Transportation Policy Options: New Mobility Services and Autonomous Vehicles

Spring 2019
Eugene · Gresham

Stacie Duffey • Grace Park • Michael Thomas • Benjamin Clark

PPPM 638/639 Master of Public Administration Capstone Project

UNIVERSITY OF OREGON   Eugene   CITY OF GRESHAM OREGON   SCI Sustainable Cities Institute   SCYP Sustainable City Year Program

Transportation Policy Options: New Mobility Services and Autonomous Vehicles

Stacie Duffey

Report Author • School of Planning, Public Policy, and Management

Grace Park

School of Planning, Public Policy, and Management

Michael Thomas

School of Planning, Public Policy, and Management

Benjamin Clark

Associate Professor • School of Planning, Public Policy, and Management

Michael Howard

Advisor • School of Planning, Public Policy, and Management

COLLEGE OF DESIGN

Acknowledgments

The authors wish to acknowledge and thank the following companies, governments, and individuals who helped make this project possible by offering their time, expertise, and input.

Contents

About SCI

The Sustainable Cities Institute (SCI) is an applied think tank focusing on sustainability and cities through applied research, teaching, and community partnerships. We work across disciplines that match the complexity of cities to address sustainability challenges, from regional planning to building design and from enhancing engagement of diverse communities to understanding the impacts on municipal budgets from disruptive technologies and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

—
1. Our Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and

—
2. Our Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

In all cases, we share our expertise and experiences with scholars, policymakers, community leaders, and project partners. We further extend our impact via an annual Expert-in-Residence Program, SCI-China visiting scholars program, study abroad course on redesigning cities for people on bicycle, and through our co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which is transferring SCYP to universities and communities across the globe. Our work connects student passion, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a year-long partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service-learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations resulting in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

About Urbanism Next

The Urbanism Next Center at the University of Oregon focuses on understanding the impacts new mobility, autonomous vehicles, e-commerce and the sharing economy are having and will continue to have on city form, design, and development. The Center does not focus on the emerging technologies themselves, but instead on the multi-level impacts — how these innovations are affecting things like land use, urban design, building design, transportation, and real estate and the implications these impacts have on equity, health and safety, the economy, and the environment. Urbanism Next brings together experts from a wide range of disciplines including planning, design, development, business, and law and works with the public, private, and academic sectors to help create positive outcomes from the impending changes and challenges confronting our cities.

About Eugene, Oregon

The city of Eugene is a central hub of commercial, educational, and recreational activity in the southern Willamette Valley. Incorporated in 1862 as "Eugene City," residents sought to turn Eugene into a center of learning. To that end, they raised the initial funding to start the University of Oregon, now the city's flagship university and public research facility.

With a population of just over 160,000 people, Eugene is Oregon's second largest city and the county seat of Lane County. Located in the heart of the county along the Willamette and McKenzie Rivers, Eugene is recognized for its green landscape, recreational opportunities, and sustainability efforts. The city's slogan, "A Great City for the Arts and Outdoors," reflects its commitment to the arts and culture as well as nature preservation efforts. Eugene is also popular for many nearby recreational opportunities, including Willamette Pass Ski Area, Fern Ridge Reservoir, and hiking and rafting along the McKenzie River.

About Gresham, Oregon

With over 110,000 people, Gresham is the fourth largest city in Oregon. Portland, the largest city in the state, borders it to the west. Gresham is ideal for families and businesses wanting to start something new and grow.

Gresham is near the Columbia Gorge National Scenic Area and Mount Hood, the highest point in Oregon. It has a wide variety of neighborhoods including: the Civic Center, known for its active transportation network, rapid transit connections, and residential, commercial, and retail mix; Historic Downtown which offers a walkable blend of shops, restaurants, and service businesses; and Rockwood, one of the youngest and most diverse neighborhoods in Oregon.

Course Participants

STACIE DUFFEY, Master of Public Administration

GRACE PARK, Master of Public Administration

MICHAEL THOMAS, Master of Public Administration

Acronyms & Definitions

AV — Autonomous Vehicle
eAV — Electric Autonomous Vehicle
EV — Electric Vehicle
MaaS — Mobility as a Service
SMILE — Shared Micromobility
Integration Lane with Emergency
access
TNC — Transportation Network
Company

TSP — Transportation System Plan
VMT — Vehicle Miles Traveled
Active transportation — Walking,
public transit, privately-owned bicycles,
not driving one's own car
New mobility services — Autonomous
vehicles, ride sharing/hailing, electric
scooters, bikes, drones, etc.

Executive Summary

The cities of Eugene and Gresham want policy recommendations to prepare for the future of new mobility services and autonomous vehicles (AVs). Both cities hope to integrate these new policies into their Transportation System Plans (TSPs).

This report provides practical new mobility policy options for each city to consider from eight priority topics: safety, equity, land use, innovation, environmental impact, congestion and vehicle miles traveled (VMT), active transportation, and data. Policy recommendations were created based on our research findings that included a literature review, analysis of other cities' TSPs, and interviews we conducted with transportation professionals across the public, private, and nonprofit sectors. The data from all three sources helped inform new mobility best practices presented in this report.

The literature pointed mostly to concerns with uncertainty and possible unintended consequences of new mobility services and AVs. Some examples include minimal improvements to carbon emissions, public health concerns, and major infrastructure changes needed to accommodate the future of transportation. The findings from our interviews suggest that data requirements and privacy, equity, safety, land use, and innovation were the topics of highest priority in the field. Consequently, we developed more policy recommendations for those areas of interest. We found that many policies nationwide are in pilot stages and have the potential to be changed at any moment. Review of other cities' TSPs also helped collect information on the feasibility and practical implementation of new mobility policies. While the original intent was to develop unique policy recommendations for each city, we found in our research that new mobility policies that are currently considered best practice are applicable to all cities of different sizes and contexts. Thus, most of our policy recommendations apply to both Gresham and Eugene with some added specifications for each city.

Introduction

The cities of Eugene and Gresham recognize the potential deployment and possible future demand for new mobility services such as scooters, bikes, and autonomous vehicles in their localities.

To plan for the successful deployment of many of these services, the cities partnered with the University of Oregon's Sustainable City Year Program and Urbanism Next Center to research existing best practices and possible policy recommendations for the cities to use in accordance with the goals outlined in their TSP.

These policy needs are based, in part, upon each city's adopted TSP and the projections of the future contained within. Gresham faces different challenges than Eugene due to its proximity to Portland, as well as an added level of complexity in coordinating with Metro. Eugene adjoins Springfield, but for the most part each city works independently. Public transit in Eugene is provided by a transit district similar to Gresham, but Eugene only includes buses and bus rapid transit. Transit in Gresham is comprised of light rail (MAX) and buses and will include bus rapid transit when the Division Transit Project is built. Therefore, a review of each city's TSP provides context for each city's requested policy focus and helps to frame its thinking about new mobility options. There is some commonality in the two cities and their TSPs. Readily apparent is that both TSPs acknowledge fossil-fuel powered, privately-owned vehicles as the dominant transportation mode for the foreseeable future (City of Eugene, 2017; City of Gresham, 2018).

Eugene's current 2035 TSP defines development over the next 20 years to better support transportation services and facilities for residents. The plan introduces Eugene's goal of creating a bikeshare program to make biking more appealing and establish a biking network. The deployment of PeaceHealth Rides in 2018 was key in achieving this goal. The city now wants to further amend its TSP and policy commitments to incorporate AVs and new mobility services, as well as address climate change with the reduction of fossil fuels (City of Eugene, 2017).

Eugene's TSP focuses heavily on current technology, namely privately-owned cars. The plan focuses on improving traffic flow for the immediate future and does not necessarily project for more autonomous vehicles using the road (City of Eugene, 2017). However, multiple city transportation planners we interviewed did mention that improved road infrastructure will help with the successful deployment of AVs. These officials stated that well-marked, navigable roads with no potholes, flowing on- and off-ramps, and clearly laid out interchanges and intersections will likely make addressing driving issues easier for early generation AVs.

Gresham's 2035 TSP is a 20-year blueprint to implement a multimodal transportation network. The guiding principles aim to support the growth and development of Gresham as an economically viable and livable city with a dependable transportation

system. Their policies focus on topics such as developing and improving their street system, transit system, bicycle system, and more. However, the city's TSP future projections still sees 48% of vehicle trips in the city being completed by single-occupancy, fossil-fueled, privately owned vehicles as late as 2035 (City of Gresham, 2018).

Both cities plan on incorporating policies into their plans to accommodate new mobility services, including the potential possibility of a much larger percentage of people choosing Mobility as a Service options as opposed to single-occupancy vehicles. The policies recommended in this report intend to help each city accomplish this.

With this information and research conducted through interviews, we can offer potential policies for Gresham's primary interests regarding innovation management, land use, environmental impact, and data requirements, and Eugene's focus on safety, equity, active transportation, and environmental impact.

Background

Cities preparing for AVs and new mobility services are considering the consequences for public transportation and the urban landscape of these far-reaching technological changes (Steckler, 2019). These consequences include safety, equity, and overall public health for the general public as well as land use, active transportation, vehicle miles traveled, data, and innovation.

A review of the available literature gave us a framework to design policy recommendations. The following summarizes our initial literature review regarding the topics of interest to our client cities.

1. Safety

Safety is a primary concern for cities working to develop policies addressing the advent of AVs and new mobility services. Our research concluded that AVs may improve public health by lowering rates of vehicular accidents. However, dockless transportation such as e-scooters and bikes represent an imminent safety concern for cities, and the existing research does not offer insight on improving the safety of these mobility platforms.

2. Equity

Cities can address the equity challenges AVs and other mobility services represent through new policies. AVs and mobility services use technologies (apps) that exclude populations who lack access to this technology (Steckler, 2019). AVs and new mobility services may also undercut public transportation capabilities, thus limiting access for those who rely solely on public transit (Richland, Lee, & Butto Duggan, 2016).

3. Active Transportation

Studies conclude that supporting active transportation "draws a direct connection between policy goals related to safety, health, reducing greenhouse gases, complete streets, and sustainable and livable cities" (Steckler, 2019). Cities must integrate AVs and new mobility services with existing active transportation options.

4. Environmental Impact

New mobility services may potentially lower transportation's environmental impact, specifically with greenhouse gas emissions. However, experts note if these AVs and new mobility options do not run exclusively on electricity, they "at best will be a temporary fix for the global carbon emissions crisis and at worst will exacerbate the problem by increasing vehicle miles traveled (VMT)" (Crute et al., 2018, p. 19). Policies are needed to ensure that these new services can be built to operate electrically.

5. Congestion and Vehicle Miles Traveled

Researchers debate whether AVs will increase or decrease the overall vehicle miles traveled (VMT) and congestion modern cities face, because while people might more efficiently share AVs rather than driving alone in a privately-

owned car, this ease of access may lead to more VMT and congestion. Cities could adapt anti-congestion policies designed for human controlled vehicles upon AVs.

6. Land Use and Metropolitan Footprint

AVs and new mobility services have the potential to change multiple aspects of urban living and city operations including land use and a city's footprint. AVs may decrease both a city's need for parking and its revenues from current parking policies. Cities may have to rethink their "curb space" and sidewalks to incorporate diverse new mobility options. Therefore, cities will need land use policy recommendations to handle both current and future requirements.

7. Data Requirements and Privacy

New mobility and AVs rely on data. Service providers are producing terabytes of data, requiring cities to develop policies to use, exchange, and protect these data. Access to these data is desirable because it allows cities to plan for infrastructure and manage impacts. The city of Los Angeles is leading many of these policy developments. Although not complete, Los Angeles recommends policy options for data-sharing and collection and protocols with service providers to exchange data and improve service (Hand, 2016).

8. Innovation

Transportation technology is improving at a rapid pace. Many cities could consider adapting Seattle's New Mobility Playbook (2017) or a similar strategy as it provides relevant policy options now and into the future to address new mobility, with

considerations for autonomous vehicles, electric vehicles, public transit, ride sharing, ride hailing, and other mobility options.

There is one area the preceding literature does not address. According to an International City Managers' Association (ICMA) report (2018), state governments may enact policies regarding new mobility services that will restrict cities, such as Eugene and Gresham, from being able to take action and adapt to new technology without first obtaining permission. Steckler (2019) wrote about Transportation Network Companies (TNCs) pushing state legislatures to establish statewide control of new mobility options instead of municipal governments. The article states that this will improve the economies of scale for private firms in the market by standardizing the rules by which companies must comply. However, this will likely cripple local government control of these new mobility options.

Such statewide regulations enforce a "one size fits all" approach to mobility services, making service regulation at the municipal level too restrictive for some cities and too lax for others, according to James Owain in a Mobility Lab (2018) article. Portland and San Francisco are concerned that statewide regulations will limit each city's desire for equitable and safe services while eliminating access to data and restricting the ability to earn revenue (Howell, 2019; Owain, 2018).

Mobility Strategist Andrew Hastings argued that "cities know best" when it comes to regulating mobility services (2019). He writes that private companies are backing these laws in state legislatures specifically to prevent

cities from doing what is in their best interest (Howell, 2019). Knowing cities cannot adopt ordinances that are in conflict with state laws, a concept called preemption, private companies use such laws to circumvent restrictions while invoking the concept of standardization (Hastings, 2019; Zipper, 2019).

We acknowledge that our policy recommendations may be preempted by possible future state laws, but since these state laws — at the time of this writing — have not been adopted, we consider it outside of the scope of this report.

Methodology

Our research is based on data from interviews (Appendix A), a literature review, and review of Transportation System Plans and related new mobility reports from the cities we interviewed. We used these sources of information to develop policy recommendations. However, the bulk of our recommendations are derived from our interviews.

The literature review gave us foundational information on what has already been researched on the topic of new mobility and AVs. We used this information to determine where we needed to fill in the gaps with the interviews.

We conducted interviews with 40 individuals across 28 different transportation-related entities within the public and private sectors. Interviewees included city planners, policymakers, academics, consultants, and other transportation experts. The interviews ranged from 30 to 60 minutes and included questions related to our topic areas (Appendix B). Six of the interviews were conducted in-person, while the remaining 22 were conducted over the phone. Figure 1 shows the breakdown of interview subjects. (Note: "Other" includes nonprofits, policy firms, and relevant transportation bodies).

We manually analyzed the interview data and pulled out common themes that respondents emphasized. From this analysis, we found that the four topics of highest interest were data, equity, safety, and land use, respectively. Our report details findings in all eight of our interest areas, but below are some example details of our analysis of the top four topics.

Of the government representatives we interviewed, 50% want to or are working toward adopting data specifications and policies for at least one type of new mobility company. Sixty-three percent of private sector company representatives stated that they are willing to work with government bodies to provide the relevant data they desire. Ninety-three percent of interviewed governmental representatives see accessibility to new mobility services as the greatest equity concern. Some of the mentioned barriers to access included income, language, age, understanding of technology, and able-bodiedness. Safety is also of significant interest with 71% of those interviewed mentioning the topic
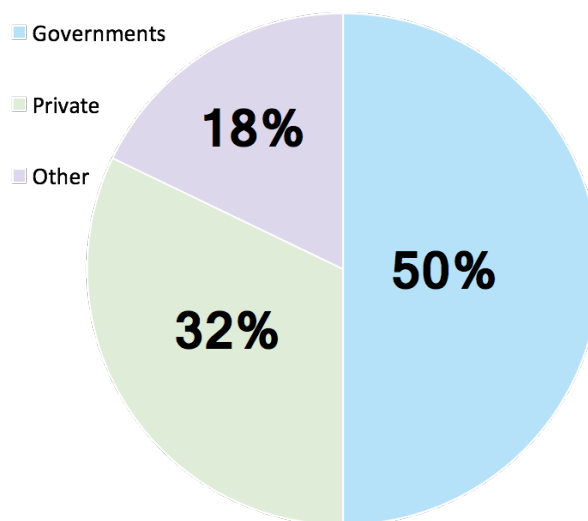
FIG. 1
Pie graph of interviews with transportation experts.

- Governments
- Private
- Other

50%

32%

18%

in their interview. Many respondents expressed a need for collaboration between all involved entities (private companies; manufacturers; and local, state, and federal government) in pursuing a holistic approach to safety with new mobility services. All respondents recognized that land use will need to be heavily adapted to accommodate the future of transportation. One of the biggest upcoming changes to land use was predicted to be parking spaces and structures.

Finally, we reviewed the city TSPs of the representatives we interviewed. We analyzed each one to see how these peer cities are implementing policies regarding new mobility services and AVs. For example, Pittsburgh spells out principles of new mobility that focus on autonomous vehicles, equity, access, and safety (City of Pittsburgh, 2019). Charlotte is working to make the city center more pedestrian-friendly (City of Charlotte, 2017). Toronto, Austin, Columbus, and Philadelphia all have plans to improve their streets to accommodate multimodal mobility as a service in the future (City of Austin, 2019; City of Columbus, 2019; City of Philadelphia, 2018; Keesmaat, 2015).

The TSPs from the cities of the representatives we interviewed also discussed a multimodal transportation future. These cities are working to improve the connections between these modes. Every city's TSP also looks to make their transportation systems more sustainable and environmentally friendly through their transportation policies and plans. The majority of cities are looking to improve active transportation including bicycling and walking. Most cities acknowledge the need to improve their data-sharing capabilities with mobility service providers such as Uber and Lyft. Pittsburgh, Austin, and Toronto are

actively preparing for an autonomous vehicle future. These findings aided our policy recommendations for Eugene and Gresham by providing context and insight into the current TSPs of other cities, especially how they relate to the future of new mobility services.

While most of the TSPs we reviewed acknowledge the arrival of autonomous vehicles, Pittsburgh and Toronto have established themselves as test cities for AVs. Unlike most cities, Toronto has dedicated staff working exclusively on AV preparation and implementation. Since 2015, the city has been taking steps such as creating a work plan, conducting consumer research, and applying for and receiving a grant to run an AV shuttle pilot program (City of Toronto, 2019). Pittsburgh is actively engaging with autonomous vehicle providers to collaboratively test these vehicles in the city (City of Pittsburgh, 2019). At the other end of the spectrum, Charlotte is more focused on improving the overall road system with the assumption that better roads for human driven vehicles will be adaptable to autonomous vehicles (City of Charlotte, 2017). Austin, a city known for technology innovation, sees the need to improve its data infrastructure as a means to incorporate autonomous vehicles and better accommodate mobility services. Austin specifically spells out a need to increase and improve the ability of smart devices to connect with each other and the city at large through improved data infrastructure (City of Austin, 2019).

Policy Recommendations

The policy recommendations we provide are currently considered "best practice" nationwide and are applicable to cities of different sizes and contexts. Thus, we recommend most policies for both our client cities, with some added specifications for each on an individual level.

Data Requirements and Privacy

The issues of data requirements and privacy were emphasized overwhelmingly by our interview subjects.

Cities must be prepared to handle the future of new mobility services and their close relationship to data. Sixty-three percent of private entities interviewed expressed that they would be willing to work with governments in providing the relevant data they desire.

We analyzed multiple TSPs and the available literature to support our data policy recommendations. We determined that every city recognizes the need for improved data-sharing between transportation providers and the city government. Each city has different types of data requests and needs, but these predominantly fall into three main categories: data to improve safety, reduce congestion, and improve access. The "Connect Columbus" TSP specifically spells out these three needs as they apply to their city, as does Philadelphia's data requirements within its TSP (City of Columbus, 2016; City of Philadelphia, 2018). Using these TSPs as a reference point, we determined a basic set of policies that Gresham and Eugene may adopt.

In our research and in our interviews, we found that many cities have adopted the Los Angeles Department of Transportation's data specifications and are recognizing them as a current "best practice." The Los Angeles Transportation Technology Planning Document states the following:

"The City should develop a template for data-sharing agreements with academic institutions, nonprofit and public interest groups and the private sector that clearly outline the type(s) of data to be shared and how it will be transmitted; terms for how the data will be represented and used; guidelines for what will happen to the data at the termination of the agreement, etc. This will give LADOT and others a useful tool when leveraging the capacity of outside organizations to analyze and use City data while expediting these opportunities by providing a template from which to start. Furthermore, it will be essential in helping LADOT create a level playing field for reporting across future contracts, regardless if it is for data analytics or other services" (Hand, 2016).

Our literature review and two of our interviewees noted that Los Angeles has already developed policies to include real time information about how many vehicles are in use, where vehicles are, the physical condition vehicles are in, as well as other parameters of interest to ensure the vitality of these services within the city. Gresham and Eugene should consider adopting these same standards.

Standardizing data requirements for every provider allows for more streamlined access to information so as to better influence policy decisions.

50% of governments are interested in working toward adopting data specifications for at least one type of new mobility company.

These data are important because they drive other policies and needs of the city. Knowing where vehicles are throughout the day can determine high volume areas that may be ripe for land use modifications. These data could also help a city plan infrastructure upgrades (e.g., locating 5G network relays) to best optimize new mobility services. Data may also tell the city if vehicles are clustered in certain neighborhoods within city limits or are being dispersed equitably.

Having trip duration, distance, and time information may assist traffic planners in modifying traffic light timing to improve traffic flow, specifically with the mass deployment of AVs, or in determining how and when to apply usage fees if those are required. One city official who was interviewed stated it is important to know "what sort of travel people are doing." Tracking how many times transit passes are used per day (and possibly linked to locations) may determine how many economically disadvantaged riders use the service. To paraphrase one transportation planner, just having the data is not important, it is what the city does with the data that is important.

Recommended Data Policies:	Policy Details:
1. Standardize data requirements of service providers and incorporate these standards into permitting	In order to be permitted to operate inside of city limits, mobility service providers should provide requested data in real time to either the city or a designated data collection and processing entity of the city. Failure to provide required data could result in a suspension of permitting and/or monetary penalties until data is provided. Standardize these data requirements to follow the Los Angeles Department of Transportation's data specifications, the national standard for best practice. Examples of collectable data: · Number of vehicles in use (for fleet providers). · Number of TNC drivers working per day (hailing services). · Current location of vehicles. · Physical condition of vehicle (fleet providers). · Start of trip / End of trip (nearest road intersection - secondary road or larger). · Time / distance / duration of trip. · Total number of daily trips. · Total number of times transit passes are used daily (singularly and in total).
2. Create restrictions on data that can be requested via Freedom of Information Act	At present, 50% of private sector companies stated that protecting individual privacy is their highest priority when it comes to data-sharing. One transportation expert in the private sector expressed concern over the safeguards related to public records and "whether or not data can be requested" through the Freedom of Information Act. This policy would give providers reassurance over the privacy of shared data.

Recommended Data Policies:	Policy Details:
3. Contract with a third-party data provider to manage different new mobility data	In the effort to adjust to the new demand for a robust understanding of data and data-handling, cities are advised to consider third party contracts for data management purposes. As one city transportation planner stated, "Whatever data are collected, we need to understand. We have to be selective and ensure data are meaningful." According to our respondents, there are multiple companies who may provide this service for a reasonable service fee with contractually obligated privacy standards using their own proprietary infrastructure and labor. This would alleviate the associated costs to cities of conducting such service in-house. Demand for data management is growing, and numerous companies are hoping to offer their services for this purpose (Davis, 2016). This may be a temporary measure because Eugene and Gresham may determine that they do want to accomplish the work internally. However, due to the upfront capital and labor costs of such an endeavor (i.e. buying the equipment and supporting infrastructure, developing or purchasing the necessary software, and hiring staff), we believe contracting is more economically feasible in the short-term future. In this case, Gresham could contract with Metro for this purpose.
4. Create data-driven performance metrics	According to one transportation professional, the largest gap in data-sharing practices is that "collecting the data and understanding how to use the data responsibly are two different things." The city could penalize (or incentivize) mobility service providers through analysis of available data if their service fails to meet designated performance-based metrics of service as established in the adopted ordinance. Penalties may accrue until metrics are met. Mobility service metrics could include equity or service, safety of service, quality of service, and operation of service. For example, the City of Portland currently tracks compliance with a provision requirement of 100 e-scooters in East Portland as a way to measure performance (Portland Bureau of Transportation, 2018). Examples of measured standards: · Complaints less than 1% per 1000 rides · Traffic violations less than 1% per 1000 rides · Reported injuries less than 1% per 10,000 rides · 95% on-time rate (ride hailing/sharing) · 95% reliability rate (fleet providers) · 85% daily coverage in "economic opportunity" areas as established by the city

Equity

The greatest concern about equity among all interviewees was ensuring access. One transportation expert stated that the question of "who has access, who is left out, [and] is the city aware of this?" is critical to ensuring mobility serves everyone in a city.

> "We have to focus our efforts on those who need it the most."
> **- Government Interviewee**

Access in this context means that people of all backgrounds have the ability and opportunity to use new mobility services. Some of the most common barriers include living too far from where mobility services are located, language barriers, not understanding how to use the technology, affordability, and not having a credit or debit card to pay for services. The geographic location of services represents an especially prominent barrier to access because it prevents people from being able to use them at all if they are not close enough. Collectively, all of our respondents were undecided when it came to who was responsible for leading equity initiatives for new mobility services.

During our research of the TSPs, we noted that three city governments have addressed equity policies (City of Austin, 2019; City of Columbus, 2016; Keesmaat, 2015). Over half of our interviewees noted that it is a joint effort between government bodies and companies to develop equitable policies and programs. One municipal transportation official notes that "companies have said they're willing to make an effort on equity because it's a requirement for initiating a [new mobility] pilot program." However, cities such as Columbus, Ohio, are already undertaking equity measures such as improving payment options for the unbanked (City of Columbus, 2016).

Recommended Equity Policies:	Policy Details:
1. Allow unbanked or low-income users to buy fares with cash at stores (e.g. gas stations, post offices, grocery stores) to use new mobility services	In Eugene, fares could be sold at WinCo, Grocery Outlet, the downtown Eugene bus depot, and participating gas stations. Similarly, in Gresham kiosks could be allowed in the Gresham History Museum as well as all of the MAX stations in addition to locations like WinCo and Fred Meyer. This mitigates the barrier to payment for certain populations who are unbanked or low income. Three city transportation officials that were interviewed stressed the importance of providing for unbanked individuals in particular who would otherwise not have access to these mobility options. A study on bike-sharing and the unbanked at the University of Chicago also argues the importance of these options, pointing to several other cities that have accomplished similar programs including Denver, where low income users are allowed to pay at a lower rate without having a credit card due to a partnership between Denver Bikesharing and the Denver Housing Authority (Carney, 2012).
2. Adapt parking meter pay stations to also sell fares	This is another way to accommodate unbanked users by modifying existing infrastructure. Users could purchase fares using cash at parking meter pay stations to use for new mobility services. As one city transportation planner said, these options "allow for people to receive services regardless of connectivity" to devices or technology that may ordinarily be required, such as a smartphone.
3. Allow low income users to pay fare with EBT (electronic benefit transfer) cards or with other benefits of monetary value	Other forms of payment could facilitate ridership and use of mobility services. In conjunction with increasing the diversity of places people may pay for use, so too should the diversity of payment options increase for lower income riders. No city currently implements this, but transportation professionals are in the process of considering options like EBT cards (Goffman, 2019).
4. Establish sliding scale fees for low income residents	Based on verified income level, a rider will be able to purchase fares at 10-25% discount. While some new mobility providers like Lime have taken the initiative to establish their own discounts, Eugene and Gresham could create their own subsidies or work with providers to have these sliding scale prices as part of their operating agreements (Wodinsky, 2018).

Recommended Equity Policies:	Policy Details:
5. Adopt a customer bill of rights that is retroactive, a part of permitting, and enforceable through refunds provided by the service entity to the consumer	The bill should be based on something similar to the following: Riders should have a safe, clean, and reliable user experience that is free of criminal activity, discrimination, and harassment; protects the integrity of their privacy and data; and is in good working order. Riders lacking this may contact the appropriate authority and receive a full refund for their ride by the provider. Such a document would not only give mobility service users a minimally acceptable level of service, but it would place liability on providers in the event that users have issues. We found a basis for this bill of rights in Los Angeles's transportation documents, which states LA "should adopt a commitment to customer service and a good user experience for all modes of travel…" (Hand, 2016).
6. Mandate service into underserved areas, enforced through penalties upon the provider determined by data collection	Multiple city officials stated the need to have service in all areas of the city, not just the most profitable. One city transportation planner said it would be "ideal if a certain percentage of a [new mobility] fleet…are accessible to vulnerable populations." In Eugene, this include mean west and northwest Eugene off Highway 99. In Gresham, this would include the North Gresham and Rockwood neighborhoods.
7. Use infographics and pictures for instructions when language translation is not possible	One city noted that transportation professionals need to "use infographics and pictures more than text to convey messages and instructions" to address equity challenges related to language. Since 70 languages are known to be used in Gresham, it would be more practical to use picture-based instructions when possible than trying to translate a high number of languages. Ireland's National Disability Authority (2019) has straightforward guidelines for creating infographics to convey directions, instructions, and user prompts. We recommend that Gresham adapt these guidelines for their use.
8. Partner with social service providers to introduce new mobility services	PeaceHealth Bikes has partnered with local nonprofits to educate diverse communities on new mobility services. Their intent is that with better knowledge on the benefits of the new mobility services, more riders will use these services. Both cities should partner with nonprofit entities to expand awareness of mobility services to consumers or to provide the service itself in some cases.

Safety

Safety concerns expressed by our interviewed experts varied from the manufactured reliability of new mobility devices themselves to the potential harm that users might inflict on themselves and others during use.

One common theme among all interviewees was the belief that ensuring the safety of these services was a shared responsibility between the user, the providers, and different levels of government at the local, state, and federal level. Several cities noted that while "the safe working of the mobility fleet is the provider's responsibility," city governments can "require levels of safety, such as routine inspections." To pursue safe use, individual users must make smart choices to not endanger themselves or others, as is expected when people drive cars. Providers must manufacture well-made devices that are tested to last and serve the user. Governments are charged to create regulations and policies that protect the relationship between all users and providers. Our research noted that only 28.5% of the metropolitan

85.7% of government employees we interviewed expressed safety as a major concern with the arrival of new mobility services.

areas included in our pool of interview subjects had any new mobility safety requirements already in place, which our experts noted was somewhat low. We determined that municipal governments should dictate the safety requirements of new mobility options in use within city limits.

Recommended Safety Policies:	Policy Details:
1. Program internal speed limit on e-bikes/scooters to 12mph	According to our research, several city planner interviewees stated that they have created speed limit policies. Providers have complied by programming internal limits into the devices themselves so they cannot exceed a set standard. This allows cities to regulate the speed of scooters and ensure the safety of users. The City of San Jose has taken the initiative on setting an internal speed limit of 12 mph for e-scooters (City of San Jose, 2019). In the future, it may be possible to extend this regulation to include altitude and airspeed limits for other technology such as delivery drones in similar areas.

Recommended Safety Policies:	Policy Details:
2. Require providers to include user agreements with safety messaging	Many providers like JUMP already have a form of a user agreement (JUMP, 2019). This policy would mandate all single user new mobility services to include specific messaging about safety. Before an individual can start using the device, they should have to accept an agreement that says they will wear a helmet and not leave the device in an unsafe place (i.e. middle of the road). For rainy cities like Gresham and Eugene, the user agreement should also specify that users will agree to go slower on the device in unsafe weather conditions or be subject to a fine. In our research, five city planners expressed the sentiment that mandating helmet usage was a challenging or counterproductive measure. With this potential policy, the onus for safety is placed upon the user of a specific service, rather than the city itself and deflects liability.
3. Use geofencing to "lock" scooters to specific areas or times	Geofencing would prevent scooters from being able to operate in areas with high foot traffic and pedestrian congestion. Denver is spearheading this by asking providers to geofence dockless scooters in areas where use is prohibited (Kawamoto, 2018). Eugene could use geofencing so that scooters cannot be ridden on sidewalks in the downtown core during peak hours when there is high pedestrian traffic, or on streets where other activities such as Saturday Market are taking place. This could also be applied to additional areas like the river paths that are intended only for biking and walking except for authorized vehicles. Similarly, Gresham could use this tactic by geofencing areas such as the historic downtown core and the Gresham Saturday Market where higher foot traffic is anticipated. The intent is to create a virtual boundary that can be programmed into the device so it does not travel into unwanted locations. A transportation professional who was interviewed for this project suggested geofencing as a potential method to deal with safety concerns, because it would allow the city to regulate the actual locations where scooters can travel.

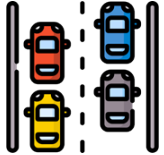| 4. Ban the use of scooters on sidewalks in areas of heavy foot traffic or lower speed limit to 1 mph | Heavy foot traffic areas may include the downtown core, venues immediately before or after an event, major transportation hubs, and areas frequented by small children, the elderly, or the disabled. In the city of San Jose, as mandated by California state law, motorized scooters are banned from use on sidewalks for the safety of pedestrians (City of San Jose, 2019).

Additionally, in the city of Santa Monica, use of scooters is banned from specific areas including the Santa Monica Pier, Third Street Promenade, and Ocean Front Walk due to these locations drawing heavy pedestrian foot traffic (Santa Monica, 2019). Another option would be to lower the speed limit to 1 mph, ensuring scooters do not operate at unsafe speeds but still may be able to access popular destinations. |
Recommended Safety Policies:	**Policy Details:**
5. Fingerprinting background check for TNC drivers	Eugene and Gresham should require TNCs to conduct fingerprinting background checks of all applicants that will be operating vehicles and directly interacting with customers. Both cities currently require general criminal background checks. Adding the fingerprinting requirement will raise the level of security. While a contentious issue, fingerprinting as a way to evaluate an individual's criminal background has become far more sophisticated with current technology and promises a high rate of accuracy (Swenson, 2004). In the ongoing effort to ensure the safety of users of TNCs, fingerprinting is one potentially promising method. Not all jurisdictions use national background check databases. Some only require the use of state databases, which will not capture offenses committed across state lines.
6. If city is notified of mobility devices blocking ADA access/ sidewalks, provider has one hour to correct it	This policy could offer cities a targeted approach to obstacles on the sidewalk, which is a known hazard echoed by several of our city planner interviewees. Penalties for failure to remove devices may include fines, allowing the city to benefit monetarily and provide funding for other areas related to transportation needs. Devices left in Americans with Disabilities Act (ADA) access/sidewalks areas that are immediately removed by a user will not be held against the provider. This policy would not only improve safety for both ADA sidewalk users and other users, it would also protect Eugene and Gresham from any legal liability. Currently, there is a class action suit against the City of San Diego and various e-scooter companies for this very issue (Disability Rights California, 2019).

Land Use and Transportation

The arrival of new modes of transportation has the potential to change the organization of land uses. TSPs look at how to best manage a city's landscape as it applies to transportation and the introduction of this new technology.

Most of the TSPs we reviewed considered land use and transportation through the lens of gas-powered, privately-owned vehicles, while others placed emphasis on supporting active transportation such as walking and biking as a secondary option. Over half of these TSPs focused on rearranging streets to either accommodate more vehicle traffic or to adapt for more bicycles or pedestrians. "Complete streets" is a term often used to address the layout of streets to accommodate more bicycles, public transportation, and pedestrians (City of Pittsburgh, 2019). Going forward, traffic planners could consider a Shared Micromobility Integration Lane with Emergency access (SMILE) pathway incorporated into the complete streets idea (Schlossberg, 2019). The intention is to build upon the concept of a bicycle lane to allow for more options, such as wider lane for two bikes or space designated for bikes and scooters. Although new in theory, it is gaining traction in academia as a way to improve access for new mobility options. A SMILE lane would help to keep scooters, bicycles, and pedestrians in their own area, improving safety for all.

One corporate transportation expert we interviewed stated some of this could be initiated with "a can of paint" and the proper motivation to repaint road lanes to redistribute access and priority. This expert also envisioned a future where some streets would be accessible to only pedestrians, emergency vehicles, autonomous vehicle passenger shuttles, public transportation, and new mobility devices, while blocking access to privately owned cars and other vehicles.

Recommended Land Use and Transportation Policies:	Policy Details:
1. Designate streets to be mixed-use with SMILE lanes: available for use by bikes, scooters, other mobility devices, pedestrians, or public transportation riders	Focusing on better design via the complete streets concept, cities can expect less pedestrian risk, reduced vehicular crashes, and improved bicyclist safety due to improvement of infrastructure specific to different types of mobility (US DOT, 2015). Eugene should partner with the University of Oregon and collaborate to redesign 13th Street from the Lane Events Center through the University grounds to pilot complete streets with SMILE lanes. Gresham should consider redesigning portions of NE 3rd Street through the historical downtown area from NW Eastman Parkway to Cleveland Ave as a complete street with SMILE incorporated.

95% of the time cars today are parked.

Most cars travel **30 miles** or less per day.

Charlotte's TSP notes that improving the overall road system for human driven vehicles will make adapting them for AVs easier.

Four of the city transportation planners we interviewed mentioned "curb management" as an issue regarding new mobility. This was not specifically mentioned in the reviewed TSPs, although references to complete streets often discussed a similar approach to curb management. Our interviewees also stated that as AVs become more prevalent, buildings like parking garages may have less utility. Electrified cars, scooters, and bicycles may require fewer gas stations but more charging facilities. As more and newer modes of transportation operate in a city, figuring out where they all go without risk of collision will become increasingly important.

Three of the cities and two of the private entities we interviewed mentioned that parking spaces and parking garages were a land use issue resulting from new mobility. They recommended converting parking garages, although each expert had different ideas as to how this should occur. One option included changing parking garages into completely new business ventures either supported by the city through public-private partnerships or through changes to zoning codes and incentives to local businesses for undertaking the conversion. As one example, Jackson Hole, Wyoming, has successfully

converted a parking garage into an urban farm (Dirksen, 2018).

Two cities mentioned that re-designating street parking spaces was necessary for new mobility services. While one interviewed city was less inclined to convert parking spaces (either on the street or in garages) to allow for electric vehicle charging stations, every city mentioned that electric vehicles were a part of the future new mobility world. Three of the private firms we interviewed also recommended that cities prepare for the electrification of these mobility services. Accommodation for electric vehicles (cars, bikes, scooters, or buses) will have to occur at some point.

During our interviews, two city traffic experts mentioned that new mobility services may reduce the revenue a city government collects while not significantly reducing the use of the public rights-of-way. Much of this automobile revenue is used to support the mobility infrastructure within the city. One city official believes that new mobility may reduce revenue by 15% so land use policies stemming that loss are necessary. Therefore, we recommend policies that may help recoup a potential decrease of revenue while addressing land use overall in the city.

Recommended Land Use and Transportation Policies:	Policy Details:
2. Direct the conversion of parking spaces to loading/drop-off zones	This would give the city an opportunity to slowly but steadily begin converting parking spaces to improve curb management. "Eliminating a parking spot per block in a congested area could allow for bike parking, personal electric transport (PETs), parklets or designated pick-up/drop-off areas" (Local Government Commission, 2019). Our recommendation would be to convert one on-street parking spot in front of high traffic public venues into a pick-up and drop-off zone for dockless mobility options. For example, in Eugene, the location could be on Willamette Street from 7th Avenue to 8th Avenue across from the Hult Center. In Gresham, this could happen on NE 4th Street in front of the History Museum. Additionally, in Eugene these conversions may be matched to current docked bicycle services. It may be useful to also convert one or two spaces in similar areas to designated ride hailing pick-up and drop-off zones as well.
3. Encourage existing parking garages to be convertible to other uses (Additionally, plan for new structures to be designed with flexibility of use)	In consideration of one private provider who suggested conversion of parking garages and current parking structures, we considered how this might benefit the cities in relationship between new mobility and land use. Garages as mobility "centers" or "hubs" does not seem to be a new idea, as parking management companies and other members of the industry are already considering how conversion of these structures might look (Smart Cities Dive, 2019; Marcus, 2019). Based on this idea, our recommendation is focused on this type of conversion. During build permitting, new parking facilities would encourage design to include a minimum of 10% of the total number of stalls for electric vehicle charging stations. Additionally, parking structures would ideally have the ability to be repurposed into other viable commercial purposes once a consistent car occupancy rate drops below a specified level or a percentage of AVs are in use.

Recommended Land Use and Transportation Policies:	Policy Details:
4. Charge taxes or fees (per ride, distance, or duration) on mobility services use to pay for road maintenance costs	Research done by Urbanism Next concludes that new mobility will result in less traffic revenue via parking fines, moving violations, and gas taxes for cities overall (Steckler, 2019). This policy is an effort to return some of that lost revenue to pay for much-needed road maintenance as private companies share the road. Our suggestion focuses on recouping some of that loss with a small tax or fee, calculated on number of rides, distance, or duration of trip. Charges would be paid to the city. Examples: · Every minute the vehicle travels empty, the vehicle owner is charged a penalty. The technology exists to enforce this, and the fines are to be handled identically to current moving violations. · Encourage consumers to choose active transportation options by establishing a surcharge on every ride hailing trip under a specified distance and a similar surcharge for rides hailed in peak hours of congestion. · Once the ride hailing pick-up and drop-off zones are established, service providers could be charged per minute on a sliding scale for idling in these zones for longer than a predetermined time. This would be sliding to charge more during high demand, or peak times, such as the end of a concert or sporting event.

Innovation

The general consensus from our research is that predicting the future is close to impossible while technology is changing so quickly. This echoes many of the comments made by the transportation experts we interviewed.

One interviewee stated a city's goal should be "moving people, not vehicles." Another expert provided an example of how a few years ago the Segway was the newest craze in mobility, and now it is rarely seen except in malls and airports when used by security or tourists. This may explain why 43% of the cities we analyzed feel as though they are reacting to changes rather than taking charge proactively.

We noted in our research that city transportation plans do attempt to project into the future and consider what innovations will be necessary to remain relevant as technology changes. Of the ones we analyzed, Austin's TSP specifically sees a need to improve connectivity between electronic devices. Austin sees a need to link the city and mobility providers, the city and mobility users, and mobility providers and users by building, increasing, and improving its data infrastructure. Austin and other cities determine that improvements are needed in their technology to both handle more data-sharing requirements and to facilitate the ease of adoption of data-based mobility systems now and into the future (City of Austin, 2019).

Our policy recommendations are based on the advice of one transportation expert who said that creating innovation policies is a "field of dreams option — make the policy and they will adapt to it." Thus, our recommendations are limited in scope, yet flexible for future use.
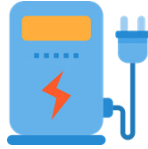
In considering relevant policies for Eugene and Gresham we asked our experts to envision the future of transportation. Most of them noted that electric vehicles will become more widely used. Although our 40 interviewees neither predicted when autonomous vehicles will arrive in large quantities nor agreed with each other on their predictions, they do believe that we are coming closer to their wider adoption in the United States. The combination of electric, autonomous vehicles (eAVs) will see many changes to mobility within Eugene and Gresham. For example, many services provided by human operated vehicles will be done by autonomous vehicles. One city transportation expert stated that in the future their city's bus drivers may become more like concierges, assisting passengers with their needs, and not actually driving the bus. Some of the private industry experts we interviewed saw automation taking away human jobs. One respondent stated only 10% of jobs will remain in certain transportation and transportation-related career fields as automation becomes standardized. Although we are aware of the possible loss of jobs and the possible social and economic impact further automation may have on the labor force, we are not focusing our efforts to this end.

We focus on the needs that AVs, EVs, and eAVs will require to operate in the coming years. As one city transportation expert stated in our

interview, "to have more EVs, you need to have the infrastructure to support them." Therefore, our recommended

policy options are designed to encourage more new mobility options.

Recommended Innovation Policies:	Policy Details:
1. Invest in 5G network infrastructure **5G** 📶	Three private companies said that "a robust 5G system" is essential for AV implementation. AVs and other new mobility services will require 5G networks to run. These new services constantly communicate between vehicles and users and will soon demand heavy wireless data usage that 4G networks cannot maintain. Eugene and Gresham have previously installed fiber optic and broadband internet in their cities. Transportation experts state the same needs to be done for 5G. Users of the infrastructure should be charged a usage fee. Currently, Gresham charges a fee to one provider based on federal regulation and intends to expand to a second provider soon. Gresham could partner with the City of Portland to buy a package deal with surrounding cities to save costs.

2. Invest in installation of city owned e-vehicle charging stations	Continue to invest in the expansion of e-vehicle charging stations for both cars and trucks. Every public parking facility, lot, or garage should have at least 10% allocated for charging stations. Additionally, charging stations should be built through public-private partnerships with private parking facilities (e.g. shopping malls) to add charging stations if none are available. Partners should share the cost of installation and revenue 50/50. The City of Charlotte, NC has already done this with more than 20 city-owned charging stations (Advanced Energy, 2019).
Recommended Innovation Policies:	Policy Details:
3. Establish a catch-all clause to allow for future adaptation of emerging technologies* *This policy is recommended in the event that state-level laws are not passed restricting local governments from creating their own regulations	Create a clause such as, "The city reserves the right to amend this permit/license/agreement to incorporate changes in technology at-will. This may include but is not limited to new services, data and physical networks, mobility modes, or computer/data capabilities. The city may only amend this permit/license/agreement with a 90 day notice and/or upon the implementation of these changes." This will allow Eugene and Gresham to have more control over new mobility services without knowing the details of what might happen in the future. A clause like this is needed because only 7% of government interviewees said they were proactive in setting policies for new mobility services. The remaining 93% faced issues in their ability to regulate how new mobility services operated in their cities because they did not have set power. One city said it was "eye opening that we needed to be proactive rather than reactive" after realizing they did not have any legal clause in place when new mobility services started operating in their municipality.
4. Hire full-time dedicated new mobility staff with technical data skills (i.e. ArcGIS) and a policy or planning background	Eugene and Gresham should each hire 1-3 new employees each to manage, process, and analyze data provided by new mobility services, often through Application Programming Interfaces (APIs). These employees could report to both transportation and city planners. Forty-three percent of government interviewees already have at least one full-time staff member dedicated to new mobility planning.

Active Transportation

Our interviewees across the board mentioned that promoting active transportation and shifting from single-occupancy vehicle use was important for our shared future. Sixty-six percent of our respondents emphasized the need to integrate all new and existing transportation and mobility services (including AVs, TNCs, scooters, bikes, public transit) into a cohesive user-friendly system.

"Worst case scenario in the future: a two-tier transportation service, private for wealthy people and increasingly slow or underinvested buses/bikes serving lower income people."

100% of governments see new mobility as complementing and supporting active transportation.

22% of private entities see new mobility as complementing and supporting active transportation.

The TSPs of Austin, Charlotte, Columbus, Philadelphia, Pittsburgh, and Toronto currently seek to integrate active transportation with new mobility (City of Austin, 2019; City of Charlotte, 2019; City of Columbus, 2019; City of Philadelphia, 2018; City of Pittsburgh, 2019; Keesmaat, 2015). Most cities also incorporate improved biking as a part of their multimodal plans. Columbus acknowledges that bicycling is in high demand by transportation consumers and plans to create more bicycle lanes on streets and improve multi-use paths for pedestrians, scooters, and bicycles (City of Columbus, 2019). Philadelphia is working to be the premier bike sharing city in the nation (City of Philadelphia, 2019).

Recommended Active Transportation Policies:	Policy Details:
1. Create a universal rider/user transit pass, with subsidies for lower income users. This may include more trips for the same cost or discounts per trip taken	Establish universal access passes for people to access every type of mobility service available. This will improve first-mile/last-mile options for riders and encourage the use of multimodal transportation, including new mobility services. Partner with regional public transit and private transit providers to develop the necessary computer application for use. This type of system already exists in Bordeaux, France, where the city has a universal regional transportation system that includes standardized fares and interchangeable user passes (TBM, 2019). This type of system encouraged the use of multimodal transportation that led users away from single-occupancy cars. Our interview respondents recommended similar types of services that would integrate all types of mobility into a single application.
2. Create or repurpose multimodal hubs for first/last mile transportation	Establish dockless and docked mobility pick-up and drop-off zones at major transit stations throughout the city. At these hubs, provide bike lockers for personally owned bikes and scooters. Set aside vehicle pick-up and drop-off zones for ride hailing and ride-sharing services. Install adequate parking and charging stations for e-vehicles. Integrate payment options for new mobility services into currently available active transportation payment options. Finally, provide adequate safety, surveillance, and security both physically and electronically throughout these multimodal transit hubs. Eugene could repurpose EmX stations for this use, and Gresham could work with TriMet to repurpose its MAX station. The City of Seattle has developed a plan for this in their New Mobility Playbook, noting that new hubs are the future for "providing better mobility and integrated transportation choices for all" (Seattle Department of Transportation, 2019).

Environmental Impact

With the advent of new mobility technology, it is crucial to consider the effect of autonomous vehicles, scooters, and other mobility services on the environment. Both Gresham and Eugene expressed an interest in lowering the potential negative environmental impact of these services.

Additionally, 57.1% of government bodies also stated concern for and awareness of the impact of new mobility on the environment. Gresham's TSP outlines its goal to "promote the use of energy-efficient or low- and zero-emission vehicles and bicycling, transit and pedestrian travel modes" (Ch. 4, p 102). For these reasons, we have focused our attention on lowering the use of fossil fuels, supporting sustainable technology, and promoting electrification of vehicles in our policy recommendations.

Recommended Environmental Policies:	Policies Details:
1. Adopt sustainability requirements for mobility products (i.e. product lifespan, materials)	Thirty-seven percent of private companies said they have sustainable products or options to lower the negative impact of mobility on the environment. By adopting requirements for product lifespan or specific materials on all new mobility vehicles, Gresham and Eugene can better improve the relationship between transportation and the environment.
2. Phase out city's gas powered vehicles with electric vehicles	In an effort to lower the use of fossil fuels, both cities could begin phasing out and replacing gas powered vehicles from their fleets in favor of electric. As vehicles reach the end of their service life, they are replaced with hybrid or fully electric vehicles. Charlotte, NC is an example of a city that is already adding electric vehicles to their fleet (Advanced Energy, 2019).

Congestion and Vehicle Miles Travelled

One hundred percent of interviewees agreed that one of the main goals of supporting the rise of new mobility services is "reducing single occupancy vehicles." Everyone wants less traffic.

One private company asserted that "we are trying to get people out of their cars and onto bikes and transit to help reduce [traffic]." However, there is some disagreement both in the literature and among interviewees about whether new mobility services would increase or decrease congestion and VMT. The policy recommendations we present here are intended as potential options for reducing congestion and VMT.

Recommended Congestion Policies:	Policies Details:
1. Adopt congestion pricing fees, adapted from Portland's proposed model	Among transportation experts, it is agreed that congestion pricing will become an accepted future reality. No city in the US currently has an adopted pricing model. The Oregon Department of Transportation is developing a model for Portland (ODOT, 2019). While Gresham would be included in this, Eugene could adopt their own future pricing model that accounts for differences in city size and scope depending on the success of Portland's model.
2. Geofence areas by mode during traffic hours	New mobility vehicles could be programmed to stop or not operate in high congestion areas during peak times. The City of Santa Monica does this with their scooter pilot program in areas of high foot traffic (Lime, 2018).

Conclusion

Like many cities nationwide, Eugene and Gresham are actively looking for policy recommendations to prepare for the future of autonomous vehicles and new mobility services. Existing literature on these topics points to the uncertainty of the future and examines what the benefits and concerns may be.

Our research has found that the priority areas for current policy adoption are data, equity, safety, and land use. Other cities around the country have already begun adopting such policies into their TSPs and have begun implementing them. Because new mobility services and AVs are evolving and still in developmental stages, Eugene and Gresham can use our policy recommendations as the first step in preparing for the future. Our policy recommendations provide the foundation of current best practices in the field. As transportation technology continues to advance, both cities will likely have to make changes to these policies and adapt to the unknown future that awaits us all.

References

Advanced Energy. (2019). Plug-in NC: City of Charlotte. Retrieved from http://www.pluginnc.com/member/city-of-charlotte/.

Channik, Robert. (2019, May 10). Illinois might start charging $1,000 per year to own an electric vehicle: 'It's outrageous.' Retrieved from https://www.chicagotribune.com/business/ct-biz-electric-vehicle-fee-illinois-20190509-story.html

Carney, Michael. (2012, July 24). Bike-Sharing and the Unbanked: A Study of the Unbanked Population in Chicago and Best Practices for Their Inclusion in Bike- Sharing. University of Chicago. Retrieved from http://chi.streetsblog.org/wpcontent/uploads/sites/4/2013/09/Bikeshare_Unbanked_Carney_Final.pdf.

Centre for Excellence in Universal Design. (2014). Use the simplest language possible for instructions, prompts and outputs and, where possible, supplement it with pictorial information or spoken language. Retrieved from http://universaldesign.ie/Technology-ICT/Irish-National-IT-Accessibility-Guidelines/Application-software/Guidelines-for-Applications-Software-Priority-1/1-9-Use-the-simplest-language-possible-for-instructions-prompts-and-outputs-and-where-possible-supplement-it-with-pictorial-information-or-spoken-language/.

City of Austin, Texas. (2019, April 11). Austin Strategic Mobility Plan. Pgs 71, 89, 91, 115-117. Retrieved from http://austintexas.gov/sites/default/files/files/Transportation/ASMP/ASMP_Chapters/ FINAL_ASMP_LowFormatVersion.pdf.

City of Charlotte, North Carolina. (2019). Bicycle Program. Retrieved from https://charlottenc.gov/Transportation/Programs/Pages/Bicycle.aspx.

City of Charlotte, North Carolina. (2017, February 27). Transportation Action Plan. Pgs 1-123. Retrieved from https://charlottenc.gov/Transportation/Programs/Documents/2016_TAP_web_adopted_reduced.pdf.

City of Columbus, Ohio. (2019). Bicycling. Retrieved from https://www.columbus.gov/publicservice/Bicycle-Program/.

City of Columbus, Ohio. (2016). Connect Columbus: Existing Conditions Assessment. Pgs. 2-3, 28-39, 41-45. Retrieved fromhttps://www.columbus.gov/uploadedFiles/Columbus/Departments/Public_Service/Traffic_Management/Multimodal_Thoroughfare_Plan/Connect%20Columbus%20Fact%20Book%20-%20Final%202016-12-01.pdf.

City of Columbus, Ohio. (2019). Electric Vehicles. Retrieved from https://smart.columbus.gov/Get-Involved/Drive-Electric/.

City of Columbus, Ohio. (2012). Green Infrastructure - Hoover (pdf). Retrieved from https://www.columbus.gov/search.aspx?q=bioswales.

City of Eugene, Oregon. (2017, February). Chapter 2: Goals Policies, and Actions. Eugene 2035 Transportation System Plan: Volume 1. Pgs. 15-31. Retrieved from https://www.eugene-or.gov/DocumentCenter/View/40989/ETSP-Volume1-No-Attachments.

City of Gresham, Oregon. (2018). Chapter 3: Forecasting Future Growth and Travel (pdf). Transportation System Plan. Pgs. 91-94. Retrieved from https://greshamoregon.gov/Transportation-System-Plan/.

City of Gresham, Oregon. (2018, September 4). Planning Framework: Vision, Policies, & Goals. Retrieved from https://greshamoregon.gov/Transportation-System-Plan/.

City of Philadelphia, Pennsylvania. (2018, October). Develop a High Quality Bicycle Network. Retrieved from http://www.phillyotis.com/wp-content/uploads/2018/11/Connect_9.8_11-09-18_sm.pdf.

City of Pittsburgh, Pennsylvania. (2019). Complete Streets. Retrieved from http://pittsburghpa.gov/domi/complete-streets.

City of Pittsburgh, Pennsylvania. (2019). Pittsburgh Bike Plan: Welcome to the Pittsburgh Bike Plan Website. Retrieved from http://pittsburghpa.gov/domi/bikeplan.

City of Pittsburgh, Pennsylvania. (2019). Pittsburgh Principles for Autonomous

Vehicles. Retrieved from http://pittsburghpa.gov/domi/autonomous-vehicles.

City of San Jose, California. (2019). DOT: e-Scooters, FAQ. Retrieved from http://www.sanjoseculture.org/FAQ.aspx?QID=1032.

City of Santa Monica, California. (2019). How to Safely Scooter in Santa Monica. Retrieved from https://www.santamonica.com/how-to-safely-scooter-in-santa-monica/.

City of Seattle, Washington. (2019). Categories > Transportation. Seattle Open Data Portal. Retrieved from https://data.seattle.gov/browse?category=Transportation&provenance=official.

City of Toronto, Canada. (2019). Cycling in Toronto. Retrieved from https://www.toronto.ca/services-payments/streets-parking-transportation/cycling-in-toronto/.

City of Toronto, Canada. (2019). Preparing for Automated Vehicles in Toronto. Retrieved from https://www.toronto.ca/services-payments/streets-parking-transportation/automated-vehicles/automated-vehicles-background/.

Crute, J., Riggs, W., Stevens, L., & Chapin, T. S. (2018). Planning for Autonomous Mobility (No. 592) (p. 88). American Planning Association.

Davis, Jessica. (2016, September 27). 25 Data Management Vendors Worth Watching. Retrieved from https://www.informationweek.com/software/information-management/25-data-management-vendors-worth-watching/a/d-id/1326963.

Dirksen, Kirsten. (2018, November 11). Ski town turns car park into vertical farm for local jobs/food. Retrieved from https://faircompanies.com/videos/ski-town-turns-car-park-into-vertical-farm-for-local-jobs-food/.

Disability Rights California. (2019, January 9). Montoya et al v. Bird Rides Inc. et al. Retrieved from https://www.disabilityrightsca.org/cases/montoya-et-al-v-bird-rides-inc-et-al.

Flaticon, the largest database of free vector icons. (n.d.). Retrieved from https://www.flaticon.com/. Goffman, Ethan. (2019,

January 28). Five ideas for planners and policymakers from TransportationCamp DC. Retrieved from https://mobilitylab.org/2019/01/28/five-ideas-for-planners-and-policymakers-from-transportationcamp-dc/.

Hand, A. Z. (2016). Urban Mobility in a Digital Age. Retrieved from Urban Mobility in a Digital Age website: http://www.urbanmobilityla.com/strategy.

Hastings, Andrew Glass. (2019, April 23). When It Comes to Shared Scooter Regulations, Cities Know Best. Retrieved from https://blog.remix.com/when-it-comes-to-shared-scooter-regs-cities-know-best-cda40471d5f.

Howell, Amanda. (2019, February 6). Coming Soon to Oregon: Statewide TNC Regulations? Retrieved from https://urbanismnext.uoregon.edu/2019/02/06/coming-soon-to-oregon-statewide-tnc-regulations/.

ICMA. (2018). 18 on 2018: Predictions on Local Government from 18 Experts. Retrieved from https://icma.org/documents/18-2018-predictions-local-government-18-experts.

James, Owain. (2018, June 24). Uber and Lyft are lobbying states to prohibit local regulation. Retrieved from https://mobilitylab.org/2018/07/24/uber-and-lyft-are-lobbying-states-to-prohibit-local-regulation/.

JUMP. (2019). Rental Agreement. Retrieved from https://jump.com/rental-agreement/.

Kawamoto, Dawn. (2018, August 9). Is Geofencing the Answer to Cities' Electric Scooter Challenges? Retrieved from https://www.govtech.com/fs/Is-Geofencing-the-Answer-to-Cities-Electric-Scooter-Challenges.html.

Keesmaat, Jennifer. Editor. (2015, June). Toronto Official Plan. Retrieved from https://www.toronto.ca/wp-content/uploads/2017/11/99b3-cp-official-plan-volume-1-consolidation.pdf.

Local Government Commission. (2019). New Frontiers on the Street: Managing Your Curb Space in a Time of Mobility Disruption.

Retrieved from https://www.lgc.org/newsletter/managing-your-curb-space/.

Lime. (2018, August 31). Lime Scooters in Santa Monica Bring Equity, Access and Smart Mobility. Retrieved from https://www.li.me/second-street/lime-scooters-in-santa-monica-bring-equity-access-smart-mobility.

Marcus, Jerry. (2018, January). The Future of Parking: Mobility Centers. Retrieved from https://weareparking.org/page/MobilityCenters.

Oregon Department of Transportation. (2019). Congestion Pricing Overview. Retrieved from https://www.oregon.gov/ODOT/Pages/VP-Feasibility-Analysis.aspx.

National Disability Authority. (2019). Guidelines for Applications Software. Retrieved from http://universaldesign.ie/Technology-ICT/Irish-National-IT-Accessibility-Guidelines/Application-software/Guidelines-for-Application-Software-Accessibility-Printable-Version/#1.9.

Paul, Yeshoshua. (2012, December 5). Pictorial Instructions – What are they Good For? Retrieved from https://techwhirl.com/pictorial-instructions-what-good/.

Portland Bureau of Transportation. (2019, March 25). Shared Electric Scooters Permit Application. Retrieved from https://www.portlandoregon.gov/transportation/article/726366.Portland Bureau of Transportation. (2018). 2018 E-Scooter Findings Report. Retrieved from https://www.portlandoregon.gov/transportation/78431.

Richland, J., Lee, J., & Butto Duggan, E. (2016). Steering Autonomous Vehicle Policy: The Role of Public Health (p. 29). Altarum Institute.

Schlossberg, Marc. (2019, May 7). Take a ride in a SMILE Lane. LinkedIn. Retrieved from https://www.linkedin.com/pulse/take-ride-smile-lane-marc-schlossberg/.

Seattle Department of Transportation. (2017). New Mobility Playbook (p. 48). Seattle, WA.

Seattle Department of Transportation. (2017). Develop integrated shared mobility hubs to seamlessly connect people to and between mobility services. Retrieved from https://newmobilityseattle.info/playbook/play/1/strategy/6.

Steckler, Becky. (2019). Navigating New Mobility: Policy Approaches for Cities (Draft). Urbanism Next.Swenson, Gayle. (2004, July 6). NIST Study Shows Computerized Fingerprint Matching Is Highly Accurate. Retrieved from https://www.nist.gov/news-events/news/2004/07/nist-study-shows-computerized-fingerprint-matching-highly-accurate.

Teale, Chris. (2018, July 6). Autonomous shuttles coming soon to Columbus, OH. Retrieved from https://www.smartcitiesdive.com/news/autonomous-shuttles-coming-columbus-ohio/527217/.

Teale, Chris. (2019, May 13). FlashParking sees the future of garages as ,urban mobility hubs'. Retrieved from https://www.smartcitiesdive.com/news/flashparking-sees-the-future-of-garages-as-urban-mobility-hubs/554609/.

Transports Bordeaux Metropole. (2019, May 31). Ticket Information. Retrieved from https://www.infotbm.com/en/ticket-information.

U.S. Department of Transportation. (2015, October 26). Complete Streets. Retrieved from https://www.transportation.gov/mission/health/complete-streets.

Various. (2019). Eugene, Oregon. Wikipedia. Retrieved from https://en.wikipedia.org/wiki/Eugene,_Oregon.

Various. (2019). Gresham, Oregon. Wikipedia. Retrieved from https://en.wikipedia.org/wiki/Gresham,_Oregon.

Wodinsky, Shoshana. (2018, August 9). Lime expands its discount program for low-income bike and scooter riders. Retrieved from https://www.theverge.com/2018/8/9/17670392/lime-scooter-bike-discount-low-income-expand.Zipper, David. (2019, May 17). The California Legislature Is Getting Played by Micromobility Companies. CityLab. Retrieved from https://www.citylab.com/perspective/2019/05/california-state-laws-shared-mobility-city-rules-ab-1112/589705/.

Appendix A

Interview Subjects

City of Santa Monica
Fairfax County
City of Austin
City of Charlotte
City of Columbus
City of Philadelphia
City of Pittsburgh
City of Eugene
City of San Jose
City of Toronto
City of Denver
City Gresham
City of Seattle
Lane Council of Governments
Lyft
Uber
Local Motors
Einride
Lime
Energicamotor
Arcimoto
PeaceHealth
Jump
Share Mobility Strategies
Shared Use Mobility Center
TriMet
Metro
University of Oregon

Appendix B

Interview questions

GENERAL QUESTIONS:

(gov) Does your city already have new mobility services (i.e. bike sharing, e-scooters, etc)? If yes, what types and when did they arrive in your city?

(gov) Does your city currently have policies in place for new mobility services?

Do you have concerns with new mobility services? If yes what is your biggest one?

Do you have any priorities related to new mobility services? If so, what are they?

TOPIC RELATED QUESTIONS:

1. Safety
Q: Who do you think is responsible for maintaining/ensuring safety for these mobility services?

Q: Do you have policies, plans, or regulations in place to ensure the safety of these services?
    If not, then why?

2. Improve Equity
Q: If you have new mobility policies, have you considered the role equity might play? If yes, in what ways?

Q: Do you have policies, plans, or regulations in place to ensure the equity of these services?
    If not, then why?
    If yes, what do they look like? How effective have they been? How did you come up with them? Who did you look to develop

them? Did you engage stakeholders in that process?

Q: (gov) Do you see any unique equity challenges for your city either related to mobility or generally? (example: a city might have a large immigrant population that speak lots of different languages, or a huge section of a city has been gentrified in recent years, etc).

Q: (private) Many cities have identified equity issues related to access, payment options, and workforce (explain in greater detail as needed). Have you observed this in the cities you work in? What is your organizational approach to addressing equity issues?

3. Support active transportation (i.e. walk/bike, not driving own car—we got this definition from Becky's report) and transit
*Reminder: define active transportation to interviewee

Q: What do you think the relationship is between new mobility services and active transportation?

4. Decrease GHG emissions and improve air quality
Q: (gov) Do you have any policies, plans, or regulations in place to reduce the impact of new mobility services on the environment?

Q: (private) Has your company considered the impact of new mobility services on the environment? Do you have any plans for using renewable or green technology?

43

*Reminder: research the firm's mission statement before to see if they already have this publicly

5. Reduce congestion and vehicle miles traveled
Q: How do you think new mobility services might impact traffic - either general flow of traffic or congestion?

Q: (gov) What policies, plans, or regulations do you have in place to address potential changes in traffic? Some research has indicated that with AVs and other new mobility, VMT will increase dramatically. What policies do you think you would need to develop in the future to meeting the challenges that could arise from increased VMT? Have you or others in your org had discussions to address this?

6. Consider changes to land use and metropolitan footprint
Q: How do you foresee new mobility services impact land use? (For example: new mobility's impact on or off street parking, possible changes to commercial developments, changes to public spaces for walking/transit/etc.)

Q: What policy changes related to land use do you think are most necessary to integrate new mobility? (i.e. zoning, right of ways, etc.)

Q: On a scale from 1-5 - where 1=unreceptive/unresponsive and 5=totally receptive/willing - where do you see (Gresham/Eugene) on the idea of changing land use policies due to AVs?

Q: On a scale from 1-5 - where 1=unreceptive/unresponsive and 5=totally receptive/willing - where do you see (Gresham/Eugene) on the idea of changing parking standards to

encourage redevelopment due to new mobility and AVs?

7. Data requirements and privacy
Q: Do you have policies, plans, or regulations in place to share new mobility data?

Q: (private) What data are you currently sharing with cities? What data would you be willing to share to improve new mobility services?

Q: (private) Are there any current limitations on the data your company is able to provide?
    If so, then why?

Q: (private) As new mobility services evolve are your approaches and policies to data-sharing evolving to address the public need? Would your company be willing to provide the data - freely for the public good?

Q: (private) Although city governments may require you to share data, where else might a city go to get data the data they need?

Q: (gov) What data would you want to have from new mobility companies?

Q: (gov) What requirements do you see as necessary for data-sharing? (i.e security protocols, privacy standards, new equipment - such as computer infrastructure, new technology hires in GIS)

Q: (gov) Besides the service providers, where else might you desire to acquire relevant data?

Q: (gov) Have you seen a lack of data-sharing by some new mobility services? How does that impact you?

8. Manage innovation / Future
Q: Do you see large leapfrogging in technology?

Q: Hypothetically, if you were able to see the future - or you get time travelled into the future 20 years - what will new mobility be like?

Q: Do you see this market expanding? Do you see the players in the market expanding with new business or consolidating through mergers and acquisitions or both?

Q: New mobility technologies are changing at a rapid pace. Is it important for your city to try to keep pace with the rapidly changing technological landscape of new mobility services? Or do you believe you will continue with business as usual?

Q: Has your city been more reactive or proactive in their response to the changing pace of new mobility? Do you seeing that changing as you move forward?

9. Final questions
Q: Outside of profit motives (business) or necessity (government) why are you interested in seeing new mobility options succeed?

Q: What are your goals for your organization regarding new mobility for the next 5 years?

Q: Is there anything we should know or that you want to share?

Q: Who else should we talk to regarding these specific topics?

SCI Directors and Staff

Marc Schlossberg	SCI Co-Director, and Professor of Planning, Public Policy, and Management, University of Oregon
Nico Larco	SCI Co-Director, and Professor of Architecture, University of Oregon
Megan Banks	SCYP Manager, University of Oregon
Sean Vermilya	Report Coordinator
Katie Fields	SCYP Graduate Employee
Jonathan Yamakami	Graphic Designer