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PLANNING FOR SHARED MOBILITY

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ABOUT THE AUTHORS

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ON THE COVER

Citi Bike docking station in New York (Patti McConville/Alamy)

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EXECUTIVE SUMMARY

In recent years, economic, environmental, and social forces have quickly given rise to the "sharing economy," a collective of entrepreneurs and consumers leveraging technology to share resources, save money, and generate capital. Homesharing services, such as Airbnb, and peer-to-peer carsharing services, such as Getaround, have become part of a sociodemographic trend that has pushed the sharing economy from the fringe and more to the mainstream. The role of shared mobility in the broader landscape of urban mobility has become a frequent topic of discussion. Major shared transportation modes—such as bikesharing, carsharing, ridesourcing, and alternative transit services—are changing how people travel and are having a transformative effect on mobility and local planning.

WHAT IS SHARED MOBILITY?

Shared mobility—the shared use of a vehicle, bicycle, or other low-speed travel mode—is an innovative transportation strategy that enables users to have short-term access to a mode of transportation on an as-needed basis. Shared mobility includes various service models and transportation modes that meet the diverse needs of travelers. Shared mobility can include roundtrip services (vehicle, bicycle, or other low-speed mode is returned to its origin); one-way station-based services (vehicle, bicycle, or low-speed mode is returned to a different designated station location); and one-way free-floating services (vehicle, bicycle, or low-speed mode can be returned anywhere within a geographic area).

Shared mobility directly influences and is influenced by most facets of urban planning, including the following:

- **Transportation and circulation:** Shared mobility can influence travel patterns, such as modal choice, vehicle occupancy, and vehicle miles traveled.
- **Zoning, land use, and growth management:** Shared mobility can affect land use–related planning factors, including zoning requirements (e.g., parking minimums), parking demand, and the use of public rights-of-way.
- **Urban design:** Shared mobility can support sustainability principles by promoting walking and cycling, providing first-and-last-mile connections to public transportation, and potentially reducing the need to own personal vehicles.
- **Housing:** Shared mobility can support affordable housing strategies by potentially reducing parking demand and allowing for reduced minimum parking requirements at new developments.
- **Economic development:** Shared mobility can create new opportunities for employment and generate revenue from underused resources.

- **Environmental policy, conservation, and climate action:** Shared mobility has the potential to reduce negative impacts commonly associated with surface transportation, such as greenhouse gas emissions.

Because of the wide range of impacts, this report examines the interdependencies, synergies, opportunities, and challenges associated with shared mobility.

IMPACTS OF SHARED MOBILITY

A number of social, environmental, and behavioral impacts have been attributed to shared mobility, and an increasing body of empirical evidence supports many of these relationships, although more research is needed. The various effects can be grouped into four categories: (1) travel behavior, (2) environmental, (3) land use, and (4) social. In recent years, climate action planning has further raised awareness among local governments of shared mobility as a transportation strategy, along with its potential impacts—both positive and negative—on transportation networks. Understanding shared mobility can aid planners in leveraging the positive impacts and taming the negative impacts to achieve planning and public policy goals, including reducing driving and parking congestion; lowering vehicle miles traveled and vehicle ownership rates; improving air quality and achieving climate action targets; and providing mobility access to underserved populations, such as low-income travelers. This report reviews findings from a number of shared mobility studies, specifically ones related to ridesharing, carsharing, bikesharing, and ridesourcing/transportation network companies (TNCs).

Insights into shared mobility can aid planners in understanding impacts on public infrastructure, implementing supportive policies, and making informed transportation and development decisions. However, differences in

service models, data collection, and study methodologies can produce inconsistent results due to limited survey samples and aggregate-level analyses (often attributed to proprietary issues). Thus, it can be challenging to provide a comprehensive and unbiased picture. While automated traveler activity data can offer a rich understanding, these data typically do not capture changes in auto ownership, travel behavior across all modes, and respondent perceptions over time. Beyond operator surveys, many large transportation surveys have begun to assess shared mobility, including the American Community Survey and the California Household Travel Survey; however, these survey instruments also collect self-reported data. While such travel behavior surveys have validity issues—including respondents exaggerating travel behaviors, underreporting the extent or frequency of travel, or reporting inaccurately as well as sample bias—they can offer another source of behavioral understanding.

SHARED MOBILITY POLICIES

The connection between shared mobility and land use is not new. Local zoning and codes can have notable unintended impacts on the success and viability of shared mobility. For example, some cities may classify shared mobility modes, such as carsharing, as a commercial use akin to traditional rental cars. In doing so, local zoning codes may prohibit shared mobility from operating in residential neighborhoods, necessitating either revisions to local codes or variances for shared mobility to operate legally. In other cases, local governments may have special zones (e.g., public transit overlay zones) allowing additional density or lower parking requirements for the inclusion of shared mobility in particular development projects. At the municipal level, the most common ways local and regional planning and policies influence shared mobility are through the allocation of public rights-of-ways (e.g., parking, curb space), developer and zoning regulations, insurance and for-hire vehicle ordinances (e.g., licensing), and taxation.

Public Rights-of-Way
Public rights-of-ways play a synergistic role in shared mobility growth. Allocating parking and curb space for the inclusion of shared mobility—such as carsharing parking; space for bikesharing kiosks; and loading zones for ridesourcing/TNCs, microtransit, and shuttles—is the most common way local governments provide access to public rights-of-way. A

number of local governments and public agencies have developed a combination of formal and informal policies to allocate public rights-of-way. Many of these policies address issues such as (1) how to define a particular shared mode; (2) how to allocate curb space; (3) how to manage demand among multiple operators for public rights-of-way; (4) how to value (and potentially assess the cost) of the rights-of-way; and (5) how to manage administrative issues, such as permits, snow removal, curb and street cleaning, parking enforcement, and signage.

Incentive Zoning
Cities can also implement a wide array of policies aimed at easing zoning regulations and parking minimums to promote the inclusion of shared mobility in new developments. Commonly referred to as incentive zoning for shared mobility, these policies can be categorized as (1) policies that enable reduced parking and (2) policies that allow increased density. Policies that allow reduced parking include parking reductions (downgrading the required number of spaces in a new development) and parking substitution (substituting general-use parking for shared modes, such as carsharing parking and bikesharing kiosks).

Transportation Demand Management
In addition to the amendment of local zoning and building codes, variances, and special-use permits, shared mobility can be incorporated as part of transportation demand management (TDM) planning. Many TDM measures offer similar incentives to developers and property owners for the inclusion of shared mobility and other TDM measures in residential, commercial, and mixed use projects. For example, a developer may be granted the previously discussed bonuses for the inclusion of other on-site amenities, such as bicycle parking, bicycle lockers, showers, and preferential or free parking for carpools and vanpools.

Insurance and Taxation
A number of other policies, such as taxation and insurance, may affect the ability of planners and public agencies to expand shared mobility in local communities. Insurance regulations, either at the state or local level, can make shared modes cost prohibitive, or they can prohibit operations in a jurisdiction altogether. Although some policies may not fall directly under the purview of local jurisdictions, local governments should understand the critical role these policies have on shared modes, particularly ridesourcing/TNCs and carsharing services. Similarly, confusion about shared mobil-

ity services has often led to the implementation of state and local taxes that increase service costs. For example, rental car taxes have been popular among politicians because the taxes were believed to target visitors rather than voters. However, the distinction between carsharing and hourly car rentals has blurred after a series of legal disputes that have made the relationship between taxation and these services less clear. Simply put, taxes on shared mobility can increase service costs and adversely affect use and mainstreaming.

SHARED MOBILITY PLANNING AND PUBLIC POLICY

The planning process allows planners and policy makers to document the state of transportation networks, including access and mobility, and establish goals and policies to guide future growth and infrastructure development. Addressing shared mobility in the planning process serves a dual purpose. First, the planning process can define the role of shared mobility and its impacts on travel behavior, transportation forecasts, and transportation models. Additionally, the planning process can leverage the positive social and environmental impacts of shared mobility to increase infrastructure efficiency, mitigate congestion and air pollution, and incorporate shared mobility into future planning and policy decision making. Shared mobility can also aid planners and policy makers in achieving a wide array of long-term visions and shorter-range goals. Public and stakeholder involvement in shared mobility planning and policy-making processes can reduce opposition, provide public agencies and mobility operators with valuable information on community and stakeholder concerns, reduce conflict among stakeholders, and help jurisdictions comply with public-agency environmental justice requirements.

As mobility services in the sharing economy have grown and evolved, the need to develop and manage public policy for these emerging modes has also expanded. Advanced technologies coupled with innovative and unclearly defined service models have increased the need for policy guidance. When considering the allocation of public resources (e.g., on-street parking and loading zones) and policy development (e.g., taxation and the distribution of vehicle medallions), policy makers and urban planners should examine a range of considerations: (1) service characteristics, (2) procedures for allocating and valuing rights-of-way, and (3) management of competition.

Three possible policy tracks could be used by local governments and public transit operators as models for de-

veloping shared mobility policies. These model approaches provide a framework for the allocation of public rights-of-way, fees and permits, signage, impact studies, and public and stakeholder involvement based on varying degrees of governmental support. The following sections briefly summarize each policy track.

Shared Mobility as a Social and Environmental Benefit

The first model is based on the social and environmental benefits of shared mobility and maximum government support. Under this framework, public agencies and local governments consider the role of shared mobility in mitigating a variety of public costs associated with personal automobile use. As such, policy makers and planners view shared mobility as contributing to the public good and therefore justify the allocation of public resources (e.g., in-kind financial support, free or reduced-cost parking). This framework also includes maximum government support from public agencies through the allocation public rights-of-way through informal (or less formal) processes (e.g., staff/administrative review, case-by-case approvals), often waiving permits and other fees and paying for the installation of signage and other infrastructure maintenance needs for shared mobility (e.g., parking markings).

Shared Mobility as a Sustainable Business

The second framework considers shared mobility to be a sustainable business with moderate government support. Under this model, local governments and public agencies view shared mobility as comprising services that yield social and environmental benefits but are simultaneously revenue-generating enterprises. Local governments, therefore, provide more limited support and infrastructure for shared modes, and mobility operators are expected to carry a larger share of the operational costs.

Shared Mobility as a Business

In the final model, shared mobility is treated like a business, and local governments provide a minimum level of governmental support. Under this policy framework, shared mobility is viewed as similar to other commercial operators, and these providers bear the full costs of operations (e.g., operators pay the full cost for public rights-of-way). In this laissez-faire approach, public agencies often provide little or no support for shared mobility. If an agency allocates public rights-of-way, it is often done through highly formalized processes, supply-and-demand management, and pricing that typically generates costs plus revenue for a jurisdiction.

SUPPORTING SHARED MOBILITY

This report underscores the need for more precise definitions of shared mobility given increasingly blurring lines among existing and emerging transportation modes. Many local entities fail to define or have differing definitions of shared mobility. As shared mobility companies continue to expand and operate alongside taxis, limousines, and rental car services, more precise designations will help to advance public policy, guide regulation, and enhance public safety in existing, new, and planned markets. Developing clear, consistent, and precise definitions will aid sector growth by providing policy and decision makers with a greater understanding of the spectrum of shared mobility services available and their associated benefits. This can also aid operators with a statewide or national target market rather than a strictly local service focus.

Planners and local municipalities can directly support shared mobility in their communities in a number of ways. Governments and public agencies can become partners of shared modes by providing marketing and administrative assistance, allocating funds for shared mobility through grants and low or interest-free loans, and developing risk-sharing partnerships, where the risk-sharing partner only pays the cost needed to maintain service availability. In addition, they can give incentives to developers aimed at easing zoning regulations, reducing parking minimums, and supplying access to public rights-of-ways.

Another important way municipalities can encourage shared mobility is by incorporating it into plans and planning processes at all levels, which can aid in understanding the current and future impacts of shared mobility on communities and allowing local communities to leverage the positive impacts of shared mobility. Public policy also can have a notable influence on the success or failure of shared mobility and other emerging transportation innovations. Public entities, based on their policy stance, can be instrumental in supporting or stifling innovation, improving public safety, regulating services, or adopting more unrestrictive approaches. Local municipalities can provide a supportive policy environment for shared mobility, as appropriate, by minimizing regulation, addressing key areas of public safety concern, defining shared modes, and providing clarity to policy ambiguities.

SHARED MOBILITY: LOOKING FORWARD

Shared mobility represents a transportation strategy that can aid planners and policy makers in achieving greenhouse gas reductions, air-quality mandates, and climate-action goals. Additionally, shared mobility can support multimodality, improve first-and-last-mile access, and enhance mobility for populations with specific needs or barriers (e.g., zero-car households, disabled individuals, older adults, children). As technology and design continue to evolve, shared mobility will likely continue to have a transformative impact on transportation access and options.

In the future, the management of public rights-of-way will likely remain a popular topic of conversation. The increasing number of modes and service providers seeking access to parking and curb space is a trend that is likely to continue. Planners and policy makers will need to develop policies that fairly manage these rights-of-way demands for a variety of uses, including private parking; parking for private shuttles, taxis, paratransit, microtransit, and car-sharing; public transportation; ridesourcing; loading zones; bikesharing; and bicycle infrastructure.

In the coming decades, the convergence of mobility services, shared modes, electric drive vehicles, and automation will undoubtedly transform how people travel, how streets are designed, and the ways in which urban land uses are planned and zoned. The impacts of emerging technologies on auto ownership, parking, and travel behavior remain to be seen. However, as these technologies come online, planners and policy makers will need to rethink more traditional views of access, mobility, and auto mobility. In the future, planners may have to reconsider parking minimums and consider replacing existing parking with infill development and affordable housing. Planners may be able to repurpose on-street parking for other uses—such as wider curbs, bicycle lanes, loading zones for shared automated vehicles, parklets, and housing. What is clear is that these new technologies will likely have a disruptive impact on traditional planning norms and urban form. Thoughtful planning, continued research, and a keen understanding of shared mobility's impacts on and role in the transportation landscape will be critical to balance public goals with commercial interests and to harness and maximize the social and environmental effects of these innovations.

CHAPTER 1
SHARED MOBILITY: AN INTRODUCTION

In recent years, economic, environmental, and social forces have quickly given rise to the "sharing economy"—a collective of entrepreneurs and consumers leveraging technology to share resources, save money, and generate capital. Homesharing services, such as Airbnb, and peer-to-peer carsharing services, such as Getaround, have become part of a sociodemographic trend that has pushed the sharing economy from the fringe to the mainstream. The role of shared mobility in the broader landscape of urban mobility has become a frequent topic of discussion. Major shared transportation modes, such as bikesharing and carsharing, and alternative transit services are transforming how people travel.

WHAT IS SHARED MOBILITY?

Shared mobility—the shared use of a vehicle, bicycle, or other low-speed travel mode—is an innovative transportation strategy that enables users to have short-term access to a mode of transportation. In North America, shared mobility encompasses the submarkets of carsharing, bikesharing, ridesharing (carpooling/vanpooling), public transit services, on-demand ride services, scooter sharing, and alternative transit services, such as shuttles and microtransit. It can also include commercial delivery vehicles providing flexible goods movement, known as courier network

services. Shared mobility can include roundtrip services (motor vehicle, bicycle, or other low-speed mode is returned to its origin), one-way station-based services (vehicle, bicycle, or low-speed mode is returned to different designated station location), and one-way free-floating service (motor vehicle, bicycle, or low-speed mode can be returned anywhere within a geographic area). Figure 1.1 provides an overview of shared mobility service models. Table 1.1 (p. 10) provides definitions of the most common shared mobility models.

Shared mobility also directly influences and is influenced by most facets of urban planning, including transportation, land use, urban design, economic development, conservation, and climate action. Because of the wide range of impacts, this report also examines the many interdependencies, synergies, opportunities, and challenges related to shared mobility.

HISTORY AND EVOLUTION OF SHARED MOBILITY

Each mode of shared mobility has its own background. This section explores the evolution of shared mobility services in the United States, including ridesharing, carsharing, bikesharing, scooter sharing, ridesouring and transportation network companies, e-Hail, courier network services, and alternative transit services.

Ridesharing: Carpooling and Vanpooling

Shared mobility traces its origins to World War II. In the 1940s, ridesharing began during the war through "car clubs"

Shared Mobility Service Models

Core and Incumbent Services
- Car Rental
- Liveries/Limos
- Paratransit
- Pedicabs
- Public Transit
- Shuttles
- Taxis

- Carpool
- Vanpool
- Casual Carpool

Innovative Services
- Bikesharing
- Carsharing
- Courier Network Services
- e-Hail
- High-Tech Company Shuttles
- Microtransit
- P2P Bikesharing
- P2P Vehicle Sharing
- Ridesourcing/TNCs
- Scooter Sharing

Figure 1.1. Shared mobility categories (Shaheen, Cohen, and Zohdy 2016)

TABLE 1.1. SHARED MOBILITY SERVICES

Alternative transit services: A broad category that encompasses shuttles (shared vehicles that connect passengers to public transit or employment centers), paratransit, and private-sector transit solutions commonly referred to as microtransit. Microtransit can include fixed-route or flexible-route services as well as offer fixed schedules or on-demand service. In its most agile form (flexible routing and scheduling), microtransit and paratransit can be bundled under the category of flexible transit services.

Bikesharing: Users access bicycles on an as-needed basis for one-way (point-to-point) or roundtrip travel. Station-based bikesharing kiosks are typically unattended and concentrated in urban settings, and offer one-way service (i.e., bicycles can be returned to any kiosk). Free-floating bikesharing offers users the ability to check out a bicycle and return it to any location within a predefined geographic region. Free-floating bikesharing can include business-to-consumer operator (e.g., Social Bicycles) or peer-to-peer systems enabled through third-party hardware and applications (e.g., Bitlock, Spinlister). Bike-sharing provides a variety of pickup and drop-off locations, enabling an on-demand and very low emission form of mobility. The majority of bikesharing operators cover the costs of bicycle maintenance, storage, and parking. Generally, trips of less than 30 minutes are included with the membership fees. Users join the bikesharing organization on an annual, monthly, daily, or per-trip basis (Shaheen et al. 2012).

Carsharing: Individuals gain the benefits of private-vehicle use without the costs and responsibilities of ownership. Individuals typically access vehicles by joining an organization that maintains a fleet of cars and light trucks deployed in lots located within neighborhoods and at public transit stations, employment centers, and colleges and universities. Typically, the carsharing operator provides gasoline, parking, and maintenance. Generally, participants pay a fee each time they use a vehicle (Shaheen, Cohen, and Roberts 2006).

Courier network services: These services provide for-hire delivery of packages, food, or other items for compensation. They use an online-enabled application or platform (such as a website or smartphone app) to connect delivery drivers using a personal transportation mode. These services can be used to pair package delivery with existing passenger trips, serve as dedicated for-hire delivery services, or be mixed mode (for-hire drivers can deliver both passengers and packages). Also referred to as flexible goods delivery.

e-Hail apps: Smartphone apps that connect taxi drivers with passengers.

Pedicabs: A for-hire service with a peddler that transports passengers on a cycle containing three or more wheels with a passenger compartment.

Personal vehicle sharing: Sharing of privately owned vehicles where companies broker transactions among car owners and renters by providing the organizational resources needed to make the exchange possible (e.g., online platform, customer support, driver and motor vehicle safety certification, auto insurance, technology) (Shaheen, Mallery, and Kingsley 2012).

Ridesharing: Ridesharing facilitates formal or informal shared rides between drivers and passengers with similar origin-destination pairings. Vanpooling consists of 7 to 15 passengers who share the cost of the van and operating expenses and may share the responsibility of driving (Chan and Shaheen 2012).

Ridesourcing/transportation network companies: Ridesourcing services (also known as transportation network companies, or TNCs) provide prearranged and on-demand transportation services for compensation, which connect drivers of personal vehicles with passengers. Smartphone applications are used for booking, ratings (for both drivers and passengers), and electronic payment (Rayle et al. 2016).

Scooter sharing: Users gain the benefits of a private scooter without the costs and responsibilities of ownership. Individuals typically access scooters by joining an organization that maintains a fleet of scooters at various locations. The scooter operator usually provides gasoline, parking, and maintenance. Generally, participants pay a fee each time they use a scooter. Trips can be roundtrip or one-way.

Taxi services: For-hire taxi services provide prearranged and on-demand vehicle services for compensation through a negotiated price, zone pricing, or a taximeter. Trips can be made by advance reservations (booked through a phone, website, or smartphone application), street hail (by raising a hand or standing at a taxi stand or specified loading zone), or e-Hail (dispatching a driver using a smartphone application).

Source: Adapted from Shaheen, Cohen, and Zohdy 2016

or "car-sharing clubs" as a means of conserving fuel and rubber for the war effort (Chan and Shaheen 2012). A 1942 US government regulation required that employers make ride-sharing arrangements for employees to workplaces when no other alternative transportation means were available. The US Office of Civilian Defense asked neighborhood councils to encourage four workers to share a ride in one car. It also created a ridesharing program called the Car Sharing Club Exchange and Self-Dispatching System (Chan and Shaheen 2012). This system matched riders and drivers through bulletin boards at workplaces. Social groups—such as churches, homemakers, and parent–teacher associations—were responsible for forming carpools to and from various social functions.

Ridesharing re-emerged in the 1960s and 1970s as a mainstream mode, in response to the energy crisis. During this period, ridesharing evolved to include employer-sponsored commuter ridematching programs, vanpooling, high occupancy vehicle lanes, casual carpooling, and park-and-ride facilities. The 1974 Emergency Highway Energy Conservation Act allowed for federal highway funds to go to 106 carpool demonstration programs in 96 US metropolitan areas until 1977. In March 1979, the US Department of Transportation then established the National Ride-Sharing Demonstration Program with the objective of increasing ridesharing use by 5 percent (Weiner, 1992); in 1980, the US carpool modal share for work trips was 19.7 percent (US Census Bureau 1980). In addition to formal ridematching, casual carpooling (known as "slugging") began to emerge en masse in the 1970s. Today slugging exists on a large scale in three US metropolitan areas: Houston; Washington, DC, and Northern Virginia; and the San Francisco Bay Area (Chan and Shaheen 2012).

Advances in computerized ridematching during the 1980s and 1990s marked a move toward more dynamic applications in the form of telephone- and internet-based ridematching programs. Beginning in the late-1990s, private software companies began developing ridematching "platforms," providing their suite of services to clients for a monthly fee (Chan and Shaheen 2012). However, carpools formed through online ridematching tended to be somewhat static and inflexible and required prearrangement. While it was easier to find ridematches in a larger online database, these carpools still suffered from the same drawbacks as traditional carpools; namely, regular commuters lost the flexibility that private auto travel offered. New services, such as Carma and Scoop, now aim to provide more agile carpooling experiences. These online "peer-to-peer" (P2P) ridesharing services allow drivers and passengers to connect more efficiently and with short notice.

In July 2011, an online search identified an estimated 638 existing ridematching services in North America (Chan and Shaheen 2012). This tally includes both online (most have an internet-based component) and offline carpooling and vanpooling programs but does not include programs located in sparsely populated rural areas, which appeared to have a very low level of use. Institutions that have their own ridematching websites but employ a common platform were each counted separately. Of the total number of services, 401 are located in the United States and 261 are in Canada, with 24 programs in both countries.

Carsharing

One of the earliest experiences with carsharing traces its origins to a cooperative known as "Sefage" (short for Selbstfahrergemeinschaft), which began service in Zurich, Switzerland, in 1948 and remained operational until 1998 (Harms and Truffer 1998). In the 1980s, carsharing, an innovative shared mode, emerged in the United States with two formal demonstration projects. The first was Mobility Enterprise, which operated as a Purdue University research program from 1983 to 1986 in West Lafayette, Indiana. The second was the Short-Term Auto Rental (STAR) program, which operated from December 1983 to March 1985 in San Francisco. The program failed approximately halfway into its pilot for a variety of reasons, including (1) the low and inconsistent incomes of users; (2) vehicle use by non-members (e.g., roommates who shared an apartment but were not actually listed on the lease); (3) pricing that encouraged long-term use; and (4) the breakdown of its older, relatively lower-quality fleet (Shaheen, Sperling, and Wagner 1999). After these two demonstration programs, carsharing would not re-emerge in North America until the mid-1990s.

In 1994 the first formal carsharing programs launched in North America. The oldest carsharing operator is Communauto, which launched as Auto-Com in Quebec City in Canada in 1994. In the mid-1990s, a series of carsharing programs started in other major Canadian cities, including Montreal, Toronto, and Vancouver. In the United States, two small carsharing cooperatives began in 1997 in Rutlegde, Missouri, and Boulder, Colorado. Both programs are still in operation today. Although early carsharing demonstrations and programs used manual operations, the advances in telecommunications, wireless, and online technologies have resulted in the vast majority of carsharing programs today using fully automated technologies—such as automated reservations, integrated billing, and mobile apps for vehicle access.

Figure 1.3. Roundtrip carsharing services (July 2015) (Susan Shaheen and Adam Cohen)

Carsharing began to become popularized when developments in telematics technology were coupled with the launch of CarSharing Portland in 1998 (Shaheen, Sperling, and Wagner 1999). Through a series of mergers with Flexcar and, most recently, Avis-Budget Group, Zipcar evolved into one of the world's largest carsharing operators. In July 2015, 22 operators of roundtrip carsharing programs (where vehicles need to be returned to pickup locations) were providing services in 51 US metropolitan areas (Figure 1.3). These programs together had 1,172,490 members and 19,270 vehicles in the United States (Shaheen and Cohen 2016).

By the late 2000s, a number of new entrants into the carsharing industry and business models emerged. These new service providers included automakers (such as BMW's ReachNow, formerly DriveNow, and Daimler's car2go, both offering one-way service); car-rental companies (such as Avis Budget Group's Zipcar, Enterprise, and U-Haul); and non-

profit organizations (such as Ithaca Carshare and eGo Car-Share), as well as peer-to-peer programs (such as Turo, formerly RelayRides, Getaround, and Flightcar). In addition to these new market entrants, two new service models began to expand. The first, one-way carsharing, is also known as point-to-point carsharing and allows members to pick up a vehicle at one location and drop it off at another location. The second is personal vehicle sharing, or peer-to-peer carsharing. In July 2015, ReachNow and car2go were offering one-way carsharing services in 13 metropolitan areas in the United States (Figure 1.4). These service providers had 311,000 members and 4,770 vehicles (Shaheen and Cohen 2016). Figures 1.5 and 1.6 (p. 14 and p. 15) show the growth of carsharing (both one-way and roundtrip) in terms of members and vehicles between 2004 and 2015.

Personal vehicle sharing (PVS) is another carsharing service model characterized by short-term access to privately

Figure 1.4. One-way carsharing services (July 2015) (Susan Shaheen and Adam Cohen)

owned vehicles. PVS companies broker transactions between car owners and renters by providing the organizational resources needed to make the transaction possible, such as an online platform, customer support, automobile insurance, and vehicle technology. Members access vehicles through a direct-key transfer from the owner to the renter or through operator-installed in-vehicle technology that enables unattended access. There are four distinct PVS models:

1. **Peer-to-peer (P2P) carsharing** employs privately owned vehicles made temporarily available for shared use by an individual or members of a P2P company. In June 2015, there were nine active P2P operators in North America, with one more planned to start in the near future.

2. **Hybrid P2P-traditional carsharing** involves individuals accessing vehicles or low-speed modes by joining an organization that maintains its own fleet but also includes private vehicles or low-speed modes throughout a network of locations.

3. **P2P marketplace** enables direct exchanges, including pricing agreements, through an online system. The parties involved in a transaction generally decide on the terms, and disputes are subject to private resolution.

4. **Fractional ownership** allows individuals to sublease or "subscribe" to a vehicle owned by a third party. These individuals have "rights" to the shared vehicle service in exchange for taking on a portion of the operating and maintenance expenses. This enables access to vehicles that individuals might otherwise be unable to afford and results in income sharing when the vehicle is rented to non-owners. Fractional ownership can be facilitated through a dealership or a partnership with a carsharing operator.
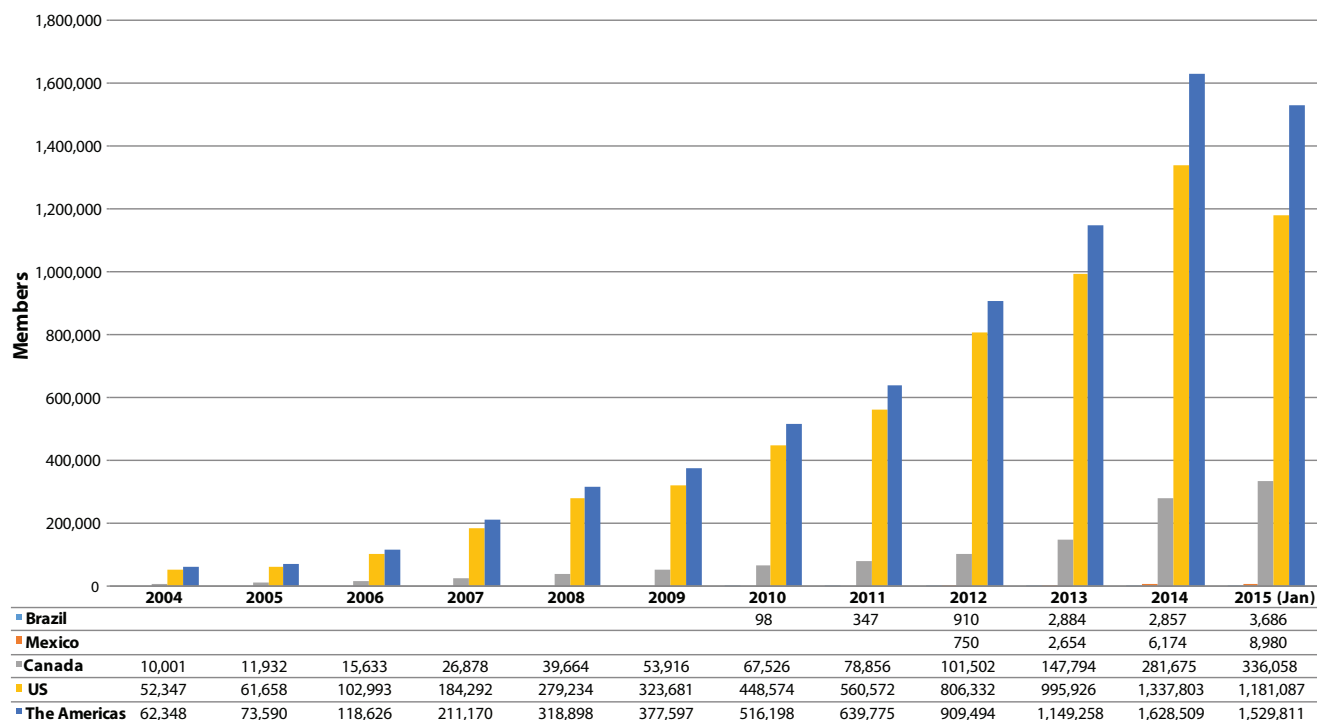
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 (Jan)
Brazil							98	347	910	2,884	2,857	3,686
Mexico									750	2,654	6,174	8,980
Canada	10,001	11,932	15,633	26,878	39,664	53,916	67,526	78,856	101,502	147,794	281,675	336,058
US	52,347	61,658	102,993	184,292	279,234	323,681	448,574	560,572	806,332	995,926	1,337,803	1,181,087
The Americas	62,348	73,590	118,626	211,170	318,898	377,597	516,198	639,775	909,494	1,149,258	1,628,509	1,529,811

Figure 1.5. Carsharing member growth in the Americas, 2004–2015 (not including peer-to-peer carsharing) (Susan Shaheen and Adam Cohen)

Fractional ownership is the newest model of personal vehicle sharing. Fractional ownership companies in the United States currently include Credit Link, Curvy Road, Gotham Dream Cars, and CoachShare. In December 2014, Audi launched its "Audi Unite" fractional ownership model in Stockholm, Sweden. Audi Unite offers multi-party leases with pricing based on vehicle model, yearly mileage, and the number of drivers sharing a car, ranging from two to five. Each Audi Unite user is given a Bluetooth key fob and uses a smartphone app that allows co-owners to schedule vehicle use.

Scooter Sharing

With scooter sharing, users gain the benefits of private scooters without the costs and responsibilities of ownership. Individuals typically access scooters by joining an organization that maintains a fleet of scooters with vehicles at various locations. The scooter operator usually provides gasoline, parking, and maintenance. Generally, participants pay a fee each time they use a scooter, and use can be roundtrip or one-way.

In September 2015, two scooter sharing systems existed in the United States: Scoot Networks in San Francisco and Scootaway in Columbia, South Carolina. Both Scoot and Scootaway offer one-way and roundtrip short-term scooter sharing; use of a scooter includes insurance and helmets. Scootaway scooters run on gasoline, which is included in the cost of the rental. Scoot Networks vehicles are electric; the company also offers electric-motorcycle sharing. Scoot launched with 60 scooters in 2012. Between 2012 and April 2014, Scoot grew to over 3,000 users and accounted for 50,000 passenger miles (Scoot 2014). Scootaway, which launched in May 2015, has a fleet of 350 scooters.

Bikesharing

There are three main types of bikesharing systems: (1) public bikesharing, (2) closed-campus bikesharing, and (3) P2P bikesharing (Shaheen and Christensen 2014). The majority of bikesharing systems in US cities are public, with anyone able to access a bicycle for a nominal fee and with a credit or debit card on file. Closed-campus bikesharing systems are increasingly being set up on university and office campuses; a system is typically only available to the particular campus community it serves. This is because the users are limited to the campus population. Closed-campus bikesharing systems are growing in popularity, along with employer and college/
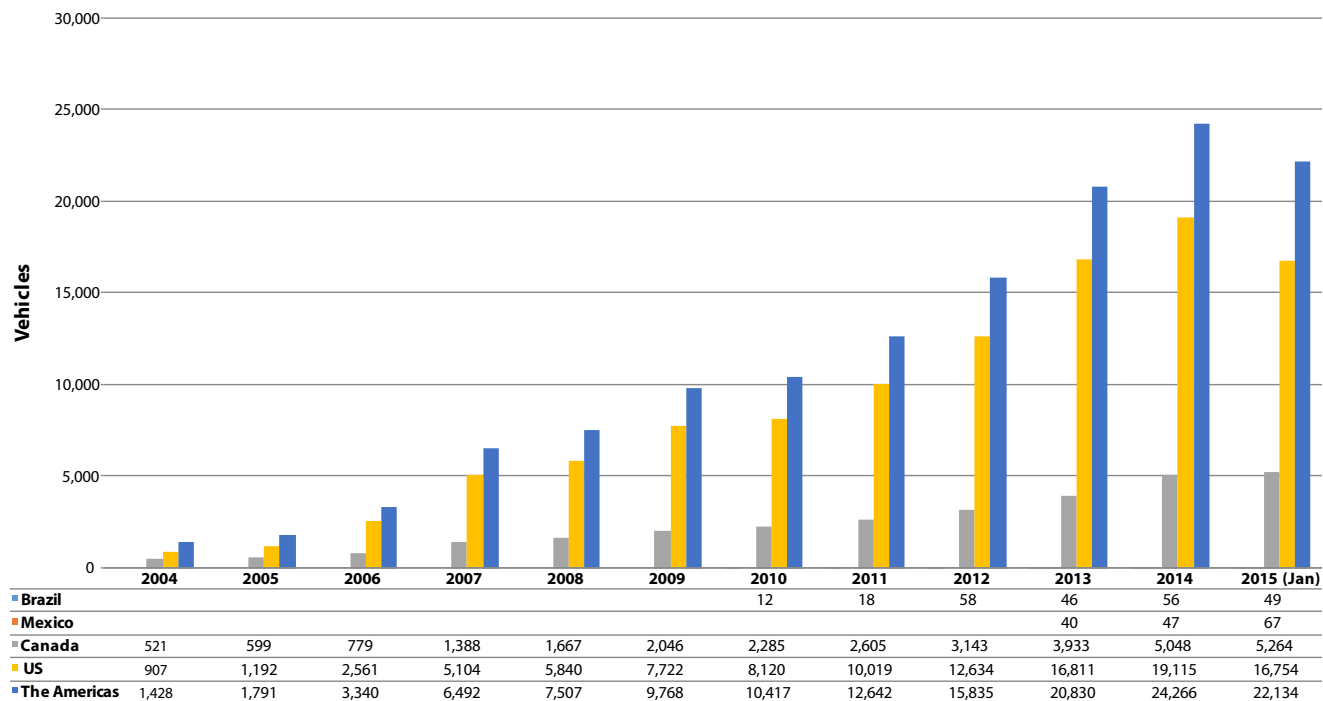
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015 (Jan)**
■ **Brazil**							12	18	58	46	56	49
■ **Mexico**										40	47	67
■ **Canada**	521	599	779	1,388	1,667	2,046	2,285	2,605	3,143	3,933	5,048	5,264
■ **US**	907	1,192	2,561	5,104	5,840	7,722	8,120	10,019	12,634	16,811	19,115	16,754
■ **The Americas**	1,428	1,791	3,340	6,492	7,507	9,768	10,417	12,642	15,835	20,830	24,266	22,134

Figure 1.6. Carsharing vehicle growth in the Americas, 2004–2015 (not including peer-to-peer carsharing) (Susan Shaheen and Adam Cohen)

university carsharing, as they provide mobility options to individuals at a campus location for trip making, individuals who might otherwise have had to rely upon a private automobile. These services can reduce parking demand, congestion, and travel time and provide health-related benefits.

P2P bikesharing services are available in urban areas where bike owners can rent out their unused bikes. This bikesharing model is growing with companies such as Spinlister and Bitlock joining the market. In 2012 Spinlister launched its P2P bicycle rental system using a smartphone application. This allowed owners to make their bikes available for short-time periods and facilitated online communication between owners and renters. The service is available in over 40 countries and provides insurance for listings in the US and Canada. In the spring of 2015, Bitlock launched an application that uses Bluetooth capabilities on smartphones to create virtual keys. The Bitlock app will also allow users to look up their bike's location on their smartphone, share the location with other users, and unlock their bicycle for other Bitlock users, enabling another form of P2P bikesharing.

An emerging innovation in shared bikes is electric bikesharing, also known as e-bikesharing (Shaheen et al. 2012).

Electric bicycles are bicycles with electric motors that assist riders and reduce the effort required, extending travel distances and enabling bikesharing in areas of steep terrain and varied topography. E-bikesharing can make it easier for older adults and people with physical limitations to use bikesharing.

Bikesharing's evolution is similar to that of carsharing, with four distinct "generations," or phases: (1) the first generation of free bikes called "white bikes," (2) the second generation of coin-deposit systems, (3) the third generation of information technology–based, or IT-based, systems, and (4) the fourth generation of demand-responsive, multimodal systems (Shaheen, Guzman, and Zhang 2010). Fourth-generation demand-responsive, multimodal systems are the next generation of IT-based bikesharing systems. They build upon the technology of third-generation systems by implementing enhanced features that support better user metrics, such as flexible, solar-powered docking stations or "dockless" bicycles; demand-responsive bicycle redistribution innovations to facilitate system rebalancing; dynamic pricing to encourage self-rebalancing; multimodal access; billing integration (e.g., sharing smartcards with public transit and carsharing systems); real-time transit in-
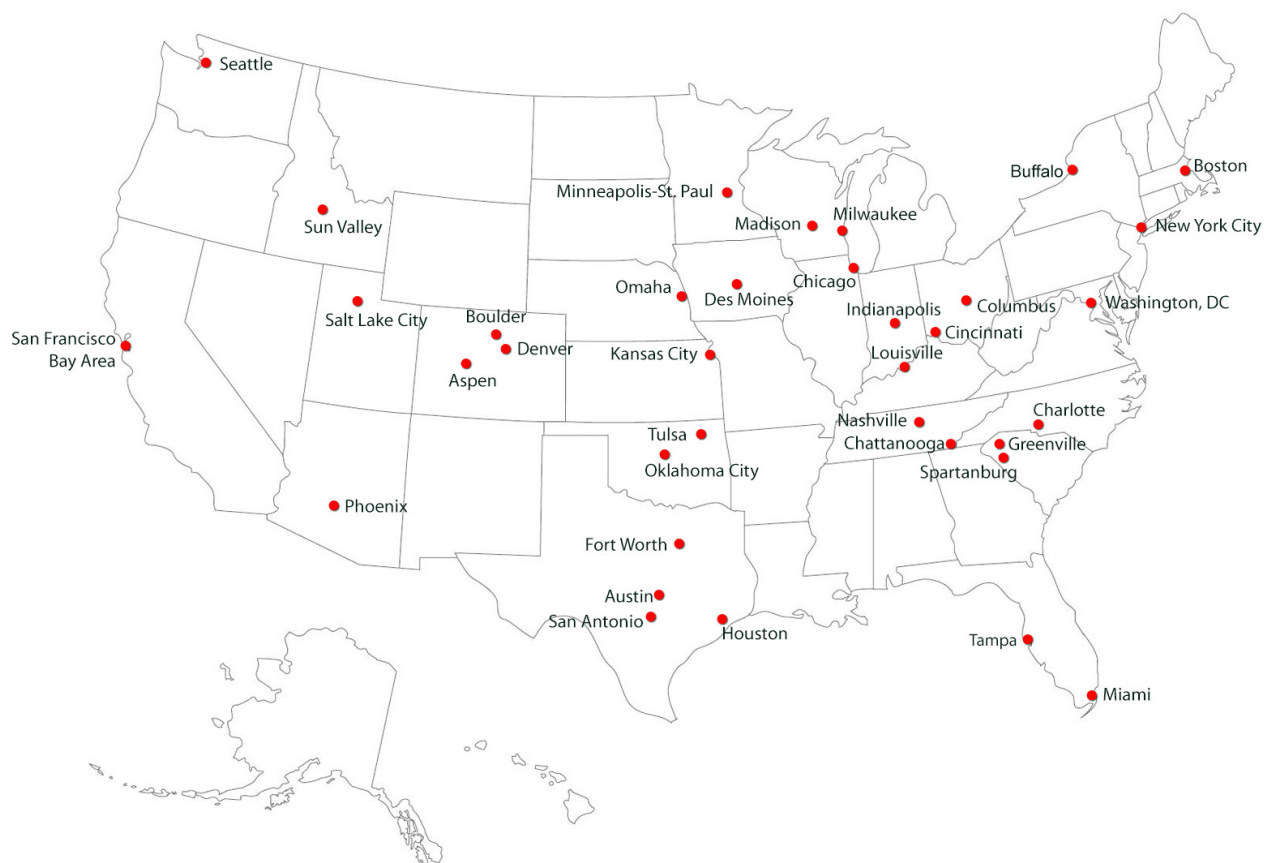
Figure 1.7. Information technology–based bikesharing programs (January 2015) (Susan Shaheen and Adam Cohen)

tegration and system-data dashboards; and GPS tracking. Fourth-generation bikesharing technologies and amenities are still evolving.

The first US bikesharing program, the Yellow Bike Project, launched with 60 bicycles in 1994 in Portland, Oregon. The program was free of charge and operated until 2001. It was followed in 1995 by the launch of the Green Bike Program in Boulder, Colorado, which was maintained by high school volunteers and made 130 bicycles available at no cost. Both of these first-generation systems eventually stopped operating because of bicycle theft (Shaheen et al. 2012). In 1997 the Twin Cities in Minnesota launched North America's first second-generation system, the Yellow Bike Hub Program. This program had greater oversight and required users to make one-time, refundable $10 deposits and sign waivers; participants also received Yellow Bike Cards. Participating businesses managed deposits and checked out bicycles. The program also allowed the deposit to be waived in exchange for two hours of volunteer time. Following the launch of the program, a number of other coin-deposit bikesharing programs were launched throughout the United States, including in Austin, Texas; Decatur, Georgia; Madison, Wisconsin; and Princeton, New Jersey. Community-based first- and second-generation bikesharing systems are still operating in the United States.

North America's first IT-based bikesharing system, Tulsa Townies, started operating in 2007 in Tulsa, Oklahoma. Tulsa Townies was the first system in the world that was solar powered and had a fully automated docking-bases system. It still provides its service free of charge (Shaheen et al. 2012). In October 2015, 87 IT-based public bikesharing programs were operating in the United States with 30,750 bicycles at 3,200 bikesharing stations. These systems typically serve one or more user groups: (1) members (users with an annual or seasonal memberships), (2) casual users (short-term bikesharing
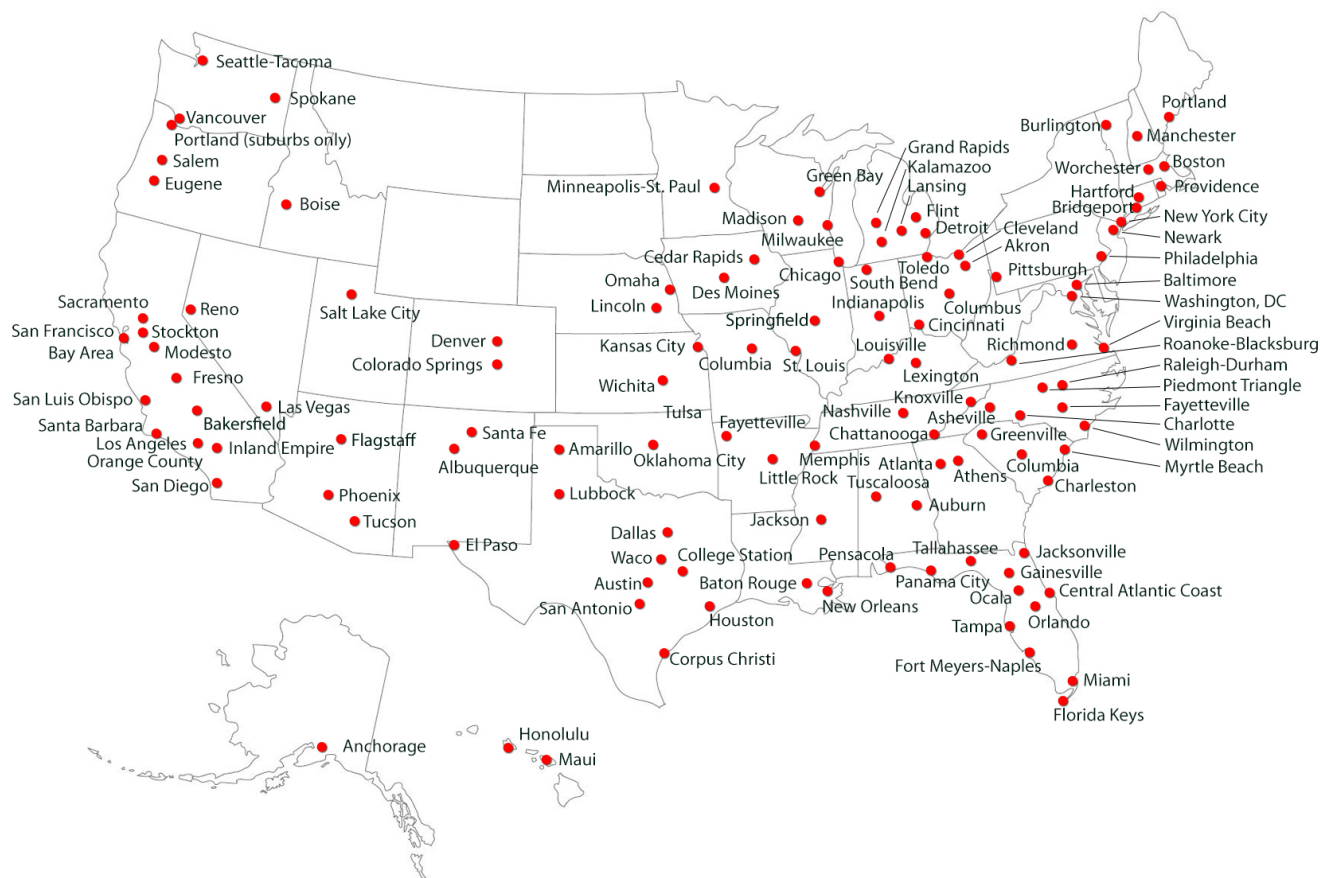
Figure 1.8. Ridesourcing services (January 2015) (Susan Shaheen and Adam Cohen)

users with 1-day to 30-day passes), and (3) occasional members (users with key fobs billed for short-term passes when swiped) (Shaheen et al. 2014). Figure 1.7 shows US cities offering IT-based public bikesharing.

Transportation Network Companies/Ridesourcing and Ridesplitting

Recent innovations in technology are enabling on-demand ridematching and for-hire vehicle services where drivers and passengers can link up using smartphone applications. In many cases, passengers can compensate drivers for fuel, parking, and other trip expenditures through these applications. Uncertainty has emerged about how to classify these programs—as taxi services or as ridesharing services—for regulatory purposes. California was the first state to regulate these for-hire vehicle services, which appeared on San Francisco streets in the summer for 2012. In 2013 the California

Public Utilities Commission coined the term "transportation network company," or TNC, to describe for-hire ride services that use drivers' private vehicles and are facilitated through smartphone apps or similar online platforms (e.g., Lyft, Uber) (California Public Utilities Commission 2016). In addition to the TNC designation, a number of public agencies also refer to these on-demand ride services as "ridesourcing" and "ride-hailing" (Rayle et al. 2016). (In this report, these services are referred to as ridesourcing.) In January 2016, various ridesourcing services were available in 175 metropolitan areas across the United States (Figure 1.8).

Ridesourcing companies introduced a new service, which this report calls "ridesplitting," in August 2014. Ridesplitting involves a person sharing a vehicle and splitting the cost of a ride acquired through a ridesourcing service with someone else taking a similar route. Lyft and Uber, through Lyft Line and UberPOOL, provide this service to match riders

with similar origins and destinations. These shared services allow for dynamic route changing as different passengers along a route request pickups in real time. Both Lyft Line and UberPOOL have experimented with "hot spots" that encourage passengers to congregate at select intersections in exchange for discounted fares—as a possible means of consolidating operations and making them more efficient (e.g., allowing drivers to make fewer turns and complete ride requests faster) (de Looper 2015).

In November 2014, Lyft launched the Driver Destination service, which enables drivers to pick up passengers along their personal trip routes—for instance, when drivers are traveling to and from work. In March 2016, Lyft launched Lyft Carpool in the San Francisco Bay Area, a service that allows commuters to pick up one rider along their route and earn up to $10 per trip (up to $400 per a month) (Lyft 2016). Ridesourcing services that encourage "pooling" and carpooling have the potential to encourage higher vehicle occupancies, reduce travel costs, and provide first-and-last-mile connectivity to public transit along routes.

E-Hail

New developments such as the launch of various taxi online applications—commonly referred to as e-Hail services— have further complicated existing public policy frameworks. Applications such as Flywheel, Gett (GetTaxi), and Easy Taxi allow a user to reserve a taxi through a smartphone, track the location and status of the cab until it arrives for pickup, and make an online payment (similar to services offered by Uber and Lyft) (Rayle et al. 2016).

Courier Network Services

In 2015 the shared mobility marketplace saw a proliferation of "courier network services," which facilitate flexible, on-demand for-hire delivery services. Service payments are handled through online applications or platforms and connect couriers using personal vehicles, bicycles, or scooters with freight, such as packages and food. Although relatively new, these services have the potential to significantly affect zoning and urban logistics. As more consumers potentially shift from in-store retail (e.g., grocery purchases) to online retail, the result could be a reduction in demand for commercial retail space and an increase in demand for industrial and warehouse uses. Two models of courier network services have emerged: (1) P2P delivery services and (2) paired on-demand passenger ride and courier services.

With P2P courier network services, any individual who signs up can use a private vehicle or bike to make deliver-

Figure 1.9. Microtransit service Via (Via Transportation)

ies. Postmates and Instacart are two P2P delivery services. Postmates couriers use bikes, scooters, and cars to deliver groceries, takeout food, and goods from any restaurant or store in a city. Postmates charges a delivery fee in addition to a 9 percent service fee based on the cost of the goods being delivered. Instacart offers a similar service, but it is limited to grocery deliveries. It charges a delivery fee of between $4 and $10, depending on the time given to complete the delivery. The second model that has emerged is one in which for-hire ride services, such as ridesourcing or pedicabs, also conduct package deliveries. Deliveries via these modes can either be made in separate trips or in mixed-purpose trips (e.g., for-hire drivers can transport packages and passengers in the same trip).

Alternative Transit Services

Alternative transit services supplement fixed-route bus and rail services and encompass a wide array of services, including shuttles, microtransit, and paratransit. These services may run along a predefined route, picking up and dropping off passengers either at designated locations or at other locations within a defined geographic area. In their most agile form, these services are often called "flexible transit services," and they have one or more of the following characteristics:

(1) route deviation (vehicles can deviate within a zone to serve demand-responsive requests), (2) point deviation (vehicles provide demand-responsive service among a limited number of stops without a fixed route between spots), (3) demand-responsive connections (vehicles operate in a demand-responsive geographic zone with one or more fixed-route connections), (4) request stops (passengers can request unscheduled stops along a predefined route), (5) flexible-route segments (demand-responsive service is available within segments of a fixed route), and (6) zone routes (vehicles operate in a demand-responsive mode along a route corridor with departure and arrival times at one or more endpoints).

Shuttles

Shuttles are shared vehicles that can connect passengers to a variety of locations. They can also act as replacement services for public transit lines undergoing repairs or maintenance. Shuttles have traditionally focused on first-and-last-mile connections, ferrying people to and from suburban residences, job centers, and public transit stations. One type of shuttle service is a distributer-circulator service, which can connect areas in urban cores that are relatively close in proximity but not within walking distance. These services are often free or low cost to riders. An example is the Emery-Go-Round, a service operating in Emeryville, California, that connects users to a Bay Area Rapid Transit station. In recent years, employer-based and privately operated shuttles have become more mainstream, supplementing traditional public transit networks. In the San Francisco Bay Area, for example, Apple, eBay, Electronic Arts, Facebook, Google, and Yahoo all offer shuttle services to employees along fixed routes in San Francisco and along the San Francisco Peninsula to their corporate campuses.

Microtransit

Microtransit refers to privately owned and operated shared transportation systems, usually made up of vans and buses, that can have fixed or flexible routes and fixed timetables or on-demand scheduling (Figure 1.9). For example, Chariot operates similar to a public transit service by running vans along predefined routes. Customers, however, can make requests for new "crowdsourced" routes that are created based on demand. Presently, Chariot operates seven predefined routes in San Francisco and plans to continue adding new routes as user demand grows and shifts. Another microtransit service, Bridj, uses millions of data points to deploy dynamic transportation routes that change based on user demand (Bridj 2016).

Paratransit

Paratransit is a transportation service for special-needs populations (e.g., disabled travelers, older adults with mobility limitations), often supplementing fixed-route bus and rail public transit service. Paratransit can include both fixed-route and more agile demand-responsive services (e.g., dial-a-ride, door-to-door services). Before the Americans with Disabilities of Act of 1990, paratransit was provided by public transit and human service agencies to maintain compliance with Section 504 of the Rehabilitation Act of 1973, which prohibited the exclusion of those with disabilities from any program or activity receiving federal assistance. The development of paratransit provided access and mobility for riders unable to navigate the public transportation system. Metropolitan planning and public transportation agencies contract many of these services to third-party operators, such as Veolia Transport, First Transit, and MV Transportation.

SHARED MOBILITY AND PLANNING

Shared mobility includes various service models and transportation modes that meet the diverse needs of travelers. Today, all of these modes—ridesharing, carsharing, bikesharing, scooter sharing, ridesourcing, e-Hail, courier network services, and alternative transit services—are having transformative effects on urban mobility and local planning. At its core, planning is the process of managing land use, urban design, and infrastructure to protect the environment, enhance livability, and guide future growth. Planning and shared mobility have a number of interdependent synergies that affect the work of professional planners and civic leaders:

- **Transportation and circulation:** Shared mobility can influence travel patterns, such as modal choice, vehicle occupancy, and vehicle miles traveled.
- **Zoning, land use, and growth management:** Shared mobility can affect land use–related planning factors, including zoning requirements (e.g., parking minimums), parking demand, and the use of public rights-of-way.
- **Urban design:** Shared mobility can support sustainability principles by promoting walkability, cycling, and public transit use, while reducing the need to own personal vehicles.
- **Housing:** Shared mobility can support affordable housing strategies by reducing the parking demand and minimum parking requirements of new developments.

- **Economic development:** Shared mobility can create new opportunities for employment and generate revenue from underused resources.
- **Environmental policy, conservation, and climate action:** Shared mobility has the potential to reduce negative impacts commonly associated with surface transportation, such as greenhouse gas emissions.

This PAS Report provides an overview of the ways in which shared mobility both can affect and is affected by urban planning and policy making. Chapter 1 was an introduction to shared mobility, including discussions of different systems and modes; their histories, evolution, and growth; and the interdependence of shared mobility and urban planning. Chapter 2 explores the impacts commonly associated with shared mobility modes, including ridesharing, carsharing, bikesharing, and for-hire vehicle services. Chapter 3 considers shared mobility policies—including those related to public rights-of-way, developer and zoning regulations, and for-hire vehicle services—in communities across the country. Chapter 4 provides recommendations to planners and policy makers about incorporating shared mobility into plans, the planning process, and local policies as well as building consensus among stakeholders. Chapter 5 concludes the report by discussing the ways planners and municipalities can support shared mobility in their communities.

While this report focuses on shared mobility and planning from the perspective of local governments, the information presented is relevant to numerous other public agencies involved in transportation and planning policy. The report provides additional resources that will be useful both to planners and others working on shared mobility issues. Appendix A (p. 76) features eight comprehensive profiles of cities with shared mobility systems: Austin, Texas; Columbus, Ohio; New York; Philadelphia; Portland, Oregon; San Francisco; Seattle; and Washington, DC. Appendix B (p. 88) provides a list of recommended readings and online resources.

THE IMPACTS OF SHARED MOBILITY

A number of social, environmental, and behavioral impacts have been attributed to shared mobility, and an increasing body of empirical evidence supports many of these relationships—although more research is needed. The various effects can be grouped into four categories: (1) travel behavior, (2) environmental, (3) land use, and (4) social. Local and regional governments commonly partner with shared mobility operators because of their role in transportation planning, public transportation, and parking policy. Local governments also have been at the forefront of addressing a number of issues that relate to shared mobility outcomes, including congestion mitigation, air quality, parking management, and multimodal integration. In recent years, climate action planning has further raised awareness among local governments of shared mobility as a transportation strategy, along with its potential impacts—both positive and negative—on the transportation network.

Insight into shared mobility can also help planners in understanding the impact of shared mobility on public infrastructure, identifying opportunities and gaps within the transportation network, achieving short-term and long-term goals, implementing policies, and informing transportation and development decisions. Understanding the roles and impacts of shared modes can aid planners in leveraging the positive impacts and taming negative impacts to achieve planning and public policy goals: reducing driving and parking congestion, lowering vehicle miles traveled and vehicle ownership rates, improving air quality, achieving climate action targets, and providing mobility access to underserved populations, such as low-income travelers. This chapter reviews findings from shared mobility studies, specifically ridesharing, carsharing, bikesharing, and ridesourcing/transportation network companies (TNCs).

DATA CHALLENGES IN UNDERSTANDING SHARED MOBILITY

Documenting the comparative impacts of shared modes can be difficult because differences in models, data collection, and study methodologies frequently produce inconsistent results based on limited survey samples and aggregate-level analyses (often attributed to proprietary issues). For these reasons, it can be challenging to provide a comprehensive and unbiased picture. While automated traveler activity data can offer a rich understanding, these data typically do not capture changes in

auto ownership, travel behavior across all modes, and respondent perceptions over time. Beyond operator surveys, many large transportation surveys have begun to assess shared mobility, including the American Community Survey and the California Household Travel Survey; however, these instruments also collect self-reported data. While travel behavior surveys have validity issues, such as respondents exaggerating travel behaviors, underreporting the extent or frequency of travel or reporting inaccurately, and sample bias, they can still offer another source of behavioral understanding.

IMPACTS OF RIDESHARING

Because ridesharing (carpooling/vanpooling) reduces the number of automobiles needed by travelers, it is often associated with numerous societal benefits, including reductions in energy consumption and emissions, congestion mitigation, and reduced parking infrastructure demand. In 1970 census data showed 20.4 percent of American workers commuted to work by carpool (Chan and Shaheen 2012). According to the American Community Survey, this figure had declined to a low of 9.2 percent by 2014; carpooling, however, still remains the second most common travel mode to work in the United States after driving alone (US Census Bureau 2014b).

A Federal Highway Administration study on ridesharing during the 1970s energy crisis surveyed 197,000 employees and found that 29,400 individuals became carpool commuters. The study also found a 23 percent reduction in vehicle

THE IMPORTANCE OF PUBLIC-PRIVATE DATA-SHARING PARTNERSHIPS

Shared mobility has begun to have a transformational impact on many cities. Not surprisingly, public policy has had to adapt quickly to many of these changes, often based on limited data and without a full understanding of the dynamics and full effects of shared mobility. While researchers have studied some individual shared modes, particularly at the aggregate level, the combined impact of these modes is not yet quantifiable. No mechanism currently exists to incorporate static and real-time shared mobility data into transportation models, plans, and network management systems. If this trend continues, it will result in ongoing uncertainty in transportation planning, investment, and operational decisions.

The synergistic relationship between shared mobility systems and smartphone applications presents new opportunities to enhance understanding of shared mobility and to incorporate this insight into local transportation planning and operations activities. The individual mobility apps of service providers and mobility aggregators (apps that provide routing, booking, and payment functions) collect an array of data points that are useful to public agencies for both static planning and analysis and real-time network management and response. Key data include information on origins, destinations, modal choice, transfer points, wait and transfer times, vehicle occupancies, journey length, and journey times. Such data can help public agencies understand how these innovative modes can help fill gaps in the transportation ecosystem. While these data are essential, public agencies must also work to protect the privacy of users and the proprietary interests of companies through transportation data analytics (e.g., data aggregation, opt-ins, encryption).

Public and private data-sharing partnerships can play a critical role in improving dynamic understanding and transportation network efficiency. For example, during the 2014 World Cup, officials in Rio de Janeiro, Brazil, shared network data—such as sensor data and construction information—with Google's Waze app in exchange for driver navigation data from Waze. These data were combined with pedestrian information from the Moovit app resulting in aggregate data on more than a 100,000 drivers and pedestrians, which allowed public agencies to identify real-time congestion, incidents, and hazards (Olson 2014).

To build upon this model, data exchanges or cloud-based portals would enable public agencies to provide data to private-sector app developers in exchange for de-identified user data. Public agencies should also consider investing in personnel and other resources to establish data standards, manage data, and develop analytic dashboards for public-agency use. Data dashboards could assist local governments in tracking real-time and historical longitudinal data metrics and impact benchmarks, such as travel behavior and app-based mobility usage.

Public-private data-sharing partnerships provide an opportunity for government agencies, app developers, and shared mobility operators to form data-sharing cooperatives that can maximize efficiency, aid in infrastructure planning and investment, and provide operational analysis and feedback to address activities such as congestion mitigation and emergency response. Furthermore, these partnerships can further collaboration on other initiatives, such as infrastructure projects that support shared mobility and other service-related transportation activities.

vehicle miles traveled (VMT) among the survey respondents (Pratsch 1979). Each year, the average passenger car and sports utility vehicle consumes an estimated 550 and 915 gallons of fuel, respectively. An estimated 33 million gallons of gasoline could be saved daily if each average commuting vehicle carried one additional passenger (PACommutes 2016). Although cost effective and environmentally conscious, ridesharing passengers must be willing to give up the flexibility and independence of single-occupancy vehicle travel and be comfortable potentially traveling with unfamiliar drivers.

Because of the lack of systematic documentation of carpooling's history and few quantitative analyses on its impacts, the magnitude of ridesharing's costs and benefits for travelers is unclear. Carpools are difficult for researchers to observe and record. As such, carpooling has often been referred to as the "invisible mode" (Paul Minett, managing director, Trip Convergence, pers. comm.). The available findings, however, do shed light on the demographic characteristics and travel behavior patterns of carpoolers.

One early study of ridesharing based on the 1977 Nationwide Personal Transportation Survey found that ridesharing participants were more likely to have lower incomes and be the "second worker" of households, typically females of households had more workers than vehicles (Teal 1987). Additionally, the study found that ridesharing users generally traveled longer commute distances and because of this had higher commute costs. More recent data from the National Household Travel Survey and the American Community Survey show that ridesharing users still tend to have lower incomes, and Hispanics and African Americans carpool more than other racial and ethnic groups. Studies indicate that ridesharing may serve an important role in enhancing mobility in low-income, immigrant, and nonwhite communities where travelers are more likely to be unable to afford personal automobiles and obtain drivers' licenses (Liu and Painter 2012.).

A more recent study of casual carpoolers (slugging users) and high occupancy vehicle (HOV) lane users in Houston, Texas, showed that these two categories of carpoolers are quite distinct. Casual carpoolers between the ages of 25 and 34 were more likely to make commute trips (96 percent) versus non-commute trips (80 percent), and they are more likely to be single or married without children. In contrast, HOV lane users tended to belong to larger households, where over 60 percent of carpools comprise family members (Burris and Winn 2006).

In the San Francisco Bay Area, commuters often use casual carpooling to get from the East Bay to downtown San Francisco during the morning commute. Carpooling, which

uses the HOV lanes of the San Francisco-Oakland Bay Bridge, allows travelers to take advantage of a toll discount and shorter waits at the toll plaza. According to a 1998 survey, approximately 6,000 riders and 3,000 drivers used casual carpooling each morning (Metropolitan Transportation Commission 1999). Only about 9 percent of these riders used the carpooling system for the reverse trip in the evening; the remainder used public transportation for the return journey. A 2011 study of casual carpooling in the Bay Area estimated a total reduction of 450,000 to 900,000 gallons of gasoline per year, the majority of this savings attributable to ridesharing's congestion reduction impact on the rest of traffic (Minett and Pearce 2011). A more recent study of Bay Area casual carpooling revealed that motivations of the 503 respondents include convenience, time savings, and monetary savings, while environmental and community-based motivations ranked low (Shaheen, Chan, and Gaynor 2016). Interestingly, 75 percent of casual carpool users were previous public transit users and over 10 percent previously drove alone.

In the Washington, DC, area, a 2006 study counted 6,459 riders and 3,229 drivers (9,688 total participants) using casual carpooling during the morning commute on a typical weekday in Virginia and the District of Columbia (Virginia 2006). A separate online survey of slugging users in Northern Virginia found that the majority, 60 percent, participated as passengers, while 12 percent were drivers and 28 percent were both passengers and drivers (Oliphant 2008). Drivers reported departure flexibility as the primary reason for driving instead of riding. The top reason for choosing to be a rider was the desire to save on the cost of gasoline, followed by a preference to do other things during the drive. The study also found that 85 percent of respondents slugged roundtrip and a large percentage of respondents had used slugging for extended periods (e.g., 40 percent of female and 45 percent of male respondents had been slugging for more than five years).

Despite the uncertain magnitude of impacts, ridesharing participants experience cost savings due to shared travel costs, travel-time savings through use of HOV lanes, and possibly reduced commute stress as the result of shared driving responsibilities. Additionally, commuters who participate in ridesharing frequently have access to preferential parking and additional incentives, such as rewards programs that provide money or gift cards for carpooling. As fleets become cleaner and more efficient, the proportion of aggregate emission reduction due to ridesharing will be lessened. However, ridesharing will continue to contribute to increased environmental awareness and remain an important strategy for congestion mitigation.

IMPACTS OF CARSHARING

A number of academic and industry studies of shared mobility have documented the impacts of carsharing, predominantly based on self-reported survey data. These studies collectively show the following commonly associated outcomes of carsharing:

- Sold vehicles or delayed or foregone vehicle purchases
- Increased use of some alternative modes of transportation (e.g., walking, biking)
- Reduced vehicle miles/kilometers traveled (VMT/VKT)
- Increased access and mobility for formerly carless households
- Reduced fuel consumption and greenhouse gas emissions
- Greater environmental awareness

One documented effect of roundtrip carsharing on the transportation system is a reduction in vehicle ownership. Several Canadian studies and member surveys suggest that between 15 to 29 percent of roundtrip carsharing participants sold a vehicle after joining carsharing programs, while 25 to 61 percent delayed or had forgone a vehicle purchase (Communauto 2000; Jensen 2001; Martin, Shaheen, and Lidicker 2010). Studies and surveys in the United States indicate that 11 to 26 percent of roundtrip carsharing participants sold a personal vehicle and 12 to 68 percent postponed or entirely avoided a car purchase (Lane 2005; Martin, Shaheen, and Lidicker 2010; Price and Hamilton 2005). For example, a study of City CarShare members in the San Francisco Bay Area found that 30 percent of members shed one or more of their own personal cars, and two-thirds chose to postpone the purchase of another vehicle after using the service for two years (Cervero and Tsai 2004). Furthermore, an aggregate-level study of 6,281 people who participated in roundtrip carsharing in the United States and Canada documented these outcomes: 25 percent of members sold a vehicle due to carsharing and another 25 percent postponed purchasing a vehicle (Martin and Shaheen 2011b). US and Canadian aggregate data also reveal that each roundtrip carsharing vehicle removes between 6 and 23 cars on average from roads (Lane 2005; Martin, Shaheen, and Lidicker 2010; Zipcar 2005). Martin and Shaheen (2011b) concluded that one carsharing vehicle replaces 9 to 13 vehicles among carsharing members (on average across this aggregate-level study). According to European studies, a carsharing vehicle reduces the need for 4 to 10 privately owned vehicles on average (Stockholm 2005).

Similar to roundtrip carsharing, studies of one-way carsharing have also documented a reduction in vehicle ownership. A study of station-based one-way carsharing participants in France found a 23 percent reduction in private-vehicle ownership after joining Autolib' (6t 2014). The study also found that each Autolib' vehicle removed three private vehicles on average from the road. A recent study of free-floating one-way carsharing members across five cities in the United States and Canada found that 2 to 5 percent of participants sold a vehicle after joining carsharing and 8 to 10 percent on average delayed or had foregone a vehicle purchase (Martin and Shaheen forthcoming). This study also found that each free-floating one-way carsharing vehicle removed 7 to 11 vehicles on average from the road in the cities studied (see Table 2.1, p. 29).

Roundtrip and one-way carsharing also has a notable impact on modal shift. Studies have examined the impact of roundtrip and one-way carsharing on public transit and non-motorized travel (Martin and Shaheen 2011b, 2016). While they found a slight overall decline in public transit use, carsharing members exhibited an increase in use of alternative modes, such as walking. Table 2.2 (p. 30) shows the mode shifts for free-floating one-way carsharing, and the tables in Appendix C (p. 93) show shifts for free-floating one-way carsharing in five North American cities. Location-specific variations—including urban density, public transit service and availability, sociodemographics, and cultural norms—contribute to these modal shifts, and they are likely to result in differences in impacts.

The French national survey comparing roundtrip and station-based carsharing showed differing impacts on modal shift (6t 2014). The study found that both forms of carsharing reduced private-automobile use, with roundtrip carsharing having a greater reduction effect. Interestingly, roundtrip carsharing slightly increased public transit use, whereas station-based one-way carsharing reduced it. While the study found that both forms of carsharing reduced private-bicycle use, roundtrip carsharing increased bikesharing ridership.

A reduction in vehicle ownership may result in lower VMT, reduced traffic congestion and parking demand, and an increase of other transport modes (such as biking and walking) in lieu of car travel. Carsharing is thought to lead to lower VMT by emphasizing variable driving costs, such as per hour and/or mileage charges (Shaheen, Cohen, and Roberts 2006). Reductions range from as little as 7.6 percent to as much as 80 percent of a member's total VMT on average in Canada and the United States for roundtrip car-

MEASURING THE IMPACTS OF CARSHARING: SURVEY DATA

Carsharing has succeeded because it provides consumers with enhanced mobility or it provides sufficient mobility at reduced costs. The reduction in costs drives most of the emissions and fuel-use reductions, with travel substitutions replacing private-vehicle use. Carsharing fundamentally changes the cost structure of driving from a fixed cost to a variable cost. Because carsharing involves substituting "driving with driving" (from use of a private auto to use of a shared vehicle), measurement of the magnitude of these driving changes is necessary to assess carsharing's fundamental impacts. This is challenging, however, because carsharing participants are not known until they join a program. Among the carsharing member population, researchers need to know (1) how individuals traveled before they started carsharing and how their modal behaviors changed due to carsharing (e.g., postponed vehicle purchase) and (2) how individuals would have traveled in the absence of carsharing.

The use of data from national, state, and regional travel surveys to evaluate shared mobility impacts is currently less feasible for two reasons. First, these surveys are generally snapshots of activity over large areas that may or may not have a robust range of shared mobility services. They generally lack the longitudinal structure that would span the period before and after a person begins using a system. Second, the subsample of people in a large survey, such as the National Household Travel Survey, using shared mobility services is relatively small, and the time between such surveys can be years. In addition, the same respondents are rarely included in follow-up surveys. Because of these factors, use of national and regional surveys to evaluate household-level changes in behavior resulting from shared mobility is limited at present and is likely to remain so at least into the near future.

The effects of carsharing are challenging to measure without some type of member survey that asks participants directly about modal shifts. Activity data can only tell researchers how individuals used a particular shared mode rather than changes in their overall travel behavior. Survey respondents, however, are best positioned to report the impacts that carsharing has had on their lives. These data help researchers understand an individual's travel lifestyle before joining a carsharing program, including miles driven in personal vehicles. In addition, the shifts that users make as a result of carsharing are different for different people. Many individuals will invariably drive marginally more after they start carsharing and have access to cars while others will drive substantially less as use of an auto becomes one of necessity rather than convenience. For some people, the impact of carsharing on their lives is inconsequential. For others, carsharing plays a central role in facilitating lifestyle changes, such as increased mobility and reduced fuel consumption and emissions. The member survey, although not exact, is a key instrument for obtaining these before-and-after measures. Despite advances in technology that improve measurement of travel behavior, surveys will likely continue to play a fundamental role in assessing the causal factors related to changes in travel behavior as the result of shared mobility.

THE IMPACTS OF ROUNDTRIP CARSHARING

Between September and November 2008, Martin and Shaheen (2010) conducted an online survey of the impacts of roundtrip carsharing across 11 North American programs (four Canadian and seven US operators). A total of 6,281 respondents were included in the final data set. Overall, 9,635 surveys were completed, which constituted a response rate of approximately 10 percent. A raffle incentive was offered to encourage survey response. This incentive was a $100 credit to the respondent's carsharing account.

The survey asked respondents key questions about the lifestyles of their households, including annual vehicle miles traveled (VMT) using personal household vehicles (if any) and travel on non-motorized modes and public transportation, during the year before they joined carsharing. The survey then asked respondents to report on the same annual parameters at the time of survey completion. To evaluate vehicle holdings, the survey collected the make, model, and year of each vehicle in the household before joining carsharing and again at the time of the survey. Finally, the survey asked whether members would have purchased a vehicle in the absence of carsharing to evaluate whether members viewed carsharing as a replacement or substitute for a vehicle.

One limitation of the self-reported information from the survey is that respondents may have exaggerated or underreported the amount of travel in their households or they may have failed to properly recall the travel details covered in the survey. Furthermore, this study did not include a control group due to budget limitations. Results are reported at the aggregate level rather than for cities or regions due to data

agreements with the participating companies, which required data aggregation for proprietary reasons.

The study found that each roundtrip carsharing vehicle results in 9 to 13 vehicles on average taken off the road—including sold and postponed auto purchases (Martin, Shaheen, and Lidiker 2010). When taking into account carless households that joined carsharing, an aggregate analysis suggests that these carsharing programs have collectively taken between 90,000 and 130,000 vehicles off the road.

Martin and Shaheen (2011b) found that roundtrip carsharing had a neutral to negative impact on public transit ridership. For every 5 members that used rail less, 4 used rail more, and for every 10 members that took the bus less, almost 9 took it more. The study also found a positive impact on non-motorized modes and carpooling, with more roundtrip carsharing members increasing walking, biking, and carpooling use than decreasing it. Respondents reduced their average annual greenhouse gas emissions per household by 0.58 metric tons for the observed impact (based on vehicles sold) and 0.84 metric tons for the full impact (based on vehicles sold and postponed purchases combined). This is the equivalent of a 34 to 41 percent decline on average in greenhouse gas emissions per household (Shaheen and Chan 2015).

Carsharing can result in both increased and decreased and VMT. Carsharing increases emissions and VMT by providing automotive access to households that were previously carless. Average observed VMT declined 27 percent across the entire sample due to households that owned a vehicle prior to carsharing. Although some households may increase their automobile use, they

also obtain access to a shared mode previously unavailable. Carsharing also reduces emissions by permitting households that were more reliant on personal vehicles to use automobiles in a more cost-conscious and efficient manner. Many households discard or shed one or more personal vehicles when obtaining a carsharing membership, and they adapt to a new travel lifestyle characterized by shifts to lower-impact modes and reduced reliance on personal vehicles, a change facilitated by shared mobility.

THE IMPACTS OF FREE-FLOATING ONE-WAY CARSHARING

An online survey of the impacts of free floating one-way car2go carsharing users was conducted between September 2014 and September 2015 in five US and Canadian cities (Calgary, Alberta; San Diego; Seattle; Vancouver, British Columbia; and Washington DC) with 9,497 completed responses (Martin and Shaheen 2016). Respondents in each city had a chance to win one of ten $50 Amazon gift cards in order to increase survey response.

The survey asked questions about vehicle holdings, the sale of vehicles, and foregone vehicle purchases as the result of carsharing. This survey methodology differed from the roundtrip carsharing survey conducted almost a decade early (Martin and Shaheen 2011a, 2011b; Martin, Shaheen, and Lidicker 2010). In this study, researchers screened inconsistent responses that conflicted with operator-provided activity data (actual usage). Activity data were also used to screen active users (car2go use more than once per month). Additionally, the data were disaggregated by city, which allowed for analysis across cities. The survey was initially administered in San Diego in September 2014 in partnership with the San Diego Association of Governments and the Federal Highway Administration. This study did not include a control group due to budget limitations.

The study found that each free-floating one-way carsharing vehicle resulted in the removal of 7 to 11 vehicles on average from the road, including vehicles sold and foregone and postponed vehicle purchases (Table 2.1). However, the number of vehicles shed or suppressed varied considerably by metropolitan region. When accounting for carless households that joined carsharing, free-

TABLE 2.1. VEHICLE IMPACTS FROM FREE-FLOATING ONE-WAY CARSHARING

City	Vehicles Shed (sold)	Vehicles Suppressed (foregone purchases)	Total Vehicles Removed per Carsharing Vehicle	Range of Vehicles Removed per Carsharing Vehicle
Calgary, AB (n=1,498)	2	9	11	2 to 11
San Diego, CA (n=824)	1	6	7	1 to 7
Seattle, WA (n=2,887)	3	7	10	3 to 10
Vancouver, BC (n=1,010)	2	7	9	2 to 9
Washington, DC (n=1,127)	3	5	8	3 to 8

Source: Martin and Shaheen 2016

floating one-way carsharing removed 28,703 vehicles from the road across the five study cities. (The number of vehicles removed reflects an estimate based on the operator's 2015 fleet size across the cities surveyed.)

In four of the five cities surveyed, a majority of respondents stated that one-way carsharing had no impact on their public transit use. For those respondents who used transit less, the primary reason was that one-way carsharing is faster. Those respondents using public transit more reported the primary reason was the first-and-last-mile connectivity that carsharing provides. A majority of respondents said that one-way carsharing did not affect their walking frequency. Those that were affected reported walking much more often. Generally one-way carsharing had a relatively neutral impact on ridesourcing and ridesharing. In Seattle and Washington, DC, respon-

dents reported using ridesourcing less as the result of one-way carsharing. Finally, one-way carsharing reduced the use of taxis in all cities surveyed.

Reductions in customer vehicle miles traveled ranged from 6 to 16 percent on average across the car2go population. Correspondingly, reductions in greenhouse gas emissions ranged from 4 percent (Calgary) to 18 percent (Washington, DC) on average. In four cities (Calgary, Seattle, Vancouver, and Washington, DC), respondents indicated that the most important factors in deciding whether to use carsharing services were free parking, closely followed by the availability of parking and no parking time limits. This suggests that parking cost and convenience are key factors in encouraging carsharing use and in reducing on net private-vehicle ownership, vehicle miles traveled, and greenhouse gas emissions.

TABLE 2.2. AGGREGATE SHIFT IN PUBLIC TRANSIT AND NON-MOTORIZED MODES (ROUNDTRIP CARSHARING)

	Average Hours per Week			Round Trips per Week		
	Decreased	No Change	Increased	Decreased	No Change	Increased
Rail	589 (9%)	5198	494 (8%)	571 (9%)	5226	484 (8%)
Bus	828 (13%)	4721	732 (12%)	783 (12%)	4794	704 (11%)
Walk	568 (9%)	4957	756 (12%)	559 (9%)	5046	676 (11%)
Bike	235 (4%)	5418	628 (10%)	219 (3%)	5480	582 (9%)
Carpool	99 (2%)	5893	289 (5%)	86 (1%)	5932	263 (4%)
Ferry	13 (0%)	6262	6 (0%)	14 (0%)	6259	8 (0%)

Source: Adapted from Martin and Shaheen 2011b

sharing; estimates differ substantially between members who gave up vehicles after joining carsharing programs and those that gained vehicle access through carsharing (City CarShare 2004; Cooper, Howes, and Mye 2000; Lane 2005; Zipcar 2005). European studies of roundtrip carsharing also indicate a large reduction in VMT ranging from 28 to 45 percent on average (Shaheen and Cohen 2007). Martin, Shaheen, and Lidicker (2010) also documented roundtrip carsharing reductions in VMT from 27 to 43 percent in the United States and Canada. One-way studies have also documented reductions in VKT/VMT. The study of one-way station-based carsharing in France documented an 11 percent reduction in VKT (6t 2014). A recent study of free-floating one-way carsharing in the United States and Canada found VMT reductions ranging from 6 percent (in Calgary, Alberta) to 16 percent (in Vancouver, British Columbia, and Washington, DC) (Martin and Shaheen 2016). This percentage reduction considers an estimate of the total driving by households on average, as derived from annual VMT responses and broader reductions in driving computed for the population.

Not surprisingly, reduced vehicle ownership rates and VMT lead to lower greenhouse gas emissions levels, as trips are shifted to other modes. In Europe, carsharing is estimated to reduce the average user's carbon dioxide emissions by 40 to 50 percent (Rydén and Morin 2005). In an aggregate study across North American cities, Martin and Shaheen (2011a) estimated an average greenhouse gas emission reduction of 34 to 41 percent per household or an average reduction of 0.58 to 0.84 metric tons per household for roundtrip carsharing.

Recent studies of free-floating one-way carsharing estimate that each car2go vehicle reduced greenhouse gas emissions by 4 percent (Calgary) to 18 percent (Washington, DC) on average (Martin and Shaheen 2016). In addition, many carsharing organizations include low-emission vehicles—such as electric, plug-in hybrid, and gasoline-electric hybrid cars—in their fleets; use of these types of vehicles can result in additional decreases in greenhouse gas emissions. Carsharing members also report a higher degree of environmental awareness after joining a carsharing program (Lane 2005).

Finally, empirical evidence demonstrates that carsharing has a range of beneficial social impacts. Households can gain or maintain access to vehicles without bearing the full costs of car ownership. Depending on the location and the organization operating the carsharing program, the maximum user mileage where carsharing is more cost effective (in comparison to owning or leasing a personal vehicle) is between 6,200 to 10,000 miles (Shaheen, Cohen, and Roberts 2006). Low-income households and college students can also benefit from participation in carsharing programs. Numerous studies of roundtrip carsharing in North America have found that carsharing households saved an average of $154 to $435 per month when compared to their private-vehicle use expenses (Shaheen, Mallery, and Kingsley 2012). Businesses can also enroll in carsharing and provide mobility options for their employees. A recent study of Zipcar for Business members showed that two in five members sold or avoided buying a vehicle due to joining Zipcar through their employers (Shaheen and Stocker 2015).

IMPACTS OF BIKESHARING

Although before-and-after studies documenting public bikesharing benefits are limited, a few North American programs have conducted user surveys to record program outcomes. Early documented impacts of bikesharing include increased mobility, reduced greenhouse gas emissions, decreased automobile use, economic development, and health benefits. Bikesharing can be integral in bridging first-and-last-mile gaps in the transportation network and encourage multimodal trips. Studies indicate that bikesharing can also enhance mobility, reduce congestion and fuel use, lower emissions, and increase environmental awareness. (See Shaheen et al. 2014 for more information on the impacts of bikesharing beyond what is discussed in the following sections.)

Boston's Hubway system recorded over 1.5 million trips from its launch in July 2011 through June 2014 (Hubway 2016). In its first six months, Citi Bike in New York recorded nearly six million trips and approximately 11 million miles traveled (Citi Bike 2016). In 2011 the number of Denver BCycle riders increased by 30 percent, and the number of rides taken increased by 97 percent compared to the previous year (Figure 2.1) (Denver Bike Sharing 2012). Hubway data from Boston show a carbon offset of 285 tons since public bikesharing began in July 2011 (Hubway 2016). Emissions reduction estimates, however, can vary substantially across studies due to different study methodologies for measuring and analyzing user behavior, modal shifts, trip distribution, and trip substitution—factors that influence carbon dioxide reduction.

By addressing the storage, maintenance, and parking aspects of bicycle ownership, public bikesharing enables cycling among users who might not otherwise use bicycles. Additionally, the availability of a large number of bicycles in multiple dense, nearby locations frequently creates a "network effect," where bicycles in close proximity add value to bikesharing and encourage its use for trip purposes, such as commuting and errands (Shaheen et al. 2014). A 2008 study found that 89 percent of Vélib' users reported that the program made it easier to travel through Paris (Vélib' 2012). Among Nice Ride Minnesota users, 59 percent said that they most liked the "convenience factor" of their program (Shaheen, Cohen, and Martin 2013). In addition to bikesharing's impact on emissions and modal shifts, bikesharing also has had measurable effects on economic activity, health, helmet use, and safety.

Public Transportation and Auto Use

Research has shown that public bikesharing typically reduces driving and taxi use while increasing cycling in most

Figure 2.1. Denver BCycle (BCycle)

cities (Shaheen et al. 2012; Shaheen et al. 2014). One study found that half of all bikesharing members report reducing their personal automobile use (Shaheen et al. 2014). An online survey of annual bikesharing members was conducted between November 2011 and January 2012. Respondents were annual bikesharing members and 30-day subscribers in four cities: (1) Montreal, Quebec (n=3322), (2) Toronto, Ontario (n=853), (3) Washington, DC (n=5248), and (4) the Twin Cities (Minneapolis-Saint Paul) in Minnesota (n=1238), with an overall response rate of about 15 percent. Respondents in each city were entered into a raffle drawing for $50 to increase survey response.

In Minneapolis-Saint Paul, more people shifted toward rail (15 percent) than away from it (3 percent) in response to bikesharing. For walking, more respondents shifted toward walking (38 percent) than away from it (23 percent) in response to bikesharing. However, the study found a slight decline in bus ridership: 15 percent of respondents increased their use of buses compared to 17 percent that decreased it. In Washington, DC, more people in response to bikesharing shifted away from rail (47 percent) than to it (7 percent), and more respondents shifted away from walking (31 percent) than to it (17 percent). Similar to the Twin Cities, the study also found a decline in bus ridership, with just 5 percent of respondents increasing bus ridership compared to 39 percent that decreased it.

A geospatial analysis of this study data involved mapping modal shifts and found that shifts away from public transportation were most prominent in urban environments within high-density urban cores. Shifts toward public transportation in response to bikesharing tended to be more prevalent

BIKESHARING AND HELMET USE

Experts and users generally perceive helmet laws as an obstacle to public bikesharing use because of the inconvenience associated with carrying a helmet, the lack of availability for last-minute trips, and the challenges associated with providing sterile shared helmets. Three North American programs are in jurisdictions that require helmet use: Vancouver Bike Share in Vancouver, British Columbia; Golden Community Bike Share in Golden, British Columbia; and Pronto Cycle Share in Seattle. In the summer of 2016, the Vancouver Bike Share program launched. It provides helmets to users to comply with British Columbia's mandatory helmet law. Golden Community Bike Share provides a complimentary helmet with each bike rental, and Pronto Cycle Share offers helmet

rentals at its stations. Many operators sell helmets through central locations or offer them for purchase when members join the program (e.g., Capital Bikeshare, Hubway). In addition, many offer helmets through partnerships with local bike stores and provide discounts on helmet purchases.

According to a study by Buck et al. (2013), only 6 percent of short-term Capital Bikeshare users (in the Washington, DC, area) wore helmets, while 37 percent of annual users wore helmets. Shaheen et al. (2012) conducted a member survey in 2011 of four North American public bikesharing programs and found that the majority of respondents never wear helmets. In Montreal, Quebec, 62 percent of respondents indicated that they never wear helmets while bikesharing com-

pared to 50 percent in Minneapolis-Saint Paul, Minnesota; 45 percent in Toronto, Ontario; and 43 percent in Washington, DC. The survey also found that helmet use ranged between 20 and 38 percent while using bikesharing (Shaheen et al. 2012). In a follow-up study, Shaheen et al. (2014) conducted another bikesharing member survey in Montreal; Toronto; Minneapolis-Saint Paul; Salt Lake City, Utah; and Mexico City in 2013 with similar helmet use results. The percentage of respondents who reported never wearing helmets was 74 percent in Mexico City, 54 percent in Montreal, 46 percent in Toronto, and 42 percent in Minneapolis (Figure 2.2). In contrast, members of GREENBike SLC in Salt Lake City reported a notably different pattern of helmet use. Only 15 percent of respondents reported never wearing a helmet, while 40 percent reported always wearing one.

To understand this issue further, Shaheen et al. (2014) asked additional questions to respondents who did not report always wearing a helmet, in order to get insight into why helmet usage was not higher. The first question asked respondents whether they owned a helmet. The responses showed distributions that may partially explain the relative magnitude of the "never" responses shown in Figure 2.2. Mexico City, where respondents reported the lowest rate of helmet use, had the lowest helmet ownership level, with only 34 percent of respondents stating they owned a helmet. Montreal, which reported the second lowest rate of helmet use, also had the second lowest ownership level, 66 percent. Similarly, Toronto, with the third lowest rate of helmet use, also reported the third lowest helmet ownership level, and Minneapolis-Saint Paul exhibited a just slightly higher rate of helmet use
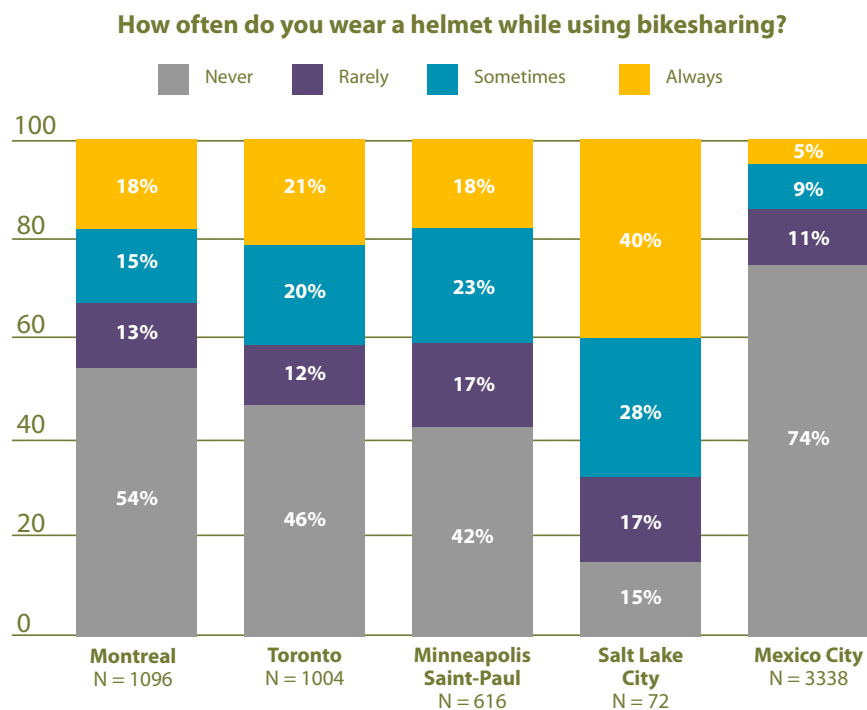
How often do you wear a helmet while using bikesharing?

Figure 2.2. Helmet use while using public bikesharing (Shaheen et al. 2014)

than Toronto and showed just higher helmet ownership rates. Finally, respondents in Salt Lake City reported near universal helmet ownership. While helmet ownership clearly does not ensure helmet use while bikesharing, it is a necessary prerequisite to regular use and suggests that a relationship exists between the two factors (Shaheen et al. 2014).

Respondents who did not always wear a helmet were asked to describe the main reason why they did not. Respondents in four of the five surveyed cities indicated that the most common reason for not always wearing a helmet was the unplanned nature of bikesharing trips. The second most common response was that users did not like carrying a helmet around. The distribution in Mexico City was slightly different, with the top response being "I never wear a helmet" followed by "unplanned use" and "do not like carrying a helmet." Notably, 13 percent of respondents reported that the lack of helmet ownership was a key inhibitor to using one, whereas far fewer respondents cited this reason in the other cities (Shaheen et al. 2014).

For those respondents that simply answered "I never wear a helmet while riding any bicycle," the survey probed even further to understand why. Overall, most responses indicated that people who never wear helmets do so more by choice than constraint. Other responses offered to respondents included "helmets are uncomfortable," "helmets mess up my hair," and "helmets do not look good on me." When aggregated together, these "choice-based" responses made up over 60 percent of the responses in the cities in the United States and Canada, and 45 percent of responses in Mexico City. Responses based on helmet availability ranged between only 15 percent and 30 percent of responses in the United States and Canada and 42 percent in Mexico City (Shaheen et al. 2014).

in lower-density regions on the urban periphery. This early study of North American bikesharing indicates that public bikesharing may serve as a first-and-last-mile connector in smaller metropolitan regions with lower densities and less robust transit networks. The findings also suggest that in larger metropolitan regions with higher densities and more robust public transit networks, public bikesharing may offer faster, cheaper, and more direct connections compared to short-distance transit trips. In addition, public bikesharing may be more complementary to public transportation in small and medium metropolitan regions and more substitutive in larger metropolitan areas, perhaps providing relief to crowded transit lines during peak periods (Martin and Shaheen 2014).

Economic Activity

An email survey of monthly and annual Nice Ride Minnesota subscribers focused on understanding the economic impacts of bikesharing (Schoner 2012). The survey was sent to 3,693 subscribers, with 1,197 responses and a response rate of 30 percent. The survey findings show that users spent an average of $1.25 per week on new economic activity that would likely have not occurred without the bikesharing system; this resulted in approximately $29,000 of new economic activity per season in the Twin Cities. Respondents reported increased spending primarily at food-related destinations, including sit-down restaurants, coffee shops, bars and nightclubs, and grocery stores. The findings suggest that bikesharing stations increase accessibility to station areas, users may alter destinations or make additional trips, and users spend more money in the immediate vicinity around bikesharing kiosks.

Health Impacts

In addition to the economic impacts of bikesharing, a number of programs have also documented health impacts. Boston's Hubway estimated that in the first two years of operation, between July 2011 and July 2013, users expended 40 million calories riding on its bicycles (Hubway 2013). Similarly, Citi Bike in New York determined its users burned 50 million calories just in the first month of operation (Citi Bike 2016). Capital Bikeshare in Washington, DC, reported that its users expended almost 90 million calories between September 20, 2011, and September 20, 2012 (Capital Bikeshare 2016). Capital Bikeshare, along with researchers at George Washington University, conducted a user survey in the fall of 2012, primarily focused on the system's health benefits (Alberts, Palumbo, and Pierce 2012). Of the over 3,100 responses, 31.5 percent reported reduced stress and about 30 percent indicated they lost weight due to using Capital Bike-

share. However, a key limitation of these bikesharing health impact assessment studies is that they do not examine potential negative health impacts associated with ridership, such as the costs associated with increased exposure and risk related to injuries and collisions.

An important fact to note is that annual crash rates are relatively low among North American public bikesharing operators, averaging 1.36 accidents reported per operator systemwide in 2011 (Shaheen, Cohen, and Martin 2013). Bikesharing crashes are tracked in one of three ways: (1) total number of crashes annually, program wide, (2) number of crashes per number of rides, and (3) number of crashes per distance of bikesharing use. Differences in data collection, however, make it difficult to compare bikesharing crash rates among operators. Shaheen et al. (2013) interviewed 19 public bikesharing operators in North American in 2011 to 2012. One operator reported a crash rate of approximately one incident for every 50,000 to 60,000 rides, and another noted one crash approximately every 100,000 miles of riding. Operators with more than 1,000 bicycles reported an average of 4.33 crashes per year, those with between 250 and 1,000 bicycles averaged 0.6 reported crashes a year, and those with fewer than 250 bikes reported 0.3 crashes per year (Shaheen, Cohen, and Martin 2013). The first US bikesharing fatality, which involved a collision with a truck, was reported in July 2016 in Chicago (Bauer 2016).

Safety

A recent study of bikesharing safety in the San Francisco Bay Area, Minneapolis-Saint Paul, and Washington, DC, using data on bicycle and bikesharing activity and bicycle collisions found that the number of bicycle collisions was generally rising in bikesharing regions, but this increase was very likely due to a growth in bicycle activity in all regions (Martin et al. 2016). For example, between 2006 and 2013, the estimated number of people commuting to work by bicycle in Washington, DC, increased 162 percent, while bicycle collisions increased 121 percent. In San Francisco, the estimated number of bicycle commuters increased 98 percent and collisions increased 40 percent over this same period. Only in Minneapolis-Saint Paul were collisions relatively flat (a 1 percent increase), while bicycle commuters increased an estimated 65 percent.

The issue of comparative safety is complicated by the question of whether or not the use of bikesharing actually increases overall transportation safety. If trips were diverted from automobiles, buses, or rail, then the risk to individual bikesharing users as well as overall transportation safety

could be expected to increase—based on statistics comparing the per-trip fatality rates of bicycle riding to travel by car, bus, or train. Aside from relatively low helmet usage, experts interviewed as part of this study generally believed that bike-sharing bicycles were safer than their road-bike counterparts because the bikes are generally painted bright colors and ride slower than road bikes—both because of the added weight from larger and heavier frames and because the bikes are often engineered with fewer gears, which then limit speeds (Martin et al. 2016)

IMPACTS OF RIDESOURCING/TRANSPORTATION NETWORK COMPANIES AND TAXI SHARING

On-demand ride services—also known as ridesourcing, transportation network companies (TNCs), or ride-hailing—use smartphone applications to connect community drivers with passengers (Figure 2.3). The following discussion refers to these services as ridesourcing.

Studies on the impacts of ridesourcing are limited, particularly the effects of these innovative services on core transportation modes (e.g., taxis, public transportation). However, ridesourcing services are believed to have the following impacts:

- Increasing access and mobility for non-vehicle owners
- Increasing for-hire vehicle service availability, particularly in the evenings and on weekends, and in smaller markets where taxi service is limited or unavailable

Figure 2.3. Lyft rideharing app (Lyft)

- Affecting labor in various ways, including increased employment opportunities and varying upward and downward wage pressures (when accounting for hourly rates, app fees, employee versus independent contractor status, and worker benefits)

The impacts of ridesourcing on vehicle trips, vehicle occupancy, VMT, greenhouse gas emissions, and other transportation modes have not been extensively studied and are not well known. The following sections review several areas of research on this topic, including the impacts of ridesourcing on labor, trip purpose and auto use, and ridesplitting and ridesharing.

Labor Impacts

The growth of the sharing economy has disrupted traditional economic models, allowing private individuals to commercialize previously underused personal use assets. Debates about the impact of ridesourcing on labor often focus on whether the drivers are classified as employees or independent contractors, whether drivers should be provided benefits, and the impact of ridesourcing on wages (both of ridesourcing drivers and complementary and competitive industries). Research and the existing literature on this topic are still minimal, and labor-related issues and outcomes continue to emerge.

However, one study analyzing the for-hire vehicle labor market identified various demographic trends associated with Uber drivers compared to their taxi-livery driver counterparts (Hall and Krueger 2015). This study found that 19 percent of Uber drivers were under 30 years of age compared to just 9 percent of taxi and livery drivers. Only 22 percent of Uber drivers were ages 50 to 64 compared to 37 percent of taxi drivers and chauffeurs. The study also found that women make up a higher percentage, 14 percent, of Uber's workforce compared to the taxi-chauffeur sector, where women account for 8 percent of the labor force. Although this is less than the share of women in the workforce overall, this suggests that perhaps ridesourcing may provide benefits that attract women, such as schedule flexibility.

Trip Purpose and Auto Use

A recent study of 380 ridesourcing users (a 50.2 percent response rate) in San Francisco found that UberX provided the majority of trips, 53 percent, while other Uber livery services (such as Uber Black) accounted for an additional 8 percent (Rayle et al. 2016). Lyft trips made up another 30 percent, 7

percent of trips were made using Sidecar (no longer in operation), and the remaining 2 percent were made from other for-hire vehicle services. To reduce sample bias, respondents received a five-dollar coffee card for completing the survey.

The study survey asked respondents about key trip characteristics, including trip purpose, origin and destination, and wait times. Most trips, 67 percent, were social or leisure in nature (such as trips to bars, restaurants, and concerts or visits to friends or family) in contrast to just 16 percent of trips that were work related. Of all trips reported, 47 percent originated somewhere other than home or work (e.g., restaurant, bar, gym) while 40 percent had a home-based origin.

If ridesourcing were unavailable, 39 percent of respondents reported they would have taken a taxi, 33 percent would have taken public transportation, 8 percent would have walked, and 6 percent would have driven their own vehicles. Another 11 percent of respondents said they would have taken another mode. Respondents were asked if they still would have made the trip had ridesourcing services not been available and, if so, how they would have traveled. Among respondents, 92 percent replied they still would have made the trip, suggesting that ridesourcing has an 8 percent induced travel effect (Rayle et al. 2016).

A public transit station was reported as the origin or destination of a trip by 4 percent of respondents. This study suggests that ridesourcing can serve as a first-and-last-mile trip to and from public transit and may have a substitutive effect on taxis and public transportation. Ridesourcing may be able to provide opportunities for public transit agencies seeking to manage congested lines during peak periods, but it could also pose farebox recovery challenges during evenings and weekends, low-demand service periods, by drawing riders away. Additionally, 40 percent of the ridesourcing respondents stated that they had reduced their driving due to the service. However, a key limitation of this study is that responses were based on user surveys in the San Francisco Bay Area and did not include an analysis of actual travel behavior. The results of this study are not generalizable and warrant further research. Ridesourcing trips within San Francisco tended to be slightly shorter than taxi journeys, averaging 3.1 miles compared to 3.7 miles for taxi trips.

Vehicle-occupancy levels were somewhat higher for ridesourcing vehicles as for taxi trips and about the same as for driving trips to work. Half of the ridesourcing trips had more than one passenger (i.e., not including the driver); the average number of passengers was 2.1. For the matched-pair taxi sample, the average was 1.1. This difference is likely because ridesourcing trips overrepresented social trips in this study.

The study also found that ridesourcing wait times tended to be substantially shorter than taxi street hail and dispatch wait times in the matched pair analysis.

This study did not examine e-Hail taxi services, as they were not widely deployed at the time of the survey. Since the survey, there has been a dramatic increase in taxi use of e-Hail services. In October 2014, 80 percent of San Francisco taxis (1,450 taxis) were reportedly using the e-Hail app Flywheel, which has brought taxi wait times closely in line with those of ridesourcing (Sachin Kansal, Flywheel, pers. comm.). These data were from an exploratory study that did not include ridesplitting services, such as Lyft Line and UberPOOL, which blend for-hire ridesourcing services with pooling by pairing individuals with similar origins and destinations to offer ridesourcing-type services with the increased occupancy of pooled rides. Future research should seek to determine if ridesourcing services are more additive (increasing transportation access to travelers who do not own cars), more subtractive (reducing vehicle trips or VMT, or both, by encouraging shared rides and multimodal connections), or a combination that depends on different factors.

Taxi Sharing

As shared mobility becomes more mainstream and technology continues to evolve, the blending of for-hire vehicle services with ridesharing will likely continue. In addition to ride and fare splitting services, such as Lyft Line and UberPool, a number of efforts have attempted to increase taxi splitting, such as Bandwagon in New York City. Launched in 2009, Bandwagon allows users to "hail seats" using their mobile device, share cabs, and split fares. The Brooklyn-based company claims that the app contributes to shorter taxi lines, reduced wait times (when a user at the end of the line is paired with a passenger at the front of the line), and cost savings of up to 40 percent per cab ride (Covert 2015).

A study of New York taxi trips in 2011 found that taxi sharing could reduce taxi trips by an estimated 40 percent and reduce carbon dioxide emissions by 423 grams per mile (Santi et al. 2014). In 2010 the New York City Taxi and Limousine Commission commenced a one-year pilot program of shared taxis along three Manhattan cab routes; the cabs had a discounted per-person flat fare that ranged from three dollars to four dollars (Orsi 2010). The shared cabs picked up passengers at designated taxi stands and allowed passengers to get off anywhere along the route during the morning commute. The pilot program was praised for making cab-sharing more convenient, increasing taxi capacity during a peak com-

mute time, providing cost savings to passengers, and reducing greenhouse gas emissions over single-fare-rider taxi use (Daigneau 2010).

OVERVIEW: IMPACTS OF SHARED MOBILITY ON PLANNING

Urban planners should be aware of the potential positive and negative impacts of shared mobility on local communities. Understanding the impacts of shared mobility will enable planners and policy makers to leverage positive transportation impacts and environmental outcomes as well as tame unintended or negative impacts. Planners should consider the potential role of shared mobility in local planning programs by doing the following:

- Understanding sociodemographic trends about the sharing economy more generally and the impacts on cities and regions
- Maximizing infrastructure capacity by minimizing VMT, mitigating congestion, and reducing parking demand
- Encouraging multimodality and the bridging of first-and-last-mile connections
- Supporting economic development goals and new urbanist principles
- Reducing fuel consumption and supporting climate action and air quality goals
- Raising environmental awareness
- Avoiding, reducing, or mitigating the negative health, social, and economic effects of the transportation network on vulnerable populations and communities, such as minority and low-income communities, older adults, and zero-vehicle households
- Ensuring affordable, full, and equitable transportation access and mobility to all communities

To understand the impacts of shared mobility on local and regional communities, planning agencies, municipal governments, and public entities can consider various strategies. First, municipalities and public agencies could require shared mobility operators to share data and report key impact metrics. Second, they could emphasize local and regional data and impacts (versus state- and national-level data) to better understand shared mobility in neighborhoods. Third, they could develop and administer studies to measure the travel, social, and economic impacts of shared mobility on local communities.

By understanding the impacts of shared mobility, urban planners can be better informed as they design and work to integrate and minimize conflicts between different transportation modes and private operators. Additionally, planners can incorporate shared mobility into a variety of planning efforts, such as environmental and climate action planning, land use planning, environmental justice policies, and processes for public involvement.

SHARED MOBILITY POLICIES

Shared mobility has the potential to offer many communities a wide array of individual and community benefits, including increased mobility; greater environmental awareness; reduced vehicle emissions; and links between alternative modes, such as walking, cycling, and public transportation. With careful planning and public policy, it also has the potential to enhance accessibility and quality of life in cities of all sizes. Shared mobility has thrived in high-density and mixed use urban environments. But it offers flexible options for addressing community goals—strategies that can be used across metropolitan regions in areas with different characteristics.

Increasingly, shared modes are expanding into lower-density and more suburban locations. For example, carsharing is available in many small- and medium-sized college towns, and for-hire vehicle services, such as Uber and Lyft, are mainstreaming in smaller metropolitan regions—areas with populations typically between 50,000 and 500,000 (e.g., Fresno, California; Greenville, South Carolina; Lubbock, Texas). Numerous local and state public agencies, often with shared or overlapping responsibilities, can and do influence shared mobility policy and regulation. While San Francisco has an agency that manages the entire municipal transportation system, the San Francisco Municipal Transportation Agency, all other US cities spread particular roles across multiple departments. For example, in Philadelphia, the Southeastern Pennsylvania Transportation Authority operates public transportation while the Philadelphia Parking Authority manages carsharing parking policy and taxi medallions. It is important to note that many states have adopted shared mobility policies that cities and regions within the state must follow.

Planning controls are meant to ensure livability and quality of life by regulating the design and development of communities, guiding growth, and ensuring adequate infrastructure. Local, regional, and state governments accomplish this through state laws; local ordinances; specific, master, and general plans; zoning laws; and building codes. Many local and regional governments manage these functions through legislative bodies, planning commissions, planning departments, or a combination of these.

Through zoning regulations and other growth management practices, planners try to regulate how a building will affect the neighborhood and mitigate negative externalities. For example, zoning codes may encourage mixed use and multimodal access in neighborhoods with limited parking or high levels of roadway congestion. There are a number of tools planners and legislative bodies can employ to manage growth:

- **Zoning:** A law or ordinance that divides land within a city into zones and specifies permitted uses and standards required within each zoning district.
- **Overlay zoning:** An additional layer of zoning standards applied over part of a zoning district or multiple zoning districts.
- **Zoning changes:** A strategy employed to permit a project that would not otherwise be allowed under a parcel's existing zoning district.
- **Conditional-use permits:** A mechanism to permit a full array of land uses required in a community while giving planners control over specific circumstances that could cause conflict. Generally, conditional-use permits focus on business or use types rather than building size or position on a parcel. For example, a zoning ordinance may not permit commercial activity in a residential zone, but a conditional-use permit could provide specific exceptions for shared mobility services, such carsharing, to operate in residential neighborhoods or for other sharing economy activities, such as allowing a resident to rent a room on Airbnb.
- **Variances:** Special permission granted to parcel owners granting them permission for an activity that would otherwise be prohibited.

- **Discretionary review:** A process that permits local officials and planning commissions (or other designated bodies) to review specific development proposals and attach specific conditions or deny approval.
- **Code enforcement:** A broad term to describe the enforcement actions taken by zoning enforcement officers, building inspectors, health inspectors, fire marshals, and local law enforcement. Code enforcement can be key for shared modes to ensure that mobility operators are in compliance with their use of public rights-of-way and that non-mobility operators are not misusing rights-of-way assigned to another user (e.g., a private citizen parking in a carsharing stall).

The connection between shared mobility and land-use zoning is not new. Local zoning and codes can have notable unintended impacts on the success and viability of shared mobility. For example, some cities may classify a shared mobility mode, like carsharing, as a commercial use akin to traditional rental cars. In doing so, local zoning codes may prohibit shared mobility from operating in residential neighborhoods, necessitating either revisions to local codes or variances for shared mobility to operate legally. In other cases, local governments may have special zones (e.g., transit overlay zones) allowing additional density or lower parking requirements for the inclusion of shared mobility in particular development projects.

This chapter reviews the most common ways local and regional planning and other key public policies influence shared mobility at the municipal level: the allocation of public rights-of-way (typically on-street parking), incentive zoning, transportation demand management, insurance and local for-hire vehicle ordinances (e.g., local policies affecting the operation of taxis and ridesourcing/transportation network company services), and taxation.

POLICIES INVOLVING PUBLIC RIGHTS-OF-WAY

Right-of-way is a term used to describe the legal passage of people (and their means of transportation) along public and sometimes private property (the latter typically through licenses and easements). As part of the development process, local governments generally require developers to set aside infrastructure and easements to facilitate transportation access, egress, and parking on subdivided lands. Rights-of-way often encompass most surface transportation facilities—including streets, bicycle lanes, and sidewalks—as well as easements and other public and quasi-public spaces. A number of local governments and public agencies have developed a combination of formal and informal policies to allocate public rights-of-way such as curb space and parking. Many of these policies cover a number of issues (Cohen, Shaheen, and McKenzie 2008; Shaheen et al. 2010; Shaheen, Cohen and Roberts 2006):

- How a particular shared mode is defined
- If and how curb space—such as loading zones (for taxis and employer shuttles), parking, and other rights-of-way—should be allocated
- Whether there should be a policy differentiation between for-profit and nonprofit mobility operators
- How to manage demand among multiple mobility operators for public rights-of-way
- How to determine the monetary value of the rights-of-way
- How to address administrative issues, such as permits, snow removal, curb and street cleaning, parking enforcement, and signage

Public rights-of-ways play a synergistic role in the growth of shared mobility. The development of municipal policies allocating public rights-of-way for shared mobility and the differing approaches to allocating and managing carsharing parking are two important aspects of this relationship.

Municipal Policies Allocating Public Rights-of-Way

When allocating public rights-of-way to private-sector shared mobility operators, local and regional governments and public agencies have a host of policy questions to consider, including the following:

- What will be the process for allocating public space to shared mobility operators?
- Should there be limits on the amount of public space allocated (e.g., a specified amount of curb feet, number of parking spaces, square footage)?
- Will fees or permits be assessed for private use of the rights-of-way? If so, how will these costs be determined and assessed?
- Will special signage and marking be permitted to identify areas, such as special parking spaces and loading zones, and who will be responsible for their installation and maintenance?

- What type of enforcement mechanisms will be in place to prohibit unauthorized activities (e.g., ticketing, booting, towing)?
- What processes will be in place to ensure public involvement and address environmental justice issues?
- Will documentation of social, environmental, and transportation impacts be required? Will future allocation and/or fees be based on program impacts?

Each of these considerations is discussed further in the following sections.

Processes for Allocating Public Space

The allocation of public rights-of-way, such as parking and curb space, is typically implemented through a combination of formal and informal processes. Some municipalities have established zones that designate the locations of on-street carsharing parking and private-shuttle and ride-sharing pickup and drop-off locations. In the early to mid-2000s, numerous cities allocated parking stalls and curb space for particular modes (e.g., carsharing, bikesharing) rather than dedicating rights-of-way to specific operators. With an increase in the number of competing shared mobility operators in many cities, the allocation of space based on mode has been largely replaced by dedicated site approvals for specific operators. In addition, local agencies may allocate public space through the use of parking permits and real-estate agreements that allow exclusive use of parking or curb space within a specific parking zone or district or the use of a particular parking spot.

When multiple operators are seeking rights-of-way, public agencies should consider how they will allocate space among operators. Allocation processes can be formal using established policies that are written, codified by local ordinances and zoning provisions, or negotiated through a formal request for proposal (RFP) process. For example, the Washington Metropolitan Area Transit Authority has employed an RFP process to allocate carsharing parking. The allocation process can also be more informal through the approval of requests for public rights-of-way using variances, special permits, and case-by-case approvals from either administrative staff or an elected council. In Philadelphia, the process initially was more formal based on a 2006 ordinance permitting on-street carsharing parking for nonprofit carsharing operators only. For-profit operators Zipcar and UhaulCarShare were not permitted on-street parking spaces. Philadelphia's early parking policy has since been amended to allow on-street parking by all carsharing operators provided the operator obtains letters of support from adjacent property owners, community organizations, and a councilmember; makes a public presentation; and pays the Philadelphia Parking Authority a $150 annual lease fee (Geeting 2015).

Limits on Space Allocated

Due to limited space, numerous multimodal needs, and competing operators, public agencies may want to limit the amount of right-of-way space dedicated to shared modes, specific operators, or both. Numerous strategies can be used to achieve this goal. For example, a local government considering the allocation of on-street carsharing parking may consider providing rights-of-way based on the number of parking spaces, linear feet, or vehicle permits. Public agencies often confront challenges in developing equitable parking policies for station-based and free-floating carsharing systems. One way to address this is to allocate a certain number of station-based parking spaces for roundtrip carsharing and an equivalent number of parking permits for free-floating one-way carsharing. Cities with multiple shared modes vying for on-street curb space (e.g., carsharing, ridesourcing, private shuttles) may want to consider a comprehensive approach that allocates on-street space (measured in linear feet) that is based on the ridership of each mode. Cities, however, should carefully consider such policies to ensure that they do not stifle innovation and development of new operators and modes.

Fees and Costs

Public rights-of-way have value, although estimating this value is not always easy to do. Local governments may opt to provide rights-of-way to shared mobility operators free of charge or at a reduced cost, or charge market rates. For the sidewalk space needed for bikesharing stations, for example, the value of this space is not easy to estimate because curbs are rarely monetized. With on-street rights-of-way, some public agencies may charge shared operators the foregone meter revenue resulting from the conversion of metered parking to this other use. Measures for determining the amount an operator will be assessed for on-street rights-of-way include the following: (1) residential parking permit costs, (2) foregone meter revenue, (3) costs of providing parking (e.g., operations, administrative costs, overhead, maintenance), and (4) the market rate for private or public off-street parking in a given parking district or municipal jurisdiction. Other public agencies have opted to allow free parking and free loading zones for shared mobility operators.

Signage Installation and Maintenance

Almost all public agencies allocating public rights-of-way allow shared mobility operators to place special signage to highlight their services. Some public agencies regulate signage so it conforms to local requirements (e.g., size, color, material). Many public agencies formally negotiate maintenance requirements through real estate lease agreements or informally with an operator on an as-needed basis.

Enforcement Mechanisms

Enforcement is critical to ensure that shared-mode vehicles use spaces in designated locations and that other vehicles do not occupy, for example, a "carsharing only" parking space or a shuttle and ridesharing loading zone. Some public agencies have created specific carsharing license plates to identify these vehicles and aid in parking enforcement (e.g., preventing ticketing or towing of carsharing vehicles legally parked in designated zones). Because many state and municipal vehicle codes lack formal definitions of shared modes, jurisdictions lack the authority to ticket, tow, or boot non-shared mode vehicles located in shared mobility spaces. To address this challenge, some local governments and public agencies have amended local codes to grant law enforcement the ability to enforce restrictions in these designated spaces.

Public Involvement

Some public agencies require that shared mobility operators work with local neighborhoods and community groups to gain approval for the location of carsharing parking and bikesharing kiosks prior to installation. A few examples of public processes previously incorporated by cities include the following:

- **New York:** In 2013, the city together with the operator initiated over 400 public meetings related to the development of the Citi Bike bikesharing program and provided a website for public input, which received more than 10,000 suggestions about station locations and 55,000 responses in support of station proposals.
- **Seattle:** When the city implemented its first carsharing parking program, the operator submitted the parking requests to the city. The city planning staff reviewed these requests and forwarded them to the transportation operations division for review and adjudication. After the requests were approved, the city provided written notifications to adjacent property owners.
- **Washington, DC:** When the District of Columbia implemented its first carsharing parking program, the director

of public works could authorize carsharing parking spaces after consulting with the advisory neighborhood commissions. Alternatively, carsharing operators and individuals and businesses wanting carsharing parking access could also submit their requests to the commissions. After endorsement, requests are forwarded to the District Department of Transportation for action.

Impact Studies

Public agencies may require shared mobility operators to conduct impact studies documenting the transportation, social, and environmental effects of a system when considering the allocation of public rights-of-way. These studies can take place at the time of the initial application, at regular intervals after the rights-of-way have been granted, or both. At present, most public agencies requiring impact studies do not release the results and often link policy decisions to the outcome of such studies.

Parking Policies

Ceding public rights-of-way to private enterprises can be highly controversial and is often only justified where a public good is being served. Local governments frequently cite the transportation, land-use, environmental, and social benefits of shared mobility as justification for allocating public rights-of-way and, in some cases, providing it free or at a reduced cost as a form of nonmonetary support. Allocating parking and curb space for the inclusion of shared mobility—such as carsharing parking, space for bikesharing kiosks, and loading zones for ridesourcing, microtran-

Figure 3.1. Zipcar allocated street parking (Zipcar)

sit, and shuttles—is the most common way local governments provide access to public rights-of-way (Figures 3.1 and 3.2). In many cases, incorporating shared mobility into the public rights-of-way will require removing general use of on-street parking, which can be highly contentious. In short, curb frontage remains fixed while a growing array of mobility services seek the access and visibility provided by on-street locations.

Numerous other parking policies can be implemented alongside the inclusion of shared mobility in the public rights-of-way for a synergistic effect. The following are examples of different parking policies:

- **Variable market-rate on-street parking:** Allow parking rates to fluctuate with demand to help manage the supply-demand balance and optimize parking availability.
- **Unbundled parking costs:** Enable parking spaces to be sold or leased separately from the sale or rental of properties. Unbundling parking costs can incentivize individuals to drive less, own fewer vehicles, and use shared mobility and public transportation.
- **Parking taxes and surcharges:** Assess taxes and surcharges to discourage certain parking behaviors. For example, a city may implement a meter surcharge on parking over four hours to encourage parking turnover and commuter use of alternative transportation.
- **Parking cash-outs:** Allow employers to charge employees for parking while providing pay increases or bonuses to employees who use alternative transportation.

Figure 3.2. car2go parking permit in Montreal, Quebec (car2go)

Broadly, these policies let supply and demand price parking, encourage transparency of the true cost of parking (and often pass these costs onto users), and use incentives and disincentives in an attempt to shift drivers to more efficient, lower-impact alternative modes.

San Francisco, California: Roundtrip and Peer-to-Peer Carsharing Parking Policy

The San Francisco Municipal Transportation Agency (SFMTA) maintains an on-street carsharing parking program. City CarShare and Zipcar, roundtrip carsharing programs, and Getaround, a peer-to-peer carsharing program, all participate in the SFMTA parking program, which designates up to 900 parking spaces for use by carsharing vehicles. SFMTA has requirements for participating programs, and each operator must comply with the following:

- Maintain a citywide network of at least 10 vehicles
- Make vehicles available 24 hours a day, seven days a week using a virtual storefront (e.g., no staff are required) or available during the hours a vehicle is parked in a garage
- Provide automobile insurance to each member for the duration of the rental
- Provide vehicles that are only made available for rent in increments of an hour or less
- Provide vehicles that are made available for at least 75 percent of any given month
- Conduct new member outreach and provide a summary of outreach activities to SFMTA
- Provide quarterly reports to SFMTA about the number of members in the city by zip code, vehicle locations, trip data, and operational metrics
- Survey carsharing members to gauge changes in travel patterns at the beginning and end of the pilot program

Each organization that participates in the program is eligible for 150 parking spaces (0.05 percent of the city's total on-street parking supply). Locations are allocated through a process that includes an engineering review, community outreach, and approval by the SFMTA board of directors. Monthly pricing per space varies from $50 to $225 based on the location in three demand zones established by the city. Operators pay a one-time installation fee of $400 per space. Each approved carsharing vehicle receives a special parking permit that exempts it from street sweeping, time limits, and other restrictions (SFMTA 2013).

Seattle, Washington: Free-Floating One-Way Carsharing Parking Policy

In December 2012, the Seattle city council approved a one-year pilot program with car2go that enabled its one-way carsharing fleet to "float" around the city. Initially, car2go paid the city $1,330 per vehicle per year for administrative costs, on-street parking, and residential parking zone permits for 350 vehicles. At the end of 2013, car2go was required to provide the city with data about parking used and to pay additional fees for meter overages (Dudley 2013). In December 2014, Seattle amended its carsharing policy to allow up to four carsharing operators to each apply for 500 vehicle permits (or 750 vehicle permits if the operator agrees to cover the entire city). The coverage requirement is intended to encourage station-based carsharing operators (roundtrip and one-way) to place vehicles over the entire city. Free-floating carsharing operators generally provide geo-fenced areas where vehicles must be returned. This provision encourages free-floating operators to expand their permissible vehicle return area to the entire city. The permits cost $1,703 per vehicle per year, and it was estimated these fees would provide $2.2 million in revenue in 2015 and $3.4 million in 2016 (Feit 2014).

Portland, Oregon: Parking Auctions

In 2013 the City of Portland revised its carsharing parking policy and established an auction process for carsharing parking. Each year, the Portland Bureau of Transportation (PBOT) creates a list of on-street metered parking spaces available for lease to carsharing operators. PBOT manages a process where carsharing operators can bid on parking spaces (Portland 2016b). The minimum bid is calculated by adding together the amount of lost meter revenue and installation, maintenance, and administrative costs associated with leasing the parking space for exclusive carsharing use. Carsharing operators may also apply for on-street parking outside of the metered district by receiving approval from adjacent property owners. Portland is also one of the few municipalities to incorporate a "utilization clause" in its program. If a parking space generates less than 60 trips per month for at least three months, the spaces are considered underused and may be removed by the city's traffic engineer and converted to another use (Portland 2016b).

INCENTIVE ZONING

Finding and leasing parking spaces in urban areas can be difficult and time consuming for carsharing operators. For de-

velopers, each parking space can cost upwards of tens of thousands of dollars to construct. Surplus parking can be costly for developers, urban homeowners, and renters alike. Providing designated, on-street parking spaces is one example of how city managers, planners, and public works departments can support shared mobility. Cities can also implement a wide array of policies aimed at easing zoning regulations and parking minimums to promote the inclusion of shared mobility in new developments. Commonly referred to as incentive zoning for shared mobility, these policies can be categorized as (1) policies that enable reduced parking and (2) policies that allow increased density. Policies that allow reduced parking include parking reductions (downgrading the required number of spaces in a new development) and parking substitution (substituting general-use parking for shared modes, such as carsharing parking and bikesharing kiosks).

Parking reduction policies are ideal in urban areas with particularly high housing or parking construction costs. This strategy can help make housing more affordable by reducing per-unit costs and can encourage neighborhood redevelopment and revitalization by making it easier for developers to have positive cash flows and higher capitalization rates on real estate projects. Similarly, parking substitution can be employed in both new and existing developments. Carsharing parking stations can contribute to an overall network effect: the more cars an operator has in a city, the more members it can attract, which in turn can lead to both more vehicle miles traveled and vehicle reductions. To encourage modal shift, parking reduction and substitution strategies should be employed in high-density areas with more robust public transit services.

Policies that allow increased density include greater floor-to-area ratios, more dwelling units permitted per acre, and greater height allowances. Similar to parking reduction, policies that allow for increased density aim at making development more lucrative for developers and real estate investors. Rather than reducing per-unit or overall project costs, these policies increase the overall cash flow of development projects. Allowing increased density is most appropriate for cities seeking to increase overall urban density, residential density, or both. These strategies can be particularly effective at encouraging brownfield redevelopment because these parcels are often more expensive to repurpose due to the costs commonly associated with environmental remediation.

While the majority of these provisions are codified into municipal codes, parking reductions and policies allowing for increased density can also be granted on case-by-case bases through mechanisms like variances. A variance is

a process where applicants can request a departure from standard municipal codes, such as zoning and building codes. Some cities may need to grant special-use permits to allow shared mobility to legally operate. For example, in Massachusetts, the City of Cambridge prohibits carsharing parking on residential driveways. A special-use permit is another method that could allow specific exceptions to the zoning regulations for a particular parcel, neighborhood, or zoning district.

Examples of Incentive Zoning for Shared Mobility

Incentives can come in various forms and will often depend on the local customs and desired outcomes for a city. Sometimes a city will be approached by a developer or other local interest requesting a zoning code amendment. In other cases, a city may proactively change its zoning code and model it after other incentive mechanisms employed in the jurisdiction or after the zoning code of another city. Across the United States, a wide array of incentives is being employed by local governments, such as parking reductions and reduced transportation impact fees. The following sections describe three examples of incentive zoning from Seattle; Vancouver, Washington; and Indianapolis.

Seattle, Washington

Seattle's municipal code allows for a reduction of up to 5 percent of a development project's required total parking spaces with the inclusion of a city-recognized carsharing program. Seattle's ordinance reduces the number of required spaces by one space for every parking space leased by a carsharing program. For developments requiring 20 or more parking spaces and that provide carsharing parking, the number of required spaces may be reduced by the lesser of three required parking spaces for each carsharing space or 15 percent of the total number of required spaces (Seattle Municipal Code, § 23.54.020). To qualify for the latter provision, the code stipulates that there must be an agreement between the property owner and the carsharing operator filed and approved by the city and recorded with the deed.

Vancouver, Washington

In Vancouver, Washington, just north of Portland, the municipal government has implemented reduced transportation impact fees (TIF) reductions along with residential density bonuses for the inclusion of alternative transportation in the city's transit overlay district. TIF reductions are granted on a percentage basis for implementation of one or more alternative transportation measures (Table 3.1).

TABLE 3.1. TRAFFIC IMPACT FEE REDUCTIONS (VANCOUVER, WASHINGTON)

Action	TIF Reduction (%)
Construction of direct walkway connection to the nearest arterial	1
Installation of pedestrian-convenient information kiosk, with maintained information	2
Installation of on-site sheltered bus stop (with current or planned service) or bus stop within a quarter mile of site with adequate walkways (if approved by C - TRAN)	1
Installation of bike lockers	1
Commercial development that would be occupied by employer subject to Commute Trip Reduction Ordinance	4
Voluntary compliance with Commute Trip Reduction Ordinance, where compliance is not required	5
Connection to existing or future regional bike trail (either directly or by existing, safe access)	1
Direct walk/bikeway connection to destination activity (e.g., a commercial/retail facility, park, school) if a residential development or to an origin activity (e.g., a residential area) if a commercial/retail facility	2
Construction of on-site internal walk/bikeway network	2
Installation of parking spaces that will become paid parking (by resident or employee)	3
Installation of preferential carpool/vanpool parking facilities	1
Regular distribution of transportation demand management information packets to all new tenants	1
Total (all strategies implemented)	**24**

Source: Vancouver Municipal Code, § 20.550.050

Vancouver's ordinance allows a maximum total TIF reduction of 24 percent, if all alternative transportation strategies are implemented. Additionally, any development within the first tier of the city's transit overlay district receives a density bonus equivalent to the percentages, if five or more of the alternative transportation actions are implemented. Developments located in the second tier of the district are entitled to the incentive, provided that building orientation, frontage, and setback requirements for the tier are met (Vancouver 2009).

Indianapolis, Indiana

In April 2016, the City of Indianapolis adopted a revised consolidated zoning and subdivisions ordinance (Indianapolis 2016). Under the revised zoning code, developers will be permitted a cumulative reduction in required parking of up to 35 percent. The code includes the following shared mobility–related parking reductions:

- **Shared vehicle, carpool, or vanpool spaces:** The minimum number of required off-street parking spaces may be reduced by four for each shared vehicle, carpool, or vanpool space provided. Each shared space counts toward the minimum number of required parking spaces.
- **Electric-vehicle charging stations:** The minimum required off-street parking may be reduced by two parking spaces for each electric-vehicle charging station provided. Each charging station counts toward the minimum number of required parking spaces.
- **Bicycle parking:** For every five bicycle parking spaces provided in excess of the required bicycle parking spaces (or where no bicycle parking is required), the minimum number of required off-street parking spaces may be reduced by one or up to a maximum of five.
- **Proximity to public transportation:** The minimum number of off-street parking spaces required for any development may be reduced by 30 percent, if the developer builds within a quarter mile of a sheltered public transit stop or public transit corridor. The minimum number of off-street parking spaces required may be reduced by 10 percent, if the development is between a quarter mile and a half mile of a stop or public transit corridor.

TRANSPORTATION DEMAND MANAGEMENT

In addition to amending local zoning and building codes, variances, and special-use permits, shared mobility can be incorporated as part of transportation demand management (TDM) planning. Many TDM measures offer similar incentives to developers and property owners for the inclusion of shared mobility and other TDM measures in residential, commercial, and mixed use projects. For example, a developer may be granted the previously discussed bonuses for the inclusion of other on-site amenities, such as bicycle parking, bicycle lockers, showers, and preferential or free parking for carpools and vanpools.

Other common measures include guaranteed rides home, passenger loading zones to facilitate ridesharing as for-hire vehicle services, compressed work weeks, and telecommuting. Many of these TDM opportunities expand beyond shared mobility. In addition, the US Green Building Council offers various credits for the inclusion of shared mobility in its Leadership in Energy and Environmental Design (LEED) rating system. LEED is a voluntary program for projects that meet recommended sustainability benchmarks (US Green Building Council 2016).

INSURANCE AND ON-DEMAND RIDE SERVICE POLICIES

In recent years, the growth of shared mobility and, in particular, on-demand for-hire vehicle services (e.g., Uber, Lyft) have posed notable challenges for urban transportation planning and policy. In many cases, public agencies and local governments have been left with the difficult task of developing regulations that protect consumer safety without stifling innovation. In many jurisdictions, the regulation of these services occurs both at the local and state level; however, the specific regulatory agencies vary. Some cities regulate these services through local parking authorities, taxi and limousine commissions, or municipal transportation authorities. Other cities may defer to state agencies, such as public utilities commissions and departments of motor vehicles. The following discussion examines insurance-related issues that affect shared mobility, as well as other on-demand ride service policies that may fall under the purview of local government.

Insurance

Municipalities looking to employ shared mobility in their communities should pay close attention to insurance policies affecting these services. Insurance regulations can make shared modes cost prohibitive or they can prohibit operations in a jurisdiction altogether. Although these policies may not fall directly under the purview of local jurisdictions,

local governments should understand the critical role these policies have on shared mobility, especially if urban planners want to encourage shared mobility and the environmental, social, and transportation benefits often associated with several shared modes.

In the early 2000s, vehicle insurance emerged as one of the biggest industry obstacles for shared mobility, particularly for carsharing. Following the September 11th attacks, North American carsharing operators confronted substantially higher premiums, which often exceed $2,500 per vehicle annually (Shaheen, Cohen, and Roberts 2006). The most common insurance coverage carried by carsharing providers was generally $1 million (per accident, per claim) single-limit policies. As the decade progressed, carsharing insurance became increasingly affordable as services became more common.

One form of strict secondary liability occurs when vehicle owners (in this case, a carsharing operator or rental car company) are vicariously liable for the negligence of the person to whom the vehicle has been rented or loaned. In 2005 Congress passed the Graves Amendment, which established a statutory basis for dismissing vicarious liability claims against rental car owners whose vehicles are involved in accidents. In 2010 Zipcar was the first carsharing operator to successfully argue before the New York Supreme Court that carsharing was akin to a rental car service, and so it was entitled to Graves Amendment protections from vicarious liability claims (Auto Rental News 2010).

Insurance re-emerged as a key issue in 2010 with the rise of peer-to-peer vehicle services and in 2012 with the use of on-demand ride service apps. Most state insurance laws have not kept pace with the advent of peer-to-peer carsharing models. One issue is defining when the vehicle owner's policy ends and the peer-to-peer carsharing operator's commercial policy begins. California, Oregon, and Washington have revised their insurance laws to cover peer-to-peer mobility services and require companies to provide vehicle liability insurance and assume liability in the event of loss or injury while a vehicle is in use by the service (Shaheen, Mallery, and Kingsley 2012).

These laws also generally prohibit a vehicle owner's liability insurers from cancelling a policy or reclassifying use from a private passenger motor vehicle to commercial-use vehicle because of use in a vehicle-sharing program (RentMyCar 2011). In the majority of states that do not have peer-to-peer insurance legislation related to peer-to-peer carsharing, vehicle owners may be held responsible for loss or injury while their vehicles are used for carsharing or face premium spikes or non-renewal of their personal insurance

policies. As of May 2016, 32 states and the District of Columbia have enacted insurance legislation for ridesourcing companies, and an additional 13 states have active legislation. The remaining states have either pending or failed legislation or do not have active legislation. Appendix D (p. 96) provides a listing of the insurance legislation status for states.

On-Demand Ride Service Policies

In recent years, the growth of on-demand ride services, such as UberX and Lyft, has become more of a policy and regulatory issue. A number of policy questions have emerged as local and state governments classify these services as traditional ridesharing or taxi services or as a new service category (Rayle et al. 2016). Key policy questions for local governments include the following:

- How are these services defined?
- Is there a difference between taxis (e.g., Yellow Cab), ridesourcing, and e-Hail services (e.g., Flywheel)?
- How are these services similar to and different from ridesharing services (i.e., carpooling and vanpooling)?
- What are the impacts of these services on local vehicle miles traveled, air quality, accessibility, and mobility?
- How should local and state agencies develop equitable policies?
- What is the role of local governments in enacting and enforcing legislation to ensure public safety?
- How are the appropriate regulatory authorities identified?
- What are the impacts of these and other innovative mobility services on public transportation? Do they complement or compete with public transit?

Limited legislative policy guidance and research exist to answer many of these questions. The growth of the sharing economy, the advent of new technologies, the blurring of new and core service models (e.g., ridesourcing, taxi e-Hail), and an increasing number of service models are disrupting mobility and its regulation. In the broader sharing economy, policy makers and public agencies have been unable to reach consensus on if and how to regulate the private distribution, sale, and reuse of goods and services. Should companies providing shared economy services, such as Airbnb and Lyft, be taxed and regulated like hotels and taxi services?

Across the country, state and local governments have varied considerably on their approaches to regulating ridesourcing companies. At one end of the spectrum, public agencies have issued consumer alerts of "rider beware" and "driver beware" of potential insurance gaps. Fundamentally, these are

TABLE 3.2. COMMON TRANSPORTATION NETWORK COMPANY PUBLIC POLICY APPROACHES

Policy	Description	Example
Consumer Alerts	A consumer alert warns the public of potential auto insurance gaps for individuals working as drivers for transportation network companies (TNCs). Generally, these consumer alerts warn that personal auto policies may not provide coverage for TNC drivers and often urge drivers to talk with their insurance agent or broker. Generally, these consumer alerts are issued by state insurance departments.	In September 2014, the Utah Insurance Department issued a consumer alert advising drivers that most standard personal auto policies list exclusions for livery use (using a personal vehicle to transport passengers for a fee). The alert encouraged potential drivers to seek information from their personal auto insurance broker and TNC representatives about liability insurance, deductibles, commercial liability, and insurance coverage periods. Additionally, it advised drivers acting as employees to make sure the employer is providing worker's compensation insurance.
Cease-and-Desist Letters	A cease-and-desist letter (commonly known as a demand letter) is a document sent by a public agency to TNC drivers, TNC companies, or both demanding that they refrain from engaging in an alleged unlawful activity. Generally, these letters warn that if the parties do not stop the alleged unlawful activity, the regulatory agency may take certain administrative actions or sue the infringing party.	In December 2014, Broward County in Florida issued cease-and-desist letters to Uber and Lyft. In the spring of 2015, the county cited and fined drivers that failed to comply with the cease-and-desist order.
Temporary Restraining Orders	A temporary restraining order is a court order of limited duration that directs a specific action until the court can hear further evidence and decide whether to issue an injunction.	In July 2014, the New York attorney general and the New York City Taxi and Limousine Commission jointly filed a temporary restraining order against Lyft meant to postpone the launch of its operations until the legality of the operations could be ruled on in court.
Injunction	Similar to a temporary restraining order, an injunction is a final court order requiring a person or company to whom the order is directed to do a particular act or refrain from doing a particular act.	In May 2014, a coalition of taxi companies sought a permanent injunction to stop Uber and Lyft from operating in the state of Connecticut.
Legislation	Legislation includes a statutory law (state) or an ordinance (local) enacted by a governing body.	In California, Governor Jerry Brown signed Assembly Bill 2293 (proposed by Assemblymember Susan Bonilla), which establishes new insurance limits for on-demand ride services and prohibits private auto insurance from subsidizing commercial activities. The law took effect in July 2015. It requires $200,000 of insurance coverage during the "app-on-to-match" period and $1 million primary coverage from the time a driver accepts a match until the passenger exits the vehicle. The California Public Utilities Commission, which previously defined these on-demand services as TNCs, increased insurance requirements for these operators until the bill took effect.

Source: Adam Cohen and Susan Shaheen

just warnings to ridesourcing users; the warnings do not attempt to address any insurance gaps. At the other end of the spectrum, public agencies have issued cease-and-desist letters or sought court action (e.g., restraining orders, injunctions) to stop ridesourcing companies from operating until legislation clarifies the nature and operating requirements of these services. Descriptions of these approaches are included in Table 3.2. The particular approach a public agency may pursue will often depend on politics, the agency's understanding of the services and interpretation of existing and potential applicable laws and regulations, and the existence and severity of any documented accidents or consumer complaints.

The California Public Utilities Commission (CPUC) was the first government agency to raise potential public safety concerns. In August 2012, the CPUC issued cease-and-desist letters to Sidecar and Lyft. Eventually, it created a new legislative category of "transportation network companies," or TNCs, and established a number of requirements for legal operations. The CPUC's regulatory framework consists of nearly two dozen different rules for TNCs related to required CPUC licenses, criminal background checks for drivers, driver training programs, minimum insurance requirements, and vehicle inspections (California Public Utilities Commission 2016).

The decision whether to regulate for-hire vehicle services at the local or state level will vary considerably depending on circumstances in a municipality, particularly the historical regulation of taxis, limousines, and liveries. Local governments with taxi commissions and parking authorities responsible for regulating taxis may be more apt to regulate other for-hire vehicle services than municipalities in states where the primary regulatory authority is at the state level of governance (e.g., public utilities commissions, insurance departments). In October 2014, the City of Austin in Texas passed one of the nation's most comprehensive ridesourcing ordinances at the municipal level. The ordinance provides a number of key provisions meant to protect consumer safety and ensure accessibility. At the state level, Tennessee passed a state law with similar provisions in May 2015. These examples are explored in more detail in the following sections.

Austin, Texas: Comprehensive Transportation Network Companies Ordinance

In Texas, the City of Austin defines a transportation network company as "an organization whether a corporation, partnership, sole proprietor, or other form, which provides on-demand transportation services for compensation using an online-enabled application (app) or platform to connect passengers with drivers" (Austin 2016a). The 2014 municipal ordinance requires that TNCs enter into an agreement with the city that includes provisions around insurance, health and safety, accessibility, and pricing.

The ordinance requires TNCs to provide primary commercial automobile liability insurance coverage with a minimum combined single limit of $1 million for each occurrence of bodily injury and property damage for accidents involving TNC vehicles in transit (defined as the time period beginning when a driver accepts a trip and ending when a rider departs the vehicle). Additionally, the ordinance requires that insurance policies name the City of Austin as an additional insured party.

During the time period when a TNC driver has logged into an app and indicated the availability to drive, the TNC is required to provide insurance coverage of at least $30,000 for death and personal injury per person, $60,000 for death or personal injury per incident, and $25,000 for property damage. This insurance can be provided by the driver, the company, or both. Additionally, TNCs must notify their drivers that there may be a period of required insurance that starts when a driver logs into the app but before a passenger is picked up. Finally, TNCs are required annually to submit data to the city on insurance claims and the effectiveness of coverage limits.

Austin's ordinance requires TNCs to establish a driver training program and implement a zero-tolerance policy for drug and alcohol use among drivers. Drivers must be at least 21 years old, and TNCs must conduct driver background checks. In December 2015, Austin's city council amended its ordinance to require fingerprinting as part of its background checks. The fingerprinting establishes four benchmarks for TNCs to achieve compliance by February 2017. (In May 2016, Austin residents rejected a voter referendum that would have repealed the fingerprinting requirements.)

Additionally, drivers are prohibited from driving more than 12 hours in any 24-hour period and may not accept any rides outside of the online application. The ordinance further mandates that TNC apps display a picture of the driver, a description or picture of the vehicle, and the vehicle's license plate number. The ordinance also requires that TNCs and their drivers make reasonable accommodations for service animals. In addition, drivers are prohibited from refusing to accept or charging higher fees for disabled passengers. TNCs also must conduct outreach to low-income communities and to organizations with vehicles that meet accessibility standards under the Americans with Disability Act.

Austin's ordinance mandates that passengers receive a trip cost estimate and a receipt with the total amount paid

POST-DISRUPTION TRANSPORTATION NETWORK COMPANY POLICY PLANNING

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Since the advent of disruptive for-hire on-demand app-based services (also referred to as ridesourcing, ridehailing, and transportation network companies, or TNCs), many laws have been enacted in the United States and around the globe to permit market entry of these services through partial deregulation and self-regulation. Essentially, TNCs are a hybrid form of on-demand taxi service, with a taximeter-like fare calculator in the service's app, that provide virtually the same service as for-hire services that are pre-arranged or pre-booked, including taxicabs, limousines, and livery (black car and other for-hire pre-arranged sedans and chauffer services). In many instances, these TNC services operate with unlicensed vehicles, less scrutinized vetting of drivers, and limited or insufficient insurance coverage.

There is no question that the competition and disruption created by TNCs have set the stage for a broader paradigm shift in transportation policy and planning. This disruption has led governments to start thinking about the planning process as not just about the management of roadways and public transportation systems, but also about the integration of private for-hire transportation services into the overall mix of public and private modes. Addressing these emerging issues is important, especially since distinctions between modes and sub-modes, as well as between public and private transportation, continue to become more blurred as the result of technological improvements. These technological innovations include shared mobility networks, connected and automated vehicles, smartphone technology, and data-sharing platforms. With transportation worlds both collid-

ing and merging with one another, a new planning paradigm involves a host of seminal issues that must be addressed. Who should regulate (federal, state, and/or local governments)? What should they regulate and to what extent? How should regulation occur (street enforcement, automated enforcement, and/or self-regulation)?

Regulation and Enforcement

Taxicab service (on-demand street hails, taxicab stands, and pre-booked services) has traditionally been regulated locally, although the authority to do so is delegated by the state. For-hire services are less regulated than taxicabs at the state and local levels around issues including fares, closed entry or permit limitations, and driver vetting. While federal regulation is unlikely to work legally or logistically, federal laws and appropriations provide state, regional, and local funding for research that could be directed toward analyzing incentives, disincentives, and technology pilot programs. This research could then help guide more uniform state, regional, and local policies. TNCs have generally pushed for statewide regulation and laws that semi-legitimize their business model because doing so at the state level involves conceivably less lobbying, legal, and media-related resources than engagement with multitudinous municipalities and jurisdictions.

TNCs recognize that states typically lack the same enforcement capabilities as municipalities. While it is difficult to police and enforce safety standards at the state level, some safety standards could be uniform, particularly those related to basic safety and licensing of professional drivers. For all private for-

hire ground transportation, minimum requirements should include uniform insurance coverage available 24/7 (whether on or off duty) or, alternatively, a new insurance model that covers injuries and is affordable and available to all participants; biometric (fingerprint) background checks for all drivers (Daus and Russo 2015); reasonable and affordable licensing fees that cover only the cost of issuing licenses; driving record licensing restrictions; and standard rules of conduct for driver misbehavior.

Although states could set licensing criteria or even issue licenses, enforcement should always be either local or regional for all for-hire modes, as long as statewide licensing standards are clear, consistent, and appropriately stringent. Self-regulation, which is the regulatory paradigm for new TNC laws, could work, in theory, but would require rigorous penalties, data sharing, and extensive government auditing functions and resources. These features, while using less government resources than field enforcement activities, would require that self-regulated TNCs pay more to support government functions. This payment should not take the form of unreasonably high TNC licensing fees, which may serve as a barrier to small businesses, but rather as separate fees for monitoring and auditing expenses based on the number of licensed vehicles and drivers.

Under most circumstances, it is generally best for local municipalities to set taxicab fares, regulate for consistency and transparency, set entry limitations on the number of permits, and assess supply and demand expectations. Regulation of these complex issues is best reserved for local regulators because of their knowl-

edge of geographic characteristics (e.g., cities versus suburbs) and economic variables (e.g., public transit options, fare affordability). Limitations on the number of permits, along with compensation and fare regulation, should happen at the local or regional level, as the standard of living, wages, and demand for services can differ between neighborhoods, localities, and regions. Limiting or managing the increase in the number of drivers and vehicles is an important regulatory activity that can ensure liveable wages for drivers, and manage or mitigate congestion and pollution.

Despite the foregoing challenges, states could theoretically regulate consumer protection and set baseline licensing standards for all professional drivers, including safety and accountability of the vehicle, driver, and transportation business. These licensing requirements should apply to all professional drivers and passengers in the state and could be enforced at the local level. These standards could include penalties for overcharging passengers and not having proper levels of insurance, mandated vehicle and emissions inspections, and driver misconduct regulations. Current TNC laws do not provide these levels of consumer protection, but new more stringent provisions that provide equal protection for all for-hire on-demand modes could remedy disparities.

Leveling the Playing Field

At present, TNCs typically benefit from less restrictive regulations than their taxi, limousine, and livery counterparts in most jurisdictions. TNCs often conduct less stringent background checks that are facilitated by the operator and/ or exclude fingerprinting requirements. In addition, insurance may or may not be required and coverage differs from those of taxi and limousine operators.

The number of TNC drivers and vehicles may not be limited whereas the number of taxi licenses and medallions is frequently limited. Finally, TNC laws may not contain provisions for access under the Americans with Disabilities Act (ADA) (e.g., wheelchairs, service animals).

Leveling the playing field between TNCs and taxi companies involves addressing the regulatory and financial competitive advantages that TNCs have over the incumbent taxi, livery, and limousine industries. TNC legislation does not currently address a number of these issues and contains differing regulatory standards despite providing essentially the same for-hire pick-up and drop-off services. The question is not how TNCs and incumbent industry players are different, because they are providing comparable services, but rather why they are regulated differently. The bigger issue is whether policy makers want to take an incremental approach toward TNCs that does not narrow the equity gap, or make more fundamental changes that will permanently fix the underlying conditions.

For-hire on-demand mobility laws will likely be revised either due to equal protection challenges, disparate standards, or both. The outcome will be higher standards than what the TNC laws currently provide, with some partial or slight deregulation for incumbent on-demand modes.

Next Planning Steps and Policy Recommendations

Planning for the future must be done swiftly and with all stakeholders at the table—public transit agencies, airports, business improvement districts, incumbent for-hire and taxi services, and TNCs—thinking outside of the box. The federal role should not be to regulate or force specific solutions, but to appropriate funding for statewide

and regional planning studies to help integrate all modes and technologies. The policy emphasis should be on promoting shared mobility, zero emissions and clean-air vehicles, ADA accessibility, equitable services, and affordable fares.

As TNCs become increasingly part of the mainstream transportation system, certain safety and accountability standards should be raised, and these standards should apply across modes. Self-regulation should be carefully monitored. State-level uniform safety and licensing standards could work, but these must be coupled with local enforcement and appropriate penalties for noncompliance. Solutions do exist, but action is needed. Governments should work closely with public and private transportation operators to carefully assess and deploy strategies quickly.

TAXI REGULATORY FRAMEWORKS

Many local governments use taxi-driver licenses to regulate the number of drivers and ensure driver standards, and taxicab medallions or taxicab licenses to limit the number of taxicabs and ensure minimum vehicle safety standards. In 1937 New York Mayor Fiorello La Guardia signed the Haas Act, which established taxi medallions and was intended to protect passengers from price gauging. The medallion system was meant to limit the number of licensed taxis to stabilize taxi supply and demand and regulate cab drivers, vehicles, and franchises. A limited number of medallions are sold each year and are typically affixed to the hood of a taxi cab.

Over the past 70 years, the number of New York taxi medallions has remained relatively stable, increasing from 11,787 to 13,150 (New York City Taxi and Limousine Commission 2013). Demand for taxis and their licenses have caused the value of medallions to rise. In May 2013, the cost of a New York taxi medallion peaked at $1.32 million (Barro 2014). Recent estimates place the value of New York taxi medallions around $700,000 each; in Boston they were valued at $700,000, $400,000 in Philadelphia, $350,000 in Chicago, and $300,000 in Miami (Badger 2014; Rivoli 2015).

after the completion of a trip. Additionally, passengers must be able to consent to dynamic pricing (commonly referred to as "surge pricing") on apps; surge pricing is prohibited during periods of market disruption. Surge pricing is a primary mechanism that TNCs can use to help manage the supply-demand balance and ensure service quality (e.g., guaranteed maximum wait times for pickup). While the regulation of taxi fares is a fairly common practice, Austin's prohibition of TNC surge pricing was the first municipal regulation of such fares (Austin 2014).

Tennessee: Transportation Network Company Services Act

In May 2015, Tennessee enacted the Transportation Network Company Services Act, which defines a TNC as a business entity operating in the state that uses a digital network to connect riders to TNC services provided by TNC drivers. The bill distinguishes TNCs from taxi, limousine, shuttle, and other private passenger transportation services and exempts TNCs from any other public agency or local government regulations. It requires that TNCs comply with the following requirements:

- Provide riders with any applicable rates and the option to receive an estimated fare before entering a driver's vehicle
- Use a software application or website to display a photograph of the driver and license plate number of the vehicle providing service
- Transmit an electronic receipt after the completion of a ride, which provides the consumer with information about the origin, destination, trip time, and trip distance as well as an itemized breakdown of the fare paid
- Implement a zero-tolerance policy on the use of drugs and alcohol when a driver is providing transportation services (either driving a passenger or passively logged into the application)
- Require driver applicants to provide, at a minimum, their address, age, driver's license number, and vehicle registration during the application process
- Maintain trip records for each driver for a minimum of one year
- Conduct a local and national criminal background check on each applicant (or contract out to a third party)
- Obtain motor vehicle records for each applicant to review past moving violations.

Tennessee's law requires that the driver, the TNC, or both maintain (1) automobile liability insurance of at least $50,000 for death and bodily injury per person, $100,000

for death and bodily injury per incident, and $25,000 for property damage while logged into an app but not engaged in a ride and (2) at least $1 million in liability insurance for death, injury, or property damage while a driver is providing TNC services.

Additionally, TNCs are required to establish procedures to report complaints of driver drug and alcohol use. TNC drivers are prohibited from soliciting or accepting street hails or cash payments. The law also prohibits discrimination against and higher fares imposed on disabled passengers. The services must provide passengers with the ability to indicate the need for a wheelchair-accessible vehicle. If a ride in a wheelchair-accessible vehicle cannot be arranged, the TNC must direct the rider to an alternative service with a wheelchair-accessible vehicle, if available. Finally, TNCs are prohibited from disclosing a rider's personal identifiable information. (Tennessee 2015)

TAXATION

Confusion about shared mobility services has often led to the implementation of state and local taxes that raise service costs. Rental car taxes have been popular among politicians because the taxes were believed to target visitors rather than voters. However, the distinction between carsharing and hourly car rental has blurred after a series of legal disputes making the relationship between taxes and services less clear. In addition, this issue is complicated by the entry of rental car companies into the carsharing market. Four types of taxes are levied on carsharing modes: (1) state, county, and municipal sales taxes applied to shared mobility (e.g., percentage-based taxes on sales or receipts from sales), (2) rental car taxes (e.g., state and local percentage-based taxes on the transaction value of a vehicle rental), (3) transaction fees and per-use excise taxes (e.g., a fixed-rate tax or fee applied to a transaction), and (4) miscellaneous taxes applied to shared mobility (e.g., percentage-based and fixed-rate taxes used to fund public transportation and special projects, such as convention centers and arenas).

A study of carsharing taxes found that municipal governments with the highest total tax rates charged between 34.44 percent and 61.89 percent on an hourly carsharing reservation (Table 3.3, p. 54) (Schwieterman and Spray forthcoming). In addition, hourly rentals were charged a much higher tax rate than 24-hour reservations and significantly higher than the average tax rate for other goods and services. The result is that short-term vehicle users, such as

TABLE 3.3. CITIES WITH THE HIGHEST TAX RATES FOR CARSHARING

City	Total Cost for One-Hour Rental ($)	Hourly Base Rate ($)	Tax ($)	One-Hour Reservation Tax Rate (%)	Sales Tax Rate for Goods and Services (%)
Fresno, CA	14.57	9.00	5.57	61.89	8.75
Jersey City, NJ	15.70	10.00	5.70	57.00	7.00
Tuscon, AZ	13.12	8.50	4.62	54.35	8.60
Columbus, OH	13.70	9.00	4.70	52.22	7.50
Phoenix, AZ	11.17	7.50	3.67	48.93	8.60
Pittsburgh, PA	15.18	10.25	4.93	48.10	7.00
Jacksonville, FL	12.84	9.00	3.84	42.67	7.00
Denver, CO	12.19	9.00	3.19	35.44	7.65
Albuquerque, NM	12.10	9.00	3.10	34.44	7.19

Expressed as a percentage of the cost of the reservation, with comparison to general sales tax rate

Source: Schwieterman and Spray (forthcoming)

carsharing members, often pay notably higher tax rates for their hourly rentals.

In many places, carsharing members are charged some combination of state and local sales and rental car taxes. Table 3.4 provides examples from cities and states across the country. By 2009 a total of 115 rental car excise taxes had been enacted in 43 states and the District of Columbia, many of which were being applied to carsharing (American Car Rental Association 2011). In the subsequent 15 years, taxation of shared transportation services, specifically carsharing, has become a public policy issue. In 1999 Multnomah County, Oregon, was one of the first jurisdictions to amend its code to exempt carsharing from the rental car tax (17 percent in that jurisdiction). In 2005 the City of Chicago amended its municipal code and eliminated the 8 percent "personal property lease transaction tax" on carsharing rentals of less than 24 hours.

However, as these jurisdictions were exempting carsharing from rental car taxes, other jurisdictions were announcing that carsharing would be subject to rental car excise taxes. The State of Washington in 2007 announced that carsharing operators would be required to pay the state's 9.7 percent rental car tax. In Boston, carsharing members were assessed a $10 "convention center financing surcharge" on every vehicle rental transaction (Bieszczat and Schwieterman 2011).

The state has revised its policy for carsharing to collect the surcharge fee only once on the first carsharing reservation of an annual membership contract.

Some states have also implemented transaction fees and per-use excise taxes. In January 2015, Hawaii started charging a carsharing tax of $0.25 for each half hour that a vehicle is rented through a carsharing program. Previously, the state had been applying a flat three-dollar rental car transaction fee on all carsharing rentals (Cole 2014). At the same time, Florida lowered its carsharing per-use excise to one dollar. Previously, the state had been charging two dollars for each carsharing rental (Auto Rental News 2015).

Excise taxes have also affected other shared modes, such as bikesharing and on-demand ride services. Some bikesharing programs charge a sales tax but bundle the tax into member and usage fees. Other programs add it onto the rental fees, making it difficult for bikesharing users to understand the actual cost of bikesharing. For example, Madison B-cycle includes a sales tax in its membership and usage fees, while Citi Bike users are billed the advertised rates plus tax.

Another issue is that the federal government has not yet recognized bikesharing as a form of public transportation. Under the US tax code, qualified transportation benefits are

TABLE 3.4. EXAMPLES OF SALES, RENTAL, AND TRANSIT TAXES APPLIED TO CARSHARING

Austin, Texas, carsharing members are charged up to 15% for the following taxes:

- State rental car tax: 10%
- Municipal rental car tax (if a rental starts within the city): 5%

Columbus, Ohio, carsharing users are subject to a 7.75% tax rate consisting of:

- State sales tax: 5.75%
- County tax: 1.75%
- Central Ohio Transit Authority tax: 0.25%
- City rental car surcharge: $4.00

Denver carsharing members are subject to 11.25% tax rate consisting of:

- State sales tax: 2.9%
- Rental car tax: 7.25%
- Regional Transportation District tax: 1.10%
- Road Safety Program fee: $2.00

Miami members are charged a 7% sales and use tax plus a $2 daily Florida rental car surcharge.

Minneapolis carsharing trips are subject to a 21.975% tax rate consisting of:

- State sales tax: 6.875%
- Minneapolis local city tax: 0.5%
- Transit improvement sales tax: 0.25%
- Hennepin County sales tax: 0.15%
- Rental car tax: 9.2%
- Leased or rented vehicle fee: 5%

San Diego carsharing users are subject to an 8% sales and use tax.

Seattle users are subject to a 17.3% tax consisting of:

- State sales tax: 6.5%
- Seattle sales tax: 3.1%
- State rental car tax: 5.9%
- Local rental car tax: 1.8%

Washington, DC, carsharing members are subject to a 10% sales and use tax.

Source: Schwieterman and Spray (forthcoming)

a type of statutory employee or fringe benefit that may be excluded from gross income. The current tax code allows public transit pass holders, vanpool participants, and private-bicycle commuters (non-bikesharing users) to lower their commuting costs by using pre-tax dollars to pay for commute expenditures (US Department of the Treasury 2015). Bikesharing users, however, are prevented from claiming transportation costs as pre-tax deductions.

Tax issues affecting on-demand ride services, such as Lyft and Uber, are more complex. Whether drivers or on-demand ride services should pay sales taxes remains an unresolved issue. Generally, however, websites and mobile platforms facilitating third-party transactions, such as Amazon and eBay, collect sales tax on behalf of their sellers because as third parties they collect payments and facilitate monetary exchanges.

DEVELOPING SHARED MOBILITY POLICIES

Numerous local and state public agencies are involved in shared mobility policy and regulation, often with shared or overlapping responsibilities. Identifying the most appropriate primary regulatory authority may be difficult for policy makers. Many of the responsibilities for regulating for-hire vehicle services may be shared among multiple local and state agencies. Policy makers and urban planners should develop policies aimed at increasing accessibility, enhancing mobility, and maximizing the benefits of shared mobility—such as decreasing energy consumption, reducing congestion, and improving air quality. Policy approaches that support shared mobility, including the provision of public rights-of-way and incentive-based zoning, are a few ways that urban planners can encourage shared mobility in their communities. Documentation of social and environmental impacts should be collected whenever possible to support policy development and revisions, as appropriate.

CHAPTER 4
DEVELOPING A SHARED MOBILITY PLANNING AND POLICY FRAMEWORK

For more than two decades, shared mobility has been employed by numerous local governments and urban planners as a strategy to address a range of climate, environmental, and congestion mitigation goals while simultaneously increasing accessibility options and encouraging multimodal travel by users. Over the past decade, some of the most notable challenges confronting local governments and public agencies regarding shared mobility planning and policy have included: incorporating shared mobility into the planning process; fostering citizen involvement and consensus building in planning and policy making around shared mobility; supporting shared modes and developing public policies that balance competing demands for finite resources, such as on-street parking; and developing public policies that are equitable for both emerging and incumbent service models, such as on-demand ride services and taxis. This chapter addresses each of these planning-related issues and presents examples of shared mobility included in plans from municipalities across the country.

SHARED MOBILITY AND PLANNING PROCESSES

The planning process allows planners and policy makers to document the state of transportation networks (including access and mobility) and establish goals and policies to guide future growth and infrastructure development. Addressing shared mobility in the planning process serves a dual purpose. First, it can document the role of shared mobility and its impacts on travel behavior and evolve transportation forecasts and models, as appropriate. Second, it can leverage understanding of the positive social and environmental impacts of shared mobility to increase infrastructure efficiency, mitigate congestion and air pollution, and incorporate shared mobility into future planning and policy-decision activities. Planning can be done at various levels and produce a range of plans, including comprehensive plans, community plans, and specific plans.

Comprehensive Plans

Comprehensive plans—also known as general or master plans—are plans with a set of long-term goals and policies that communities use to guide development decisions. While these plans typically establish a planning vision around specific issues (e.g., transportation), these high-level plans rarely regulate these areas. Common plan elements include transportation, land use, housing, conservation and climate, open space, noise, and public safety. These plans offer planners an opportunity to catalog the array of mobility services, such as

shared mobility, in a municipality beyond major roads and public transportation.

Santa Monica, California: General Plan

In California, communities are required to formulate a general plan that comprises seven statutory elements: (1) land use, (2) circulation, (3) housing, (4) conservation, (5) open space, (6) noise, and (7) safety. An update of the City of Santa Monica's land-use and circulation element in the 2010 general plan calls for the implementation of carsharing as part of the city's goal to increase multimodal options and mitigate congestion. The plan includes shared mobility as a strategy to reduce greenhouse gas (GHG) emissions and future congestion (Santa Monica 2010, 3.2-2):

> A developer who seeks to develop projects above the base height shall also be required to provide additional Transportation Demand Management (TDM) trip reduction measures to address congestion and GHG emission reduction. TDM incentive programs could include: bicycle facilities, shower facilities, dedicated shuttles, flex cars, transit passes, parking cash-out programs, car-sharing programs, on-site transportation information, and shared parking programs.

The plan identifies two key approaches to increase carsharing: (1) new development that provides "right-of-first-refusal" to parking spaces for carsharing organizations and the

city and (2) the provision of public on- and off-street spaces to qualified carsharing operators for little or no charge. In addition, as part of a coordinated parking management strategy, the plan recommends that the city "bring car-sharing to Santa Monica. In other urban markets in the United States, every carshare vehicle provided has eliminated up to 25 private vehicles, with residents selling their second or only car, or avoiding the purchase of a car altogether. Such neighborhood rental cars are perfect for Santa Monica, especially as its transit investments make it easier to live without multiple vehicles" (Santa Monica 2010, 4.0-69).

Seattle, Washington: Comprehensive Plan

Seattle has a long history of incorporating shared mobility into its comprehensive planning process. The city is currently updating its comprehensive plan. The draft plan recognizes that "new technological innovations in transportation such as smart parking and shared transportation options will change the way people move through Seattle" (Seattle 2015, 72). It also acknowledges the overall benefits of a wide array of transportation options, including shared mobility (Seattle 2015, 77):

> Transit, bicycling, walking and shared transportation services reduce collisions, stress, noise, and air pollution, while increasing social contact, economic vitality, affordability, and overall health. . . . How the City manages curb space can affect the efficiency of various travel modes. Bicycles, buses, cars, taxis, food trucks, parklets, shared transportation vehicles, deliveries, and other uses all need curb space.

The draft plan also includes a number of specific policies related to shared mobility (Seattle 2015, 75, 78):

T2.1. Designate space in the public rights-of-way to accommodate multiple travel modes, including public transit, freight movement, pedestrians, bicycles, general purpose traffic, and shared transportation options.

T2.3. Employ the following tactics to resolve potential conflicts for space in the [rights-of-way]:

- Allocate needed functions across a corridor comprised of several streets or alleys, if all functions cannot fit in a single street
- Share space among modes and uses
- Prioritize assignment of space to shared and shorter duration uses

- Encourage off-street accommodation for non-mobility uses, including parking and public transit layover
- Implement parking and transportation demand management strategies to encourage more efficient use of the existing rights-of-way

T3.11. Develop programs and facilities, such as bike share, that encourage short trips to be made by walking or biking.

Adoption of Seattle's comprehensive plan update is anticipated to occur during the summer or fall of 2016.

Community Plans

A community, or subarea, plan focuses on a smaller area, such as a neighborhood. These plans may be part of a larger master plan, or they may be standalone plans. Their purpose is to address specific issues in more detail in more focused areas. Community plans offer planners an opportunity to identify the locations and availability of shared mobility services within particular neighborhoods.

For example, the Association of Bay Area Governments (ABAG) has established Priority Development Areas (PDAs) (ABAG 2015). PDAs represent growth areas that ABAG communities have identified. These areas are generally made up of at least 100 acres and have public transit service. The City of Rohnert Park in Sonoma County, California, received a PDA grant from the region's Metropolitan Transportation Commission. The city incorporated shared mobility into multiple areas of its PDA plan, including goals, policies, and implementation actions (Rohnert Park 2015, 5-1, 8-5):

5.2. Circulation and Connectivity Goals and Policies, Policy C-5.6: Encourage car share or bike share programs within the PDA through partnership with car sharing or bike sharing entities.

8.3. Implementation Actions, D.7 Circulation Improvements, Car Share or Bike Share Program: The City will study the feasibility to implement car share and bike share programs at the SMART rail station or City Center, through partnership with car-sharing or bike sharing entities.

Specific Plans

Specific, or functional, plans are the most detailed plans, and they are used to implement particular planning provisions. Specific plans generally include special development standards that apply to limited geographical areas. In some

jurisdictions, specific plans can be used in lieu of zoning ordinances. The development of specific plans allows planners to illustrate how shared mobility can be deployed at specific sites and support urban design that connects people and places through a cohesive mobility vision. In California, the City of Santa Monica has developed a draft downtown community plan that that includes shared mobility services as a policy goal (Santa Monica 2016a, 28, 143):

Policy LU1.3: Promote the development of uses and facilities that enable and encourage mobility by alternative modes to the automobile; these include businesses for sale, service, rental, and sharing, of bicycles, as well as rideshare, flex vehicle leasing and rental services.

Action AM3.7B: Create curb space for new mobility modes as part of a coordinated approach such as bike corrals, ride sharing and ride hailing, car share, and shuttles.

Lead Agency: PCD [Planning and Community Development] Supporting Agencies: PW [Public Works], Police Timeframe: Short-Term

Santa Monica's community plan is currently undergoing environmental review in accordance with the California Environmental Quality Act (Santa Monica 2016b). It is anticipated that the provisions incorporating shared mobility will be included in the final plan and approved in the summer of 2016.

Seattle, Washington: Transportation Strategic Plan
Since 1998 the City of Seattle has maintained a Transportation Strategic Plan (TSP) outlining the city's strategies, projects, and programs that implement local transportation policies and goals. Today Seattle's most recent TSP (adopted in 2005) covers a 20-year time horizon and incorporates carsharing as a key transportation demand management (TDM) strategy (Seattle 2005, 65):

TDM6. Encourage Car Sharing. Continue to support Seattle's car sharing organizations. Car sharing helps extend the public transportation network, increase transportation choices, reduce the land devoted to parking spaces, and reduce the overall number of car trips and vehicle miles traveled (VMT). Seattle has the nation's oldest and largest car-sharing program called Flexcar [now Zipcar], developed as a public-private partnership with King County Metro and a private firm. In previous years, the City of Seattle has provided funds for off-street parking

incurred by the program and the City modified the Land Use Code to provide incentives for new development to offer car-sharing spaces in new buildings. SDOT [Seattle Department of Transportation] continues to sign on-street parking spaces for car-sharing parking where consistent with SDOT policies, and promotes and increases the awareness of car-sharing. SDOT should continue to investigate, evaluate, and explore methods of supporting carsharing organizations.

Integrating Shared Mobility into the Planning Process

Because of shared mobility's impacts on the transportation network, development regulations, and environmental policy, it should be incorporated into these planning documents—although historically this has rarely been done. Shared mobility can also help planners and policy makers achieve a wide array of long-term visions and shorter-range specific goals. For example, shared mobility in a comprehensive plan can support smart growth strategies that encourage densification and infill development; smart growth provides transportation choices that support first-and-last-mile connections and give people mobility options. Another example is shared mobility incorporated into a subarea plan to help planners reimagine an automobile-centered "edge city" or suburb by providing innovative and financially sustainable mobility options to complement traditional public transportation.

On a smaller scale, shared mobility could be incorporated into specific, functional, or even site plans—such as the inclusion of bikesharing into a transit-oriented development site plan—to encourage new urbanism. When incorporating shared mobility into plan making and implementation, policy makers and planners should consider and attempt to address the following issues: the lack of formal definitions for shared mobility modes, potential competition or lack of cooperation among service providers and stakeholder groups, and the role shared mobility could play in both dense urban and suburban environments.

Stakeholder and Public Involvement

Public and stakeholder involvement in shared mobility planning and policy making processes can reduce opposition, provide public agencies and mobility operators with valuable information on community and stakeholder concerns, reduce conflict among stakeholders, and help jurisdictions comply with public-agency environmental justice requirements. Fundamentally, planning should be a public decision-making

process to help communities ensure health, safety, livability, and conservation. Therefore, the plan-making process related to shared mobility as well as specific siting for shared modes frequently necessitates public participation. Public processes may vary depending on the exact role of elected and appointed officials. For example, appointed boards (e.g., planning commissions) may have the authority to approve specific policies or projects incorporating shared mobility, subject to the appeal of elected officials. In other jurisdictions, appointed officials may serve only in an advisory capacity, leaving project or policy approval up to elected officials.

Public engagement by planners on shared mobility issues helps in different ways. On one level, involving the public in decisions pertaining to shared mobility ensures fair treatment, where no community bears a disproportionate share of the negative impacts of shared mobility or benefits more from the positive impacts. For example, one neighborhood should not be given more access to innovative mobility services than another neighborhood.

On another level, planners can engage the public to coordinate meaningful involvement. Specifically, planners should ensure that stakeholders have the opportunity to participate in the decisions about shared mobility that affect them. For example, this could include providing both business owners and residents on a particular parcel or block ways to provide input on proposed changes to on-street rights-of-way. It could also involve incorporating the topic of shared mobility into planning focus groups and planning documents, encouraging civic participation in policy and tax issues, and fostering public involvement in the design and implementation of developer incentives for the inclusion of shared mobility (e.g., reduced parking minimums in exchange for the inclusion of shared mobility in TDM initiatives). Planners should continually ensure that the public can contribute to and influence shared mobility policies. The public and stakeholders can also provide important input to municipal staff and elected officials on a wide array of issues related to shared mobility implementation, such as the location of on-street carsharing vehicles, bikesharing kiosks, and pick-up and drop-off zones for on-demand vehicles and taxis.

Typically, these processes reflect a jurisdiction or agency's policies and procedures and vary by municipality. Washington, DC, as described in the following section, has opted to receive feedback through neighborhood councils. Other jurisdictions have used public hearings, town hall meetings, and staff review processes. Some municipalities have provided municipal staff and regulatory agencies wider authority to develop and manage policies, such as public comment periods

and administrative law hearings. Flexible and collaborative public processes often reflect best practices in policy making, planning, and problem solving because they can reduce conflict (and litigation) among stakeholders, while simultaneously advancing shared goals.

Although federal definitions of environmental justice often focus on equity around race, ethnicity, disability, and income, planners and public agencies should consider expanding the definition of special-needs populations to include other populations facing mobility challenges, such as older adults and zero-vehicle, single-parent, and non-English-speaking households. By broadening environmental justice considerations, planning and public agencies can better leverage the benefits of shared mobility to enhance access and mobility among a broader segment of the community, particularly those with unmet transportation needs.

Washington, DC

In Washington DC, the director of the District Department of Transportation (DDOT) may authorize a one-year contract for on-street carsharing parking. The city's municipal regulations permit the director to designate such spaces without publishing notices, provided that the director consults and notifies Advisory Neighborhood Commissions (ANCs). Established in 1974 by a district referendum, ANCs comprise elected commissioners and hired staff who consult on a wide array of policies and programs affecting neighborhoods. The district's regulation also allows DDOT to mandate that up to seven vehicles be located in low-income neighborhoods, require carsharing operators to provide data to DDOT for evaluating program impacts, permit special license plates for parking enforcement of carsharing parking spaces, and allow unauthorized vehicles to be fined (DC Municipal Regulations, Title 18, §§ 2404, 2406, 2601, 3313, 9901).

New York, New York

As part of the planning process for the Citi Bike bikesharing program, the New York City Department of Transportation conducted 159 public meetings, presentations, and demonstrations between the fall of 2011 and the spring of 2013. The outreach included two Spanish presentations and a Mandarin-Cantonese presentation. In addition to this in-person outreach, the city conducted virtual outreach and received more than 10,000 station suggestions and 55,000 notices of support for proposed stations. The Citi Bike planning and visioning process was one of the most extensive efforts undertaken in the development of a shared mobility system (New York City Department of Transportation n.d.).

SEATTLE, WASHINGTON'S COLLABORATIVE STAKEHOLDER POLICY PROCESS

In March 2014, Seattle's city council voted to impose a limit of 150 drivers on each transportation network company (TNC)/ridesourcing company platform—an agreement that left both TNCs/ridesourcing companies and taxi lobbyists displeased. Seattle's mayor then convened representatives from taxi companies, the Western Washington Taxi Cab Operations Association, and ridesourcing companies. In June 2014, they reached a compromise. Under the brokered compromise, the city agreed to issue 200 new taxi licenses over a four-year period and removed the 150-driver limit. In addition to lifting the ridesourcing driver limit, the agreement requires that these companies be licensed and insured, and it established a 10-cent-per-ride surcharge for an accessibility fund to pay for riders who require Americans with Disabilities Act (ADA) accessible services. By bringing all of these stakeholders together, Seattle was able to accomplish a number of important goals, which benefited both stakeholders and the public. The city was able to increase the number of available taxi and ridesourcing drivers, protect consumer safety through new insurance requirements, and establish a policy to help ensure ADA compliance.

Figure 4.1. Factors and participants driving mobility policy in the sharing economy (Susan Shaheen and Adam Cohen)

POLICY PLANNING FOR SHARED MOBILITY

As mobility services in the sharing economy have grown and evolved, the need to develop and manage public policy for these emerging modes has also expanded. This evolution brings with it a host of new, complicated, and often unanswered questions. Can carsharing be considered its own mode? Is it akin to an hourly rental car service with a virtual storefront? Are on-demand ride services (such as uberX and Lyft) ridesharing, e-Hail taxi services, or a different mode altogether? Should owners renting their private vehicles or bicycles through peer-to-peer services be subject to sales or rental car taxes? At what point do these activities switch from "hobbies" to cost recovery activities (e.g., activities that involve reimbursement for gas or tolls) to for-profit ventures? Should these business models have a bearing on public policy? Do two individuals sharing a ride constitute a carpool, or does this situation involve a driver acting as a sole proprietor with clients? Is joint ownership of a vehicle a cooperative or a business partnership?

Advanced technologies coupled with innovative and not clearly defined service models have increased the need for public policy guidance. Local governments, public transit agencies, parking authorities, employers, developers, and shared mobility operators represent some of the many different stakeholders that influence and are influenced by shared mobility operations and policies. Figure 4.1 illustrates some of the diverse interests and stakeholders challenging the existing and proposed mobility policies of local governments. Many of the stakeholders may

TABLE 4.1. CONSIDERATIONS IN THE ALLOCATION OF SHARED MOBILITY RESOURCES

Service Characteristics (e.g., hourly rentals, membership-based services)
- Business characteristics (e.g., for-profit, nonprofit)

Procedures for Allocating Rights-of-Way
- Jurisdiction (e.g., city staff, city council, parking authority)
- Process (e.g., first-come, first-served; lottery, auction; request for proposals)

Methodology for Valuing Rights-of-Way
- Cost recovery of program administration
- Foregone meter, permit, and other revenue
- Supply and demand (e.g., auctions)
- For profit (e.g., generate revenue for local coffers)

Management of Competition
- Methods for managing competition between operators (e.g., two carsharing operators seek the same on-street parking locations/space)
- Methods for managing competition between modes (e.g., ridesourcing, taxis, liveries, and other for-hire services)
- Method for dispute resolution (e.g., administration hearings/appeals, mediation, arbitration, litigation)

Source: Susan Shaheen and Adam Cohen

have a variety of similar, and in some cases competing, goals and interests. Innovative policies and collaborative partnerships can help forge partnerships and overcome challenges.

When considering the allocation of public resources, such as on-street parking and loading zones, and the development of public policies, such as taxation and the distribution of vehicle medallions, policy makers and urban planners should consider service characteristics, procedures for allocating and valuing rights-of-way, and management of competition. Table 4.1 provides a summary of these various issues.

Over the past decade, one trend has been clear: increasing competition among operators and modes. It is imperative that local governments and public agencies involve these different stakeholders in the planning process and develop equitable policies that include diverse interest groups. Some of the methods that can be used to address competition among operators and modes—particularly when considering the allocation of public rights-of-way and other finite resources—are shown in Table 4.2.

TABLE 4.2. METHODS USED TO ADDRESS COMPETITION AMONG OPERATORS

Method	Description	Advantages and Disadvantages	Example
First-Come, First-Served	A public policy where requests for public rights-of-way by private operators are attended to in the order they arrive	**Advantages**: No need to develop more sophisticated policies, particularly when there is only one requester **Disadvantages**: Policy may give preferential treatment to market incumbents; new entrants may have difficulty getting access to the same resources if those resources are taken by an earlier requester	In 2004 the Chicago Transit Authority approved a pilot to allow I-GO, a local carsharing operator, to have parking at five stations.
Lotteries	A public policy where requests for rights-of-way are selected by random drawing	**Advantages:** Generally perceived as fair **Disadvantages:** Excludes other potentially mitigating factors that may warrant preferential or disadvantageous treatment to further the public good	In San Diego, the Metropolitan Transit System issues taxi medallions by lottery to drivers meeting minimum experience requirements.
Auctions	A public policy where requests for rights-of-way are granted to the highest bidder	**Advantages:** Raises money for municipal coffers and establishes market rate pricing for public rights-of-way **Disadvantages:** Equity issues where operators with greater financial resources can outbid operators with fewer financial resources; costs may be passed onto the carsharing consumer	In 2011 Washington, DC, established parking auctions to allocate carsharing parking between operators
Preferential Treatment	A public policy that gives preferential treatment to a specific mobility operator for a particular reason (e.g., providing preferential parking to PhillyCarShare because of its nonprofit status)	**Advantages:** Allows a public agency to incentivize certain behaviors or characteristics **Disadvantages:** Requires careful planning and legal review to ensure policy is fairly implemented	Philadelphia's former carsharing parking policy allowed on-street parking for nonprofit operators.
Collaborative Approaches	A public policy employing a collaborative process, such as negotiation or mediation, in an attempt to reach a mutually beneficial outcome	**Advantages:** Brings all stakeholders together to possibly obtain a mutually beneficial outcome **Disadvantages:** Not all parties may be willing to have an open dialogue	In 2014 Seattle gathered representatives from TNC/ridesourcing, taxi, and labor stakeholder groups to develop a compromise policy that removed the limit on the number of TNC/ridesourcing drivers and increased the number of taxi licenses.
Requests for Proposal	A solicitation, often through a bidding process, by a public agency or government interested in procuring a shared mobility service	**Advantages:** Gives public agencies and local governments greatest control to select the service characteristics and requirements they desire **Disadvantages:** Potentially time consuming and susceptible to litigation if not properly executed	The Street Transportation Department in Phoenix, Arizona, issued a request for proposals for a bikesharing program; it specified "ideal" program characteristics.
Tandem Policies	A public policy where every stakeholder receives an equal share of the public rights-of-way	**Advantages:** Generally perceived as fair **Disadvantages:** May not be appropriate for vastly different scales of shared mobility services to give large and small operators the same allocation	In 2006 the San Francisco Bay Area Rapid Transit District approved eight parking spaces each for Flexcar and Zipcar, two competing carsharing operators.

Source: Susan Shaheen and Adam Cohen

TABLE 4.3. SHARED MOBILITY POLICY FRAMEWORKS

	Shared Mobility as an Environmental Benefit (maximum governmental support)	Shared Mobility as a Sustainable Business (moderate governmental support)	Shared Mobility as a Business (minimum governmental support)
Allocation of Rights-of-Way	Jurisdiction may allocate public rights-of-way (e.g., parking, loading zones) on a case-by-case basis or through more informal processes, such as non-binding council/board of director resolutions.	Jurisdiction that once allocated public rights-of-way through an informal process formalizes this process.	Jurisdiction maintains a highly formalized and established process for the allocation of public rights-of-way, including a process for allocation among multiple operators.
Fees and Permits	Recognizing the social and environmental benefits of shared mobility, public rights-of-way are provided free of charge or significantly below market cost.	Fees may be based on cost recovery of providing rights-of-way (e.g., fees based on foregone meter revenue and administrative costs) associated with providing on-street parking. In other instances, fees may be reduced to reflect environmental goals, such as charging a reduced carpooling rate for carsharing parking.	Fees are based on a cost recovery or profit-based methodology. This could include permit costs, lost meter revenue, and administrative expenses for program management.
Signage, Markings, and Installation	Jurisdiction pays for the sign installation and maintenance, striping, and markings associated with the shared modes.	Jurisdiction pays for the installation, and the operator pays for the maintenance of signage, striping, and markings.	Jurisdiction requires shared operators to pay for the installation and maintenance of signage, striping, and markings.
Social and Environmental Impact Studies	Shared operators are required to study and document local social and environmental impacts at regular intervals.	Shared mobility operators may be required to study and document local social and environmental impacts on a one-time basis or at regular intervals.	Shared mobility operators are not required to study and document any social or environmental impacts.
Public and Stakeholder Involvement	Informal process, if any, led by the jurisdiction to elicit public input into the location and scaling of shared modes on public rights-of-way. For example, staff may internally determine the location and number of carsharing parking spaces or public bikesharing stations without public comment.	Informal process where the jurisdiction and shared mobility operator seek public input into the locations of shared services through public notification and staff management of possible public concerns.	Highly formalized process where shared mobility operators are responsible for obtaining public input and approval on the locations of services through neighborhood councils, commissions, or formal hearings.

Source: Susan Shaheen and Adam Cohen

Broadly, public agencies may allocate public rights-of-way on a case-by-case basis (e.g., informal processes, such as collaborative approaches) or through formal processes (e.g., ministerial acts, such as lotteries, auctions, and tandem policies). The types of policies implemented by a jurisdiction will often depend on local law, custom, and the competitive nature of the shared mobility marketplace (e.g., how many companies are vying for public rights-of-way, how competitive or collaborative these companies are with each other). Fewer marketplace competitors and "friendly"

competition tend to lead to more informal and collaborative policy approaches. A more competitive marketplace tends to necessitate that public agencies develop more formalized policies and often market-based approaches, such as auctions and lotteries.

Three policy tracks can be used by local governments and public transit operators as models for developing their shared mobility policies. The policy approaches together provide overall policy frameworks for the allocation of public rights-of-way, fees and permits, signage, impact studies, and

public/stakeholder involvement based on varying degrees of governmental support. Table 4.3 outlines the characteristics of each of these frameworks, and they are discussed in more detail in the following sections.

Shared Mobility as a Social and Environmental Benefit

The first framework is based on the social and environmental benefits of shared mobility and maximum governmental support. Under this framework, public agencies and local governments consider the role of shared mobility in mitigating a variety of public costs associated with personal automobile use. As such, policy makers and planners view shared mobility as contributing to the public good and therefore justify the allocation of public resources (e.g., in-kind financial support, free or reduced-cost parking). This framework also includes maximum governmental support from public agencies through the allocation of public rights-of-way through less formal processes (e.g., staff/administrative review, case-by-case approvals), often waiving permits and other fees and paying for the installation of signage and other infrastructure maintenance needs for shared mobility (e.g., parking markings).

Due to the informal nature regarding the allocation of rights-of-way, public agencies may or may not solicit public involvement on the location and scaling of shared mobility. Rather, agency staff will likely require that shared mobility operators provide social and environmental impact data. Data documenting the positive social and environmental impacts of shared mobility can make it easier for public agencies to continue less formalized processes and increase public support.

Shared Mobility as a Sustainable Business

The second framework considers shared mobility to be a sustainable business with moderate governmental support. Under this framework, local governments and public agencies view shared mobility as comprising services that generally yield net social and environmental benefits but are simultaneously revenue-generating enterprises. Local governments, therefore, provide more limited support and infrastructure for shared modes, and mobility operators are expected to carry a larger share of the operational costs. For example, public agencies may base permits and other fees on a cost-recovery method (e.g., cost of program administration, recapture of foregone meter revenue), and the jurisdiction and the private operator may share the costs of installation and maintenance of signage and street fixtures. Public agencies may or may not require impact studies and public comments regarding the scaling and location of shared modes, and this process is often managed informally by agency staff.

Shared Mobility as a Business

In the final framework, shared mobility is treated like a business, and local governments provide a minimum level of governmental support. Under this policy framework, shared mobility is viewed as similar to other commercial operators, and these operators bear the full costs of operations (e.g., operators pay the full cost for public rights-of-way). In this laissez-faire approach, public agencies often provide little or no support for shared mobility. If an agency allocates public rights-of-way, it is often done through highly formalized processes, supply-and-demand management, and pricing that typically generates cost plus revenue for a jurisdiction (e.g., parking auctions). Operators are typically required to pay for the cost of installation and maintenance of all signage and necessary street fixtures for operations. Jurisdictions providing minimal government support typically have highly formalized processes for soliciting public feedback and may not require impact studies of shared mobility.

PLANNING AND POLICY MAKING FOR SHARED MOBILITY

The planning process is a way for planners and policy makers to assess the state of the transportation network and establish goals and policies to guide future growth and infrastructure development. Incorporating shared mobility into this process allows local governments and public agencies to understand modal and intermodal complexities affecting the transportation system and provides an opportunity for practitioners to use shared mobility as a possible strategy to improve infrastructure efficiency, mitigate congestion, and reduce air pollution and greenhouse gas emissions. The three policy frameworks can offer local governments and public agencies possible models for developing shared mobility policies while also addressing competition among a growing numbers of operators.

A TALE OF TWO DISRUPTIONS

Melanie Crotty, Director of Operations, Metropolitan Transportation Commission

The mission of the Metropolitan Transportation Commission (MTC) is to build a stronger transportation system that works for everyone, promotes economic vitality, and protects the environment. As the San Francisco Bay Area's metropolitan planning organization (MPO), MTC works to be a part of every trip San Francisco Bay Area travelers take. There is a clear opportunity—and some would say imperative—for the region to actively incorporate innovation into its transportation system. The interest in shared mobility services is simple: MTC views them as a promising new way to fill the unused capacity in vehicles and to complement transportation investments. But before fully embracing these new modes, MTC is also considering the possible impacts and consequences of these transportation innovations.

Shared Mobility in the Region

While much of the media's attention has focused on app-based mobility providers, such as Uber and Lyft, other ridesharing and carpooling services are emerging and increasingly available to Bay Area residents. For example, Google-owned Waze recently launched a local carpool pilot program with 25,000 employees. The region has also quickly emerged as an important location for other shared mobility modes: bikesharing, carsharing, scooter sharing, microtransit, employer shuttles, and app-based mobility aggregators. These new technologies and business models are disrupting incumbent transportation modes.

Many of these services are privately funded, and there is a lack of reliable and consistent transportation planning information about basic features of these programs, including usage, trip deci-

sions, and service areas. A 2015 report estimated that the city of San Francisco had 23 private-sector mobility service providers and 10 different types of services available (Frontier Group 2015). Similar regional estimates are not available; it is unclear how many of services are available and whether they are providing longer-distance, cross-county regional trips. MTC is pursuing two different initiatives to enhance its understanding of these private-sector initiatives. First, MTC is partnering with private ridesharing providers to better understand how these services are affecting the traditional carpooling market. Second, MTC is coordinating with employer shuttle operators to gain insight into their impact on public transportation systems.

Breathing New Life into Carpooling

MTC has long managed the regional rideshare program. The US Census Bureau's American Community Survey has shown that since 2006 carpooling has been steady at about 10 percent of the region's commute mode share. While carpooling participation has stagnated, Bay Area freeway congestion and public transit ridership are at near historic highs (Vital Signs 2015). Given the constraints of both transit and highway infrastructures, MTC believes filling empty seats in cars is the quickest and most cost effective way to provide more capacity.

MTC also believes that the private sector can enhance ridematching by cultivating a larger match database (to establish a critical mass), integrating ridesharing with other relevant traveler services, and providing a user-friendly interface that removes the barriers associated with traditional carpool matching.

To test this, MTC issued a call for partners among private-sector ridesharing app providers and subsequently executed agreements with four companies—Lyft, Scoop, Carma, and MuV. These partner organizations are piloting marketing and incentive strategies that encourage commuters to test new app-based carpooling services and that help to increase the ridesharing modal share. While not all the major carpool app providers are partnering with MTC yet, these partnerships improve access to private-sector data and are a mechanism to track travel behavior and gauge consumer interest.

If carpooling using private-sector apps proves successful, MTC plans to phase out its public ridematching database in the next few years. While MTC's primary objective is to increase occupancy in vehicles, another outcome would be the estimated savings of approximately $500,000 annually, if the private sector can take on ridematching functions. Other initiatives MTC hopes to support in the future that will make carpooling a more convenient and viable option for the public include the integration of app-based ridematching with MTC's 511 traveler information services, creation of common pickup/dropoff "hot spot" areas (e.g., an expansion of casual carpooling spots), integration with commuter park-and-ride facilities, coordination of first-and-last-mile connections to public transit, and vanpooling expansion.

The Ascent of Employer Buses

Public transit ridership in the Bay Area has been on the rise in the last few years. Bay Area Rapid Transit and Caltrain, regional rail services, set ridership records in 2014 with a continued increase in

2015 (Vital Signs 2016). However, some new players are on the transit scene. Large Bay Area employers are providing additional transit service and may be absorbing some of the peak demand of these two systems. These employer-sponsored shuttle services—operated by companies including Google, Facebook, Genentech, Apple, and Yahoo—provide transportation services exclusively for their employees primarily from San Francisco and the East Bay to employer sites in Silicon Valley. Capital and operating costs are covered entirely by these private-sector companies. MTC estimates that these buses, if grouped together as a single operator, would be one of the largest transit operators in the region.

MTC has different roles in the operations of employer shuttles versus public transit. For public transit agencies, it has statutory authority, both federal and state, for oversight and fund programming. While employer-shuttle providers generally will benefit from a number of regional initiatives MTC is pursuing (e.g., the network of express lanes currently under development), MTC's direct role is limited since these services are privately funded. Most of the public policy issues being addressed now are at the local level, with equity and safety related to the allocation of curb space for passenger pick-ups and drop-offs being one of the most prominent issues. MTC's primary activity has been to experiment with ways to collect passenger and service data and report on ridership. If employers continue to grow these fleets, MTC could possibly become more active, particularly in service coordination.

Looking to the Future

From its efforts around carpooling and employer shuttles, MTC hopes to better understand the potential contributions of shared mobility services and

their effect on the regional transportation network. As MTC explores ways to monitor, leverage, and support these services, it faces a growing list of public policy questions:

- Should regional MPOs continue to seek more data to better understand impacts?
- Should MPOs coordinate services or let market forces run their course?
- Can innovative mobility services complement public transit services, bikesharing, and carsharing?
- How should public transit respond to these innovations? Should MPOs be evaluating new business and service models?
- How does the growth of these services help meet the region's economic, mobility, and environmental goals? Is it appropriate to subsidize these services to incentivize "good behavior"?
- How can MPOs ensure equal access for all income levels, including the underbanked?
- How reliant on these services, many of which are not self sustaining and are funded by private investments, should the public sector allow itself to become?
- How are applicable laws regarding labor, accessibility, safety, and civil rights being enforced?
- Who is best suited to address these emerging issues? Who has authority over what?

While it will take time to answer these questions, it is clear that local officials and planning agencies cannot ignore the ongoing transformation of the transportation marketplace. In the last version of MTC's long-range plan for the region, *Plan Bay Area*, the chapter on "evolving transportation" was a single page in a 154-page document. Each sub-topic—automated vehicles, employer

buses, and ridesharing networks—was reviewed in a single paragraph. The plan was adopted in 2013, and what a difference a few years makes. MTC is now gearing up to develop the next version of the plan, which will be called Plan Bay Area 2040, and these mobility innovations will certainly warrant much greater attention because what we now view as disruptors will likely in the not-too-distant future be viewed as mainstays of how we get around.

CITY CARSHARE'S ACCESSIBILITY INITIATIVES

Teresa Gaynor, Special Projects and Operations Director, Carma

City CarShare launched in San Francisco in 2001. In 2015 it entered into a strategic alliance with Carma, a provider of commuter solutions. City CarShare powered by Carma provides two programs to enhance carsharing accessibility for disabled and low-income San Francisco Bay Area residents: AccessMobile and CommunityShare.

AccessMobile

For people with disabilities, transportation options are limited and mobility independence can be particularly challenging. In 2008 City CarShare introduced AccessMobile, the nation's first wheelchair-accessible carsharing program, in partnership with the City of Berkeley and Berkeley's Commission on Disability. AccessMobile's wheelchair-accessible vans offer riders increased independence and the ability to reach locations that are often otherwise inaccessible or where travel would be cost prohibitive using mass transit, paratransit, ridesourcing/transportation network companies, or taxi services.

AccessMobile also allows disabled members access to vehicles that meet the accessibility standards of the Americans with Disabilities Act without the cost of owning and retrofitting a private vehicle. The vans can seat up to six people and one wheelchair. Disabled members who do not have a driver's license can have a family member or friend sign up and drive for them. The AccessMobile program currently has three vans located in the cities of Berkeley and San Francisco.

CommunityShare

Despite the cost savings commonly associated with carsharing, serving low-income communities can be challenging. City CarShare and Carma have located over 60 percent of their fleet in low- to moderate-income neighborhoods in an effort to make carsharing accessible in these communities. They also offer CommunityShare, a plan providing reduced fees and driving rates for low-income residents.

In addition, City CarShare and Carma partner with affordable housing complexes, community associations, and other agencies and programs—such as the City of San Francisco's Working Families Credit program—to increase awareness of carsharing as a viable mobility option for low-income residents. Through affiliation with an accredited association, City CarShare and Carma provide carsharing memberships to eligible participants. In 2014 City CarShare was a founding member of the CarShare4All program, a partnership with the Contra Costa Transportation Authority and the Bay Area Climate Collaborative to expand City CarShare's fleet to underserved low-income communities in the East Bay, such as the cities of Richmond, El Cerrito, and Oakland.

SUPPORTING SHARED MOBILITY

In recent years, American cities have witnessed an urban renaissance. Demographic shifts, such as young professionals and retiring baby boomers relocating to urban centers, are contributing to a reversal of the historic suburban exodus that had become emblematic of America's growth for nearly six decades during the post-war years (Green 2014; Westcott 2014). These demographic changes, together with urban renewal and an increasing suite of modal options often facilitated through internet and mobile technologies, are beginning to transform how Americans live and travel. Technological, economic, environmental, and social forces have changed the sharing economy and shared mobility from niche topics to mainstream ones. This potentially transformative role in mobility has become a focus of conversation among new and prospective service providers and public agencies at all levels of governance.

This report underscores the need for more precise definitions of shared mobility given increasingly blurring lines between existing and emerging transportation modes. Many local entities either do not define or have differing definitions of shared mobility. For example, the State of Washington defines carsharing as "a membership program intended to offer an alternative to car ownership under which persons or entities that become members are permitted to use vehicles from a fleet on an hourly basis" (Revised Code of Washington, § 82.70.010). The City of Seattle defines "car sharing [as] a system in which a fleet of cars (or other vehicles) is made available for use by members of the car share group in a wide variety of ways. Car sharing provides an alternative to car ownership under which (a) persons or entities that become members are permitted to use vehicles from a fleet on an hourly basis; (b) vehicles are available to members in parking spaces at dispersed locations or facilities; and (c) no separate written agreement is required each time a member reserves and uses a vehicle" (Seattle Municipal Code, § 11.14.087). Although there are similarities in these two definitions, Seattle's approach includes more additional requirements needed to meet its local legislative definition of carsharing.

As shared mobility companies continue to expand and operate alongside taxis, limousines, and rental car services, more precise designations will help to advance public policy, guide regulation, and enhance public safety in existing, new, and planned markets. Developing clear, consistent, and pre-cise definitions can aid sector growth by providing policy and decision makers with a greater understanding of the spectrum of shared mobility services available and their associated impacts. This can also assist operators with a statewide or national target market rather than a strictly local service focus. In addition, planners and local municipalities can directly support shared mobility in their communities in a number of ways. The following sections describe strategies and activities to advance shared mobility goals.

BECOMING PARTNERS OF SHARED MODES

Governments and public agencies can support shared mobility by providing marketing and administrative assistance. For example, municipalities can engage in joint marketing campaigns with shared mobility operators and ensure that programs have visibility on public agency websites and in newsletters, outreach materials, and press releases. They can also serve as partners by becoming business customers of shared mobility services. The US General Services Administration, for example, which manages one of the largest federal government vehicle fleets, announced in the fall of 2014 that it was beginning a one-year pilot program to replace its fleet vehicles with Enterprise CarShare in Boston, Chicago, New York, and Washington, DC (Government Fleet 2014). Additionally, public agencies can support shared mobility providers, particularly nonprofits and startups, by offering administrative help, such as free or reduced-cost office space.

ALLOCATING FUNDS FOR SHARED MOBILITY

Grants and low-interest or interest-free loans from local municipalities and agencies to operators are another way to support shared mobility. These funds can provide the seed money for capital expenditures that may be unavailable through the private sector. This funding can also be used to finance feasibility studies and pilot programs. For example, $18 million in federal Congestion Mitigation and Air Quality Improvement Program funds and $3 million in municipal funds were leveraged to launch the first phase of Chicago's bikesharing program, Divvy (Chicago n.d.).

FORMING RISK-SHARING PARTNERSHIPS

Another way public agencies can support shared mobility is through risk-sharing partnerships. Using the "subtraction model," a shared mobility operator values the monthly operational cost of providing a service at a particular location and then subtracts the monthly revenue. If there is a shortfall, they can bill the partner. Under this model, the risk-sharing partner only pays the cost needed to maintain service availability. This can also be a strategy to encourage service in new locations (e.g., low-income or lower-density areas) that may not otherwise be economically feasible for a shared mobility operator. For example, Montgomery County in Maryland launched a one-year carsharing pilot program with WeCar (now Enterprise CarShare) using a risk-sharing model. Under the pilot program, the county provided $1,100 per month in guaranteed revenue for 20 to 30 vehicles placed on county property (Suderman 2009).

GIVING DEVELOPER INCENTIVES FOR THE INCLUSION OF SHARED MOBILITY

Planning departments can implement policies aimed at easing zoning regulations and reducing parking minimums for the inclusion of shared mobility in new developments. Some examples include parking reductions, parking substitutions, increased floor-to-area ratios, a greater number of dwelling units permitted per acre, and increased building heights. In other cases, shared mobility may be used as a mitigation measure by developers to ameliorate concerns about neighborhood parking and traffic related to proposed development projects. For example, in Denver, private developer Avanti proposed a develop-

ment made up of eight shipping containers where local chefs and restaurateurs could test food concepts without the risk involved in opening their own establishments. The project was permitted to proceed through a partnership with BCycle to build a 30-dock on-site bikesharing station (Hendee 2015).

SUPPLYING ACCESS TO PUBLIC RIGHTS-OF-WAY

Access to public rights-of-way helps support shared mobility. This could include access to on-street parking for carsharing, curb or street space for bikesharing kiosks, and designated loading zones for shuttles and ridesourcing/transportation network company drivers. Access benefits to the rights-of-way are enhanced when they are offered for free or below market costs. Today the vast majority of carsharing and bikesharing operators have access to on-street parking, and many bikesharing kiosks are located on public land. While access to rights-of-way for ridesourcing companies may be more limited, a growing number of airport authorities are permitting their operations at airports, including Dallas/Fort Worth International Airport, Los Angeles International Airport, San Francisco International Airport, and Reagan National Airport and Dulles International Airport in Washington, DC.

ISSUING REQUESTS FOR PROPOSALS

For numerous shared modes, particularly bikesharing and carsharing, local governments and public agencies can encourage startup operations in their communities by issuing requests for proposals (RFPs). In April 2016, for example, the City of New Orleans issued an RFP for the private operation and financing of a comprehensive bikesharing system (New Orleans 2016). In many cases, an RFP process allows public entities to be active advocates and partners of shared mobility, providing the agencies the ability to negotiate and regulate areas such as parking and institute requirements for operations (e.g., requirements that shared mobility operators provide travel behavior data to local governments). Key elements that may be included in an RFP process include the following:

- **Location:** Identify the focus of shared mobility services, such as a redevelopment district or low-income community, by municipalities.

- **Accessibility compliance:** Require that shared mobility operators provide equipment compliant with Americans with Disabilities Act (ADA) requirements, such as vehicles with hand controls.
- **Maintenance:** Request that operators take responsibility for maintaining shared mobility facilities and equipment, such as graffiti and snow removal and the relocation of equipment to allow street cleaning.
- **Public involvement:** Ensure that shared mobility operators solicit public feedback before locating services at particular sites.
- **Reporting and evaluation:** Require shared mobility operators to report data and/or calculate impacts on a quarterly, annual, or other time-interval basis.

When evaluating RFPs, public entities may want to consider the following evaluation criteria: economic and long-term program viability; history of successful implementation; emerging innovations not present in the marketplace; cost to the public entity and users; locations of proposed services; environmental impacts of proposed services; ADA compliance; services for special-needs populations (e.g., low-income, linguistically isolated, and elderly users); business model (e.g., for-profit, nonprofit, benefit corporation); and minority-, female-, or veteran-owned business status of providers.

INCORPORATING SHARED MOBILITY INTO PLANS AND PLANNING PROCESSES

Incorporating shared mobility into plans and planning processes at all levels can aid in understanding the current and future impacts of shared mobility on communities and allow local communities to leverage the positive impacts of shared mobility. The incorporation of shared mobility allows communities to establish a longer-term vision for shared mobility's role in urban design, planning, and policy-making efforts. For example, San Diego's general plan identifies numerous transportation policies that support shared mobility, alternative modes and, more broadly, transportation demand management (TDM). Some of the policies specified in San Diego's mobility element include the following (San Diego 2008 ME-37, ME-44):

ME-E.6. Require new developments to have site designations and on-site amenities that support alternative modes of transportation. Emphasize pedestrian and bicycle-friendly design, accessibility to transit, and provision of amenities that are supportive and conducive to implementing TDM strategies such as car sharing vehicles and parking spaces, bike lockers, preferred rideshare parking, showers and lockers, on-site food service, and child care, where appropriate.

ME-G.2. Implement innovative and up-to-date parking regulations that address the vehicular and bicycle parking needs generated by development.

a. Adjust parking rates for development projects to take into consideration access to existing and funded transit with a base mid-day service frequency of ten to fifteen minutes, affordable housing parking needs, shared parking opportunities for mixed-use development, provision of on-site carsharing vehicles and parking spaces, and implementation of TDM plans.

ADDRESSING KEY PUBLIC POLICY ISSUES AFFECTING SHARED MOBILITY

Public policy can have a notable influence on the success or failure of shared mobility and other emerging transportation innovations. Public entities, based on their policy stance, can be instrumental in supporting or stifling innovation, improving public safety, or adopting a more laissez-faire approach. Local municipalities can provide a supportive policy environment for shared mobility by minimizing regulation, addressing key areas of public safety concern, defining shared modes, and providing clarity to policy ambiguities.

Through public policy, public entities can help ensure that shared mobility provides a range of social and environmental benefits by (1) developing equitable public policies that enhance accessibility, (2) encouraging competition and modal choice, (3) supporting multimodality, and (4) ensuring fairness among operators and modes. Understanding the impacts of shared mobility can aid planners in achieving short- and longer-term goals and policies by guiding transportation and development decisions. Planners and policy makers will also want to think ahead to policy issues that will emerge related to innovative on-demand ride services and automated vehicles, such as parking and insurance.

SHARED MOBILITY: LOOKING FORWARD

Shared mobility is an innovative transportation strategy that is continually evolving and reshaping urban mobility. Over

the past 20 years, shared mobility services have continued to grow in the United States and around the world. Numerous studies have documented its environmental, social, and transportation-related impacts, such as the reduction in vehicle use, vehicle ownership, and miles traveled through roundtrip carsharing and bikesharing. Shared mobility has the potential to help planners and policy makers achieve greenhouse gas reductions, air quality mandates, and climate action goals. However, more study is needed to verify impacts based on mode and temporal and spatial scales. Additionally, shared mobility has the potential to support multimodality, improve first-and-last mile access, and enhance mobility for populations with specific needs or barriers (e.g., zero-car households, disabled individuals, older adults, and children). As technology and service models continue to evolve, shared mobility modes could have a transformative impact on transportation access and options.

How planners manage rights-of-way will remain a topic of conversation. Over the past decade, a trend that has emerged is the growing need for access to parking and curb space. Planners and policy makers will have to develop policies that fairly manage demands for access to rights-of-way (e.g., automobile parking; parking for private shuttles, taxis, paratransit, microtransit, and carsharing; public transportation; ridesourcing; loading zones; bikesharing; bicycle infrastructure).

What is also clear is that urban transportation is on the verge of rapid transformation. The convergence of mobility services, shared modes, electrification, and automation will undoubtedly transform how people travel, how streets are designed, and the ways in which urban land uses are planned and zoned. The impacts of emerging technologies on auto ownership, parking, and travel behavior remain to be seen. However, as these technologies come online, planners and policy makers will need to rethink traditional notions of access, mobility, and auto mobility. Planners may have to reconsider parking minimums and consider replacing existing parking with infill development and affordable housing. Planners may be able to repurpose on-street parking for other uses (such as wider curbs, bicycle lanes, and loading zones for shared automated vehicles). What is clear is that these innovative technologies will likely have a disruptive impact on traditional planning norms and urban form. Thoughtful planning, continued research, and a keen understanding of shared mobility's impacts and role in the transportation landscape will be critical in order to balance public goals with commercial interests and to harness and maximize the social and environmental benefits of these developments.

APPENDIX A: SELECTED CITY PROFILES OF SHARED MOBILITY

Appendix A features profiles of shared mobility networks in eight US cities: Austin, Texas; Columbus, Ohio; New York; Philadelphia; Portland, Oregon; San Francisco; Seattle; and Washington, DC. These cities were selected because they reflect a variety of geographic and population sizes and urban densities, they offer multiple shared mobility services, and many have notable public policies and local ordinances regulating or supporting shared mobility.

While these profiles of shared mobility in different cities may appear similar, a closer look reveals markedly diverse characteristics and types of implementation strategies. For example, San Francisco is the second densest urban area (after New York) defined by municipal, not regional, boundaries. Since the 1980s, the San Francisco Bay Area has been an epicenter of shared mobility experimentation and innovation. Numerous carsharing and station car pilot programs were tested in the 1980s and 1990s, and it was the first city in the western hemisphere with scooter sharing. The region continues to embrace shared mobility, offering one of the widest arrays of shared modes and platforms—carsharing, bikesharing, scooter sharing, ridesourcing/transportation network companies (TNCs), e-Hail, microtransit, and courier network services—of any city in the Americas.

Washington, Seattle, Portland, and New York were also early adopters of shared mobility, in large part due to the start up and mainstreaming of programs such as CarSharing Portland, Flexcar, and Zipcar as well as bikesharing systems in most of these cities. But a closer look at these cities reveals distinctions in the histories and types of systems. Portland, for example, has a vast array of shared modes available, but was one of the last major metropolitan cities without a public bikesharing system. Bikesharing launched in July 2016 (Portland 2016a). Despite the later launch of bikesharing, the city's cycling culture enabled a different focus on and approach to shared mobility: carsharing and ridesourcing/TNC options with bicycle racks.

New York, an early experimenter with shared mobility, launched carsharing in 2000. It is also home to Citi Bike, the

	Austin, TX	Columbus, OH	New York City, NY	Philadelphia, PA	San Francisco, CA	Portland, OR	Seattle, WA	Washington, DC
Carsharing	✓	✓	✓	✓	✓	✓	✓	✓
- Roundtrip Carsharing	✓	✓	✓	✓	✓	✓	✓	✓
- One-way Carsharing	✓	✓	✓	✓	✓	✗	✓	✓
- Peer-to-Peer Carsharing	✓	✓	✓	✓	✓	✓	✓	✓
Bikesharing	✓	✓	✓	✓	✓	✓	✓	✓
- Public Bikesharing	✓	✓	✓	✓	✓	✓	✓	✓
Scooter Sharing	✗	✗	✗	✗	✗	✓	✗	✗
Alternative Transit Services	✗	✗	✓	✓	✗	✓	✓	✓
- Shuttles	✗	✗	✗	✓	✗	✓	✓	✗
- Microtransit	✗	✗	✓	✗	✗	✓	✗	✓
Ridesourcing/TNCs	✓	✓	✓	✓	✓	✓	✓	✓
e-Hail Services	✓	✓	✓	✓	✓	✓	✓	✓
Courier Network Services (CNS)	✓	✓	✓	✓	✓	✓	✓	✓
Mobility Aggregators	✓	✓	✓	✓	✓	✓	✓	✓

✓ service available
✗ service unavailable

Figure A.1. Shared mobility availability by city (Susan Shaheen and Adam Cohen)

largest bikesharing program in the country. New York, San Francisco, and Washington, DC, have also been innovators in courier network services featuring a wide range of app-based delivery services.

Philadelphia is another city that was an early adopter of carsharing in 2003. It later launched the Indego bikesharing program in the spring of 2015. In Philadelphia, the nonprofit organization PhillyCarShare became one of the first carsharing programs to target low-income residents. Additionally, Philadelphia was an early pioneer in on-street parking policies for shared mobility, and it remains one of the few municipal governments to experiment with a policy to provide preferential status to nonprofit operators.

Austin and Columbus, two cities of similar size and density, have a very different history of shared mobility. Austin adopted shared mobility early on compared to other similarly sized cities, and it was the first city to launch free-floating one-way carsharing in North America, enabled through an innovative partnership with car2go. In contrast, the first ef-

forts with shared mobility in Columbus focused on the college demographic market, with early launches targeting Ohio State University (launched in 2007) and Columbus State University (launched in 2010).

Figure A.1 provides a summary of the existing shared mobility modes available in the cities profiled in the following sections. Each profile provides demographic and mobility characteristics for the city along with a discussion of key shared mobility metrics and notable policies. (The Walk Score, Transit Score, and Bike Score for each city were obtained from the Walk Score site. The methodology is described at www.walkscore.com/methodology.) In reviewing these profiles, planners should consider how these cities are evolving and adapting shared mobility models and the ways in which shared mobility is a flexible innovation that can be employed in a variety of communities.

AUSTIN, TEXAS

Population	885,400
Land area (sq. mi)	297.9
Population per sq. mi.	2,653
Persons per household	2.42
Mean travel time to work (min)	22.9
Median household income ($)	53,946
Walk Score	35
Transit Score	33
Bike Score	52

Austin is the state capital and ranks as the 11th most populous city in the United States. The city is known for a highly educated workforce and as an epicenter of high-tech jobs. According to the census, it is one of the country's fastest growing cities, and its population grew 12.5 percent between 2010 and 2014. In recent years, Austin's growth has been a tale of two cities: growth of the urban core driven by new residential and infill development with the simultaneous expansion of suburban development on the periphery. At present, the Capital Metropolitan Transportation Authority provides bus, bus rapid transit, and commuter rail services.

Key Metrics

Austin has been a pioneer in providing shared mobility services; it was the first city to launch one-way carsharing

services in North America. Austin's shared mobility services include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 26,000 people shared 380 vehicles through the roundtrip carsharing operator Zipcar and one-way carsharing program car2go. About 88 percent of Austin's business-to-consumer carsharing fleet is one-way capable.
- **Peer-to-peer carsharing:** In September 2015, one peer-to-peer carsharing operator, Turo (formerly RelayRides), accounted for an estimated 1,400 members sharing approximately 170 privately owned vehicles. (Figures for FlightCar were not available.)
- **Bikesharing:** In September 2015, one station-based bikesharing program, Austin B-cycle, had 385 bikes and 50 bikesharing stations. The program had 2,659 long-term members (annual and monthly) and 44,183 casual users.
- **Ridesourcing/TNCs:** In the fall of 2015, Lyft and Uber were providing services. In May 2016, however, a referendum vote to repeal the fingerprinting requirement for drivers failed to pass, and both companies left the region (Woodyard and Toppo 2016). Since then, several new ridesourcing operators have entered Austin.
- **e-Hail apps:** In October 2015, two e-Hail apps, Curb and Hail a Cab, were providing digital dispatch services for taxis. In September 2015, there were an estimated 669 permitted taxis.
- **Courier network services:** In October 2015, five services—GrubHub, Instacart, Postmates, Roadie, and Uber—were providing for-hire delivery services.
- **Mobility aggregators:** In October 2015, five mobility aggregators—Google Now, Metropia, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies

While the private sector has been instrumental in the expansion of shared mobility in Austin, this growth would not have been possible without strong institutional support and policy leadership. The following are key policies:

- **Carsharing parking:** In September 2006, Austin's city council adopted a resolution granting four free, highly visible, permanent parking spaces to what was then Austin CarShare (Austin 2006).
- **Carsharing parking minimums:** More than two years before an operator stepped forward to provide service, Austin's city council included carsharing in its parking

reduction policy, allowing for minimum off-street parking reductions of 20 spaces for every carsharing vehicle provided (up to a maximum 40 percent reduction of total parking). For multifamily residential uses in the University Neighborhood Overlay District, off-street parking requirements are reduced to 40 percent of regular standards for participation in a carsharing program (Austin 2013).

- **One-way carsharing parking:** In 2009 the City of Austin and car2go began a partnership where the city granted car2go on-street parking in exchange for city-employee use of these vehicles. Although there was no exchange of money, the deal was valued at an estimated $85,000 (Austin Business Journal 2010).
- **Carsharing parking signage and parking meters:** Austin has partnered with both Zipcar and car2go to provide on-street parking and designated signage for carsharing. Additionally, car2go users may park at city parking meters free of charge (Austin 2016b).
- **Ridesourcing/TNCs:** The city recently ratified an extensive municipal ordinance regulating ridesourcing/TNCs that includes a number of provisions, including the establishment of minimum insurance requirements, driver training requirements, a limit on the number of consecutive hours a driver can work, and prohibitions on refusing to pick up passengers or charging more for disabled passengers (Hoffberger 2014). In December 2015, the Austin City Council amended its local ordinance to require fingerprinting of ridesourcing/TNC drivers. A ballot referendum that would have repealed this requirement failed to achieve the required number of votes in May 2016. Lyft and Uber withdrew service from the Austin marketplace in May 2016.

COLUMBUS, OHIO

Population	822,553
Land area (sq. mi)	217.2
Population per sq. mi.	3,624
Persons per household	2.40
Mean travel time to work (min)	21.3
Median household income ($)	44,072
Walk Score	40
Transit Score	30
Bike Score	37

Columbus is the capital of and largest city in Ohio, and it ranks as the 15th most populous US city. Originally a midwestern industrial epicenter, Columbus has become one of the region's preeminent cultural and educational centers. It is home to numerous colleges, universities, and institutions, including Ohio State University and Columbus State University. Today approximately 87,000 people work and more than 25,000 students attend school in downtown Columbus. However, in spite of the large daytime population, only 6,300 of the city's more than 800,000 residents live downtown (Ferenchik 2013). Columbus has a fairly extensive municipal bus service operated by the Central Ohio Transit Authority but, at present, does not have passenger rail service. In June 2016, the city was selected to receive $50 million as part of the US Department of Transportation's Smart City Challenge pilot project, which will leverage data and technology to show the future of urban passenger and goods movement (McGregor 2016).

Key Metrics
Columbus is a prime example of how shared mobility can be employed in small- to medium-sized cities with less urbanized central cores. In spite of its comparatively lower density, carsharing, bikesharing, and ridesourcing/TNCs are all readily available in Columbus. Key services include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 21,000 Columbus residents shared 300 vehicles between roundtrip carsharing operator Zipcar and one-way carsharing program car2go. An estimated 99 percent of Columbus's business-to-consumer carsharing fleet is one-way capable.
- **Peer-to-peer carsharing:** In September 2015, one peer-to-peer carsharing operator, Turo (formerly RelayRides), accounted for an estimated 400 members sharing approximately 50 privately owned vehicles.
- **Bikesharing:** In September 2015, one bikesharing program, CoGo, had 300 bicycles and 30 bikesharing stations. At the end of the 2013 season, CoGo had 744 annual members and 5,595 daily users.
- **Ridesourcing/TNCs and taxis:** In October 2014, Uber was providing ridesourcing services in Columbus. There were 530 licensed taxi cab drivers and 486 licensed Uber and Lyft drivers in the city. In September 2015, Uber announced plans to add 3,000 drivers to the Columbus metropolitan area (Rouan 2015).
- **e-Hail apps:** In October 2015, three e-Hail apps—Curb, GoFastCab, and Yellow Cab of Columbus—were providing digital dispatch services for taxis in Columbus.

- **Courier network services:** In October 2015, two services, GrubHub and Roadie, were providing for-hire delivery services in Columbus.
- **Mobility aggregators:** In October 2015, four mobility aggregators—Google Now, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services in Columbus.

Notable Policies

Policy developments in Columbus have been more limited and focused on three key areas: (1) a request for proposals to bring bikesharing to the city, (2) an ordinance regulating ridesourcing/TNCs, and (3) provisions to allocate free-floating carsharing parking. Key policies include the following:

- **Bikesharing:** In 2012 the City of Columbus issued a request for proposals to solicit qualified contractors to launch bikesharing.
- **Ridesourcing/TNCs:** In 2014 the city council amended the city's business regulation and licensing code to include "peer-to-peer transportation networks." The new provisions require TNCs to conduct driver background checks and vehicle safety inspections (Etchison 2016).
- **One-way carsharing parking:** In November 2014, Columbus concluded its one-year carsharing pilot withcar2go. Under a new agreement, car2go will compensate the city for lost meter revenue and purchase parking permits for $150 per vehicle. Columbus is setting aside $15,000 of the fees from car2go for transportation projects. As part of the agreement, car2go must share with the city quarterly data, including the age of its fleet, vehicle parking patterns, subscriber demographics, and trip-purpose information.

NEW YORK, NEW YORK

Population	8,405,837
Land area (sq. mi)	302.6
Population per sq. mi.	27,013
Persons per household	2.64
Mean travel time to work (min)	39.2
Median household income ($)	52,259
Walk Score	88
Transit Score	30
Bike Score	37

With nearly 8.5 million people living in just over 300 square miles, New York is both the most populous and the densest city in the United States. New York also features the largest public transportation system in the country with a wide array of modal options, including buses, subways, commuter rail, and ferries in addition to the city's iconic taxis. New York's public transportation system accounts for one in three mass transit riders in the country, and two-thirds of the country's rail passengers live in the New York metropolitan area (Metropolitan Transportation Authority 2016).

Key Metrics

New York was one of the East Coast's early adopters of shared mobility. Since carsharing first launched in 2000, the number of modes and the scale of shared mobility have grown notably. Today shared mobility services include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 318,000 New York residents shared 4,351 vehicles among two roundtrip carsharing operators, Enterprise CarShare and Zipcar, and one-way carsharing program car2go. An estimated 69 percent of New York's business-to-consumer carsharing fleet is one-way capable. New York accounts for approximately a quarter of carsharing memberships and fleets deployed in the United States.
- **Peer-to-peer carsharing:** In October 2015, two peer-to-peer carsharing operators, Turo (formerly RelayRides) and JustShareIt, were providing services in New York. (A market size estimate for peer-to-peer carsharing in New York was not available.)
- **Bikesharing:** In September 2015, Citi Bike, the largest US bikesharing program, had nearly 21,000 annual members and approximately 326,000 casual users sharing 5,168 bicycles across 468 bikesharing stations.
- **Microtransit:** In October 2015, one microtransit operator, Via, had approximately 500 vehicles operating. Since its launch in late 2013 through October 2015, Via has provided over 1.5 million rides.
- **Ridesourcing/TNCs and taxis:** In September 2015, there were 52,671 cab drivers and 13,237 medallion taxis. As of the fall of 2015, Lyft and Uber were providing ridesourcing services in New York. In September 2015, there were 8,124 Uber vehicles in the city. (Data for Lyft were not available.) Between 2014 and 2015, the total number of for-hire drivers increased by 16.9 percent to 138,000. Over this same period, the number of vehicles regulated by the New York City Taxi and Limousine Commission increased by 21.5 percent to 79,000 (Gartland 2015).

- **e-Hail apps:** In October 2015, four e-Hail apps—Arro, Bandwagon, Gett, and Way2ride—were providing digital dispatch services for taxis in New York.
- **Courier network services:** In October 2015, seven services—DoorDash, GrubHub, Instacart, Postmates, Shyp, Roadie, and Uber—were providing for-hire delivery services in New York.
- **Mobility aggregators:** In October 2015, six mobility aggregators—Citymapper, Embark, Google Now, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services in New York.

Notable Policies

New York has a number of policies supporting shared mobility. Broadly, these policies address carsharing parking, parking reductions for incorporating carsharing into pre-existing buildings, regulations for ridesourcing/TNCs, and the development of a citywide taxi smartphone application. New York's key policies include the following:

- **Carsharing zoning amendment:** In September 2010, the City of New York enacted a Carsharing Zoning Text Amendment. The amendment defines carsharing, permits carsharing vehicles to occupy public parking garages (not to exceed 40 percent of total spaces), and allows the conversion of up to 15 general-use parking spaces to carsharing parking in existing buildings, with additional carsharing parking provisions dependent on other applicable zoning categories and regulations (City of New York Zoning Resolution, § 16-16). Generally, New York limits the maximum number of parking spaces allotted to carsharing by zone type and density (City of New York Zoning Resolution, §§ 13-16, 25-412).
- **Ridesourcing/TNCs:** In April 2015, the New York City Taxi and Limousine Commission updated its for-hire dispatch service provider rules. Key provisions include (1) a requirement to provide passengers with an itemized receipt, (2) a mandate that driver-facing interfaces operate via one-touch or voice activation while in motion, and (3) a requirement to provide passengers the option to request an accessible vehicle. Additionally, the regulations mandate that ridesourcing/TNCs provide trip logs and other data to the commission. These data include pick-up locations, dates, times, and dispatching services (New York City Taxi and Limousine Commission 2015).
- **Municipal e-Hail app:** In the summer of 2015, New York began beta testing a taxi application known as Arro. It allows users to e-Hail taxis and pay for yellow and green taxi rides, similar to the apps offered by ridesourcing/TNCs and a number of third-party e-Hail app companies (Zillman 2015).

PHILADELPHIA, PENNSYLVANIA

Population	1,553,165
Land area (sq. mi)	134.1
Population per sq. mi.	11,380
Persons per household	2.56
Mean travel time to work (min)	31.8
Median household income ($)	37,192
Walk Score	77
Transit Score	67
Bike Score	68

Philadelphia is the fifth most populous city in the United States. Like other cities in the Northeast, Philadelphia is denser, with 11,380 people per square mile. Seven Fortune 1000 companies are based in Philadelphia. Financial, health, and education make up the city's largest economic sectors. The city's public transportation is managed by the Southeastern Pennsylvania Transportation Authority (SEPTA), which operates bus, rail, and trolley systems throughout the metro region. In the early 1980s, significant portions of SEPTA's regional rail service were discontinued due to lack of funding.

Key Metrics

Philadelphia represents an early innovator of shared mobility. The City of Philadelphia showed its support for shared mobility as the first municipal consumer of these travel options. Today shared mobility services include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 46,000 Philadelphia residents shared 669 vehicles among two roundtrip carsharing operators, Enterprise CarShare and Zipcar. There are no one-way carsharing services in Philadelphia; however, Zipcar recently announced plans to add a one-way service option (Norton 2015).
- **Peer-to-peer carsharing:** In September 2015, peer-to-peer carsharing operator Turo (formerly RelayRides) accounted for an estimated 1,000 members sharing approximately 130 privately owned vehicles. (Data for the operator FlightCar were not available.)

- **Bikesharing:** In September 2015, the Indego bikesharing program had 616 bicycles at 72 stations. Launched in April 2015, the program reached 100,000 rides after two months of operation (Saksa 2015). In the spring of 2016, Indego added 24 stations with support from the William Penn Foundation (LoBasso 2016).
- **Employer shuttles:** Employer shuttle services are offered by the University of Pennsylvania and Thomas Jefferson University with service to and from their campuses in neighborhoods including Center City, West Philadelphia, and Powelton Village.
- **Ridesourcing/TNCs and taxis:** In September 2015, Lyft and Uber were providing ridesourcing services. The city had 1,600 taxi medallions and 12,000 Uber drivers (Orso 2015). (Data for Lyft were not available.)
- **e-Hail apps:** In October 2015, three e-Hail apps—215getacab, Freedom Taxi, and Way2ride—were providing digital dispatch services for taxis.
- **Courier network services:** In October 2015, four services—GrubHub, Instacart, Postmates, and Roadie—were providing for-hire delivery services.
- **Mobility aggregators:** In October 2015, five mobility aggregators—Citymapper, Google Now, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies

In addition to the City of Philadelphia being a shared mobility consumer, the city has several shared mobility policies that include ordinances allocating on-street carsharing parking, parking reductions for developments for the inclusion of carsharing, and pending ridesourcing/TNC legislation that would allow these services to legally operate in the city. Key shared mobility policies in Philadelphia include the following:

- **Government as a carsharing consumer:** In 2004 Philadelphia became the first city in North America to replace its municipal fleet of 400 vehicles with carsharing (Philadelphia 2004). Twelve years later, the City of Philadelphia is still a carsharing customer.
- **Carsharing zoning amendment:** In 2012 the City of Philadelphia adopted a new zoning code that permits a reduction in the required number of parking spaces with the inclusion of carsharing. The current ordinance permits a reduction of two parking spaces (up to a maximum of 25 percent) for each carsharing space provided (Philadelphia Zoning Code, § 14-802(8)(b)).

- **Carsharing parking:** Carsharing operators seeking on-street parking from the Philadelphia Parking Authority must submit letters of support from adjacent property owners, the local Registered Community Organization, and the district councilperson (Geeting 2015). Exclusive permits for on-street spaces cost $150 per permit annually (Burnley 2015).
- **Ridesourcing/TNCs:** In Pennsylvania, ridesourcing/TNCs are regulated by the Pennsylvania Public Utility Commission in 66 of the state's 67 counties. In 2015 the commission granted Lyft and Uber a two-year experimental license to operate. In Philadelphia, taxis are regulated by the Philadelphia Parking Authority. TNCs are still considered illegal by the authority, which has fined drivers and impounded vehicles. Numerous bills are currently pending in the state legislature. Broadly, these bills would establish a definition for and legalize ridesourcing/TNCs. As of May 2016, the latest version of the bill would levy a 1.7 percent tax on ridesourcing/TNC services, with a minimum $2 million fee from operators with more than 10,000 drivers. Tax revenue generated in excess of $4 million would be split between the Philadelphia Parking Authority and the School District of Philadelphia (Brey 2016).

PORTLAND, OREGON

Population	609,456
Land area (sq. mi)	133.4
Population per sq. mi.	4,375
Persons per household	2.31
Mean travel time to work (min)	24.4
Median household income ($)	52,657
Walk Score	63
Transit Score	50
Bike Score	72

Portland is the most populous city in Oregon and the 28th largest US city. It is widely accredited for its compact mixed use and transit-oriented development, largely a result of the state's conservation policies stipulating an urban growth boundary. For a relatively small city, it has a wide array of multimodal options, including buses, light rail, commuter rail, and streetcars. In 2014, 11.8 percent of all commute trips in Portland were on public transit (US Census Bureau 2014a).

Key Metrics

Portland is another early adopter of shared mobility, featuring the first US carsharing program in the late-1990s. Today Portland's shared mobility services include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 41,000 Portland residents shared 575 vehicles provided by roundtrip carsharing operator Zipcar and one-way carsharing operator car2go. A third carsharing operator, SCOOT, operated by Kitsap Transit offers roundtrip carsharing in Vancouver, Washington, just outside of Portland. An estimated 55 percent of Portland's business-to-consumer carsharing fleet were one-way capable.
- **Peer-to-peer carsharing:** In September 2015, two peer-to-peer carsharing operators, Turo (formerly RelayRides) and Getaround, accounted for an estimated 1,600 members sharing approximately 200 privately owned vehicles. (Data for the operators JustShareIt and FlightCar were not available.)
- **Bikesharing:** In July 2016, Motivate launched BIKETOWN with 1,000 bicycles at 100 stations.
- **Ridesourcing/TNCs and taxis:** In September 2015, Lyft and Uber were providing ridesourcing services, and there were 480 taxi permits. (Data for Lyft and Uber were not available.)
- **e-Hail apps:** In October 2015, three e-Hail apps—Curb, Flywheel, and GoFastCab—were providing digital dispatch services for taxis.
- **Courier network services:** In October 2015, three services—GrubHub, Postmates, and Roadie—were providing for-hire delivery services.
- **Mobility aggregators:** In October 2015, five mobility aggregators—Google Now, Nimbler, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies

Unlike other cities, Portland has a number of state laws that support shared mobility locally. In addition to supportive state legislation, the city has a carsharing parking policy and reduced developer impact fees for the inclusion of shared mobility. The following are key state and local shared mobility policies in Portland:

- **Urban growth boundary:** Under Oregon state law, each city and metropolitan area must establish an urban growth boundary around its perimeter to limit the development of farmland and open space. Metropolitan Portland's regional government is responsible for managing this boundary. Despite Portland's relatively small geographic size, its urban growth boundary has been widely attributed to be a significant factor in the region's compact mixed use urban development and in the growth of shared mobility in the region.
- **Personal vehicle sharing:** Oregon has approved personal vehicle sharing (PVS) legislation, HB 3149, which defines and outlines peer-to-peer vehicle sharing coverage. Specifically, the law requires PVS programs to provide vehicle liability insurance and assume liability in the event of loss or injury for periods when a vehicle is in use by the program. The law also prohibits a motor vehicle owner's liability insurer from cancelling a policy or reclassifying use from a private passenger motor vehicle to a commercial-use vehicle because of a vehicle's use in a PVS program.
- **Carsharing parking:** In January 2013, the City of Portland revised its carsharing parking policy and established an auction process. Each year, the Portland Bureau of Transportation creates a list of on-street metered parking spaces available for lease to carsharing operators. It manages a process where carsharing operators can bid on these parking spaces (Portland 2016b). The minimum bid is calculated by adding together the amount of lost meter revenue and the installation, maintenance, and administrative costs associated with leasing the parking space for exclusive carsharing use.
- **Reduced transportation impact fees:** In Vancouver, Washington, the municipal government has implemented reduced transportation impact fees as well as residential density bonuses for the inclusion of alternative transportation in developments in the city's transit overlay district.

SAN FRANCISCO, CALIFORNIA

Population	837,442
Land area (sq. mi)	46.9
Population per sq. mi.	17,179
Persons per household	2.31
Mean travel time to work (min)	30.5
Median household income ($)	75,604
Walk Score	84
Transit Score	81
Bike Score	75

With 17,179 people per square mile, San Francisco is the densest city in California and the second densest city in the United States (after New York). San Francisco is also the only jurisdiction that is a consolidated city-county. The San Francisco Municipal Transportation Agency (SFMTA) is a consolidated public agency that manages the city's roadways, public parking, public transportation, and taxicabs. In addition to SFMTA, numerous other public agencies operate regional public transit systems, including the Bay Area Rapid Transit District's BART system and the San Mateo County Transit District's Caltrain service. San Francisco features a highly diverse array of public transportation options: buses, light rail, commuter rail, rapid transit, street cars, cable cars, and ferries. Approximately one third of San Francisco's residents use public transportation for commute trips.

Key Metrics

San Francisco has been the epicenter of shared mobility. A number of operations were founded in the San Francisco Bay Area: the nation's first scooter sharing company, Scoot Networks; peer-to-peer carsharing providers Getaround, Turo (formerly RelayRides), and FlightCar; and ridesourcing/TNC providers, including Lyft and Uber. In October 2013, the city hosted the first Shared Mobility Summit. This event brought together mobility providers, policy makers, government agencies, nonprofit organizations, technologists, academics, the media, other stakeholders, and representatives from affiliated industries. The summit provided an opportunity for participants from nearly 200 organizations to engage in a lively dialogue. Today shared mobility services include the following:

- **Business-to-consumer carsharing:** In October 2015, an estimated 82,000 San Francisco residents shared 1,260 vehicles through three roundtrip carsharing operators—City CarShare, Enterprise CarShare, and Zipcar. (In August 2015, City CarShare launched a strategic alliance with Carma, a carpooling network that connects commuters with similar routes through a free smartphone app.) DriveNow (now ReachNow), a one-way carsharing operator, left the city in the fall of 2015 and reopened operations in Seattle in the spring of 2016.
- **Peer-to-peer carsharing:** In September 2015, three peer-to-peer carsharing operators—Getaround, JustShareIt, and Turo—accounted for an estimated 7,600 members sharing approximately 970 privately owned vehicles. (Data for FlightCar were not available.)
- **Bikesharing:** In September 2015, Bay Area Bike Share provided 350 bicycles at 35 bikesharing stations in San

Francisco. The program has an estimated 200 additional bicycles at 28 stations throughout the region with plans to add another 7,000 bicycles in cities including San Francisco, Berkeley, Emeryville, Oakland, and San Jose. Bay Area Bike Share had 4,011 annual members, who made 306,890 trips, and 22,294 casual users, who made 45,376 trips.
- **Scooter sharing:** From 2012 to April 2014, Scoot scooter sharing in San Francisco increased from 4 to 12 stations and from 20 to 50 scooters. During this period, Scoot grew to include over 3,000 users and accounted for 50,000 passenger miles (Scoot 2014).
- **Employer shuttles:** Numerous employer shuttles operate in the San Francisco Bay Area, primarily offered by biotechnology and technology firms, including Apple, eBay, Electronic Arts, Facebook, Genentech, Google, and Yahoo. Most of these shuttles offer direct service from San Francisco neighborhoods to the San Francisco Peninsula and Silicon Valley. A few also connect to nearby rail service, such as BART and Caltrain.
- **Ridesourcing/TNCs and taxis:** In September 2015, Lyft, Sidecar (which ceased operations in December 2015), and Uber were providing ridesourcing services. In addition, there were 1,900 taxi medallions and approximately 16,000 ridesouring/TNC vehicles in the city.
- **e-Hail apps:** In October 2015, four e-Hail apps—Curb, Flywheel, GoFastCab, and YellowCabSF—were providing digital dispatch services for taxis.
- **Courier network services:** In October 2015, nine services—DoorDash, Instacart, GrubHub, Postmates, Roadie, Shipbird, Shyp, Sidecar Deliveries (which has since ceased operations), and Uber—were providing for-hire delivery services. For six of these nine, San Francisco was the first marketplace where they launched their courier services.
- **Mobility aggregators:** In October 2015, eight mobility aggregators—Citymapper, Embark, Google Now, Nimbler, Swyft (now Swiftly), RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies

San Francisco has some of the most diverse shared mobility policies allocating public rights-of-way for carsharing parking and employer shuttles. Like Oregon, California also has PVS legislation and was the first state to legally define and regulate ridesourcing/TNCs. Notable policies include the following:

- **Carsharing parking:** SFMTA has an on-street carsharing parking program. City CarShare (roundtrip carsharing),

Zipcar (roundtrip carsharing), and Getaround (peer-to-peer carsharing) all participate in the SFMTA parking program, which designates up to 900 parking spaces for carsharing vehicles. At present, this program does not include one-way carsharing. Each organization that participates in the program is eligible for 150 parking spaces (0.05 percent of the city's total on-street parking supply). Locations are allocated through an application process that includes an engineering review, community outreach, and approval by the SFMTA board of directors. Monthly pricing per space varies between $50 and $225 and is based on three demand zones established by the city. Operators pay a one-time installation fee of $400 per space. Each approved carsharing vehicle receives a special parking permit that exempts it from street sweeping, time limits, and other parking restrictions.

- **Ridesourcing licensing:** In April 2016, the City and County of San Francisco Treasurer and Tax Collector sent 37,000 notices to ridesourcing drivers informing them that they would have to obtain and display a business license. Registration fees are $91 for drivers with gross receipts less than $100,000. The fee varies depending on the nature of the business activity and amount of annual gross receipts (Batey 2016).
- **Employer shuttles:** In January 2014, SFMTA announced a program that enables employer-based shuttle services to pay to use loading zones if certain guidelines are followed, such as yielding to public buses and pulling to the front of the loading zone to make room for other vehicles (SFMTA 2015).
- **Personal vehicle sharing:** California's AB 1871 represents the first PVS legislation in the country. It has been a key model for PVS legislation in other states, including Oregon and Washington. California's law classifies PVS as a noncommercial use and limits "the circumstances under which the vehicle owner's automobile liability insurance can be subject to liability," to prevent cancellation of primary automobile insurance policies (AB 1871, Chapter 454). PVS programs assume liability when a vehicle is rented in a shared capacity, and the owner's insurance policy resumes coverage once it is returned (Shaheen, Mallery, and Kingsley 2012). In turn, vehicle owners are indemnified for any loss or injury that occurs through shared use not resulting from their negligence. Time of use, along with initial and final locations of vehicle usage, must be clearly delineated through "verifiable electronic records" identifying when it is being used as part of a PVS program. This prevents premium spikes for primary insurance poli-

cies resulting from unverified shared use. Vehicle owners who share their autos in states lacking PVS legislation risk nonrenewal of primary insurance policies, as well as premium spikes resulting from increased use (Shaheen, Mallery, and Kingsley 2012).

- **Ridesourcing/TNCs:** In San Francisco, the California Public Utilities Commission (CPUC) is the primary regulatory agency of TNCs. In September 2013, the CPUC became one of the first public agencies to adopt regulations defining and legalizing TNC operations in California.

SEATTLE, WASHINGTON

Population	652,405
Land area (sq. mi)	83.9
Population per sq. mi.	7,251
Persons per household	2.08
Mean travel time to work (min)	25.4
Median household income ($)	65,277
Walk Score	71
Transit Score	57
Bike Score	63

Seattle is the 20th most populous city in the United States. With more than 7,000 people per square mile, Seattle is relatively dense compared to similarly populated cities. Originally a timber and mining town, today a number of high-tech employers are based in the Seattle metropolitan region, such as Amazon (which was founded in the city), Boeing, and Microsoft. Seattle has an array of public transportation options, including buses, light rail, commuter rail, and monorail, collectively managed by King County Transit, Sound Transit, and the City of Seattle.

Key Metrics

Seattle is another innovator in shared mobility, and supportive public policies have contributed to the growth of shared mobility. Its numerous shared modes include the following:

- **Business-to-consumer carsharing:** In September 2015, an estimated 60,000 Seattle residents shared 830 vehicles between the roundtrip carsharing operator Zipcar and the one-way carsharing program car2go. An estimated 57 percent of Seattle's business-to-consumer carsharing fleet is

one-way capable. An additional one-way operator, Reach-Now (formerly DriveNow) launched service in the spring of 2016.

- **Peer-to-peer carsharing:** In September 2015, one peer-to-peer carsharing operator, Turo (formerly RelayRides), accounted for an estimated 2,500 members sharing approximately 320 privately owned vehicles. (Data for FlightCar were not available.)
- **Bikesharing:** In September 2015, one bikesharing program, Pronto Cycle Share, had 500 bicycles and 50 bikesharing stations. Pronto Cycle Share also had 3,298 annual members and 24,288 casual users.
- **Employer shuttles:** Numerous employer shuttles operate in Seattle, primarily offered by technology and aerospace employers such as Amazon, Boeing, and Microsoft. Many of these shuttle services serve dual purposes by providing both first-and-last-mile connections and building-to-building transportation on sprawling business campuses.
- **Ridesourcing/TNCs and taxis:** In September 2015, there were an estimated 674 taxi licenses and 5,000 ridesourcing/TNC vehicles through three service—Lyft, Sidecar (which ceased operations in December 2015), and Uber.
- **e-Hail apps:** In October 2015, two e-Hail apps, Flywheel and SeattleYellowCab, were providing digital dispatch services for taxis.
- **Courier network services:** In October 2015, five services—Instacart, GrubHub, Postmates, Roadie, and Sidecar Deliveries (which has since ceased operations)—were providing for-hire delivery services.
- **Mobility aggregators:** In October 2015, four mobility aggregators—Google Now, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies

Seattle has a number of state and local laws affecting shared mobility. These include policies allocating carsharing parking, parking reductions for developments for the inclusion of carsharing, local ridesourcing/TNC regulations, a county helmet law, and state PVS legislation. The following are key policies:

- **Carsharing parking:** In December 2012, the Seattle city council approved a one-year pilot program with car2go that enables its one-way carsharing fleet to "float" around the city. Initially, car2go paid the city $1,330 per vehicle per year for administrative costs, on-street parking, and residential parking zone permits for 350 vehicles. At the end of the year, car2go was required

to provide the city with data on how much parking was used and had to pay for any additional parking fees that were accrued. In December 2014, Seattle amended its carsharing policy to permit up to four carsharing operators to each apply for 500 vehicle permits (or 750 vehicle permits, if the operator agreed to cover the entire city). Carsharing operators in Seattle currently pay $300 annually for designated on-street parking in free zones, $3,000 annually for designated on-street spaces in paid zones, and $1,730 for an annual free-floating parking permit (the fee is adjusted annually based on actual meter use in paid parking areas) (Seattle Municipal Code, Chapter 11.23). One-way operators car2go and Reach-Now (formerly DriveNow) paid approximately $1.3 million and $532,000, respectively for carsharing permits for their fleets (Lerman 2016).
- **Carsharing zoning amendment:** Seattle's municipal code allows for a reduction of up to 5 percent of a development project's total parking spaces with the inclusion of a city-recognized carsharing program. The ordinance states the number of required spaces "will be reduced by one (1) space for every parking space leased by a carsharing program. For any development requiring twenty (20) or more parking spaces that provides a space for vehicles operated by a carsharing program, the number of required parking spaces may be reduced by the lesser of three (3) required parking spaces for each carsharing space or fifteen (15) percent of the total number of required spaces" (Seattle Municipal Code, § 23.54.020). To qualify for the latter provision, an agreement between the property owner and the carsharing operator must be filed and approved by the city, and notice that the agreement is the basis for the reduced parking requirement must be recorded with the deed.
- **Personal vehicle sharing:** In Washington, state law HB 2384 protects vehicle owners by categorizing shared personal vehicles as a noncommercial use, which enables the vehicles to be insured while rented through secondary policies provided by a peer-to-peer carsharing.
- **Helmet law:** The King County board of health in Washington enforces a bicycle helmet law that has been in effect since August 2003 requiring all cyclists regardless of age to wear helmets. Pronto Cycle in Seattle has maintained compliance with the helmet law by allowing users to pick up helmets from boxes adjacent to bicycle kiosks. The helmets are loaned on the honor system, which Pronto Cycle believed would be operationally easier to implement than a helmet-dispensing mechanism.

- **Ridesourcing/TNCs:** In June 2014, Seattle's mayor brokered a compromise between the city's taxi and ridesourcing/TNC interest groups. The city agreed to issue 200 new taxi licenses over a four-year period and to remove a prior 150-driver limit on TNC companies. The agreement also requires that TNCs be licensed and insured, and it establishes a 10-cent-per-ride surcharge for an accessibility fund to pay for riders who require accessible services under the Americans with Disabilities Act.

WASHINGTON, DISTRICT OF COLUMBIA

Population	646,449
Land area (sq. mi)	61.1
Population per sq. mi.	9,857
Persons per household	2.20
Mean travel time to work (min)	29.7
Median household income ($)	65,830
Walk Score	74
Transit Score	70
Bike Score	70

Washington, DC, is relatively dense with just under 10,000 people per square mile. It has a robust public transportation network including the nation's sixth largest bus network and the second busiest rapid rail system in the country, with 91 stations, 118 miles of track, and more than 750,000 trips on an average weekday (WMATA 2014). Additionally, the district's Union Station is the second busiest Amtrak station in the country with approximately 70,000 daily boardings and 4.6 million annual passengers. Of Washington metro travelers, 37 percent commute using public transportation, second only to New York (Christie 2007).

Key Metrics
In June 2014, Washington, DC, hosted the Innovation in Mobility Public Policy Summit to discuss new developments in shared mobility and to foster collaboration among federal, state, and local governments and private-sector mobility providers. Washington, DC has continued to build upon this momentum, and today shared mobility includes multiple modes:

- **Business-to-consumer carsharing:** In September 2015, an estimated 86,000 district residents shared 1,225 vehicles through two roundtrip carsharing operators, Enterprise CarShare and Zipcar, and a one-way carsharing program, car2go. An estimated 35 percent of the Washington DC business-to-consumer carsharing fleet is one-way capable.
- **Peer-to-peer carsharing:** In September 2015, two peer-to-peer carsharing operators, Getaround and Turo (formerly RelayRides), accounted for an estimated 2,300 members sharing approximately 300 privately owned vehicles. (Data for FlightCar were not available.)
- **Bikesharing:** In September 2015, one bikesharing program, Capital Bikeshare, with 3,000 bicycles and 350 bikesharing stations was operating in the district. Capital Bikeshare had 5,663 annual members and 250,651 casual users.
- **Ridesourcing/TNCs and taxis:** In September 2015, Lyft, Sidecar (which ceased operations in December 2015), and Uber were providing ridesourcing services. The district had an estimated 8,134 taxi licenses and 12,000 Uber vehicles. (Data for Lyft were not available.)
- **e-Hail apps:** In October 2015, four e-Hail apps—Curb, mytaxi, Taxi Transportation, and Yellow Cab of DC—were providing digital dispatch services for taxis.
- **Courier network services:** In October 2015, seven services—DoorDash, Instacart, GrubHub, Postmates, Roadie, Sidecar Deliveries (which has since ceased operations), and Uber—were providing for-hire delivery services.
- **Mobility aggregators:** In October 2015, seven mobility aggregators—Citymapper, Embark, Google Now, Nimbler, RideScout (now Moovel), TripGo, and Waze—were providing route planning and aggregation services.

Notable Policies
Washington, DC, was one of the first municipal jurisdictions to allocate on-street parking for carsharing. In addition, the district has policies regulating ridesourcing/TNCs, mandating the use of an e-Hail app by taxicabs, and addressing environmental justice concerns for unbanked users through private-sector partnerships. These policies and initiatives include the following:

- **Carsharing parking:** In 2005 Washington, DC, established a carsharing parking initiative permitting the director of the District Department of Transportation (DDOT) to authorize a one-year contract for on-street carsharing parking. The district's municipal regulation also allows the director to authorize such spaces without publishing notice provided that the city's Advisory Neighborhood Commissions are consulted. The district's regulation also

allows DDOT to require up to seven vehicles be located in low-income neighborhoods, requires carsharing operators to provide data to DDOT to assist in evaluating program impacts, permits the establishment of special license plates to aid in parking enforcement of carsharing parking spaces, and allows unauthorized vehicles to be fined (Municpal Regulations and DC Register, Rule Number 18-2406). In 2011 the DDOT supplemented the initiative parking policy with parking auctions for carsharing parking. Minimum bidding in the first year of the auction was set at $3,600 per space (Garthwaite 2012). In April 2015, the Washington Metropolitan Area Transit Authority announced that it selected Enterprise CarShare to offer carsharing at its metrorail stations (WMATA 2015).

- **Bikesharing environmental justice initiatives:** Capital Bikeshare has partnered with financial institutions that allow users to establish accounts, obtain debit cards, and receive promotional gift cards to offset the cost of bikesharing memberships.

- **Ridesourcing/TNCs:** The council of the District of Columbia unanimously passed the Public Vehicle-for-Hire Innovation Amendment Act in December 2012. The act defined "digital dispatch" services, required that app users have the option of selecting a wheelchair-accessible vehicle, and mandated that consumers have the ability to see fare estimates (DC Municipal Regulations and DC Register, Act 19-631 2013). In October 2014, the council approved revised ridesourcing/TNC legislation that includes new provisions such as requiring multijurisdictional background checks, $1 million of liability coverage the moment a driver accepts a ride, and an annual vehicle inspection (Courtney 2014)

- **e-Hail:** The District of Columbia Taxicab Commission has mandated that all district taxicabs use the Universal DC TaxiApp. The commission began testing the app in March 2015.

APPENDIX B: SHARED MOBILITY RESOURCES FOR PLANNERS

RECOMMENDED READINGS

Bikesharing

Borecki, Natalie, Darren Buck, Payton Chung, Patricia Happ, Nicholas Kushner, Tim Maher, Bradley Rawls, Paola Reyes, Matthew Steenhoek, Casey Studhalter, Austin Watkins, and Ralph Buehler. 2012. *Virginia Tech Capital Bikeshare Study*. Available at https://ralphbu .files.wordpress.com/2012/01/vt-bike-share-study -final3.pdf.

Gleason, Rebecca, and Laurie Miskimins. 2012. *Exploring Bicycle Options for Federal Lands: Bike Sharing, Rentals and Employee Fleets*. Report Number FHWA-WFL/TD-12-001, Federal Highway Administration. Available at www.nps.gov /transportation/pdfs/FHWA_bicycle_options.pdf.

Institute for Transportation and Development Policy. 2013. "Riding the Bike-Share Boom: The Top Five Components of A Successful System." Available at www.itdp.org/riding -the-bike-share-boom-the-top-five-components-of-a -successful-system/.

Martin, Elliot, Adam Cohen, Jan Botha, and Susan Shaheen. 2016. B*ikesharing and Bicycle Safety*. San Jose, CA: Mineta Transportation Institute. Available at http://transweb .sjsu.edu/PDFs/research/1204-bikesharing-and-bicycle -safety.pdf.

Nair, Rahul, Elise Miller-Hooks, Robert Hampshire, and Ana Busic. 2013. "Large-Scale Vehicle Sharing Systems: An Analysis of Vélib." *International Journal of Sustainable Transportation* 7 (1): 85–106.

Shaheen, Susan, Stacey Guzman, and Hua Zhang. 2011. "Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future." *Transportation Research Record* 2143: 159–167.

Shaheen, Susan, Elliot Martin, Nelson Chan, Adam Cohen, and Mike Pogodzinski. 2014. *Public Bikesharing in North America During A Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts.* Available at http://transweb.sjsu.edu/project/1131.html.

Shaheen, Susan, Elliot Martin, and Adam Cohen. 2013. "Public Bikesharing and Modal Shift Behavior: A Comparative Study of Early Bikesharing Systems in North America." *International Journal of Transportation* 1 (1): 35–54.

Carsharing

Cervero, Robert. 2003. "City CarShare: First-Year Travel Demand Impacts." *Transportation Research Record* 1839: 159–166.

Cervero, Robert, and Yuhsin Tsai. 2004. "City CarShare in San Francisco, California: Second-Year Travel Demand and Car Ownership Impacts." *Transportation Research Record* 1887: 117–127.

Cervero, Robert, Aaron Golub, and Brendan Nee. 2007. "City Carshare: Longer-Term Travel Demand and Car Ownership Impact." *Transportation Research Record* 1992: 70–80.

Cooper, Gigi, Deborah A. Howe, and Peter Mye. 2000. *The Missing Link: An Evaluation of CarSharing Portland Inc. Portland, Oregon.* Available at http://pdxscholar.library.pdx.edu /usp_murp/74/.

Firnkorn, Jörg and Martin Müller. 2012. "Selling Mobility Instead of Cars: New Business Strategies for Automakers and the Impact of Private Vehicle Holdings." *Business Strategy and The Environment* 21 (4): 264–280.

Lane, Clayton. 2005. "PhillyCarShare: First-Year Social and Mobility Impacts of Carsharing in Philadelphia, Pennsylvania." *Transportation Research Record* 1927: 158–166.

Martin, Elliot, and Susan Shaheen. 2011. "Impacts of Carsharing on Household Vehicle Ownership." *Access* 38: 22–27.

Millard-Ball, Adam, Gail Murray, Jessica Ter Schure, and Christine Fox. 2005. *Car-Sharing: Where and How It Succeeds*. TCRP Project B-26, Transportation Research Board. Available at http://onlinepubs.trb.org/onlinepubs /tcrp/tcrp_rpt_108.pdf.

Shaheen, Susan, Nelson Chan, and Helen Micheaux. 2015. "One-Way Carsharing's Evolution and Operator Perspectives from the Americas." *Transportation*: 42: 519–536

Shaheen, Susan, and Adam Cohen. 2013. "Carsharing and Personal Vehicle Services: Worldwide Market Developments and Emerging Trends." *International Journal of Sustainable Transportation* 7 (1): 5–34.

Shaheen, Susan, Adam Cohen, and Melissa Chung. 2010. "North American Carsharing: A Ten-Year Retrospective." *Transportation Research Record* 2110: 35–44.

Shaheen, Susan, Adam Cohen, and Elliot Martin. 2010. "Carsharing Parking Policy: Review of North American Practices and San Francisco, California, Bay Area Case Study." *Transportation Research Record* 2187: 146–156.

Shaheen, Susan, Adam Cohen, and Darius Roberts 2006. "Carsharing in North America: Market Growth, Current Developments, and Future Potential." *Transportation Research Record* 1986: 116–124.

Peer-to-Peer Carsharing

Ballús-Armet, Ingrid, Susan Shaheen, Kelly Conts, and David Weinzimmer. 2014. "Peer-to-Peer Carsharing: Exploring Public Perception and Market Characteristics in the San Francisco Bay Area, California." *Transportation Research Record* 2416: 27–36.

Dill, Jennifer, Anais Mathez, Nathan McNeil, and Steven Howland. 2015. "Who Uses Peer-to-Peer Carsharing? An Early Exploration." Report Number 15-3881, TRB 94th Annual Meeting Compendium of Papers.

Shaheen, Susan, Mark Mallery, and Karla Kingsley. 2012. "Personal Vehicle Sharing Services in North America." *Research in Transportation Business & Management* 3: 71–81.

Ridesharing

Chan, Nelson, and Susan Shaheen. 2012. "Ridesharing in North America: Past, Present, and Future." *Transport Reviews* 32 (1): 93–112.

Deakin, Elizabeth, Karen Trapenberg Frick, and Kevin Shivley. 2012. "Dynamic Ridesharing." *Access Magazine* 40: 23–28.

Ridesourcing, Taxis, and Transportation Network Companies

City of Montreal Taxi Bureau. 2016. *Study for a Centralized Application for Taxis in Montréal*. Prepared by Matthew W. Daus, Sharon Klein, Salma Mallah, Andrew Matera, Jason Mischel, and Brook Taye, Windels Marx Lane & Mittendorf. Available at www.windelsmarx.com/resources /documents/Study%20for%20a%20Centralized%20 Application%20for%20Taxis%20in%20Montreal%20-%20 April%202016.pdf.

Daus, Matthew W., and Jasmine K. Le Veaux. 2014. *The Disruptive Transportation Technology Movement—A Litigation Primer and Roadmap*. Available at www.windelsmarx.com/resources/documents/The%20Disruptive%20 Transportation%20Technology%20Movement%20 (10990519).pdf.

Daus, Matthew W., and Jason R. Mischel. 2014. "Accessible Transportation Reform: Transforming the Public Paratransit and Private For-Hire Ground Transportation Systems." *The Transportation Lawyer* 17 (2): 37–41. Available at http://www.beneschlaw.com/Files/Publication/0f84dd11 -9c46-4ccc-b1e9-5fed7d22db70/Presentation/Publication Attachment/603fac98-36e9-4b0f-a446-6a63f40d74cf /TTL%20October%202015_Web.pdf.

Daus, Matthew W., and Pasqualino Russo. 2015. *One Standard for All: Criminal Background Checks for Taxicab, For-Hire, and Transportation Network Company (TNC) Drivers*. Available at www.utrc2.org/sites /default/files/pubs/Background%20Check%20Report .pdf.

Dempsey, Paul Stephen. 1996. "Taxi Industry Regulation, Deregulation, and Reregulation: The Paradox of Market Failure." *Transportation Law Journal* 24 (1): 73–120.

Mississauga, City of (Ontario). 2016. *Study of Regulations for Transportation Network Companies ("TNCs").* Prepared by Windels Marx Lane & Mittendorf. Available at www.windelsmarx.com/resources/documents/Updated%20Mississauga%20Report%20-%20Transportation%20Group%20(11187023).pdf.

Rayle, Lisa, Susan Shaheen, Nelson Chan, Danielle Dai, and Robert Cervero. 2015. "App-Based, On-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco." Report Number 15-4633, TRB 94th Annual Meeting Compendium of Papers.

The Sharing Economy, Shared Mobility, Smartphone Applications, and Millennials

Bostman, Rachel, and Roo Rogers. 2010. *What's Mine Is Yours.* New York: Harper Collins.

Davis, Benjamin, and Tony Dutzik. 2012. *Transportation and the New Generation: Why People Are Driving Less and What That Means for Transportation Policy.* Available at www.uspirg.org/sites/pirg/files/reports/Transportation%20%26%20the%20New%20Generation%20vUS_0.pdf.

Gansky, Lisa. 2010. *The Mesh: Why the Future Is Sharing.* New York: Portfolio Hardcover.

Hallock, Lindsey, and Jeff Inglis. 2015. *The Innovative Transportation Index: The Cities Where New Technologies and Tools Can Reduce Your Need to Own a Car.* Available at www.uspirg.org/sites/pirg/files/reports/Innovative_Transportation_Index_USPIRG.pdf.

Harris, Malcolm, and Neal Gorenflo. 2012. *Share or Die: Voices of the Get Lost Generation in the Age of Crisis.* Gabriola Island, British Columbia: New Society Publishers.

Owyang, Jeremiah, Alexandra Samuel, and Andrew Grenville. 2013. *Sharing Is the New Buying.* Available at www.slideshare.net/jeremiah_owyang/sharingnewbuying.

Shaheen, Susan, Adam Cohen, and Ismail Zohdy. 2016. *Shared Mobility: Current Practices and Guiding Principles.* Available at www.ops.fhwa.dot.gov/publications/fhwahop16022/index.htm.

Shaheen, Susan, Adam Cohen, Ismail Zohdy, and Beaudry Kock. 2016. *Smartphone Applications to Influence Travel Choices: Practices and Policies.* Available at www.ops.fhwa.dot.gov/publications/fhwahop16023/fhwahop16023.pdf.

Transit Cooperative Research Program 2013. *Millennials and Mobility: Understanding the Millennial Mindset and New Opportunities for Transit Providers.* Prepared by Neela Sakaria and Natalie Stehfest, Latitude° Research. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_w61.pdf.

Transportation Research Board. 2016. Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services. Available at http://onlinepubs.trb.org/onlinepubs/sr/sr319.pdf.

ONLINE RESOURCES

Academic and Non-Governmental Organizations

Eno Center for Transportation
www.enotrans.org

The Eno Center for Transportation is a neutral, nonpartisan think tank promoting policy innovation and providing professional development opportunities to transportation professionals.

Frontier Group
www.frontiergroup.org

Frontier Group provides research and analyses to help citizens address a range of issues, including fracking, solar energy, global warming, transportation, and clean water.

Innovative Mobility Research
http://innovativemobility.org

Innovative Mobility Research conducts research on technology applications, behavioral response, and public policies that seek to expand and enhance transportation choices, better manage demand for transportation services, and improve the environment.

Institute for Transportation and Development Policy
www.itdp.org

The Institute for Transportation and Development Policy works with cities worldwide to develop transport solutions that cut greenhouse gas emissions, reduce poverty, and improve the quality of urban life. It has offices in Argentina, Brazil, China, India, Indonesia, Mexico, and the United States.

Living Cities
www.livingcities.org

Living Cities is a member organization of foundations and financial institutions that works with leaders in cities across the United States to improve the economic well-being of low-income people.

Mineta Transportation Institute
http://transweb.sjsu.edu

The Mineta Transportation Institute conducts research, develops education programs, and facilitates information and technology transfer focusing on multimodal surface transportation policy and management issues.

Mobility Lab
http://mobilitylab.org

The Mobility Lab conducts research and provides best practices guidance to advocates related to the development of healthy, efficient, and sustainable transportation options. One of its primary goals is to measure the impacts of transportation demand management services in Arlington County, Virginia.

National Center for Mobility Management
http://nationalcenterformobilitymanagement.org

The National Center for Mobility Management helps communities adopt transportation strategies that increase mobility options and promote health, economic development, and self-sufficiency. An initiative of the United We Ride program, the center is supported through a cooperative agreement with the Federal Transit Administration and operates through a consortium between the American Public Transportation Association, the Community Transportation Association of America, and the Easter Seals Transportation Group.

Natural Resources Defense Council
www.nrdc.org

The Natural Resources Defense Council is an international environmental advocacy organization with a staff of over 500 lawyers, scientists, and other policy experts and more than two million members and online activists around the world working to ensure the rights of all people to air, water, and the wild.

PeopleForBikes
www.peopleforbikes.org

PeopleForBikes is a membership organization made up of individual riders, businesses, community leaders, and elected officials that works to promote bicycling.

Shared-Use Mobility Center
http://sharedusemobilitycenter.org

The Shared-Use Mobility Center is a public-interest partnership working to foster collaboration around shared mobility and helping to connect the growing industry with public transit agencies, cities, and communities across the country.

Transportation Research Board
www.trb.org

The Transportation Research Board promotes transportation innovation and progress through research activities involving engineers, scientists, researchers, and practitioners from the public and private sectors and acadamia. It is one of seven major programs of the National Research Council, which is the principal operating agency of the National Academies and is jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Transportation Sustainability Research Center
http://tsrc.berkeley.edu

The Transportation Sustainability Research Center conducts analyses and evaluation to develop findings and recommendations for key transportation issues of interest to industry leaders and policy makers to aid in decision making. It is part of the Institute of Transportation Studies at the University of California, Berkeley.

University of California Center on Economic Competitiveness in Transportation
http://ucconnect.berkeley.edu

The University of California Center on Economic Competitiveness in Transportation serves as the University Transportation Center for federal Region 9, supporting the faculty of its consortium of five University of California campuses (Berkeley, Irvine, Los Angeles, Riverside, and Santa Barbara) and its affiliate, Cal Poly, Pomona. It pursues research aligned the broad theme of promoting economic competitiveness by enhancing multimodal transport for California and the region.

University of California Transportation Center
www.uctc.net

The University of California Transportation Center works to advance the state of the art in transportation research and practice and to expand the workforce of transportation professionals. It is a multi-campus organization headquartered at the University of California, Berkeley.

United States Public Interest Research Group
www.uspirg.org

The United States Public Interest Research Group is a consumer group focused on consumer health and safety, financial security, and public participation.

Industry Associations

Carsharing Association
http://carsharing.org

The CarSharing Association is a member organization that works to maximize the environmental and social impacts of the carsharing industry. Collectively, the it represents more than 4,000 shared vehicles and 125,000 drivers.

North American Bikeshare Association
http://nabsa.net

The North American Bikeshare Association is a member association of bikesharing system owners, managers, operators, and service vendors. It facilitates collaboration, sharing of experiences and best practices, enhanced communication, and guidance on the new and fast growing bikesharing industry.

Other Online Resources

Bike Share Map
http://bikes.oobrien.com

The Bike Share Map shows the locations of docking stations in bicycle sharing systems in over 150 cities around the world.

Shareable
www.shareable.net

Shareable is a nonprofit news, action, and connection hub for sharing-related movements and activities, including the maker movement, collaborative consumption, and the solidarity economy.

World Carshare Consortium
http://ecoplan.org/carshare

The World Carshare Consortium is a free, independent communications program supporting carsharing projects and programs worldwide.

World Share/Transport Forum
http://ecoplan.org/sharetransport

The World Share/Transport Forum is an open, collaborative group project examining the potential of shared mobility for sustainable transport in cities.

APPENDIX C: UNWEIGHTED AGGREGATE SHIFT IN PUBLIC TRANSIT, SHARED, AND NON-MOTORIZED MODES (FREE-FLOATING ONE-WAY CARSHARING)

TABLE C.1. CALGARY, ALBERTA

Mode	Did Not Use Before or Now	Much More Often	More Often	About the Same	Less Often	Much Less Often	Changed (but not because of carsharing)
Personal Cycling (n=2,098)	702 (33%)	43 (2%)	52 (2%)	1,041 (50%)	64 (3%)	9 (0%)	187 (9%)
Public Transportation (n=2112)	262 (12%)	29 (1%)	85 (4%)	934 (44%)	545 (26%)	139 (7%)	118 (6%)
Ridesharing (n=2,094)	4,650 (49%)	77 (1%)	331 (4%)	3,690 (39%)	355 (4%)	46 (1%)	245 (3%)
Taxis (n=2,096)	197 (9%)	6 (0%)	26 (1%)	469 (22%)	871 (42%)	485 (23%)	42 (2%)
Walking (n=2,102)	N/A	67 (3%)	396 (19%)	1,279 (61%)	223 (11%)	20 (1%)	117 (6%)

Source: Martin and Shaheen 2016 (percentages may not add to 100 due to rounding; ridesourcing data not collected for Canadian cities)

TABLE C.2. VANCOUVER, BRITISH COLUMBIA

Mode	Did Not Use Before or Now	Much More Often	More Often	About the Same	Less Often	Much Less Often	Changed (but not because of carsharing)
Personal Cycling (n=1,427)	422 (30%)	30 (2%)	43 (3%)	707 (50%)	110 (8%)	6 (0%)	109 (8%)
Public Transportation (n=1,430)	41 (3%)	31 (2%)	68 (5%)	580 (41%)	528 (37%)	120 (8%)	62 (4%)
Ridesharing (n=1,422)	827 (58%)	5 (0%)	41 (3%)	452 (32%)	55 (4%)	9 (1%)	33 (2%)
Taxis (n=1,421)	165 (12%)	6 (0%)	32 (2%)	273 (19%)	527 (37%)	394 (28%)	24 (2%)
Walking (n=1,419)	N/A	59 (4%)	226 (16%)	915 (64%)	143 (10%)	7 (0%)	69 (5%)

Source: Martin and Shaheen 2016 (percentages may not add to 100 due to rounding; ridesourcing data not collected for Canadian cities)

TABLE C.3. SAN DIEGO, CALIFORNIA

Mode	Did Not Use Before or Now	Much More Often	More Often	About the Same	Less Often	Much Less Often	Changed (but not because of carsharing)
Personal Cycling (n=1,077)	337 (31%)	35 (3%)	41 (4%)	525 (49%)	50 (5%)	15 (1%)	74 (7%)
Public Transportation (n=1,079)	263 (24%)	29 (3%)	100 (9%)	383 (35%)	184 (17%)	79 (7%)	41 (4%)
Ridesharing (n=1,078)	413 (38%)	23 (2%)	82 (8%)	452 (42%)	48 (4%)	13 (1%)	47 (4%)
Ridesourcing (n=1,078)	240 (22%)	76 (7%)	162 (15%)	347 (32%)	157 (15%)	20 (2%)	76 (7%)
Taxis (n=1,078)	164 (15%)	8 (1%)	15 (1%)	215 (20%)	338 (31%)	303 (28%)	35 (3%)
Walking (n=1,074)	N/A	66 (6%)	295 (27%)	569 (53%)	87 (8%)	12 (1%)	45 (4%)

Source: Martin and Shaheen 2016 (percentages may not add to 100 due to rounding)

TABLE C.4. WASHINGTON, DC

Mode	Did Not Use Before or Now	Much More Often	More Often	About the Same	Less Often	Much Less Often	Changed (but not because of carsharing)
Bikesharing (n=1,324)	539 (41%)	12 (1%)	29 (2%)	585 (44%)	58 (4%)	14 (1%)	87 (7%)
Personal Cycling (n=1,321)	507 (38%)	16 (1%)	27 (2%)	605 (46%)	31 (2%)	7 (1%)	128 (10%)
Public Transportation (n=1,327)	8 (1%)	19 (1%)	32 (2%)	855 (64%)	304 (23%)	28 (2%)	81 (6%)
Ridesharing (n=1,321)	823 (62%)	4 (0%)	13 (1%)	410 (31%)	36 (3%)	4 (0%)	31 (2%)
Ridesourcing (n=1,325)	126 (10%)	16 (1%)	57 (4%)	544 (41%)	437 (33%)	50 (4%)	95 (7%)
Taxis (n=1,323)	107 (8%)	3 (0%)	11 (1%)	388 (29%)	551 (42%)	202 (15%)	61 (5%)
Walking (n=1,325)	N/A	20 (2%)	119 (9%)	939 (71%)	151 (11%)	4 (0%)	92 (7%)

Source: Martin and Shaheen 2016 (percentages may not add to 100 due to rounding)

TABLE C.5. SEATTLE, WASHINGTON

Mode	Did Not Use Before or Now	Much More Often	More Often	About the Same	Less Often	Much Less Often	Changed (but not because of carsharing)
Personal Cycling (n=3,481)	1,324 (n=38%)	28 (1%)	60 (2%)	1,666 (48%)	168 (5%)	28 (1%)	207 (6%)
Public Transportation (n=3,494)	151 (4%)	68 (2%)	254 (7%)	1,912 (55%)	808 (23%)	136 (4%)	165 (5%)
Ridesharing (n=3,489)	1,563 (45%)	28 (1%)	109 (3%)	1,538 (44%)	138 (4%)	17 (0%)	96 (3%)
Ridesourcing (n-3,484)	968 (28%)	40 (1%)	201 (6%)	1,169 (34%)	801 (23%)	149 (4%)	156 (4%)
Taxis (n=3,486)	831 (24%)	8 (0%)	54 (2%)	988 (28%)	907 (26%)	569 (16%)	129 (4%)
Walking (n=3,484)	N/A	101 (3%)	593 (17%)	2,295 (66%)	295 (8%)	26 (1%)	174 (5%)

Source: Martin and Shaheen 2016 (percentages may not add to 100 due to rounding)

APPENDIX D: RIDESOURCING/TRANSPORTATION NETWORK COMPANY INSURANCE LEGISLATION

Property Casualty Insurers (2016) tracks transportation network company regulatory and insurance developments. The following are states with enacted legislation, pending legislation, and no legislation as of May 2016.

ENACTED LEGISLATION

Thirty-two states and the District of Columbia have enacted ridesourcing/transportation network company insurance legislation: Arizona, Arkansas, California, Colorado, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, and Washington. Broadly, these states require some type of primary insurance, generally during the time that the application is on and the driver is available.

PENDING LEGISLATION

Thirteen states have pending insurance bills in their legislatures: Alaska, Alabama, Connecticut, Hawaii, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Iowa's legislature has passed a bill that was sent to the governor in April 2016 for ratification.

NO LEGISLATION

Two states have not enacted or proposed any insurance legislation: Oregon and Wyoming.

GLOSSARY

alternative transit services   Broad category of mobility services that includes shuttles (shared vehicles that connect passengers to public transit or employment centers), paratransit, and private-sector transit solutions (commonly referred to as microtransit). Paratransit and microtransit in their most agile form (flexible routing and/or flexible scheduling) can be included in the category of services known as flexible transit services.

bikesharing   System where users access bicycles on an as-needed basis for one-way (point-to-point) or roundtrip travel. Station-based bikesharing kiosks are typically unattended, concentrated in urban settings, and offer one-way station-based service (bicycles can be returned to any kiosk). Free-floating bikesharing offers users the ability to check-out bicycles and return them to any location within a predefined geographic region.

carpooling   Formal or informal arrangement where commuters share a vehicle for trips from a common origin and/or destination.

car rental   Non-membership-based service or company that rents cars or light trucks, typically by the day or week. Traditional rental car services include storefronts that require an in-person transaction through a rental car attendant. Rental car services may also use "virtual storefronts," allowing unattended vehicle access similar to the access carsharing provides.

carsharing   Program where individuals have short-term access to a vehicle without the costs and responsibilities of ownership. Individuals typically access vehicles by joining an organization that maintains a fleet of cars and light trucks.

closed-campus bikesharing   Bikesharing system deployed on university and office campuses. Bicycles are available only to members of the particular campus community being served.

courier network services   Services providing for-hire delivery of packages, food, or other items for compensation through an online-enabled application or platform (such as a website or smartphone app) that connects delivery drivers using a personal transportation mode. These services can also be used to pair package delivery with existing passenger trips.

employer shuttles   Employer-sponsored shuttles that transport employees between workplaces and public transit stations.

fractional ownership   Model where individuals sublease or subscribe to have access to a motor vehicle or low-speed mode owned by a third party.

hybrid peer-to-peer access model   Model where individuals access vehicles or low-speed modes by joining an organization that maintains its own fleet but also includes privately owned autos or low-speed modes.

limousines and liveries   Prearranged transportation services driven by for-hire drivers or chauffeurs.

metropolitan planning organization   Agency that administers the federally required transportation planning processes in every urbanized area with a population over 50,000. It is responsible for the 20-year long-range plan and the transportation improvement program.

microtransit   Privately owned and operated shared transportation system typically comprising vans and buses, which can have fixed routes and schedules or flexible routes and on-demand scheduling.

modal split   Proportion of total person-trips for each mode of transportation.

mode of travel   Means of travel (e.g., auto, public transit, bicycle, walking).

multimodal   Use of more than one mode of transportation to complete a trip.

one-way carsharing   Form of carsharing that enables members to pick up a vehicle at one location and drop it off at another location. This is also called point-to-point carsharing service. One-way carsharing can be station based or free floating.

pedicabs   Bicycle for-hire service with a peddler who transports passengers on a cycle with three or more wheels and a passenger compartment.

peer-to-peer bikesharing   System where users rent out their privately owned bicycles.

peer-to-peer carsharing   Program that uses privately owned vehicles made temporarily available for shared use by an individual or members of a peer-to-peer carsharing company. Also called a peer-to-peer access model.

peer-to-peer marketplace   Network that enables direct online exchanges between individuals.

personal vehicle sharing   Sharing of privately owned vehicles where companies broker transactions between car owners and renters.

public transportation   Any transportation service that charges set fares, operates on fixed routes, and is available to the public (such as buses, light and heavy rail, and ferries).

ridesourcing/transportation network companies   Programs that provide prearranged and on-demand transportation services for compensation by connecting drivers of personal vehicles with passengers through mobile applications.

ridesplitting   Form of ridesourcing where riders with similar origins and destinations are matched to the same driver and vehicle in real time, with the ride and costs split among users.

roundtrip carsharing   Program that allows members hourly access to shared vehicles that must be returned to the same location where the vehicles were picked up.

scooter sharing   Program that provides members access to private scooters for roundtrip or one-way trips.

shared mobility   Shared use of a motor vehicle, bicycle, or other low-speed mode.

single occupant vehicle   Vehicle occupied by one person.

slugging   Informal carpooling between strangers (a hybrid between commuter carpooling and hitchhiking). This is also known as casual carpooling.

smart parking   The integration of technologies to streamline the parking process, ranging from dynamic space availability information to simplified payment methods. Smart parking can also include app-based valet (or e-Valet) services.

taxis   Type of for-hire vehicle service (prearranged or on-demand) with a driver and used by one or more passengers.

trip   One-directional movement for a specific purpose, which begins at an origin at a start time and ends at a destination at an arrival time.

vanpooling   Program consisting of vans, small buses, and other vehicles operating ridesharing services with capacity for a minimum of seven passengers. Typically, participants split the vehicle and operational costs and may share the responsibility of driving.

vehicle miles traveled   Number of miles traveled annually by vehicles .

REFERENCES

6t. 2014. *One-Way Carsharing: Which Alternative to Private Cars?* Available at http://6t.fr/download/AD_ExecutiveSummary _140523.pdf.

ABAG (Association of Bay Area Governments). 2015. "Priority Development Areas/Priority Conservation Areas." Available at http://abag.ca.gov/priority/.

Alberts, Brian, Jamie Palumbo, and Eric Pierce. 2012. "Vehicle 4 Change: Health Implications of the Capital Bikeshare Program." Available at www.capitalbikeshare.com/assets/pdf/v4c _capstone_report_final.pdf.

American Car Rental Association. 2011. *Draft Hill Two Pager: Why Congress Should Protect Consumers from Having to Pay New 'Special Taxes' on Car Rentals.* Available at https://server9.fused network.com/~acraorg/wp-content/uploads/2011/01/hr4175.pdf.

Austin, City of (Texas). 2016a. *An Ordinance Amending City Code Chapter 13-2 Relating to Transportation Network Companies (TNCs).* Available at www.austintexas.gov/edims /documentcfm?id=247569.

———. 2016b. "Transportation: On Street Parking, Car Share Parking." Available at www.austintexas.gov/page/street-parking.

———. 2014. *Ordinance No. 20141016-038.* Available at www .austintexas.gov/edims/document.cfm?id=220985.

———. 2013. *Resolution No. 20131024-058. Article 7. Off-Street Parking and Loading.* Available at www.austintexas.gov/edims /document.cfm?id=206885.

———. 2006. *Resolution No. 20060928-069I.* Available at www .austintexas.gov/edims/document.cfm?id=98431.

Austin Business Journal. 2010. "City Extends Car2go for Six Months." *Austin Business Journal*, April 14. Available at www .bizjournals.com/austin/stories/2010/04/12/daily21.html.

Auto Rental News. 2015. "Florida CarShare Tax Cut in Half." *Auto Rental News*, February 19. Available at www.autorentalnews .com/channel/legislative/news/story/2015/02/florida-carshare -tax-cut-in-half.aspx.

———. 2010. "Zipcar Granted Graves Protection." *Auto Rental News*, June 16. Available at www.autorentalnews.com/channel /legislative/news/story/2010/06/zipcar-granted-graves -protection.aspx.

Badger, Emily. 2014. "Free Market Advocates Say DC Is the Uber-Friendliest City in the Nation." *The Washington Post*, November 12. Available at www.washingtonpost.com/news/wonk /wp/2014/11/12/free-market-advocates-say-d-c-is-the-uber -friendliest-city-in-the-nation/.

Barro, Josh. "New York Taxi Medallion Prices Fall Again." *The New York Times*, December 2. Available at www.nytimes .com/2014/12/03/upshot/new-york-taxi-medallion-prices-fall -again.html?_r=0.

Batey, Eve. 2016. "Business Licenses for Some SF Uber and Lyft Drivers Cost Hundreds More Than Expected." *SFist*, April 27. Available at http://sfist.com/2016/04/27/business_licenses_for _some_sf_uber_1.php.

Bauer, Kelly. 2016. "Divvy Driver Killed, Believed to Be Nation's First Bike-Sharing Death." DNAinfo, July 1. Available at www .dnainfo.com/chicago/20160701/avondale/divvy-rider-hit-by -truck-avondale-critical-condition-police-say.

Bieszczat, Alice, and Joseph Schwieterman. 2011. *Are Taxes on Carsharing too High? A Review of the Public Benefits and Tax Burden of an Expanding Transportation Sector.* Chicago: Chaddick Institute for Metropolitan Development. Available at https:// las.depaul.edu/centers-and-institutes/chaddick-institute-for -metropolitan-development/Documents/DePaul%20University %20Study%20on%20Taxation%20of%20Carsharing%20 FINAL.pdf.

Brey, Jared 2016. "'Tax' on Uber and Lyft Would Actually Be a $4 Million Windfall to the PPA." *Philadelphia*, May 23.Available at www.phillymag.com/citified/2016/05/23/uber-lyft-tax-philadelphia-school-district/.

Bridj. 2016. "How It Works.: Available at www.bridj.com/#how.

Buck, Darren, Ralph Buehler, Patricia Happ, Bradley Rawls, Payton Chung, and Natalie Borecki. 2013. "Are Bikeshare Users Different from Regular Cyclists? A First Look at Short-Term Users, Annual Members, and Area Cyclists in the Washington DC Region." *Transportation Research Record* 2387: 112–119.

Burnley, Malcolm. 2015. "How Car Sharing Can Solve Philly's Parking Problems." *Philadelphia*, April 6. Available at www.phillymag.com/citified/2015/04/06/car-sharing-parking-philadelphia/#B7yhdHritc42jfQq.99.

Burris, Mark, and Justin Winn. 2006. "Slugging in Houston—Casual Carpool Passenger Characteristics." *Journal of Public Transportation* 9 (5): 23–40.

California Public Utilities Commission. 2016. "Transportation Network Companies." Available at www.cpuc.ca.gov/General.aspx?id=787.

Capital Bikeshare. 2016. "System Data." Available at www.capitalbikeshare.com/system-data.

Cervero, Robert, and Yuhsin Tsai. 2004. "City CarShare in San Francisco: Second-Year Travel Demand and Car Ownership Impacts." *Transportation Research Record* 1887: 117-127.

Chan, Nelson, and Susan Shaheen. 2012. "Ridesharing in North America: Past, Present, and Future." *Transport Reviews* 32 (1): 93–112.

Chicago, City of (Illinois). n.d. "CMAP FY 2016–2020 CMAQ Project Application—Other Projects: "Divvy" Bike Sharing Program—2016 Capacity and Geographic Expansion." Available at www.cmap.illinois.gov/documents/10180/396493/OT01164102+Chicago+DOT-Divvy+2016+Expansion.pdf/c5e773f9-64fc-4bf3-8cfd-03c35d1a7688.

Christie, Les. 2007. "New Yorkers Are Top Transit Users." *CNN Money*, June 29. Available at http://money.cnn.com/2007/06/13/real_estate/public_transit_commutes/.

Citi Bike. 2016. "System Data." Available at www.citibikenyc.com/system-data.

City CarShare. 2004. "First-Ever Study of Car-Sharing."

Cohen, Adam, Susan Shaheen, and Ryan McKenzie. 2008. "Carsharing: A Guide for Local Planners." *PAS Memo*, May/June.

Cole, Gail. 2014. "Hawaii Car Sharing Tax, January 2015." *TaxRates.com*, June 26. Available at www.taxrates.com/blog/2014/06/26/hawaii-car-sharing-tax-january-2015/.

Communauto. 2000. *Potentiel de L'Auto-Partage Dans Le Cadre d'Une Politique de Gestion de La Demande en Transport.* Forum de L'AQTR, Gaz à Effet de Serre: Transport et Développement, Kyoto: Une Opportunité d'Affaires? Montréal, Canada. February 7. Available at www.communauto.com/images/Presentation%2007%2002%2000.pdf.

Cooper, Gigi., Deborah. Howes, and Peter. Mye. 2000. *The Missing Link: An Evaluation of CarSharing Portland Inc., Portland, Oregon.* Portland, OR: State of Oregon Department of Environmental Quality.

Courtney, Shaun. 2014. "Uber, Lyft Now Legal in DC." *District Source*, October 29. Available at http://districtsource.com/2014/10/uber-lyft-now-legal-d-c/.

Covert, James. 2015. "Taxi-Sharing App Doesn't Want You Waiting on Line at the Airport." *New York Post*, May 22. Available at http://nypost.com/2015/05/22/taxi-sharing-app-doesnt-want-you-waiting-on-line-at-the-airport/.

Daigneau, Elizabeth. 2010. "New Yorkers 'Share a Cab'" *Governing*, March 4. Available at www.governing.com/idea-center/New-Yorkers-Share-a.html.

Daus, Matthew W., and Pasqualino Russo. 2015. "One Standard for All: Criminal Background Checks for Taxicab, For-Hire, and Transportation Network Company (TNC) Drivers." MPA Newsletter, May. Available www.whosdrivingyou.org/wp-content/uploads/2015/06/background_check_report.pdf.

de Looper, Christian. 2015. "Uber Testing Bus-Like 'Smart Routes.'" *Tech Times*, August 24. Available at www.techtimes.com/articles/79084/20150824/uber-testing-bus-smart-routes.htm.

Denver Bike Sharing. 2012. *2011 Annual Report*. Available at https://denver.bcycle.com/docs/librariesprovider34/default-document-library/annual-reports/dbs-2011-annual-report.pdf?sfvrsn=2.

Dudley, Brier. 2013. "Car2Go a Handy Option, but It Doesn't Come Cheap." *The Seattle Times*, May 12. Available at www.seattletimes.com/business/car2go-a-handy-option-but-it-doesnrsquot-come-cheap/.

Etchison, Amanda. 2016. "Ride-Hailing Service Lyft Returns to Columbus." *Lantern*, March 24. Available at http://thelantern.com/2016/03/ride-hailing-service-lyft-returns-to-columbus/.

Feit, Josh. 2014. "Council Legislation Would Expand Car Sharing." *Seattle Metropolitan*, November 24. Available at www.seattlemet.com/articles/2014/11/24/council-to-look-at-expanding-car-sharing-november-2014.

Ferenchik, Mark. 2013. "Downtown Looking Up as Population Grows." *Columbus Dispatch*, September 18. Available at www.dispatch.com/content/stories/local/2013/09/18/downtown-looking-up.html.

Garthwaite, Josie. 2012. "Car Sharing Redefines the Value of a Parking Space." *National Geographic*, November 30. Available at http://energyblog.nationalgeographic.com/2012/11/30/carsharing-redefines-the-value-of-a-parking-space/.

Gartland, Michael. 2015. "City Hits Uber and Yellow-Cab Drivers with Spate of Summonses." *New York Post*, September 24. Available at http://nypost.com/2015/09/24/city-hits-uber-and-yellow-cab-drivers-with-spate-of-summonses/.

Geeting, Jon. 2015. "As Zipcar Passes the 400-Car Landmark, What's Next for Car-Sharing in Philly?" *PlanPhilly*. June 3. Available at http://planphilly.com/articles/2015/06/03/as-zipcar-passes-the-400-car-landmark-what-s-next-for-car-sharing-in-philly.

Government Fleet. 2014. "GSA Begins Car Sharing Pilot Program." *Government Fleet*, October 3. www.government-fleet.com/channel/safety-accident-management/news/story/2014/10/gsa-begins-car-sharing-pilot-program.aspx.

Green, Richard. 2014. "Are People Moving Back To The City? Or Do They Just Start There?" *Forbes*, February 7. Available at www.forbes.com/sites/richardgreen/2014/02/07/are-people-moving-back-to-the-city-or-do-they-just-start-there/#5a8d0514739c.

Hall, Jonathan, and Alan Krueger. 2015. "An Analysis of the Labor Market for Uber's Driver-Partners in the United States." Available at https://irs.princeton.edu/sites/irs/files/An%20Analysis%20of%20the%20Labor%20Market%20for%20Uber%E2%80%99s%20Driver-Partners%20in%20the%20United%20States%20587.pdf.

Harms, Sylvia, and Bernard Truffer. 1998. *The Emergence of a Nationwide Carsharing Co-Operative in Switzerland*. Available at www.communauto.com/images/Nation%20wide%20CS%20org%20Suisse.pdf.

Hendee, Caitlin. 2015. "Denver Welcomes Its Largest B-cycle Bicycle Sharing Station Ever." *Denver Business Journal*, March 24. Available at www.bizjournals.com/denver/news/2015/03/24/denver-welcomes-its-largest-b-cycle-bicycle.html.

Hoffberger, Chase. 2014. "Buy Yourselves a Ride—Legally!" *Austin Chronicle*, October 24. Available at www.austinchronicle.com/news/2014-10-24/buy-yourselves-a-ride-legally/.

Hubway. 2016. "Hubway Media Kit." Available at www.thehubway.com/mediakit.

———. 2013. "Hubway Celebrates Two Years and One Million Rides." Available at www.thehubway.com/news/2013/07/30/hubway-celebrates-two-years-and-one-million-rides-.

Indianapolis, City of (Indiana). 2016. *Consolidated Zoning/Subdivision Ordinance*. Available at http://downtowndevelopment.com/pdf/Indpls%20Zoning%20Ord.pdf.

Jensen, Nicole. 2001. *The Co-Operative Auto Network Social and Environmental Report, 2000–2001*. Vancouver, British Columbia: Cooperative Auto Network.

Lane, Clayton. 2005. "PhillyCarShare: First-Year Social and Mobility Impacts of Carsharing in Philadelphia, Pennsylvania." *Transportation Research Record* 1927: 158–166.

Lerman, Rachel. 2016. "BMW Wants to Share in Seattle's Car-Sharing Boom." *Seattle Times*, April 8. Available at www.seattletimes.com/business/technology/bmw-wants-to-share-in-seattles-car-sharing-boom/.

Liu, Cathy Yang, and Gary Painter. 2012. "Travel Behavior among Latino Immigrants: The Role of Ethnic Neighborhoods and Ethnic Employment." *Journal of Planning Education*, 32 (1): 62–80.

LoBasso, Randy. 2016. "Indego Bike Share Turns 1-Year-Old, Gets Lots of Gifts." *Bike Coalition Blog*, April 22. Available at http://bicyclecoalition.org/190712-2/#sthash.cNImgNS9.aVS30050.dpbs.

Lyft. 2016. "Meet Lyft Carpool: A New Way to Commute." *Lyft Blog*, March 29. Available at https://blog.lyft.com/posts/meet-lyft-carpool.

Martin, Elliot, Adam Cohen, Jan Botha and Susan Shaheen. 2016. *Bikesharing and Bicycle Safety*. San Jose, CA: Mineta Transportation Institute. Available at http://transweb.sjsu.edu/PDFs/research/1204-bikesharing-and-bicycle-safety.pdf.

Martin, Elliot, and Susan Shaheen, 2016. *Impacts of car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*. Berkeley, CA: Transportation Sustainability Research Center. Available at http://innovativemobility.org/wp-content/uploads/2016/07/Impactsofcar2go_FiveCities_2016.pdf.

———. 2011a. "Greenhouse Gas Emission Impacts of Carsharing in North America." *IEEE Transactions on Intelligent Transportation Systems* 12 (4): 1074–1086.

———. 2011b. "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data." *Energies* 4: 2094–2114.

———. 2010. Greenhouse Gas Emission Impacts of Carsharing in North America. San Jose: Mineta Transportation Institute. Available at http://transweb.sjsu.edu/MTIportal/research/publications/documents/Carsharing%20and%20Co2%20(6.23.2010).pdf.

Martin, Elliot, Susan Shaheen, and Jeffrey Lidicker. 2010. "Impact of Carsharing on Household Vehicle Holdings." *Transportation Research Record* 2143: 150–158.

McGregor, Jim. 2016. "Columbus Wins the Smart City Challge and $50M in Grants." *Forbes*, June 24. Available at www.forbes.com/sites/tiriasresearch/2016/06/24/columbus-wins-the-smart-city-challenge-and-50m-in-grants/#53c036361185.

Metropolitan Transportation Authority. 2016. "The MTA Network: Public Transportation for the New York Region." Available at http://web.mta.info/mta/network.htm.

Metropolitan Transportation Commission. 1999. *Casual Carpooling 1998 Update. Prepared by RIDES for Bay Area Commuters.* Available at www.nctr.usf.edu/wp-content/uploads/2011/04/Casual-Carpool-Report-1998.pdf.

Minett, Paul, and John Pearce. 2011. "Estimating the Energy Consumption Impact of Casual Carpooling." *Energies* 4 (12): 126–139.

New Orleans, City of (Louisiana). 2016. "City of New Orleans Releases Bicycle Share System 'Request for Proposals.'" Available at www.nola.gov/mayor/press-releases/2016/20160419-pr-bicycle-share-rfp-released/.

New York City Department of Transportation. n.d. *NYC Bike Share: Designed by New Yorkers.* Available at www.nyc.gov/html/dot/downloads/pdf/bike-share-outreach-report.pdf.

New York City Taxi and Limousine Commission. 2015. *Chapter 77: Licensing & Rules for Dispatch Service Providers.* Available at www.nyc.gov/html/tlc/downloads/pdf/newly_passed_rule_fhv_dispatch.pdf.

———. 2013. *Medallion Sale Information: Background Information.* Available at www.nyc.gov/html/tlc/medallion/html/background/main.shtml.

Norton, Marcy. 2015. "Car Sharing Service Zipcar Adding One Way Option in Philadelphia." *CBS Philly,* September 16. Available at http://philadelphia.cbslocal.com/2015/09/16/car-sharing-service-zipcar-adding-one-way-option-in-philadelphia/.

Oliphant, Marc. 2008. "The Native Slugs of Northern Virginia: A Profile of Slugging in the Washington DC. Region." Major Paper, Master of Sciences in Urban and Regional Planning, Urban Affairs and Planning, Virginia Tech. Available at www.toolsofchange.com/userfiles/Slugging_Report_Oliphant(2).pdf.

Olson, Parmy. 2014. "Why Google's Waze Is Trading User Data with Local Governments." *Forbes*, July 7. Available at www.forbes.com/sites/parmyolson/2014/07/07/why-google-waze-helps-local-governments-track-its-users/#c8211571db69.

Orsi, Janelle. 2010. "Taxi Cab Sharing in New York City and Beyond." *Shareable*, February 23. Available at www.shareable.net/blog/taxi-cab-sharing-in-new-york-city-and-beyond.

Orso, Anna. 2015. "Uber in Philly: One Year In, How's the Not-Quite-Legal Ride-Sharing Service Doing?" *Billy Penn*, October 26. Available at http://billypenn.com/2015/10/26/uber-in-philly-one-year-in-hows-the-not-quite-legal-ride-sharing-service-doing/.

PACommutes. 2016. "Eco-Impact." Available at www.pacommutes.com/ridesharing/car-pooling/eco-impact/.

Philadelphia, City of (Pennsyvania). 2004. *City to Join PhillyCar-Share, Cut 400 Vehicles.* Available at www.phila.gov/pdfs/City_to_Join_PhillyCarShare.pdf.

Portland, City of (Oregon). 2016a. "BIKETOWN—Portland Bike Share." Available at www.portlandoregon.gov/transportation/57983.

———. 2016b. *TRN-3.309—Carsharing Administrative Rules.* Available at www.portlandoregon.gov/citycode/article/135620?.

Pratsch, Lew. 1979. "Commuter Ridesharing." In *Public Transportation: Planning, Operations, and Management*, edited by George E. Gray and Lester A. Hoel. Englewood Cliffs, NJ: Prentice Hall.

Price, Jeff, and Chris Hamilton. 2005. *Arlington Pilot Carshare Program. First-Year Report.* Available at http://mobilitylaborg/wp-content/uploads/2012/02/ArlingtonCarshareProgram.pdf.

Property Casualty Insurers Association of America. 2016. "Transportation Network Company: States with Enacted Legislation." Available at http://viewer.zmags.com/publication/60841263#/60841263/1.

Rayle, Lisa, Danielle Dai, Nelson Chan, Robert Cervero, and Susan Shaheen. 2016. "Just A Better Taxi? A Survey-Based Comparison of Taxis, Transit, and Ridesourcing Services in San Francisco." *Transport Policy* 45: 168–178.

RentMyCar. 2011. "Oregon Passes Peer to Peer Car Sharing Law HB3149." *RentMyCar.org*, June 22. Available at www.rentmycar.org/?p=35.

Rivoli, Dan. 2015. "Court Halts Citibank from Seizing Medallions from Taxi Kingpin." *New York Daily News*, June 15. Available at www.nydailynews.com/new-york/court-halts-citibank-seizing-medallions-taxi-owner-article-1.2259297.

Rohnert Park, City of (California). 2015. *Central Rohnert Park Priority Development Area Plan: Preliminary Public Review Draft.* Prepared by AECOM. Available at www.ci.rohnert-park.ca.us/Modules/ShowDocument.aspx?documentid=14421.

Rouan, Rick. 2015. "Uber Plans to Add 3,000 Drivers in Columbus, 10,000 in Ohio." *Columbus Dispatch*, September 24. Available at www.dispatch.com/content/stories/local/2015/09/23/uber-columbus-expansion.html.

Saksa, Jim. 2015. "Indego Bike Share Cruises to 180,000 Rides in First 100 Days." *PlanPhilly*. August 6. Available at http://planphilly.com/articles/2015/08/06/indego-bike-share-cruises-to-180-000-rides-in-first-100-days. San Diego, City of (California). 2008. *City of San Diego General Plan*. Available at www.sandiego.gov/sites/default/files/legacy//planning/genplan/pdf/generalplan/adoptedtoc.pdf.

Santa Monica, City of (California). 2016a. *The Downtown Community Plan: A City of Santa Monica Specific Plan*. Available at www.downtownsmplan.org/files/managed/Document/167/DCP%20Draft%202.17.16.pdf.

———. 2016b. "Downtown Specific Plan Program EIR." Available at www.smgov.net/Departments/PCD/Environmental-Reports/Downtown-Specific-Plan-Program-EIR/.

———. 2010. *Santa Monica Land Use & Circulation Element*. Available at www.smgov.net/uploadedFiles/Departments/PCD/Plans/General-Plan/Revised%20LUCE%207.24.15_web.pdf.

Santi, Paolo, Giovanni Resta, Michael Szell, Stanislav Sobolevsky, Steven Strogatz, and Carlo Ratti. 2014. "Quantifying the Benefits of Vehicle Pooling with Shareability Networks." *PNAS (Proceedings of the National Academy of Sciences of the United States of America)* 111 (37): 13290–13294.

Schoner, Jessica. 2012. "Sharing to Grow: Economic Activity Associated with Nice Ride Bike." Presentation at 23rd Annual Center for Transportation Studies Research Conference, University of Minnesota, May 24.

Schwieterman, Joseph P., and Heather Spray. Forthcoming. *When Sharing Is Taxing: Comparing the Tax Burden on Carsharing Services in Major US Cities*. Chicago: Chaddick Institute for Metropolitan Development.

Scoot. 2014. [Scooter sharing benchmarking data on number of members and vehicles]. Unpublished raw dataset.

Seattle, City of (Washington). 2015. *Draft Seattle Comprehensive Plan: Transportation.* Available at www.seattle.gov/dpd/cs/groups /pan/@pan/documents/web_informational/p2294962.pdf.

———. 2005. *The Transportation Strategic Plan (TSP) Update.* Available at www.seattle.gov/transportation/tsp_2005.htm.

SFMTA (San Francisco Municipal Transportation Agency). 2015. *Commuter Shuttle Program Policy.* Available at www.sfmta .com/sites/default/files/projects/2015/Commuter%20Shuttle %20Program%20Policy%20-%20Oct%2016%202015.pdf.

———. 2013. *Carsharing Policy and Pilot Project.* Available at www.sfmta.com/sites/default/files/projects/SFMTA%2Car%20 Sharing%20Policy_MTAB_20130716.pdf.

Shaheen, Susan, and Nelson Chan. 2015. *Mobility and the Sharing Economy Impacts Synopsis: Shared Mobility Definitions and Impacts.* Berkeley, CA: Transportation Sustainability Research Center. Available at http://innovativemobility.org/wp-content/ uploads/2015/07/Innovative-Mobility-Industry-Outlook_SM -Spring-2015.pdf.

Shaheen, Susan, Nelson Chan, and Teresa Gaynor. 2016. "Casual Carpooling in the San Francisco Bay Area: Understanding Characteristics, Behaviors, and Motivations." *Transport Policy* January, advance online publication.

Shaheen, Susan, and Matt Christensen. 2014. *Shared-Use Mobility Summit: Retrospective of North America's First Gathering on Shared-Use Mobility.* Berkeley: Transportation Sustainability Research Center. Available at http://innovativemobility.org /wp-content/uploads/2015/04/Shared-Use-Mobility-Summit -White-Paper-1.pdf.

Shaheen, Susan, and Adam Cohen. 2016. [Carsharing benchmarking data on number of members and vehicles]. Unpublished raw dataset.

———. 2007. "Worldwide Carsharing Growth: An International Comparison." *Transportation Research Record* 1992: 81–89.

Shaheen, Susan, Adam Cohen, and Elliot Martin. 2013. "Public Bikesharing in North America: Early Operator Understanding and Emerging Trends." *Transportation Research Record* 2387: 83–92.

Shaheen, Susan, Adam Cohen, and Darius Roberts. 2006. "Carsharing in North America: Market Growth, Current Developments, and Future Potential." *Transportation Research Record* 1986: 116–124.

Shaheen, Susan, Adam Cohen, and Ismail Zohdy. 2016. *Shared Mobility: Current Practices and Guiding Principles.* Report No. FHWA-HOP-16-022, US Department of Transportation. Available at www.ops.fhwa.dot.gov/publications/fhwahop16022/index.htm.

Shaheen, Susan, Stacey Guzman, and Angela Zhang. 2010 "Bikesharing in Europe, The Americas, and Asia: Past, Present, and Future." *Transportation Research Record* 2143: 159–167.

Shaheen, Susan, Mark Mallery, and Karla Kingsley. 2012 "Personal Vehicle Sharing Services in North America." *Research in Transportation Business & Management* 3: 71–81.

Shaheen, Susan A., Elliot W. Martin, Nelson D. Chan, Adam P. Cohen, and Mike Pogodzinski. 2014. *Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends, and User Impacts.* San Jose, CA: Mineta Transportation Institute. Available at http://transweb .sjsu.edu/PDFs/research/1131-public-bikesharing-business -models-trends-impacts.pdf.

Shaheen, Susan, Elliot Martin, Adam Cohen, and Rachel Finson. 2012. *Public Bikesharing in North America: Early Operator and User Understanding.* San Jose, CA: Mineta Transportation Institute. Available at http://transweb.sjsu.edu/PDFs/research/1029 -public-bikesharing-understanding-early-operators-users.pdf.

Shaheen, Susan, Caroline Rodier, Gail Murray, Adam Cohen, and Elliot Martin. 2010. *Carsharing and Public Parking Policies: Assessing Benefits, Costs, and Best Practices in North America.* San Jose: Mineta Transportation Institute. Available at http://transweb.sjsu.edu/MTIportal/research/publications documents/09-09/2612_Carsharing-Parking.pdf.

Shaheen, Susan, Daniel Sperling, and Conrad Wagner. 1999. "A Short History of Carsharing in the 90's." *The Journal of World Transport Policy & Practice* 5 (3): 18–40.

Shaheen, Susan, and Adam Stocker. 2015. "Information Brief: Carsharing for Business, Zipcar Case Study & Impact Analysis." Available at http://innovativemobility.org/wp-content /uploads/2015/07/Zipcar_Corporate_Final_v6.pdf.

Stockholm, City of (Sweden). 2005. *Mobility Services for Urban Sustainability: Environmental Assessment. Report WP 6.* Prepared by Christian Rydén and and Emma Morin, Trivector. Available at www.communauto.com/images/Moses_environnement.pdf.

Suderman, Alan. 2009. "Montgomery County Examines Costly Car-Sharing Program." *Washington Examiner*, December 10. Available at www.washingtonexaminer.com/montgomery-county-examines-costly-car-sharing-program/article/19552.

Teal, Roger. 1987. "Carpooling: Who, How, and Why." *Transportation Research Part A* 21 (3): 203–214.

Tennessee, State of. 2015. *House Bill 992—Transportation Network Company Services Act.* Available at https://trackbill.com/bill/tn-hb992-transportation-dept-of-as-enacted-enacts-the-transportation-network-company-services-act-amends-tca-title-7-title-54-title-55-title-56-and-title-65/1135990/.

US Census Bureau. 2014a. *Means of Transportation to Work by Selected Characteristics: 2010–2014 American Community Survey 5-Year Estimates.* Available at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_S0802&prodType=table.

———. 2014b. *Table B08006. Sex of Workers By Means of Transportation to Work, American Community Survey 2014 (1-Year Estimates).* Available at www.socialexplorer.com/data/ACS2014/metadata/?ds=ACS14&table=B08006.

———. 1980. "Means of Transportation to Work for the US: 1980 Census." Available at: www.census.gov/hhes/commuting/files/1990/mode6790.txt.

US Department of the Treasury. 2015. *Employer's Tax Guide to Fringe Benefits.* Available at www.irs.gov/pub/irs-prior/p15b--2015.pdf.

US Green Building Council. 2016. *Bicycle Network—LT5 Possible Point.* Available at www.usgbc.org/credits/lt5.

Vancouver, City of (Washington). *2009. Transit Overlay District—Section 20.550.050, Incentives.* Available at www.cityofvancouver.us/vmc/7301/20550050-incentives?throbber=1.

Vélib'. 2012. "Vélib', Un Service Qui Plaît Plus Que Jamais!" Available at www.jcdecaux.com/fr/Presse/Communiques/2012/Velib-un-service-qui-plai-t-plus-que-jamais-!.

Virginia, (State of). 2006. *Dynamic Ridesharing (Slugging) Data.* Prepared by Vanasse Hangen Brustlin.

Vital Signs. 2016. "Transit Ridership." Available at www.vitalsigns.mtc.ca.gov/transit-ridership.

———. 2015. "How Much Are Bay Area Residents Relying on Public Transportation?" Available at www.vitalsigns.mtc.ca.gov/transit-ridership.

Weiner, Edward. 1992. *Urban Transportation Planning in the United States.* Washington, DC: US Department of Transportation. Available at http://ntl.bts.gov/DOCS/UTP.html.

Westcott, Lucy. 2014. "More Americans Moving to Cities, Reversing the Suburban Exodus." *The Wire*, March 27. Available at www.thewire.com/national/2014/03/more-americans-moving-to-cities-reversing-the-suburban-exodus/359714/.

WMATA (Washington Metropolitan Area Transit Authority). 2015. "Metro Announces Partnership with Enterprise to Expand Car Sharing at Parking Facilities." Available at www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5918.

———. 2014. "Metro Launches Silver Line, Largest Expansion of Region's Rail System in More Than Two Decades." Available at www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5749.

Woodyard, Chris, and Greg Toppo. 2016. "Uber, Lyft Halt Austin Service after Losing Vote." *USA Today*, May 9. Available at www.usatoday.com/story/money/cars/2016/05/08/uber-lyft-halt-austin-service-after-losing-vote/84119554/.

Zillman, Claire. 2015. "New York City Taxis Finally Have an App to Compete with Uber." *Fortune, A*ugust 27. Available at http://fortune.com/2015/08/27/new-york-city-taxi-app-uber/.

Zipcar. 2005. "Zipcar Customer Survey Shows Car-Sharing Leads to Car Shedding." Available at www.prnewswire.com/news-releases/zipcar-customer-survey-shows-car-sharing-leads-to-car-shedding-54081127.html.

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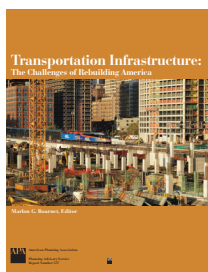
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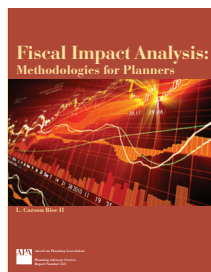**PAS Essential Info Packets**
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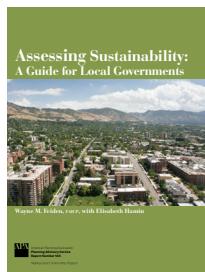**Transportation Infrastructure**
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