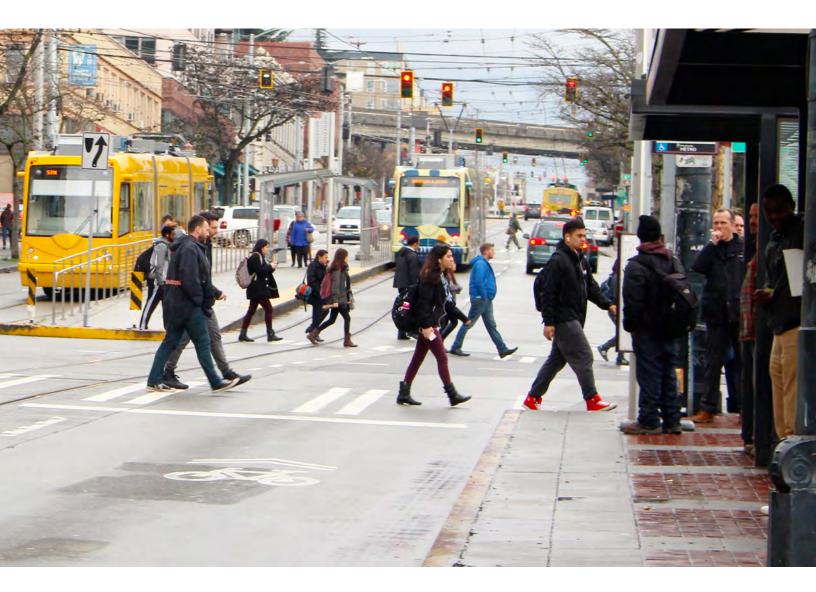
Seattle Department of Transportation

# NEW MOBILITY PLAYBOOK



Version 1.0



September 2017

MORE MOBILITY MORE INFORMATION MORE SEATTLE

# ACKNOWLEDGEMENTS

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# WELCOME TO SEATTLE

Welcome to Seattle, one of the fastest-growing cities in America.

Our population increased by over 121,000 between 2006 and 2010, with 20,000 people moving into the city from 2015 to 2016 alone. The pace of our growth is accelerating and could seriously strain our transportation system. But, this is Seattle and we know all about the upsides and downsides of change. We are responding and adapting.

Seattle voters have approved new funding for transportation through the city's \$930 million Levy to Move Seattle as well as the region's \$54 billion Sound Transit 3 initiative. We are building new light rail and streetcar lines, expanding bike routes that are safe for all ages and abilities, building more sidewalks and expanding high frequency bus services—and we are seeing results. Between 2010 and 2016, downtown Seattle added nearly 45,000 new jobs. Over the same span, the number of downtown commuters driving alone grew by only about 2,000 people. Everyone else—95 percent of new commuters—chose to walk, bike, or take transit to get to work.

At the same time, the way we get around our cities is changing faster than it has since the advent of the automobile. Seattleites can still choose tried-and-true options like the bus, the light rail, or the streetcar and they can walk, ride their bike, or drive their car. But new transportation modes and are rapidly emerging. Today, Seattleites can get to work on a shared bike or in a shared car. They can hail a ride or join a vanpool. They can use technology to coordinate a trip across the city using any combination of these options, and they can book many of these services on their phones. These new travel options—technology-enabled, on-demand, shared—are what we call new mobility. New mobility has the potential to provide greater convenience, improve safety, and make transportation more equitable and affordable for us all. But it could just as easily take our cities in another direction, toward congested roads, unsafe streets, insecure data, and exclusive, expensive services that benefit only a few.

Seattle has a history of welcoming and fostering innovation, especially in transportation. Boeing, UPS, and Flexcar (one of the first car sharing companies) were all launched in Seattle. We were one of the first cities to regulate Uber and Lyft. We are the first city to permit dockless bikeshare systems like Spin and Limebike. And we are home to local, mobility-focused startups like Luum, mobility service innovators like ReachNow, and Amazon, a company that is changing urban transportation patterns all over the world.

Seattle generates innovation, but the future of our city will be shaped by our shared values. We are committed to equity and racial and social justice. We acknowledge that misguided decisions and plans in the last century, particularly in transportation policy and infrastructure, often made life harder for our neighbors who were already at a disadvantage. So, as we embrace new transportation technology, we seek to shape it in a way that ensures our city's evolving transportation system works better for all of us. We must ensure new mobility puts people first.

That's why we created this Playbook. The New Mobility Playbook is a set of plays, policies, and strategies that will position Seattle to foster new mobility options while prioritizing safety, equity, affordability, and sustainability in our transportation system. With state-of-theart infrastructure, community engagement, and thoughtful regulation, we hope to strike a balance between technology's drive toward what's new and our city's essential commitment to equity and social justice.

The Playbook is as flexible as it is groundbreaking, with an extensive scope that addresses everything from shared transportation to data management to impacts on the local labor market. We're getting started immediately with 20 "first moves," a set of strategic actions that will test new ways of getting around while laying the groundwork for meaningful change. We're also looking further ahead, establishing policies now to prepare for automated vehicles, the evolving role of drones, and other innovations we cannot yet imagine or predict. By leading the way and creating a city where new mobility works in service to the people, we hope to establish a foundation for other cities and innovators to build on, with today's technology and whatever comes next. We also hope to collaborate with innovators and experts worldwide—the Playbook includes an open invitation to join us so we can learn from each other, pilot new solutions, and share ideas, best practices, and findings from the field.

We're all in this together, and the future will be determined by how we navigate this new frontier. Now is the time to lead. We invite you to join us in shaping the Seattle of tomorrow.

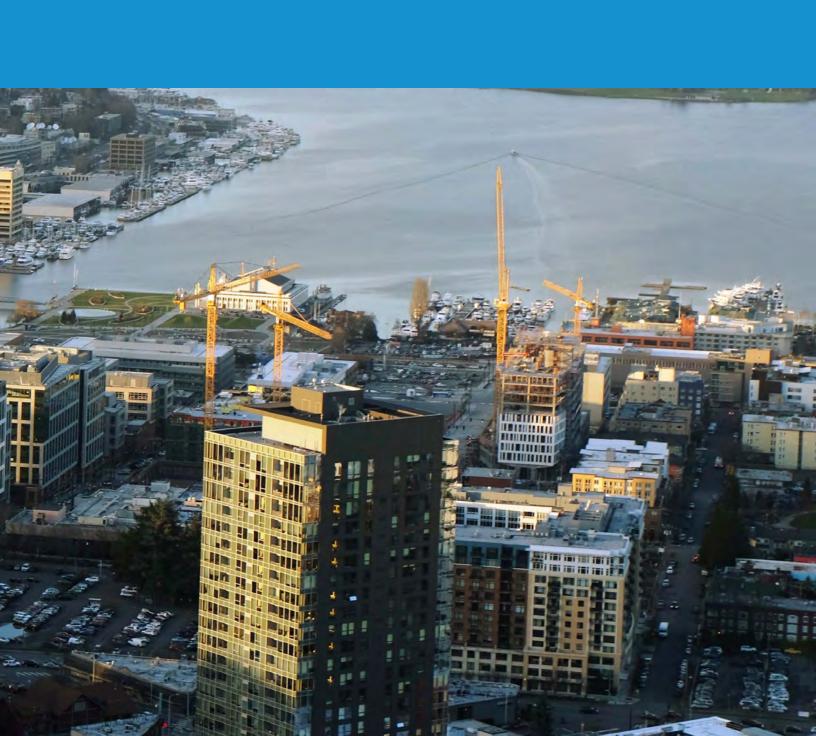
Sincerely,

Scott Kubly Director, Seattle Department of Transportation (SDOT)



# OUR CHANGING LANDSCAPE







Corner of 3rd Avenue and Seneca Street looking northwest

# IN THE EARLY DECADES OF THE CENTURY...

New technology is transforming transportation systems in cities across the country. There are new vehicles on the streets, new services, and new ways to travel.

These innovations could lead to safer, more vibrant cities, but they could also disrupt existing services, reduce options, increase prices, and upend current business models. They could supplement public transit or compete with our investments in buses, streetcars, and light rail. City administrators need to accommodate new technologies while also ensuring that innovations benefit the people living and working in our cities. Cities will need new infrastructure and new policies and rules to manage the rapidly changing transportation system.

Some jobs may change dramatically or go away altogether, but there are also new opportunities, new skills to learn, and new industries about to emerge.



Corner of 3rd Avenue and Seneca Street looking northwest, 1910

### ...**THE YEAR IS 1910**

The year is 1910, and the B-type double-decker bus, the first mass-produced motorized bus, has just begun service in London. In the United States, the Ford Model T, the first mass-produced car, has begun to take over city roads. Sales of the Model T eventually reach more than 15 million Model Ts, ushering in the age of the automobile.

Motorized cars and buses were faster than previous technologies and saved cities thousands of dollars in the costs of clearing horse manure from the streets. Over the next few decades, they completely transformed American cities, leading to streets, public spaces and commerce designed to serve the automobile—often at the expense of people.

Gas stations, car repair shops, and auto showrooms popped up on street corners. Stables, blacksmiths, and groomsmen disappeared. In 1916, the same year Congress approved the Federal Aid Road Act, New York City held its last horse auction—there were simply no more buyers.

#### Highways to the suburbs

Parking garages, parking meters and Interstate highways soon followed, and with them came an exodus from cities to new communities built on former farm fields. In 1918, Chicago's Hotel La Salle built the first multi-story parking garage. In 1935, Oklahoma City installed the first parking meter. Highway building exploded in 1956 when President Eisenhower signed the Federal Highway Act.

The new highways powered the construction of suburbs and exurbs. Along with racist local and federal housing and zoning regulations and rapacious real estate developers, the automobile and the new roadways built to accommodate it—encouraged people (particularly middle- and upper-class white people) to move away from the urban core, resulting in disinvestment, racial disparity, and city decay.

#### **Cities for cars**

The automobile industry started in the 1890s with hundreds of startup companies but consolidated until only three remained: General Motors, Ford, and Chrysler. The Big Three dominated not only the automobile industry and the national economy, but also urban planning and policy.

The car and related technologies and innovations delivered on the promise of economic growth, middle-class jobs, and mobility on demand. At the same time, they contributed to massive economic, social justice, and environmental inequities.

In reshaping our existing cities and planning new cities optimized for privately owned cars, we took down mass transit systems, disconnected and razed whole communities (usually communities of color), and created new ways to exclude people by race and income. As we narrowed sidewalks to widen roads, our cities became uncomfortable to people walking. As we re-engineered our streets to prioritize speed over safety, our roads became hostile to anyone not traveling in a car.

#### **Cities for people**

In the opening decades of the 21st century, we face a similar challenge. With another onslaught of new transportation technology, how will we mold our city into a more livable, vibrant, and equitable place? How do we manage these new services so they improve our transportation system and ensure that it works for all of Seattle?

With cars, we forced our city to adapt to the technology instead of shaping the technology to serve the people living and working in our city. The New Mobility Playbook is our chance to forge a different future.



# SEATTLE'S VISION AND VALUES FOR TRANSPORTATION

At the Seattle Department of Transportation (SDOT), our vision is a vibrant Seattle with connected people, places, and products. Our mission is to deliver a high-quality transportation system for the city of Seattle.

#### SDOT is focused on creating a safe, interconnected, vibrant, affordable, and innovative city for all. We value:

#### **A Safe City**

We will not accept traffic deaths as an inevitable part of traveling together in a safe city. *Our goal is to eliminate serious and fatal crashes in Seattle.* Safety also means being prepared for a natural disaster by seismically reinforcing our bridges to withstand earthquakes.

#### **An Interconnected City**

More travel options doesn't always equate to an easy-to-use, interconnected system. *Our goal is to provide an easy-to-use, reliable transportation system* that gives you the options you want when you need them.

#### **A Vibrant City**

A vibrant city is one where the streets and sidewalks hum with economic and social activity. People meet and shop and enjoy the beautiful city we live in, side by side with goods delivery and freight shipping. Our goal is to use Seattle's streets and sidewalks to improve the city's health, prosperity, and happiness.

#### **An Affordable City**

*Our goal is to give all people high-quality and low-cost transportation options* that allow them to spend their money on things other than transportation. The transportation system in an affordable city improves the lives of all travelers – those with the latest model smart phones in their pockets and those without.

#### **An Innovative City**

Demographic changes and technological innovation are radically reshaping transportation. *Our goal is to understand and plan for the changes of tomorrow, while delivering great service today.* This includes newer, more nimble approaches to delivering projects and programs to our customers.



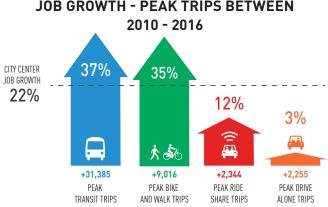
## SEATTLE TODAY

Seattle was the fastest growing big city in the U.S. in 2016<sup>1</sup>, but growth is putting pressure on our infrastructure and straining our affordability.

On average, 57 people move to the city every day, nearly 1,600 a month, and we are on track to add 120,000 more residents by 2035. Our new neighbors are attracted to the Puget Sound's beautiful environment and the booming local economy that's projected to add 115,000 jobs in the next two decades.

Growth is putting pressure on our city's infrastructure and making it more expensive to live here. We are investing in our transportation system to accommodate this continuing growth and maintain our quality of life, preserve our environment, and protect our diverse communities. We're expanding transportation options so people can safely and easily take transit, walk, and bike, rather than driving for most trips.

We are seeing success. Through our Vision Zero plan to end traffic deaths and serious injuries by 2030 and our Safe Routes to School programs, Seattle is now one of the safest big cities in America for people walking and riding bikes.<sup>2</sup>



# **JOB GROWTH - PEAK TRIPS BETWEEN**

#### <sup>1</sup>Jul. 1, 2015, to Jul. 1, 2016 - U.S. Census. <sup>2</sup>Vision Zero, May 2017.

<sup>3</sup>National Transit Database, 2016.

#### A shift toward transit

Despite our surging population and job growth, auto traffic is not growing as fast. More people are taking public transit to get to work, and fewer people who work downtown are driving alone:

- The share of people driving alone to commute downtown fell from 35% in 2015 to 30% in 2016.
- From 2015 to 2016, Seattle's transit ridership grew at the highest rate in the nation (4.1%).
- From 2000 to 2016, the share of people taking transit to commute downtown increased from 29% to 47%.<sup>3</sup>

Public transit—our original and most vital "shared mobility" mode—is the backbone of our transportation system. By the end of 2017, 64% of Seattle households will live within a 10-minute walk of a frequent bus route, where riders wait 10 minutes or less for the next bus.

#### More options, more affordability

When people have a range of safe, reliable transportation options, our city becomes more affordable. On average, owning a car in King County adds about \$12,500 a year to the household budget. Our investments will reduce household transportation costs and enable Seattleites to live a car-free or car-lite lifestyle.

While there is still work to be done, we believe our city has entered a beneficial self-reinforcing cycle when it comes to transportation options. As more people choose to walk, bike, or take transit, the demand increases for more services and infrastructure: as we add services and build infrastructure, we invite more people to walk, bike, or take transit. With our partners, Sound Transit and King County Metro, we are expanding Seattle's light rail and streetcar systems,

increasing the reach and reliability of RapidRide services, and adding or expanding express and local bus routes. We are also making walking and biking infrastructure safer for people of all ages and abilities.

#### Looking ahead

As we invest in the city's public infrastructure, private services are expanding their options, too, and providing new and intriguing ways to get around. Services like car sharing and ride-hailing are providing flexibility and further reducing the need to own a car. Day to day, people can rely on walking, biking, and transit but still have access to a car where and when they need one.

Move Seattle, our 10-year strategic plan for transportation, sets our priorities and guides our investments for building a transportation system that's convenient, affordable and provides many options. City residents overwhelmingly supported Move Seattle through the Transportation Levy to Move Seattle, Voters approved the levy in 2015, committing \$930 million over nine years to fund projects that improve safety for all travelers, maintain our streets and bridges, and invest in reliable, affordable travel options for our growing city.

People of color, LGBTQ people, women, people with disabilities, low-income households, and other historically marginalized groups continue to experience systemic discrimination and exclusion. Our challenge is to advance new mobility and access to opportunity for all, while preventing residential, commercial, and cultural displacement. By ensuring transportation options work for everyone, particularly historically underrepresented communities, we can play a key role in advancing racial and social justice.

In the early decades of the 21st century, we are excited to explore new technologies and service innovations that could help us deliver an even better, more equitable transportation network.



# SEATTLE AND NEW MOBILITY

While walking, biking, and taking public transit will remain the backbone of the city's transportation system, new technologies and service innovations are giving Seattleites more options and more convenience.

To get around the city and the region, our ORCA cards let us get on the bus, the ferries, Link Light Rail, and the Seattle Streetcar. We can choose from ride-hailing (like Uber and Lyft, taxis, and for-hire services) and car sharing services (like ReachNow, Zipcar, and Car2Go). We can arrange to join a carpool or split a ride with strangers. Free-floating bike share services allow people to pick up and drop off shared bikes all over the city. Neighborhoods that previously fell outside the Pronto Cycle Share service area, gained access to bike share overnight.

#### On the horizon

Soon, technology will expand our options even more. "Microtransit" services may offer the possibility of using vans or small buses to transport passengers. "Mobility hubs" will bring multiple options together at one location to allow easy transfers and individualized solutions.

These new and emerging services are enabled by the internet, mobile data, and the smartphones in our pockets. Mobile apps help us find the best driving route, catch the right bus, or bike the least hilly route. Mobile payment systems allow us to book services and pay for them automatically.

Technology is rapidly changing, and we're going to see even more innovations. Some will lead to sustained successes; others will rise and fall. The future could hold automated or driverless vehicles, drones on wheels, and drones in the air delivering goods. We may even see drones that can carry passengers across our city's air space.

#### The new mobility

These systems allow communications between travelers, vehicles, and the infrastructure that governs them. They could even be run by artificial intelligence that not only manages the routes, but also allows users to "talk" to the vehicle they are using.

This emerging, technology-enabled, seamless, nearly door-to-door transportation system is what we call the new mobility. It allows Seattleites to treat urban transportation as a customizable, on-demand service. They can book and pay for different transportation services as they go, based on what they need.

#### ASSISTANCE FROM TECHNOLOGY

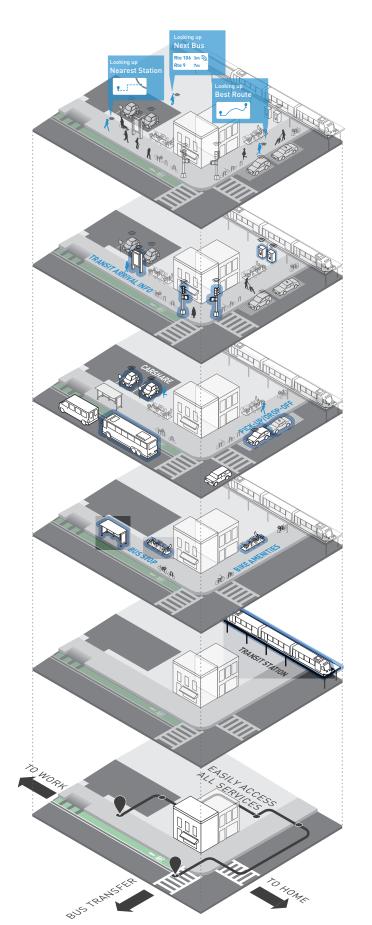
REAL-TIME NAVIGATION

#### MOBILITY SERVICES

INFRASTUCTURE SUPPORTING MOBILITY

TRANSIT STATION

#### CONNECTIONS



Seattle's streets, sidewalks, and transit infrastructure are the conduit that move people throughout the city. More recently, shared mobility services (including public transit), real-time travel information, and other digital technologies are providing "à la carte" mobility and customer experience offerings that get people where they want to go based on their needs. These new ways that people interact with transportation infrastructure are at the heart of what we refer to as the new mobility.



#### Tech and the city

Seattleites tend to be tech-savvy. Our residents take over a million app-enabled ridehail and car share trips every month. This, along with the increase in transit use, is why we have fewer people driving to work alone. And yet 15% of Seattle residents do not have internet access at home and roughly a third do not have access to a mobile device.<sup>4</sup>

Many of these new mobility services are electric, and the share of electric vehicles across the transportation sector will accelerate rapidly in the coming years. In addition to significantly reducing pollution, the transition to electric transportation will demand coordination with the electricity sector to tap new mobility into the electric grid.

Most of the new, tech-enabled services require a credit card or a bank account, putting the out of reach for many lower-income households, especially those with poor credit or with no bank accounts. Many ride-hailing services don't accommodate people in wheelchairs and other people with disabilities. Research from MIT and the University of Washington also shows that ride-hailing services can discriminate against people of color or of particular ethnicities.<sup>5</sup> And liability risks associated with car share programs place disproportionately burdensome costs on lowincome people who can't take on those risks.

#### Seizing the moment

New mobility could greatly benefit the people of Seattle, but it also brings risks. We created the New Mobility Playbook so we can blaze a trail toward a new mobility that works for us all. With the five plays, we are rethinking how we manage our streets to deliver an equitable transportation system in this new environment. Together, we are working to ensure that Seattle becomes an even safer, more interconnected, more vibrant, more affordable, and more innovative city.

We aim to update this Playbook every six months to reflect the dynamic nature of new mobility services and the rapid changes in transportation technology.

<sup>&</sup>lt;sup>4</sup>2014 Information Technology Access and Adoption Report, City of Seattle.

<sup>&</sup>lt;sup>5</sup> Researchers from Stanford, MIT and the University of Washington find rideshare drivers discriminate based on race and gender." Stanford News, October 2016.

## **NEW MOBILITY TRENDS**



#### Information is the new infrastructure.

We tend to think about the transportation system as a set of physical infrastructure -roads, bridges, sidewalks, traffic lights along with the vehicles that

use the infrastructure. But increasingly the infrastructure is becoming virtual—it's the sensors and control systems that we use to manage flow and movement and the data we collect and use to improve our travel options.

The new information infrastructure includes bike and pedestrian counters, the traffic signal controls that sense and smooth out traffic flow, and the systems that tell us if our bus or train is running on time. It's the internet-connected sensors that track vehicle speed and driver behavior and the ride-hailing apps that track our routes to determine the fare.

The flow of data will only increase as Seattleites continue to navigate the city in new ways. All that data (and the data about the data) will give us a valuable, up-to-the-minute, understanding of how people are getting around Seattle—and how we can improve the experience of getting around. To make the most of the data, we need to invest in information infrastructure: the systems to store and analyze the data, and the people to manage the systems and interpret the findings.



#### People will share mobility.

Whether taking public transit, hailing a ride, or using a car share vehicle, more and more people are choosing

shared mobility services to get around the city. Shared mobility—the services that allow temporary use of a shared vehicle, usually for a fee—allows Seattleites to get a ride or borrow a vehicle at their convenience. Shared mobility includes public and private transportation services that fit varied needs: from a pickup truck to haul furniture to a ridehail limo for a fancy date to the public bus to get to work. Because shared mobility services require fewer vehicles but serve more trips, they have the potential to reduce the number of vehicles on the road, reduce traffic congestion, and decrease the need to dedicate valuable space to parking.



#### Clean energy will power transportation.

Transportation pollution is responsible for over two-thirds of

Seattle's carbon footprint, but clean hydroelectric power fuels our electrical grid, and electric vehicle technology continues to improve. New research by Bloomberg New Energy Finance forecasts that electric vehicles could take up 35% of new light duty vehicle sales by 2040.<sup>6</sup>

This creates ideal conditions to electrify the local transportation system. The City's Drive Clean Seattle initiative aims to transition our transportation sector from polluting fossil fuels to clean, carbon-neutral electricity by purchasing and promoting electric vehicles and adding infrastructure to make it easier for Seattleites to go electric.



Automakers are shifting to shared, electric, connected, and automated. A recent McKinsey & Company report predicted that new mobility services

could drive down the volume of car

sales by more than 30% by 2030.<sup>7</sup> Automakers are adapting to this shift in consumer needs and demands by developing new technologies and positioning themselves as mobility service providers. Automakers and technology firms have invested billions of dollars in the research, development, and deployment of automated vehicles and connected vehicle technology.

While demand for car ownership will likely continue well into the future, the automakers' pivot toward automated vehicle production and shared fleet services will create new mobility options, revenue models, and partnership opportunities.

<sup>6</sup>New Energy Outlook. Bloomberg New Energy Finance, 2016.

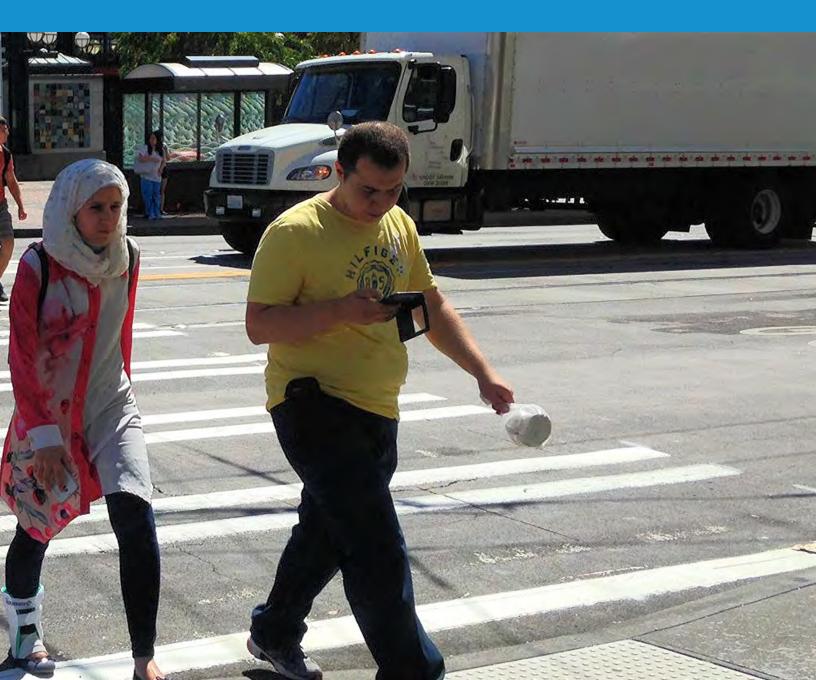
<sup>&</sup>lt;sup>7</sup>"How shared mobility will change the automotive industry," McKinsey & Company Automotive & Assembly, April 2017.

# THE RAPIDLY CHANGING WORLD OF URBAN TRANSPORTATION

Jan 2007: Apple unveils the iPhone, begins the marketplace for phone apps Oct 2007: Boston-based Zipcar buys out Seattle based	<ul> <li>New mobility service or technology</li> <li>Key SDOT milestone</li> </ul>
Flexcar, merging the largest car share companies Dec 2007: South Lake Union streetcar line begins service	
2007 2008 2003	• Jul 2009: Central Link light rail opens
Dec 2008: Hertz Launches Hertz on Demand to compete with Zipcar	ay 2010: Uber rolls out beta service in San Francisco (full service launches in 2011)  2010: Some 35% of downtown Seattle commuters drive alone to work 2010: Seattle removes all single-space meters and uses only credit card solar multi-space parking technology
Sept 2008: Google and T-Mobile unveil the first Android device	Jun 2012: Zimride, a long-distance ride sharing company launches Lyft to compete with Uber
Dec 2012: Seattle begins its free-floating	• Dec 2012: Daimler launches Car2Go free-floating car
car share program	sharing service in Seattle
Apr 2013: Avis buys Zipcar for \$500 million	• 2013: SDOT launches mobile payment for on-street parking
	Jun 2014: Bridj launches microtransit service in Boston
71	<ul> <li>Jul 2014: Seattle City Council votes to legalize the operations of Transportation Network Companies (TNCs) like Uber and Lyft</li> </ul>
operations	• Nov 2014: Seattle voters approve the Seattle Transportation Benefit District (Proposition 1), a \$45 million annual increase in Metro bus service
Dec 2014: Google unveils first complete	Jan 2015: Uber hits 1 million daily rides with 160,000 drivers in the U.S.
version of its self-driving car	March 2015: Leap Transit begins operating private transit service in San Francisco
Oct 2015: Amazon launches	• July 2015: Leap Transit files for Chapter 7 bankruptcy and ends operations
Amazon Flex, the "Uber" of package delivery	• Aug 2015: Amazon launches PrimeNow one-hour delivery in Seattle
Dec 2015: Uber tests UberHop carpooling	• 2015: SDOT makes all parking transactions and other parking APIs available on data.seattle.gov
2016: 30% of downtown Seattle commuters  drive alone to work	Nov 2015: Seattle voters approve the 9-year, \$930 million Levy to Move Seattle to implement Move Seattle:10-Year Strategic Vision for Transportation
Jan 2016: California authorizes a pilot project to test	• Jan 2016: First Hill streetcar line begins service
AVs "not equipped with steering wheels, brake pedals, accelerators, or operators inside"	• Mar 2016: Link light rail extends to University of Washington through Capitol Hill
Apr 2016: BMW launches ReachNow free-floating car • sharing service in Seattle	Aug 2016: Uber ends UberHop
<b>Sep 2016:</b> Ford Motors buys Chariot, a San Francisco-based ——microtransit startup	• Oct 2016: Lyft hits 3 million monthly riders, with 315,000 drivers worldwide
<b>Nov 2016:</b> Puget Sound region voters approve the Sound Transit 3 (ST2) ballet measure a 25 year regional transit avaarian program	
(ST3) ballot measure, a 25-year regional transit expansion program	unit debuts self-driving trucks
<b>Dec 2016:</b> Michigan enacts the first statewide AV regulations •—— Jan 2017: ReachNow begins beta-testing its ride-hailing service in	Seattle Mar 2017: Pronto Cycle Share ends operations
Mar 2017: Virginia become first states to legalize robotic door-to-do Apr 2017: Marble and Yelp24 introduce automated robot food delive	
Apr 2017: Citymapper tests "pop-up, tech-enabled" bus routes with Apr 2017: After failing to get new investments, Bridj closes shop May 2017: San Francisco proposes to ban robotic delivery vehicles of	<b>Jul 2017:</b> Seattle begins free-floating
Jul 2017: Seattle begins permit program allowing electric vehicle c	

# OUR DIRECTION





New technologies transforming transportation have the potential to provide great benefits to Seattle—upsides that could result in more convenience, safety, equity, and affordability. But new mobility carries risks, too. There are potential downsides, from increased congestion and pollution to less support for public transit.

Our job is to manage the emerging mobility system so everyone can benefit from the upsides, while protecting against the downsides. Together, we can create a transportation system that works for us all.

# THE UPSIDE Potential benefits of new mobility

#### 1. We can accommodate growth without increasing congestion

New mobility options, paired with transit, could replace or reduce the use of private cars, especially if shared automated vehicles become a reality. By 2030, as many as 108,000 privately owned cars could come off the streets of Seattle—a 27% reduction. If fleets of shared, automated vehicles go into service, there could be an astonishing 45% fewer cars in Seattle.

Before autonomous vehicles hit our streets, giving up one's vehicle could equate to roughly \$10,000 in cost savings for people who regularly use public transit, car share, ride-hailing, and bike share services.<sup>8</sup> This shift away from private cars would not only prevent traffic from worsening, it also could save road space by reducing the need for parking. Privately owned cars are usually driven for 1.5 to two hours a day. The rest of the time, they're stored in parking lots, garages, and on our streets. Storing personal cars is a burden on our limited public right-of-way—Sightline Institute estimates that parking takes up between 10 and 20 percent of the area of cities in the Pacific Northwest.<sup>9</sup> It also contributes to our ongoing housing affordability crisis.

New mobility services could free up precious city space so we can put it to more productive use, like dedicated transit lanes, wider sidewalks, safer bikeways, or public parks and plazas.

<sup>8</sup>See Appendix B for more details. <sup>9</sup>www.sightline.org/2013/08/08/park-place/

#### 2. We can enable more transportation options

New mobility services can complement public transit, adding convenience and flexibility to the transportation system. For example, with new mobility, someone could share a ride to a transit station, then take rapid transit, then get off at another station where they could use bike share, ride share, or car share to get to their destination.

New mobility could also add predictability to our monthly transportation expenses. Data-driven mobility platforms could allow us to decide how much we want to spend on transportation each month and then provide us with the most costefficient ways to travel every day.<sup>10</sup> New mobility services could benefit people with disabilities and older adults by expanding their options for getting where they need to go—as long as they are comfortable using the technology. Research has shown that the more options older adults have, the better positioned they are to age in place.

#### 3. We can build a more responsive transportation system

With vehicles that can carry many people at once, public transit will remain the most efficient way to move large numbers of people. Yet, public transit becomes less efficient in areas and times in which fewer people use it.

Partnerships with new mobility providers may have great potential to offer more responsive services at more cost-efficient rates in certain geographies and at certain times of the day. For example, we analyzed the cost of paying for ride-hailing fares as an alternative to providing transit service and found that paying for ride-hailing fares could be a more cost-efficient way to provide as many as 5% of transit trips by bus. The majority of these trips occur late at night and early in the morning, when bus ridership is lower and service is less frequent. While there are additional important factors to consider, If those trips could be served by new mobility, Metro could reallocate resources to provide even more frequent service in corridors in need of more service.

The data generated by new mobility could also revolutionize the way we plan the transportation system and direct resources. We could operate more nimbly while also making better-informed policy decisions and investments. We could have more responsive transportation management and may even be able to forecast and correct for problems before they occur.

<sup>&</sup>lt;sup>10</sup>Appendix B includes an economic analysis that estimates how many households could forgo car ownership in favor of shared mobility, and, in return, realize significant financial savings.

#### 4. We can create a more equitable transportation system

Coupled with high-quality public transit, new mobility enables self-determination. When people can decide how to get from one place to another, quality of life improves. And when great options are available to everyone, we all have an opportunity to thrive, regardless of race, ethnicity, ability, age, sex, or income.

New mobility services could lead to greater equity by connecting workers to jobs that are currently difficult to get to on public transit. This is especially true of commute trips that don't start or end in downtown or in the peak periods. For example, someone who lives in Lake City could get to a job in Georgetown without having to go through downtown, saving time. New mobility services could help the city provide more efficient and cheaper transportation to those who can afford it least. The data that these services generate will help us understand the unseen biases in the transportation system so we can correct them. We can then create incentives and regulation to make sure the system serves everyone. We could also better target subsidies to those who need them most.

The new mobility paradigm could potentially offer new, better-paying, and technology-based job opportunities. Entire new industries are being created. If actively engaged, we could align workforce pipelines and development opportunities with community partners.

#### 5. We can have a safer and greener transportation system

The transportation sector generates over a quarter of the country's greenhouse gas emissions, a key contributor to climate change. In Seattle, transportation pollution represents over two-thirds of our carbon footprint.

If they shift people away from driving a private car, new mobility services could significantly reduce harmful emissions. By 2030, that could mean 85,000 fewer daily trips of people driving alone—a 4.4% decrease from 2014 daily trips. Emissions would decrease even more if we required all new mobility vehicles to run on electricity. See Appendix B for more detail. Fully automated vehicles could also reduce vehicle crashes. Automation will remove risky driving behavior, anticipate collision factors, and control speeding, making the streets even safer for people on foot, people on bikes, and people in vehicles.





#### 1. We could have more congestion and more pollution

Recent research out of San Francisco, New York City, and Denver shows that ride-hailing services like Uber and Lyft are adding to traffic congestion. While these services may be reducing private car use, they are also putting more cars on the road—cars that are cruising already-congested areas, circling as they wait for customers, and sometimes blocking travel lanes.

Recent research from the San Francisco County Transportation Authority found that ride-hailing makes up roughly 15% of all trips within San Francisco.<sup>11</sup> Last year, ride-hailing services appear to have added more than six million miles of driving on New York City's streets. From 2013 to 2016, ride-hailing added an estimated 7% to existing miles driven in the most congested areas of Manhattan, Brooklyn, and Queens. There is also data coming from London and Washington D.C. that shows e-commerce has increased deliveries and put more delivery trucks on the road.

We don't currently have the same data available, but preliminary analysis suggests an increase in cruising in downtown Seattle. This behavior is very different from the circling pattern of drivers looking for parking. We estimate that as much as half of the vehicles cruising and circling downtown are ride-hailing vehicles, including taxis, for-hire, and ridesourcing services. Automated vehicles may not require parking, but they could also increase congestion. Especially if they are privately owned, automated vehicles could transport children too young to drive or older adults unable to drive. While this is great for personal mobility, it could mean more vehicles on the road. Automated vehicles could also run without passengers (or zero occupancy vehicles) in between rides. Apart from potentially adding to traffic congestion, new mobility vehicles that run on fossil fuels would increase the city's total greenhouse gas emissions.

Without strategic action by the City and its partners, we risk people using lower-occupancy automated vehicles and ride-hailing services to take more and longer trips. We need policies that require and incentivize clean energy for new mobility services and require fully autonomous vehicles be electric and part of shared fleets. We also need the right mix of incentives and disincentives to keep ride-hailing, even autonomous vehicles from cruising around empty while they wait for customers.

<sup>&</sup>lt;sup>11</sup> "TNCs Today: A Profile of San Francisco Transportation Network Company Activity", San Francisco County Transportation Authority, June 2017.

## IS RIDE-HAILING CONGESTING NEW YORK CITY?

New York City had been seeing an increase in traffic congestion rates over the last few years. Their transportation managers suspected that ride-hailing was a part of the problem, but they didn't have the data to support the analysis. Using data from taxis (which are required to have GPS tracking) and from bus, subway, and bike share (all equipped with GPS) allowed researchers to infer that up to 7% of the additional congestion in Manhattan was likely from Uber and Lyft vehicles.

In February 2017, New York City's Taxi and Limousine Commission unanimously approved a rule that would require ride-hailing providers to share their data on the locations of pick-ups and drop-offs. The data will help the city understand where the biggest demand for service is so they can respond with better traffic management, new policies, or improved public transit. Data can help the city predict where congestion is likely to happen. Data can also show where services like Uber and Lyft don't go—despite demand—to see if the exclusion is discriminatory.<sup>12</sup>



<sup>12</sup>"The secret Uber data that could fix your commute," WIRED, February 3, 2017.

#### 2. New mobility services could lead to more inequity

New mobility services should be affordable, intuitive, and available to people of all backgrounds. As Seattle becomes more culturally diverse, we will be challenged to ensure equitable access to new mobility services.

Almost a fifth of Seattle residents were born in another country. Close to a quarter of residents speak a language other than English at home.<sup>13</sup> New mobility services could leave already marginalized populations behind if:

- The service is marketed in only one or two languages or is culturally inappropriate
- The services are too expensive
- The physical locations of the services exclude communities of color or low-income neighborhoods
- The services do not accommodate the unique needs of families with children, youth, older adults, women, or people with disabilities
- The algorithm or the human providers discriminate against LGBTQ, people of color or of certain ethnicities using names or pictures
- Some residents do not know how to use these services
- Not all Seattleites can access or pay for shared mobility services because they lack a bank account

While 72% of Seattleites own a laptop and 66% own a mobile device (a smartphone or a tablet), at least 15% of Seattle's residents have no internet service at home. Home internet access is even lower for immigrant and refugee families.<sup>14</sup> Residents earning under \$20,000 per year are about 25% less likely to use the internet than those earning more than \$100,000 per year.

Many shared mobility services require users to a smart phone and have a debit or credit card to register or pay for service. Prices of smartphones are dropping and more and more Seattleites have access to one, but access to credit is still a barrier. How do "unbanked" people who do not have credit cards, debit cards, or checking and savings accounts, and the "underbanked" who have poor or unreliable access to formal financial services benefit from new mobility? An FDIC survey showed that roughly 4% of households in the Seattle-Tacoma-Bellevue area qualify as unbanked, while 16% are underbanked.<sup>15</sup>

Without proper oversight and solutions to ensure equity, we risk advancing transportation options that are not accessible to a significant portion of the population.

<sup>&</sup>lt;sup>13</sup>American Community Survey, 2014.

<sup>&</sup>lt;sup>14</sup>2014 Information Technology Access and Adoption Report, City of Seattle.

<sup>&</sup>lt;sup>15</sup>2015 National Survey of Unbanked and Underbanked Households, Federal Deposit Insurance Corporation, 2015.

#### 3. We could erode the support and resources for public transit

Public transit—the original and most vital "shared mobility" mode—is the most efficient and cost-effective way to move people through the city. Public transit also makes the city more affordable, accessible, and vibrant.

New mobility services could compete with public transit. While research shows that people who use ride-hailing services are also more likely to use transit, we could see a shift if new mobility services deliver convenience and affordability that undercuts public transit. If we are not careful, every trip shifted from transit toa lower occupancy shared mode will could exacerbate congestion, contribute to longer travel times for other travelers, and reduce the costeffectiveness of public transit.

The shift toward shared mobility services and electric vehicles could impact the funding streams we depend upon to maintain, operate, and expand our transportation system and services. Revenues from the gas tax, commercial parking tax, and parking meters will likely decrease, compelling us to identify new and creative funding sources to support and continue to enhance public transit.

# **4. We could disrupt the economy and lose jobs faster than innovation creates them**

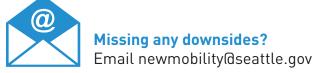
Seattle is home to tens of thousands of licensed ride-hailing vehicle drivers. There is an ongoing legal dispute over whether the drivers are contractors or employees, and another fight on whether they can unionize. And yet, all these jobs could be threatened if new mobility services shift rapidly to autonomous vehicles. We could also lose jobs if new mobility services eat into the ridership of public transit. Fewer riders translates into lower farebox revenue for public transit, which could result in reduced services and lay-offs. The changing nature of urban goods delivery could also see major job losses for delivery drivers.

#### 5. We could have systems we don't understand, can't manage, and can't protect

We cannot effectively manage our streets without the right data. But currently, Seattle does not have access to the real-time and historic data generated by many new mobility services. This lack of access can create an uneven playing field between the City of Seattle and the service providers.

While we need to ensure the privacy of users and protect each company's ability to compete, we also need to make sure the system is safe and equitable. Data allows us to understand and assess the impacts of new mobility services and technologies on the transportation network. Without proper access to data and secure, modern systems to protect and analyze it, we risk being unable to protect our communities and residents. New mobility services driven by artificial intelligence could make decisions we can't understand or interrogate.<sup>16</sup> Further, malicious actors could hack and compromise the computer systems that run these services. There are also documented cases where new mobility providers used their algorithms to deceive authorities.<sup>17</sup>

We need policies and safeguards that allow us to understand and better manage these systems.



<sup>16</sup>See "The Dark Secret at the Heart of AI," MIT Technology Review, April 2017.

<sup>17</sup>See "Uber faces criminal probe over the secret 'Greyball' tool it used to stymie regulators," L.A. Times, May 5. 2017.

# PRINCIPLES FOR NEW MOBILITY

As new mobility presents both upsides and downsides, we must guide our actions with clear principles. These principles reflect our city and regional values,<sup>18</sup> aligning the opportunities presented by innovative mobility services with our commitment to serving the public good. Our approach to mobility innovations and shared transportation in Seattle will be driven by the following:

Put People and Safety First	The public right-of-way is our most valuable and most flexible public space. Our streets should prioritize access for people, amplifying the role and value of walking, biking, and transit in Seattle. We respect the desire to retain and use privately owned vehicles but will continue to manage the transportation system to move people and goods safely and efficiently. Safety is paramount, no matter how you get around Seattle. Our streets should be comfortable and intuitive for our most vulnerable travelers (people walking and biking). Shared, automated, and other new mobility models should not only advance our Vision Zero safety goals, they should also maintain consumer protections.
Design for Customer Dignity and Happiness	Transportation happiness is a key indicator of the 21st century Seattle Department of Transportation. We will not only simplify and enhance the user experience of public transit and new mobility services, we will also continue to promote a diversity of transportation choices. Dignified public transit and new mobility services must accommodate people with mobility impairments, non-traditional schedules, and families that need flexible mobility options.
Advance Race and Social Justice Mobility, whether shared, public, private, or automated, is a fundamental human need. Everyone needs a barrier-free transportation system and affordable transportation options that are understandable and accessible to all who want use them. New mobility models should also promote clean transportation and back systemic racial and social injustices borne by the transportation system.	
Forge a Clean Mobility Future	We are committed to climate action. We will transition our transportation sector to one that furthers our climate goals and builds replicable models for the rest of the world. New mobility services should use clean energy and expand human-powered transportation.
Keep an Even Playing Field	Data infrastructure is foundational to understanding, operating, and planning in a constantly changing transportation system. Partnerships and a fair and flexible regulatory environment will nurture and expand new mobility ideas, companies, jobs, and workforce training.

<sup>18</sup>We collaborated with King County Metro on these Principles for New Mobility.

# OUR PLAYBOOK





## **OUR PLAYS**

New mobility is constantly changing and evolving. New startups with new services continue to enter the market and our transportation system. New players could pop-up one month and suddenly fold six months later.

As this era of rapid change plays out around us, there are two elements of our transportation system that do not change:

- Our hard infrastructure (sidewalks, roads, bridges, etc.)
- 2. Our mission, vision, values, and goals

These two elements establish the parameters for where and how new mobility innovations are tested and deployed. This is our playing field. We know it. We will protect it. We will play to succeed.

We will work with new mobility through five "plays" so that new technologies adapt to, rather than reshape, our city. These plays, along with a set of concrete strategies, will help us achieve the ideal outcomes and avoid the most problematic scenarios. They will guide the way we want new mobility to work for the city and our residents, the way the Seattle Department of Transportation works, and the way we prepare for rapid, unpredictable change.

Over the next 18 months, we will implement our *First Moves*—our immediate (and even current) actions—and we will issue Invitations to *Innovators*, calling upon them to bring their solutions to Seattle and help us achieve our goals.

Appendix A provides additional details about the strategies that can achieve our five plays over the next five years—with the understanding that trends and technologies will continue to rapidly change.

Each play, corresponding strategy, first move, and further action is based in our principles for new mobility and help us achieve Seattle's five core values.

#### Our five plays are to:

#### PLAY 1:

Ensure new mobility delivers a fair and just transportation system for all

#### **PLAY 2:**

Enable safer, more active, and people-first uses of the public right of way

#### **PLAY 3:**

Reorganize and retool SDOT to manage innovation and data

#### PLAY 4:

Build new information and data infrastructure so new services can "plug-and-play"

#### PLAY 5:

Anticipate, adapt to, and leverage innovative and disruptive transportation technologies

PLAY 1: Ensure new mobility delivers a fair and just transportation system for all

#### IF WE LEAVE IT TO CHANCE...

There are more transportation choices, but only for those who can afford it. New mobility innovations cannibalize resources and erode support for public transportation. Workers are vulnerable to disruptions. The city becomes disconnected.

#### **IF WE SHAPE IT...**

More affordable and better integrated transportation choices make the city and the region more accessible to people with disabilities and the disadvantaged. Public transit flourishes. The transportation workforce earns a living wage and is resilient to disruptions.

We must ensure that shared mobility services provide dignified, reliable, and affordable transportation options that are accessible to all. We will make targeted investments and broker partnerships to integrate new technology and ensure seamless connections to and between shared mobility modes. New services should be attentive to the needs of people of color, low-income, immigrant, refugee and aging populations, women, families, youth, LGBTQ people, and people with disabilities. New mobility options and technology must fight against the displacement of vulnerable communities and develop the living wage transportation workforce of tomorrow. We will:

**Strategy 1.1:** Advance shared mobility equity programs targeting people of color, low-income, immigrant, refugee, youth, and aging populations, women, LGBTQ, and people with disabilities

**Strategy 1.2:** Deploy digital equity solutions to ensure everyone has access to app-enabled mobility options

**Strategy 1.3:** Advance as diverse an array of payment options as possible to improve access to app-enabled mobility options

**Strategy 1.4:** Ensure new mobility services are ADA accessible across the region

**Strategy 1.5:** Ensure new mobility complements and enhances the public transit system

**Strategy 1.6:** Develop integrated shared mobility hubs to seamlessly connect people to and between mobility services



**PLAY 2:** Enable safer, more active, and people-first uses of the public right of way



#### IF WE LEAVE IT TO CHANCE...

Car ownership may go down, but vehicle miles traveled (VMT) increase, leading to more congestion. Ride-hailing services crowd our curbs and e-commerce demands overwhelm our goods delivery system. The urban environment becomes more hostile to people walking, people with disabilities, older adults, and people riding bikes. Overwhelmed by these changes, our streets lose vibrancy.

#### **IF WE SHAPE IT...**

We expand the network of pleasant public spaces and people-friendly streets. We can accommodate more green space as our population grows, which encourages more walking and biking. People feel safe walking along and across streets. Serious traffic collisions are eliminated and Seattle attains Vision Zero. The streets function well and goods are delivered efficiently.

New mobility services can potentially move more people using fewer vehicles. This would reduce the need for car storage (parking) and help us align our streets with our right of way priorities: mobility, access for people, and activation first; storage last. We can change the way we use our streets, sidewalks, and curbs. We can provide more space to people, while accommodating urban goods delivery. Managed appropriately, new mobility services can help us fulfill our Transit, Pedestrian, Bicycle, and Freight Master Plans, as well as achieve the goals of our Move Seattle strategy.

We will harness the efficiency benefits of shared mobility to make way for a future with great pedestrian spaces and community places, no fatal and serious traffic collisions, more reliable transit, and safe, convenient routes for people of all ages and abilities to ride their bikes. We will also partner with

regional logistics leaders and startups to implement innovative policies and services that facilitate the movement of urban goods and e-commerce deliveries. We will:

**Strategy 2.1:** Recover street space and expand the public realm as the demands for access shift

**Strategy 2.2:** Ensure that new mobility advances our Vision Zero goal of ending traffic deaths and serious injuries on city streets by 2030

**Strategy 2.3:** Support the development of efficient urban goods delivery and new freight technology solutions



PLAY 3: Reorganize and retool SDOT to manage innovation and data



#### IF WE LEAVE IT TO CHANCE...

Lack of capacity and knowledge leads the city government to over-regulate in some areas, and is preempted from critical regulatory and auditing functions in other areas. City government stifles innovation or is susceptible to unintended consequences.

#### IF WE SHAPE IT...

The city becomes a proving ground for innovation, improving transportation options for residents. Our data infrastructure allows us to manage the transportation system in real-time, providing anticipatory responses and strengthening protections against emerging threats.

We will advance innovative, data-driven policies, services, technologies, and projects that create an abundant mobility marketplace with options for all. The Seattle Department of Transportation will be a 21st Century DOT, accommodating changing consumer expectations and leveraging disruption in the mobility industry to meet our desired outcomes. We will engage in a two-way dialogue about new mobility. We will also be transparent as we test and learn about new ideas, daylighting our successes and lessons learned. We will pivot to new funding mechanisms as our gas tax and parking revenue sources deplete over time. This will require data-driven, anticipatory governance and a fresh perspective on organizational structures, staff skills, procurement rules, and partnerships. We will:

- Strategy 3.1: Manage risk related to emerging mobility services
- Strategy 3.2: Foster a culture of innovation and proficiency in new mobility solutions
- Strategy 3.3: Understand the mobility needs of the community
- Strategy 3.4: Continuously update citizens about mobility innovations
- Strategy 3.5: Pursue nimble regulations that meet the public good while spurring innovation

**Strategy 3.6:** Establish new transportation funding mechanisms in response to the changing financing landscape

**Strategy 3.7:** Build strategic mobility partnerships with King County Metro, Sound Transit, and other public and private entities

**Strategy 3.8:** Attract mobility companies, services, and jobs to Seattle's burgeoning mobility industry cluster

Strategy 3.9: Encourage travel behavior that ensures people can move safely and efficiently

### PLAY 4 Build new information and data infrastructure so new services can "plug-and-play"



#### IF WE LEAVE IT TO CHANCE...

Disconnected systems and lack of interoperability creates new transportation silos. Data asymmetries leave users in the dark and allow private mobility players to game the system. Transportation technologies are vulnerable to cyber attacks.

#### IF WE SHAPE IT...

We create clear rules for testing new technology, piloting new services and prototyping in the city. The results of prototypes are clearly evaluated against the city's values and goals. Successful prototypes can scale rapidly. Services that don't work can "fail gracefully." Transportation data is open and interoperable. Finding your way around the city without your own car is easy. Seattleites can purchase transportation services when they need them.

Our streets flow with a rich stream of data generated by traffic sensors, on-vehicle sensors, and mobile data from ride-hailing, car share, and other services. This flow of data could give us more insights into emerging travel patterns and the effects of new mobility services on the way people use transportation. But the flow of data is currently unstructured and our community has concerns about privacy. We will advance solutions that protect publicly identifiable information, while expanding our data infrastructure. We will relay travel information in culturally sensitive and appropriate ways.

Approaching data not just as information, but also as infrastructure, will help us build a better platform for delivering Mobility as a Service: generating abundant shared mobility options, digital mobility marketplaces, seamless fare payment solutions, incentives and subsidies, and access to real-time mobility data.

This data infrastructure will also help us develop clear rules so startups can roll out their prototypes and pilot services in Seattle. We will:

Strategy 4.1: Access relevant data to ensure the public good is served

**Strategy 4.2:** Facilitate trusted data flows between connected vehicles, sensor infrastructure, personal devices, and community digital devices

**Strategy 4.3:** Develop analytical tools that model the evolving state of mobility

Strategy 4.4: Establish an open marketplace for Mobility as a Service

Strategy 4.5: Simplify and enhance the fare payment experience

Strategy 4.6: Unlock new opportunities for trip planning

PLAY 5 Anticipate, adapt to, and leverage innovative transportation technologies



#### IF WE LEAVE IT TO CHANCE...

The transportation system is unable to adapt to or leverage innovations when the city gets locked into dead-end technologies, much like how governments got locked into Blackberry phones for years even while iPhone and Android were becoming ubiquitous.

#### IF WE SHAPE IT...

Seattle leads in transportation thinking and practice. New mobility accelerates a virtuous cycle that makes the city safer, more affordable, more livable, more vibrant. Technology adapts to the city and what we want it to be. Quiet, zero emission vehicles that run on clean energy dramatically reduce climate and noise impacts.

In Seattle, we have a long tradition of testing new technology, including the roll out of our mobile parking payment app and pay stations. By establishing a policy framework that anticipates new, potentially disruptive technologies, we will harness new mobility to meet our broader community goals. Our vision for automated mobility focuses on shared transportation, connected movement, and clean vehicle technology. We will pursue these technologies to complement our robust investments in transit. We will manage the negative impacts of single-occupant and zero occupant vehicles. We will also advance innovations in electric mobility and other clean fuels. We will take action to ensure that, by 2030, at least 30 percent of all light duty vehicles registered in Seattle are electric. And, we will collaborate with other cities, experts, and global leaders to exchange successful policy and technological innovations. We will:

**Strategy 5.1:** Establish a comprehensive set of people-first policy parameters to introduce and manage fully shared, electric, connected, and automated vehicle<sup>19</sup>

**Strategy 5.2:** Use pilots and promotions, to manage the technological and cultural shift to automated technology

**Strategy 5.3:** Promote the shift toward electric shared mobility services

**Strategy 5.4:** Support King County Metro in their effort to achieve a zero-emissions fleet by 2034



<sup>19</sup>See Appendix C for our preliminary policy framework, which will be updated periodically.

#### **OUR FIRST MOVES**

While planning and vision are critical to shaping our transportation landscape, we must also take immediate actions to jump start changes that can benefit our city and lay the groundwork for future innovation.

The following 20 "first moves" represent the most foundational and strategic actions that will set us up for success over the long-term. Each first move corresponds to a specific play and strategy.

These first moves will allow us to jump start changes that will make our transportation system more sustainable, get ahead of negative impacts for vulnerable communities, and expand access to new technologies and transportation options.

Over the next 18 months, we will...

#### Establish the following policies:

- Adopt the preliminary Automated Mobility Policy Framework (see Appendix C) as an ordinance and require annual updates to reflect changes within the automated mobility industry (Strategy 5.1)
- 2. Adopt a policy framework and permit program that enables electric vehicle charging in the public right of way **(Strategy 5.3)**
- 3. Develop a set of principles to guide ongoing regulatory and legislative efforts—including a protocol for updates (see SDOT's regulatory principles in Appendix D) **(Strategy 3.5)**
- 4. Craft a free-floating bike share policy framework to extract the most benefit out of privately funded bike share systems **(Strategy 3.1)**
- 5. Partner with King County Metro and Sound Transit to develop a microtransit policy framework and pilot its ability to serve first-/last-mile connections, emerging transit markets, and capacity relief needs (Strategy 1.5)

#### Initiate the following programs:

- 6. Build staff capacity for data analytics, technology investments, pilot delivery, and policy-making **(Strategy 3.2)**
- 7. Host community conversations with transportation advocates, social justice-oriented communitybased organizations, and community members to understand broader challenges and opportunities related to new mobility **(Strategy 3.3)**
- 8. Work with regional and national partners to establish a neutral trusted data platform that houses data from new mobility service providers, sensors, and other data sources, automates data analytics, and enables predictive analytics **(Strategy 4.2)**
- 9. Develop a Mobility as a Service platform that enables an open marketplace for mobility aggregation apps to compete and meet customer needs **(Strategy 4.4)**
- Develop a Shared Mobility Hub program with a public-facing brand, actionable Implementation Plan (including a regional definition of shared mobility hubs, a hub typology, access hierarchy, siting plan, financing, phasing, and other implementation considerations), and demonstration sites (Strategy 1.6)
- Develop a digital data master plan to take stock of our data, establish data sharing standards, and create data handling and privacy standards for the trusted data platform, Mobility as a Service platforms, and connected infrastructure (Strategy 4.1)
- 12. Democratize and test technology in the public right of way such as interactive digital kiosks and other information interfaces **(Strategy 4.6)**
- 13. Develop a multi-income level shared mobility subsidy program (Strategy 1.1)

#### Conduct the following research:

- Work with the University of Washington's Urban Freight Lab to understand the impacts and benefits of e-commerce and other emerging shared goods delivery models in Seattle (Strategy 2.3)
- 15. Conduct a Racial Equity Toolkit for the New Mobility program to ensure shared mobility initiatives promote, rather than roll back, equity **(Strategy 3.1)**
- 16. Analyze the labor implications of automated and electric mobility strategies to mitigate job loss, identify new growth areas for people of color, low-income, immigrant, and refugee communities, and pinpoint workforce development and training needs **(Strategy 5.2)**

#### Prototype or pilot the following projects:

- 17. Expand 3-minute passenger loading zones citywide from which ridesourcing and microtransit services can be required to pick-up and drop-off passengers (i.e., "pin drops" are tied to physical passenger loading zones) (Strategy 2.1)
- Develop new solutions for the Wheelchair Accessible Taxi (WAT) program to reduce operating costs, meet customer expectations, and work more efficiently across jurisdictional boundaries (Strategy 1.4)
- 19. Strategically site electric vehicle fast charging infrastructure at shared mobility hubs to facilitate electric shared mobility **(Strategy 5.3)**
- 20. Establish a permit process that allows sensor infrastructure providers to expand the network of sensors at intersections and multiply vehicle-to-infrastructure (V2I) communications citywide **(Strategy 4.2)**

#### **OUR INVITATIONS TO INNOVATORS**

We're looking for innovators and creative thinkers in fields like technology, transportation and government to bring their solutions to Seattle.

Many of the strategies included in the Playbook will require collaboration with government agencies, private companies, and community groups to achieve our shared vision for the future of transportation in Seattle. As we implement the Playbook, there will be opportunities for partners to:

- Collaborate on solutions to equity challenges
- Work for change in the community
- Launch or prototype a new product or service
- Advise on technology
- Contribute to policies and proposals

We invite you to join us by sharing your contact information and initial thoughts at www. newmobilityseattle.info.

#### We invite innovators to help us answer the following questions:

- 1. How might we open up data from new mobility services in a way that serves the public good, but also protects the privacy of users?
- 2. How might we obtain frequently updated data (even up-to-the-minute data) on how new mobility services are impacting the transportation system and furthering racial and social justice?
- 3. How might we design new mobility services so they work just as well for people with disabilities (including the neurodiverse) and for older adults?
- 4. How might we allow people to pay for new mobility services without a credit card or a bank account?
- 5. How might we create information interfaces for new mobility that do not require a smartphone, a gadget, or a screen?
- 6. How might we create localized test procedures that allow us to safely test prototypes on city streets?
- 7. How might we create incentives and nudges to encourage people to use the most economical, most operationally efficient, and environmentally-friendly shared or new mobility service?
- 8. How might we encourage and create a system that uses data, technology, and new delivery vehicles to deliver e-commerce and urban goods?
- 9. How might we use technology to make the street friendlier to people walking and biking?
- 10. How might we use sensors that tell us very useful information about how people are using our roads, streets, sidewalks, and public spaces while respecting their privacy?
- 11. How might we make sure human providers and drivers of new mobility services are economically resilient?
- 12. How might we redesign our procurement process so we can find innovative solutions and better partner with the private sector?

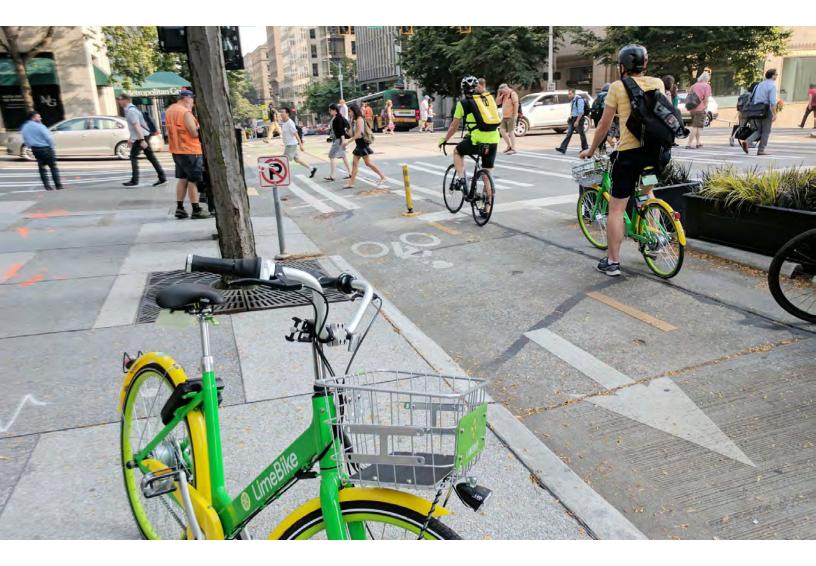


If you have ideas that are relevant to our questions above, please email us at <u>newmobility@seattle.gov</u>.

#### WE'RE JUST GETTING STARTED...

In Seattle, we know that innovation and new technology, when applied in service to the greater good, can reshape the world for the better. The people of Seattle have driven the personal computer revolution, changed the way we shop and read, engineered revolutionary aircraft, and spread gourmet coffee across the globe, all while taking the necessary steps to ensure racial and social equity as our city changes.

Now, as transportation becomes increasingly shared, active, self-driving, electric, and datadriven, we look forward to building upon our legacy of innovation to ensure the fast-paced changes in mobility contribute to a city that is safer, more sustainable, and more equitable. The New Mobility Playbook offers guidelines and a game plan to address emerging technologies and prepare for changes that are yet to come. We expect to update the Playbook every six months as new opportunities and challenges emerge. We look forward to collaborating with you to adapt and improve the Playbook and begin implementing solutions that will create a transportation system that works for us all.



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# APPENDIX A FURTHER ACTIONS

### **Further Actions**

Our New Mobility Playbook offers a vision for the future of transportation in Seattle that will allow us to embrace innovation and align it with our values. To keep pace with quickly changing technology, we need a responsive, resilient strategy to ensure new mobility puts people first.

Our five "plays" will guide our efforts to shape new mobility services and technologies so they work for the city and all of its residents, and set us up to respond to rapid, unpredictable change.

#### Our five plays are to:

PLAY 1	Ensure new mobility delivers a fair and just transportation system for all
PLAY 2	Enable safer, more active, and people-first uses of the public right of way
PLAY 3	Reorganize and retool SDOT to manage innovation and data
PLAY 4	Build new information and data infrastructure so new services can "plug-and-play"
PLAY 5	Anticipate, adapt to, and leverage innovative and disruptive transportation technologies

In the following sections, we list a set of strategies under each play. In addition to the First Moves, our immediate (and even current) actions listed in the main Playbook document, this appendix provides details on *Further Actions* that will help us achieve our five plays over the next five years. This appendix establishes our roles, partnerships, and implementation and regulatory considerations. While our agenda promotes many value-driven policies, we will continue to use pilots and iterative data analysis processes to test new policy and operational ideas at intersection, corridor, neighborhood, and even citywide scales.

#### WHAT IS OUR ROLE?

SDOT will assume a variety of roles in advancing policy and investments related to shared mobility and emerging mobility innovations. Each strategy highlights the type of role we will undertake to deliver each move or action. Our roles may include the following:



#### Implementer

Write policies, deploy programs and pilots, and drive capital projects to ribbon-cutting



#### **B** Capacity Builder

Build internal and partner organizational and leadership skills needed to advance shared mobility



#### Funder

Allocate funding and staff resources to implement programs, pilots, and projects

### WHO ARE OUR PARTNERS?

#### A Advocate

Raise the profile of innovative projects, galvanize support for policy change and implementation, and reinforce accountability



#### Convener

Establish collaborative networks, cross-pollinate projects with diverse perspectives, and create peer learning networks



#### **Thought Leader**

Shape the direction of policy and projects and advance innovation

- Collaboration and ongoing partnership will be essential as we meet the current and future transportation demands of our bustling city. SDOT will actively collaborate with our public transit and private mobility partners as we pursue our values. The strategies, first moves, and further actions that make up our Playbook include partner roles for the following entities. This list represents only a portion of all stakeholders that will be engaged as policies, programs, and projects are formed and deployed.
- CBO: Community-Based Organization Partners **DC**: Development Community DCI: Seattle Department of Construction and Inspections **DON**: Seattle Department of Neighborhoods FAS: Seattle Finance and Administrative Services FP: Foundation/Non-Profit Partners **HSD**: Seattle Human Services Department **IP**: Infrastructure Providers (private) IT: Seattle Information Technology KCL: King County Records and Licensing Services KCM: King County Metro ME: Major Employers **MP**: Mobility Providers (private/non-profit) **OCR**: Seattle Office for Civil Rights **OED**: Seattle Office of Economic Development **OEM**: Operating Equipment Manufacturers (e.g., automakers) **OIR**: Seattle Office of Intergovernmental Relations
- **OLS**: Seattle Office of Labor Standards
- **OPI**: Seattle Office of Policy and Innovation
- **OSE**: Seattle Office of Sustainability and Environment (including Drive Clean Seattle)
- PCD: Seattle Office of Planning and Community Development
- PSC: Puget Sound Cities and Ports
- PSE: Puget Sound Energy
- **PSRC**: Puget Sound Regional Council
- RP: Research Partners (e.g., Univ. of Washington)
- SCL: Seattle City Light
- SOH: Seattle Office of Housing
- **SPD**: Seattle Police Department
- **SPU**: Seattle Public Utilities
- **SPR**: Seattle Parks and Recreation
- ST: Sound Transit
- **TP**: Technology Providers (private)
- WSDOT: Washington State Department of Transportation



### PLAY 1

#### Ensure new mobility delivers a fair and just transportation system for all

We must ensure that shared mobility services provide dignified, reliable, and affordable transportation options accessible to all. We will make targeted investments and broker partnerships to integrate new technology and ensure seamless connections to and between shared mobility modes. New services should be attentive to the needs of low-income, immigrant, refugee and aging populations, women, families, youth, people of color, LGBTQ people, and people with disabilities. New mobility options and technology must fight against the displacement of historically underrepresented communities and develop the living wage transportation workforce of tomorrow.

#### **STRATEGY 1.1:** ADVANCE SHARED MOBILITY EQUITY PROGRAMS TARGETING PEOPLE OF COLOR, LOW-INCOME, IMMIGRANT, REFUGEE, YOUTH, AND AGING POPULATIONS, WOMEN, LGBTQ, AND PEOPLE WITH DISABILITIES

We are a city of diverse cultures, races, and economic means. While Seattle is growing in ways that allow people to get around without a car, our historically underrepresented communities and vulnerable populations often do not have access to app-enabled shared mobility services (both due to availability and limited literacy) or are actively discriminated against. We will develop programs that close racial disparities in transportation costs by enacting policies and programs to reduce shared mobility fares for marginalized communities. We will deploy programs that connect immigrant and refugee households to shared mobility options, supported by education and culturally-resonant marketing. Our pilots with shared mobility providers should serve the most vulnerable populations in the city, including late night services for women and intuitive options for aging Seattleites.

#### First Moves

Move	Partners	SDOT Role
Develop a multi-income level shared mobility subsidy program	KCM, MP	Implementer, Funder, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Market the financial benefits for low-income communities to reduce personal car use	DON, SOH, KCM, ST, MP	Advocate, Convener
Work with shared mobility providers to provide services and incentive structures that encourage use by women and families with children	KCM, MP	Advocate, Convener, Thought Leader
Partner with the Seattle Office of Housing and nonprofit organizations to learn from and develop culturally sensitive approaches to socialize and subsidize shared and emerging mobility options	SOH, FP, MP, KCM, DON	Advocate, Convener
Develop a shared mobility ladders of opportunity roadmap for communities of color, women, and all other protected classes	OED, OCR, DON, FP, CBO, OLS, OSE, MP	Implementer, Advocate, Convener
Develop age-friendly mobile apps, subsidy programs, and travel training based on a human centered design process	OPI, KCM, HSD	Funder, Advocate
Use various ethnic media to convey benefits of shared mobility	DON, OSE, CBO	Advocate
Partner with workforce development groups to establish a job training program to prepare shared mobility workers for an electric and automated mobility future	OCR, OLS, CBO	Implementer, Advocate, Funder, Thought Leader
Work with ride-hailing companies to implement platform features and programs that encourage more women to become drivers	OED, OCR, DON, OLS, MP	Advocate, Convener, Thought Leader

- Use the Mobility as a Service platform to disburse low-income shared mobility subsidies
- Funnel shared mobility equity fees into income eligible subsidies, first mile/last mile services, and other digital equity actions
- Consider allowing TNC digital platforms for women-only to ensure women feel comfortable using and operating ride-hailing services
- Host a hackathon to expand shared mobility services that cater to the needs of women and families



# **STRATEGY 1.2:** DEPLOY DIGITAL EQUITY SOLUTIONS TO ENSURE EVERYONE HAS ACCESS TO APP-ENABLED MOBILITY OPTIONS

Most app-enabled shared mobility services require access to a digital device and wireless connectivity. To overcome these barriers, the City of Seattle launched a Digital Equity Initiative, where technology is used to equitably empower all residents and communities. We are collaborating with Seattle IT to invest in new avenues to access mobility using digital devices, focusing on devices, infrastructure, connectivity, and education. Digital kiosks, community tablets, and publicly-available Wi-Fi will also provide public access to community information and data visualizations that impact the lives of community members.

#### First Moves

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Expand and democratize access to new mobility trip planning and booking beyond the smart phone	IT, KCM, ST, TP, IP	Implementer, Thought Leader
Establish a targeted public Wi-Fi hotspot program and provide low cost smart phone devices that are served by free Wi-Fi	IT, TP	Implementer, Funder
Develop a multi-lingual call center service to enable trip planning and booking via cell phone or land line	KCM, ST, TP	Advocate, Convener
Work with Seattle IT to develop a community learning program to increase digital literacy	IT	Capacity Builder, Advocate
Support Seattle IT as they distribute smart phones to income- eligible individuals	IT, OED	Capacity Builder, Advocate

- Identify Community Reinvestment Act grant opportunities to fund digital infrastructure projects that both increase digital and financial literacy and provide access to app-based mobility services
- Establish flexible procurement rules for digital equity infrastructure investments



#### **STRATEGY 1.3:** ADVANCE AS DIVERSE AN ARRAY OF PAYMENT OPTIONS AS POSSIBLE TO IMPROVE ACCESS TO APP-ENABLED MOBILITY OPTIONS

Many shared mobility providers require users to have a credit or debit card for registration or payment, which hinders many unbanked or underbanked Seattleites from using these services. This effectively disqualifies some residents from a wide range of app-enabled mobility services, excluding them from the individual benefits of affordable and safe door-to-door transportation options. We will advance options for improving access so we can provide the same level of service to all residents, whether the service is publicly or privately provided.

#### **First Moves**

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Develop a mobility securitization program with one or more community credit unions to bank the unbanked	IT, OCR, CBO, KCM, ST	Advocate, Convener, Thought Leader
Market to and educate residents about existing and new payment options	DON, KCM, ST, CBO, FP, MP	Implementer, Advocate
Partner with web-based third-party payment methods that accept cash	IT, OCR, CBO, KCM, ST, MP, TP	Implementer, Advocate, Convener, Thought Leader
Allow cash payments, low-income rates, and direct subsidies as part of the Mobility as a Service platform (see Strategy 4.5)	IT, OCR, CBO, KCM, ST, MP, TP	Implementer, Advocate, Convener, Thought Leader
Consider adding permit or operational requirements for alternative payment methods for all shared mobility modes	FAS, IT, OCR, CBO, KCM, ST, MP, TP	Implementer, Thought Leader

#### Implementation and Regulatory Considerations

• Coordinate with private mobility providers to understand the opportunities and limitations of alternative payment methods



### **STRATEGY 1.4:** ENSURE NEW MOBILITY SERVICES ARE ADA ACCESSIBLE ACROSS THE REGION

Community access transportation, accessible taxis, and Access paratransit services are vital mobility options for people with disabilities and eligible medical issues. Paratransit service is provided at high subsidy levels, costing nearly \$53 per trip. Human services, Wheelchair Accessible Taxi (WAT) services, and paratransit transportation is ripe for innovation and enhancements to the customer experience. They typically require advanced booking and cannot offer on-demand mobility, largely due to outdated booking and dispatching technology.

Shared mobility services in Seattle could greatly reduce the cost of these services if they offer accessible ride options in compliance with the Americans with Disabilities Act. We will take proactive steps to ensure new mobility services enhance the customer experience for people with disabilities. We will also invest in new solutions that will reduce the operating costs of WAT services.

#### First Moves

Moves	Partners	SDOT Role
Develop new solutions for Wheelchair Accessible Taxi (WAT) program to reduce operating costs, meet customer expectations, and work more efficiently across jurisdictional boundaries	FAS, KCM, KCL, MP, TP	Implementer, Funder, Convener, Thought Leader

#### Further Actions

Tactics	Partners	SDOT Role
Develop a shared mobility Level of Service guarantee for people with disabilities or those needing medical trips (measured as a maximum wait time by geography and time of day)	KCM, ST, MP	Implementer, Thought Leader
Develop collateral materials to educate WAT, TNC, and other for-hire drivers about the varying needs of people with mobility impairments (e.g., people with seeing eye dogs)	FAS, KCL, KCM, MP	Implementer
Work with the disability community to identify appropriate signage and/or audible indicators, as well as street design strategies that facilitate the movement of wheelchair users, blind, or hearing impaired people from the curb to passenger loading zones	FAS, CBO, KCM, KCL, MP, TP	Implementer, Advocate, Convener
Promote and support apps that allow users to find ADA accessible routes or minimize transfers and walking distances on their trip	SDOT, King County, KCM, ST	Advocate

- Conduct a needs assessment for the WAS program, prior to making new operational investments
- Evaluate the effectiveness of the current WAS program from the perspective of the private providers and disability advocates, using surveys and in-person interviews
- Align the WAS program with the City's Age-Friendly Initiative



### **STRATEGY 1.5:** ENSURE NEW MOBILITY COMPLEMENTS AND ENHANCES THE PUBLIC TRANSIT SYSTEM

As our city grows, people increasingly expect more frequent and more reliable transit service. We will test new services in underserved geographic areas and explore opportunities for shared mobility to complement public transit. Our transit system has two key ingredients needed to test innovation— a built-in user base and the ability to scale rapidly.

We seek to position shared mobility and other emerging mobility innovations to create a system of seamless, dependable transit travel, regardless of geographic location or time of day. We will leverage shared mobility services to extend the reach of high capacity transit, integrating car share, ridesourcing, shuttles, and other modes into major transit connections.

#### **First Moves**

Moves	Partners	SDOT Role
Partner with King County Metro and Sound Transit to develop a microtransit policy framework and pilot its ability to serve first-/last-mile connections, emerging transit markets, and capacity relief needs	KCM, ST, MP, OEM	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Use Mobility as a Service to establish regional guaranteed ride home partnerships with ride-hailing and car sharing services	KCM, ST, MP, ME, TP, FP	Advocate, Convener, Thought Leader
Subsidize ridesplitting and car sharing for first- and last-mile trips in low-income neighborhoods, focusing on shift workers and other vulnerable populations	KCM, ST	Implementer, Funder, Thought Leader
Explore subsidy options for passengers who use shared mobility services to or from shared mobility hubs	KCM, ST	Implementer, Funder, Thought Leader
Identify ways to integrate peer-to-peer car share services into Shared Mobility program initiatives, marketing, and outreach	KCM, MP	Convener, Thought Leader
Test the use of transit only lanes and business and transit access lanes by non-public transit high occupancy vehicles (including microtransit, ridesplitting, and private employer shuttles)	KCM, ST, MP, ME	Implementer, Advocate, Convener, Thought Leader

- Think creatively when designing transit integration pilots, but establish a strong data sharing agreement to measure success
- Focus future private bike share integration on physical siting, fare integration, and user experience improvements like messaging and wayfinding



#### **STRATEGY 1.6:** DEVELOP INTEGRATED SHARED MOBILITY HUBS TO SEAMLESSLY CONNECT PEOPLE TO AND BETWEEN MOBILITY SERVICES

Navigating connections between Seattle's wide range of public transit and private shared mobility services can be a challenging endeavor. Connections are not always intuitive as customers are met with either multiple layers of information or a lack of information altogether.

Shared mobility hubs are a physical representation of the digital mobility marketplace. Shared mobility hubs aggregate transportation connections and travel information into a seamless, understandable, and on-demand travel experience, often collocated with major transit facilities (e.g., Link Stations, RapidRide Stations, King Street Station, and Colman Dock) and places where frequent transit services intersect. In partnership with transit agencies and private operators, we will implement a network of shared mobility hubs throughout the city, providing better mobility and integrated transportation choices for all. Each shared mobility hub will feature amenities that uniquely meet the needs of the immediate community it serves with a strong emphasis on placemaking.

#### First Moves

Moves	Partners	SDOT Role
Develop a Shared Mobility Hub program with a public-facing brand, actionable Implementation Plan (including a regional definition of	KCM, ST, DC, ME, PCD, OPI,	Implementer, Funder,
shared mobility hubs, a hub typology, access hierarchy, siting plan,	SOH, PRSC, OSE, MP, CBO, FP. WSDOT	Capacity Builder, Advocate, Convener, Thought Leader
financing, phasing, and other implementation considerations), and demonstration sites	11,00001	Convener, mought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Integrate shared mobility hub amenities into ongoing Sound Transit 2, Sound Transit 3, and Move Seattle transit projects	PCD, KCM, ST, DC	Implementer, Funder, Capacity Builder, Advocate, Thought Leader
Work with the Office of Sustainability and Environment and Seattle City Light to develop an electric vehicle roadmap for shared mobility hubs	OSE, SCL	Advocate, Thought Leader
Develop and deliver a community outreach strategy to ensure community ownership in the design and programming of shared mobility hubs	KCM, ST, DC, ME, PCD, OPI, SOH, PRSC, OSE, MP, CBO, FP, WSDOT	Advocate, Convener, Thought Leader
Partner with the Equitable Development Initiative to create a workforce and local economic development strategy for shared mobility hubs to ensure these locations become hubs of job and skills growth	OED, OLS, OCR, PCD, OSE, CBO, FP, DC, DON	Capacity Builder, Convener, Thought Leader
Adopt a Shared Mobility Hub Overlay Zone to implement hub amenities as part of ongoing development projects at major transit transfer locations	PCD, DCI, DC, OPI	Implementer, Advocate, Convener
Inventory vacant properties, private development opportunities, and transit properties that could be leveraged for shared mobility hub amenities and placemaking/open space opportunities	PCD, DCI, SOH, KCM, ST, DC	Implementer, Advocate

- Develop targeted measures of success for shared mobility hubs
- Integrate concepts related to cultural hubs, emergency management hubs, workforce development, and community information into the Shared Mobility Hub Implementation Plan
- Partner with local parking efficiency app developers to facilitate car share parking at private parking lots near shared mobility hubs
- Work with local public, private, and foundation funding partners to establish an open innovation procurement process, whereby technology applicants propose mobility solutions to be applied and tested at shared mobility hubs
- Complete detailed siting plans for mobility amenities at all future shared mobility hubs
- Conduct focus groups and interviews with developers and land owners to educate them about shared mobility hubs and to formalize implementation partnerships
- Consider flexible zoning requirements at shared mobility hubs to enable multiple uses on private and public land (e.g., retail, transportation, etc.)

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### PLAY 2

#### Enable safer, more active, and people-first uses of the public right of way

New mobility services can potentially move more people using fewer vehicles. This would reduce the need for car storage and help us align our street with our right of way priorities: safety, mobility, access for people, and activation first; storage last. We can change the way we use our streets, sidewalks, and curbs. We can provide more space to move people, while accommodating urban goods delivery. Managed appropriately, new mobility services can help us fulfill our Transit, Pedestrian, Bicycle, and Freight Master Plans, as well as achieve the goals of our Move Seattle strategy.

We will harness the efficiency benefits of shared mobility to make way for a future with great pedestrian spaces and community places, zero fatal and serious injury traffic collisions, more reliable transit, and safe, convenient routes for people of all ages and abilities to ride their bikes. We will also partner with regional logistics leaders and startups to implement innovative policies and services that facilitate the movement of urban goods and e-commerce deliveries.



## **STRATEGY 2.1:** RECOVER STREET SPACE AND EXPAND THE PUBLIC REALM AS DEMANDS FOR ACCESS SHIFT

As new mobility use continues to grow, Seattle's curbspace can be repurposed to accommodate shared vehicle and commercial loading, with less emphasis on personal vehicle storage. We will manage transitioning curb use behavior and evaluate impacts on demand and commercial land use access using pilots and new sensor technologies. We will also capitalize on major corridor projects to strategically advance transit priority and protected bike lane implementation as well as expanded opportunities for commercial and passenger load zones.

As we increase the carrying capacity of our transit network and move into a future with shared and fully automated fleets, we will fundamentally rethink how we manage public space. We have the unique opportunity to incrementally expand the public realm and enhance the quality of our streets. While strategically maintaining curbspace for car share storage and commercial loading needs, we will seek to shift space from less productive motor vehicle storage toward safe, accessible, and well-designed public spaces.

#### **First Moves**

Moves	Partners	SDOT Role
Expand 3-minute passenger loading zones citywide from which ridesourcing and microtransit services can be required to pick- up and drop-off passengers (i.e., "pin drops" are tied to physical passenger loading zones)	KCM, MP, OEM	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Integrate the concept of public realm transitioning into the One Center City planning process	PCD, FP, CBO	Advocate, Convener, Thought Leader
Develop curbspace technology roadmap to identify new capabilities and strategies for future parking, curbspace and transportation needs	IT, TP	Implementer, Thought Leader
Digitize all curb faces and travel lanes citywide in advance of dynamically managed lanes and curbspaces	PCD, IT, TP, WSDOT, PSRC	Implementer, Funder
Delineate and prioritize high-activity versus low-activity spaces in SDOT's Right-of-Way Decision Making Framework and Streets Illustrated (i.e. the Right-of-Way Improvements Manual)	N/A	Implementer
As shared mobility use and occupancies increase, dynamically manage high occupancy vehicle only lanes in Urban Centers and Urban Villages throughout the city	OPI, WSDOT, MP, RP	Implementer, Advocate, Thought Leader
Investigate policies and incentives to increase car share turnover where high car share accumulation and high parking demand overlap (e.g., South Lake Union, Capitol Hill, SODO, etc.)	MP, RP	Implementer, Convener, Thought Leader
Partner with technology companies to advance ride matching services for car share users	OED, KCM, ST, MP, TP	Advocate, Convener, Thought Leader
Identify near- and long-term Pavement to Parks and parklet opportunities for the Adaptive Streets program	PCD	Implementer, Funder, Convener, Thought Leader

- Determine any regulatory barriers by integrating ride matching and car share digital booking platforms
- Evaluate the efficacy of various optical parking sensor technologies and enumerate the revenue potential of this permit program
- Work with SDOT parking management experts to identify a network of future passenger loading zones on every block face in Urban Centers and Urban Villages, as feasible
- Work with local chambers of commerce and a cross section of the business community to ensure buy-in for curbspace conversion
- Consider using a reverse or Dutch auction approach to selling utility pole rights on optical parking sensor open market
- Coordinate with the Office of Planning and Community Development and Seattle Parks and Recreation as we expand public realm opportunities
- Consider piloting flexible transit lane use by non-public transit high occupancy vehicles





#### **STRATEGY 2.2:** ENSURE THAT NEW MOBILITY ADVANCES OUR VISION ZERO GOAL OF ENDING TRAFFIC DEATHS AND SERIOUS INJURIES ON CITY STREETS BY 2030

In 2015, we unveiled our Vision Zero Plan—a commitment to ending traffic deaths and serious injuries by 2030. A data-driven approach grounds our Vision Zero initiative and directs our efforts to invest in and coordinate traffic safety efforts. The plan identifies safety efforts that combine engineering solutions with targeted enforcement and educational outreach to address behavioral issues. We will strike a balance between managing and partnering with shared mobility service providers to ensure passengers are safe and drivers are operating safely. We will also employ shared mobility operational data to expose unsafe behavioral patterns and redirect resources to ensure our streets are safe.

#### First Moves

None

#### Further Actions

Further Actions	Partners	SDOT Role
Improve safety and access for transit through signal priority and transit lane enhancements	KCM, ST	Implementer, Funder
Communicate the safety benefits of shared mobility to the public	DON, KCM, ST, MP	Advocate
Conduct randomized undercover inspections to educate TNC drivers on safe driving behavior	FAS, MP	Implementer
Continue outreach efforts highlighting the impact of SDOT's Vision Zero campaign and how it changes the way people behave on City streets	DON, SPD, KCM, MP	Implementer, Capacity Builder, Advocate
Continue 'safe ride home' partnerships with transit, ride-hailing, and microtransit services to deter impaired driving	DON, SPD, KCM, MP	Implementer, Advocate
Partner with TNCs and microtransit services to develop tailored safety push notifications to drivers where pick-ups and drop-offs coincide with bike lanes and transit lanes	FAS, MP	Advocate, Convener, Thought Leader

- Work closely with SDOT's Vision Zero and Transportation Operations team as pilots are developed
- Test designated loading zones for TNCs and other for-hire services at stadium and other major events as a way to promote the safe loading, ingress and egress of ride-hail passengers
- Consider dedicating funding for "safe-ride home" discounts
- Expand the network of 3-minute passenger load zones citywide so ride-hail-based services can safely load and unload passengers
- Update regulations to require shared mobility providers share safety related data generated from telematics (e.g., illegal u-turns, rapid decelerations, rapid accelerations, etc.)



#### **STRATEGY 2.3:** SUPPORT THE DEVELOPMENT OF EFFICIENT URBAN GOODS DELIVERY AND NEW FREIGHT TECHNOLOGY SOLUTIONS

The economic health of our city depends on the efficient and predictable movement of goods. The retail and urban logistics industries are being reshaped by new digital technologies, creating previously unforeseen impacts on our streets. As people continue to rely on e-commerce websites to purchase goods, we must reconsider how we manage delivery vehicles and their relationship with curbspace and alleys.

In partnership with the University of Washington's Urban Freight Lab and our local logistics innovators, we will support and actively integrate intelligent delivery solutions. We will capitalize on the blurring lines between goods movement and shared mobility and find new ways to accommodate the "Final 50 Feet". Our objective is to reduce unnecessary delivery trips and dwell time by facilitating a range of delivery vehicle and process options.

#### **First Moves**

Moves	Partners	SDOT Role
Work with the University of Washington's Urban Freight Lab to understand the impacts and benefits of e-commerce and other emerging shared delivery models in Seattle	PSC, RP, TP, MP	Funder, Capacity Builder, Advocate, Convener, Thought Leader

#### **Further Actions**

Tactics	Partners	SDOT Role
Test and enable the use of small trucks, delivery bots, aerial drones, and human-powered delivery (e.g. cargo bikes)	PSC, RP, TP, MP	Implementer, Advocate, Convener, Thought Leader
Implement Move Seattle corridor improvements to reduce conflicts, increase safety, and enhance freight mobility	PSC, MP	Implementer, Funder
Implement new digital technology for Commercial Vehicle Load Zone Permits to add demand-based pricing and improved eligibility requirements	OED, IP, TP	Implementer
Develop a Goods Trip Reduction program within SDOT to reduce unnecessary urban delivery trips and inefficient delivery movements	RP, ME,	Implementer, Funder, Advocate, Thought Leader
Coordinate urban goods movement policies, pilots, and logistical improvements with the Port of Seattle and the Northwest Seaport Alliance	PSC, DC, RP, TP, MP	Advocate, Convener
Use shared mobility hubs as common carrier delivery locker hubs	RP, TP, ME, DC	Implementer, Advocate, Convener, Thought Leader
Assess the applications, impacts, and design implications of drone delivery and building integration	PSC, RP, TP, ME, DC	Capacity Builder, Advocate, Convener, Thought Leader
Work with digital logistics platforms to build delivery capacity using shared vehicles	PSC, RP, TP, MP	Capacity Builder, Advocate, Convener, Thought Leader
Develop a strategy to use parking structures and surface lots as common carrier delivery locker hubs and short-term loading zones to better accommodate loading needs off-street	DC, ME, RP, TP, MP	Implementer, Advocate, Convener, Thought Leader
Test the cross-functionality of Mobility as a Service incentives and common carrier delivery locker hubs	RP, TP	Implementer, Thought Leader

- Coordinate policy development and pilot delivery with the Port of Seattle and freight companies to meet our shared objectives
- Consider piloting electric bike delivery services, drone delivery testing, off-hour delivery, and package delivery incentive pilot through the Mobility as a Service platform (see Strategy 4.4)
- Establish appropriate pilot permitting frameworks to test "final 50 feet" automated delivery bots





### PLAY 3

#### Reorganize and retool SDOT to manage innovation and data

We will advance innovative, data-driven policies, services, technologies, and projects that create an abundant mobility marketplace with options for all. The Seattle Department of Transportation will be a 21st Century DOT, accommodating changing consumer expectations and leveraging disruption in the mobility industry to meet our desired outcomes. We will engage in a two-way dialogue about new mobility. We will also be transparent as we test and learn about new ideas, daylighting our successes and lessons learned. We will pivot to new funding mechanisms as our gas tax and parking revenue sources deplete over time. This will require data-driven, anticipatory governance, and a fresh perspective on organizational structures, staff skills, procurement rules, and partnerships.



**STRATETGY 3.1:** ADVANCE SHARED MOBILITY EQUITY PROGRAMS TARGETING LOW-INCOME, IMMIGRANT, REFUGEE, YOUTH, AND AGING POPULATIONS, WOMEN, LGBTQ PEOPLE, PEOPLE OF COLOR, AND PEOPLE WITH DISABILITIES

Shared mobility services are vital transportation options for people who want to reduce their reliance on privately-owned cars. While car sharing, bike sharing, ridesourcing, microtransit, and other mobility services continue to innovate, grow, and vie for market share, the long-term viability of these business models are not guaranteed. They could go bankrupt, end operations, or deliver services that do not serve the public's interest. We must find ways to manage public risk, while maximizing citizen value.

To manage risk in the mobility landscape, we will leverage the personal mobility, efficiency, and safety aspects of shared mobility services, while preparing for their potential growth or stagnation. Public transportation by rail, bus, and other new service models will continue to be the common denominator of our transportation system. We will assess and manage the risks associated with overreliance on appenabled mobility solutions, ensuring that shared mobility complements, rather than supplants, the person-carrying and livability benefits of our public transit investments.

#### First Moves

Move	Partners	SDOT Role
Conduct a Racial Equity Toolkit for the New Mobility program to ensure shared mobility initiatives promote, rather than roll back, equity	PCD, OSE, DON, OCR, CBO	Implementer, Advocate, Convener
Craft a free-floating bike share policy framework to extract the most benefit out of privately funded bike share systems	FAS, KCM, SPD, MP, TP	Implementer, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Continue citywide service and capital investments in and promotion of public transit as the backbone of the transportation system	KCM, ST, DON, CBO, ME, PSC, WSDOT	Implementer, Advocate, Funder, Thought Leader
Establish and apply a risk assessment scale (from low risk to high risk) to all investment, program, and policy decisions related to new mobility services and technology deployments	KCM, ST	Implementer, Convener
Develop a core set of performance metrics to be applied to all new mobility pilots	KCM, ST, OSE, OED, PCD	Implementer, Convener, Thought Leader
Support Sound Transit 3 programming and implementation and ensure the needs and strengths of new mobility are factored into investments	KCM, ST, CBO, FP	Capacity Builder, Advocate, Convener, Thought Leader

- Consider updating the New Mobility Playbook every 4-6 months to reflect the dynamic nature of the new mobility services industry and rapid changes in technology
- Establish consistent and use case-specific performance metrics for shared mobility pilots
- Continually coordinate and research with shared mobility providers and technology companies to understand risk factors
- Collaborate with the National Association of City Transportation Officials (NACTO) cities to inform SDOT's policy and permitting framework for private free-floating bike share



### **STRATEGY 3.2:** FOSTER A CULTURE OF INNOVATION AND PROFICIENCY IN NEW MOBILITY SOLUTIONS

In our changing mobility landscape, we need to modernize our business practices and change how we manage data, deploy projects, and develop policy. Working with our public and private mobility partners, we will continually strive to understand, anticipate, and leverage changes in the mobility landscape. Shared mobility and other emerging mobility innovations will become a part of our everyday lexicon as we will build in-house capacity to analyze data, generate new ideas, and test their efficacy. We will establish strategic policies to capture the benefits of new technologies and mobility models, while mitigating their unintended consequences. We will operate like a nimble, yet technically rigorous start up, hiring data-driven, collaborative staff, and investing in the analytical tools needed to identify business needs, rapidly prototype solutions, and evaluate their effectiveness.

#### First Moves

Moves	Partners	SDOT Role
Build staff capacity for data analytics, technology investments, pilot delivery, and policy-making	OPI	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Adopt a demonstration policy to enable rapid testing and deployment of innovative transportation solutions	OPI, FP, MP, TP	Implementer
Organize quarterly new mobility webinars for SDOT and other City of Seattle department staff	PCD, OSE, IT, MP, TP, FP, OEM, ME	Advocate, Convener, Thought Leader
Continue working with national and regional peer learning networks like NACTO to strengthen new mobility and emerging technology policies, projects, planning processes, and pilots	RP, FP	Capacity Builder, Advocate, Convener, Thought Leader
Integrate new mobility considerations into modal plans and sub- area plan updates	KCM, ST, CBO	Capacity Builder, Advocate, Convener, Thought Leader
Formalize a rapid prototyping and ideation process driven by data science	ME, RP	Capacity Builder, Thought Leader
Produce an annual New Mobility report card to track Playbook implementation progress and standardize shared mobility metrics reporting	IT, FAS, OSE, KCM, ST, RP, MP	Implementer, Advocate
Develop shared mobility data dashboards to track key performance indicators and system productivity	FAS	Implementer, Advocate

Further Actions	Partners	SDOT Role
Collaborate with regional partners and local technology companies to train staff in data science and visualization and search for opportunities to pool data and expertise across agencies	IT, KCM, ST, RP, FP, ME	Capacity Builder, Convener
Rethink procurement processes to unlock creative mobility solutions and remove barriers to public-private partnership	OPI, FAS, CBO, IP, TP, MP, OEM	Implementer, Funder, Thought Leader
Establish a pipeline for all SDOT staff to suggest and discuss pilot ideas	N/A	Advocate, Convener
Phase in shared mobility options into the City of Seattle employee motor pool	FAS, MP	Implementer, Funder, Capacity Builder

- Leverage the knowledge and experience of local technology companies and start-ups as we pivot toward an open innovation/rapid prototyping model
- Conduct a scan of national and international best practices in municipal data science and their organizational structures
- Strategically allocate Shared Mobility or Mobility Innovation staff time on modal and sub-area plan advisory committees, so that resources are not depleted
- Employ SDOT's Transportation Innovation Leadership Team (TILT) program to research the policies, procedures, Title 20 code changes, scoring metrics, and staff capacity necessary to move to an open procurement model



### **STRATEGY 3.3:** UNDERSTAND THE MOBILITY NEEDS OF THE COMMUNITY

Managing new mobility models requires a thorough understanding of people's needs. The community understands their streets, local intersections, and the services that operate on them. We will facilitate a dialogue with community members and community organizations about shared mobility and other mobility innovations. We will gather information about service gaps, solicit ideas for better neighborhood integration, and identify local impacts and considerations related to new mobility.

#### First Moves

Moves	Partners	SDOT Role
Host community conversations with transportation advocates, social justice-oriented community organizations, and community members to understand broader challenges and opportunities related to new mobility solutions	DON, OSE, CBO, MP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader

#### Further Actions

Further Actions	Partners	SDOT Role
Integrate shared mobility and transportation technology-related questions into City of Seattle surveys to gather more data about customer experience and expectations	N/A	Advocate
Map ongoing issues, preferences, attitudes related to shared mobility by neighborhood	DON, KCM, ST, CBO	Advocate
Develop a paper and web-based survey instrument to establish baseline and ongoing attitudes, preferences, and comprehension levels related to shared mobility	DON, OSE, KCM, ST, CBO	Advocate
Establish a "Find It Fix It"-style reporting mechanism on the New Mobility webpage to identify ride-hailing, microtransit, private shuttle, and car share loading and operational issues	IT	Advocate
Create an online calculator to calculate and compare private car expenses with shared mobility expenses (including public transit)	KCM, ST, PSRC, PSC, FP	Advocate

- Ensure the outreach approach with community-based organizations and community members adheres to the Equity and Environment Agenda principles
- Perform a stakeholder analysis as part of the near-term community consultation strategy to determine the appropriate engagement approach
- Conduct shared mobility trainings with community-specific community liaisons



# **STRATEGY 3.4:** CONTINUOUSLY UPDATE SEATTLEITES ABOUT MOBILITY INNOVATIONS

Marketing and educating about new mobility will be critical to ensure Seattleites understand the changes happening in the transportation sector. By serving as a conduit between new concepts and our residents, this new role transcends our conventional responsibility for community outreach and consultation. This strategy requires testing various types of media to keep people informed and provide a feedback loop on policy, program, and project-related issues.

#### First Moves

None

#### **Further Actions**

Tactics	Partners	SDOT Role
Provide information about shared mobility at community events (e.g., project and planning open houses, farmer's markets, etc.)	DON, OPCD, OSE, CBO, FP	Funder, Advocate, Convener
Use ethnic media to convey benefits and 101-level info about shared mobility	DON, CBO, FP	Advocate
Create a new mobility webpage on the SDOT website featuring data dashboards, reports and policy documents, educational materials, and an events calendar	FAS, DON	Funder, Advocate, Thought Leader
Host an ongoing Mobility Innovations Speaker Series to familiarize the public with new mobility concepts	PCD, MP, IP	Advocate, Convener, Thought Leader
Create marketing partnerships with shared mobility companies	DON, KCM, ST, MP	Advocate
Create an online calculator to compare private car expenses with shared mobility expenses (including public transit)	KCM, ST, PSRC, PSC, FP	Advocate

- Develop targeted outreach and education strategies and materials for immigrant and refugee communities
- Develop promotional and educational collateral about shared mobility to be used during community events
- Work with SDOT data scientists to establish open data dashboards



## **STRATEGY 3.5:** PURSUE NIMBLE REGULATIONS THAT MEET THE PUBLIC GOOD WHILE SPURRING INNOVATION

Seattle continually advances a welcoming regulatory environment for shared mobility operators, dating back to the launch of the country's first car sharing service—FlexCar. Altogether, more than a half-dozen app-enabled car share, ridesourcing, and ridematching companies currently operate in our city. However, current regulatory tools and frameworks are being challenged as disruptive shared mobility services arise and blur the lines between traditionally distinct service models. We will revisit our regulatory approach to ensure innovative mobility services can both thrive and fulfill key policy objectives like equity, accessibility, curb management, and first- and last-mile connections to public transit.

#### First Moves

Moves	Partners	SDOT Role
Establish and continually update a joint set of regulatory principles to guide ongoing regulatory and legislative efforts (see SDOT's regulatory considerations in Appendix D)	OIR, FAS, KCM, KCL	Advocate, Convener, Thought Leader

### **Further Actions**

Further Actions	Partners	SDOT Role
Collaborate with local and statewide partners to develop an umbrella regulatory framework for new mobility services that maintains core local regulatory and management functions	OIR, FAS, KCM, KCL, PSC, MP, CBO	Advocate, Convener, Thought Leader
Track state and federal legislative activities that impact SDOT's ability to manage and embrace shared mobility, data sharing, and other mobility-related technology	OIR, FAS, KCM, KCL	Capacity Builder, Advocate, Convener
Work with King County Metro and King County Records and Licensing Services to develop a regulatory and permitting framework for microtransit services, including fees and service parameters	OIR, FAS, KCM, KCL, MP	Implementer, Convener, Thought Leader
Work with King County Records and Licensing Services and other Puget Sound cities to develop a regional permitting framework for car sharing services	OIR, FAS, KCM, KCL, PSC, MP	Implementer, Convener, Thought Leader

- Maintain a strategic partnership with King County Metro and Records and Licensing Services on all regulatory work, continually revising the joint regulatory principles in response to industry disruption
- Convene focus groups or individual meetings with shared mobility service providers to understand regulatory challenges and opportunities to achieve shared objectives with new regulatory approaches
- Update the Utility and Transportation Commission's Washington Administrative Code to clearly define the role and regulations related to microtransit operations



#### **STRATEGY 3.6:** ESTABLISH NEW TRANSPORTATION FUNDING MECHANISMS IN RESPONSE TO THE CHANGING FINANCING LANDSCAPE

Increasing use of electric and other fuel-efficient vehicles, ridesourcing services, and the coming wave of automated vehicles signals the decline and eventual demise of gas tax, Commercial Parking Tax, and on-street parking revenues (including fines). Political changes at the federal level can also challenge our commonly-held funding assumptions. The changing transportation funding landscape will impact how we pay for the services and infrastructure that keep our citizens moving and jeopardize financing for future transportation capital improvements. The future will revolve around creative revenue and partnership models.

We see this disruptive climate as an opportunity, rather than a threat, as new revenue streams are created. Morgan Stanley's 2016 Autonomous Vehicles & Municipal Bonds report estimates that the revenue models associated with automated vehicles will generate a half trillion dollars for city budgets across the nation. We will advance new funding models like road and curb use pricing, commodifying data as a service, and leveraging innovative partnerships to fund major capital projects.

#### First Moves

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Develop variable fee mechanisms for TNC and car share services that increase vehicle occupancy and manage congested corridors during the peak commute hours	FAS, OPI, KCM, KCL	Implementer, Advocate, Thought Leader
Conduct a funding partner analysis to understand the universe of potential local and regional partners	OED, FP, CBO, KCM, ST	Implementer, Capacity Builder, Convener
Investigate the feasibility, process, and implementation considerations related to congestion pricing (e.g., gantry-less cordon tolling)	OIR, FAS, OPI, OCR, DON, WSDOT, KCM, ST, CBO, FP, TP, IP, RP	Implementer, Funder, Advocate, Convener, Thought Leader
Begin lobbying to enable statewide vehicle miles traveled road use fees	OIR, KCM, ST, WSDOT, CBO	Advocate, Convener, Thought Leader
Develop an equity strategy and low-income eligibility program for congestion pricing and vehicle miles traveled road use fees	OPI, OCR, DON, WSDOT, KCM, ST, CBO, FP, TP, IP, RP	Implementer, Advocate, Convener, Thought Leader
Monetize and commodify real-time data for sale to private roadway users, shared mobility services, and infrastructure providers	IT, FAS, MP, IP, TP, RP	Implementer, Capacity Builder, Thought Leader
Revise the sign code to capitalize on advertising revenue opportunities with digital kiosks and other smartscaping features	OPI, FAS, IT	Implementer, Advocate, Thought Leader
Establish demand-based curb use pricing for fleet services tied to appropriate data sharing and auditing agreements	FAS, OPI, KCM, KCL	Implementer, Advocate, Thought Leader
Monetize the use of City parking facilities for public and private electric fleet vehicle charging	FAS, MP, IP	Implementer, Funder, Capacity Builder, Thought Leader

#### Implementation and Regulatory Considerations

- Consider the use of fee discounts for mobility services that provide detailed historic and real-time data
- Establish a strategic community outreach and public relations campaign to advance pay-as-you-go and congestion charging revenue models
- Obtain authorization from the Washington State Legislature to pursue pay-as-you-go and congestion charging revenue models (toll rates and exemptions will be determined by the Washington State Transportation Commission)



As more people use ridesourcing and ridesplitting services, our \$64 million in annual parking revenue and fines will steadily decline and demand for passenger loading zones will increase.



#### **STRATEGY 3.7:** BUILD STRATEGIC MOBILITY PARTNERSHIPS WITH KING COUNTY METRO, SOUND TRANSIT, AND OTHER PUBLIC AND PRIVATE ENTITIES

We cannot achieve the vision of ubiquitous mobility for all without the contributions, innovation, and buy-in of our diverse regional partners. Disruption in the transportation sector has regional impacts and requires local and regional solutions. We will foster a collaborative ethos with our public and private mobility partners to:

- Exchange ideas and lessons learned on processes, pilots, and policies
- Uncover technology and transit integration opportunities
- Grow the transit market
- Research ongoing problems related to equity and right of way use
- Pursue grant and foundation funding opportunities
- Engage with influential change-makers like Challenge Seattle to help drive policy change and generate momentum on key initiatives

#### **First Moves**

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Work with regional partners to update transportation planning processes and develop analytical tools that reflect the new mobility paradigm	KCM, ST, PSRC, WSDOT, PSC, MP	Advocate, Convener, Thought Leader
Meet regularly with private mobility providers to advance research and pilot, innovative service partnerships	OED, KCM, ST	Implementer, Convener
Convene a regional innovative mobility working group to advance regional shared mobility initiatives, ensure ongoing coordination and partnership, and evaluate new technologies	KCM, ST, PSRC, WSDOT, PSC	Capacity Builder, Advocate, Convener, Thought Leader
Establish a Seattle transportation technology industry mixer with regular meet ups to exchange ideas and build partnerships	KCM, ST, MP, ME, FP	Convener
Connect SDOT's New Mobility Playbook with the work of Challenge Seattle and the University of Washington's various mobility research teams (e.g., Mobility Innovation Center)	FP, RP	Capacity Builder, Convener

- Identify the key policymakers and implementers at local public agencies to engage in the regional innovative mobility working group
- Catalogue mobility-related or supportive companies, services, and apps in the Puget Sound region to keep abreast of partnership and ideation opportunities
- Advance multi-agency data sharing pilots (including the trusted data and Mobility as a Service platforms)
- Use the research capabilities of the University of Washington's research centers (i.e., CoMotion/Mobility Innovations Center and PacTrans) during pilot and rapid prototyping projects



#### **STRATEGY 3.8:** ATTRACT MOBILITY COMPANIES, SERVICES, AND JOBS TO SEATTLE'S BURGEONING MOBILITY INDUSTRY CLUSTER

Successful and economically resilient cities have a common thread: they reinvent themselves and stay relevant by nurturing the growth of new industries. Companies and talent tend to cluster in cities that strategically grow new industry. This cycle of clustering and reinvestment is occurring in Seattle today in the mobility industry. Over the past five years, Seattle has seen an influx in mobility-related companies like ReachNow, Uber, and Lyft, and mobility industry jobs are growing. Homegrown mobility services like Moovn, Motor, and Luum are also injecting new ideas and fresh perspectives on how to deliver and manage mobility in our city. We will continue to nurture our burgeoning mobility industry cluster.

#### First Moves

None

#### Further Actions

Tactics	Partners	SDOT Role
Develop a "pitch book" showcasing our vision for new mobility and innovation as a way to attract talent and companies to Seattle	OED	Implementer, Advocate
Inventory mobility-related or supportive companies, services, and apps located in Seattle, including number of employees, number of patents, and economic influence	OED, MP, IP, TP	Advocate, Convener
Develop a shared and automated mobility workforce development strategy	OED, OCR, OLS, DON, OSE, KCM, ST	Advocate, Convener, Thought Leader
Investigate the feasibility, constraints, and permitting options of a private scooter share system	OPI, KCM, ST, ME, OEM, TP	Implementer, Funder
Leverage the Seattle Office of Economic Development's expertise to conduct a scan of established and emerging transportation technology and OEM companies that are candidates to move to Seattle	OED	Convener
Work with the Seattle Office of Economic Development to lure an automated vehicle technology company or OEM to Seattle	OED, OPI, KCM	Advocate, Convener

- Work with the University of Washington to conduct a scooter share feasibility study
- Use internal marketing and communications resources to promote new services and mobility industry cluster growth



# **STRATEGY 3.9:** ENCOURAGE TRAVEL BEHAVIOR THAT ENSURES SAFE AND EFFICIENT PEOPLE MOVEMENT

Establishing a Mobility as a Service culture requires much more than digital tools and shared mobility services. As service-based transportation solutions continue to enter the Seattle market, we need to modify our approach to transportation demand management (TDM) and broaden our suite of solutions. Our TDM programming must adapt to new data, analytical tools, and frameworks like Mobility as a Service to achieve even greater reductions in single-occupancy vehicle travel.

Building on the successes of our Commute Trip Reduction (CTR) and travel options programs like NavSeattle, we will leverage the behavioral change functions of Mobility as a Service to understand how people make their transportation decisions and nudge people to use the current infrastructure we have in place for walking, biking, transit, and other shared transportation modes. We will partner with shared mobility services and use a variety of incentives and regulatory tools to achieve a future of accessible and affordable mobility options.

#### **First Moves**

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Adopt a citywide TDM ordinance for new development and major renovation projects that includes a menu of shared mobility amenities (including requirements for one-way car share vehicles and dedicated stalls in major residential developments), subsidies, real-time information to tenants and employees, and sensor deployment	PCD, DCI, KCM, DC, MP, ME	Implementer, Capacity Builder, Advocate, Convener, Thought Leader
Promote shared mobility services to CTR- and non-CTR-affected work sites as a complement to public transit and an option for emergency trips home	KCM, ST, FP, MP, ME	Implementer, Capacity Builder, Advocate
Subsidize (or partially subsidize) ridesplitting trips and ridematching for pooled free-floating car share trips through the Mobility as a Service platform	KCM, MP, TP, ME	Implementer, Funder, Convener, Thought Leader
Require transportation management plans and major institution master plans to analyze shared mobility demand and supply needs, promote supporting policies, programs, and capital investments (e.g., shared mobility hubs, loading zones, etc.), and include shared mobility and emerging mobility innovations as mitigating actions to major institution growth	ME, RP	Advocate, Convener, Thought Leader

- Use future TDM ordinances to relax or completely remove parking requirements and encourage low parking construction in areas with parking maximums. This provision would occur in exchange for ongoing non-single occupancy vehicle mobility subsidies and a menu of travel option amenities like passenger loading zones, dedicated car share stalls, digital kiosks and wayfinding, and sensor installation to expand the connected infrastructure network and real-time data analytics platform.
- Leverage Commute Trip Reduction Program to provide incentives through employers
- Collect and analyze data that is generated from MaaS platforms to tailor TDM strategy and programming
- Deploy branded and effective marketing and outreach campaigns to promote shared mobility and increase adoption rates



## PLAY 4

## Build new information and data infrastructure so new services can "plug-and-play"

Our streets flow with a rich stream of data generated by traffic sensors, on-vehicle sensors, and mobile data from ride-hailing, car share, and other services. This flow of data could give us more insight into the emerging travel patterns and the effects of new mobility services on the way people use transportation. But, the flow of data is currently unstructured and our community has concerns about privacy. We will advance solutions that protect publicly identifiable information, while expanding our data infrastructure.

Approaching data not just as information, but also as infrastructure, will help us build a better platform for delivering Mobility as a Service, generating abundant shared mobility options, digital mobility marketplaces, seamless fare payment solutions, incentives and subsidies, and access to real-time mobility data. This data infrastructure will also help us develop clear rules so startups can roll out their prototypes and pilot services in Seattle.



# **STRATETGY 4.1:** ACCESS RELEVANT DATA TO ENSURE THE PUBLIC GOOD IS SERVED

Effective management of a complex transportation network is built on a foundation of accurate and reliable data. Emerging Internet of Things sensor and data flow capabilities will unlock new ways to collect and collaboratively use data. As digitally-enabled mobility services transform how Seattleites travel, they generate tremendous amounts of historical and real-time data. However, we are unable to ascertain, analyze, or plan for these shifts in travel behavior in the absence of cooperative data sharing agreements. This information gap is creating drastic consequences for the transportation system. We must balance concerns over private mobility providers' sensitive business data with the need to make policy and investments informed by the best data available. We will employ a need-based approach to collecting mobility service and sensor data.

#### First Moves

Move	Partners	SDOT Role
Develop a digital data master plan to take stock of our data, establish data sharing standards, and create data handling and privacy standards for the trusted data platform, Mobility as a Service platforms, and connected infrastructure	IT,OPCD, PSRC, KCM, ST, RP, MP, TP, OEM	Implementer, Capacity Builder, Advocate, Convener

#### **Further Actions**

Further Actions	Partners	SDOT Role
Expand our data collection tools including optical sensors, Bluetooth sensors, roadside units, and Array of Things functionality	IT, TP, IP, WSDOT	Implementer, Funder
Establish an open data protocol for shared mobility services and transportation technology, balancing objectives related to citizen-led innovation and private service provider protections	IT, KCM, ST, MP	Implementer, Advocate, Thought Leader
Create a data cube or other multidimensional data matrix to organize and analyze complex new mobility data sets	IT	Implementer, Capacity Builder
Work with digitally-enabled mobility services to leverage telematics to assess roadway infrastructure quality	MP, OEM, RP	Capacity Builder, Convener
Formalize a transportation happiness metric to continually track progress towards making our customers happy	DON, KCM, ST, RP, MP	Capacity Builder, Convener, Thought Leader

- Ensure that data agreements meet the requirements for transportation planning functions, including information by time of day, origin-destination, number of passengers per trip, connecting trip origin-destination, and other elements
- Ensure that data collected by SDOT and mobility providers protect citizen privacy
- Update TNC Ordinance to require more detailed historic and real-time data



#### **STRATEGY 4.2:** FACILITATE TRUSTED DATA FLOWS BETWEEN CONNECTED VEHICLES, SENSOR INFRASTRUCTURE, PERSONAL DEVICES, AND COMMUNITY DIGITAL DEVICES

The future of urban, data-driven mobility depends on government, private mobility companies, and the public having confidence that their data is being used in the way it's intended. Automated vehicles (AVs) will create new real-time data connections between vehicles, infrastructure, connected devices, and third party data repositories. In a future of constant data flows, we will need to separate petabytes of data noise from data that is necessary to manage the right of way.

We are taking a proactive approach to gather, store, and unlock the value of AV-generated data. Data collection, storage, and privacy controls will be central to our work. New sensor systems will continue to collect vital data for City street management. We will establish robust requirements around data security and cybersecurity to ensure individual privacy is maintained and critical systems are secure. We will collaborate with our regional partners to build the capacity needed to store, process, and analyze large data sets. We will also increase our broadband capabilities to ensure data flows in real-time and latency is limited.

Our public transit investments have the most to gain from emerging mobility innovations and Internet of Things data flows. Coupled with our Move Seattle-funded transit speed and reliability corridor investments, real-time data can reduce transit travel times and significantly improve the passenger experience. We will leverage our data and right of way resources to ensure transit is reliable and responsive to customer demands. Real-time routing, vehicle tracking, transit loads, and shared mobility availability will vastly improve how we operate the public right of way, and enhance the consumer experience navigating our transportation network.

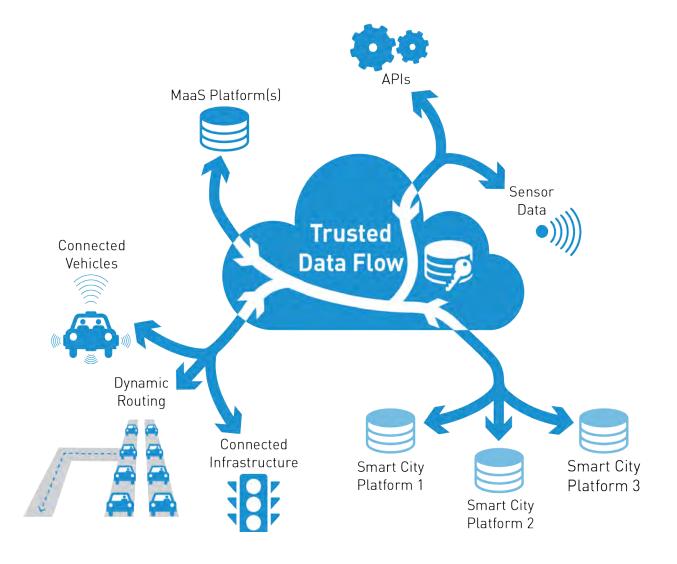
#### First Moves

Move	Partners	SDOT Role
Work with regional and national partners to establish a neutral trusted data platform that houses data from new mobility service providers, sensors, and other data sources, automates data analytics, and enables predictive analytics	IT, KCM, ST, RP, PSRC, WSDOT, PSC, MP, TP, OEM	Implementer, Capacity Builder, Advocate, Convener, Thought Leader
Establish a permit process that allows sensor infrastructure providers to expand the network of sensors at intersections and multiply vehicle-to-infrastructure (V2I) communications citywide	IT, IP, SCL, WSDOT	Implementer, Thought Leader

### **Further Actions**

Further Actions	Partners	SDOT Role
Work with Seattle IT and the University of Washington to establish data handling and privacy standards for all automated vehicles and service models to access the trusted data platform, Mobility as a Service platforms (Strategy 4.4), and connected infrastructure	IT, OEM, PSRC, RP, KCM, ST, MP	Advocate, Convener, Thought Leader
Work with regional partners to share and integrate real- time data feeds, data analytics, and other data sets into the trusted data platform	IT, OEM, PSRC, RP, KCM, ST, MP, IP, TP, ME	Advocate, Convener, Thought Leader
Push parking information into trip planning apps so that people see parking costs and availability before they drive	DC, MP, TP	Advocate, Convener, Thought Leader

- Integrate sensors into smartscaping and other coordinated street furniture elements
- Establish base memoranda of agreements to establish the trusted partnership with the University of Washington's Transportation Data Collaborative
- Determine data sharing standards for the data SDOT collects and requires of mobility services
- Ensure individual privacy is protected through proper encryptions and data privacy and handling policies
- Consider the needs of AV data collection and flow rates as 5G or better broadband implementation is deployed





# **STRATEGY 4.3:** DEVELOP ANALYTICAL TOOLS THAT MODEL THE EVOLVING STATE OF MOBILITY

The impacts and opportunities of shared mobility have yet to be widely incorporated into citywide and regional planning processes. Our planning processes do not currently measure the existing or future market for non-transit shared mobility services, nor do they acknowledge the opportunities and potential pitfalls of automated mobility. State-of-the-art analytical tools are just as important as reliable data sources. We will update our existing transportation planning methods and advance data analytics using inhouse staff, research partners, and the civic tech community.

#### First Moves

None

### **Further Actions**

Further Actions	Partners	SDOT Role
Leverage Bluetooth sensors to understand the level and impact of TNC, taxi, and for-hire vehicle cruising and risky driving behavior	FAS, IT	Thought Leader
Develop a methodology to determine appropriate levels of shared mobility subsidies for different income levels	RP	Capacity Builder, Convener, Thought Leader
Work with local and national research institutions and private foundations to prototype new analytical tools and services	KCM, ST, PSRC, WSDOT, RP	Capacity Builder, Convener, Thought Leader
Partner with King County Metro, University of Washington, and other regional partners to train staff in data analysis and visualization and search for opportunities to pool data and expertise across agencies	KCM, ST, PSRC, WSDOT, RP, ME	Capacity Builder, Convener
Create analytical methods that monitor inequities in shared and other new mobility services	KCM, ST, PSRC, RP	Capacity Builder, Convener, Thought Leader
Develop a shared mobility hub access demand forecasting tool	KCM, ST, PSRC, RP	Convener, Thought Leader
Create ridesourcing and car share loading demand methodologies for Urban Villages and Urban Centers to determine block-level loading supply needs	MP, KCM, RP	Capacity Builder, Convener, Thought Leader
Integrate assumptions related to shared mobility supply and demand into trip generation and passenger loading rates used in traffic impact analyses and development review	PCD, PSRC, WSDOT, RP, ME	Implementer, Thought Leader
Work with PSRC and other local cities to update the base assumptions in the activity-based regional travel demand model to reflect Mobility as a Service and other emerging mobility trends	PCD, KCM, PSRC, WSDOT, RP	Advocate, Convener, Thought Leader

- Adopt a "building blocks" approach for analytical tools that will evolve into a solid foundation for reporting
- Host biannual Hackathon events involving local and national research partners and the civic tech community to develop analytical tools and real-time monitoring dashboards



# **STRATEGY 4.4:** ESTABLISH AN OPEN MARKETPLACE FOR MOBILITY AS A SERVICE

Imagine being able to see all your transportation options for every trip, weigh the time, cost, and environmental tradeoffs of these options side-by-side, and purchase your fare with one app. This is Mobility as a Service (MaaS) and it allows you to purchase mobility services like transit, car sharing, ride-hailing, bike share, and microtransit based on consumer preferences and real-time availability instead of buying the means of transportation. Customers can pay-as-they-go or purchase mobility packages based on their individual or their family's monthly needs. Beyond the basic trip planning function of the platform, MaaS provides seamlessly integrated fare payment across modes and "gamified" incentive programs that nudge people to use high-occupancy modes and travel during offpeak times.

We will partner with various public and private sector partners to create a competitive marketplace for Mobility as a Service retailers to develop mobility aggregation apps. This marketplace could enable endless levels of customization and innovation, while the consumer experience is maximized. Our role is not to own a MaaS platform, but rather to establish the operating parameters and performance metrics that governs a MaaS operator's access to mobility provider APIs, real-time data made available through trusted data collaboratives, subsidies and incentives, and even managed lanes.

#### **First Moves**

Moves	Partners	SDOT Role
Develop a Mobility as a Service platform that enables an open marketplace for mobility aggregation apps to compete and meet customer needs	IT, RP, KCM, ST, MP, TP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader

### **Further Actions**

Tactics	Partners	SDOT Role
Develop a Mobility as a Service concept of operations, including functional requirements, service parameters, and data privacy/handling policies	IT, RP, KCM, ST, MP, TP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader
Develop a Mobility as a Service branding, marketing, and outreach strategy prior to platform launch to ensure the concept is socialized and accepted by the community	DON, CBO	Implementer, Funder, Capacity Builder, Advocate
Help secure seed funding for the base Mobility as a Service platform with public and private partners	KCM, ST, RP, MP, TP, ME, FP	Funder, Advocate, Convener
Tether the base Mobility as a Service platform to the Trusted Data Platform to ensure mobility providers can securely integrate their APIs and customers are routed efficiently with real-time data <sup>2</sup>	IT, RP, KCM, ST, MP, TP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader
Integrate behavioral economics functionality to test incentives like mobility lottery, high-occupant vehicle and off- peak nudges, and rewards programs	RP, KCM, ST, MP, ME, FP	Funder, Advocate, Thought Leader
Ensure interoperability between Mobility as a Service mobility bundle payments and Next Generation ORCA fare payments	KCM, ST, RP, MP	Advocate, Convener, Thought Leader

<sup>2</sup> Data aggregation, participation from all shared mobility providers, and robust data sharing/API integration agreements will be challenging if a trusted data network is not implemented.

#### Implementation and Regulatory Considerations

- Leverage SDOT assets (e.g., curbspace, managed lanes, access to data, etc.) and funding (e.g., subsidies and incentives, etc.) to strengthen Mobility as a Service policy parameters
- Integrate travel costs, travel time, environmental impact, health impact, transfer penalty, and other mode choice tradeoffs into the Mobility as a Service platform's integrated trip planning feature
- Develop a traveler incentive pilot with local retailers to reward low-impact mode choice and off-peak travel
- Develop a menu of digital equity, community education, and outreach solutions to ensure adoption in underserved neighborhoods and immigrant communities
- Envision long-term features with local technology companies that will enhance the customer experience (e.g., augmented reality, machine learning, etc.)
- Use the expertise of local app developers, technology company partners, and the civic technology community to optimize the user interface design of MaaS apps



Image from Seattle Department of Transportation



# **STRATEGY 4.5:** SIMPLIFY AND ENHANCE THE FARE PAYMENT EXPERIENCE

Fare payment systems that are intuitive and function across various shared mobility modes could be an important determinant of reducing drive alone trips in the future. The Puget Sound's One Regional Card for All (ORCA) fare card system is nearing its end of life, providing a unique opportunity for account-based and multimodal fare payments in Seattle. While SDOT is not currently an ORCA Joint Board member, we seek to streamline the fare payment experience when using shared mobility services using your preferred form of fare payment (e.g., tap card, mobile payment, cash, etc.). Ultimately, a customer should be able to seamlessly pay for a trip using a Next Generation ORCA account through the Mobility as a Service platform.

#### **First Moves**

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Collaborate with the current ORCA technology contractor to integrate the current fare card with other shared mobility services and parking management systems	KCM, ST, RP, MP, TP	Advocate, Thought Leader
Consider joining the ORCA Joint Board to provide more direct policy influence	OPI	Advocate, Thought Leader
Work with the ORCA Joint Board to ensure the Next Gen ORCA is designed as an open architecture platform and seamlessly integrates multimodal fares	KCM, ST, MP, TP, MP	Advocate, Thought Leader
Explore options to introduce special fares targeted for shared mobility trips that feed public transit	KCM, ST, MP, TP, MP	Advocate, Thought Leader
Integrate the Next Generation ORCA e-purse into Mobility as a Service platforms	KCM, ST, MP, TP, MP	Advocate, Thought Leader

#### Implementation and Regulatory Considerations

• Work with shared mobility providers to understand the technical needs and challenges of integrating their APIs into Next Gen ORCA



## **STRATEGY 4.6:** UNLOCK NEW OPPORTUNITIES FOR TRIP PLANNING

While our residents enjoy a high rate of access to personal digital devices (roughly 85%), not all Seattleites are willing or able to purchase a smart phone, tablet, or personal computer. As Seattle's menu of transportation options are increasingly more reliant on digital, app-based technology, we need to ensure that all Seattleites can enjoy the benefits of these new mobility services.

We will provide multiple avenues for Seattle residents and visitors to access real-time mobility information and plan trips. Whether your mobile device is out of battery or you do not have access to a phone, we will offer the same customer service as someone with the latest smart phone technology. We will work with the private sector to "smartscape" our public spaces with digital displays and interactive kiosks accessible to all in the community. These digital engagement features will connect people to trip planning tools as well other community applications and information sources. We will also expand access to digital devices in retail shops, community centers and other public institutions.

#### First Moves

Moves	Partners	SDOT Role
Democratize and test technology in the public right of way such as interactive digital kiosks and other information interfaces	PCD, DCI, DC, MP	Implementer, Funder, Advocate, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Provide community accessible tablets for people to access trip planning services, Mobility as a Service, and other community services	IT, KCM, ST, DC, IP, TP	Implementer, Funder, Advocate, Thought Leader
Work with regional transit partners to develop a concierge-trip planning and booking service	KCM, ST, CBO, FP	Advocate, Thought Leader
Ensure MaaS platforms are available to all by integrating into community digital kiosks and tablets displays	IT, KCM, ST, DC, IP, TP	Implementer, Funder, Advocate, Thought Leader

- Develop a phasing strategy to make community digital kiosks and tablets available citywide
- Ensure trip planning tools are translated into multiple languages
- Develop public private partnerships with private infrastructure providers to expand the number of public digital tools available in public spaces



## PLAY 5

#### Anticipate, adapt to, and leverage innovative transportation technologies

In Seattle, we have a long tradition of testing new technology, including the roll out of our mobile parking payment app and pay stations. By establishing a policy framework that anticipates new, potentially disruptive technologies we will harness new mobility to meet our broader community goals. Our vision for automated mobility focuses on shared transportation, connected movement, and clean vehicle technology. We will pursue these technologies to complement our robust investments in transit. We will manage the negative impacts of single-occupant and zero-occupant vehicles. We will also advance innovations in electric mobility and other clean fuels. We will take action to ensure that, by 2030, at least 30 percent of all light duty vehicles registered in Seattle are electric. And, we will collaborate with other cities, experts, and global leaders to exchange successful policy and technological innovations.



#### **STRATEGY 5.1:** ESTABLISH A COMPREHENSIVE SET OF PEOPLE-FIRST POLICY PARAMETERS TO INTRODUCE AND MANAGE FULLY SHARED, ELECTRIC, CONNECTED, AND AUTOMATED VEHICLES

Automated vehicles (AVs) have the potential to dramatically reduce traffic deaths and serious injuries, helping us achieve our Vision Zero safety goals. Shared automated fleets could also strengthen connections to and from public transit, and dramatically reduce the personal costs of mobility. How do we transition to a future with connected and automated vehicles without exacerbating congestion and land use impacts? Our vision for automated mobility focuses on shared, connected, and electric mobility, managing the negative impacts of single-occupant and zero occupant vehicles, while leveraging this tool to feed into our robust transit investments.

Automated mobility in Seattle will be human-centered in its design. Like any other emerging technology, we must shape how automated mobility impacts and benefits our citizens even as the details of the technology are in flux. We will plan for the inevitable emergence of connected and fully automated vehicles with a historical lens. We have a century's worth of experience understanding and managing the impacts of motor vehicles. As automated vehicles arrive in Seattle, we must ask: What do we want our city to look like? To what extent should we use these new technologies to ensure our citizens are included, happier, healthier, safer, and more financially secure?

Our strategy to successfully deploy automated mobility boils down to four elements: Policy Framework, Platforms for Data Flows, Pilot Testing, and Promotion within the community. We will develop and continually update policy parameters that directs us toward a future with fully automated, shared, connected, and electric mobility. But first and foremost, Seattle will be a walkable, bikeable, transitoriented, and innovation-friendly city. Our approach balances innovation with clear expectations for management and operation. We will:

- 1. Continue **prioritizing the needs of people** walking, biking, and taking transit by leveraging the growth of our robust transit network
- 2. Support the **development and testing** of automated mobility technology, learning from the **pilots and partnerships** with local and national technology and operating equipment manufacturers (OEMs)
- 3. Establish clear **policy parameters** that ensure automated vehicles help achieve SDOT's five core values and our shared and emerging mobility principles —not counteract them

### First Moves

Moves	Partners	SDOT Role
Adopt the Automated Mobility Policy Framework as an ordinance and require annual updates to reflect changes within the automated mobility industry <sup>3</sup>	OPI, PCD, OEM, MP, TP	Implementer, Advocate, Thought Leader

## **Further Actions**

Further Actions	Partners	SDOT Role
Integrate automated mobility concepts and policy direction into SDOT's pedestrian, transit, bicycle, and freight master plans	OPI, PCD	Implementer, Capacity Builder, Thought Leader
Develop an automated mobility modal plan to establish Seattle's first functional classification system for automated vehicles and a network of peak period smart lanes dedicated to Level 4 and 5 automated vehicles	OPI, PCD, OEM, MP, TP, FP, ME, CBO, WSDOT	Implementer, Capacity Builder, Convener, Thought Leader
Evaluate signal operations and traffic control warrants under an automated mobility paradigm	WSDOT, FP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader
Develop a Transition to Full Automated Mobility Phasing Plan to seamlessly shift between human-driven vehicles and fully- automated vehicles	OPI, PCD, OEM, MP, TP, FP, ME, CBO, WSDOT	Implementer, Convener, Thought Leader
Update minimum street design standards in Seattle's public ROW improvements manual, Streets Illustrated, to reflect changes in automated vehicle form factors		Implementer, Capacity Builder, Thought Leader

- While the State of Washington does not prohibit the use of automated vehicles with human drivers at the wheel, additional legislation will be needed to further define the rules surrounding licensing, piloting, and use of higher levels of automation
- Develop a lobbying strategy at the state and federal level to ensure that Seattle's policy framework and regulations for automated mobility are not preempted
- Develop an interim AV technology pilot permitting framework
- Study the regulatory needs for aquatic or aerial-based automated vehicles (e.g., delivery drones)

<sup>&</sup>lt;sup>3</sup> See Appendix C for Seattle's Preliminary Automated Mobility Policy Framework.



# **STRATEGY 5.2:** USE PILOTS AND PROMOTIONS TO MANAGE THE TECHNOLOGICAL AND CULTURAL SHIFT TOWARD AUTOMATED TECHNOLOGY

The public perception surrounding automated vehicles is mixed. A recent national survey found that 60% of people surveyed have limited to no understanding about automated vehicles. We are concerned that senior, low-income, and immigrant/refugee populations are unprepared for a world where most if not all vehicles are fully automated. Pilots, education, and public outreach will be critical to ensure the public can shape how automated vehicle roll out onto our streets.

We will develop pilot partnerships with operating equipment manufacturers (OEMs) and technology companies to test this nascent technology in Seattle's complex operating environment for all to observe. We are also committed to understanding and being transparent about the potential positive and negative implications of automated mobility. We will conduct market research, focus groups, and community forums to educate the community about AV technology and gather the community's ideas and concerns. Working with the Office of Economic Development, Office of Labor Standards, the Office of Civil Rights, and the Office of Sustainability and Environment, we will identify and pilot new labor models that could serve as a blueprint for other cities in the State of Washington and across the nation.

#### First Moves

Moves	Partners	SDOT Role
Analyze the labor implications of automated and electric mobility strategies to mitigate job loss, identify new growth areas for people of color, low-income, immigrant, and refugee communities, and pinpoint workforce development and training needs	OPI, DON, OCR, OLS, RP, KCM, ST, CBO, FP	Implementer, Funder, Capacity Builder, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Work with regional partners to pass state legislation or an Executive Order that enables Level 4/5 automated vehicle testing in Washington	OIR, OPI, FAS, KCM, KCL, RP, ST	Advocate, Convener, Thought Leader
Develop partnerships with automated vehicle technology companies and OEMs to begin testing on City streets	OPI, KCM, OEM, MP, TP	Implementer, Funder, Capacity Builder, Convener, Thought Leader
Establish clear outreach milestones, community action triggers, and public communication protocols as part of the Transition to Full Automated Mobility Phasing Plan (see Strategy 5.1)	OPI, DON, OCR, OLS, RP, FP, CBO	Implementer, Capacity Builder, Convener, Thought Leader

- Work with the State of Washington to minimize regulatory barriers to testing Level 4 and 5 automated private vehicles, shared vehicles, and freight that operate on City streets
- Integrate SDOT's Transportation Equity program into automated mobility piloting, community research, public education, and promotional work
- Establish a behavioral economics pilot to understand price elasticities of automated mobility and incentivize shared rides through the Mobility as a Service platform(s)
- Consider delivering the following pilots: Automated first/last-mile and late night service shuttle with public transit partners; SAE Level 4 and 5 automated vehicle and V2I data flow pilots with permitted technology companies and OEMs; and Automated "Final 50 Feet" delivery solution pilots in partnership with the University of Washington's Urban Freight Lab



# **STRATEGY 5.3:** PROMOTE THE SHIFT TOWARD ELECTRIC SHARED MOBILITY SERVICES

Seattle has developed a reputation as one of the nation's leading hubs for electric vehicles (EVs). Thanks to carbon-neutral electricity from Seattle City Light, each gallon of oil that is replaced with electricity equates to a 100% reduction in carbon pollution. According to the Electric Power Research Institute, 4,784 vehicles in Seattle are registered as plug-in EVs, representing roughly 22% of all plug-in EVs in the State of Washington. As of the end of 2015, Seattle ranked 7th of the 50 largest US cities in both highest electric vehicle sales share (2nd highest outside of California) and most extensive public electric charging infrastructure (3rd highest outside of California).

Shared mobility fleet vehicles typically drive many more miles per year than the average vehicle. This necessitates a shift towards electrification to maximize the economic and environmental returns on investment. Shared EVs present an opportunity to reduce emissions and ensure a cleaner and healthier future for the region. As EVs become more affordable, these Further Actions will encourage new electric shared mobility models to emerge and support the rapid adoption of shared electric fleets by car share companies and TNCs.

#### First Moves

Moves	Partners	SDOT Role
Adopt a policy framework and permit program that enables electric vehicle charging in the public right of way	OSE, DCI, SCL, MP, TP, DC, FP	Implementer, Capacity Builder, Advocate, Convener, Thought Leader
Site electric vehicle fast charging infrastructure at shared mobility hubs to facilitate electric shared mobility	OSE, DCI, SCL, ST, KCM, MP, DC, ME	Implementer, Advocate, Convener, Thought Leader

#### **Further Actions**

Further Actions	Partners	SDOT Role
Reduce permit fees for fully electric car share vehicles	OPI, OSE, MP	Implementer
Support free-floating electric bike share with charging infrastructure	OSE, MP, TP, IP, OEM	Implementer, Funder, Convener, Thought Leader
Develop an off-street electric vehicle charging master plan to promote vehicle charging for households without a private driveway	OSE, PCD, DC, ME, FP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader
Allow neighborhood electric vehicles (NEVs) on all streets with a speed limit 25mph or below	OPI, OSE	Implementer, Thought Leader
Revise the zoning code to allow shared EV parking at single-family residential properties (i.e., on private driveways) or at multi-family housing (i.e., within private parking structures)	DCI, PCD, SCL, OSE, MP, DC, ME	Implementer, Advocate, Convener, Thought Leader
Revise the zoning code to require all or a percentage of new parking stalls to be furnished with Level 2 EVSE infrastructure	DCI, PCD, SCL, OSE, MP, DC, ME	Implementer, Advocate, Convener, Thought Leader
Advance the idea of an electric vehicle parking brokerage for neighborhoods	OSE, CBO, FP, MP, DC, ME	Implementer, Advocate, Convener, Thought Leader

Further Actions	Partners	SDOT Role
Reduce the licensing fees for electric TNC vehicles	OPI, FAS, KCM, KCL, MP	Implementer
Provide Wheelchair Accessible Services funding to electrify the WAT fleet	KCM, KCL, FAS, MP, TP	Implementer, Funder, Capacity Builder, Advocate, Convener, Thought Leader
Develop a shared mobility fleet fueling program and business plan at the Seattle Municipal Tower and SeaPark parking structures as a way to encourage electric shared mobility	FAS, SCL, OSE, MP	Implementer, Capacity Builder, Thought Leader

#### Implementation and Regulatory Considerations

- Allowing widespread electric vehicle charging stations in the public right-of-way will require City Council approval and coordination with utility companies
- Permitting neighborhood electric vehicles to operate on City streets will require a City Council adopted ordinance



Image from Ecomento



# **STRATEGY 5.4:** SUPPORT KING COUNTY METRO IN THEIR EFFORT TO ACHIEVE A ZERO-EMISSIONS FLEET BY 2034

The 2015 King County Strategic Climate Action Plan includes goals to double transit ridership by 2040, increase usage percentage of alternative fuels and expansion of transit service through 2020 with no increase in greenhouse gas emissions. Currently, Metro Transit operates one of only five electric trolley systems in the United States and nearly 70% of Metro's fleet is comprised of either all-electric or hybrid-electric vehicles. Considering Metro has one of the largest transit vehicle fleets and the largest public vanpool programs in the nation, transitioning to an electric fleet would not only reduce greenhouse gas emissions within the region, but also influence the worldwide market for electric transit vehicles. We will work with King County Metro to advance their fleet electrification initiatives and provide fleet charging infrastructure.

#### **First Moves**

None

#### **Further Actions**

Further Actions	Partners	SDOT Role
Support and actively coordinate with King County Metro's process to site electric bus and van charging stations on publicly owned or on-street locations	KCM, DCI, SLC, OSE, PSE	Capacity Builder, Convener
Coordinate with King County Metro and utility companies to ensure sufficient power can be provided to meet charging station needs	KCM, DCI, SLC, OSE, PSE	Capacity Builder, Convener
Educate the public on the benefits of an electric fleet and its important role in reducing greenhouse gas emissions	KCM, OSE	Implementer, Funder, Convener
Continue to market and promote the Metro VanPool program in all communities	КСМ	Implementer, Funder, Convener

- Manage technology and manufacturing risks for scaling up electric bus fleet
- Collaborate with King County Mero to test vanpool fueling at the Seattle Municipal Tower and SeaPark parking structures as well as layover charging using DC fast charge infrastructure at select shared mobility hubs
- Support expanded procurement of electric buses
- Partner with King County Metro on vehicle technology grants

Prepared for: Seattle Department of Transportation King County Metro

# APPENDIX B TECHNICAL REPORT

## Sam Schwartz

With Support from: UC Berkeley Transportation Sustainability Research Center CityFi Windels, Marx, Lane & Mittendorf, LLP Interface Studio

## Preface

Quantitatively predicting the future of urban mobility is a very challenging undertaking in any environment. The task is fraught with uncertainties in many areas as trends are influenced by regional growth, shifting demographics, changing technologies, economic conditions, and industry decisions, as well as local, state, and federal policy. Inevitably, predicting the future of urban mobility involves evaluating how those new technologies will interact with travelers in a future urban environment. Yet, despite its challenges, such exercises are necessary to provide what insights can be gained from evaluating what is known today, and conjecturing what will be tomorrow. It is critical for urban regions to anticipate as best as possible the changes that will be imposed upon them through new technologies and emerging mobility systems, while at the same time providing the understanding for those regions to implement sound planning and policy.

This report advances this kind of ambitious effort for the City of Seattle and King County and offers insight as to how shared mobility systems could interface with travelers, enhancing accessibility while also facilitating travel in ways that are potentially more energy efficient. The report provides context and classification to the existing shared mobility landscape, detailing the relative advantages of different modes to the traveling public. One of the key impacts that shared mobility brings is greater mobility without the need for personal vehicle ownership. While the dynamics of vehicle shedding and suppression have been studied in previous research of system users, it is entirely a different problem to assess how such effects may scale to a population for which such services are not yet accessible or still gaining acceptance. A number of key questions arise. What is the maximum potential impact of these systems within a broad and diverse population on vehicle holdings? How does the presence of shared mobility influence mode choice and vehicle miles traveled now and in the future? What is the expected scale of pick-up and drop-off curbside capacity needed to accommodate a region when it is served by circulating shared vehicles? Under what conditions and scale could Transportation Network Company systems serve to cost effectively substitute for under-utilized public transit? These are some of the questions explored using in-depth analysis and modeling through a mix of methods suited to address each question. In support of this effort, researchers at the University of California, Berkeley's Transportation Sustainability Research Center (TSRC) reviewed and commented on the report along with others, providing supportive input and feedback on assumptions, methods, and interpretation of outputs. The results provide a snapshot of impacts and opportunities that are presented by shared mobility, and yield recommendations of near and long-term lessons that can guide decision-making in the future. As with every exercise in predicting the future, some forecasted outcomes may not be manifested. But the report serves as an ambitious start, translating what is known today in shared mobility research and transit planning methods to planning a future of integrated services that both enhance mobility and simultaneously reduce energy consumption in urban transportation.

### **Executive Summary**

This Technical Report summarizes the potential impacts of shared mobility services for Seattle and the broader King County region and policy considerations related to these impacts. This report came about through a combined interest from the City of Seattle Department of Transportation (SDOT), King County, and King County Metro to establish an understanding of emerging shared mobility options and the impacts on the agencies' respective missions, planning policies, and operations. The challenge of this report was to establish new methodologies with existing data sets to understand new models of mobility and translate the outputs into actionable policy direction. The analysis seeks to answer two basic questions: (1) "What could happen?" and (2) "What are the impacts?". Shared mobility and automated mobility will have major impacts on mode choice, access, transit integration, right-of-way, and other transportation-related issues.

In the chapters that follow, shared mobility is defined from the consumer's perspective, in that the term 'shared mobility service' is a catchall for any transportation mode where users pay for a trip rendered or for the temporary use of a vehicle. Shared mobility includes any scenario where vehicles are either shared continuously among multiple users (e.g. buses and trains), or shared among different individual users for personal use over discrete time intervals (e.g. taxis, car share, bike share). It includes fixed-route public transit, vanpool, taxi, and fixed rate services, as well as new mobility services such as ridesourcing (provided by transportation network companies), car sharing (including two-way, one-way, and fractional ownership), bike sharing, microtransit, and private shuttles. While SDOT and King County Metro considers transit and vanpool ride share products, most of the analyses measure the impact of new mobility services. Each analysis indicates data used and implications for each of these shared mobility service types. In addition, the report identifies policies related to each model that could foster Mobility as a Service in the region's future.<sup>1</sup>

#### Building new analytical tools

There is a growing body of shared mobility research covering topics such as public-private partnerships, international best practices, open data standards, mode shift, mobility solutions for aging populations, streamlined fares, emerging technologies, and more. A selection of such research is available in the appendix. The technical exercises in this report build off the vast base of academic work to date to create tools for practitioners in today's quickly evolving mobility landscape.

Sam Schwartz Consulting developed eight analytical exercises to begin to understand various aspects of the impacts of shared mobility. Instead of relying on one or two analyses to provide answers, the process was built on several analyses creating a panoramic snapshot of the impacts of shared mobility today and what could occur in the future. The tools in this report were built in collaboration with SDOT and King County Metro with the intent of providing an initial understanding of how shared mobility can impact the city and region and serving as a first step for future analyses. Most importantly, a diagnosis of how these models will impact policy decisions was included to provide an important step in identifying the issues and opportunities of new and emerging modes.

Several analyses were performed for this study to identify the impacts of shared mobility services on the transportation network in Seattle and King County. The purpose is to take the outputs of those analyses and use them to inform decision-making processes that complement stakeholder values that were identified in a series of workshops. These analytical tools explore various aspects of mobility, such as consumer response, transit provision, and spatial requirements of different modes and are a first step in identifying impacts of shared mobility.

<sup>1</sup> Mobility as a Service (MaaS): A concept that emerged in Scandinavia, it is a mobility model based on commodifying trips and seamlessly facilitating the sale and purchase of trips (from both public and private companies) through a common user interface that integrates all modes available. This concept was popularized by the MaaS Alliance, http://maas-alliance.eu/

#### The opportunity to reduce car ownership

A key focus of these analyses is how shared mobility could reduce car ownership and/or single occupant vehicle (SOV) trips in King County. As mobility options continue to evolve, expand, and mature, many people will have the opportunity to give up their car, or decide to not purchase one in the first place. Prior to the widespread arrival of shared mobility, driving single-occupancy vehicles to get around has been one of the primary choices as many transit connections are limited when traveling outside the city center from suburb to suburb or in off-peak periods. This new reality would be economically liberating due to the average cost of car ownership in King County, at approximately \$12,500 per year by recent estimates.<sup>2</sup>

Shared mobility options, and the technologies that enable them, increase the possibilities for how people can travel. Results estimate that up to 17-22% of existing vehicles in King County could be eliminated if cost was a consumer's only consideration in deciding whether to switch to shared mobility options. This approach estimates an upper bound of vehicle shedding potential as an attempt to predict the potential for a decrease in personally owned vehicles, but does not consider lifestyle choices, convenience, or geographic prevalence of shared mobility options.

Personal vehicles are often used for a small portion of the day, roughly 4-6%, to travel to work, run errands, or go to an activity. Personal vehicles largely sit dormant at night and between travel. When a vehicle is not being operated, it takes up space in parking lots, garages, and streets. Storage of these vehicles is a burden on the available public right-of-way and built form of our cities, which could be used for more productive uses that serve a larger number of people than the vehicle owner.

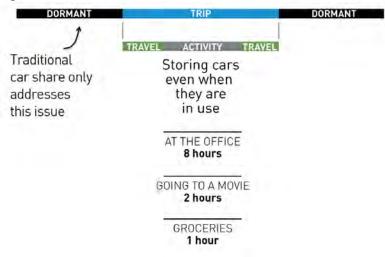


Figure A: Traditional use of a vehicle

Shared mobility services, such as Transportation Network Company (TNC) and car sharing, increase the productivity of privately owned vehicles, giving them the ability to serve multiple users through multiple trips throughout the day and even night. In short, shared mobility services increase the latent capacity and efficient use of vehicles that otherwise would be underutilized and absorb valuable space. A tremendous opportunity exists to reallocate precious urban space as the need to store cars is reduced. An initial analysis using trip generation calculations suggested a relatively small amount of space is needed to serve different land uses and entire neighborhoods when people can access destinations

<sup>2</sup> Balk, Gene. "Second-biggest expense likely out in your driveway." The Seattle Times (Nov 10 2016). Available at: http://www.seattletimes.com/seattle-news/second-biggest-expense-likely-out-in-your-driveway/

without needing to store their vehicles. While the need for parking will always exist, the analysis suggests that some land uses could easily be served by a few pick-up spaces for shared mobility vehicles or taxis.

#### Network benefits of shared mobility options

Shared mobility has already begun to play a significant role in the transportation ecosystem in Seattle and the broader King County region. Several services provide coverage in underserved areas, providing redundancy for public transit, and increase options for "first and last mile" connections. These services have to potential to replace single occupancy vehicle (SOV) trips. This analysis leveraged the Puget Sound Regional Council (PSRC) Travel Demand Model to understand these implications on mode choice and vehicle miles traveled in the year 2030. If vehicle mode share was reduced by 25% or 50% by 2030<sup>3</sup> the demand model suggests that there could be a 10% reduction in SOV peak trips in the region and 45% in Downtown Seattle. Using the same inputs, the region could see an increased transit use of three times the current share, from 2.9% to 11.4%.

These benefits would be provided in a paradigm where high quality fixed-route transit is expanded in the future serving hundreds of thousands of riders. At the same time, the analyses identify a starting place where microtransit or transportation network companies (TNCs) could complement the fixed-route transit network at a lower cost than bus service, especially at off-peak times.<sup>4</sup>

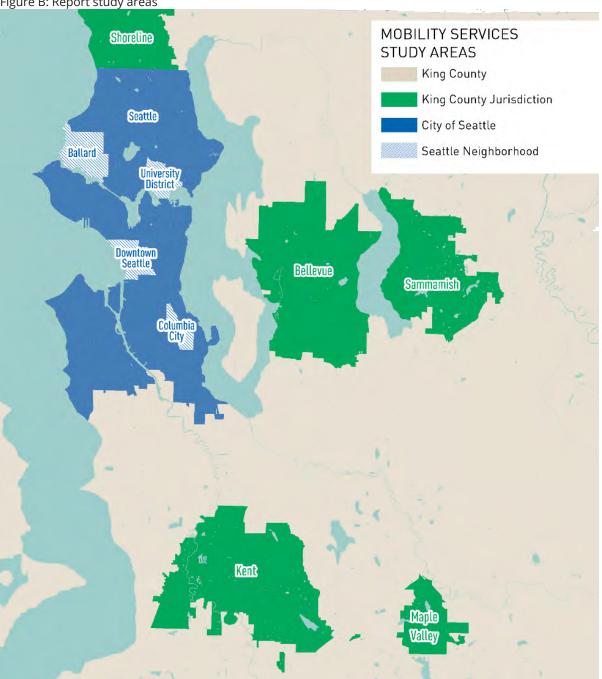
Finally, looking further into the future we discovered the potential to completely change the way people get around. A study in Stockholm<sup>5</sup> identified that shared automated vehicles, operated as a ride-matching network, could accommodate all car commute trips with only 10% of the current vehicle fleet.

The purpose, methodology, results, and policy implications are included in the following eight chapters and appendix. Each analysis is outlined with limitations and suggestions for future use. In addition, select chapters include results for select study areas representing varying urban and suburban typologies in Seattle and King County (see Figure B).

3 These reductions are not suggested policy goals of either SDOT of King County Metro. These figures were used as inputs into the travel demand model to understand the range of mode shift.

<sup>4</sup> This assumes continuation of subsidized transit with the current low cost to user.

<sup>5</sup> Rigole, Pierre-Jean. Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm (2014). Kungliga Tekniska Högskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf



### **Chapter 1: Social Utility Exercise**

#### 1.1 Exercise Logic and Methodology

Social utility describes any service that provides benefit to the majority population in a society. Applied to the mobility landscape, social utility is the ability of various transportation modes to support positive or minimize negative policy outcomes. This planning exercise supports an initial understanding of the potential impacts of shared mobility on factors such as congestion, accessibility, user costs, and space requirements. The exercise is a ranking of the overall social utility of each mode in relation to one another based on informed value judgments. Each mode is ranked on a scale of 1 to 10 based on a set of criteria. Scores of 1 to 4 represent little to no benefit to society, 5 represents a neutral social utility, and 6 to 10 represent a positive effect on social utility.

The criteria used to evaluate the social utility of each mode include:

- Space efficiency when in motion/ congestion
- Accessibility
- Equity
- Vehicle miles traveled (VMT)
- Cost to user
- Parking requirements and land use
- Curb space use
- Potential for car-free lifestyles
- Healthy/active lifestyle related to use of service
- Greenhouse gas (GHG) emissions

The results of this exercise show that each transportation mode has a net social utility based on its impacts on the public realm, the environment, and equity. The social utility exercise was created through analyses of the inherent capabilities of each transportation mode. Criteria such as space efficiency, parking requirements, and curb space help to understand each mode's impact on public space. Considering equity (access to transportation services for people with different economic and social statuses) and accessibility (access to transportation services for people with disabilities) identifies disparities between modes for different users. Many factors are context specific, such as the cost to own, operate, and maintain a single-occupancy vehicle or whether public transit is beneficial to the environment (i.e. if buses have low ridership and are mostly empty). In other cases, the mode may not be currently available in a suburban context, which is noted in the results. To account for issues associated with context specificity, this exercise assumes a relatively dense area in an urban core. Holding transit-oriented land use and urban form constant allows for a comparison among all modes and a base understanding of the function of shared mobility. The rankings may not be unanimously agreed upon by policy makers or members of the public, but is an important starting point for further discussion.

#### 1.2 Results

The model results are based on a scale of 1 to 10 (1 being the lowest, 10 the highest). Social utility by mode is exhibited in two methods below, from the perspective of the social utility indicator (Figure 1.1) and the mode (Figure 1.2). Figures 1.3 through 1.9 provide further definition of the mode and its impact to social utility. The rankings are further exhibited in Table 1.1 on page 12.

Figure 1.1 Mode Scoring by Social Utility Indicator

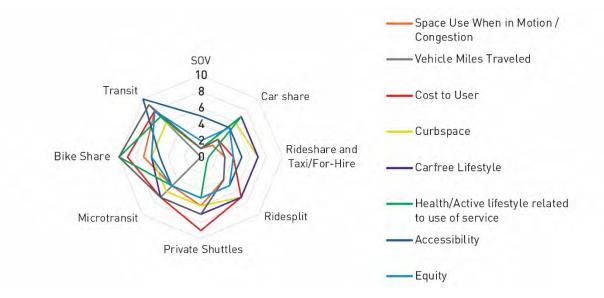
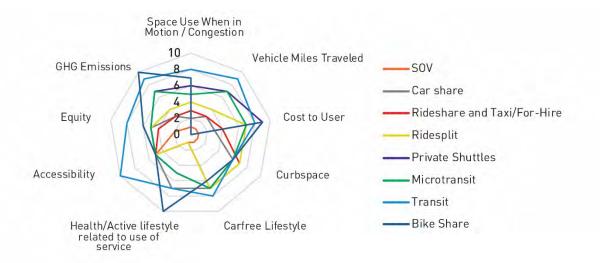


Figure 1.2 Social Utility Indicator Scoring by Mode



#### Figure 1.3 Single- Occupancy Vehicle



Figure 1.4 Car Share



**Single Occupancy Vehicle (SOV)** – Single Occupancy Vehicle describes the mode of travel whereby only the driver uses a private vehicle. SOVs are ubiquitous in transportation networks across all geographies and are the primary mode of travel for many commuters. As compared to other modes, SOVs require the most amount of space per passenger transported than any other travel mode and contributes significantly to vehicle miles traveled, and land use storage requirements (parking spaces, curb space, and parking lots). Owning and operating a private vehicle relative to other travel modes is a large expense, unaffordable to some while a true economic burden to others. The sunk costs of auto ownership often result in higher usage, and when combined with other factors contributes to increased traffic congestion (notably during peak hours) and higher volumes of greenhouse gas emissions. Other negative impacts include poor user health outcomes, which have broader implications for society.

Car share - Car sharing is a membership based rental service offering unlimited access to a network of shared vehicles on a per trip basis. Roundtrip car share and one-way car share are two models present in the region. Roundtrip car share users begin and end their trip at the same location and are charged by the hour, mile, or both. One-way car share users pay by the minute and can begin and end a trip at different locations. Car share has a similar social utility to SOVs, such as space required for parking requirements. As the cost of the vehicle is relegated to each company and spread over many users, it provides a lower cost solution to temporary private vehicle access (cost differs based on service model). The required curb space and capability to provide users with the option to not own a personal vehicle are factors that improve car share's net impact on social utility. One-way car share may more successfully allow for a carfree lifestyle, as user can pair trips with other modes and do not have to pay for the time they are at their destination (i.e. shopping at the grocery store). However, drawbacks to car share include the limited regional distribution of services based on population density and barriers for low-income, un-banked, or disabled residents.

#### Figure 1.5 Rideshare and Taxi/For-Hire



#### Figure 1.6 Ridesplit

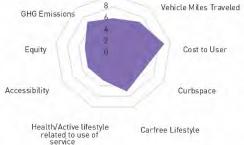


Rideshare and Taxi/For-Hire- Point-to-point service has been offered for over a century with traditional taxi services. These have been effective for key traffic generators (i.e. hotels and airports), and as a dispatch service. Ridesharing services provide a similar service, but utilize mobile applications as the dispatch and can offer greater information sharing with GPS technology. While the trip purpose is very similar (providing point-to-point trips for customers), TNCs such as Uber, Lyft, and Wingz provide services to customers with the use of non-commercial vehicles. Passengers and drivers are connected exclusively through online means, often with mobile applications. Rideshare and taxi vehicles take up the same roadway space as personally owned SOVs and contribute to the region's VMT (potentially more than SOVs because of frequent 'deadheading' when a driver is traveling to pick up a passenger). In addition, queuing of rideshare and taxi vehicles to pick-up or drop-off customers can be an issue during peak periods and events, but takes up a fraction of the space for these activities compared with parked SOVs. Ridesharing provides benefits to the public as a practical last mile connection to public transit options and allow people in some areas to live car-free. Many areas throughout the U.S. have some form of rideshare or taxi service, though they are not always equitable geographically and financially, or accessible to persons with disabilities.

**Ridesplit** – Ridesplit refer to those TNCs that provide ride matching services as part of or in addition to rideshare options. Examples such as uberPOOL and Lyft Line allow customers to split the cost of the fare among other riders at the expense of potentially longer wait and in-vehicle travel times. Like ridesharing, ridesplit vehicles require less curb space due to brief pick-up and drop-offs (as compared to SOVs parking for extended periods), have the potential to reduce congestion, and can increase capacity of the right-of-way. The service area for uberPOOL includes Seattle and some surrounding areas (Kirkland, Redmond, Bellevue, and Renton) and Lyft Line is available in Seattle (from International District to University District including Belltown, South Lake Union, Capitol Hill, and Fremont). Ridesplit services currently operate in large cities with high population density.<sup>6</sup>

6 As of February 2017, UberPool and Lyft Line operate in around 15 U.S. cities: https://www.uber.com/ride/uberpool/ and https://help.lyft.com/hc/en-us/articles/213815178-Lyft-Line-Pricing

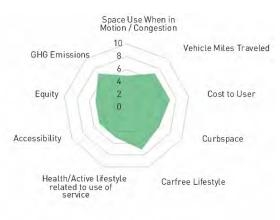




**Private Shuttles** – This mode of transportation typically transports employees between their place of employment and transportation hub connections. Private shuttles, like the Microsoft Connector<sup>7</sup> and the Amazon Ride<sup>8</sup> (among others), typically have zero user costs. Yet, because these systems are generally closed to the broader public, their social utility is limited, by definition. Benefits of private shuttles to the public include higher capacity thereby reducing congestion and allowing those with access to a private shuttle to consider shedding their personal vehicle if there are alternative modes available for discretionary trips. Private shuttle services can be found in areas with employment centers and central business districts.

Microtransit - A new privately-owned and operated transit solution known as microtransit provides both commuter and non-commuter shuttle services to the general public. Similar to TNCs, Microtransit companies such Via, Chariot or Bridj rely on mobile applications to connect users to the service. These services can be designed to pick up users in designated geographic zones along deviated fixed routes, or can be dynamically routed based on demand. Microtransit is beneficial for filling in gaps in the public network, lowers congestion if users switch from personal vehicles, and has a lower transportation cost compared with SOVs and the other transportation modes in this analysis with exception to transit and bike share. Microtransit services that complement public transit should not be redundant with existing routes or services. At the time of writing this technical report, none of these services were available in King County.

#### Figure 1.8 Microtransit

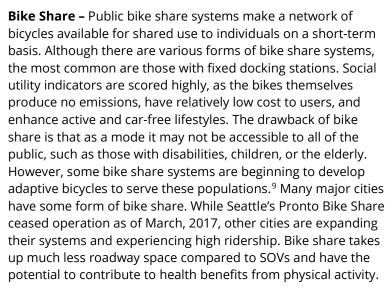


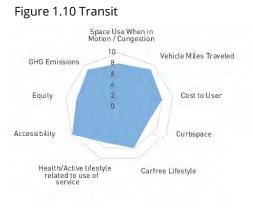
<sup>7</sup> Microsoft Connector information available at:

http://wstc.wa.gov/Meetings/AgendasMinutes/agendas/2010/July13/documents/20100713\_BP8\_MicrosoftConnectorCommuteFactSheet.pd f and https://www.connectorride.com/Account/Login

<sup>8</sup> Amazon Ride information available at: http://www.geekwire.com/2016/amazon-quietly-debuts-commuter-shuttle-program/ and https://amazon.thebus.mobi/#/







**Transit** – Public transit encompasses a variety of modes including buses, streetcars, light rail, commuter rail, shuttles, and ferries. In King County, public transit is provided by Metro Transit and Sound Transit. Transit is typically the mode with the highest accessibility, is widely available, and the most affordable option. Public transit is the only mode required to follow Title VI regulations to ensure equitable service coverage. Buses and trains have the highest capacity (people per square foot) relative to other modes and have positive effects on lessening congestion at peak hours. As a publicly-available mode, users can often live car-free lifestyles where transit service is provided.

According to this assessment, SOVs provide the lowest social utility, whereas public transit and public bike share programs offer the highest social utility. Table 1.1 reflects the social utility that each mode provides, as represented above. It is important to note that no weighting has been identified for each category and the overall ranking will differ based on context.

<sup>9</sup> Adaptive Bicycling Pilot Project. Portland Bureau of Transportation. Available at: https://www.portlandoregon.gov/transportation/article/582518

	TRANSPORTATION MODE							
CRITERIA	SOV Car share		Rideshare and Taxi/For-Hire Ridesplit		Private Shuttles	Microtransit	Bike Share	Transit
Space Use When in Motion / Congestion	1	2	3	4	6	5	7	8
Vehicle Miles Traveled	1	3	3	4	7	7	9	9
Cost to User	1	3	4	7	9	7	9	8
Curbspace	1	6	7	7	6	6	6	6
Carfree Lifestyle	1	7	7	7	7	7	6	8
Health/Active Lifestyle Related to Use of Service	1	7	1	1	5	5	10	7
Accessibility	5	5	5	5	5	5	5	10
Equity	2	5	4	5	5	5	6	8
GHG Emissions	1	3	3	4	7	7	10	9
Social Utility Rating	Low	Medium	Low	Medium	Medium	Medium	High	High
Suburban Applicability	Yes	Limited	Yes	No	Limited	No	Limited	Yes

#### Table 1.1: Social Utility Indicators by Mode

#### Suburban Context Considerations

5

10

1

Population density, employment density, access to a high-frequency transit network, and other factors may limit the suitability of bike share, car share, ridesplit, and microtransit in some suburban contexts. The remaining modes (ridesource, transit, and private shuttles) provide service throughout the region, but at a limited availability compared to the dense urban centers. This is because shared mobility services generally require dense urban conditions to be financially viable enterprises or require subsidies. This may change in the future with the potential introduction of shared automated vehicle fleets where operation costs would be significantly lowered, allowing for expansion in the suburban regions.

For example, bike share and car share often require a large subsidy or have limited availability in areas with low population density where a continuous network is not available. The exception is closed-loop systems that are usually contained on college or corporate campuses. Zipcar has recently launched bike share to complement car share systems on college campuses and could be a model for suburban expansion.<sup>10</sup>

Another consideration for suburban contexts is that rideshare, taxis, and fixed-rate for-hire services may be valued higher in exurban areas because it is the only alternative to driving and the enhancement in mobility has a high value in a mobility-scarce atmosphere. Additionally, rideshare vehicles may not have

<sup>10</sup> Zipcar and Zagster launch Zipbike, the first national, sponsored bike-share program for universities (2016). http://www.zipcar.com/press/releases/zipbike

the negative externalities of congestion in exurban areas that, by their geographic location and lack of trip generators, do not have current congestion issues.

The availability of these services does not necessarily change the social utility, but practical considerations must be made when creating partnerships or sponsoring new services to ensure mobility and policy goals are achieved.

## 1.3 Lessons learned

- The intent of this exercise is to show the relative costs and benefits of shared mobility in relation to SOVs and each other. The quantitative analysis is meant to be a planning exercise to help the user identify the potential social value of different modes for a variety of factors.
- As the ranking of the factors is highly context specific, conducting this exercise in the framework of a high density urban environment provides points for discussion but also introduces limitations. This exercise should be adapted for more specific contexts and unique issues if possible.
- Emphasis or weighting of individual values will impact the relative social utility. For instance, if equity is of high value in an area that does not have congestion issues, then car share and rideshare may score much higher in a similar analysis. This emphasis may be seen as mid-sized metro areas or suburban regions fully embrace shared mobility.
- As some shared mobility models are in their early stages, latent demand realized in the future as services become more widely accessible may affect pricing and cost to users. Social utility must be continuously re-evaluated to account for changes in pricing and demand.
- This analysis is a first step to help socialize the relative costs and benefits of shared mobility options compared with SOV and other modes. Other uses for this analysis beyond this purpose will require additional research.

## 1.4 Policy Implications

- The findings identify that all shared mobility modes have a higher social utility (or public benefit) in comparison to SOV ownership. Transit and bike share provide the highest social utility in relation to the rest of the private shared mobility modes, but have limitations in market capabilities. This further identifies the value of both (1) investing in transit and bike share and (2) continuing to pursue partnerships with shared mobility providers, especially to support high-occupancy modes.
- This exercise can be completed on a smaller scale and incorporate public input when planning shared mobility pilots and making decisions regarding potential partnerships.
- Identifying the social utility of transportation modes allows for a first step in considering how a true Mobility as a Service model could affect social utility. Implementing MaaS may mean balancing positive impacts of one mode (e.g. low GHG emissions of bike share) with negative impacts of others (e.g. VMT of car share). This could be achieved through prioritizing service coverage or offering subsidies for modes with higher net social utility. While true MaaS may not be implementable in the next few years, prioritizing modes with high social utility may begin to manifest in the design of shared mobility hubs.

## **Chapter 2: Economic Model**

## 2.1 Model Logic

The emergence of shared mobility transportation options and an expanding high-quality transit network could result in a reduction in personal vehicle use and ownership in the coming years. The opportunity to reduce vehicle ownership is important in cities for the following reasons:

- 1) Vehicle ownership creates an incentive to drive more to capture the value of their investment
- Reduced vehicle ownership encourages more transportation alternatives, transit, car sharing, active transport, etc.
- *3)* Shifting to transit and other shared mobility options will significantly reduce household transportation costs
- *4)* A decrease in vehicles reduces the need for residential and commercial parking, creating the opportunity to use limited space for a more productive purpose

The Economic Model explores the potential for shared mobility services to replace the need for vehicle ownership. From a purely economic perspective, the initial analysis of the potential for TNCs, such as Uber or Lyft, to reduce vehicle ownership identified significant cohorts within King County and Seattle car owners that would experience an economic benefit from giving up their car and using rideshare or ridesplit (at current market prices) for their travel needs.

The economics of mode choice is one of the foundations of consuming mobility as a service. The Economic Model is based on the idea that ridesharing and ridesplitting can provide a comparable alternative to driving a single-occupancy vehicle in regard to time, customer experience, and direct pick-up/drop-off at an individual's origin or destination (although users further from the urban core may experience longer wait times with less prevalence of such services). In other words, when considering vehicle miles traveled (VMT), car ownership costs, and shared mobility costs, there is a point where it becomes economically rational for consumers to switch to rideshare instead of using their personal vehicle. This model is a first step in estimating potential vehicle shedding (getting rid of a vehicle) but does not explicitly capture potential vehicle suppression (the decision to not buy a vehicle in the first place due to the presence of shared modes).

A limitation of focusing solely on economic rationale is that decisions to travel by personal vehicle or rideshare, which often vary by individual or household type, may not be captured. For example, a household that includes multiple adults and small children might consider convenience and comfort before, or in tandem with, financial decisions. Current shared mobility systems may struggle to serve families with children, regardless of how much those households drive, when factors such as multiple pick-up and drop-offs, carpooling, and car seats are included.

With these limitations in mind, this model helps us to understand the potential for a reduction of personal vehicles, which could result in increased right-of-way capacity (from reduced parking demand or pooling), decreased need for parking space, decreased greenhouse gas emissions, lower consumer costs, and a redundancy in transportation options. In other cases, a reduction in personal vehicles and congestion which frees up roadway space, may "tap into" latent demand of single-occupancy vehicles.

The following modes were utilized as options in the Economic Model:

- Rideshare
- Ridesplit
- Transit
- Car share (one-way model)
- Automated vehicle rideshare
- Automated vehicle ridesplit

Transit is the only subsidized mode while the rest are privately operated. The cost per user differs for each mode and is based on current pricing in the region. While shared automated vehicle services are not yet available, they are included in this analysis to begin to understand their potential impact on private vehicle ownership.

## 2.2 Methodology and Assumptions

As the Economic Model is a purely cost-driven approach, the methodology produces an upper bound of possible vehicles that could be shed. Since personal vehicle ownership is motivated by more than just cost, the definition of market size by purely cost parameters will inherently produce an over estimate of the market size.

The methodology is broken down into five steps:

- 1. Calculate user costs of all modes- personal vehicle, TNC, transit, car share, and TNC automated vehicles.
- 2. Determine per mile user cost of personal vehicle versus TNC, transit, and car share as a function of annual miles driven. In other words, when the vehicle miles traveled (VMT) increases, what happens to the cost of operating and maintaining the vehicle?
- 3. Calculate the total number of vehicles for each geography by vehicle type.
- 4. Determine the total vehicles miles traveled where it would be cheaper for a person to give up their personal vehicle and use shared mobility and/or transit instead.
- 5. Develop scenarios that include different combinations of shared mobility modes to model the potential personal vehicle reduction. A timeframe for vehicle reduction was not included in this analysis.

## Step 1: Calculate annual costs of each mode

**Personal vehicle costs**- Car ownership data from AAA includes the cost of license and registration, fuel, maintenance, tires, insurance, depreciation, and finance for small, medium, and large sedans. The average vehicle costs per mile, along with parking costs and fuel efficiency, are inputs for private vehicle ownership costs.

#### Table 2.1: Personal Vehicle Cost Estimates

Cost Type	Small sedan	Mid-size sedan	Large sedan (SUV or Minivan)
License, registration, taxes (\$/year)	502.00	701.00	838.00
Insurance (\$/year)	1,169.00	1,208.00	1,212.00
Lease payment / depreciation (\$/year)	2,568.00	3,792.00	4,639.00
Financing (\$/year)	481.00	698.00	800.00
Fuel cost (\$/gallon)	2.12	2.12	2.12
Fuel efficiency (MPG)	23.88	22.64	19.38
Maintenance, repair, tires (\$/mile)	0.055	0.066	0.068
Parking (\$/year) <sup>11</sup>	3,528	3,528	3,528

**Rideshare costs**- Rideshare costs were calculated using Uber customer costs in the Seattle area in 2016. Inputs for rideshare include base fare (\$3.30/trip), mileage fee (\$1.37/mile), and a time fee (\$13.20/hour). Surge pricing, an increase in rideshare cost to the user based on time of day or location, was not included in the analysis.

**Ridesplit costs**- The cost of rideshare is discounted by 25 percent for ridesplit services (i.e. UberPool and Lyft Line). Acknowledging that ridesplit cost could vary based on the TNC, costs were calculated using Uber customer costs in the Seattle area in 2016. Inputs for ridesplit include base fare (\$2.48/trip), mileage fee (\$1.03/mile), and a time fee (\$9.90/hour).

#### Table 2.2: SOV and Ridesplit Costs <sup>12</sup>

Rideshare		
Base fare (\$/trip)	3.30	
Mileage fee (\$/mile)	1.37	
Time fee (\$/hour)	13.20	
Ridesplit (25% discount from rideshare)		
Base fare (\$/trip)	2.48	
Mileage fee (\$/mile)	1.03	
Time fee (\$/hour)	9.90	

**Automated rideshare costs**- The cost per mile for automated vehicles was assumed to remain similar to existing rideshare costs, but discounted by 50% to account for the removal of labor costs for driverless cars (see Table 2.2). This assumption is based on a variety of conversations with transportation industry professionals<sup>13</sup>, which range from a 50% - 80% decreased cost of operating a vehicle. Inputs for automated rideshare include base fare (\$1.65/trip), mileage fee (\$.69/mile), and a time fee (\$6.60/hour).

content/uploads/2011/07/globalcolliersparkingratesurvey2011.pdf

<sup>11</sup> Parking costs are estimated available data for parking in the central business district. Source: Collier International, Survey of parking rates in 156 CBD's worldwide. Accessible at: http://www.thetruthaboutcars.com/wp-

<sup>12</sup> Uber July 2016

<sup>13</sup> ITE Annual Conference, 2016. Session: Ready or Not... Self-Driving Vehicles are Coming to a City Near You. Speaker: Wes Guckert.

**Automated ridesplit costs-** Ridesplit costs for automated vehicles are further reduced by 20% from automated rideshare per mile costs. The 20% reduction was utilized (as opposed to 25%), due to the already lowered estimate of base cost of automated rideshare costs. Inputs for automated ridesplit include base fare (\$1.32/trip), mileage fee (\$.55/mile), and a time fee (\$5.28/hour).

Automated rideshare (50% discount from rideshare)				
Base fare (\$/trip)         1.65				
Mileage fee (\$/mile)	0.69			
Time fee (\$/hour)	6.60			
Automated Ridesplit (20% discount from automated rideshare)				
Base fare (\$/trip)	1.32			
Base fare (\$/trip) Mileage fee (\$/mile)	1.32 0.55			

**Transit costs**- The transit fare (\$/trip) for the economic model is \$2.75, which is the median price for a Sound Transit Link light rail trip and for a Metro transit bus ride.

Transit		
	Fare \$/trip	2.75

**Car share costs-** The cost for car share is based on ReachNow's per minute fee of \$0.49.<sup>14</sup> With ReachNow, a one-way car share model, users pay per-minute with mileage and time rate caps for longer trips. Round trip car share companies often charge an annual membership fee in addition to an hourly fee. Only one-way car share pricing was included in this model as the analysis is based on a per trip basis.



#### Step 2: Determine cost of each mode as a function of annual miles driven

Using car ownership, TNC, transit, and car share cost data, the annual cost and cost per mile function for each mode was calculated as miles driven annually increases. Inputs include costs per mile and average number of trips per day<sup>15</sup> and is calculated for a range of 250 to 15,000 VMT per year. The average number of trips per day used in the calculations below (2.6/day) is from the National Household Travel Survey for the Seattle area.<sup>16</sup> As there is no explicit input for trip length in this model, the model assumes those driving a greater number of miles per year are taking longer trips each day.

<sup>14</sup> ReachNow, 2016

<sup>15 2.6</sup> trips per day. Source: National Household Travel Survey

<sup>16</sup> National Household Travel Survey, 2009

Personal vehicle cost per mile calculation:

SOV cost per mile by miles driven per year= (License, registration, taxes + Insurance + depreciation + financing /miles driven per year) + (fuel cost x 1 /fuel efficiency) + maintenance

Rideshare cost per mile calculation:

Rideshare cost per mile by miles driven per year= (Number of trips per day x 365 days per year x rideshare base fare) + (Miles driven per year x rideshare mileage fee) + (Miles driven per year/MPH x rideshare time fee))/miles driven per year

Figures 2.1 and 2.2 below show the annual cost and per mile cost by mode.

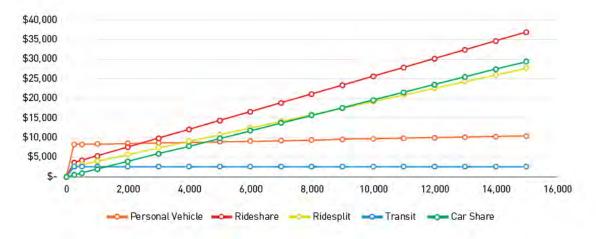


Figure 2.1: Annual Cost by Mode

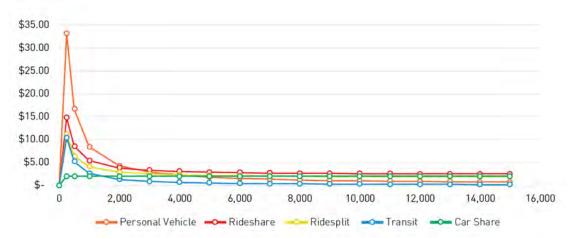


Figure 2.2: Cost per Mile by Mode

#### Step 3: Calculate the total number of vehicles for each geography by vehicle type.

As shown in Table 2.1, the per mile costs for personal vehicles varies by vehicle type. Using U.S. Census American Community Survey 5-year estimates, the total vehicles available for each geography was distributed into small, medium, and large sedans based on a national distribution of the car fleet.

# Step 4: Determine the number of total vehicles miles traveled (VMT) below which it would be cheaper for a person to give up their personal vehicle and use shared mobility and/or transit instead (i.e. the 'breakeven point')

As exhibited in Figure 2.3, a dataset of all registered vehicles in the state of Massachusetts shows the distribution of estimated annual mileage by total number of Vehicle Identification Numbers (VINs).<sup>17</sup> VINs were utilized as the analysis attempts to analyze mode change by vehicle. As data were not available on the number of people who use each vehicle (i.e. a family of four sharing one vehicle), the results are calculated in the potential number of vehicles reduced, not the number of people giving up their vehicles. The model assumes that the VMT distribution is similar in King County since a comparable proportion of land use types and traffic patterns are represented. A local data source is not available with this type of VMT distribution.

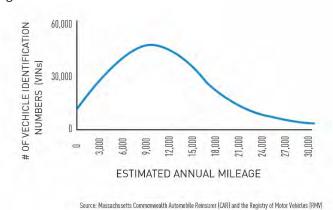
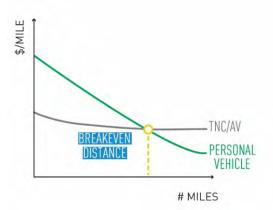


Figure 2.3: Massachusetts Annual VMT

It is assumed that the cost of owning a personal vehicle decreases when the total number of miles driven per year increases. The 'breakeven point' is the point where annual cost by number of miles driven is equal for personal vehicles and TNCs, transit, car share, or shared automated vehicles (see Figure 2.4). Each mode has a different breakeven point and many people may use a combination of modes to replace personal vehicle miles driven. In this analysis, the breakeven point finds the total cost of vehicle ownership below which drivers would switch (i.e. vehicle shedding) to use one or more alternative modes. Those who choose not to buy a vehicle in the first place (i.e. vehicle suppression) are not explicitly captured in this analysis, but the breakeven concept still applies to their travel choices centered around cost.

<sup>17</sup> Massachusetts Commonwealth Automobile (CAR) and the Registry of Motor Vehicles (RMV)

#### Figure 2.4: Breakeven Point schematic



Using this VMT distribution, the model determines the number of vehicles which have been driven the 'breakeven' number of miles or fewer. The model assumes that if a person drives the breakeven number of miles or fewer, they will choose to give up their personal vehicle in favor of a more economical shared mobility or transit option.

## Step 5: Develop scenarios that include different combinations of shared mobility modes to model the potential personal vehicle reduction.

Six scenarios were selected to model a variety of transportation alternatives to personal vehicles, including combinations of rideshare, ridesplit, transit, car share, and rideshare automated vehicles (Table 2.6). Each scenario is from the perspective of the consumer and answers the question, "What is the potential for consumers to give up their personal vehicle based on the economical choice?" For example, if car owners had the option to either drive their personal vehicle or take rideshare (Scenario 1), which would they choose based on cost alone? As earlier noted, the use of an economic rationale accounts for potential vehicles shed, rather than vehicles suppressed.

Scenario	Alternative modes	Example
Scenario 1	Rideshare Only	Instead of using a personal vehicle for every trip, you take an Uber or Lyft
Scenario 2	50% Rideshare, 50% Ridesplit	Rather than driving your own vehicle for every trip, you order an Uber half the time and an UberPool for the rest of your trips
Scenario 3	25% Transit, 50% Rideshare 25% Ridesplit	You give up your car and take a combination of shared mobility services and transit
Scenario 4	25% Transit, 25% Rideshare 25% Ridesplit, 25% Car share	Instead of driving a personal vehicle, you use transit, TNCs, and car share
Scenario 5	Rideshare AV Only	You use a shared fleet of automated vehicles becomes available to the public through the MaaS, CAV, SAV
Scenario 6	50% AV Rideshare, 50% AV Ridesplit	Half the time you use Rideshare AV and the other half you share your AV ridesplit with at least one other person

#### Table 2.6: Economic Model Scenarios

## 2.3 Results

Results indicate that the break-even VMT, or the number of miles driven below which would be cheaper to not own a personal vehicle, vary from 2,400 to 10,000 depending on the scenario and vehicle profile (see Table 2.7 below). For example, in Scenario 1 it would be cheaper for a person who owns an "econobox" car and drives 2,429 miles or less per year to travel using rideshare instead.

Mobility Scenario		Profile A: Econobox Car	Profile B: Mid-Size Cars	Profile C: Large Vehicles (SUV or Minivan)
		Break-Even	Vehicle Miles Traveled	i (VMT)
1.	Rideshare Only	2,429	3,251	3,804
2.	Rideshare and ridesplit	3,822	4,961	5,740
3.	Transit, rideshare, and ridesplit	4,466	4,301	5,248
4.	Transit, rideshare, ridesplit, and car share	4,679	6,014	6,935
5.	AV Rideshare Only	6,688	8,540	9,846
6.	AV Ridesplit Only	7,748	9,864	10,058

Table 2.7: Break-Even VMT by Scenario and Vehicle Profile

Based on the breakeven points of each scenario, approximately 17-27% (see Table 2.8) of existing vehicles in King County could be reduced because it's cheaper for those drivers to choose shared mobility options. In other words, approximately 68,000 vehicles are driven less than the breakeven point calculated for Scenario 1, which amounts to 17% of the total car fleet. The personal vehicle reduction potential could be more than 100,000 vehicles in the City of Seattle and 370,000 in King County (see Table 2.8).

In addition, an Automated Vehicle (AV) shared fleet scenario showed a 31-45% reduction potential in personal vehicles. This is attributed to the potential lower consumer cost as compared to current rideshare costs. With an AV ridesplit scenario, the reduction potential reaches more than 600,000 vehicles in King County and nearly 180,000 in Seattle (see Table 2.9).

Mobility Scenario	Vehicle Reduction Potential
1. Rideshare	16.66%
2. Rideshare and ridesplit	22.71%
3. Transit, rideshare and ridesplit	22.18%
4. Transit, rideshare, ridesplit and car share	27.23%
5. Autonomous vehicle rideshare	31.46%
6. Autonomous vehicle ridesplit	44.77%

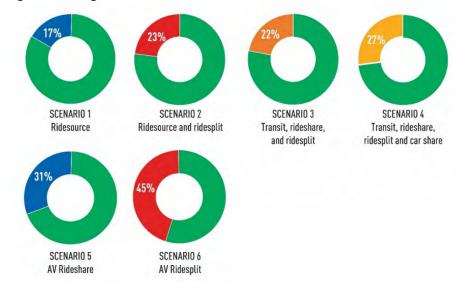


Figure 2.5: Range of Potential Personal Vehicle Reduction (% of total vehicles available)

#### Table 2.9: Potential Vehicle Reduction by Geography

	King County	Seattle	
Total Vehicles	1,366,859	398,477	
Mobility scenario (% reduction)	Potential personal vehicle reduction		
1. Rideshare Only (17%)	227,658	66,368	
2. Rideshare and Ridesplit (23%)	310,365	90,480	
<ol> <li>Transit, Rideshare, and ridesplit (22%)</li> </ol>	303,160	88,380	
4. Transit, Rideshare, ridesplit, and car share (27%)	372,192	108,504	
5. AV Rideshare Only (31%)	429,972	123,528	
6. AV Ridesplit Only (45%)	612,000	179,315	

When applying the potential vehicle reduction to smaller geographies, additional constraints were added as certain areas have a lower prevalence of TNCs than others and would therefore be less likely to give up personal vehicles. Data gathered by the City of Seattle shows the number of TNC pickups from each city zip code for one quarter of 2015. Using this data, the model adjusted to ensure a more conservative vehicle reduction to the neighborhoods of Columbia City and Ballard as there was lower TNC use than in Downtown Seattle and the University District.

As shown in Table 2.10, Downtown Seattle and University District, which both have the most TNC trips, are used as a baseline. An estimated adjustment in vehicle reduction was applied to Ballard (12.5%) and Columbia City (25%) based on the portion of trips as compared to Downtown Seattle.

Table 2 10. Model a	divistments for	Seattle Neighborhoods
Table 2.10. Would a	aujustiments ior	Seattle Neighborhoods

Origin neighborhood	# TNC trips	% of total	Model adjustment	
Downtown	97,025	39.8%	0%	
University District	85,379	35.0%	0%	
Ballard	45,178	18.5%	-12.5%	
Columbia City	16,045	6.6%	-25%	

Note: The number of TNC trips were averaged for zip codes containing each neighborhood

Rideshare data elsewhere in King County is not currently publicly available, so population density from the U.S. Census was used to determine rideshare and SOV use as compared to the City of Seattle. It is assumed that with a lower population density, these areas may remain more auto-dependent as compared to dense urban neighborhoods or there may be a lower availability of rideshare or ridesplit services. A qualitative assessment was utilized for the suburban jurisdictions.

The results for Shoreline, an inner ring suburb, received the lowest adjustment among the suburban jurisdictions (25%) due to the proximity to the CBD and current transit network. At the other end of the spectrum, results for Maple Valley and Sammamish, exurban jurisdictions, were adjusted at an additional 50% based on land-use, proximity to CBD and other job centers and connections to the transit network. Bellevue and Kent received a 30% adjustment, more conservative than Shoreline, and higher compared to exurban jurisdictions due to the relative proximity to the transit network. The model applies an adjustment to vehicle reduction potential for each geography, as show in Table 2.11.

Origin neighborhood	Population density	Model adjustment <sup>18</sup>	
Sammamish	2,693.2	50%	
Shoreline	4,647.4	25%	
Bellevue	4,137.6	30%	
Maple Valley	4,202.6	40%	
Kent	4,283.6	30%	

Table 2.11: Model Adjustments for King County Suburban Jurisdictions

The model adjustments shown in Tables 2.10 and 2.11 were applied to the results. As shown below in Table 2.12, the potential reduction of personal vehicles varies throughout four Seattle neighborhoods and five King County jurisdictions based on total vehicles.

Table 2.12: Potential persona	l vehicle reduction by scenario
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	Area	Ballard	U- District	Colum bia City	Downtown Seattle	Sammamish	Shoreline	Bellevue	Maple Valley	Kent
To	tal Vehicles	15,613	10,125	7,915	29,358	33,927	37,811	89,942	17,079	76,395
	obility enario		~ 	- -	Potential pe	rsonal vehicle	reduction	^		
ad <u></u> for	lditional justment r each pology	-12.5%	None	-25%	None	-50%	-25%	-30%	-40%	-30%
1.	Rideshare Only (17%)	2,275	1,686	989	4,890	2,825	4,723	10,486	1,707	8,907
2.	-	3,102	2,299	1,348	6,666	3,852	6,439	14,296	2,327	12,143
3.	Transit, Rideshare, and ridesplit (22%)	3,030	2,246	1,317	6,511	3,762	6,290	13,964	2,273	11,861
4.	Transit, Rideshare, ridesplit, and car share (27%)	3,720	2,757	1,616	7,994	4,619	7,722	17,144	2,790	14,562
5.	AV Rideshare Only (31%)	4,297	3,185	1,867	9,235	5,336	8,921	19,805	3,224	16,822
6.	AV Ridesplit Only (45%)	6,117	4,533	2,658	13,145	7,595	12,697	28,190	4,588	23,944

These results show the number of personal vehicles that could be reduced in each Seattle neighborhood or suburban jurisdiction. As expected, the most dramatic reduction in personally-owned vehicles is in the Seattle neighborhoods. Key highlights include:

- Downtown Seattle would see nearly 8,000 SOVs (over a quarter of current vehicles) taken off the road in Scenario 4, which combines transit with shared mobility options.
- A decrease of 3,720 vehicles in Ballard, an area less than three square miles, could have major implications for available right-of-way and a shift in land uses for the City neighborhood.
- Even with conservative reduction adjustments in suburban jurisdictions, there is great potential to see a shift from privately owned vehicles to rideshare, ridesplit, transit, car share, and automated vehicles. Kent and Bellevue, suburbs with high vehicle ownership, could experience around 15,000 less SOVs (over 18%).
- When considering the larger geographic areas, King County and Seattle would experience a vehicle reduction over 370,000 and 108,000 (or 27%), respectively.

## 2.4 Lessons learned

- The results of this analysis indicate upper bounds of potential vehicle reduction given that lifestyle factors may make ownership necessary for some households, particularly in the suburbs.
- This model was created by compiling available data, and as such, limitations include using nonlocal datasets such as the Massachusetts VMT information. Due to available datasets from the U.S. Census, the potential reduction in total vehicles was performed using the count of vehicles available in each geography. Converting vehicles to people could be performed in the future, but data for this conversion was not available.
- The model, by design, only includes an economic rationale without consideration of lifestyle factors which vary by individual and household. Households with children cannot easily use carsharing or ridesharing in ways that wholly replace personal vehicles, and therefore VMT may not be the main impetus for mode choice.
- Additional factors, such as travel time, were not included in the analysis as the data sets were too limited to adequately assess the impacts. This stated, there is an assumption that rideshare travel time and customer experience would be similar to driving for many of the trip types.
- The model is limited by the inability to adequately include surge pricing. Surge pricing may impact the economic competitiveness of ridesplitting.
- The results assume the present population as fixed. However, population growth and the potential expansion of shared mobility may impact the number of total vehicles in each area.
- The model does not include a timeframe for vehicle reduction. People may decide to shift to a car-free lifestyle when opportunities such as at the end of a car lease present themselves. The model shows the trade-off from an economic perspective which will result as major purchasing or life decisions are made by individual car-owners
- Induced demand of shared modes could change the cost of these services and needs to be considered if utilizing this analysis in the future.

## 2.5 Policy Implications

- The reduction in vehicles and mode shift will have implications for personal parking reduction, parking requirement for new development, and street parking supply. These implications will be even more apparent after the implementation of ST3, Metro Connects, and Move Seattle.
- Vehicle ownership reduction in the range of 17 to 27% will have dramatic impacts on both onstreet and off-street parking requirements. With regard to on-street parking, the potential to add transit-only lanes, cycling infrastructure, and pedestrian improvements is expected to appear as the parking demand is diminished. A full analysis of parking demand reduction is also identified in Chapter 5 of this report.
- Integrating shared mobility with transit could escalate vehicle shedding up to 27%. A true Mobility as a Service (MaaS) network, currently being adopted in Northern Europe and the United Arab Emirates, provides a potential benefit of an additional vehicle reduction. This would increase as future transit improvements (ST3 and Metro Connects) are implemented in the region.
- The potential reduction in household transportation costs through the use of transit and ridesplit services could impact the distribution of equity in the region. Currently ridesplit services such as UberPool and Lyft Line are available throughout many areas of Seattle and King County. However, demographics such as population density may impact the use of ridesplit services in

different geographies. Policies to balance the availability of these lower-cost services should be pursued to provide additional low-cost options to areas that would see the greatest economic benefit.

• Suburban jurisdictions with high vehicle ownership (i.e. Kent and Bellevue) should consider partnerships with TNCs to provide a regional last-mile solution where gaps in transit service exist or certain demographics may be attracted to a transit-to-ridesource trip as opposed to a two-seat transit trip.

## 3.1 Model Logic

Travel demand models calculate the expected demand for transportation facilities by modeling population and employment data as well as roadway and transit networks to estimate daily travel patterns in a region or city. Travel-demand models allow for planners and policy makers to understand what the transportation network (i.e. capacity, traffic flows) will look like in the future with population and employment change, transportation infrastructure or service improvements, or the introduction of new modes.

The **Puget Sound Regional Council (PSRC) Travel Demand Model** was recalibrated for this report to understand the upper bounds of shared mobility's effects on mode choice and vehicle miles traveled. As shared mobility modes were not included in PSRC's most recent travel demand model, this exercise sought to integrate shared mobility data with PSRC's four-step travel demand model to more accurately determine the future of mobility within the region.

The project team collaborated with and provided input to PSRC to perform over twenty model runs, the results of which are introduced in this chapter. The model iterations intended to produce results that showed potential impacts to travel behavior that new shared mobility and imminent automated vehicles will have on the region. However, the results in early runs were problematic as the travel demand model was re-assigning very few trips to new shared mobility modes. This was because at the time of the survey, TNCs were not yet a mobility option and were therefore not reflected in the results of the survey. This stated, the solution included utilizing the results of the economic model (see Chapter 2) as inputs in the travel demand model. The model was run in scenarios where 25% and 50% of people shifted behavior and gave up their cars. These inputs were modeled for the 2030 horizon year matched with price-point options for TNCs and resulted in a major shift in mode choice.

A reduction of auto-ownership of 25% and 50% were used as inputs for the model runs and are not policy goals of SDOT or Metro. These numbers were reflective of staff input, the range of outputs from the economic model in Chapter 2, and identify a dramatic shift in current mode share. These are inputs to identify potential transportation impacts if there were to be a dramatic shift to shared mobility services and automated vehicles. These percentage reductions should not be interpreted as mode shift goals. A full breakdown of this process and results are described in the following section.

## 3.2 Methodology and Assumptions

According to PSRC, "For every household in the region, the model estimates how many trips are made each day, where they go, what time of day they travel, which modes they use, and which routes they follow. The relationships that are estimated for the base year are combined with future population, employment, and transportation infrastructure growth assumptions to produce future travel forecasts. The future travel forecasts are then analyzed to inform regional transportation studies and plans."<sup>19</sup>

The travel model was built from the Puget Sound Household Travel Survey conducted in 2006 and adjusted with 2014 survey data. Working with the City of Seattle, PSRC sampled 6,000 households in the region on travel behavior. The surveys, along with traffic counts, transit boarding, and Census data, were considered to determine current travel behavior in a holistic model for the Seattle Region. This model can measure impacts of transportation improvements and provide outputs such as VMT, changes in mode share, and other metrics that inform decision-making for potential transportation improvements.

<sup>19</sup> PSRC. Trip Based Travel Model. Available at: http://www.psrc.org/data/models/trip-based-travel-model/

#### **Background Assumptions**

For this analysis, the model assumed a forecast year of 2030. For the network assumptions, it assumed the buildout of ST3 and Metro Connects<sup>20</sup> as well as the region's Transportation 2040 Long Range Plan. The 2030 Land Use is based on PSRC's Land Use Vision data product.

There are four primary components as part of the four-step modeling process<sup>21</sup>:

**Trip generation:** The trip generation models estimate the number of trips produced and attracted to each of the Traffic Analysis Zones (TAZs) in the model system. A TAZ is a geographic boundary used to assess transportation patterns in transportation planning models. There are approximately 4,000 TAZs in the Seattle Region based upon homogeneous land uses, connections to transportation infrastructure, and other demographic factors. The trips produced are estimated from households and their socioeconomic characteristics. The trips attracted are estimated from employment categorized by type.

**Trip distribution:** The trip distribution models estimate the number of trips from each TAZ to each other TAZ. This is performed by gravity models that utilize transportation costs, travel time, and other factors to determine the travel between TAZs.

*Mode choice:* Productions and attractions of the trip generation model are linked in trip distribution, creating zone-to-zone person-trip movements. These trips are then apportioned to the available travel modes through the application of the mode choice model.

**Trip assignment:** The trip assignment model estimates the volume on each link in the transportation system for both highway and transit modes. In addition, the trip assignment model generates specific performance measures, such as the congested speed or travel time on a highway link or the boardings and alightings on a transit route. Trip assignment is performed separately for each mode (auto and transit) and time period (am peak, midday, pm peak, evening, and night).

With rapidly changing transportation options it can prove difficult to accurately reflect true travel behavior. In 2006, car share was in its beginning stages and shared mobility had a very small presence overall. In order to include shared mobility in the PSRC model, the model used an approach to include the cost of shared mobility as well as transit and single-occupancy vehicles.

21 Text from PSRC Travel Model Documentation Final Report (2007) and Puget Sound 4K Model Version 4.0.3 (2015). Available at http://www.psrc.org/assets/1511/model\_doc\_final\_.pdf and

http://www.psrc.org/assets/12593/4kModelDocumentation4.0.3.pdf

<sup>20</sup> Sound Transit 3 will add 62 miles of new light rail for a total of 116 miles serving 3.7 million future residents of the Seattle Region. Metro Connects will increase Metro service by 70 percent, thereby introducing an additional 2.5 million new service hours to Metro service by 2040.

## Step 1: Calculate travel demand between each TAZ (traffic analysis zone)

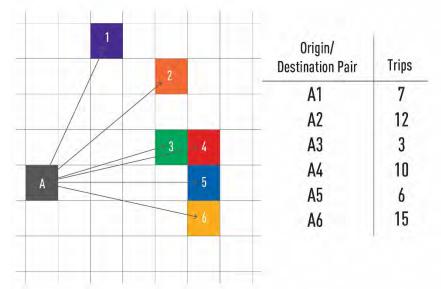


Figure 3.1: Travel demand

The PSRC model calculated travel demand between each traffic analysis zone, including the total number of trips for each origin and destination pair.

#### Step 2: Calculate total cost ("disutility") by mode

Total cost is a combination of factors which varies by mode. A wide range of cost variables are incorporated into total costs, an example of which is shown below:

#### Total Cost\_sov = $\beta$ (driving time) + $\beta$ (fuel cost) + $\beta$ (parking price)

Total Cost\_TRANSIT =  $\beta$ (waiting time) +  $\beta$ (in-vehicle time) +  $\beta$ (fare)

" $\beta$ " is a parameter calculated by PSRC that modifies the impact each variable has on the total cost For TNC, TNC pool, and Microtransit, we estimated  $\beta$  based on current shared mobility costs.

#### Step 3: Estimate mode share

The mode share is calculated as:

*Mode Share\_sov* = *Total Cost\_sov* ÷ *sum of total cost of all other modes* 

## Step 4: Calibrate $\beta$ parameters using magnitude of shared mobility data and updated 2014 results

Using the magnitude of shared mobility trips per quarter gleaned from SDOT's TNC data, initial outputs of the model were calibrated to reflect realistic figures.

These calibration runs were tested on PSRC's 2014 model, which included updates to the 2006 model. However, when the model was initially run to determine future mode share with shared mobility included, the resulting outputs were found to be less sensitive than was expected to changes in the input parameters. Since the PSRC model uses a car ownership sub-model based on 2006 survey data, there is an over-reliance on personal vehicle use. The model revealed that auto ownership was completely tied to demographics and that certain household income levels always returned high auto ownership levels. Although zero-car households were once an indicator of socio-economic status, it is no longer an absolute indicator, as people now voluntarily decide to sell their vehicle or not buy one in the first place for reasons other than cost alone.

To overcome this bias, the model was run with two personal vehicle reduction inputs:

- 1. 25% personal vehicle reduction in 2030
- 2. 50% personal vehicle reduction in 2030

In this model, personal vehicle reduction is not a goal or result, but rather an input from the results of the economic model (Chapter 2). Challenges that stem from this approach include that mode share outputs may be overestimated for 2030 if a high rate of vehicle reduction does not occur. However, using these inputs, the model was found to be more sensitive to changes and other variables, which included Sound Transit 3 (the regional transit expansion plan) and Metro Connects (Metro's long-range transit plan). Both have the potential to be influential factors that change the mode share of auto ownership and shared mobility.

Observations in the City of Seattle reveal the share of transit and shared mobility has been increasing due to a reduction in HOV and SOV share but also from an increase in the share of walking and biking. As our regional and urban centers grow and our active transportation networks continue to expand, the biking and walking mode share is predicted to grow. To account for the predicted increase in biking and walking mode share, the model was post-processed to retain both walk and bike trips and eliminate any transit-walk bias that is often not reflected in regional travel demand models. Two main findings resulted from multiple model iterations. First, the model found that the 2014 bike and walk mode share was being undercounted, which was consequently resolved by making post-process adjustments to raise the 2014 share as well as increase it in the 2030 scenarios. The second involved keeping non-motorized mode share at the same level for each 2030 scenario. The presence of shared mobility does not indicate that bike mode share would decrease. Adjustments were made based on observations from the household survey at the regional level and applied to all geographies.

#### **Commute Seattle Center City Mode Split Survey**

Separate from the travel survey conducted by PSRC, Commute Seattle, a not-for-profit Transportation Management Association (TMA), conducts a survey every two years to understand how commuters travel downtown.<sup>22</sup> The study surveys commuters traveling to worksites located in Seattle's Center City to measure mode share in the morning peak hours. The study combines 2016 mode-split study with data from Washington State Department of Transportation's (WSDOT's) survey of employees at larger Seattle Center City businesses affected by the State of Washington's Commute Trip Reduction (CTR) Efficiency Act.

This Commute Seattle Center City Survey is not representative of the entire City of Seattle or King County because it is biased towards downtown Seattle and morning commuters. As a result, transit, walk, and bike mode split in the Commute Seattle Survey is higher than the PSRC results. The Commute Seattle survey should be considered in conjunction with PSRC results, but cannot be calibrated in this exercise.

## 3.3 Results

Key results of the model included the following:

• With a 25% reduction of personal vehicle ownership, the City of Seattle could see 85,000 less SOV trips each day, a 4.4% decrease from 2014 daily trips. King County (including Seattle) could experience 220,000 less daily SOV trips and 350,000 less trips in the Region overall.

<sup>22 2016</sup> Center City Commuter Mode Split Survey. Available at: https://commuteseattle.com/wp-content/uploads/2017/02/2016-Mode-Split-Report-FINAL.pdf

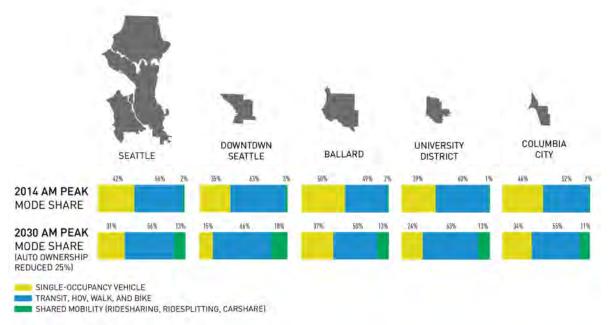
- With a 50% reduction of personal vehicles, the model results indicate 240,000 less daily SOV trips. Similarly, King County (including Seattle) could see 870,000 less trips with SOV trips potentially reduced by 420,000 in the entire Region.
- Results indicate that shared mobility mode share could increase from 1% of all trips in the Region (2014) to 10-13% of daily trips.
- The model also predicts in increase in transit mode share. While transit is currently 3% of regional daily trips, a 25% and 50% reduction in personal vehicles could see 7% and 11% daily transit mode shares, respectively.
- The model suggests that in 2030, there will be 3% to 4% more transit trips in the AM peak as compared to the PM peak.
- The results suggest an increase in transit and shared mobility at the same time, suggesting shared mobility will not necessarily decrease transit mode share or even compete with fixed-route transit service.

Daily Mode Share	2014 Regional Daily Mode Shares	2030 Regional Daily Mode Shares: Auto Ownership reduced 25%	2030 Regional Daily Mode Shares: Auto Ownership reduced 50%		
Daily Trips	15,489,742	19,818,490	19,818,490		
Trips by personal vehicle	86%	72%	65%		
trips by personal vehicle: SOV	44%	36%	32%		
trips by personal vehicle: HOV	43%	36%	33%		
% trips by transit	3%	7%	11%		
% trips by walk and bike	10%	11%	11%		
% trips by shared mobility	1%	10%	13%		

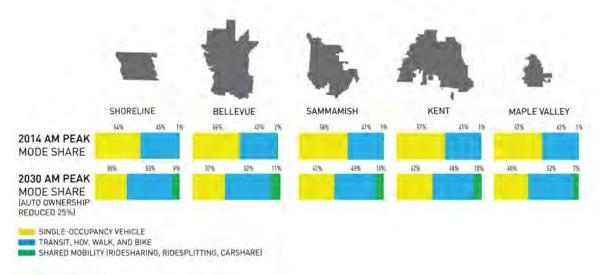
#### Table 3.1: Regional Mode Share: 2014 to 2030

The results are exhibited below in Figure 3.2 and 3.3 the study areas with addition information available in the typology appendix.

#### Figure 3.2 Seattle typology results







## 3.4 Lessons Learned

• Planners and academics are beginning to model shared modes into travel demand models and other analyses.<sup>23</sup> Limitations exist, as in this analysis, where shared mobility is not included in the travel-demand survey or as a coefficient along with other modes. Our expectations were always that the PSRC Travel Demand Model would be utilized to supplement findings from the other models that were created in this project (as opposed to being utilized for decision-making on its own).

<sup>23</sup> Ciari, F., Balac, M., Axhausen, K. W. Modeling carsharing with the agent-based simulation MATSim: state of the art, applications and future developments, accepted for publication in Transportation Research Record, 2016.

- A reduction of auto-ownership of 25% and 50% were used as baselines for the model runs. These percentage reductions should not be interpreted as mode shift goals for the City or the County. These numbers were reflective of the range of outputs from the economic model in Chapter 2. This is an academic exercise and therefore, these percentage reductions should not be interpreted as mode shift goals.
- The Travel Demand Model (and every Travel Demand Model) is most useful in identifying impacts and trends on a regional basis. The model is not as useful in predictions on a neighborhood scale. Our team was aware of these limitations up front and understood this is a starting point for analyzing impacts on a smaller scale.
- The Travel Demand Model is limited in assessing changing attitudes related to the value of car ownership. The survey results utilized in the model were conducted in 2006; at a time where shared mobility options were not included in the survey or in operation in the Seattle Region. This stated, producing useful results for this exercise was not feasible without changing the inputs to the model and reducing auto ownership. Additional data is needed from subsequent surveys taken in the future to analyze these future trends and questions related to shared mobility usage are imperative. A 2017 travel survey is currently underway and the PSRC model will be updated with this information.
- The Commute Seattle survey results can be used in conjunction with PSRC survey results to understand Seattle Center City mode split and how it may vary if Mobility as a Service is integrated into Seattle's transportation system.
- The activity-based model, currently in development by PSRC, would provide more accurate and sophisticated results. Activity- based models more accurately replicate traveler decisions than travel demand models, as they predict how people plan and schedule their daily travel.<sup>24</sup> SDOT and King County Metro should work with PSRC to utilize this model for future modeling activities of this kind. The intent of utilizing the Travel Demand Model was to identify trends and broad-level results. As behaviors and conditions continue to change, receiving and updating information in the activity based model with survey data gathered every two years as opposed to six to eight years is vital for tool accuracy.

## 3.5 Policy Implications

- Results of this analysis can be utilized for decision-making related to integrating shared mobility into the transportation system, optimizing the public right-of-way, and making shared mobility equitable to all. All geographic regions in King County will experience major impacts on parking demand, mode share, transit ridership, and decreased vehicle ownership.
- This would allow for major overhauls in right-of-way design, transit deployment, and an explosion in shared mobility options. These significant changes would also impact demand for street parking and private parking and would help achieve mode share goals set by the Commute Trip Reduction Program and local cities.
- For smaller neighborhoods and suburban jurisdictions, the changes would also be significant, allowing for more pedestrian space in residential districts and commercial nodes.
- An increase of shared mobility, transit, walking, and biking mode shares should be planned for with integrated shared mobility hubs throughout the study areas to further increase accessibility and use of these transportation options.
- Induced demand of shared mobility could affect mode share in 2030, which may not be reflected in the model's results.

<sup>24</sup> Transportation Research Board (2015). Activity-Based Travel Demand Models. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2\_C46.pdf

• While SOV trips are modeled to decrease by 2030, the number of miles driven by shared mobility vehicles should be considered when creating transportation policies, potentially by encouraging high-occupancy microtransit or ridesplitting.

## Chapter 4: Right-of-Way Capacity and HOVe Model

## 4.1 Model Logic

Transit is by far the most effective tool to increase the people throughput capacity of a given roadway. However, new transit service and infrastructure is not feasible in all locations and can't serve all origindestination pairs. Carpooling has shown great promise to potentially reduce congestion and increase people throughput. However, the goal to match drivers and riders at a large scale has never been achieved. Ridesplit trips have the potential to significantly increase the average occupancy of vehicles on King County's roadways. One method to measure the occupancy of vehicles on a roadway is by calculating high-occupancy vehicle efficiency (HOVe). The higher the HOVe, the more efficient the people throughput of a street is. In other words, an increase in HOVe means cities can move more people with less vehicles, which could result in decreased congestion and pollution levels.

The Capacity Analysis first looks at the people throughput implications of different levels of transit service on a typical two lane Seattle street. The output of the model shows how HOVe, or number of people per vehicle, increases by adding high-occupancy vehicle (HOV) shared mobility options, HOV lanes and/or transit only lanes, and increasing bus frequency.

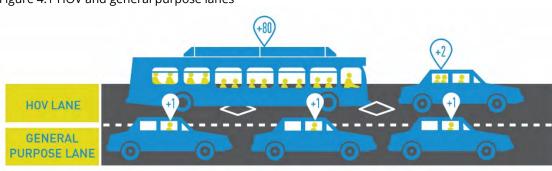


Figure 4.1 HOV and general purpose lanes

Icons created by Matt Berggren from the Noun Project

## 4.2 Methodology and Assumptions

Inputs of the model include varying levels of bus frequency, passengers per bus, cars per lane, people per single-occupancy vehicle (SOV) or rideshare vehicle/taxi, and total people throughput.

Input	Value
Bus frequency	Every 1 to 20 minutes
Passengers per bus	80 people
Cars per lane per hour	800 cars
People per SOV	1.2 people

Table 4.1: Model Inputs and Assumptions<sup>25</sup>

<sup>25</sup> Inputs for each mode are based on assumptions and/or estimates and can be altered to model different vehicle capacities.

People per rideshare vehicle or taxi/for-hire	2 people
People per microtransit vehicle	15 people

The Capacity Model makes assumptions about the number of people traveling in each vehicle type, all of which can be manipulated to understand how a change in occupancy increases or decreases HOVe. The level of transit service ranges from 1 minute to 20 minute headways and the model assumes a capacity of 80 people per 60-foot bus. In the King County region, personally owned vehicles carry 1.2 passengers on average per the PSRC regional model. The model assumes that the typical lane carries 800 cars per hour at full capacity. For rideshare or taxi, it assumes 2 people per vehicle (in addition to the driver) and 15 people per microtransit vehicle.

#### Step 1: Establish different mode split and dedicated lane scenarios

The model uses four different roadway scenarios to determine HOVe under different transit and ridesplit constraints:

Scenario	Description
SCENARIO 1	Two general purpose lanes
SCENARIO 2	One general purpose lane + one transit-only lane
SCENARIO 3	One general purpose lane + one transit and ridesplit only lane (HOV3)
SCENARIO 4	One general purpose lane + one transit and microtransit only lane (HOV10)

#### Table 4.2: Description of scenarios

#### Step 2: Calculate number of people per vehicle in general purpose lanes

HOVe is the *number of people per vehicle per hour* traveling on a street, so the main inputs are the occupancy of each vehicle type.

People in buses = buses per hour x people per bus

- + People in single-occupancy vehicles = vehicles per lane per hour x people per vehicle
- + People in rideshare vehicles = vehicles per lane per hour x people per vehicle
- = total people traveling on roadway

## Step 3: Calculate number of people per vehicle in transit and rideshare dedicated lanes

In Scenario 1, single-occupancy vehicles and buses travel in two general purpose lanes, which means there are 800 vehicles per lane (1,600 total) with buses. This scenario also explores how HOVe changes when 25% of SOVs are replaced with higher occupancy taxi or ridesplit vehicles. Scenarios 2 through 4 examine how HOVe changes with lanes dedicated to high occupancy vehicles. In Scenario 2, SOVs and ridesplit vehicles only travel in one lane (800 cars total) and buses run at various headways in their own lane free from car traffic.

Scenario 3 introduces ridesplit vehicles into the dedicated lane. In this situation, the model accounts for the space each vehicle type takes up in the lane to ensure buses are not slowed by other vehicles and retain a high level of service. It assumes that each bus takes up 60-feet, each rideshare vehicle uses 20-

feet, and each microtransit vehicle uses 35-feet. For example, if there are 6 buses per hour occupying 360 feet, the number of rideshare vehicles must decrease from 800 vehicles per lane to allow a high-level of transit service.

## 800 vehicles per lane per hour - (Number of buses x 60 feet)/ (Space used by each vehicle)

= total ridesplit vehicles that can use the bus lane and maintain a high level of service

## Step 4: Calculate HOVe

To find the HOVe for each scenario, the total number of people traveling in single-occupancy vehicles, transit, rideshare vehicles and microtransit is divided by the total number of vehicles.



## 4.3 Results

The following results show the HOVe of a two-lane roadway for each scenario and all inputs.

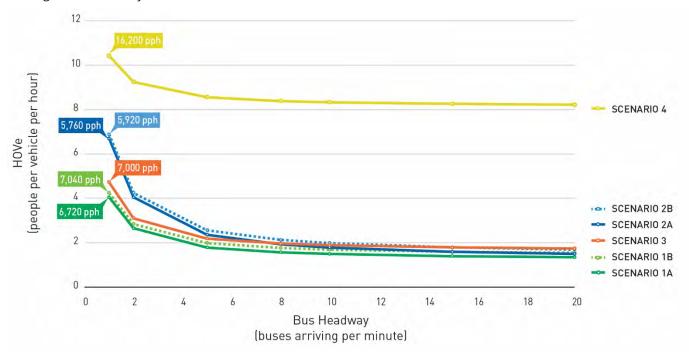


Figure 4.2: HOVe by Scenario

In scenario 1, a roadway with two general purpose lanes with single-occupancy vehicles and buses can reach an HOVe of 4.05 people with a frequency of one bus per minute. HOVe decreases to less than 2 people per vehicle when bus headways are every five minutes or more. When replacing 25% of single-occupancy vehicles with ridesplit in Scenario 1B, HOVe can reach 4.25 people per vehicle. In this scenario, the increases in HOVe with ridesplit are minimal because while there are 320 more people per hour traveling on the road, there are the same number of cars.

In scenario 2, a bus only lane with only SOVs only in the second lane can produce an HOVe of 6.7 with bus headways every minute. Replacing 25% of SOVs with ridesplit can increase HOVe to almost 77 people per vehicle (Scenario 2B). As with the previous scenario, there are marginal gains in HOVe when replacing 25% of SOVs with ridesplit. When bus headways are every 10 minutes or greater, the use of a bus-only lane will not increase HOVe beyond 2 people per vehicle. In this case, the bus lane will be unoccupied for most of the time and an inefficient use of roadway.

A comparison of scenarios 3 and 4 shows the potential of dedicated HOV lanes to have an effect on HOVe. In scenario 3, ridesplit vehicles and buses share one dedicated lane. With one minute bus headways, this allows for more than 7,000 people to travel through the corridor in one hour in 60 buses and 1,420 vehicles. However, this scenario allows for more cars (both SOV and ridesplit) than scenarios 1 and 2, and therefore HOVe is lower at similar headways.

Scenario 4 shows the greatest potential to move more people efficiently through a corridor. With 1 minute bus headways and microtransit vehicles at full capacity, vehicles carry more than 16,000 people and HOVe reaches more than 10 people per vehicle. With this many people in high capacity vehicles, HOVe changes minimally as bus service becomes less frequent.

## 4.4 Lessons Learned

- This is intended to be a theoretical exercise. Additional details are needed to perform this analysis on corridor-specific projects. Considerations for traffic, varied bus capacity, pick-up/drop-off implications, capacity of street with protected bike lanes, and other infrastructure and operational issues will need to be investigated prior to any specific recommendations are made.
- This analysis does not set a cap on total demand in the corridor. Instead, it shows the potential for higher HOVe if the demand existed to fill buses at 1, 2, or 5 minute headways or enough ridesplit vehicles to warrant a separated lane. The change in optimization to reach these levels of HOVe may not be possible on roadways without the demand to fill buses at such frequent headways.
- Induced demand of shared mobility should be considered in future analyses, especially in the context of HOV lanes. If the supply of shared mobility vehicles increases, lanes reserved for transit and ridesplit vehicles could experience congestion.
- Delays specific to pick-up/drop-off activity were not included in the model and would vary depending on roadway facilities and land use types with varying levels of peak demands. There is a possibility that pick-up/drop-off activity could decrease person throughput if it contributes to congestion. A more detailed analysis including delays and issues associated with queuing is required when assessing HOVe and future re-designation of the roadway.
- Variables for automated vehicles, including potential for reduction in vehicle size, potential vehicle-chaining, and other efficiencies that would increase HOVe were not included in this analysis. Other variables for automated vehicles, including potential decrease throughput at intersections, that would decrease HOVe were also not included in this analysis. The choice not to include these potential impacts was due to the lack of significant testing at the network-level and unavailability of necessary data. It is recommended that these inputs are included when such data is available.

- This analysis did not consider TNC deadheading, which occurs when a driver is traveling to pick up a passenger or driving around waiting for a ride request. If deadheading were incorporated in future analyses, it could more accurately reflect the people throughput of a corridor.
- This analysis could be utilized in conjunction with the capacity model to create high capacity corridors in places where current street parking spaces may no longer be required.

## 4.5 Policy Implications

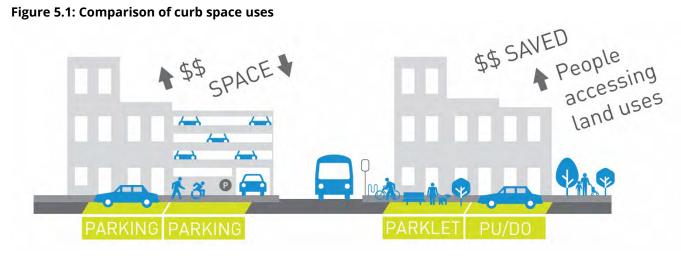
- Assessing HOVe of specific corridors or corridor typologies could be a useful method to help implement aspects of the Transit Master Plan, Metro Connects, RapidRide Expansion, and Move Seattle. As exhibited by this analysis, the power of transit to move the masses will not be replaced by shared mobility options on congested corridors, and transit should therefore continue to be the top priority for increasing mobility and equitable access.
- Further study regarding utilization of transit-only lanes to include ridesplitting and microtransit outside of the CBD should be pursued. The analysis shows that HOV shared mobility options can be utilized to supplement the optimization power of transit, providing an HOVe of 19.8 when combined with microtransit (scenario 4). This speaks to the excess capacity on a dedicated bus lane, similar to the way many HOV highway lanes are implemented to increase people throughput. Further analysis is required to identify operational, enforcement, and pick-up and drop-off issues.
- While the efficiency of vehicle capacity may be a desired policy, a capacity maximizing policy in environments in which buses cannot meet the travel demand may be destructive to capacity and likely wasteful in fuel, emissions, and cost. Policies to increase HOVe of a roadway must be based on current and predicted demand.
- Corridors suitable for higher HOVe could be prioritized as locations to implement shared mobility hubs to work towards MaaS.
- HOVe could be used for policy goal setting at a multitude of different levels, including blocklevel, roadway-section level, neighborhood-level, city-level, and region-wide. The HOVe could be utilized as a tool for future goal-setting, just as carbon emissions goal-setting is prevalent throughout the world in identifying benchmarks for climate goals.
- HOVe will differ depending on roadway type as it depends on the number of vehicles per hour, types of vehicles, and number of lanes. A highway with four lanes, no buses, and predominantly SOVs would have a lower HOVe than a local road with frequent bus service.

## **Chapter 5: Spatial Drop-Off Model**

## 5.1 Model Logic

To plan for a transition from excessive space dedicated to parking to more pick-up and drop-off spaces for rideshare and ridesplit vehicles and taxis, we need to consider: **built form** (on- and off-street parking supply) and **activity pattern** (intensity of arrival and departure demand). Parking is a costly and an inefficient use of space, especially in urban settings. Being driven (or driverless transport) takes less space than a parking-based transportation model since we are only accommodating the interstitial activity of getting in and out of the vehicle at the destination - not storing the vehicle itself for the duration of the activity at the destination. Rideshare or automated vehicles do, however, use roadway space when traveling to pick up a passenger or when waiting for a ride request (e.g. deadheading). Nonetheless, whereas drop-off activity is measured in tens of seconds, parking turnover is typically measured in hours.

The Spatial Drop-Off model was used to analyze the pick-up and drop-off space needed for different land uses depending on the number of trips occurring during the peak period. This model does not suggest replacing the entire parking supply with pick-up/drop-off areas, as there will always be some need for parking. Rather, it acts as a tool for determining curb space demand depending on the land use. The outputs of this model are an estimated total number of pick-up and drop-off for different urban and suburban typologies. Parking supply for each land use is provided for a point of comparison, but is not an input for this model, as determining parking demand and trip demand are not synonymous methodologies.



#### Figure 5.1: Comparison of curb space uses

## 5.2 Methodology and Assumptions

## Step 1: Determine number of trips per hour for each land use

Using the Institute of Transportation Engineers (ITE) Trip Generation Manual<sup>26</sup>, the number of peak trips per hour was determined for a variety of land uses, including residential, office, commercial, and institutional. ITE trip generation rates are determined by observations and studies, many of which are carried out in suburban environments. Each land use type generates a different number of trips per hour, based on factors such as square footage or number of units.

<sup>26</sup> Institute of Transportation Engineers (ITE). Trip Generation Manual, 9th Edition (2012).

For example, in the morning peak period, a coffee shop generates around 65 trips per hour while an elementary school generates 520 trips. Some land uses see a sharp peak in trips at a certain time of day while others have more constant trip arrival. The trip generation rate informs the number of pick-up and drop-off spaces needed for each land use. This analysis assumes that the number of trips generated by each land use are filled by ridesource or rideshare vehicles. While this concept does not match current estimates of shared mobility mode share, it serves as a methodology to understand the space needed to accommodate shared mobility in the future.

## Step 2: Calculate average pick-up and drop-off time

Using an assumption of 45 seconds per pick-up/drop-off<sup>27</sup>, a peak hour loading zone requirement was determined for each typology.

1 hour / 45 seconds (time needed for each pick-up or drop-off)

= 80 pick-up drop offs per space

#### Step 3: Estimate the number of pick-up and drop-off spaces needed for each land u

Trip generation rates used in the model are based on an average morning peak-hour trip rate per 1,000 square feet or number of units, in the case of apartment buildings and hotels. To find the activity level (peak trips per hour), the square footage is divided by 1,000 and multiplied by the ITE trip rate.

#### Activity level = (Square footage/ 1,000) x ITE trip rate

To calculate the pick-up/drop-off spaces needed for each land use, the activity level is divided by 80.

#### Pick-up/drop off spaces needed = Activity level/80

Example: Single Family Home

2,500 square feet/ 1,000= 2.5 2.5 x .77 = 1.93 1.93/80 = .024 Rounded to 1 pick-up drop-off space per single-family home

The main assumption for this model is there is a constant rate of arrival for peak trips. It assumes that the 45 second pick-up and drop-offs are occurring in succession throughout the hour and therefore does not account for potential queuing as a result of many arrivals or departures occurring at the same time.

For this model, all land uses were assigned an average square footage, which realistically differ depending on urban and suburban typologies.

#### Step 4: Estimate parking supply for comparison

The parking supply for each land use provides a point of comparison for the estimated pick-up and dropoff spaces needed for each land use. For example, a medical office may have more than 200 spaces, but with only 40 trips arrivals per hour, could be accommodated by far fewer curbside pick-up and drop-off areas. While this model does not suggest replacing 100% of the parking supply with 100% shared mobility

<sup>27</sup> This input is based on observed pick-up and drop-off times for shared mobility services. It can be made more conservative to accommodate different land uses or urban forms.

space, understanding the maximum space needed provides context to the pick-up and drop-off space estimates.

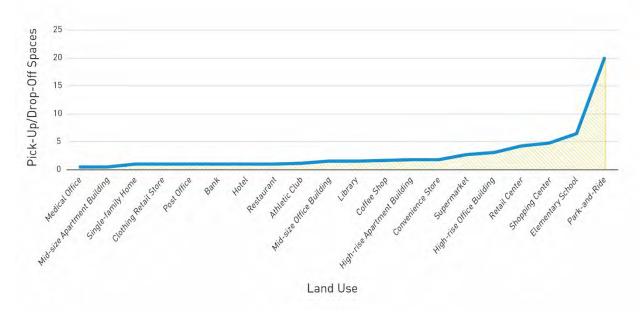
The parking supply ratio is estimated by applying the average peak period parking demand ratio specified in the ITE Parking Generation Manual, Volume 4<sup>28</sup> and the square footage (or unit) associated with each land use. Similar to trip generation rates, the average peak period demand ratio is derived from surveys completed in a variety of urban and suburban locations that may not reflect the unique travel/parking demand patterns in the Seattle Region.

The per unit ITE average peak period parking demand ratio is multiplied by the number of units or square footage (per 1,000) to calculate the average parking supply of each land use.

Per unit parking supply ratio/units or 1,000 sqft = Average parking supply

## 5.3 Results

Table 5.1 shows the morning peak-hour trip generation rate, resulting activity level, and pick-up/drop off spaces needed per hour. The number of spaces is rounded in the last column to account for results which are less than 1 space. The parking supply is provided for a point of comparison. Figure 5.1 exhibits the range of spaces needed for typical land uses found in an urban/suburban area.



#### Figure 5.2: Pick-up and drop-off space required for each land use

<sup>28</sup> Institute of Transportation Engineers (ITE). Parking Generation Manual (4th Edition), 2010. Available at: http://www.ite.org/tripgeneration/parking.asp

Land Use	Sq. Feet	Units	ITE Trip generation <sup>ss</sup>	Activity Level (peak trips/hour)	Pick-up/drop-of spaces needed per hour	Pick-up/drop off spaces needed per hour (rounded up)	Average Peak Period Parking Supply
Single family home	2,500		0.77	1.93	0.02	1	2
Mid-size apartment building	80,000	120	0.35	42	0.53	1	168
Clothing retail store	2,000		3.83	7.66	0.1	1	26
Post Office	4,500		2.71	12.2	0.15	1	149
Medical Office	50,000		0.8	40	0.5	1	200
Bank	4,500		2.63	11.84	0.15	1	38
Hotel <sup>29</sup>	80,000	100	0.53	53	0.66	1	130
Convenience store	2,000		73.1	146.2	1.83	2	11
High-rise apartment building <sup>₃0</sup>	160,000	420	0.34	142.8	1.79	2	840
Mid-size office building	80,000		1.56	124.8	1.56	2	160
High turnover (sit-down) restaurant	6,000		13.53	81.18	1.01	2	86
Coffee shop	2,000		64.21	128.42	1.61	2	37
Athletic Club	30,000		3.19	95.7	1.2	2	117
Library	30,000		4.17	125.1	1.56	2	105
Supermarket	30,000		7.07	212.1	2.65	3	174
High-Rise Office Building	160,000		1.56	249.6	3.12	4	320
Retail Center	50,000		6.84	342	4.28	5	250
Shopping Center	400,000		0.96	384	4.8	5	2,200
Elementary School	100,000		5.2	520	6.5	7	100
Football stadium <sup>31</sup>	1,500,000		46.5	69,750	871.88	872	1,600
Park-and-ride <sup>32</sup>	250,000 (mainly parking)		6.4	1,600	20	20	

## Table 5.1: Inputs used to calculate pick-up and drop-off spaces for each land use

<sup>29</sup> Average per 1,000 Sq. Ft. GFA, AM Peak30 The ITE manual provides trip generation rates per apartment unit31 The ITE manual does not provide trip generation for these specific land uses32 The ITE manual does not provide trip generation for these specific land uses

Assuming a constant rate of arrival of trips and parking demand, many land uses only require 1 to 3 pickup/drop-off spaces in the morning peak period. A large shopping center, prevalent in suburban jurisdictions, sees around 380 arrivals in the peak period, which could be accommodated by only five curbside spaces. In comparison, shopping centers often provide 2,000 or more parking spaces. Office buildings with around 250 arrivals in the peak period, which typically require approximately 300 parking spaces, could be accommodated by around 4 pick-up and drop-off spaces.

As the ITE manual only provides trip generation rates for certain land uses, a supplementary analysis looked at two specific parking facilities in Seattle and estimated the necessary loading zone space to accommodate the same level of throughput. The parking facilities are the Seattle Municipal Tower parking structure and the Eastgate Park and Ride facility. Assuming a constant rate of arrival for peak trips, the loading zone requirement was calculated for both structures. Initial estimates predict a requirement of around 6 loading zone spaces for the Seattle Municipal Tower and around 20 loading zone spaces for the Eastgate Park and Ride facility analysis used a slightly different methodology than the land use typologies mentioned above. As the ITE trip generation manual does not have specific estimates for trip generation at park and ride facilities, the project team used the total number of parking spaces as a proxy for demand. The estimated 20 loading spaces are the requirement for accommodating all the equivalent 1,600 trips that terminate at the parking facility within one hour. Again, this analysis assumes that all trips arrive at a constant rate during the peak hour.

## 5.4 Results by Geography

The results shown in Table 5.1 were applied to three geographies to understand how curb space could be allocated in downtown areas, urban neighborhoods, and suburbs. This exercise uses the primary use of the parcel<sup>33</sup> to determine the pick-up and drop-off spaces needed. For example, if a high-rise apartment building in downtown Seattle also has restaurants and retail on the first floor, the pick-up and drop-off rate is calculated using the trip generation rate for the apartment building, which is its primary designation.

The numbers on the map represent the estimated curb space requirements for all the land uses on each street if trips were accommodated by rideshare, ridesplit, or taxis. These results provide a basic understanding of curb space requirements where there is a mix of residential, commercial, and office uses.

<sup>33</sup> Parcel use defined by the King County GIS parcel dataset. Available at: http://www5.kingcounty.gov/gisdataportal/

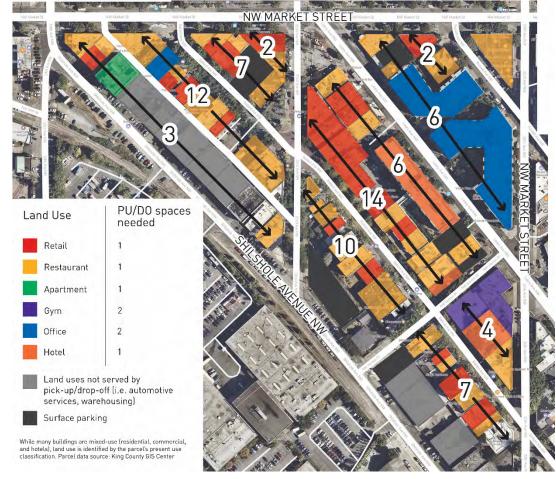


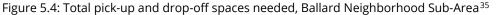
Figure 5.3: Total pick-up and drop-off spaces needed, Downtown Seattle Sub-Area<sup>34</sup>

Downtown Seattle is predominantly a mix of mid to high-rise office and apartment buildings with first floor commercial uses. The sub-area identified in Figure 5.2 has an on-street parking supply of 15 spaces, as well as parking garages and underground parking. The blocks between Pike and Pine Streets have the highest portion of retail uses in the area in addition to a number of offices and condominium buildings, could be served by around 100 pick-up and drop-off spaces total. The blocks further south on Spring Street would require less dedicated pick-up spaces as they are mainly office buildings and hotels and include less retail space. Should surface parking lots be developed into more productive uses, the number of required shared mobility loading spaces would need to be re-analyzed and correlate to the volume of subsequent increased trips to the area.

Based on the average peak period parking demand ratio associated with each of the land uses in Figure 5.2, the total parking supply required in this area is approximately 42,000 spaces, assuming no shared parking. However, the number of pick-up and drop-off spaces required for this area is around 330.

<sup>34</sup> Sub-area boundaries are from Pine to Spring and Alaskan Way to 7th Avenue.



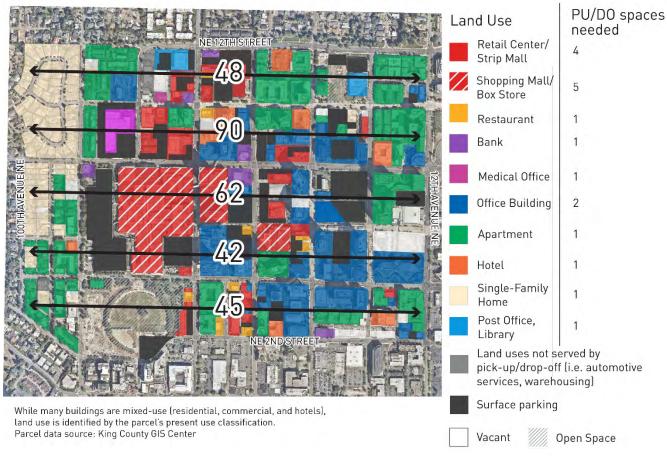


This sub-area of Ballard is a main commercial area and is surrounded by industrial uses adjacent to Salmon Bay and residential areas to the north and east. At this scale, examining the necessary curb space for shared pick-up and drop-off space on each block provides an understanding of the potential to eliminate a portion of the on- and off-street parking supply. As this is an area where people may walk to multiple destinations once they arrive to the neighborhood, the number of pick-up and drop-off spaces needed may be even further reduced. Shared mobility options do not adequately serve industrial and warehousing land uses and therefore were not included in the analysis.

Based on the average peak period parking demand ratio associated with each of the land uses in Figure 5.3, the total parking supply required in this area is approximately 4,800 spaces, assuming no shared parking. However, the number of pick-up and drop-off spaces required for this area is around 55.

<sup>35</sup> Sub-area is bound by NW Market Street to the north, 20th Avenue NW to the east, and Shilshole Avenue to the southwest in the Ballard neighborhood of Seattle.





This area of Bellevue is composed of a mix of land uses including shopping malls, mid-size office buildings, single-family homes, and apartments. A large amount of surface parking exists, especially near the shopping mall and retail centers or strip malls. Bellevue Square Mall alone has a parking lot with more than 1,000 spaces. Based on average parking supply ratios for each land use, the parking supply in this area is approximately 28,000 spaces while the required pick-up/ drop-off spaces is around 300.

The pick-up/ drop-off space estimation for Bellevue was determined using the same methodology as the other geographies. However, since TNC use is less prevalent in suburban jurisdictions and there is higher auto-dependence, the estimation of spaces needed could be made more conservative in further analyses. This may be achieved by decreasing the assumed number of arrivals by shared modes per hour.

## 5.5 Lessons Learned

While this model does not suggest rideshare or taxi pick-up and drop-off spaces will replace the
parking supply, it does assume that trips generated by each land use are fulfilled by rideshare or
ridesplit services that do not require vehicle storage on-site. This methodology estimates the size
of pick-up and drop-off space needed. The model could be made more conservative by adjusting
the number of trips assumed to be arriving by taxi, rideshare or ridesplit vehicles. This could be
accomplished by comparing available data from TNC trips on origin and destinations to current

<sup>36</sup> Sub-area is bound by NE 12th Street to the north, 12th Avenue NE to the east, NE 2nd Street to the South, and 200th Avenue NE to the west in the city of Bellevue.

mode split in the study area. Another approach could include identifying land-use types most often serviced by TNCs and planning for pick-up and drop-off spaces on those blocks.

- Weaknesses of the model include that only one land use is assumed for each building and an average square footage is used. If this model were to be used in an area to determine curb space requirements, specific building size and mixed-uses would need to be incorporated, as well as space used for bus stops or other curb space uses.
- An important assumption of this model is that trips are assumed to arrive at a constant rate throughout the hour, however this is not likely for every land use. For example, an elementary school may experience a sudden peak in trip arrivals between 8:00 and 8:30 am, which could result in queuing and potential traffic congestion. To further improve this model for a specific land use or geography, a queuing model would account for more uneven arrival rates.<sup>37</sup>
- The assumption of how long it takes for an arrival and departure to occur might be reviewed and given a more conservative margin, or perhaps a range, for suburban environments to show sensitivity for the different land uses and density.
- As curb space is limited to the width of a block, congestion issues may occur along high demand blocks or corridors, creating latent demand in which the rider travels to a different area when they are not able to conveniently access the block. Latent demand is experienced today along retail/commercial corridors when incoming drivers are not able to locate a parking space, ultimately leading them to leave the area altogether. Although latent demand is difficult—if not impossible—to calculate, it can be prevented or alleviated by pursuing infrastructure investments or policies that improve the circulation and traffic flow of curb space.
- Another possible outcome of shifting travel patterns toward shared mobility and away from individual car storage is capturing the latent demand of additional patrons who are not currently able to access these services. Latent demand could come from patrons who are physically constrained, have limited access to transportation services, or not able to locate a parking space during peak demand periods. It is possible that the demand for these curb spaces could be even greater than the numbers estimated above due to the latent demand associated with these users.

### 5.6 Policy Implications

- There is great potential to reduce the amount of right-of-way space required per trip if people do not drive their own vehicle. The reduction in vehicle storage provides an opportunity to utilize urban spaces for more productive uses that serve more people.
- Results of this analysis can be utilized for decision-making related to optimizing the public rightof-way and integrating shared mobility into the transportation system. For example, the reallocation of curb space to accommodate pick-up and drop-off needs balanced with bus zones.
- The model identifies the potential for drop-off spaces for various land-use types and the need to investigate this in more detail on a neighborhood level or as part of future sub-area plans, such as One Center City.
- Careful planning and mitigation of potential conflicts between pick-up and drop-off space and transit and bike infrastructure is critical.
- Replacing parking spaces with pick-up/drop-off spaces will have major implications on zoning, parking requirements, park-and-ride facilities, and other uses. SDOT should consider developing a network of TNC and taxi/for-hire pick up/drop off "stations".
- This analysis provides the first steps to consider the transformation of current park-and-rides or surface parking lots to shared mobility hubs. Placing many mobility options in one place with

<sup>37</sup> Methodology to set up a spreadsheet using queuing theory: "Queuing Theory Cookbook." Samuel L. Baker, 2006. http://web.ist.utl.pt/mcasquilho/acad/or/queue/SBakerQCookbook.pdf

further integration between modes is the first steps toward a true MaaS system. The Mobility as a Service (MaaS) model is particularly conducive to shared mobility services and reducing the need for car storage facilities in urban areas, as it eliminates the need for personal vehicle ownership and encourages the use of transit, carsharing, and ridesharing services instead. SDOT and Metro should consider adopting policies which encourage the adoption of the MaaS model to reduce the need for excess parking and decrease congestion associated with SOVs.

- By definition, these loading zones take much less physical space than parking for the same trips. However, the increase in pick-up/drop-off activity puts increasing pressure on curb space which already accommodates many other uses, such as bus stops, dedicated space for emergency vehicles, loading zones, and public plazas. Therefore, at places with high peak activity levels, specific measures for off-street loading and unloading become necessary to prevent degradation of roadway throughput.
- As parking supply and demand data for each of these sub-areas was not provided, a comparison of space dedicated for parking versus non-parking uses for each land use is based on average peak period parking demand ratios provided by ITE. To complete an adequate parking analysis for individual sites or areas, a more in-depth evaluation of specific parking utilization patterns, land use distribution, and parking demand ratios, would need to be completed. Replacing parking facilities with pick-up/ drop-off spaces would be a next step for this analysis and should be performed on a site-specific basis.

### **Chapter 6: Transit Analysis**

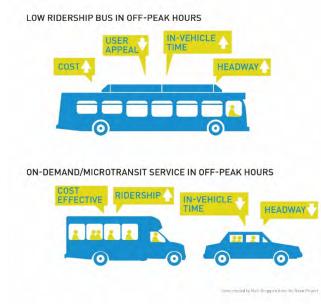
### 6.1 Model Logic

The transit analysis model identifies potential King County Metro bus trips that may be better served, at a comparable cost, using shared mobility services. The model's intent is not to prescribe the replacement of bus service with shared mobility or recommend a specific solution. Rather, it identifies low-ridership bus runs, or trips, that may be better served by a dynamically-routed (rideshare or microtransit) transportation solution in comparison to Metro's primary option of fixed route service utilizing a 40-foot or 60-foot bus.

The analysis evaluates ridership data from all Metro local, non-express bus runs. The data is broken down by each bus run, or trip, and the model identifies specific low-productivity runs where there is a cost-neutral or a cost savings if Metro paid for a rideshare trip for each current customer. The rationale for this model is that dynamically-routed transit would be preferred from a customer point of view and be a cost-neutral or more cost-effective transit solution for Metro. The output of this analysis includes which runs of specific routes at what times may be good candidates for a dynamically routed service.

### 6.2 Methodology and Assumptions

The analysis utilizes King County Metro data<sup>38</sup> and identifies bus runs with headways over 15 minutes with less than six boardings per mile which operate during low congestion time periods. Headways over 15 minutes were considered 'low productivity' runs, defined as a circumstance where Metro provides these services based on service coverage mandates. All transit agencies include these runs in their system as they are an important part of the network to ensure system connections remain intact. However, these "low productivity" runs could potentially be supplemented or replaced by point-to-point mobility options or microtransit. This analysis assumes that the customer's fare would remain equal to a transit fare if the trip was alternatively provided by rideshare, ridesplit, or microtransit.



#### Figure 6.1: Qualities of off-peak buses versus on-demand/microtransit

<sup>38</sup> Service file provided by Metro reports on Spring 2016 data. The table contains data on all service and deadhead trips Metro operates and subcontracts to others. The data is pulled from scheduled service data.

#### Step 1: Identify costs for providing dynamically-routed transportation services

The first step in the process was to identify a formula that provides accurate costs of offering dynamicallyrouted transportation services. Working under the advisement of Metro, the analysis utilized Uber rideshare (1 passenger) costs for this formula.<sup>39</sup> These costs were chosen because Uber's rideshare service was available throughout Metro's service area and it was determined the best basis to identify an opportunity cost for providing service. While other forms of microtransit and ridesplit services may have less-expensive price points, they were limited in availability at the time of this analysis.

The calculation is based on Uber's costs from Summer, 2016 and includes the following inputs:

#### Table 6.1: TNC Costs

TNC costs	
Base fare (\$/trip)	3.30
Mileage fee (\$/mile)	1.37
Time fee (\$/hour)	13.20
Assumed travel speed	15 MPH

Trip costs were calculated from these inputs with the addition of data for average trip length, which is determined in Step 5 of the analysis.

#### Step 2: Acquire data from Metro to identify "low productivity" runs

Data sources from Metro were acquired with the intent of identifying bus runs that had low ridership.

Data	Description
Trip ID	Bus run or unique trip of a Metro bus route
Route	Bus Route
Direction of trip	Direction the bus is travelling (inbound/outbound)
Period	Time period when the observed trip operates
Observations	Amount of data observations for the data set
Bus distance	Distance the bus travels on the particular trip
Average Trip Length/Trip	Average trip length per customer derived from Orca Card data
Average boarding	Average boardings per trip.

#### Table 6.2: Metro service data

#### Step 3: Eliminate express routes and low observation data

The next step was to eliminate express routes and bus runs with low data observations. Express routes were eliminated since, by design, the express routes carry passengers for long distances and have different measures for productivity; therefore, the cost per passenger mile calculation is not comparable.

<sup>39</sup> Uber prices for this analyses were taken from a day in Summer, 2016. Prices shift often which is not reflected here.

Low data observations, those runs that had four or less observed data inputs, were eliminated because of the limited sample size.

#### Step 4: Calculate boardings per mile

To calculate average boardings per mile from the refined data set, the average number of boardings is divided by the bus trip distance:

Boardings per mile= average boardings / bus distance

#### Step 5: Calculate passenger miles traveled

To identify all the passenger miles served, the following calculation was used:

Passenger miles traveled= average boardings x average trip length

The result identifies the length of all passenger trips for one bus trip and combines it into one number.

#### Step 6: Calculate the cost to Metro for each trip

This step calculates the cost to Metro for providing each trip. Metro provided a per mile cost of \$12/mile which was multiplied by the bus distance for the trip.

Cost per mile x bus distance

#### Step 7: Calculate Metro cost per passenger mile

To compare the cost of providing a bus trip to the cost of moving these customers on a rideshare trip, the following calculation was used to identify Metro's cost per passenger mile:

Cost per passenger mile= Metro cost of trip per passenger / Passenger miles traveled

This result can be compared with the cost of rideshare (in step 8).

#### Step 8: Calculate the cost of providing all passenger trips through TNCs

Step 8 analyzed the cost to provide a rideshare trip for all customers on the bus run for the distance that each customer travels. The cost of the rideshare trip is calculated using factors of (1) base fare (\$3.30/trip) combined with a mileage fee (\$1.37/mile) and a time fee (\$13.20/hour) based on the average trip length multiplied by average vehicle speed.

Cost to Metro to provide TNC trips = Average boardings x cost of rideshare

This determines the cost of purchasing a rideshare trip for all passengers on each trip.

# Step 9: Calculate bus runs that would be cost-neutral or cost-effective if provided by TNC

The final step of this analysis is to calculate the difference between Metro's cost per passenger and cost of providing all passenger trips through TNCs. This will determine if the trip cost would be equal to or lower, should the trip be provided through rideshare trips.

```
= Metro's cost of trip – cost to provide trips through TNC
```

Positive results identify savings to Metro by trip if Metro stopped running the bus trip and bought every customer a TNC trip.

### 6.3 Results

An analysis of the productivity of Metro's non-express bus service (around 8,600 trips) shows that 5% of runs and 4% of service miles would be cheaper to the agency if provided by TNC (Figure 6.1). As Figure 6.2 shows, around one-quarter of these trips occur between 5:00 am to 9:00 am and one-third occur from 10:00 pm to 5:00 am. Based on the average trip length, the costs to King County Metro for these services are approximately \$8.65/rider. This analysis is a starting point for potential partnerships with shared mobility services to continue providing consistent service during low-ridership periods at a lower cost. Results of this analysis can be utilized for decision-making regarding future planning efforts related to integrating shared mobility into the transportation system.

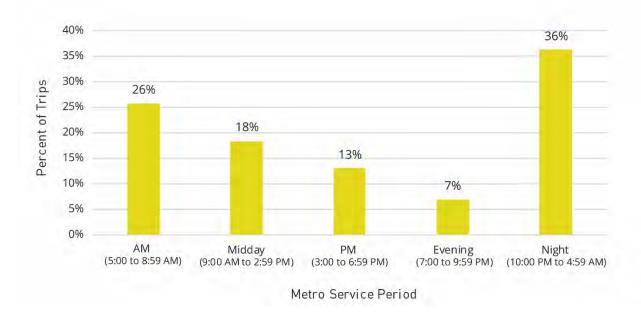


Figure 6.1: Distribution of trips by Metro service period

The results of this analysis include all routes and trips sorted by cost differential of providing the trips through rideshare compared to fixed bus route service.



Figure 6.2: Cost differential by number of runs for Metro (non-express) bus trips

Figure 6.2 and Table 6.3 identify the top five routes with the highest number of runs which have been identified as providing potential savings to Metro.

Table 6.3: Number	of runs for t	the top five	potential	cost saving routes <sup>40</sup>
	01101151011	the top nee	potentiai	cost suving routes

Route	Number of Runs
Route 236 - Woodinville P&R to Kirkland TC	30
Route 204 - South Mercer Island to Mercer Island P&R	23
Route 36 - Othello Station to Beacon Hill to Downtown Seattle	20
Route 248 - Avondale to Redmond TC to Kirkland TC	18
Route 22 - Arbor Heights to Westwood Village to Alaska Junction	17

<sup>&</sup>lt;sup>40</sup> King County Metro Service Data, 2016.

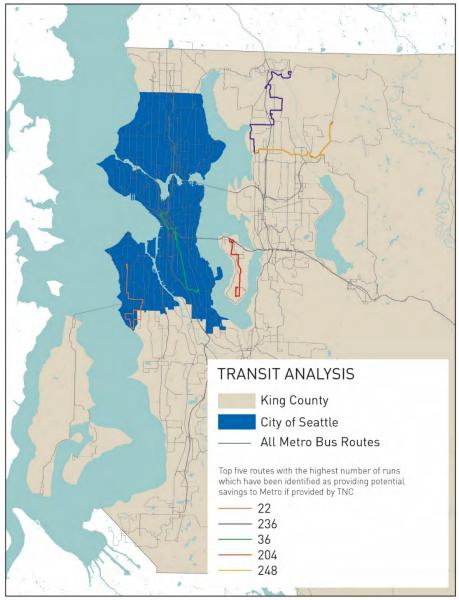


Figure 6.2: Top five routes with highest number of runs which have been identified as providing potential cost savings to Metro if provided by TNC

Route 236 Woodinville Park and Ride to Kirkland Transit Center has the highest total number of runs at 30 (including both inbound and outbound trips). Each run for each route was observed at various times throughout the day. For example, consecutive runs of route 236 were observed at the following times: 5:22 am, 5:42 am, 6:13 am, 6:20 am, 7:13 am, 7:16 am, 8:14 am, 8:17 am, 9:13 am, 9:16 am, 9:42 am, 10:13 am, 10:16 am, 10:47 am, 11:12 am, 11:18 am, 12:13 pm, 12:18 pm, 1:12 pm, 1:18 pm, 1:42 pm, 3:28 pm, 3:58 pm, 4:57 pm, 5:54 pm, 6:02 pm, 6:25 pm, 7:00 pm, 7:02 pm, 7:33 pm.

Analyzing the number of runs, the time of day for each run, and cost differential for routes will assist in identifying the least cost-effective routes and/or periods of bus service.

### 6.4 Lessons Learned

The following are lessons learned and limitations of the analysis:

- This analysis does not identify a front-haul, back-haul relationship for routes that operate in the peak. Some runs with low ridership are in service to get the bus back to the starting point for peak-period peak-direction trips that are very productive.
- The major limitation is that many of the low-productivity routes or segments may be in place for coverage reasons or to build new market growth. It may not be advantageous to cut the routes as they may reduce the reach of the transit network.
- Induced demand was not included in the calculations. It is assumed there would be more demand when replacing fixed route service with more agile service, especially for customers that currently must walk to the bus stop. While there may be limited information on the effect of induced demand, further investigation will help to further evaluate the trade-off in which TNCs and microtransit may provide more cost-effective mobility over low utilization bus lines.

### 6.5 Policy Implications

Policy implications of this analysis include the following:

- The model's intent is not to prescribe the replacement of bus service with shared mobility or recommend a specific solution. Rather, it identifies low-ridership bus runs, or trips, that may be better served by a dynamically-routed (rideshare or microtransit) transportation solution other than a 40-foot or 60-foot bus.
- This analysis is intended to be a starting point for discussion on where fixed-route bus service could be replaced by more agile, lower capacity, microtransit or shared mobility. It is not necessarily intended to recommend routes that should be converted to a partnership with rideshare services. Further analysis on the corridor is required as well as outreach to ensure there are no unintended consequences.
- The analysis could also be utilized to combat opinions that transit should be replaced by rideshare. 95% of Metro's service would be more expensive to operate if it was outsourced to or replaced by rideshare.
- Additional investigation is recommended with Metro Service Planning prior to considering any adjustments in service. This is because many of the trips identified in the analysis may include either (1) newer trips that are under a trial period to grow ridership; these trips are commonly the first or the last trip; and/or (2) trips that are run for coverage reasons according to Metro's service standards. Next steps would include comparing these routes to Metro's Service Guidelines Analysis.
- Ways to seamlessly integrate fare payment for transit and shared mobility for this concept is necessary and would be a first step towards an important aspect of MaaS.
- Any change in service could affect Title VI implications, especially if vehicles are not ADA compliant. Coordination with the FTA is paramount prior to establishing any replacement of fixed-route operations.

## Chapter 7: Shared Mobility Supply (SUMC)

### 7.1 Model Logic

The **Shared Mobility Benefits Calculator**, created by the Shared Use Mobility Center (SUMC), explores the benefits of transit, car share, bike share, and rideshare. The tool allows the user to select a target vehicle reduction and a mix of shared modes. The results identify decreases in VMT, GHG emissions, and savings of personal vehicle transportation costs. Results of this analysis can be utilized for decision-making regarding future planning efforts related to making shared mobility equitable to all, integrating shared mobility into the local and regional transportation system and optimizing the right-of-way.

The Shared Mobility Benefits Calculator was run through SUMC's web toolkit, available at <a href="http://calculator.sharedusemobilitycenter.org/#/">http://calculator.sharedusemobilitycenter.org/#/</a> utilizing the results of the Economic Model for key inputs on vehicle reduction.

### 7.2 Methodology and Assumptions

The model estimates vehicle ownership based on data provided by the U.S. Census 2014 American Community Survey (ACS). Data variables from the 2014 ACS include the journey to work patterns and total workers, which is used to calculate density. Then, the model utilizes statistical techniques to produce metrics based on the census and other data, including bike share and car share locations and usage information. Tests by the SUMC proved this model to be accurate based on a set of variable coefficient values. The table below shows the coefficient values used to model increases or decreases to car ownership:

Variable	Effect on Vehicle Ownership
Car share	11.27 fewer cars per car share vehicle
Carpool/Rideshare	0.2 fewer cars per carpool user
Vanpool	0.26 fewer cars per vanpoool user
Bikesharing	0.16 fewer cars per bike shared bike
Transit commuters	0.22 fewer cars per new transit commuter
Working Population	1.31 cars added per person

Table 7.2- Variable Coefficient Values used in SUMC Shared Mobility Benefits Calculator

This model contends that public transit (including vanpool and transit commuters) and car share are the two most effective variables in reducing vehicle ownership. The model's car share coefficient depicts round-trip car share vehicles rather than one-way car share vehicles as one-way car share is still relatively new and not as geographically widespread.

This exercise uses the inputs of scenario 4 of the Economic Model, a 27% reduction in total vehicles, and applies it to the calculator for the City of Seattle (the only geography in the region available on the calculator). As scenario 4 is the only scenario that includes transit, ridesource, ridesplit, and carshare, the SUMC model is utilized as an additional method to calculate how a 27% reduction of vehicles could occur with a range of transportation options. These numbers represent what the total size of such carsharing or bikesharing fleets might look like to achieve the same reduction of 27% based on existing factors. That is, the economic model defines the bounds of vehicles that would be reduced due to the systems described above, and the factors describe the equivalent size of the system that would support that reduction. The

results show the count of additional units per mode needed for Seattle, such as number of car share vehicles, transit commuters, or shared bikes.

The outputs of the Shared Mobility Benefits Calculator were applied to the report's study areas. As neither King County nor other neighborhoods and cities in the region are currently available through the calculator, the results for the city of Seattle were applied to the study areas based on the difference in total vehicles available in each area as compared to Seattle. Therefore, this exercise assumes the same proportion of additional units needed in Seattle are also necessary in the other geographies to support a 27% reduction of vehicles. To more accurately calculate these numbers, additional data for each geography is necessary.

### 7.3 Results by Geography

The current number of units for each transportation mode in Seattle are depicted below:

City of Seattle	Current Units	
Transit commuters	71,117	
Car share vehicles	1,391	
Shared bikes	500	
Ridesharers/carpoolers	29,571	

Table 7.3- Existing number of current units by transportation mode in Seattle<sup>41</sup>

Table 7.4 presents the total current vehicles, potential vehicle reduction, and additional units needed per mode as calculated by the SUMC model for the City of Seattle. In addition, these results were applied to the other study areas based on the ratio of total vehicles as compared to Seattle. The results show that transit commuters and rideshare/carpool must increase by the greatest number, followed by car share and bike share respectively.

In Seattle, to support a reduction of the personal vehicle fleet by around 110,000 (27% of total vehicles), an additional 36,000 transit commuters, 9,000 car share vehicles, 6,600 shared bikes, and 17,500 rideshare users or carpoolers is necessary

As this methodology does not account for number of units available and usage data, journey-to-work data, or total workers, the results appear unrealistic for some geographies. For example, adding 22,262 shared bikes in King County will be unrealistic anytime in the near future. Apart from the fact that Pronto bike share's program ended in March 2017, bike share systems in cities such as New York and Chicago only have 7,500 and 6,000 bikes, respectively.<sup>42</sup>

<sup>41</sup> This analysis took place before Pronto Bike Share ceased operations.

<sup>42</sup> Divvy and Citibike information available at: https://www.divvybikes.com/about and https://www.citibikenyc.com/system-data/operating-reports

Current 27% Vehicle Additional units needed per mode to real Congraphic Current Reduction				er mode to reac	h reduction	
Geographic area	Total Vehicles	Total Vehicles Reduced	Transit commuters	Car share vehicles	Shared bikes	Ridesharers/ carpoolers
Seattle	406,156	110,595	35,785	9,055	6,615	17,534
King County	1,366,859	372,192	120,429	30,473	22,262	59,008
Ballard	15,613	4,251	1,376	348	254	674
U-District	10,125	2,757	892	226	165	437
Columbia City	7,915	2,155	697	176	729	342
Downtown Seattle	29,358	7,994	2,587	655	478	1,267
Sammamish	33,927	9,238	888	225	164	435
Shoreline	37,811	10,296	990	250	183	485
Bellevue	89,942	24,491	2,355	596	435	1,154
Maple Valley	17,079	4,651	447	113	3	219
Kent	76,395	20,802	2,000	506	370	980

Table 7.4: Additional units needed to reduce total vehicles by 27%

Figure 7.1: Additional units needed to reduce total vehicles by 27% in Seattle

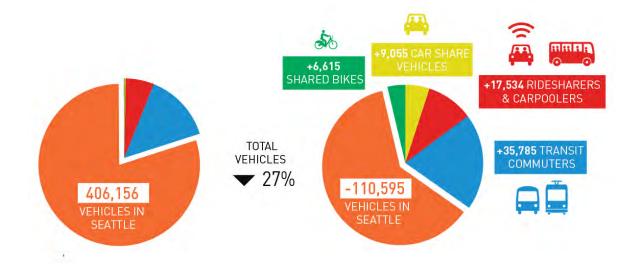


Table 7.5 exhibits the resulting benefits to air quality and transportation costs from reducing the total car in Seattle.

Table 7.5: Benefits in Seattle resulting for reduction of vehicle fleet by 27%

Reduction in miles traveled by personal vehicles	1,116,463,100
Reduction in metric tons of GHG emissions related to personal vehicle ownership	400,300
Reduction in personal vehicle transportation costs	\$393,955,000

### 7.4 Lessons learned

- The SUMC calculator serves as a method to estimate the size of the shared mobility system that would achieve a reduction in personal vehicles. While the economic model considers a menu of shared mobility options that could replace the use of a personal vehicle, the SUMC calculator quantifies the number of transit commuters, car share vehicles, and rideshare users to support the same reduction.
- The calculator offers the option to analyze shared mobility benefits in around 30 cities, including Seattle. In this exercise, applying the Seattle results to King County, neighborhoods, and other jurisdictions only provides a precursory understanding of the potential distribution of shared mobility services in the region. Further analyses must include the number of existing units (car share vehicles, transit commuters, etc.), usage data, and journey-to-work data in each study area to provide a complete analysis.

## **Chapter 8: Stockholm Study**

### 8.1 Model Logic

A study completed in Stockholm<sup>43</sup> found that automated transportation technology can solve mobility demands by reducing the need for personal vehicles and enable cities to become more sustainable, reduce traffic congestion, and increase road safety.

The study identified the capacity of a reduced number of vehicles to move more people with ridesharing. The study is based on the premise that self-driving vehicles, named Shared Automated Vehicles (SAVs), would provide services similar to those of existing rideshare services and for-hire taxis and replace all private SOV commuter trips.

A SAV-based transportation network could result in every personal vehicle commuter trip being accommodated while utilizing no more than approximately 10% of current vehicles and parking spaces. The study explains that while transit trips are not included in the analysis, the model can be used to identify benefits that a SAV-based transportation network could have in conjunction with an efficient public transportation and increases to cycling and walking. For example, SAVs could connect to shared mobility hubs on land previously used as parking lots to provide first-mile or last-mile transportation options. Other studies on the benefits of AVs support these findings for improving societal, economic, and environmental sustainability.<sup>44</sup>

### 8.2 Methodology and Assumptions

The study utilized scenarios to explore outcomes that a SAV-based transportation system could have for the City of Stockholm. Evaluation factors included number of vehicles needed to provide service, total vehicle miles travelled (VMT), and energy usage or vehicles parked within the city. The study found Stockholm to be a suitable city for SAV implementation based on its traffic density and traffic data availability. The model targeted an end date of 2030 to ensure relevant existing data could be used to reasonably project traffic in 2030 Stockholm. There are two main facets of this model; 1) to determine how varying input factors (wait time and travel time passengers will tolerate), impact outputs (total travel time, number of vehicles needed in fleet, and VMT) and 2) the environmental impacts of each scenario comparing fleet vehicles using internal-combustion engines or electric motors.

#### Step 1: Establish the road network and road network characteristics

The road network used in the model linked together a series of nodes and zones that were used in the analysis of travel time of rideshare simulations. In addition, traffic modeling software evaluated trip demand utilizing real traffic conditions in Stockholm. The traveling patterns of Stockholm County residents were used in the trip demand model to display vehicle travel from work to home during a typical weekday.

#### Step 2: Model SAV scenarios on road network

The next step was to model scenarios of a SAV-based system, including trips completed with or without ridesharing. To simulate SAV trip scheduling to include ridesharing, carsharing, and empty vehicle routing, an additional model was created. This model relied on the road network and assumptions of traffic congestion and driving speed.

<sup>43</sup> Rigole, Pierre-Jean. Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm (2014). Kungliga Tekniska Hogskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf

<sup>44</sup> Other works that have contributed to this subject include "Operations of a Shared Autonomous Fleet for the Austin, Texas Market," by Fagnant and Kockelman (2015), as well as "Autonomous taxis could greatly reduce greenhouse-gas emissions of US light-duty vehicles," by Greenblatt and Saxena (2015).

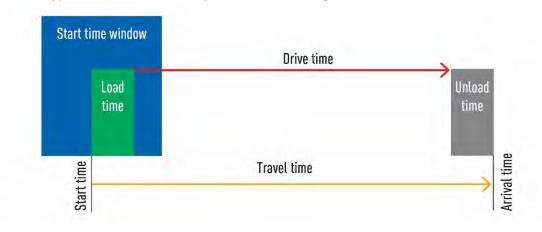
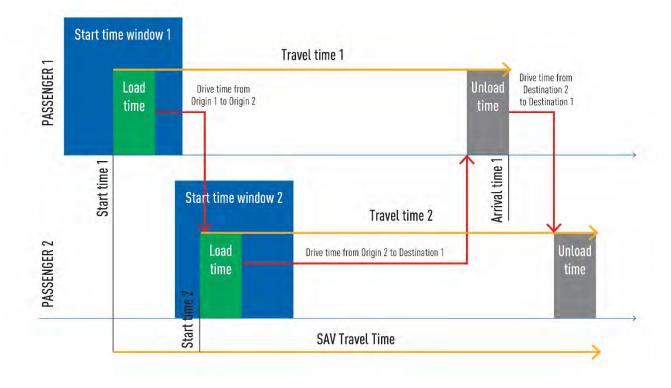


Figure 8.2 – Typical time definition for trip with no ridesourcing<sup>45</sup>





<sup>45</sup> Modified from Rigole, Pierre-Jean. *Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm* (2014). Kungliga Tekniska Högskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf 46 Modified from Rigole, Pierre-Jean. *Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm* (2014). Kungliga Tekniska Högskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf

Under step 2, rules for ridesharing were established for the ridesharing schemes:

- 1) Passengers are dropped-off in the same order as they were picked-up
- 2) The route taken is the one with the shortest drive time
- 3) When multiple concurrent passenger pick-ups are possible, SAVs will choose the users with the closest start time
- 4) The time needed for passenger exit is assumed shorter than passenger entry upon pick-up

#### Step 3: Add parameters to SAV scenarios

In the next step, the study based ridesourcing in a SAV-based system on the following parameters:

**Maximum number of passengers in vehicle** - The SAV fleet is assumed to consist of a single type of vehicle with approximately 4 seat capacity for passengers.

Start time – The earliest time for a passenger to start the trip.

**Start time window** – The range of time measured from the start time within which a passenger is accepting a trip.

Load time – The time given to the passenger to enter the SAV.

**Unload time** - The length of time given to the passenger to exit the vehicle upon arriving at the destination.

**Relative increase in travel** time – The increase in travel time relative to the travel time assuming no detour that a passenger is ready to accept. The increase in travel time is required to allow for picking-up additional passengers in the ridesharing scheme.

**Intra-zone travel time** – The amount of time taken to pick-up passengers within the same trip origin zones

#### Step 4: Create Optimization Algorithm

Next, an algorithm was established for determining optimized routing methods for SAV ridesourcing based on the above parameters. Three ride-sharing schemes were then used to evaluate trips based on the following trip itineraries:

- 1) Same origin and destination
- 2) Same origin and different destination
- 3) Different origin and same destination

The study found that SAV fleet size is dependent on the vehicles needed for trip demand in each of the above schemes as well as the expected quality of service (passenger wait time).

#### **Step 5: Outline Performance Indicators**

The model delineated key indicators for SAV fleet performance and environmental impact. They are as follows:

Indicator	Sub-indicator
SAV fleet	# of SAVs
Mileage	Total
	Average per SAV/private car
	Average per passenger
Travel time	Total for the fleet
	Average increase in travel time
	Average per SAV/private car
	Average per passenger
Start time window	Average use per passenger
Parking time	# parked SAV
	Total parking time
	Average parking timer per SAV/private car
Ride-sharing	Average of passengers per SAV

#### Table 8.2: Environmental Impact Indicators

Indicator	Sub-indicator
Emissions	GWP <sub>100</sub> (global warming potential over 100 years)
Energy	Energy (fuel/electricity)

#### Step 6: Evaluate Scenario Variables

The variables below were used to evaluate each scenario:

**Maximum increase in travel time –** The amount of increase in time that a user would be subjected to as a result of taking a shared vehicle (multiple passenger pickup and drop off).

**Start time window –** The amount of time allocated from when a user accepts to start a trip to the time of actual trip start.

**Cost function –** This equation evaluates how SAVs are dispatched to pick up passengers. The function is set to minimize costs and does so by assessing amount of time parked between trips and the driving distance needed to travel between users.

Table 8.3: Scenario Evaluation

Scenario	1	2	3	4	5	6
Allowed maximum increase in travel time	0%	0%	30%	30%	50%	50%
Start time window (minutes)	0	0	10	10	15	15
Cost function	K1=0 K2=1	K1=1 K2=0	K1=0 K2=1	K1=1 K2=0	K1=0 K2=1	K1=1 K2=0

Scenarios 1 and 2 were modeled without ridesharing while Scenarios 3 through 6 are modeled to include ridesharing. As shown in Table 8.3, there were no increases to travel time in scenarios 1 and 2 (ridesourcing was not included, which increases the travel time as the SAV needed to pick up more people). Scenarios 3 and 4 had a 30% maximum increase of travel time and scenarios 5 and 6 included a 50% maximum increase. The cost function for each scenario measures the difference between only minimizing empty mileage (when cost function K1=1 and K2=0) and only minimizing parking time (when cost function K2=1 and K1=0).

The baseline case represents the current conditions of private single occupancy vehicles accommodating all commuter car trips. This model does not include transit, walking, or biking commuter trips. The number of person-trips is calculated by doubling the number of personal vehicles making home-to-work trips, which accounts for work-to-home trips. The model ran the scenarios using the baseline case as the controlled variable to measure the impacts of the different scenarios.

Indicators	Unit	Baseline	
# person-trips (home to work + work to home)	Trips	271,868	
# vehicles = private cars	Vehicles	135,934	
Total mileage	Kilometers (thousands)	2,606	
Average mileage per trip	Kilometers	10	
Total travel time	Hours (thousands)	66	
Average travel time per person	Hours	0.5	
Average travel time per private car	Hours	0.5	
Total parking time	Hours (thousands)	3,196	
Average parking time per private car	Hours	23.5	

#### Table 8.4: Baseline Indicators

### 8.3 Results

The study's main findings revealed that SAV-based systems can provide door-to-door service while using less than 10% of the current number of private cars and parking spaces. When comparing SAVs without ridesharing (scenarios 1 and 2) to SAVs with ridesharing schemes (scenarios 3, 4, 5 and 6), the latter provided the highest benefit toward reducing congestion and environmental impacts due to vehicle traffic in Stockholm. Results are presented as ratios to the baseline. Scenario 2 has the lowest reduction of vehicles, with 8.6% of total baseline vehicles accommodating all trips (meaning 91.4% of private cars reduced), while scenario 5 has the greatest reduction in vehicles as compared to the baseline at 5.4% (96.4% of cars reduced). The model demonstrates that ridesharing scenarios offer a reduction in total mileage but at the cost of quality of service for users.

Scenarios modeled to include ridesharing had both the least number of SAVs on the road as well as number of SAVs parked when compared with the baseline and non-ridesharing scenarios. For example, the medium case scenario (scenario 3) that included ridesharing provided an additional reduction of private vehicles as scenarios 1 and 2 of 2.7% and 3.2%, respectively. Utilizing the ridesharing scheme, scenario 3 reduced parking requirements by 95% while miles traveled were reduced by 11% from the baseline case.

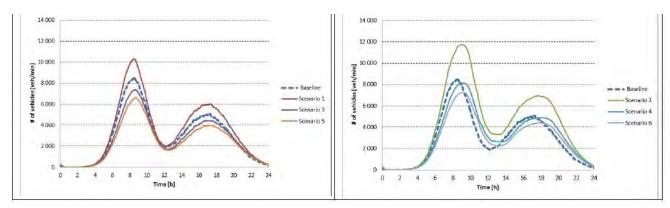
Scenario	Unit	1	2	3	4	5	6
# Vehicles	%	8.1%	8.6%	5.4%	6.0%	4.9%	5.3%
Total Mileage	%	124.4%	171.6%	88.8%	114.6%	76.0%	96.7%
Total Parking Time	%	5.8%	5.5%	3.6%	3.8%	3.3%	3.4%
Total drive time (time on the road)	%	120.4%	157.1%	93.5%	113.5%	84.7%	100.8%
Average use of start time window relative to start time window	%	0.0%	0.0%	59.6%	24.9%	55.6%	29.4%
Average increase in travel time	%	0.0%	0.0%	13.1%	13.1%	25.1%	25.1%

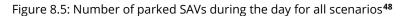
The results of each scenario (below) are ratios compared to baseline values.

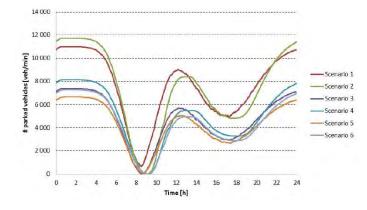
The model reflects the potential of a SAV-based system to reduce the number of vehicles and parking time. The study asserts that when compared to the baseline, SAVs increase vehicle efficiency through servicing multiple users simultaneously and maximize driving time on road.

#### Table 8.5. Simulation results by scenario as ratios to baseline

Figure 8.4: Number of SAVs per minute on road versus time. Scenarios minimizing empty miles (Left), Scenarios minimizing parking time (right).<sup>47</sup>







Based on the results of the scenarios that included ridesharing (scenarios 1-3), the study concluded that without reaching an adequate ridesharing threshold that SAVs may add to congestion and environmental impacts rather than reduce them. However, the model reveals that using SAV fleets powered with electric motors rather than internal combustion engines can negate any adverse environmental impacts. The study addresses how SAVs will impact the triple bottom line of sustainability:

- **Social sustainability** The impact that SAVs would have on social sustainability over the private car includes increased accessibility to all people regardless of driving capability, such as elderly or disabled persons.
- **Economic sustainability** The study determined that SAVs can be an economical solution due to the cost of the vehicle being shared across many users with no additional costs for drivers/operators. Users who would rely upon a SAV-based system for transportation mobility would no longer experience the costs of owning and operating a vehicle. The study believes that these savings will be transferred into the companies of the SAV fleet owners/operators. Additionally, the economic cost of constructing parking lots will be eliminated as parking demand is reduced.

<sup>47</sup> Rigole, Pierre-Jean. *Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm* (2014). Kungliga Tekniska Hogskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf

<sup>48</sup> Rigole, Pierre-Jean. *Study of a Shared Automated Vehicles Based Mobility Solution in Stockholm* (2014). Kungliga Tekniska Högskolan, Royal Institute of Technology. Available at: http://kth.diva-portal.org/smash/get/diva2:746893/FULLTEXT01.pdf

• Environmental sustainability – The study found that a SAV-based system can help to reduce congestion and environmental impacts, though caution must be used. KTH asserts that such an easily accessible, comfortable, and lower cost door to door mobility service could possibly increase demand and consequently negate any positive environmental impacts by making other modes less appealing. However, negative impacts could be offset by advances in robotic and artificial intelligence technology leading to traffic flow increases by reducing need for spacing, stops, and accidents between vehicles. The study emphasizes that land use benefits could be made possible by reducing the parking demand in Stockholm as parking lots could be freed up for other transportation modes creating an increase in walking, cycling, and transit use.

#### **Applications to the Seattle Region**

To understand the implications of a reduced personal vehicle fleet in Seattle, a 90% reduction was applied to each geography, as shown in Table 8.6. This stated, the results should be taken with caution as the roadway networks are different from Stockholm and vary greatly between typology. Additional analysis of traffic, roadway capacity, and parking supply are necessary to provide a comparison between this study and Seattle.

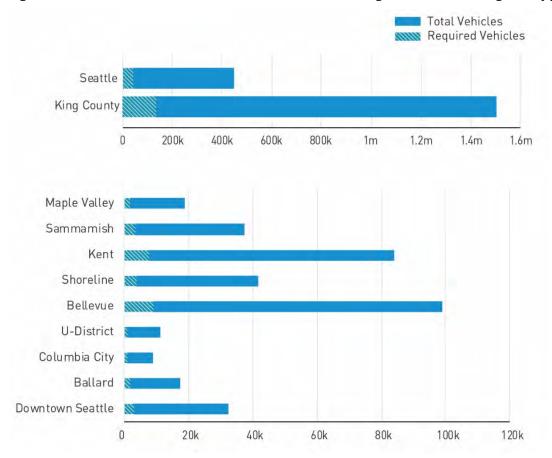


Figure 8.6: Results of a 90% reduction of vehicles in Seattle neighborhoods and King County jurisdictions

### 8.3 Lessons learned

This study is an early attempt to identify the potential positive benefits of a Shared Autonomous Vehicle network, with a focus on reduction in vehicles and parking spots. The exploratory nature of the modelling exercise provides initial results, but also recognizes several its own limitations, including:

The study only included internal traffic that represents about 60% of all vehicle traffic in Stockholm, leaving a large portion of traffic unaccounted for.

The demand is constructed on a survey using several calculation steps and assumptions. It states that they believe the total amount of traffic to be adequate but the detailed traffic flow patterns have not been verified and compared to real traffic data.

The study asserts that the simulation is based on a simple model that does not include dynamic traffic simulation and utilizes simple ridesourcing algorithms. To increase accuracy on the impacts of a SAV transportation system, an advanced model would be required.

- The study proposes several areas of future study that will impact transportation and cities in the future:
  - 1) Social considerations Areas surrounding safety and legal responsibility in the event of a collision should be explored further.
  - 2) Land Use With a SAV system in place, excess parking lots and spaces will release land back into other uses. In addition, the current system of building infrastructure may change as space needs and travel methods of SAVs will operate under a different set of conditions than humans do.
  - 3) Research Further studies on ridesharing and car sharing using more advanced models with greater dynamic conditions, SAV-based freight and goods delivery transportation systems, and comparing SAV-based systems between various cities.
- Additional limitations include that the study is based on the City of Stockholm, which has unique land use characteristics. Results will vary in US urban contexts, especially suburban contexts where trip patterns and land use characteristics are often distributed to a wider range of origin and destination patterns and longer commute lengths and times.

### 8.4 Policy Implications

- The study model demonstrates that SAV-based transportation can effectively and efficiently reduce a number of negative transportation, environmental, and economic impacts with no or little impact to travel time (depending on the different model scenarios). The biggest benefit for SAV systems from the model were scenarios which included ridesharing, and when coupled with an electric motor equipped fleet of SAVs, were the most effective combination to decrease traffic congestion, parking demand, and energy use and greenhouse gas emissions.
- This study contains a unique approach that can be further refined and/or built on for analysis of potential SAV or MaaS systems in the Seattle region. The methodology of this study could be combined with PSRC data that identifies high TAZ-to-TAZ travel to analyze the potential for a future MaaS strategy in the region. Finally, this data could be compared to Car2Go, Zipcar, ReachNow, Uber Pool, Lyft Line, and other shared services to identify relative potential for future SAV services in the Seattle Region.

## Typology Appendix

### Introduction

This section is an overview for each geography analyzed in this report. It is intended to offer an alternative lens to identify results and policy implications from the perspective of each typology. These overview summaries will provide concise geographic and demographic contexts to frame the potential impacts of shared mobility as it relates to the various geographies in Seattle and King County. Each typology is representative of different neighborhoods and suburbs in the region.

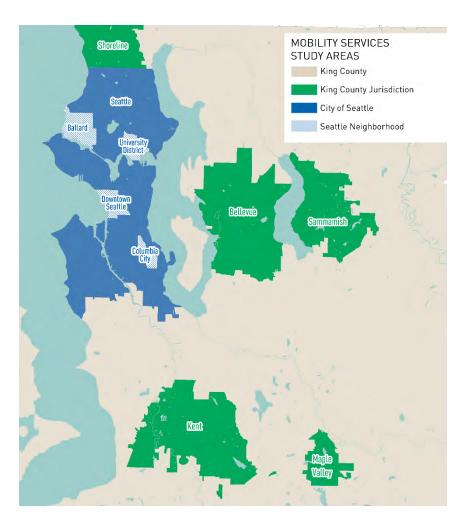
The typologies in Seattle include:

- Downtown Seattle (Center City)
- Ballard, Colombia City, and University District: representative of city neighborhoods

Typologies of King County include:

- Bellevue and Shoreline: representative of high density suburbs
- Kent: representative of regional manufacturing and shipping hubs
- Sammamish and Maple Valley: representative of exurban communities

Figure 9.1: Typology study-areas in Seattle and King County



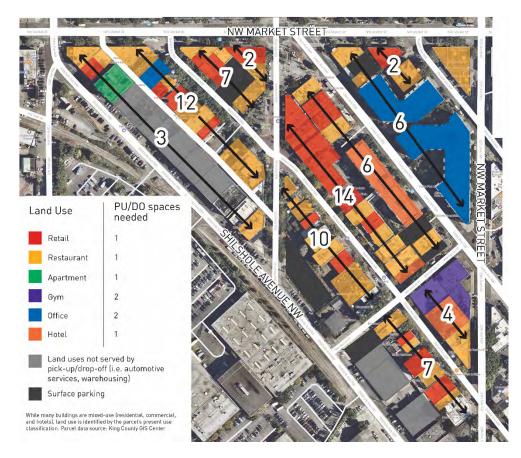
### Ballard

Ballard is a relatively-dense neighborhood of approximately 2.1 square miles on the north side of Seattle and contains several regional attractions, including commercial corridors along Market Street and Ballard Avenue. Ballard is served by a variety of King County Metro bus lines and contains an entertainment district. It has a population of 22,122 and contains approximately 10,000 people per square mile.

The economic model (Chapter 2) demonstrates that there is a tremendous opportunity to reduce autoownership. Of Ballard's 15,613 personal vehicles, a reduction of approximately 2,000 to 6,000 (15% to 39%) could occur after substantial shifts to shared mobility transportation options. The potential reduction of personal vehicles through shared mobility in Ballard would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Ballard as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Ballard would:

- Significantly decrease the share of SOV daily trips from 42% to 33%
- Increase transit trip mode share from 3% to 7%



• Increase total daily trips by shared mobility from 1% to 11%

This sub-area of Ballard is a main commercial area and is surrounded by industrial uses adjacent to Salmon Bay and residential areas to the north and east. At this scale, examining the necessary curb space on each block provides an understanding of the potential to eliminate some surface and on-street parking. As this is an area where people may walk to multiple destinations once they arrive to the neighborhood, the number of pick-up and drop-off spaces needed may be even further reduced. Shared

mobility options do not appropriately serve Industrial, warehousing, and automobile land uses and therefore were not included in the analysis.

Based on average parking supply ratios for each land use, the parking supply in this area is approximately 4,800 spaces while the required pick-up and drop-off spaces is around 55. Ballard's small area and relatively high density would be greatly served by all modes of shared mobility and will experience the benefits of these services including reductions to congestion and parking requirements.

#### **Policy Implications**

As a dense urban neighborhood with a large commercial district, there are many traffic generators in Ballard, and, therefore, many potential implications for optimization and reutilization of the public ROW. Primary to these implications is the potential for overall decline in the demand for car storage (including reductions in car ownership and in visitors arriving by SOVs to the neighborhood).

As a result, this neighborhood is a key candidate to identify new alternatives for parking facilities, especially those at surface level. First, a fresh look at land-use planning should occur to identify lower parking requirements and minimize surface parking lots. Second, identification of infill development to transform these pockets of existing surface parking lots to more active uses should be studied. Third, potential for elimination of on-street parking spaces should be monitored, especially in consideration for potential to implement other uses as transit lanes, on-street bike facilities, parklets for adjacent businesses, and enhanced pedestrian facilities. These actions will require further analysis and can be implemented as part of neighborhood and sub-regional planning activities.

The next policy implication relates to safety. As with other entertainment districts, there is an opportunity to encourage shared mobility options when people become impaired due to alcohol consumption. Additional pilots, as previously performed around large events<sup>49</sup> and at times when drunk-driving activity most often occurs could be expanded on a regular basis.

Finally, as potential shifts to shared mobility occur, there is a once-in-a-generation opportunity to identify incentives to encourage higher-occupancy forms of shared mobility, including transit, bikeshare, and microtransit to increased optimization of the constrained roadways serving this neighborhood.

### **University District**

University District (U-District) is located in Northeastern Seattle bounded on the south by the Lake Washington canal. U-District has a population of approximately 31,434 people and a land area of just under 2.5 square miles giving it a population density of 13,543 people per square mile. As implied by its name, the neighborhood is home to the University of Washington campus and, as such, has a large student population. Transit connections can be made using Sound Transit's Link light rail system at University Station or one of numerous King County Metro bus lines.

As the economic model (Chapter 2) demonstrates, there is considerable opportunity to reduce autoownership in U-District. In U-District there are 10,125 personal vehicles. The U-District neighborhood would see personal vehicles reduced by 2,000 to 4,500 (17% to 45%) vehicles having significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for U-District as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 U-District would:

- Significantly decrease the share of SOV daily trips from 37% to 26%%
- Increase transit trip mode share from 9% to 16%

<sup>49</sup> SDOT Safe Ride available at: http://sdotblog.seattle.gov/2016/06/21/get-a-discounted-safe-ride-this-pride-weekend

• Increase total daily trips by shared mobility from 1% to 12%

U-District's higher density and student population would be greatly served by all modes of shared mobility and will experience the benefits of these services including reductions to congestion, parking requirements, curb space optimization, car-free lifestyle, and others.

#### **Policy Implications**

The U-District has many of the same characteristic and opportunities as Ballard. In addition to the policy implications identified in the Ballard section of this report, including alternatives to parking facilities, impaired user safety, and incentives for more HOV shared mobility usage, there are additional items to consider.

First, the University of Washington Station opened just over one year ago. This station leads to the center of the nieghborhood should be utilized as a local hub, connection to Center City, SEATAC, and other traffic generators along the line. There is an opportunity to create a shared mobility hub at this station to provide and encourage easy first and last mile connections.

Next, the University of Washington hosts major events on a regular basis. These events range from arts and culture to large sporting events. Attendance for these events also ranges from the 100's to over 70,000 for football games at Husky Stadium. Special events strategies to nudge attendees to higher capacity modes can ease congestion on local streets and reduce impacts of these major events.

Finally, there is a large student population that lives and commutes to U-District on a daily basis. The City and Metro should work with the University of Washington on MaaS solutions to encourage car-free travel to and from campus. There is the potential to create intra-campus MaaS networks, as well.

### **Columbia City**

Columbia City is located in Southeastern Seattle and has a population of 12,531 people. The neighborhood has a land area of 1.6 square miles and a population density of 7,783 people per square mile. Columbia city is a diverse neighborhood with a historic commercial district. The neighborhood is connected by King County Metro bus services and Sound Transit's Link light rail. The economic model reveals the tremendous opportunity to reduce vehicle ownership in Columbia City. There are 7,915 personal vehicles in the neighborhood. A shift to shared mobility transportation modes would reduce the number of personal vehicles by 1,000 to 2,600 (13% to 33%) vehicles. This vehicle reduction would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Columbia City as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Columbia City would:

- Significantly decrease the share of SOV daily trips from 42% to 34%
- Increase transit trip mode share from 4% to 9%
- Increase total daily trips by shared mobility from 1% to 11%

Columbia City would be greatly served by all modes of shared mobility and will experience the benefits of these services including reductions to congestion, parking requirements, curb space optimization, car-free lifestyle, and others.

#### **Policy Implications**

Columbia City has many shared characteristics of both Ballard and U-District. All of the policy implications, with exception to the large event item, should be considered for this neighborhood. Columbia City is served directly by the light rail, contains vibrant commercial corridors, and can benefit from expanded shared mobility.

Columbia City also contains a diverse population from both racial and income perspectives. A special lens on equity should be utilized to ensure that everyone in this neighborhood has access to shared mobility modes. The City can create incentives for reduced-fare or more pooling options in this neighborhood in order to achieve a balance for the access to these services. In addition, issues as the unbanked, language barriers, outreach, and others should be considered in identifying equity measures.

### Downtown Seattle

Downtown Seattle is the central business district of Seattle and is centrally located within the city. The Downtown Seattle neighborhood has a population of 61,633 people, a land area of 3.2 square miles and a population density of 19,074 people per square mile. Within the neighborhood are many districts for government, finance, shopping, nightlife, and culture. As the primary location for employment in the Puget Sound Region, Downtown Seattle acts as the transit hub for the region. This demonstrates the enormous potential to reduce personal vehicles in Downtown Seattle as determined by the economic model (Chapter 2). The number of personal vehicles in Downtown Seattle is 29,385 and would be reduced by 5,000 to 13,000 (17% to 45%) vehicles through increased shared mobility. This vehicle reduction would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Downtown Seattle as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Downtown Seattle would:

- Significantly decrease the share of SOV daily trips from 30% to 18%
- Increase transit trip mode share from 8% to 15%
- Increase total daily trips by shared mobility from 1% to 14%

Downtown Seattle is predominantly a mix of mid to high-rise office and apartment buildings with first floor commercial uses. There are at least 15 surface parking lots in this area in addition to parking garages and underground parking. The blocks between Pike and Pine Streets, which have the highest portion of retail uses in the area in addition to offices and condominium buildings, could be served by around 100 pick-up and drop-off spaces. The blocks further south on Spring Street would require less dedicated pick-up spaces as they are mainly office buildings and hotels. Should surface parking lots be developed into more productive uses, the number of required shared mobility loading spaces would need to be re-analyzed with the subsequent increased trips to the area.



Based on average parking supply ratios for each land use, the parking supply in this area is approximately 42,000 spaces while the required pick-up and drop-off spaces is around 280. All modes of shared mobility would have a tremendous positive impact on Downtown Seattle. It would experience the benefits of these services through reductions to congestion, decreased parking requirements, curb space optimization, car-free lifestyle, and others.

#### **Policy Implications**

Downtown Seattle mobility is already a model for U.S. cities. The Commute Trip Reduction Program already sets targets for non-SOV commute modes and provides incentives for transit and alternate modes. In addition, One Center City, a holistic 20-year transportation plan has begun initial stages and will be critical to identify how people will connect and move through this growing employment and population center. Policy considerations, including those discussed in other neighborhoods regarding ROW, land-use, safety, major event planning, equity, and others, is to utilize both of these programs to ensure that Downtown Seattle can continue to grow and connect all residents and visitors in the region.

Finally -- due to the number of residents, visitors, and commuters this area serves -- a minor mode shift could have major implications. This stated, both programmatic policies and nuanced "nudges" should be employed accompanied by a continuous cycle of pilots.

### Bellevue

Bellevue is a major commercial and residential center in King County located to the east of Seattle and is bounded by Lake Washington to the west and Lake Sammamish to the east. It is also considered a major hub in many ways, and has a population of approximately 132,268 people and a land area of 31.97

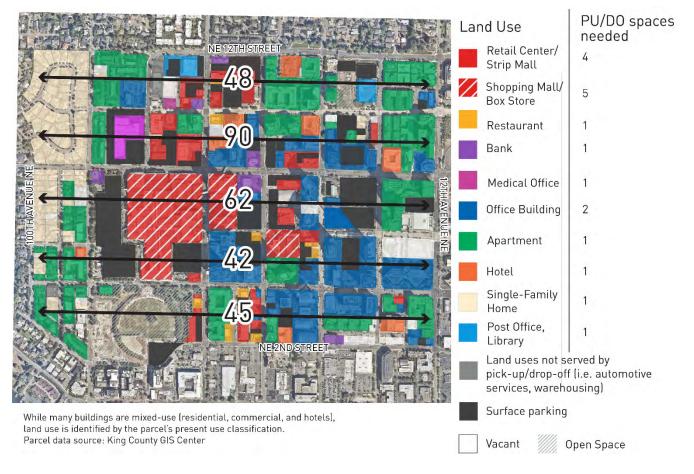
square miles giving it a population density of 4,137 people per square mile. King County Metro and Sound Transit provide transportation services to Bellevue transit hub.

The future travel demand for Bellevue as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Bellevue would:

- Significantly decrease the share of SOV daily trips from 50% to 30%
- Increase transit trip mode share from 3% to 13%
- Increase total daily trips by shared mobility from 1% to 12%

The analysis in Bellevue focused on the Eastgate Neighborhood, which is located on the south side of Bellevue. Bisected by I-90, this area includes a regional shopping center and express transit connection via a major park-n-ride, but is largely surrounded by a disjointed street network. It comprises of a mix of land uses including shopping malls, mid-size office buildings, single-family homes, and apartments. A large amount of surface parking exists, especially near the shopping mall and retail centers or strip malls.

Surface parking dominates much of the landscape in Eastgate. For instance, Bellevue Square Mall alone has a parking lot with more than 1,000 spaces. The spatial analysis shows that with an estimated 384 trips per hour, arrivals and departures to the mall could be accommodated by 5 pick-up and drop-off spaces.



This area of Bellevue is composed of a mix of land uses including shopping malls, mid-size office buildings, single-family homes, and apartments. A large amount of surface parking exists, especially near the shopping mall and retail centers or strip malls. Bellevue Square Mall alone has a parking lot with more than 1,000 spaces. The analysis shows that with an estimated 384 trips per hour, arrivals and departures to the mall could be accommodated by 5 pick-up and drop-off spaces.

Land use implications are the largest potential improvement for areas that are (1) built out, (2) well connected to the transit network, and (3) have other regional destinations in proximity to the site. Based on average parking supply ratios for each land use, the parking supply in this area is approximately 28,000 spaces while the required pick-up and drop-off spaces is around 285.

#### **Policy Implications**

Similar to Ballard, Eastgate could potentially see a transformation of surface parking to active uses. In addition, major arterials could be optimized if connections to the park-in-ride were improved. Identifying more connections for bikes, transit, and shared mobility would greatly-improve usage of the park-n-ride facility leading an increase to the number of transit riders on both express and local routes. Additionally, the park-n-ride could be transformed into a shared mobility hub that creates space for different connecting modes and prioritizes these modes based on the number of users per trip.

As a result of increased shared mobility, Bellevue will receive benefits that will grow over time and will enable new access to last mile connections. Benefits include reductions to congestion, curb space optimization, car-free lifestyle, and others. Additionally, lower parking requirements would free up land use for denser redevelopment opportunities.

### Kent

Kent is a major warehouse and employment center in King County located to the south of Seattle and in near of Sea-TAC airport. Associated with much of the employment opportunities, Kent has a population of approximately 122,620 people and a land area of 28.63 square miles giving it a population density of 4,283 people per square mile. Several large corporations are headquartered in Kent and is one of the largest manufacturing and distribution areas in the United States. Kent is served by King County Metro bus lines and Sound Transit commuter rail. The economic model (Chapter 2) demonstrates that there is meaningful opportunity to reduce auto-ownership. In Kent there are 76,395 personal vehicles. Through increased shared mobility methods, the number of personal vehicles would be decreased by 8,900 to 24,000 (12% to 31%) vehicles. These reductions would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Kent as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Kent would:

- Significantly decrease the share of SOV daily trips from 51% to 36%
- Increase transit trip mode share from 2% to 9%
- Increase total daily trips by shared mobility from 1% to 10%

Kent would receive some benefit from shared mobility especially new last mile connections. Population density, employment density, access to transit, and other factors will limit availability of , carshare, bike share , car share, ridesplitting, and microtransit. Ridesourcing may be a higher valued shared mobility option for Kent as it is the only alternative option for similar mobility as SOV driving. The benefits of these services including reductions to congestion, lower parking requirements, curb space optimization, car-free lifestyle, and others.

#### **Policy Implications**

The biggest mobility challenge for Kent is to establish reliable connections to many manufacturing and warehouse jobs at various hours through the multiple work shifts. Several King County Metro routes serve Kent, but it lacks the density for a high-frequency network. Kent would best leverage shared

mobility through creating partnerships in the near-term for last-mile connections and airport-bound trips. Models can be found in similar pilots in Pinellas County<sup>50</sup> or SEPTA.<sup>51</sup>

Additionally, the Kent Sounder train station has the opportunity to be a focal point for regional mobility and a shared mobility hub for the City of Kent. The station currently sits in the central commercial area and, combined with more mobility options, could enhance density and mixed use land uses. As future regional transit is expanded and service levels increase, opportunities for last-mile will increase.

### Shoreline

Shoreline is a jurisdiction in King County and is located immediately north of Seattle's northern city limits. Though primarily residential it has a similar density to Seattle. Shoreline has a population of approximately 54,254 people and a land area of 11.67 square miles giving it a population density of 4,647 people per square mile. Transit services include King County Metro Transit, Community Transit, and Sound Transit. Our economic model (Chapter 2) demonstrates that there is meaningful opportunity to reduce auto-ownership. In Shoreline there are 37,811 personal vehicles. Through increased shared mobility methods, the number of personal vehicles would be decreased by 4,700 to 12,697 (13% to 34%) vehicles. These reductions would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Shoreline as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Shoreline would:

- Significantly decrease the share of SOV daily trips from 50% to 34%
- Increase transit trip mode share from 2% to 10%
- Increase total daily trips by shared mobility from 1% to 10%

Shoreline has always benefited from close proximity to major employment centers. A big opportunity to strengthen these connections will come along in the next decade due to the Lynwood Link Extension bringing two new light rail stations to Shoreline. In 2023, Shoreline would have a new light rail stations at 145<sup>th</sup> and 185<sup>th</sup> streets located just to the east of I5. The City of Shoreline, in coordination with Sound Transit, is currently identifying ways to ensure these connections enhance mobility and land use.

#### **Policy Implications**

Similar to recommendations for U-District and Kent, a shared mobility hub around the new stations would encourage more connections to the fixed-route transit network, a higher and better mixed of uses, and enhance mobility overall. The City of Shoreline has responded and is performing new sub-area planning efforts. Metro should continue to encourage that shared mobility connections are identified as a key consideration for this area.

As a result of increased shared mobility and light rail service, Shoreline has the opportunity to transform key sub-areas that will benefit from greater connections, lower parking requirements on new developments, curb space optimization, car-free lifestyle, and others.

### Maple Valley

Maple Valley is an exurban bedroom community in King County located to the south east of Seattle at the edge of the Metro Service area. It has a population of approximately 24,040 people and a land area of

<sup>50</sup> http://www.psta.net/press/10-2016/directconnect/index.php

<sup>51</sup> http://www.septa.org/media/releases/2016/05-25-16a.html

5.72 square miles giving it a population density of 4,202 people per square mile. The area is served by King County Metro and Sound Transit.

The economic model (Chapter 2) demonstrates that there is meaningful opportunity to reduce autoownership. In Maple Valley there are 17,079 personal vehicles. Through increased shared mobility methods, the number of personal vehicles would be decreased by 1,700 to 4,600 (10% to 27%) vehicles. These reductions would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Maple Valley as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Maple Valley would:

- Significantly decrease the share of SOV daily trips from 53% to 38%
- Increase transit trip mode share from 1% to 5%
- Increase total daily trips by shared mobility from 0% to 7%

Maple Valley would receive some benefit from decreased SOV and shifts to shared mobility especially new last mile connections. Population density, employment density, access to transit, and other factors will limit availability of , carsharebike share , car share, ridesplitting, and microtransit. Ridesourcing may be a higher valued shared mobility option for Maple Valley as it is the only similar alternative to SOV driving for many trips. The benefits of these services including reductions to lower parking requirements, curb space optimization, car-free lifestyle, and others.

#### **Policy Implications**

Maple Valley could pursue subsidized partnerships with shared mobility providers to make connections to the transit network, essentially serving as an extension of the fixed-route network. Currently, it is served by the 164/168 at limited service intervals. Ridesourcing could help fill in the gaps of service, extending the availability of the entire network. Additionally, Maple Valley would be a good candidate for a dynamically-routed microtransit route/dial-a-ride option that would serve the low-density neighborhoods.

### Sammamish

Sammamish is a jurisdiction in King County located to the east of Seattle. Bounded by Lake Sammamish to the west with bountiful parks, Sammamish has a population of approximately 49,077 people and a land area of 18.22 square miles giving it a population density of 2,693 people per square mile. There are no freeways within the city limits, however King County Metro and Sound Transit provide transportation services to residents. Our economic model (Chapter 2) demonstrates that there is meaningful opportunity to reduce auto-ownership. In Sammamish there are 33,927 personal vehicles. Through increased shared mobility methods, the number of personal vehicles would be decreased by 2,800 to 7,600 (8% to 22%) vehicles. These reductions would have significant benefits to the available right-of-way and land use in the neighborhood.

The future travel demand for Sammamish as presented in the PSRC Travel Demand Model (Chapter 3) shows a remarkable shift in the travel modes of choice. With a 25% reduction in auto ownership in 2030 Sammamish would:

- Significantly decrease the share of SOV daily trips from 52% to 37%
- Increase transit trip mode share from 1% to 6%
- Increase total daily trips by shared mobility from 1% to 9%

Sammamish would receive some benefit from decreased SOV and shifts to shared mobility especially new last mile connections. Population density, employment density, access to transit, and other factors will limit availability of bike share, car share, ridesplitting, and microtransit. Ridesourcing may be a higher

valued shared mobility option for Sammamish as it is the only similar in mobility but alternative to SOV driving for many trips and the enhancement in mobility is valuable in a mobility-scarce atmosphere. The benefits of these services including reductions to congestion, lower parking requirements, curb space optimization, car-free lifestyle. Additionally, people aging in place and low income groups would have increased accessibility to transportation.

#### **Policy Implications**

Similar to Maple Valley, Sammamish could pursue subsidized partnerships with shared mobility providers to make connections to the transit network, essentially serving as an extension of the fixed-route network, which currently ends outside of the city limits. Ridesourcing could help fill in the gaps of service, extending the availability of the entire network. Additionally, Maple Valley would be a good candidate for a dynamically-routed microtransit route/dial-a-ride option that would serve the low-density neighborhoods.

## Selected Bibliography

The following bibliography is derived from selected chapters of "Shared Mobility: Current Practices and Guiding Principles", an FHWA report written by Susan Shaheen, Adam Cohen, and Ismail Zhody. It contains a collection of references that provide relevant background regarding the state of the shared mobility industry in 2016 and supporting research. For more background, please see report number FHWA-HOP-16-022.

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# APPENDIX C

PRELIMINARY AUTOMATED MOBILITY POLICY FRAMEWORK

## PRELIMINARY AUTOMATED MOBILITY POLICY FRAMEWORK FOR SEATTLE

The automaker and transportation technology industries are investing billions of dollars to advance automated vehicle (AV) research and development. The industry envisions bringing the technology to market within the next decade. Automated vehicles have the potential to dramatically reduce traffic deaths and serious injuries, helping us achieve our Vision Zero safety goals. Shared automated fleets could also strengthen connections to and from public transit and dramatically reduce the personal costs of mobility. But how do we transition to a future with connected and automated vehicles without exacerbating congestion and land use impacts? Automated vehicles will be a reality in Seattle, and we must be prepared to extract the best outcomes from their arrival.

Like any other emerging technology, the City of Seattle must shape how automated mobility impacts and benefits our citizens even as the details of the technology are in flux. We will plan for the inevitable emergence of connected and fully automated vehicles using a historical lens. Cities around the country continue to learn tough lessons from overreliance on the automobile. As a new model of automobility is introduced to Seattle, we have a century's worth of experience understanding and managing the impacts of motor vehicles. As automated vehicles arrive in Seattle, we must ask: What do we want our city to look like? To what extent should we use these new technologies to ensure our citizens are included, happier, healthier, safer, and more financially secure?

## "New disruptive technology has the potential to remake city streets, and policies must directly address their expected widespread impact on safety, mobility, and land use"

– NACTO, Policy Recommendations for the Future of Automated Vehicles

The following policy framework directs us toward a future with fully automated, shared, connected, and electric mobility and advances Seattle as a walkable, bikeable, transit-oriented, and innovation-friendly city in the future. Our approach balances innovation with setting clear expectations for management and operating parameters. We aim to:

- 1. Continue prioritizing the needs of people walking, biking, and taking transit and leveraging the growth of our robust transit network
- 2. Support the development and testing of automated mobility technology, learning from the pilots and partnerships with local and national technology and operating equipment manufacturers (OEMs)
- 3. Establish clear policy parameters that ensure automated vehicles help achieve SDOT's five core values and our shared and emerging mobility principles —not counteract them

Building on the National Association of City Transportation Officials' (NACTO) Policy Statement on Automated Vehicles, released in June 2016, Seattle's automated mobility policy framework is organized according to seven policy pillars. While we intend to adopt the policy framework by City Council ordinance, the policy directives highlighted below should be reassessed periodically to mirror not only the dynamic nature of the automated mobility industry and new advancements in supply- and demandside mobility strategies, but also the complex dynamics related to shifting from human-operated vehicles to fully automated vehicles. This is a starting point that will be monitored and updated as the field advances.

# What are the ground rules for regulating automated vehicles?

In 2016, the United States Department of Transportation (USDOT) and the National Highway Traffic Safety Administration (NHTSA) established draft regulatory guidance on federal and state agency roles regarding the manufacture and operation of automated vehicles. USDOT and NHTSA have broad authority to set Federal Motor Vehicle Safety Standards, vehicle design requirements, and cyber security elements. State agencies play a role in licensing drivers and vehicles, setting liability rules, and establishing pilot regulations, among other controls.

But what is the role of local governments? Under the City of Seattle's police powers, we can develop and enforce automated-vehicle-specific traffic laws, dedicate right of way for automated vehicles, manage and price parking, and establish specific requirements related to levels of automation. We can also manage system impacts and introduce road use pricing schemes to manage demand. Finally, fleet services that are licensed by the City of Seattle could be required to meet basic requirements related to data sharing, equity, and accessibility.

#### Figure 1: Federal, state, and local regulatory authority over automated vehicles

Federal	State	Local
<ul> <li>Safety standards</li> <li>Base privacy and data sharing requirements</li> <li>Cyber security</li> <li>Equipment and manufacturing standards</li> <li>Vehicle design</li> <li>Infrastructure planning and funding</li> <li>Funding for AV operations</li> <li>Research funding</li> <li>Public communication</li> </ul>	<ul> <li>Infrastructure planning and funding</li> <li>Funding for AV operations</li> <li>Research funding</li> <li>Human driver licensing</li> <li>Motor vehicle registration</li> <li>Insurance and liability regulations</li> <li>Traffic laws and regulations</li> <li>Safety inspections</li> <li>Pilot regulations</li> <li>Demand and system management for State and Interstate highways</li> </ul>	<ul> <li>Demand and system management for local streets</li> <li>Parking and curbspace</li> <li>Land use regulation</li> <li>Curb and road use fee setting</li> <li>Local transportation financing</li> <li>Traffic laws and regulations</li> <li>Data sharing for system planning and real-time operations</li> </ul>

## PRINCIPLES FOR AUTOMATED MOBILITY

Embracing technology alone will not meet our city's needs. In the end, automated vehicle technology is only one of the future tools that could help us achieve our broader community goals. We leverage innovation to support our transit network and provide ubiquitous mobility for all. We use shared automated vehicle services and other emerging mobility technologies in service of our core values: to become a safe, interconnected, vibrant, affordable, and innovative city.

Leveraging automated mobility to meet our core values requires an intentional, outcome-driven, and anticipatory approach to policy direction. As with any other shared or innovative mobility solution, automated mobility will be driven by the following principles.

Put People First	The public right of way is our most valuable and most flexible public space. Our streets should prioritize access for people, never jeopardizing the role and value of walking, biking, and transit in Seattle. We respect the desire to retain and use privately owned vehicles but will continue to manage the transportation system to move people and goods safely and efficiently.
Design for Customer Dignity and Happiness	Transportation happiness is a key indicator for the 21st century Seattle Department of Transportation. We will not only simplify and enhance the user experience of public transit and new mobility services, we will also continue to promote a diversity of transportation choices. Dignified public transit and new mobility services must accommodate people with mobility impairments, non-traditional schedules, and families that need flexible mobility options.
Advance Race and Social Justice	Mobility, whether shared, public, private, or automated, is a fundamental human need. Everyone needs a barrier-free transportation system and affordable transportation options that are understandable and accessible to all who want to use them. New mobility models should also promote clean transportation and roll back systemic racial and social injustices borne by the transportation system.
Forge a Clean Mobility Future	We are committed to climate action. We will transition our transportation sector to one that furthers our climate goals and builds replicable models for the rest of the world. New mobility services should use clean energy and expand human-powered transportation.
Keep an Even Playing Field	Data infrastructure is foundational to understanding, operating, and planning in a constantly changing transportation system. Partnerships and a fair and flexible regulatory environment will nurture and expand new mobility ideas, companies, jobs, and workforce training.

## **REGULATION AND PARAMETERS**

The following policies establish regulations and operating parameters that standardize automated vehicle behavior to ensure their operations are safe, shared, connected, and electric.

**Policy RP1:** Enact a "people and transit first" approach to automated mobility, ensuring our streets safely move people and goods and prioritize transit, based on the following right of way priorities (in order):

- 1. Modal plan priorities
- 2. Access for people
- 3. Access for commerce

- Greening
   Minimized storage
- 7. Minimized zero occupancy vehicles

4. Activation

**Policy RP2:** Allow a combination of human-driven (SAE Level 0 or 1) and fully automated vehicle operations (SAE Level 4 or 5) within the City of Seattle to eliminate the dangers of partial automation (SAE Levels 2 and 3), such as creating a false sense of security, encouraging distracted driving, and exacerbating driver error.

### Levels of Automation

Automated vehicles—whether they are private vehicles, buses, trains, or freight vehicles—provide different levels of automation or human-driven functions depending on the type of task or operating scenario. The Society of Automotive Engineers (SAE International) developed a six-level taxonomy governing the varying degrees and types of vehicle automation and associated levels of human interaction.

SAE LEVEL	NO AUTOMATION	At SAE Level 0, the human driver performs all driving tasks across all driving scenarios
SAE LEVEL	DRIVER ASSISTANCE	At SAE Level 1, an automated system on the vehicle can assist the human driver in steering, accelerating and decelerating in some driving scenarios. The human driver is responsible for monitoring the driving environment.
SAE LEVEL	PARTIAL AUTOMATION	At SAE Level 2, an automated system on the vehicle can control steering, acceleration and deceleration in some driving scenarios, while the human continues to monitor the driving environment and performs the rest of the driving tasks
SAE LEVEL	CONDITIONAL AUTOMATION	At SAE Level 3, an automated system, in some driving scenarios, can conduct all parts of the driving task and can monitor the driving environment. However, the human driver must be ready to take back control when the automated system requests.
SAE LEVEL	HIGH AUTOMATION	At SAE Level 4, an automated system can conduct all parts of the driving task and can monitor the driving environment in some driving scenarios. Within these select driving scenarios, the human driver does not need to be ready to take control of the vehicle.
SAE LEVEL	FULL AUTOMATION	At SAE Level 5, the automated system can perform all driving tasks in all driving scenarios. Human passengers need not be attentive or even capable of driving the vehicle.

Source: SAE International Standard J3016: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems

**Policy RP3:** Hard code the following base operating parameters into connected and automated vehicles:

- Maximum operating speeds for automated vehicles on City arterials and non-arterial streets at legal limits to ensure our streets are safe, comfortable, and vibrant.
- Passenger occupancy requirements for non-transit vehicle use of transit lanes.
- Functional classification system for automated vehicles and network of peak period smart lanes dedicated to SAE Level 4 and 5 automated vehicles. This includes but is not limited to:
  - Lanes for fully automated vehicles only (no human operation allowed)
  - Full access for automated vehicles with SAE automation Levels 1, 2, 4, and 5
  - Limited access for low-occupancy automated vehicles
  - Zero access for automated or human-operated vehicles
- Time-based access restrictions on geofenced congestion management corridors and districts.
- Transit priority at all intersections along frequent transit corridors.

**Policy RP4:** Collaborate with federal and state policymakers to ensure SDOT's core local controls and police powers related to automated vehicle regulation are not preempted.

**Policy RP5:** Establish time-based access restrictions or pricing for geofenced congestion management corridors and districts for certain vehicle types (e.g., automated freight, single-occupant, and zero-occupant vehicles during peak travel periods).

Policy RP6: Require shared automated vehicle fleets to use fully electric vehicles.

**Policy RP7:** Require submission of detailed data from automated owned vehicles, shared fleet services, commercial fleets, freight, and transit to neutral data platforms. Required data will include vehicle speeds, crash and near miss reports, average latency of vehicle-to-infrastructure and vehicle-to-vehicle data flows, trip time, trip route, trip origins and destinations, vehicle occupancy, pavement quality, and environmental conditions.

**Policy RP8:** Protect the privacy of individuals by anonymizing personally identifiable data generated by connected and automated vehicles.

## **EQUITY AND ACCESSIBILITY**

The following policies ensure that automated mobility and other future transportation innovations are designed with a racial and social justice lens, accommodating the wide cross section of Seattleites' abilities and backgrounds.

**Policy EA1:** Ensure the benefits of automated mobility are equitably distributed across all segments of the community and that the negative impacts of automated mobility are not disproportionately borne on traditionally marginalized communities.

**Policy EA2:** Ensure shared automated vehicle fleets consider the safety needs of vulnerable populations and loading needs of seniors, families with children, and individuals with mobility impairments.

**Policy EA3:** Establish equitable performance standards and penalty structures for shared automated vehicle fleet wait time and declined rides as a way to eliminate discriminatory practices.

**Policy EA4:** Require a percentage of shared automated vehicle fleet vehicles to be ADA-compliant to meet the needs of people with disabilities.

**Policy EA5:** Identify and require shared automated vehicle fleets to serve markets that are underserved by transit and focus on connecting people to high-quality transit spines.

**Policy EA6:** Acknowledge and mitigate the labor implications of automated mobility, particularly in the for-hire, freight, and public transit industries, among others.

**Policy EA7:** Conduct a publicly visible community consultation and outreach process to understand concerns, needs, and opportunities related to the impending automated mobility paradigm.

**Policy EA8:** Establish a City-owned transportation network company digital platform to incubate smaller shared automated vehicle fleet businesses, mitigating the risk of mobility monopolies in Seattle.

## **PILOTS AND PARTNERSHIPS**

The following policies direct SDOT to establish partnerships and pilots that advance automated vehicle testing, particularly new models of mobility service delivery.

**Policy PP1:** Develop strategic pilot partnerships to test automated vehicle technology in Seattle's climate, hilly terrain, and urban traffic conditions.

**Policy PP2:** Develop strategic research partnerships to determine needs and effectiveness of physical infrastructure, connected sensor infrastructure, and requirements for personal digital devices.

**Policy PP3:** Work with our region's transit agencies to ensure automated vehicles support safer transit operations and grow the public transit market.

**Policy PP4:** Work with our region's transit agencies to pilot new automated transit service delivery models that improve first- and last-mile transit connections and cost effectively serve unproductive geographic markets, while recognizing the impact on labor.

**Policy PP5:** Leverage research support from the University of Washington to analyze the safety implications of automated vehicle operations and integrate policy and operational recommendations into SDOT's work implementing the Vision Zero Action Plan.

**Policy PP6:** Partner with shared automated vehicle fleet services and operating equipment manufacturers to develop and promote family-friendly shared automated fleet services.

**Policy PP7:** Promote changes in urban goods movement by participating in automated freight vehicle pilots that focus on "last 50 feet" delivery challenges, hub-and-spoke delivery models, and aerial and surface drone delivery.

**Policy PP8:** Work with Puget Sound Regional Council and other local cities to update the base assumptions in the activity-based regional travel demand model to reflect ongoing changes to travel time costs, transportation costs, travel options through Mobility as a Service platforms, vehicle shedding and suppression, and transit expansion, among others.

## **INFRASTRUCTURE AND STREET DESIGN**

The following policies establish expectations related to right of way allocation, intersection control, transit access, and connected infrastructure under an automated mobility paradigm.

**Policy IS1:** As vehicle ownership decreases and reliance on shared automated vehicle fleets increases:

- Capitalize on system efficiencies to implement our Transit, Bicycle, and Pedestrian Master Plans.
- Capitalize on opportunities to invest in placemaking features and expand the pedestrian realm.
- Identify and phase in corridors and zones dedicated to transit, walking, biking, and high-occupancy automated vehicles only.

**Policy IS2:** Establish multimodal level of service (MMLOS) or another vehicular level of service alternative as the default intersection performance measure to ensure efficient person movement, but also safer and more comfortable intersections.

**Policy IS3:** Work with our region's transit agencies to ensure automated vehicles support safer transit operations and grow the public transit market.

**Policy IS4:** Maintain intersection traffic control (e.g., signal control, stop control, and traffic calming devices) to ensure comfortable crossings for people walking and biking.

**Policy IS5:** Consider the loading needs of shared automated fleet services at shared mobility hubs to ensure seamless connections to and from high-quality transit.

**Policy IS6:** Expand SDOT's sensor network to track automated vehicle use, enable vehicle platooning, and ensure safe and efficient automated vehicle operations.

**Policy IS7:** Partner with the private sector to expand the city's network of Vehicle-to-Infrastructure (V2I)-enabled sensors (e.g., roadside units) on Seattle Department of Transportation and Seattle City Light infrastructure in the public right of way.

**Policy IS8:** Collaborate with operational equipment manufacturers, technologists, and federal AV policymakers to establish outcome-based vehicle form factors that change the way we design and operate streets.

**Policy IS9:** Develop a citywide network of shared residential streets to be operationalized when Level 4/5 automated vehicles comprise a majority of all personal and shared fleet vehicles licensed in Seattle.

**Policy IS10:** Expand passenger loading zones citywide to ensure safe and efficient loading operations for shared automated vehicle fleet services.

## **MOBILITY ECONOMICS**

Automated vehicles will have profound implications on the way we fund and manage our transportation system. The economics of automated vehicles will likely compound congestion levels by increasing per capita miles driven and creating new opportunities for zero-occupant travel and enterprise robotaxi services. These scenarios must be acknowledged and mitigated. Likewise, shared automated vehicle fleets as well as electric vehicles will dramatically reduce gas tax and parking revenues, changing our financial approach to managing, operating, and maintaining the public right of way. The following policies provide direction on the types of funding mechanisms that could be advanced in the automated mobility paradigm. The policies also establish the pricing and demand management tools necessary to ensure automated vehicles are primarily used for shared mobility trips, limit inefficient trips, and maximize the value of our public transit investments.

**Policy ME1:** Develop a tiered and dynamic per mile road use pricing mechanism for automated vehicles operating in highly congested areas and corridors of Seattle:

- Tier 1 (elevated surcharge): Zero-occupant automated vehicles
- Tier 2 (base surcharge): Single-occupant automated vehicles
- Tier 3 (reduced surcharge): Automated vehicles using smart lanes with less than three passengers (see Policy RP3)
- Tier 4 (no surcharge): Automated vehicles using smart lanes with three or more passengers (see Policy RP3)
- Tier 5 (additional surcharge on Tiers 1-3): Peak travel period surcharge for all non-public transit vehicle trips with less than three passengers, including freight.

**Policy ME2:** Incentivize shared automated vehicle trips that provide access to public transit service at shared mobility hubs.

**Policy ME3:** Integrate shared automated vehicle fleet application programming interfaces (API) into Mobility as a Service platforms to ensure all shared fleet options are available to consumers.

**Policy ME4:** Continue Commute Trip Reduction and Transportation Demand Management investments that encourage high-occupancy vehicle trips, particularly those trips that leverage our region's investment in Seattle Transportation Benefit District (STBD) service enhancements and high capacity transit.

**Policy ME5:** Assess and establish alternatives to parking and state gas tax revenue sources, including, but not limited to, zero- and low-occupancy fees, curb-side dwell time fees, per mile road use charges, cordon tolling, and peak period surcharges.

**Policy ME6:** Provide road use fee discounts or incentives for automated vehicles with three or more passengers.

**Policy ME7:** Monetize and sell SDOT-owned sensor data to be used for data aggregations and connected vehicle optimization.

**Policy ME8:** Provide road use fee discounts or incentives for automated vehicle trips that combine a mobility and goods delivery function (e.g., fee offsets for deliveries made on behalf of delivery companies).

**Policy ME9:** Mandate connected vehicle technology in all vehicles and data sharing to establish a clear understanding of travel demand and enable financial auditing of fee revenues.

## LAND USE AND BUILDING DESIGN

The following policies reaffirm our commitment to building dense, vibrant, and transit-oriented communities. These policies also redirect development and parking standards to reflect new and dynamic relationships between automated vehicles and the built environment.

**Policy LB1:** Ensure automated vehicles advance our land use goals and capture the value of transitoriented development.

**Policy LB2:** Require future development and building standards to be future-compatible, reflecting advances in shared automated mobility and shifts toward e-commerce and new urban goods movement and delivery models.

**Policy LB3:** Consider the advancement of new passenger and delivery form factors in the design of buildings and public spaces (e.g., smaller vehicles, drone delivery services, and smaller vehicles for last-mile deliveries).

**Policy LB4:** Working with the Seattle Office of Planning and Community Development and Department of Construction and Inspections, update the zoning code to:

- Ensure all new parking is adaptively reusable for retail, distribution, and other uses (including mandating higher floor heights and above-ground parking to enable retrofits).
- Require new parking to be furnished with Level 2 EVSE charging infrastructure.
- Phase out off-street parking requirements as demand for personal vehicles decreases, and redirect these developer cost savings toward affordable housing and transportation demand management incentives.
- Integrate digital kiosks and other smartscaping features into the design of buildings so that residents, tenants, and passersby can gain access to mobility information, community data, and Mobility as a Service platforms.
- Integrate surface street and aerial drone delivery into building design and operations.

# **APPENDIX D**

REGULATORY CONSIDERATIONS FOR THE SHARED MOBILITY LANDSCAPE

# REGULATORY CONSIDERATIONS FOR THE SHARED MOBILITY LANDSCAPE

The Seattle Department of Transportation, Seattle Department of Finance and Administrative Services, King County Records and Licensing Services, and King County Metro jointly developed a set of forward-thinking regulatory considerations to address the current and future landscape of shared mobility providers. These considerations establish common values for shaping the future of shared mobility services in Seattle.

### Streamline regulation.

We will streamline code requirements and permitting processes with the intent to add new services to our mobility ecosystem, ensure regulatory compliance, and improve the customer experience.

### Defer core governing functions to the State.

Certain regulatory functions should be consistent across jurisdictional boundaries. The State should regulate safety standards, minimum vehicle emission requirements, and insurance and liability regulations, among others. Where standards are not established at the State or federal level, the City should establish basic safety principles.

### Support umbrella platforms.

Whether regulated at the local, regional, or statewide level, shared mobility services that provide similar services should be regulated equitably across service types to maximize public good, and minimize disruption to emerging mobility innovations. We prefer an umbrella licensing model based on service type, not on "mode" because of the constant blurring of shared mobility functions.

### Establish appropriate levels of data sharing.

We require historic and, in some cases, real-time data to understand the impacts and benefits of shared mobility services. Data collected should clearly connect to a clear need, so that appropriate levels of data sharing can be used for planning, policymaking, and effective right of way management. Proprietary information has been identified in other industries and exempted from disclosure, but that must be balanced against the public interest in data about the industry.

### Ensure services operating in Seattle are equitable and accessible.

New mobility services should be accessible and compliant with the Americans with Disabilities Act. Furthermore, local and statewide legislation should prevent discriminatory practices and ensure equitable service throughout Seattle.

### Maintain local control of the public right of way.

The City of Seattle should continue to manage the right of way to ensure passenger and street user safety and effective operation of the public right of way.

#### Daylight rates for customers.

The customer should know how much they can expect to pay and estimated fares should not differ significantly from the actual fare paid.

### Ensure a living wage for those employed in the shared mobility industry.

Employees and contractors of shared mobility service providers and digital platform companies should earn a living wage. The shared mobility labor force should not need to work unsafe amounts of hours to make enough money to live in the Seattle region.

### Maintain auditing and enforcement at the local level.

Auditing needs to happen at the local level and requires driver information. We should employ the "trust but verify" approach to onboard drivers and ensure compliance with ongoing background checks.

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