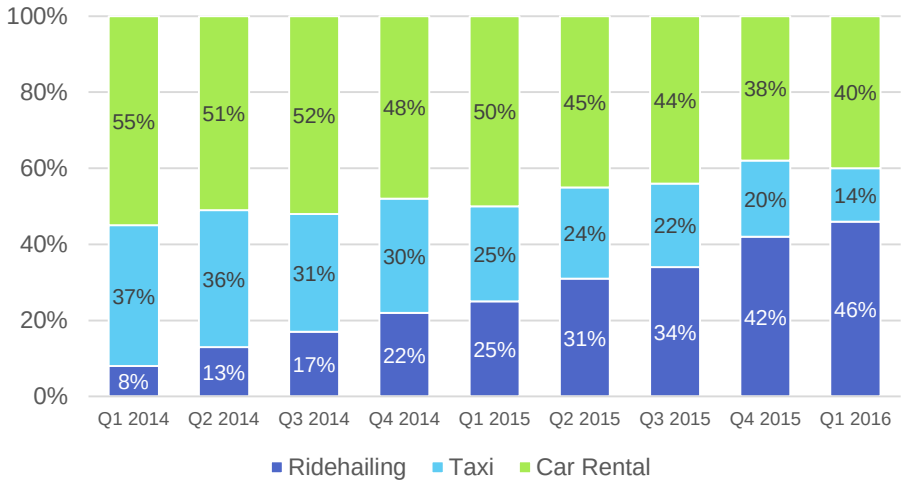
Figure 10: Changes in Personal Travel Behavior Since Using New Mobility Services



Source: Shared-Use Mobility Center (2016)

Ridehailing has a particularly important impact on taxis and rental cars, in addition to the implications for the use of private vehicles (40 percent of ridesharing users state having reduced their driving[51]) and public transit mentioned above. In terms of gross revenue, Uber already surpasses conventional taxis in several cities.[52] After ridehailing gained in popularity for personal use, corporate users started shifting towards these services as well. In reaction to that, Uber and Lyft now have programs for corporate travel. In the fourth quarter of 2015, use of ridehailing services for business trips exceeded that of rental cars for the first time, and the gap is widening. In the last two years, the number of car rental transactions for business trips has fallen 15 percentage points. For conventional taxis, the decline was even steeper, with a 23 percentage points loss over the same period. See Figure 11 for details.[53]

Figure 11: Business Expenses for Ground Transportation in the United States



Source: Certify (2016)

However, the growth of the ridehailing services is only partly at the expense of taxi companies. The introduction of ridehailing can also increase overall consumer demand, as one study based on Portland suggests. Four months after the arrival of Uber and Lyft in Portland, the weekly total of taxi and ridehailing rides increased by 40 percent. Within that total, taxi ridership decreased by 16 percent and ridehailing ridership increased by 125%.[54]

Concerning microtransit specifically, 70 to 80 percent of the first users of Bridj in Boston are transit riders, and for this population, Bridj is in direct competition with traditional transit companies.[55] Nevertheless, Bridj aims to provide transportation connections to parts metro areas that do not have a good bus service and has targeted cities like Washington and Boston, where a third of residents do not own a car.

Ridesharing has a big impact on private vehicle use and public transit. In Europe, BlaBlaCar, which specializes in long distance ridesharing, has been able to cater to people who need cheaper or more flexible transportation options than trains or long-haul buses. The service is also contributing to increasing vehicle occupancy. BlaBlaCar rides average 2.8 people in each vehicle, compared to about 1.5 people for all European passenger cars.[56] As the operations of the company expand (BlaBlaCar had 2 million passengers a month as of June 2015), increasing vehicle occupancy will start to have a visible impact in alleviating congestion and pollution.

A study of users of bikesharing programs in North America documented modal shift with respect to public transit (bus, rail) and personal vehicle. Bikesharing members in larger cities used transit less, while transit ridership increased in smaller cities. In all cities, bus ridership increased as a result of bikesharing improving access to the transit network. Half the bikesharing users reported reducing their private vehicle usage. Just 5.5 percent of the members sold or postponed a vehicle purchase.[57] In addition, the modal shift from private vehicle to bikesharing is about 4 percent.[58]

Finally, Mobility-as-a-Service, which displays several transportation choices, may help educate and incentivize users to try other transportation modes than driving alone, which may ultimately contribute to a decrease in VMT. The pilot project for UbiGo in Gothenburg, Sweden, showed that first adopters of this MaaS solution had decreased their private vehicle use.[59]

Specific Use Cases of New Mobility Services

Despite some modal shift away from public transit and private vehicles, new mobility services do not serve the exact same purpose as these two established means of transportation. Overall, NMS complement public transit and enhance urban mobility. These new transportation modes are used more often during the weekend than on weekdays, to the opposite of public transit. For example, ridehailing services are mostly used for social trips and between 8 P.M. and 4 A.M., at times when public transit service is least available. Conversely, ridehailing is least used during the morning and evening rush hours, as well as weekdays overall. During the evening and night, more people use ridehailing than their private vehicle (drive alone). At these times of day, carsharing is used just slightly less than private cars.[60] For example, more than half (54 percent) of ridehailing customers use the service for social trips, whereas only 21 percent of them use it for their commute, and 16 percent for shopping and errands. The peak demand for ridehailing is between 10 P.M. and 4 A.M. on weekends, when transit is not running or has a low frequency.[61] Carsharing is also used more for trips associated with leisure and less for the work commute.[62]

New Mobility Services as Part of a Multimodal Solution

Evidence suggests that new mobility services are generally used in combination with public transit and that they can extend the catchment area of public transit. By addressing the first-and-last mile issue related to public transit access, NMS can potentially contribute to bridging gaps in existing transportation networks and encouraging multimodality. Carsharing for example is mostly used in a multimodal mix. In San Francisco, members made 4.8 percent of their trips using carsharing, whereas 47.6 percent of trips were made by walking or biking, 28.8 percent by public transit, and 16.9 percent by private car.[63] In Portland members used carsharing for just 2.5 to 3.5 trips per month.[64]

Effects of New Mobility Services on Vehicle Miles Traveled

It is yet unclear what the overall effect of new mobility services will be on vehicle miles traveled. Several scenarios, listed in Table 8, could enter into play.

Table 8: Potential for New Mobility Services to Increase or Decrease VMT

Increase in Vehicle Miles Traveled	Decrease in Vehicle Miles Traveled
• Travel will become more convenient and productive (rest or work), and this will lower the time cost of travel. • Being freed from the need to drive, users of shared autonomous vehicles feel encouraged to move even farther from the urban cores. • More travel options for non-drivers (persons without a driving license, elderly, disabled, impaired, etc.) create more travel. • More empty backhauls for shared autonomous vehicles and ridehailing. • Shared autonomous vehicles will cause an increase in vehicle miles traveled as a result of a substantial modal shift away from public transit.	• New mobility services and shared autonomous vehicles contribute to a decrease in vehicle ownership and use. • Move to pay-as-you-go transportation models discourages unnecessary travel. • Move to pay-as-you-go transportation models may make transportation choices more dependent on fuel prices. • Vehicle occupancy will rise thanks to increased use of ridesharing, microtransit, and public transit.

State of New Mobility Industry and Potential Growth

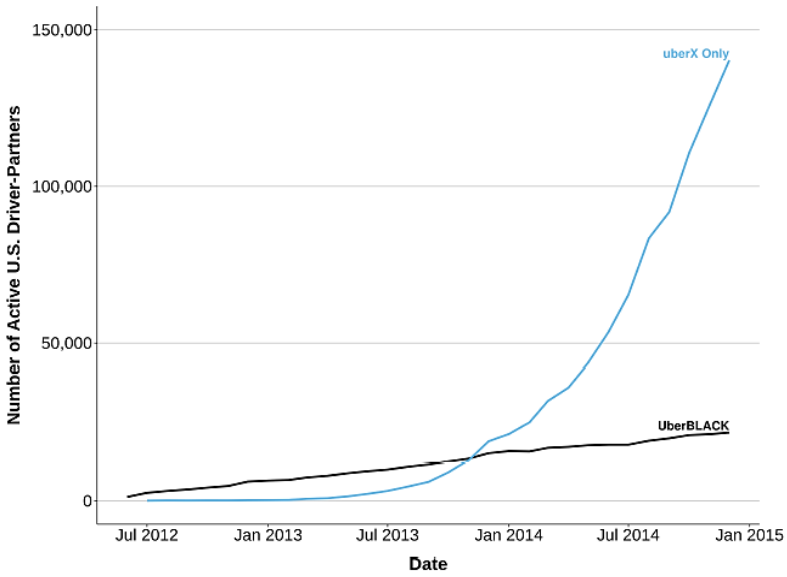
In the last decade, new mobility services have seen a substantial growth and expansion throughout the world. Their growth prospects are positive, because societal attitudes and public policy have become more supportive of new mobility services in the past years and this trend will likely continue. New mobility services have a bigger market share potential in areas where public transit is present and more used, such as in Europe and Asia. Thus, there is a bigger growth potential for NMS in Europe and Asia than in North America. Even in urban areas, NMS, like public transit, will not be suitable replacements for private vehicles for certain use cases: drivers that take pride in their vehicles or value extra comfort or privacy, parents transporting young children, and drivers who require special accessories in their vehicles, for example.

Ridehailing

Since their beginnings in the late 2000s, ridehailing services have expanded at an extremely rapid pace within the United States and to all continents. Uber, by far the most international of the TNCs, is now available in about 75 countries and counting. Up until mid-2013, the main U.S. transportation network companies registered a 25-percent monthly increase in users. By mid-2014, however, the growth rate had slowed to a 10-percent monthly increase. [65]

One of the few available studies about the growth of Uber in the United States shows the exponential growth of the number of active driver-partners between mid-2012 (launch of UberX) and late-2014, when the service had more than 160,000 drivers. In this two-year period, the number of new driver-partners more than doubled every six months (see Figure 12).[66] According to information released by Uber in April 2016, more than 450,000 driver-partners worked with the company.[67] The impact of this growth should not be overestimated, however, because only 15 percent of UberX driver-partners were driving more than 35 hours per week, whereas 55 percent of them were driving less than 15 hours per week. Also, 30 percent drove between 16 and 34 hours, at the end of 2014.[68] In addition, the turnaround at Uber is substantial, 30 percent of the drivers that start at the beginning of the year no longer work for Uber by the end of the year.

Figure 12: Active Uber Drivers by Service



Note: The sample used for the chart depicts all U.S. UberBLACK and UberX driver-partners making at least four trips per month.
Source: Hall and Krueger (2015)

The growth of the ridehailing business is boosted by a high consumer preference, the ability to fill transportation needs not well met by other modes, and a yet ill-defined regulatory framework. Given their high growth potential, investors have taken an interest in ridehailing. Companies like Uber and Lyft have so far received about $9 billion investments in 2016, almost twice than any other startup segment in all 2015. TNCs are generally cheaper than conventional taxis in almost all their markets (with some exceptions, depending on traffic conditions), which means they are likely to steadily increase their modal share. TNCs has registered steady growth, especially in cities underserved by taxis. However, taxi services are fighting back and start using apps just as convenient as ridehailing ones. Nonetheless, TNCs face significant obstacles in their growth, as competition among them stiffens, markets become saturated, and regulatory frameworks are better defined.

The competition between ridehailing companies is fierce. TNCs, and Uber foremost, seek to take advantage of the "network effect" that makes a platform or service more useful as its number of users increases. The network effect usually makes it hard for smaller players to enter the market or compete with dominant players; however, it is yet to be seen if this strategy will work in a market with very low barriers to entry, such as ridehailing. If price wars are likely to increase Uber's market share and the number of ridehailing users in the short term, it is unclear what will happen to the modal share of TNCs in the long term. From past experiences however, winner-take-all markets are not beneficial to the customer, nor for the overall competitiveness of the market.

For the last couple of years, regulators across the world have been proposing and passing legislation that would make TNC's obey similar rules as conventional taxis. It is unlikely that TNCs will be able to keep their fares at the current levels if regulation aligns TNCs with taxis. TNCs are opposing many of these regulatory changes. For example, Uber and Lyft decided to leave Austin, Texas, rather than to implement fingerprinting for their drivers, as a new provision required. Ridehailing has already been banned or restricted in several countries and cities. Thus, TNCs are involved in various legal battles concerning a

variety of aspects crucial to their business models (e.g., licensing fees, driver status and benefits, insurance, and passenger safety).

Ridesharing

In the United States, real-time ridesharing has had slow growth since its beginnings in the early-2000s, despite the 400 local services available, as of July 2011.[69] However, this new mobility solution has expanded much more in Europe. Specifically, long-distance ridesharing has become increasingly popular over the past years. Since its creation, the long-distance ridesharing community BlaBlaCar has expanded in 22 countries:

- 2006 – France;
- 2009 – Spain;
- 2011 – United Kingdom;
- 2012 – Holland, Luxembourg, Belgium, Poland, Portugal, Italy;
- 2013 – Germany;
- 2014 – Russia, Ukraine, Turkey;
- 2015 – India, Mexico, Brazil, Hungary, Croatia, Romania, Serbia;
- 2016 – Czech Republic, Slovakia.

The innovations that made carpooling more convenient and transformed into real-time ridesharing are likely to help programs overcome the critical mass barrier and ultimately contribute to an increase in the modal share of ridesharing. Increasing interoperability and open source data sharing between platforms, as well as multimodal integration (with public transit, bikesharing, etc.) could also increase attract more users. Certain public policies could also encourage ridesharing; for instance: tax incentives for ridesharing, more HOV lanes, lower toll prices for HOV.

BlaBlaCar's expansion in Europe and South America points out several factors of success linked to the ridesharing service. The first is building a community of members built on trust. That takes an important initial investment from community managers when the company expands to a new country, as well as a substantial effort in maintaining that trust through peer reviews between the members of the service. Among the other factors needed for growth of a ridesharing program are building a critical mass of community members, and focusing on serving key travel corridors.

Accurate forecasts of the growth of ridesharing in the United States are difficult to formulate given the number, diversity, and small scale of ridesharing programs. It is possible, however, to estimate the maximum potential market size for ridesharing. One recent study concluded that almost 19 million U.S. commuters would be able to switch from driving alone to ridesharing, in addition to the 11 million that carpool today, bringing combined ridesharing and carpooling to 27 percent modal share.[70] This number is much higher than the actual potential growth for ridesharing in the United States, and it is not as good an estimate for short- or long-distance ridesharing. The biggest player in the long-distance sector, BlaBlaCar, aims to expand in Asian and South American countries, before considering whether it has a chance to be viable in the United States. The American market is less attractive for this means of transportation mainly because of the lack of good urban public transit essential for the first-and-last miles of a travel involving ridesharing. European cities on the other hand are ideal for this model, because passengers can easily use public transit to get to the pick-up point and then from the drop-off to their final destination. Therefore, despite the great technological progress that is turning carpooling into real-time on-demand ridesharing,

and given that many of the U.S. public policies and market forces that could encourage ridesharing have a long time-frame, it is likely that this transportation mode will experience a limited growth in the United States in the medium term.

Carsharing

The concept of carsharing emerged from a Zurich, Switzerland, cooperative known as Sefage (Selbsfahrergemenschaft) that operated between 1948 and 1998.[71] Pilot programs were implemented in Europe and North America through the 1990s. Then, carsharing saw a rapid geographic expansion and membership growth in the 2000s.

Europe is the biggest carsharing market, with about 2,206,000 members, 58,000 vehicles, and a members-per-vehicle ratio of 38 in 2014,[72] with the largest submarket being Germany. In North America, the carsharing evolution can be divided into three phases: initial market entry and experimentation (1994 to mid-2002), growth and market diversification (mid-2002 to late-2007), and commercial mainstreaming (late-2007 to present).[73] In 2014, in North America carsharing had reached about 1,625,000 members and 24,000 vehicles. The members-per-vehicle ratio is 67, mostly due to the higher prevalence of university and corporate programs.[74] The Asia – Oceania region has registered the fastest growth, having reached 1,006,000 members and 22,000 members in 2014 (with a members-per-vehicle ratio of 46).[75]

In the United States, carsharing experienced exponential growth until the mid-2000s. Since 2010, annual growth rates have averaged 25 percent, but carsharing membership declined in the United States in January 2015 for the first time, particularly because of the closure of two operators and growing competition among mobility services.

The first wave of carsharing programs started in urban areas, especially those with strong public transportation networks, as well as universities. While these areas continue to grow, new ones are being exploited, such as new housing mega-complexes. Brooklyn's Greenpoint Landing project is considering offering carsharing as an amenity for its residents, for example. University campus carsharing programs also have a substantial growth potential, but are faced with a very limited public awareness. As many as 90% of new students and their parents do not know that carsharing exists.[76] Finally, each of the major carsharing operators also have a business program. This is an attractive format for businesses, which can lower their fleet expenses by moving from an owned fleet to a shared fleet. For this reason, municipalities such as Washington, D.C. and Sacramento, CA, have implemented carsharing programs. Many other cities, as well as several fleet management companies are considering partnering with carsharing companies.

In terms of business models, one-way flexible carsharing will likely see the biggest expansion. One-way carsharing can be a growth accelerator; as of January 2015, a third of U.S. fleets were one-way trip capable. One-way carsharing can attract three to four times the number of members of a round-trip service. However, one-way programs have higher launching costs, because they require starting off with several hundred vehicles.[77]

In terms of geographic expansion, China holds the greatest growth potential for carsharing. On the one hand, new-car demand is very strong in China, the biggest market for several years. On the other hand, high and increasing air pollution and congestion are triggering tight policies on traffic. Eight Chinese cities have already imposed restrictions on new-car registrations. For this reason, carsharing is

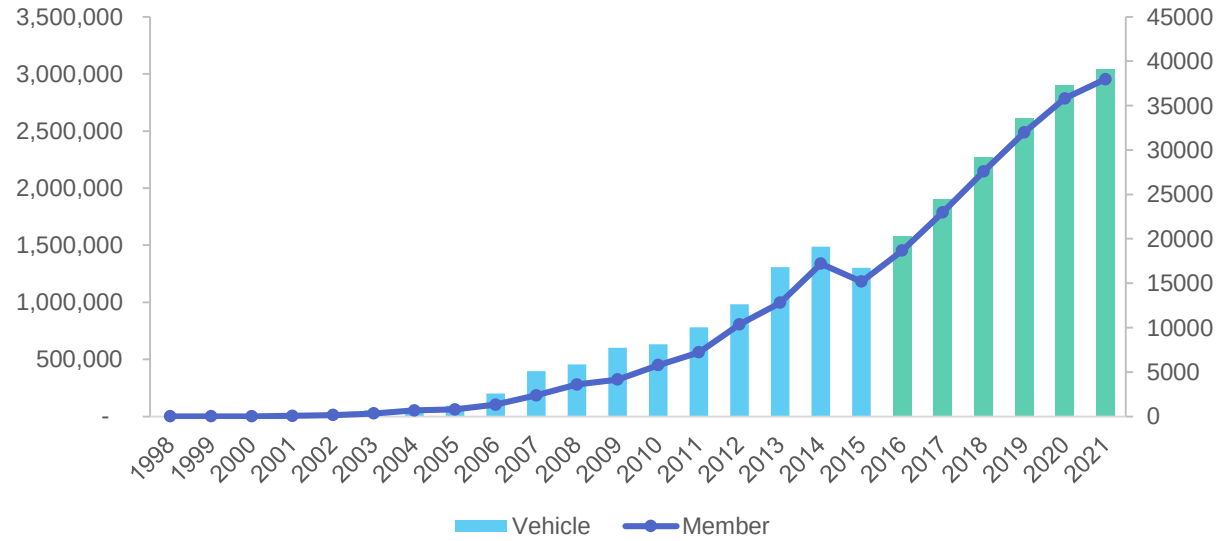
increasingly seen as a solution to provide personal mobility in cities where vehicle ownership represents a challenge. Carsharing programs are already experiencing rapid growth in the biggest Chinese cities. Car2go had its most successful launch so far in Chongqing (30 million inhabitants) where it reached 78,000 members in less than two months after it launched in April 2016. The electronics company LeEco, which backs electric vehicle startup Faraday Future, is starting an electric vehicle carsharing program in Beijing called LeShare, expected to grow from 300 vehicles in May 2016 to 3,000 by the end of 2016. The program also aims at expanding in six other cities.

The biggest drivers of the carsharing growth are the increase in population density, the slight decline in vehicle ownership, the improvement of public transit networks, and policies aimed at multimodal transportation. Some of the biggest challenges for carsharing are parking permits, high initial expenses (acquiring vehicle fleet), insurance, and adapting to the differences between cities (density, transportation networks), and brand recognition.

As the carsharing market matures, operators are undergoing a process of consolidation, multi-nationalization, and mainstreaming. The carsharing space is transitioning from a multitude of nonprofits, co-ops and a few established businesses to an industry dominated by for-profit operators. Despite this, peer-to-peer carsharing might continue to grow.

Based on the current market potential, travel behavior trends, and historic growth patterns of existing operators, CAR estimates that carsharing programs will reach almost 3 million members and amount to 39,100 vehicles in the United States by 2021 (see Figure 13). At this level, U.S. carsharing membership will represent less than two percent of the population of the 50 biggest cities in the United States in terms of public transit ridership. For the next five years, it is expected that the U.S. carsharing market will continue its steady growth (23 percent membership growth in 2016) but gradually move to a slower expansion (6 percent increase in membership projected in 2021).[78] This is consistent with a study that determined the maximum size population that could potentially consider carsharing as a viable transportation option. This analysis estimated that a total of 3.7 million Americans fit the profile of potential members in a carsharing program.[79]

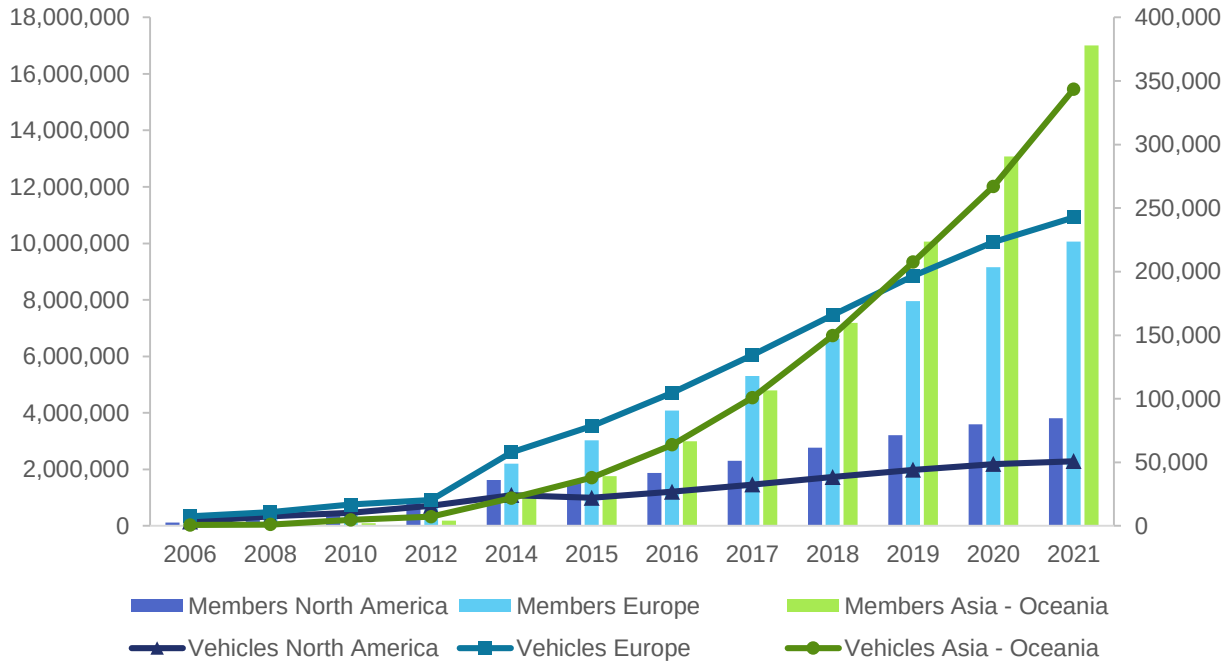
Figure 13: Carsharing: 1998 - 2015 Historic Growth and 2016-2021 Projections in the United States



Data sources: Shaheen et al. (2015), CAR

By 2021, North American carsharing programs are projected reach 3.8 million users and 50,800 vehicles. Growth will be steady, but it will gradually decrease as the market matures and saturates, from 23 percent in 2016 to 6 percent in 2021 for membership growth.[80] European programs are expected to grow to 10 million members and 242,600 vehicles. Likewise, growth will slow down, from 35 to 10 percent between 2016 and 2021.[81] Germany is expected to remain the largest European sub-market, consistent with research estimating that in Germany alone the number of members will grow from 1 million to 3 million in 2020.[82] The Asia – Oceania region has the biggest growth potential (from 70 percent expected in 2016 to 20 percent in 2021) and is likely to arrive at 15.7 million members and 317,000 vehicles.[83] See Figure 14 for details.

Figure 14: Carsharing: 2006 - 2014 Historic Growth and 2015-2021 Projections in Three Regional Markets

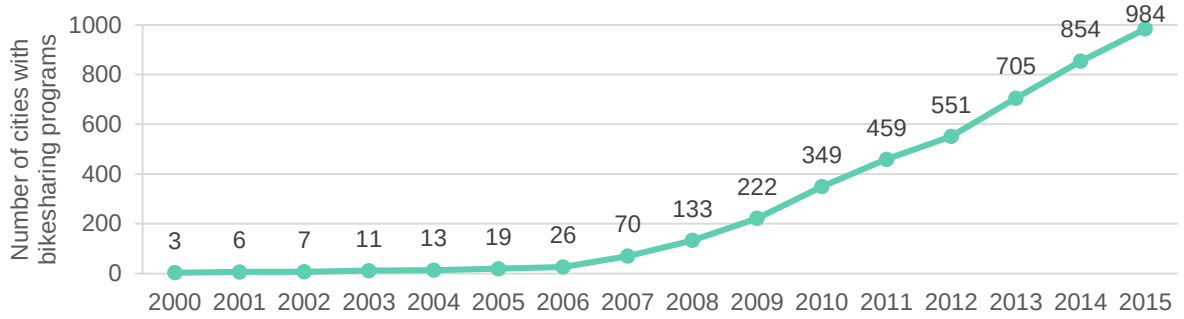


Data sources: Shaheen et al. (2015), CAR

Bikesharing

The first generation of bikesharing programs started with a 1965 initiative in Amsterdam, Netherlands, that was a free-bike system. The second-generation programs, known as coin-deposit systems, started in the mid-1990s in Copenhagen, Denmark.[84] Third generation programs are IT-based (reservations, pick-up, drop-off, and information tracking) and their deployment has increased rapidly since the beginning of the 2000s, growing from 13 programs in 2004 to almost 1000 in 2015 (see Figure 15). The countries with the largest number of systems are China (237), Italy (114) and Spain (113).[85] Bikesharing has had the biggest growth in China, followed distantly by Italy and the United States. At the end of 2015, China's bikesharing fleet reached 1,036,400 units, a dominant position in the global fleet of 1,270,000.[86]

Figure 15: Growth of Bikesharing Programs in the World

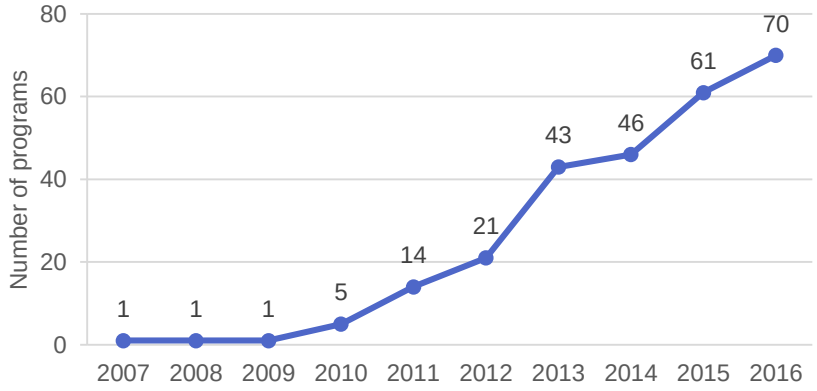


Data source: Meddin (2016)

Bikesharing programs have experienced a rapid growth in the United States[87] in recent years, and have reached 70 programs in 2016 (see Figure 16). In December 2013, 20 of the most populous U.S. cities had a bikesharing program (up from five cities two years before), a majority of which were implemented by either the city government or a nonprofit.[88]

Research has estimated that the maximum number of people that could commute to work by bicycle given current conditions. In the United States, 28.3 million commuters could switch to biking to work (a quarter of U.S. workers), in addition to the 635,029 that do now.[89] This number is extremely high, because it does not take into account social preferences, physical inabilities to ride a bike, or the quality of bike infrastructure. The only country where 25 percent of workers commute by bike is the Netherlands, the country with the largest bicycle modal share. For now, bike commuting has been increasing by about 7.5 percent annually in the United States.[90]

Figure 16: Growth of Bikesharing Programs in the United States



Data sources: USDOT, Meddin (2016)

Implications for the Automotive Industry

In the last few years, new mobility services have started to capture the attention of transportation users, the media, public authorities, and transportation sector in general. Through their innovative ways of improving mobility, NMS are gaining some control over the narrative of transportation. Just five years after the launch of NMS, two-thirds of Americans have heard of ridehailing apps, even though only 15 percent are using them. This is strong evidence of the broad reach of the concepts that are at the core of NMS.

The growth of new mobility services around the world and in the United States already has many implications for the automotive industry, and more will become notable in the next years. Increased use of new mobility services could reduce car ownership for people that do not use a private vehicle as their main mode of transportation, and instead use public transit, bike or walk. The shift towards new mobility services and away from the private vehicle will be responsible for some losses in sales of new and used vehicles, but these losses are likely to be very small compared to the overall number of transactions involving vehicles every year. In addition, services like carsharing and ridehailing will contribute to a greater vehicle turnover and a shorter vehicle life expectancy, partly counteracting forces that decrease vehicle sales.

The most important impact that new mobility services will have on the automotive industry will not be on the volume of vehicle sales, but rather it will be on how customers interact with vehicles, their expectations for vehicles, and their uses of these vehicles.

New mobility services are changing the way people use, value, and relate to personal vehicles. They are changing people's expectations about vehicles, and that is more important in the long term than the net loss in vehicle sales. New mobility services will likely contribute to a change in preferences, away from vehicle ownership and towards "vehicle usership," exploring new business models that do not involve the user owning a vehicle and having all the inconveniences associated with that.

New Markets and Opportunities for Automakers

The increasing expansion and adoption of new mobility services are already prompting vehicle manufacturers to rethink their existing business models, as well as explore new ones. The mainstreaming of NMS is more of an opportunity than a threat for automakers. As transportation preferences slowly evolve, the automotive industry is trying to show customers that it understands the shift toward on-demand shared mobility and has relevant new products and services to offer.

New mobility services: a source of opportunities for the automotive industry:

- *Partnerships with new mobility and technology firms*
- *Investments and venture capital in mobility startups*
- *R&D and experiments on mobility solutions*
- *In-house mobility services*
- *Fleet sales to mobility providers*
- *New vehicle financing models*

Beyond presenting a challenge to the vehicle ownership mode, the expansion of new mobility services could influence other aspects of the automotive industry and related sectors: the automotive value chain, logistics and the supply chain, automotive insurance, and vehicle maintenance and repair.

Mobility Services

Vehicle manufacturers, such as Ford and Volkswagen, have announced their intention to become mobility companies that offer new services alongside the established core business of manufacturing vehicles. The success of NMS is encouraging automakers to create mobility services of their own, and those can become new revenue sources. Importantly, these on-demand mobility services are a way to generate ongoing income and to engage more with customers more frequently than just through a vehicle sale every five to ten years.

For some manufacturers, the approach is to create subsidiaries in charge of experimenting with new mobility solutions and offering new services. This is the purpose of Daimler's moovel GmbH subsidiary and of Ford Smart Mobility LLC. Both American and European automakers are developing and launching their own mobility services. Carsharing operator car2go (founded in 2008) is owned by Daimler. ReachNow (founded in 2011, and operating under the name DriveNow in the United States) is a carsharing joint venture between BMW and Sixt. In early-2016, General Motors launched its own carsharing program (Maven). In all likelihood, automakers will be increasingly engaged in the carsharing market.

To appeal to customers seeking alternatives to vehicle ownership, some manufacturers have started offering fractional ownership, allowing several persons to lease or buy one vehicle together. For example, Audi launched the Audi Unite program in December 2014 in Stockholm, Sweden, and Ford has launched the Ford Credit Link pilot program in Austin, Texas, in 2016.

Several automakers are also developing mobility apps or platforms that offer travel planners (similar to mobility-as-a-service), parking reservation, and concierge services, among other features.

Investments, Partnerships, and Acquisitions

In the last several years, automakers have started investing in, partnering with, or acquiring new mobility companies (see Figure 17). Building relationships with NMS is an opportunity for vehicle manufacturers to diversify their activities and, especially, to strengthen their market share in urban areas and with the younger generations. Partnerships with NMS companies give automakers increased visibility to mobility users (who might one day become car buyers), as well as access to valuable consumer data and analysis. New mobility companies also have an interest in these deals that come with an access to auto industry engineers or discounts on vehicles.

Figure 17: Automakers and New Mobility Companies: Examples of Partnerships and Investments

There has been a great interest in transportation network companies in 2016. Lyft received a $500 investment form GM, Gett received a $300 million investment from Volkswagen; Uber obtained an undisclosed investment from Toyota; and Didi received a $1 billion from Apple. Other companies, like BMW, are using their venture funds to invest in mobility startups; iVentures has made investments in Moovit (travel planner), RideCell (fleet management software), Zirx (parking spot locator), and Summon (ridehailing) to name just a few.

Manufacturers also choose to acquire mobility companies, in order to leverage their innovations into their own products and services. For example, Daimler bought RideScout and GlobeSherpa (now part of moovel), and GM bought SideCar (ridehailing) and Cruise Automation (autonomous vehicles).

News of automakers signing different types of partnerships with new mobility companies are also multiplying. For example, Ford is providing the vehicles for the Bridj program in Boston. GM's partnership with Lyft involves short-term rental program for Lyft drivers, in the short term, and the development of autonomous vehicles, in the long term. Along with an investment in Uber, Toyota also will offer lease finance to Uber drivers.

Fleet Sales

Automakers see the opportunity to turn ridehailing and carsharing companies into reliable customers for their vehicles. With fleet sales, manufacturers are also hedging their bets on potential losses in private sales or changing structure in clientele. Selling to fleet managers represents not only a steady revenue stream from sales, but also an advertisement for their brand directed to carsharing or ridehailing users that may be tempted to buy a car one day.

Ridehailing and carsharing companies could become reliable customers specifically for fuel-efficient, electric, or luxury vehicles. Fleet sales to new mobility companies could become a way to earn credits for fuel efficiency and CO_2 emissions. In addition, the higher cost of electrical or hybrid vehicles could be more rapidly offset in a carsharing or ridehailing scheme due to the intensive use of these vehicles, than in a conventional privately owned scheme. Zipcar buys vehicles from a number of companies, including Ford and Honda. While in 2014, global carsharing fleets were estimated at 104,000 units (19,000 of

which were in the United States), they have the potential to reach 637,000 vehicles (39,000 in the United States) in 2021.

For automakers, the prospect of partnering with TNCs is particularly appealing because TNCs rely on independent drivers that need to buy their own cars compliant with the requirements of the platforms (newer models, luxury vehicles for some programs). The opportunity is therefore to develop financing, leasing, or renting programs for driver-partners of TNCs, a business model potentially more profitable than carsharing fleets. Uber is already working with several manufactures through Xchange Leasing LLC (short-term lease program), Uber Vehicle Solutions (vehicle discount program), and partnership with Cox Automotive, Enterprise and Hertz. Lyft has a similar platform called Express Drive, and has signed partnerships with GM and Hertz. Ridehailing represents an even bigger opportunity for automakers. If we consider its 450,000 active drivers, Uber can be considered the second fleet in the United States after Hertz (460,400 vehicles).

Given the intensive use of vehicles used for carsharing and ridehailing, vehicle lifespan will be shortened and turnover rate increased. That could contribute, at least marginally, to making the automotive industry less cyclical. Factors like the general state of the economy or credit conditions will have less influence of sales volumes. On the other hand, vehicle sales might react faster and to a greater extent to changes in fuel prices if vehicle usage becomes more dominated by pay-as-you-go models, for which most costs are variable, not fixed (initial purchase of vehicle).

Cost Comparisons between NMS and Private Vehicle

When new mobility services are used in combination with public transit, they tend to be more cost competitive than private vehicles. This is one of the key benefits leading to the success of NMS. For example, one report estimates that, after joining carsharing, U.S. households save between $154 and $435 in transportation costs per year.[91] The costs and benefits of new mobility services as part of a multimodal solution are highly specific to a particular type of user. To broadly analyze costs, CAR compared the costs of using a personal car,[92] on the one hand, and using *only* carsharing or a ridehailing service, on the other hand. This provides a rough estimate of the potential savings available to customers. The comparisons are either local, based on four case studies,[93] or national,[94] as detailed below. For the complete calculation method, see the endnotes.

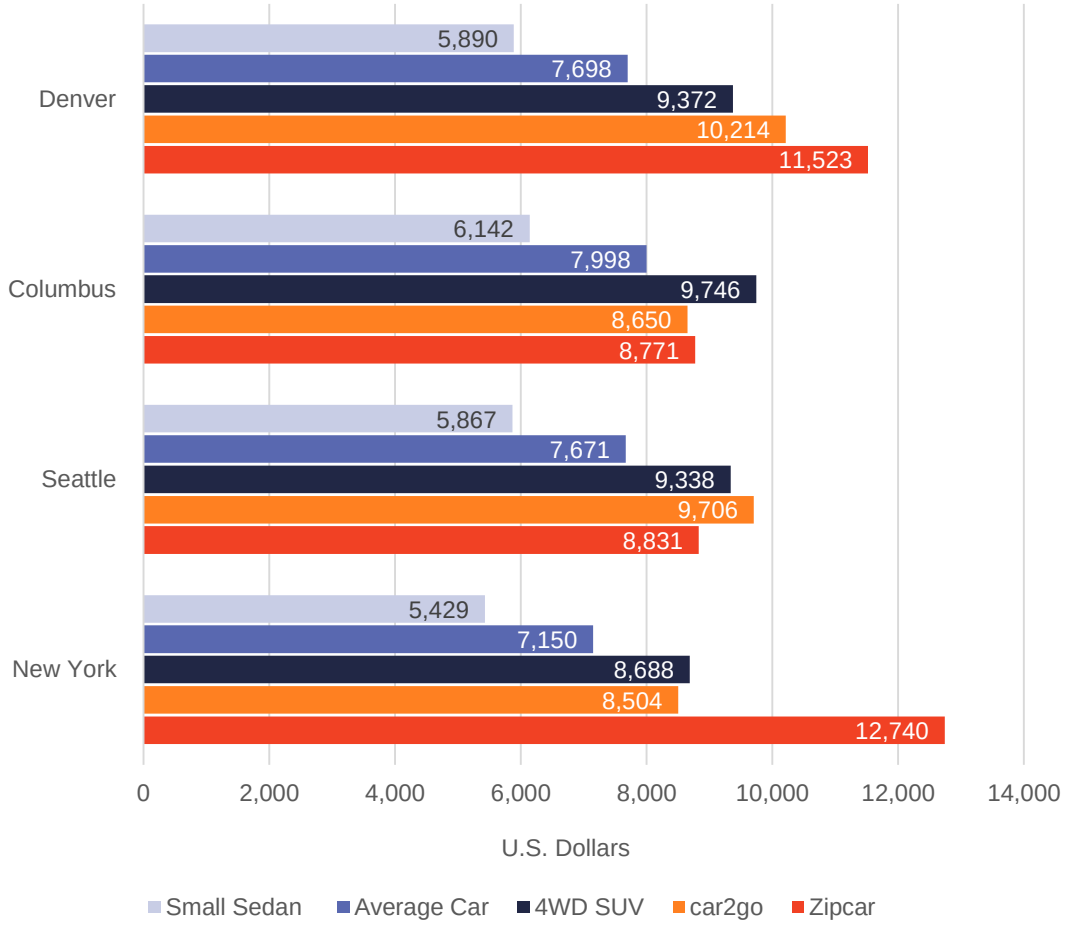
Owning a car involves car payments (loan, lease, etc.), taxes, registration fees, depreciation, cost of fuel, repairs, maintenance, tolls, and parking. New mobility services, and especially carsharing, change the perception of the costs and benefits of owning and using a car. A private car involves high fixed costs, whereas NMS costs, just as public transit costs, are mostly variable from the point of view of the customer and based on actual use (pay-per-ride systems).

Carsharing v. Private Vehicle Costs

Both the city-specific and the national average comparisons reveal that carsharing is more cost efficient than car ownership for drivers that own smaller vehicles or have a low annual mileage, because of the high fixed costs of vehicle ownership.

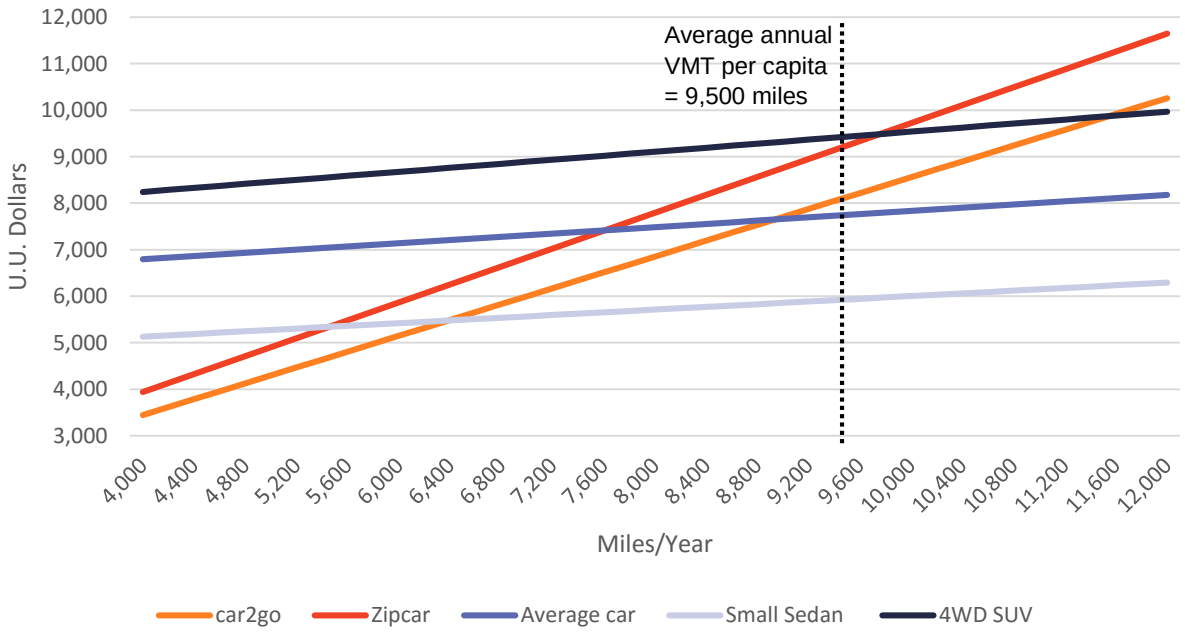
The city-based comparison highlights the differences in fare models between Zipcar (hourly fares specific to each city) and car2go (same per minute fares for all cities) and illustrates how specific the cost structures can be. For example, it is cheaper to solely use carsharing in Columbus than to drive a 4WD SUV. In Seattle and New York, Zipcar is more is more competitive than a 4WD SUV. See Figure 18 for details.

Figure 18: Annual Transportation Costs: Carsharing v. Private Vehicle (City Level)



The national average comparison reveals that car users would pay less to share than to own if they drive less than 8,200 miles a year. This means that carsharing is cost effective for people that drive less than the national average, situated at around 9,500 miles traveled/year. Using a carsharing service is cheaper than owning and operating a small sedan for fewer than 6,300 miles a year. At the other side or the spectrum, using carsharing is less expensive than owning and operating a 4WD SUV for an annual mileage of fewer than 11,600 miles. See Figure 19 for details.

Figure 19: Annual Transportation Costs: Carsharing v. Private Vehicle (National Averages)



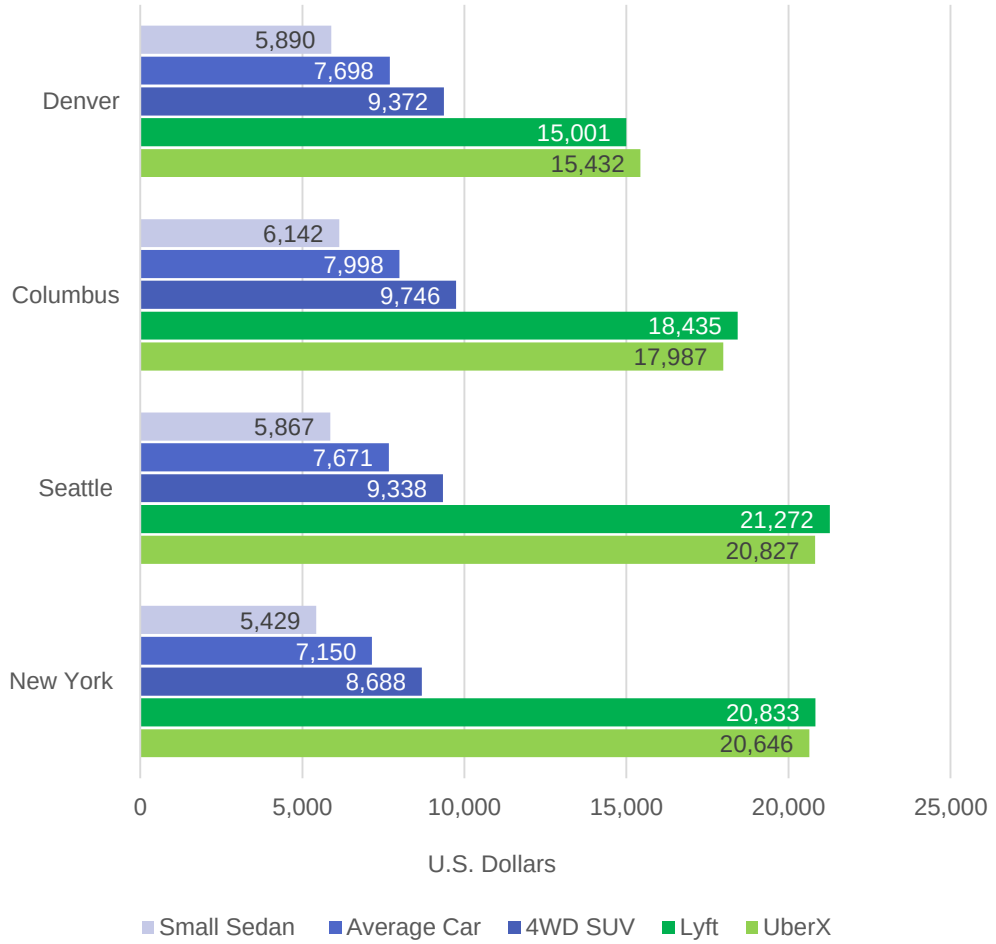
In the United States, the costs of owning and using a car are much lower than they are in other parts of the world. This explains why a similar cost comparison made by BCG for Europe estimated that city car users would pay less to share than to own if they drive less than 4,660 miles a year. The breakeven distance in Europe was greater for bigger car categories, reaching 15,223 miles a year for a large car.[95]

Most likely that the largest pool of potential carsharing users consists of owners of small sedans who need to make short trips within a limited radius; however, people make their decision to use carsharing services based not only on a cost comparison, but many other factors, such as convenience, the opportunity to use more car models, etc. Not all the people for who it is cheaper to forego ownership and become carsharing users will actually do so. Many will prefer owning a car as a status symbol, because of lifestyle choices, or the need to drive routes that do not make carsharing possible or convenient.

Ridehailing vs. Private Vehicle Costs

Using solely a ridehailing service is 1.5 to 3.8 times more expensive than owning and operating a private vehicle in the four cities analyzed (see Figure 20).

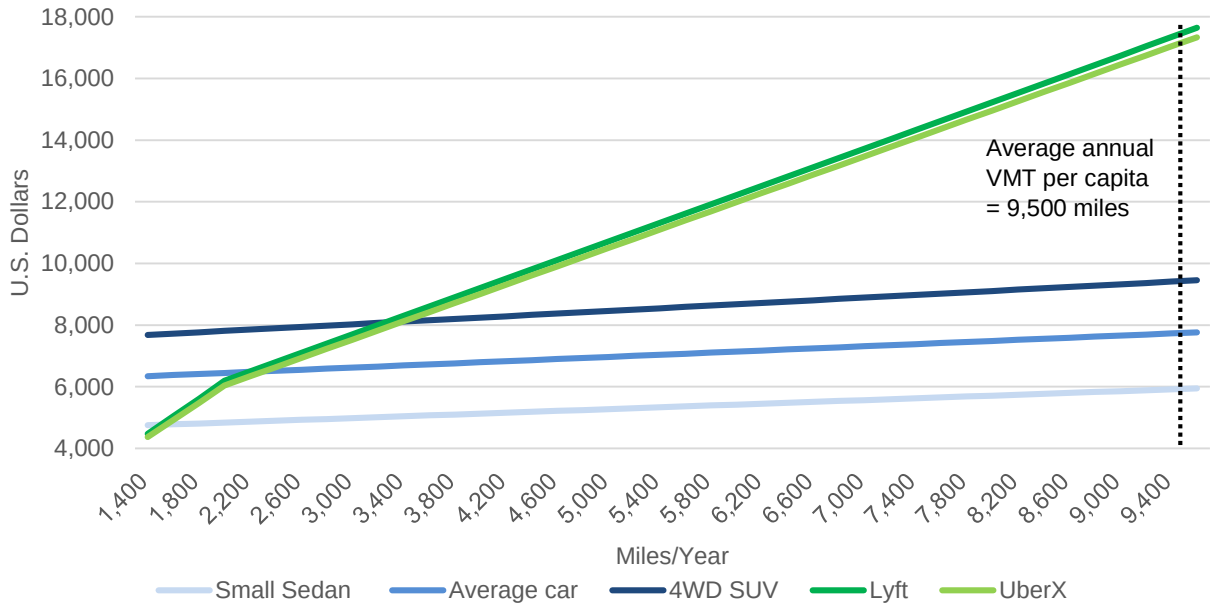
Figure 20: Annual Transportation Costs: Ridehailing v. Private Vehicle (City Level)



As previously stated, however, ridehailing is normally used as part of a mix of transportation modes. An analysis using New York and Uber as an example showed that ridehailing can be cheaper than car ownership if it is used in a combination with public transit. The cost comparison shows that a household can have transportation expenses lower than those linked to car ownership ($10,000 per year per household, in this analysis), if that household makes up to 15 percent of its trips (amounting to 300 trips) in a year using Uber (at a $20 per ride, chosen as the average price for a five-mile UberX ride in moderate traffic in New York) and the rest using public transit.[96]

On average, ridesharing is less expensive that owning and operating a car for people travelling fewer than 2,200 miles a year. The breakeven distance can vary from 1,500 miles for a small sedan to 3,400 miles for a 4WD SUV (see Figure 21).

Figure 21: Annual Transportation Costs: Ridehailing v. Private Vehicle (National Averages)



Effect on Light Vehicle Sales

While for most motorized new mobility services, such as ridesharing, ridehailing, and microtransit, there is insufficient information to estimate their impact on vehicle sales, studies on carsharing over the last 15 years allow for such projections. Bikesharing is likely to have a very small impact on vehicle sales, despite the sustained growth of this service. As shown previously, the modal shift from the private vehicle to bikesharing was about four percent, and just 5.5 percent of users postponed or foregone a vehicle purchase because of bikesharing.

As stated earlier, most households that use carsharing services do not own a vehicle; however, some carsharing members that own vehicles tend to sell them over time as a result of using the programs. The biggest shift stemmed from one vehicle households giving up that vehicle. Fewer of households went from owning two vehicles to just one.[97] One survey of carsharing members found that households that that reduced their number of vehicles after joining a carsharing service tend to be single households, own more than one vehicle prior to joining the program, or live in rental housing. The findings also indicate that households that reduced their vehicle ownership were more aware of environmental impacts and the costs of transportation.[98]

In North America, surveys[99] have found that, on average, 41 percent of carsharing users chose to postpone or forego the purchase of a vehicle as a result of using carsharing. An additional 20 percent of members shed one or more personal vehicles since becoming carsharing users.[100] To assess the impact of carsharing on vehicle sales, a rather more accurate figure is the percent of carsharing members that state they would

buy a vehicle if carsharing was not available, because the *optimism bias* is likely lower than for the other question. The average for North America is 35 percent.[101]

In Europe, 25 percent of carsharing users sold their vehicle and 32 percent refrained from a vehicle purchase on average.[102] In Australia, 21.3 percent of carsharing members sold their vehicle due to carsharing, and 28.1 percent forwent a vehicle purchase.[103] For these regions, there is insufficient information on how many carsharing members would buy a vehicle if the service was no longer available.

Given the carsharing growth projections and the propensity of some carsharing members to forego purchasing their own vehicle, CAR estimates that, in 2021, one shared car will replace 7.75 private vehicles in the United States, with a ratio of 30 *active* members —persons that use carsharing once a month or more— per car shared.[104] In North America, one vehicle shared can replace 7.78 private vehicles in 2021, if there are 30 active members per car shared.[105] One European shared vehicle is likely to replace 4.06 private vehicles in 2021 (according to a 25.9 active member/vehicle ratio). Finally, in 2021, 3.83 private vehicles may be replaced by one shared car in the Asia- Oceania region (with a 27.2 active member/vehicle ratio).[106] See Table 9 and endnotes for details.

Table 9: Number of Private Vehicles Replaced by One Shared Car, 2021 Projections

	United States 2021 Projections		North America 2021 Projections		Europe 2021 Projections		Asia - Oceania 2021 Projections	
	Carsharing members	2,952,944	Carsharing members	3,815,605	Carsharing members	10,068,366	Carsharing members	15,696,367
	Total vehicles shared	39,124	Total vehicles shared	50,875	Total vehicles shared	242,611	Total vehicles shared	317,098
	Member / vehicle ratio	75.48	Member / vehicle ratio	75.00	Member / vehicle ratio	41.5	Member / vehicle ratio	49.5
Share of members that make more than 1 trip per month	Member making 1+ trips per month / vehicle ratio, 2021	Private vehicles replaced by 1 shared vehicle, 2021	Member making 1+ trips per month / vehicle ratio, 2021	Private vehicles replaced by 1 shared vehicle, 2021	Member making 1+ trips per month / vehicle ratio, 2021	Private vehicles replaced by 1 shared vehicle, 2021	Member making 1+ trips per month / vehicle ratio, 2021	Private vehicles replaced by 1 shared vehicle, 2021
100%	75.48	19.38	75.00	19.44	41.50	6.76	49.50	6.95
75%	56.61	14.54	56.25	14.58	31.13	5.07	37.13	5.22
60%	45.29	11.63	45.00	11.67	**24.90**	**4.06**	29.70	4.17
55%	41.51	10.66	41.25	10.69	22.83	3.72	**27.23**	**3.83**
40%	**30.19**	**7.75**	**30.00**	**7.78**	16.60	2.71	19.80	2.78

The impact of carsharing on vehicle sales will be partially offset by sales into carsharing fleets that will be replaced at a rapid pace (likely about three years).[107] In addition, if competition among operators increases, carsharing fleet operators have an incentive to provide their members with the newest and most attractive fleet. Therefore, the loss in new or used vehicle sales induced by carsharing must be calculated over a longer period of time, taking into account the replacement of the carsharing fleets. The estimate lost sales due to carsharing is calculated for the 2010-2021 period by subtracting the number of vehicles sold into carsharing fleets from the number of vehicle sales avoided due to carsharing.[108]

Carsharing will have a relatively small impact on new and used vehicle sales. CAR estimates that between 2010 and 2021, more than 137,500 sales will be lost in the Unites States because carsharing members no longer need to buy their own vehicle. By comparison, 55 million new and used vehicles were sold annually in the United States on average in the 2010 – 2015 period.[109] For the whole of North America, that number reaches about 164,600 units. The amount of lost sales is projected to be bigger in Europe (about 267,500 units) and especially Asia – Oceania (just over 398,700 units).[110] That would bring the global total to 830,850 lost sales due to the use of carsharing between 2010 and 2021. See Table 10 and endnotes for details.

Table 10: Net Loss of New and Used Vehicle Sales Due to Carsharing, 2010 to 2021

Region	Annual Average	Total (2010 to 2021)
North America	15,163	164,606
United States	*12,663*	*137,507*
Europe	28,844	267,533
Asia - Oceania	49,213	398,712
Total	**93,220**	**830,850**

Broader Impacts and Policy Considerations

The mainstreaming of new mobility services will have broader implications, not just for the automotive industry, but also for the economy, personal mobility, and public policy.

New mobility services can be a driver of economic development, not just through direct contributions, but also by being a catalyst for innovation in domains beyond transportation, such as technology, communication, retail, etc. By solving the first-and-last mile problem of transit access, NMS can contribute to an increased economic activity near public transit stations and multimodal hubs, and increased access by creating opportunities for new trips not previously accessible by traditional public transportation and by enabling new one-way or point-to-point service options. Even if the use of new mobility services will be limited to urban areas and a certain type of users, the concepts that are at the heart of NMS will serve as an inspiration to improve transportation policy in general and public transit in particular.

Many established modes of transportation have started borrowing concepts from NMS and using them to make their services more attractive to customers. Faced with the fierce competition from TNCs, traditional taxi companies have made steps to modernize and offer customers the same level of on-demand convenient service. Many of them have started using smartphone apps or websites for reservations, called “e-hailing” apps. Carpooling has been transformed by technology and wireless communication. By becoming real-time and dynamic, carpooling is a viable and convenient alternative for the work commute. Using a bicycle has been made more simple and convenient in cities by bikesharing programs. Traditional car rental companies are adopting more carsharing technology at all stages of their business to make it more streamlined and on-demand.

New mobility services also present public agencies with the opportunity to bring innovation to their transportation systems, in terms of public transit, parking policy, traffic management, etc. In the medium term, public authorities may need to establish a more coherent regulatory environment that encourages innovation, and promotes safety and security, social equity and environmental sustainability. In the long term, transportation agencies may need to rethink their role and consider the opportunity for public-private partnerships and contracting with private mobility providers.

Already, an increasing number of municipalities and transportation agencies are partnering with new mobility service providers. Some of the earliest partnerships were with bikesharing and carsharing operators. Recent initiatives also involve transportation network companies. Increasingly, transportation agencies are seeing NMS as an opportunity to provide more transportation options to their users and strengthen public transit by providing first-and-last mile options and bridge gaps in the service, for example during the evening and night, or in low density areas. While new mobility companies, such as Uber, continue to have a difficult relationship with some cities, in other areas they are partnering with local authorities to build models by which ridehailing and public transit complement each other. Increasingly, public transit agencies view new mobility companies as partners, not competitors.

For example, Tampa's HART transit system, is partnering with Uber and Lyft to make it easier for transit users to go to and from transit stops. In Dallas, DART incorporated Uber, Lyft, and Zipcar into its mobile ticketing app in 2015. Atlanta's MARTA system offers a similar link-up to Uber. In Memphis, Tennessee, and Raleigh-Durham, North Carolina, Uber is available as a transportation option on the TransLoc Rider app since February 2016. In the San Francisco Bay Area, Lyft (Lyft Carpool), Carma, and Scoop will be integrated into the 511 Rideshare platform of the region.

Other communities, like St. Petersburg, Florida, and Altamonte Springs, Florida, agreed to partially subsidize Uber and taxi fares since early 2016. The goal is to appeal to people who do not use public transit because they feel it is inconvenient and people who do use it but have to walk long or unsafe routes to get to the nearest transit stop. Lyft is also working with transportation agencies in Nashville, Los Angeles, Dallas, Denver, and other places to provide more connections from homes to mass transit.

For its three programs, Bridj has approached local authorities as a partner and shares its data with bus companies, which can use this information to optimize their own routes. For example, Bridj has partnered with Kansas City, Missouri, and Ford for a one-year pilot programs that started in March 2016 and aims at providing Bridj not as a traditional supplement to transit, but as an extension of transit. The Kansas City Area Transportation Authority pays the drivers and owns the Ford Transit vehicles, which are Bridj branded. Bridj provides the technology, which is the routing algorithm, the reservation app, and the customer service.

Conclusions

The rise of new mobility services is part of a mobility evolution, a bigger and long term gradual evolution of transportation preferences, towards on-demand shared mobility and a multimodal system that is less car-centric. More users will choose to use new mobility services instead of, and in combination with, public transit and private vehicles. New mobility services also represent an opportunity to make transportation more efficient and affordable.

The near term growth of new mobility services will be concentrated in urban denser areas that offer a variety of transportation options, and to a certain type of users (urban dwellers with higher levels of income and educational attainment), especially in the United States.

Even if these new transportation options will not represent a substantial share of trips in the medium term, they will have a profound long term impact on the way society and the individual think about transportation, on their expectations, on the way transportation is organized and paid for. In a decade or two, the adoption and especially shared use of autonomous vehicles also has the potential to cause a broad change in transportation, albeit gradual. Although new mobility services will not be used by a majority of travelers, their operating concepts will profoundly impact the use of private vehicles and public transit.

New mobility solutions provide a catalyst for innovation in the automotive industry. While, in the medium term, losses in sales of vehicles linked to the use of NMS will be relatively small, new mobility services are prompting automakers to innovate, by developing mobility solutions of their own and experiment with new business models and revenue sources. Thanks to the gradual change in travel preferences, traditional transportation players – automakers in particular – will have time to adapt and maintain their market positions, despite the increasing diversification of the transportation sector. The automotive industry is advised take advantage of the great potential for innovation brought by new mobility services.

New mobility opportunities for the automotive industry, bringing new…

- *Services*
- *Vehicle concepts*
- *Vehicle functionalities*
- *Ownership models*
- *Business partnerships*

The mainstreaming of new mobility services will have broader implications, not just for the automotive industry, but also for economic development. NMS will contribute to changes in the labor market in the transportation sector as a whole and play a role in renewed regional competitiveness. New mobility services also represent an opportunity for public agencies to rethink their transportation systems and make them more efficient, affordable, and relevant for the needs of their citizens. Public authorities need to adopt the key concepts and modes of functioning that make NMS so appealing to their users. Partnerships with new mobility companies are one of the best ways to bring innovation into transportation policy.

There is an opportunity to improve public transportation, making it more…

- *Relevant to the user*
- *Cost efficient for society*
- *Affordable for the user*
- *Flexible to the needs of the user*

Many analysts and commentators have addressed the growing competition between new mobility services and the traditional automotive industry, but few have examined the interactions and relationships between these varying service and business models and the larger transportation system. To a great extent, NMS are dependent on individual passenger vehicles and will continue to be into the 2020s. Furthermore, automotive manufacturers are experimenting with their own mobility service offerings. Partnerships abound, and the potential for innovation is high. Thus, rather than the common perception of being a threat to the automotive industry, NMS provide the incentive for the development of a more resilient automotive industry, one that evolves quickly in light of changing technology, travel behavior, and consumer preferences—an automotive industry better poised to survive the market challenges of the next 100 years and remain a vital part of the overall transportation system. This added resilience, in turn, might prove to be precisely the competitive advantage that the industry needs to survive the even steeper challenges of 2030 and beyond when widely deployed crash avoidance technology and large (and growing) percentages of shared autonomous vehicles might lead to significant redesign of vehicles; together, these forces could further disrupt the now dominant private ownership model. Globally, the challenges are likely to be more formidable and more immediate than they will be in the United States; the industry must respond to these challenges soon if it wants to remain relevant and profitable as usership becomes the most prevalent relationship between consumers and vehicles.

Notes and References

[1] Pfister, J., "FTA Mobility on Demand (MOD) Program," Federal Transit Administration, December 2015

[2] CAR adaptation of the graphic originally published in Kirby, R. and Bhat, K., *Para-transit: Neglected Options for Urban Mobility*, Urban Institute, 1974

[3] As of September 2014.

[4] As of May 2016.

[5] Kalanick, T., "Growing and Growing Up," Uber Newsroom, April 2016

[6] As of March 2016.

[7] "Where is Uber Currently Available?" www.uber.com. Retrieved July 7, 2016.

[8] As of March 2016.

[9] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Winter 2016

[10] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Summer 2015

[11] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Summer 2015

[12] As of June 2016.

[13] Meddin, R., "The Bike-sharing World - Year End Data 2015," www.bike-sharing.blogspot.com, January 2016

[14] Fishman, E., "Bikeshare: A Review of Recent Literature," Transport Reviews, 2015

[15] Firestine, T., "BTS Technical Report: Bike-Share Stations in the United States," USDOT, April 2016

[16] Fishman, E., "Bikeshare: A Review of Recent Literature," Transport Reviews, 2015

[17] Urban counties are defined as areas with tract-weighted density of at least 2000 households per square mile.

[18] CAR analysis, based on 2015 population estimates for counties and metropolitan areas (U.S. Census Bureau).

[19] Fitch Ratings, "U.S. Housing Demand Pendulum Swinging Back to City Centers," www.fitchratings.com, August 2015

[20] Office space in walkable urban areas has a 74 percent price-per-square-foot premium compared to rents for office space in suburban business parks accessible only by automobiles, and this rent premium is growing over time. Source:

Leinberger, C. and Lynch, P., "Foot Traffic Ahead: Ranking Walkable Urbanism in America's Largest Metros", George Washington University School of Business, 2014

[21] There are now 83.1 million Millennials (born between 1982 and 2000) in the United States. Their size exceeds that of the 75.4 million baby boomers. Source: U.S. Census Bureau, "Millennials Outnumber Baby Boomers and Are Far More Diverse", Census Bureau Reports, Release Number: CB15-113, June, 2015

[22] Juday, L., "The Changing Shape of American Cities," Demographics Research Group, University of Virginia, March 2015

[23] CAR analysis. Data sources: JDPower and Associates, 2015, and U.S. Census Bureau – annual estimates of resident population, 2013

[24] Federal Reserve Bank of New York.

[25] Sivak, M. and Schoettle, B., "Recent Decreases in the Proportion of Persons with a Driver's License across All Age Groups," University of Michigan, January 2016

[26] ASCE, "Report Card for America's Infrastructure," March 2013

[27] "The Real Cost of Filling Up: Gasoline Prices by Country," Bloomberg, September 2015

[28] In 2014, 70.3 percent of young workers drove alone to work, compared to 76.5 percent of the overall population. In 2005, the percentage of young commuters driving alone was 71.5 percent (American Community Survey)

[29] American Community Survey, 2014

[30] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005

[31] Guidelines for a carsharing program with the density of less than 10 shared cars in a half-mile radius. Data from Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005

[32] Hall, J. and Krueger, A., "An Analysis of the Labor Market for Uber's Driver-Partners in the United States," January 2015

[33] Firestine, T., "BTS Technical Report: Bike-Share Stations in the United States," USDOT, April 2016

[34] American Community Survey 2012

[35] Alliance for Biking and Walking, "Bicycling and Walking in the United States: 2014 Benchmarking Report," 2014

[36] Deloitte, "Smart Mobility: Reducing Congestion and Fostering Faster, Greener, and Cheaper Transportation Options," May 2015

[37] Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," *APTA*, March 2016

[38] Federal Highway Administration, 2013

[39] Sakaria, N.and Stehfest,N., "Millennials and Mobility: Understanding the Millennial Mindset," *APTA*, July 2013

[40] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005

[41] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005

[42] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005

[43] Martin, E. and Shaheen, S., "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data", Energies, 2011

[44] Martin, E. and Shaheen, S., "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data," Energies, 2011

[45] Pew Research Center, "Shared Collaborative and On-Demand: The New Digital Economy," May 2016

[46] Pew Research Center, "Shared Collaborative and On-Demand: The New Digital Economy," May 2016

[47] Mundler, M.; Stocker, A.; Shaheen, S., "Online and App-Based Carpooling in France: Analyzing Users and Practices--A Case Study of BlaBlaCar," TRB 95th Annual Meeting Compendium of Papers, 2016

[48] DriveNow and car2go, "Joint Mobility Study", March 2015

[49] Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," APTA, March 2016

[50] Martin, E. and Shaheen, S., "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data," Energies, 2011

[51] Rayle, L.; Shaheen, S.; Chan, N.; Dai, D.; Cervero, R., "App-Based, On-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco," UC Berkeley, August 2014

[52] For example, Travis Kalanick said early in 2015 that Uber's gross revenue (including the drivers' cut) reached $500 million a year in San Francisco, three times more than conventional taxis in that city.

[53] Certify, 2015

[54] Caldwell, C.; Hockaday, B.; Benson, D.; Williams, M., "Portland's Private For-Hire Transportation Market: Summary Report of the PFHT Innovation Pilot Program," Portland Bureau of Transportation, October 2015

[55] "Step Aside, Uber. Bridj Is the Next Wave of Transportation Disruption," Bacon's Rebellion blog, April 4, 2015

[56] Leswing, K., "BlaBlaCar: When Will Real Ridesharing Come to the US?" International Business Times, June 4, 2015

[57] Shaheen, S. and Chan, N., "Mobility and the sharing Economy: Impacts Synopsis. Shared Mobility Definitions and Impacts," UC Berkeley, Spring 2015

[58] Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," APTA, March 2016

[59] Sochor, J.; Stromberg, H.; Karlsson, I. C. M., "An Innovative Mobility Service to Facilitate Changes in Travel Behavior and Mode Choice," 22nd ITS World Congress, October 5-9, 2015

[60] Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," APTA, March 2016

[61] Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," APTA, March 2016

[62] DriveNow and car2go, "Joint Mobility Study," March 2015

[63] Cervero, R.; Golub, A.; Nee, B., "San Francisco City CarShare: Longer-Term Travel-Demand and Car Ownership Impacts," UC Berkeley, 2006

[64] Katzev, R., "Carsharing: A New Approach to Urban Transportation Problems," Analyses of Social Issues and Public Policy, 2003

[65] Future Advisor, "Study: Uber Pulls Ahead of Lyft in Riders and Revenue With 12x Lead in U.S." September 11, 2014

[66] Hall, J. and Krueger, A., "An Analysis of the Labor Market for Uber's Driver-Partners in the United States," January 2015

[67] Kalanick, T., "Growing and Growing Up," Uber Newsroom, April 2016

[68] Hall, J. and Krueger, A., "An Analysis of the Labor Market for Uber's Driver-Partners in the United States," January 2015

[69] Chan, N. and Shaheen, S., "Ridesharing in North America: Past, Present, and Future," Transport Reviews, November 2011

[70] Deloitte, "Smart Mobility: Reducing Congestion and Fostering Faster, Greener, and Cheaper Transportation Options," May 2015

This study calculated this potential for ridesharing by first approximating the number of commuter pairs that could be made (commuters that drive alone to work, have the same census tracts as origin and destination, live within a mile or less of each other and leave for work within 30 minutes on one another). From this total were subtracted commuters that made stops during their work commute, or trip chaining (16 percent).

[71] Shaheen, S. and Cohen, A., "Carsharing and Personal Vehicle Services: Worldwide Market Development and Emerging Trends," International Journal of Sustainable Transportation, 2012

[72] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Winter 2016

[73] Shaheen, S.; Cohen, A.; Chung, M., "North American Carsharing: A Ten-Year Retrospective," Transportation Research Record, 2010

[74] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Winter 2016

[75] Shaheen, S. and Cohen, A., "Innovative Mobility Carsharing Outlook: Carsharing Market Overview, Analysis, and Trends," UC Berkley, Winter 2016

[76] Auto Rental News, "CarSharing: State of the Market and Growth Potential," March/April 2015

[77] Auto Rental News, "CarSharing: State of the Market and Growth Potential," March/April 2015

[78] CAR estimates that, in 2016 and 2017, in terms of membership, carsharing growth rates will be close to the average of the growth rates of the five previous years—23 percent. As the market begins to saturate, growth will likely slow to 20 percent in 2018, 16 percent in 2019, 12 percent in 2020, and finally 6

percent in 2021. CAR assumes that the member/vehicle ratio will slightly increase, but at a slower pace than in the previous years, due of the expansion of programs on university campuses and airports, for example. The ratio will reach 75.48 in 2021, up from 70.5 in 2015.

[79] Deloitte, "Smart Mobility: Reducing Congestion and Fostering Faster, Greener, and Cheaper Transportation Options," May 18, 2015

The approach of this study was to select the areas matching a set of characteristics that support carsharing success (high residential density, larger mode share of public transportation, lower vehicle ownership rates), as well as university campuses. Based on this selection and taking into account that only a percentage of people would be willing to join a carsharing or carpooling program, the research team calculated the maximum of potential carsharing members.

[80] CAR assumes that the growth of the entire North American market will follow that of the United States, because the United States is the biggest sub-market on this continent.

[81] Europe has a bigger growth potential than the U.S. and North America. CAR estimates that in 2015 and 2016, European membership growth was close to the 2006-2014 average annual growth, respectively 37 and 35 percent. As the market matures, growth rates will likely slow down by 5 points per year, thus reaching 10 percent in 2021. CAR assumes that the member/vehicle ratio will slightly increase in Europe as programs mature, but at a slower pace than in the previous years. The ratio will reach 41.5 in 2021, up from 38.08 in 2015.

[82] TÜV Rheinland, FSP, BBE Automotive, "Studie: CarSharing in Deutschland," 2015

[83] Between 2006 and 2014, the Asia-Oceania area had an annual membership growth of 82 percent. Taking into account the latest expansion announcements, CAR estimates that carsharing programs in this area have the potential to grow at a 75 percent rate in 2016 and 70 percent rate in 2017. Starting with 2018, CAR estimates that growth rates will decrease by 10 points every year and 20 percent in 2021. CAR assumes that in the Asia-Oceania area the member/vehicle ratio will continue to increase as programs expand to new cities. The ratio will reach 49.5 in 2021, up from 46.03 in 2015.

[84] DeMaio, P., "Smart Bikes: Public Transportation for the 21st Century," Transportation Quarterly, 2003

[85] Fishman, E., "Bikeshare: A Review of Recent Literature," Transport Reviews, 2015

[86] Meddin, R. "The Bike-Sharing World Map," January 2016

[87] Larson, J., "Public Bike Sharing Programs in the United States, Planned and Current," Earth Policy Institute, May 2013

[88] Alliance for Biking and Walking, "Bicycling and Walking in the United States: 2014 Benchmarking Report," 2014

[89] Deloitte, "Smart Mobility: Reducing congestion and fostering faster, greener, and Cheaper Transportation Options," May 2015

Workers with a commute shorter that five miles, that currently drive to work and don't make stops on their way were considered. This estimate also assumes that people are likely to commute by bike an average of 96 days a year, to account for weather-related effects on bike commuting.

[90] American Community Survey 2005-2011

[91] Shaheen, S. and Chan, N., "Mobility and the Sharing Economy: Impacts Synopsis. Shared Mobility Definitions and Impacts," UC Berkeley, Spring 2015

[92] The city specific (for Denver, Columbus, Seattle, and New York) costs of operating and owning a private vehicle (for an average car, small sedan, medium sedan, large sedan, minivan, and 4WD SUV) were obtained with the following formula: operating cost per mile (AAA 2015) * city daily VMT (FHWA 2013) * 365 + annual ownership costs (AAA 2015).

The national average costs of operating and owning a private vehicle (for an average car, small sedan, medium sedan, large sedan, minivan, and 4WD SUV) were obtained with the following formula: operating cost per mile (AAA 2015) * VMT (variable between 0 and 15,000 miles) * 365 + annual ownership costs (AAA 2015).

While parking can be a significant component of the costs associated with operating a private vehicle, due to their great variety, parking tariffs (included in the cost of housing, separate weekly, monthly, or annual rent, meter, etc.) were not included in the cost comparisons.

[93] The goal of the city-level analyses is to compare transportation costs in actual specific conditions (VMT and local speeds) as much as possible.

The city specific (for Denver, Columbus, Seattle, and New York) daily costs of ridehailing (Uber and Lyft) per day, were obtained with the following formula: city ridehailing base fare * average daily vehicle trips (NHTS, 2009) + city cost per minute * city daily VMT (FHWA 2013) / city average speeds (obtained from Google Maps data from 2009, http://infinitemonkeycorps.net/projects/cityspeed/, retrieved in June 2016) * 60 + city cost per mile * city daily VMT (FHWA 2013) + city booking fee * average daily vehicle trips (NHTS, 2009). The daily cost of ridehailing was multiplied by 365 to obtain the annual cost. UberX and Lyft fares for Denver, Columbus, Seattle, and New York were retrieved in June 2016.

The city specific (for Denver, Columbus, Seattle, and New York) annual costs of car2go carsharing were obtained with the following formula: annual membership fee + cost per minute * city daily VMT (FHWA 2013) / city average speeds (obtained from Google Maps data from 2009, http://infinitemonkeycorps.net/projects/cityspeed/, retrieved in June 2016) * 60 * 365. Car2go minute fares and membership rates for specific cities were retrieved in June 2016.

The city specific (for Denver, Columbus, Seattle, and New York) annual costs of Zipcar carsharing were obtained with the following formula: monthly membership fee * 12 + rate per hour (for Monday to Thursday) * average number of weekday trips * (365 – 52*3) + rate per hour (for Friday to Sunday) * average number of weekday trips * 52 + rate per hour (for Friday to Sunday) * average number of weekend trips * 52 *2. Zipcar hourly fares and membership rates for specific cities were retrieved in June 2016.

[94] The goal of the national average analyses is to compare transportation costs depending on how many miles are traveled every year, in this case, between 0 and 10,000 miles.

The national daily costs of ridehailing (Uber and Lyft) were obtained with the following formula: average base fare * average daily vehicle trips (NHTS, 2009) + average cost per minute * VMT (variable between 2000 and 10,000 miles) / 365 / average commute speed (NHTS 2009) * 60 + average cost per mile * VMT (variable between 2000 and 10,000 miles) / 365 + average booking fee * average daily vehicle trips (NHTS, 2009). The annual cost was obtained by multiplying the daily cost by 365. For less than 2000 miles traveled, CAR did not use the average daily vehicle trips (NHTS, 2009) because the annual mileage was too low; instead, CAR used a progression from 1 trip per day to 2.75 trips per day. Average UberX and Lyft fares were obtained based on fares from the top ten ridehailing markets, retrieved in June 2016.

The national daily costs of car2go carsharing were obtained with the following formula: annual membership fee + cost per minute * VMT (variable between 2000 and 10,000 miles) / average commute speed (NHTS 2009) * 60. car2go minute fares and membership rates are the same in all car2go markets and were retrieved in June 2016.

The national daily costs of Zipcar carsharing were obtained with the following formula: monthly membership fee * 12 + average rate per hour * VMT (variable between 2000 and 10,000 miles) / average trip length (NHTS 2009).

The average Zipcar rate per hour is based on fares from the top 23 markets for Zipcar.

[95] BCG, "What's Ahead for Car Sharing?" February 2016

[96] Silver, N. and Fischer-Baum, R., "Public Transit Should Be Uber's New Best Friend," FiveThirtyEight, August 20, 2015

[97] Martin, E. and Shaheen, S., "The impact of carsharing on public transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data," Energies, 2011

[98] Martin, E.; Shaheen, S.; Lidicker, J., "Carsharing's Impact on Household Vehicle Holdings: Results from a North American Shared-Use Vehicle Survey," Transportation Research Record, 2010

[99] For the time being, carsharing members' surveys are the most accurate source of information on their travel behavior, as carsharing use is relatively small, very localized, recent, and, as such, not take into account in established national or regional travel surveys.

[100] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005 and Shared-Use Mobility Center, "Shared Mobility and the Transformation of Public Transit," APTA, March 2016

[101] CAR analysis based on: Martin, E.; Shaheen, S.; Lidicker, J., "Impact of Carsharing on Household Vehicle Holdings. Results from North American Shared-Use Vehicle Survey," Transportation Research Record, 2010;

Arlington County Commuter Services, "Arlington Pilot Carshare Program. First Year Report," 2005; Arlington County Commuter Services, "Arlington Pilot Carshare Program. 2006 Report," 2006.

[102] Millard-Ball, A.; Murray, G.; Ter Schure, J.; Fox, C.; Burkhardt, J., "Car-sharing: Where and How It Succeeds," TCRP, 2005 and 6T-Bureau de recherche, "Enquete nationale sur l'autopartage," 2013

[103] Ramirez, M.; Tonkinwise, C.; Nawangpalupi, C., "Multiplier and Transfer Effects of Carsharing in Australia," SCORE! Sustainable Consumption Research Exchange Conference Workshop 3: Framework for Action for SCP. Milan, 2012

[104] The number of vehicles replaced by one shared car in the United States was calculated using the following formula: 0.35 (the percent of members that would buy a car if carsharing did not exist, see note 101 for detail) / 1.35 (Murphy et al. "A Meta-Analysis of Hypothetical Bias in Stated Preference Valuation," 2003, states that a calibration factor of 1.35 —median value— should be used to eliminate *optimism bias* in states preference valuation, in this case linked to carsharing members declaring they have foregone or postponed a vehicle purchase due to carsharing) * 75.48 (the projected member per vehicle ratio in 2021) * X (the percent of carsharing members that make more than one trip per month, in this analysis 100%, 75%, 60%, 55%, or 40%). This last part of the formula was added because members that are inactive or taking less than one trip per month will likely not forego buying a vehicle because of to carsharing. So as not to overestimate the impact of carsharing on vehicle sales, CAR performed a

sensitivity analysis, to account for this type of members. Few studies provide information on the actual percent of members that make less than one trip per month. Katzev (2003) calculates that 30.60 percent of members were inactive as they took no trips on each month of the first year of a carsharing program. Therefore, CAR estimates that in 2021, the most likely scenario is that 40 percent of the members will be active, making more than one trip per month. Thus the ratio active members per shared vehicle would be 30.19 and one shared car would replace 7.75 private vehicles.

[105] The number of vehicles replaced by one shared car in North America was calculated using roughly the same formula used for the United States, with the difference that the projected 2021 member / vehicle ratio is 75. CAR estimates that in 2021, the most likely scenario is that 40 percent of the members will make more than one trip per month in North America. Thus the ratio active members per shared vehicle would be 30 and one shared car would replace 7.78 private cars.

[106] The number of vehicles replaced by one shared car in Europe was calculated using roughly the same formula used for the United States: 0.326 (the percent of members that stated they forgone or postponed a vehicle purchase because of carsharing, see note 99 for details) / 2 (calibration factor based on the Murphy 2003 analysis; a different value than the median was chosen, as the question "Did you forego or postpone the purchase of a vehicle because of carsharing?" is likely to prompt more optimism bias than the question "Would you buy a vehicle if carsharing was no longer available?") * 41.5 (the projected member per vehicle ratio in 2021) * X (the percent of carsharing members that make more than one trip per month, in this analysis 100%, 75%, 60%, 55%, or 40%). There is currently insufficient data on the percent of carsharing members that would buy a vehicle if carsharing was not available in Europe. CAR estimates that in 2021, the most likely scenario is that 60 percent of the members will be active in Europe, making more than one trip per month. Thus, the ratio active members per shared vehicle would be 24.90, approaching the ratio at which carsharing services are considered to be reach financial balance (6T-Bureau de recherche, 2013). One shared vehicle would therefore replace 4.06 private vehicles.

The number of vehicles replaced by one shared car in Asia-Oceania was calculated using roughly the same formula used for Europe, with the difference that the percent of members that stated they forgone or postponed a vehicle purchase because of carsharing in this region in 28.1% and that the projected member per vehicle ratio in 2021 is 49.5. CAR estimates that in 2021, most likely 55 percent of the members will be active in Asia-Oceania, making more than one trip per month. Thus, the ratio active members per shared vehicle would be 27.23 and one shared car would replace 3.83 private vehicles.

[107] By comparison, the average American buyer keeps a new vehicle for about 6.5 years, and the average vehicle on the road in the United States is 11.5 years old, according to IHS Automotive.

[108] CAR first estimated the number of sales corresponding to carsharing fleets. The assumption is that every year, the number of vehicles sold into carsharing fleets is equal to: a third of the total fleet from the previous year, to which it is added the difference between the total carsharing vehicles of that year and the total from the previous year (or the additional vehicles purchased for program expansion). Second, CAR estimated the number of vehicle sales avoided because of carsharing. Each year, that number is equal to: the difference between the total carsharing vehicles of that year and the total from the previous year multiplied by the number of private vehicles replaced by one shared car (see notes 102 to 104). The difference between the second and the first numbers represents the net loss of new and used vehicle sales in a given year.

United States				North America			
Year	Sales into carsharing fleets	Sales avoided	Net loss - vehicles sales	Year	Sales into carsharing fleets	Sales avoided	Net loss - vehicles sales
2010	2,707	3,086	379	2010	4,516	12,165	7,649
2011	4,606	14,722	10,117	*2011*	5,870	18,640	12,770
2012	5,955	20,273	14,318	*2012*	7,251	23,165	15,915
2013	8,388	32,383	23,994	2013	9,056	29,484	20,428
2014	7,908	17,862	9,954	2014	11,153	35,966	24,813
2015	4,011	0	-4,011	2015	7,362	0	-7,362
2016	9,103	27,276	18,173	2016	12,093	20,270	8,178
2017	11,015	33,004	21,990	2017	14,642	44,358	29,716
2018	12,837	36,132	23,295	2018	16,802	46,370	29,569
2019	14,109	33,945	19,836	2019	18,373	43,132	24,759
2020	14,882	28,627	13,745	2020	19,292	35,909	16,616
2021	14,283	14,444	160	2021	18,446	17,353	-1,092
Total	109,803	247,310	**137,507**	Total	144,854	309,460	**164,606**
Annual average - net lost sales			**12,663**	Annual average - net lost sales			**15,163**

Europe				Asia - Oceania			
Year	Sales into carsharing fleets	Sales avoided	Net loss - vehicles sales	Year	Sales into carsharing fleets	Sales avoided	Net loss - vehicles sales
2010	7,824	13,581	5,757	2010	3,264	7,042	3,778
2011	7,271	6,810	-461	2011	2,726	3,191	465
2012	8,159	8,146	-13	2012	3,304	4,834	1,530
2013	20,737	56,479	35,742	2013	7,838	19,593	11,755
2014	35,027	95,653	60,626	2014	13,427	35,217	21,790
2015	39,899	83,543	43,644	2015	23,303	61,256	37,952
2016	52,303	106,040	53,736	2016	38,460	98,812	60,352
2017	64,561	120,442	55,881	2017	58,394	142,124	83,730
2018	76,262	127,785	51,523	2018	82,482	186,891	104,408
2019	85,979	124,629	38,651	2019	107,640	220,826	113,185
2020	92,230	108,458	16,228	2020	128,639	227,540	98,901
2021	93,781	78,600	-15,181	2021	139,135	191,842	52,707
Total	584,033	851,566	**267,533**	Total	608,612	1,007,324	**398,712**
Annual average - net lost sales			**28,844**	Annual average - net lost sales			**49,213**

[109] Wards Automotive

[110] For comparison, on average 18.2 million new light vehicles were sold annually in Europe between 2010 and 2015 and 35.8 million in Asia, according to Wards Automotive.

The Center for Automotive Research's mission is to educate, inform and advise stakeholders, policy makers, and the general public on critical issues facing the automotive industry, and the industry's impact on the U.S. economy and society. CAR produces industry-driven research and analyses; develops forecasts; fosters dialogue and convenes forums; and publicly disseminates our research through conferences, events, and the media.