2018 Regional Transportation Plan

Emerging Technology Strategy

A strategy for guiding innovation to support the greater Portland region's goals

December 6, 2018

oregonmetro.gov/rtp

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Regional Transportation Plan website: **oregonmetro.gov/rtp**

The preparation of this strategy was financed in part by the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration. The opinions, findings and conclusions expressed in this strategy are not necessarily those of the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration.

Public service
We are here to serve the public with the highest level of integrity.

Excellence
We aspire to achieve exceptional results

Teamwork
We engage others in ways that foster respect and trust.

Respect
We encourage and appreciate diversity in people and ideas.

Innovation
We take pride in coming up with innovative solutions.

Sustainability
We are leaders in demonstrating resource use and protection.

Metro's values and purpose

We inspire, engage, teach and invite people to preserve and enhance the quality of life and the environment for current and future generations.

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BEFORE THE METRO COUNCIL

FOR THE PURPOSE OF ADOPTING THE 2018 EMERGING TECHNOLOGY STRATEGY	)	RESOLUTION NO. 18-4869
	)	
	)	Introduced by Chief Operating Officer Martha
	)	Bennett in concurrence with Council
	)	President Tom Hughes

WHEREAS, since the Metro Council adopted the Regional Transportation Plan (RTP) in 2014 there has been a proliferation of new transportation technologies and services, including ride-hailing services, car share services, bike and scooter share services, and traveler information services; and

WHEREAS, in 2014 the Metro Council adopted the Climate Smart Strategy via Ordinance No. 14-1346B, which calls for the use of technology to actively manage the transportation system as one of the key strategies for reducing greenhouse gas emissions from light-duty vehicles in the greater Portland region; and

WHEREAS, from 2016 through 2018 Metro staff conducted outreach to stakeholders across the region regarding their perspectives concerning the impacts of emerging technology on transportation and their priorities for implementing new technologies, which formed the basis for a draft set of policies and near-term implementation actions that were further refined based on feedback from the Metro Council, Metro advisory committees, and technology-related stakeholder groups as part of developing a new regional Emerging Technology Strategy (ETS) to be adopted concurrently with the 2018 RTP; and

WHEREAS, Metro released the initial draft of the ETS for public review and comment on June 29, 2018; and

WHEREAS, Metro provided a 45-day public comment period on the draft ETS from June 29 to August 13, 2018, and received comments through September 6, 2018; and

WHEREAS, the Metro Council held a public hearing on August 2, 2018 to accept public testimony and comments regarding the draft ETS; and

WHEREAS, Metro staff invited four Native American Tribes, the Federal Highway Administration, the Federal Transit Administration, the ports of Portland and Vancouver, and other federal, state and local resource, wildlife, land management and regulatory agencies to consult on the public review draft ETS in accordance with 23 CFR 450.316, and convened four separate consultation meetings on August 6, 14 and 21 and September 6, 2018; and

WHEREAS, the Metro Council, the Joint Policy Advisory Committee on Transportation (JPACT), the Metro Policy Advisory Committee (MPAC), the Metro Technical Advisory Committee (MTAC), the Transportation Policy Alternatives Committee (TPAC), the Federal Highway Administration, the Federal Transit Administration, technology companies and stakeholder groups including the University of Oregon Sustainable Cities Initiative, the Regional Smart City Action Planning group convened by Portland State University and the City of Portland, the Technology Association of Oregon, local government elected officials and staff, business and community leaders, public agencies, private and non-profit organizations and the public, assisted in the development of the ETS and provided comment on the ETS throughout the planning process conducted for the 2018 RTP update; and

WHEREAS, JPACT and MPAC have recommended approval of the ETS by the Metro Council; and

WHEREAS, the Metro Council held two additional public hearings on the ETS identified in Exhibit A on November 8, 2018 and December 6, 2018; now therefore,

BE IT RESOLVED that the Metro Council hereby adopts the 2018 Emerging Technology Strategy attached to this Resolution as Exhibit A, as amended by the "Summary of Comments Received and Recommended Actions" in Exhibit B, as a component of the 2018 Regional Transportation Plan.

ADOPTED by the Metro Council this 6th day of December, 2018.

Tom Hughes, Council President

Approved as to Form:

Nathan A. S. Sykes
Acting Metro Attorney

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GLOSSARY

Emerging technology is a blanket term that we use throughout this plan to refer to new developments in transportation technology. We use it to refer both to technologies like automated vehicles or smart phones and services that operate using these technologies, like car and bike share. We discuss the following emerging technologies in this strategy:

Automated vehicles (AVs) use sensors and advanced control systems to operate independently of any input from a human driver. Transportation experts have developed a five-level system to distinguish between different levels of automation;[1] in this plan we focus on Level 4 or 5 AVs, which can operate independently under most or all conditions.

Connected vehicles (CVs) communicate with each other or with infrastructure like traffic signals and incident management systems. It seems increasingly likely that vehicles in the near future will be automated and may include some connected elements, we typically use "automated vehicles" to refer to vehicles that include a mix of automated and connected elements, and only use "connected vehicles" to distinguish connected from automated vehicles.

Connected vehicle (CV) infrastructure, such as traffic signals and roadside sensors, communicates information to CVs in order to help them navigate the transportation system safely and efficiently.

Electric vehicles (EVs) use electric motors for propulsion instead of or in addition to gasoline motors.

Ride-hailing services (also known as transportation network companies, or TNCs) like Uber and Lyft use apps to connect passengers with drivers who provide rides in their personal vehicles.

Microtransit services such as Via, Chariot and Leap can differ from conventional transit service in several different ways:

- Dynamic routing: Some microtransit services operate on flexible routes to pick up and drop off riders nearer to their origins and destinations. Services may deviate from a fixed route to make pickups and dropoffs, crowdsource routes from data provided by riders or make stops anywhere within a defined service area.
- On-demand scheduling: Instead of operating on a fixed schedule, microtransit services may allow riders to request a ride when they need it.
- Smaller vehicles: Microtransit services often use vans or small buses instead of 40-passenger buses.
- Private operation: Many microtransit services are privately operated or operated through partnerships between public agencies and private companies.

We distinguish between microtransit that is **coordinated** with public transit, for example services that connect people to high-frequency transit or operate in areas that are hard to serve with

conventional transit, and **luxury** microtransit that serve existing transit routes and offer more space or amenities than a public bus at a higher cost.

Car share services allow people to rent a nearby vehicle for short trips and pay only for the time that they use. Different car share service types include:

- Stationary car share (ZipCar, in some cases ReachNow), under which cars are kept at fixed stations and users pick up cars from and return them to the same station.
- Free-floating car share (Car2Go, ReachNow), which allows people to pick up and drop off cars anywhere within a defined service area.
- Peer-to-peer car share (Getaround, Turo), which enables people to rent cars from their neighbors on a short-term basis.

Bike and scooter share systems make fleets of bicycles, electric bicycles, or electric scooters available for short-term rental within a defined service area. **Conventional** bike share systems like Biketown in Portland typically use regular bikes and are operated through exclusive agreements between a private company and a public agency. In most cases users must pick up and leave bikes at designated stations, through Biketown and other modern systems also offer users a dockless option of locking a bike anywhere within the service area. Fully **dockless** systems operated by companies such as Ofo, Limebike and Spin allow users to pick up and leave bikes or electric scooters within a defined service area and require less coordination between the public and private sector.

Traveler information and payment refers to the numerous new ways in which technology enables people to learn about and pay for their travel options online. These services can help people compare different ways of getting around (moovel, Google Maps), get detailed information on their mode of choice (TransitApp, Ride Report, Waze), track and share their trips (Strava, MapMyWalk) and pay for trips (TriMet's Tickets app, Uber/Lyft).

Common ways of grouping some of these technologies together include:

New mobility services refers to transportation services like ride-hailing; microtransit and car, bike and scooter share, which operate using smart phones and other emerging technologies. Many of these services are operated by **new mobility companies**.

Shared mobility describes services that allow people to share a vehicle, such as ride-hailing trips, car and bike share and microtransit, as well as traditional shared modes like transit, taxis and car- or vanpools. Some of these services are operated by **shared mobility companies**.

Shared trips are trips taken by multiple passengers traveling in a single vehicle, including carpools, transit trips and some ride-hailing or car share trips.

Smart cities refers to the way in which public agencies are using technology to collect better data, provide better service, do business more efficiently and make better decisions.

EXECUTIVE SUMMARY

The Emerging Technology Strategy identifies steps that Metro and our partners can take to harness new developments in transportation technology—including automated, connected and electric vehicles; new mobility services like car share, bike or scooter share and ride-hailing services (for example, Uber and Lyft); and the increasing amount of data available to both travelers and planners—to create a more equitable and livable greater Portland region and meet the goals in the 2018 Regional Transportation Plan. The Strategy forecasts how technology is likely to impact transportation over the coming decades, discusses how transportation agencies can respond in an era of increasingly rapid change and identifies policies and actions that Metro and our partners can take to stay on track to achieve our regional goals as technology continues to develop.

Today

Technology is already transforming our region's transportation system. Ride-hailing services provided over ten million rides within the city of Portland in 2017, car share services operate over 1,000 vehicles in the region, people took over 676,000 trips on dockless electric scooters during a four-month pilot in the city of Portland in 2018 and the City of Portland's bike share system, Biketown, launched in July 2016 and carried over 300,000 trips in its first year. People increasingly rely on smartphone apps to help them make on-the-go decisions when congestion or a change in circumstances means that they can't travel like they normally do.

The Next Five Years

Many companies are already testing automated vehicles, and the first generation of street-ready automated vehicles will likely be available within the next five years. Ride-hailing services will be among the first to deploy automated vehicles, which will help them cut the cost of trips and serve new users; other companies are likely to launch shared, automated transportation services soon. Right now, people mainly use ride-hailing in larger cities and for occasional recreational trips or trips to the airport, but ride-hailing as well as other new options will likely become more popular for everyday travel and in smaller cities and suburban areas. These changes have big implications for the most pressing issues facing our region:

Equity: Our region is undergoing a housing crisis, and people of color and low-income households – who are the most likely to rely on transit and active transportation – are being displaced to areas that lack good transit service and safe bicycling and walking facilities. Emerging technology can help us better serve those who need it the most if we remove barriers to accessing technology and use it to provide better transportation options for underserved communities.

Congestion: As our region grows, our transportation system is becoming more crowded. Emerging technology can help us manage congestion if we shape it so that it supports transit, shared trips and active transportation.

Advancing the public interest: Metro and its public agency partners have a long tradition of working in collaboration with residents, businesses and others to create more livable communities. Private companies are now leading the way in deploying new transportation technologies. Public agencies can take an active role in shaping how technology effects our region if we're clear about our goals and we develop the relationships and tools that we need to reach them.

The Next Four Decades

Over the longer term, emerging technology stands to affect every one of our regional goals, both for better and worse, as summarized in Table 3.

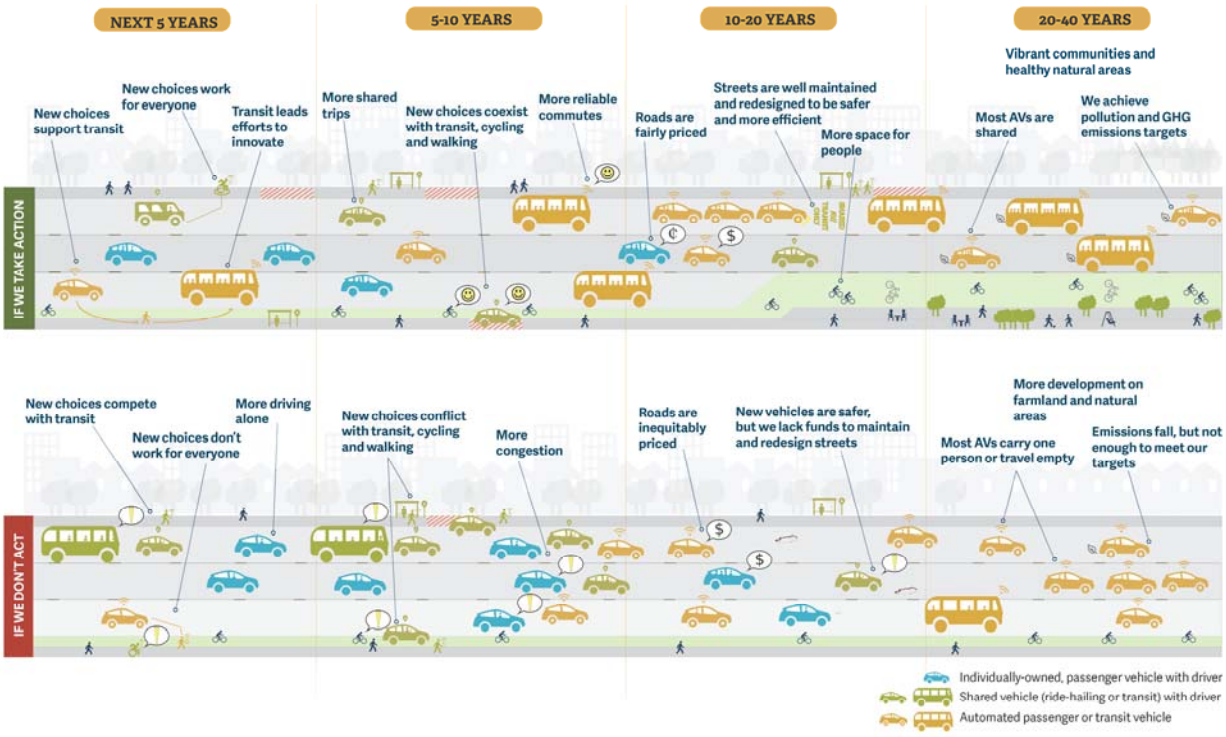
Table 1. How emerging technology could impact our regional goals

Goal	Promise	Peril
Vibrant communities	We have more space for people instead of vehicles, particularly in regional centers, because vehicles no longer need parking and use less space on the road.	We prioritize moving vehicles efficiently over creating space for people. The increased convenience of driving creates less development in regional centers and more in communities outside of the metropolitan area.
Prosperity	New mobility companies bring new jobs to the region, and people are able to spend more time working or at home with friends and family instead of sitting in traffic.	Automation eliminates thousands of jobs, and productivity only increases for people who can do their work from a vehicle.
Choices	Transit becomes more efficient and new mobility services make carpooling the norm.	Driving alone becomes more convenient and new services draw riders away from transit, walking and bicycling.
Reliability	Technology helps to reduce congestion as automated vehicles use roadway space more efficiently, carpooling becomes easier and transit becomes more efficient.	Technology increases congestion as driving becomes more convenient, vehicles travel more to move fewer people, there are more conflicts in high-demand areas and delivery vehicles clog local streets.
Safety and security	Automated vehicles eliminate crashes due to human error.	More pickups and drop-offs create curbside conflicts and the transportation system is vulnerable to cyberattacks.
Environment	Vehicles become cleaner and more efficient.	Vehicle miles traveled increase, offsetting the benefits of cleaner vehicles, and increased sprawl places development pressure on farmland and natural areas.
Health	Cleaner vehicles mean less pollution and better air quality, and bike share provides another active transportation option.	People live more sedentary lifestyles as driving becomes more convenient.
Equity	People who cannot or do not drive have more choices, and new options become more affordable as technology advances.	New services focus on affluent customers, while others face barriers to accessing new technology and services.

Goal	Promise	Peril
Fiscal stewardship	Technology enables more cost-effective pricing, management and operation of the transportation system.	The gas tax and other sources of transportation revenue dwindle.
Transparency	Collecting transportation data becomes more efficient.	Private companies withhold data from public agencies and resist oversight.

We can deliver on the promise and avoid the peril by starting today to address the most pressing issues that technology presents. Figure 3 illustrates how taking action now can set us up for future success—as well as what might happen if we don't act.

Figure 1. What the region's future could look like if we take action on technology—and if we don't



Emerging Technology Vision, Policies and Actions

The principles below articulate a long-term **vision** for how technology should support the goals of the Regional Transportation Plan. These principles, summarized in Table 2, guide Metro and its partners in planning for and working with emerging technology as it continues to evolve, as well as in developing partnerships and pilot projects.

Table 2: RTP goals and corresponding emerging technology principles

RTP goal	Emerging technology principle
Vibrant communities	Emerging technology should support our regional land use vision and enable communities to devote more space to places for people.

RTP goal	Emerging technology principle
Prosperity	Workers whose jobs are impacted by automation should be able to find new opportunities, and emerging technology should create more efficient ways to meet the transportation needs of local businesses and workers.
Choices	Emerging technology should improve transit service or provide shared travel options and support transit, bicycling and walking.
Reliability	Emerging technology should help to manage congestion by promoting shared trips, decreasing vehicle miles traveled and minimizing conflicts between modes.
Safety and security	Emerging technology should reduce the risk of crashes for everyone and protect users from data breaches and cyberattacks.
Environment	New mobility services should use vehicles that run on clean or renewable energy.
Equity	New mobility services should be accessible, affordable and available for all and meet the transportation needs of communities of color and historically marginalized communities.
Fiscal stewardship	Emerging technology companies and users should contribute their fair share of the cost of operating, maintaining and building the transportation system, and new technology should make it possible to collect transportation revenues efficiently and equitably. Public agencies should test new ideas and technologies before commiting to them in order to get the best return on public investments.
Transparency	Companies and public agencies should collaborate and share data to help make the transportation system better for everyone.

Policies focus on the key issues that Metro and its public agency partners need to address over the next decade in order to stay on track to meet our regional goals as technology and mobility continue to evolve. The Strategy identifies implementation actions for Metro and its partners to consider in implementing these policies.

Policy 1: Equity: Make emerging technology accessible, available and affordable to all, and use technology to create more equitable communities.

Policy 2: Choices: Use emerging technology to improve transit service, provide shared travel options throughout the region and support transit, bicycling and walking.

Policy 3: Information: Use the best data available to empower travelers to make travel choices and to plan and manage the transportation system.

Policy 4: Innovation: Advance the public interest by anticipating, learning from and adapting to new developments in technology.

Metro has identified four **next steps** to take in the next two years that will advance the region's work on emerging technology and support local partners in implementing the policies listed above.

Fund **technology pilot projects** to test new approaches to connecting people to transit, promoting shared and active trips and providing more equitable transportation options.

Convene partners to establish **new mobility policies** that are consistent across the region and aligned with this strategy to ensure new travel options operate safely, equitably and transparently.

Develop **better data and tools** so that we can account for the impacts of emerging technology in transportation planning efforts.

Advocate for **state and federal technology policy that supports our regional goals** and preserves local and regional authority to manage the transportation system.

INTRODUCTION

The Emerging Technology Strategy identifies steps that Metro and our partners can take to harness new developments in transportation technology—including automated, connected and electric vehicles; new mobility services like car share, bike pr scooter share and ride-hailing services (for example, Uber and Lyft); and the increasing amount of data available to both travelers and planners—to create a more equitable and livable greater Portland region and meet the goals in the 2018 Regional Transportation Plan.

Metro's Role

Metro has a variety of roles in transportation planning, including:

- setting regional transportation policies, targets and performance measures
- planning and project development for major transit projects
- supporting and introducing transportation legislation
- collecting and sharing data to inform transportation planning decisions
- coordinating partner agencies on regional issues
- funding transportation projects and programs

New mobility services are already transforming how people travel in the region, and automated vehicles are poised to usher in even more sweeping changes that will affect how Metro and its partners plan and operate the transportation system. Successfully planning and building the transporation system to meet our region's needs depends upon having a clear picture of the future. The uncertainty surrounding how new services are being used, when new innovations will arrive and what the impacts of technology makes transportation agencies' jobs more challenging. The Emerging Technology Strategy forecasts how technology is likely to impact transportation over the coming decades, discusses how transportation agencies can respond in an era of increasingly rapid change, and identifies policies and actions that Metro and our partners can take—beginning today—to stay on track to achieve our regional goals as technology continues to develop.

Planning and Public Engagement Process

The 2018 Regional Transporation Plan: Getting to Here

The Emerging Technology Strategy was created as part of the process of developing the 2018 Regional Transportation Plan, which began in summer 2015 and took place in five phases.

Phase 1: Getting started Beginning in summer 2015, the first phase consisted of engaging local, regional, state, business and community partners to prioritize the regional challenges to be addressed in the update and the process for how the region should work together to address them. This engagement included:

- interviews with 31 stakeholders

- discussion groups in partnership with Metro's diversity, equity and inclusion team with communities of color and youth on priorities and issues related to racial equity
- a partnership with PSU's Center for Public Service and 1000 Friends of Oregon to explore components of inclusive public engagement to develop an approach to better reach underrepresented communities
- a public involvement retrospective that summarized previous feedback from communities of color on transportation planning and project development
- an online survey with more than 1,800 participants to help identify the top transportation issues facing the greater Portland region.

This phase concluded in December 2015 with JPACT and Council approval of the work plan and public participation plan for the update. In addition to implementing the 2014 Climate Smart Strategy, the adopted work plan identified seven policy topics for the Regional Transportation Plan update to focus on – safety, equity, freight, transit, finance, performance, and design.

Phase 2: Framing trends and challenges The second phase began in January 2016 and concluded in April 2016. In this phase, Metro engaged the public, jurisdictional partners and business and community leaders to document key trends and challenges facing the region as well as priority outcomes for investment in the region's transportation system. This included:

- an online survey with more than 5,800 participants working through the questions
- a Regional Snapshot on transportation, published in April 2016.

Also in April 2016, the Metro Council convened members of MPAC, JPACT, state legislators, community and business leaders and other interests from across the region to discuss the key trends and challenges facing the region during the first of four regional leadership forums.

Metro staff also worked with ODOT's economist and jurisdictional partners, individually and through a technical work group, to forecast a budget of federal, state and local funds the greater Portland region can reasonably expect by 2040 under current funding trends.

Phase 3: Looking forward From May 2016 to May 2017 technical work and public engagement activities continued to focus on finalizing a shared vision statement for the plan, developing draft strategies for safety, transit and freight, and updating the evaluation framework and measures for evaluating plan performance. The engagement for this phase included:

- a round of follow up discussion groups in partnership with Metro's diversity, equity and inclusion team with communities of color and youth to review actions and priorities for the agency's racial equity strategy
- focus and discussion groups on transportation priorities for communities of color and strategies to improve engagement with underrepresented groups,
- an online survey focusing on priorities for communities of color
- an online survey with more than 2,600 participants on investment priorities and funding,

- another round of discussion groups with communities of color on hiring practices and priorities related to the Planning and Development department-specific equity plan.

Metro Council also hosted its second and third regional leadership forums. In regional leadership forums 1 and 2, there was consensus that a bold vision and more funding are needed to build a 21st century transportation system. In forum 3, leaders discussed a shared vision for the future transportation system and potential near-term priorities for addressing regional transportation challenges in ways that supported the vision. Participants also identified actions to build a path to future funding.

Staff also compiled background information and online resource guide maps to support jurisdictional partners as they updated their investment priorities for further evaluation and public review during Phase 4. In addition, staff launched the RTP Project Hub – an online visual database – for jurisdictional partners to use to update project information and collaborate with other jurisdictions. Phase 3 concluded with Metro Council directing staff to release a call for projects to update the region's transportation near- and long-term investment priorities to support regional goals for safety, congestion relief, affordability, community livability, the economy, social equity and the environment.

Phase 4: Building a shared strategy The fourth phase began in June 2017 with release of a second Regional Snapshot on transportation and the Call for Projects for jurisdictional partners to update the plan's regional transportation project priorities. Agencies were asked to identify projects that address regional needs and challenges, reflect public priorities and maximize progress toward the region's agreed upon vision and goals for the future transportation system.

Local jurisdictions and county coordinating committees worked within a constrained budget and capital funding targets to determine the project priorities to put forward for inclusion in the plan in collaboration with the Oregon Department of Transportation (ODOT), Metro, South Metro Area Regional Transit (SMART) and TriMet. All project submissions were required to have come from adopted plans or studies that provided opportunities for public input.

In summer 2017, Metro analyzed three funding scenarios: 10-year constrained project priorities, 2040 constrained project priorities and 2040 strategic project priorities. The analysis tested new and updated outcomes-based system performance measures to evaluate performance of the transportation system as a whole for each scenario to help inform finalizing the plan's project priorities in Phase 5. Metro staff also prepared an interactive map of proposed projects and lists that was made available on the project website for the public and partners to use to learn more about the projects under consideration. Safety, transit, freight and emerging technology strategies continued to be developed on parallel tracks. Jurisdictions also piloted project-level evaluation criteria on 50 projects; the pilot project evaluation will be advanced during the next RTP update.

The results of the analysis were released in November 2017. Engagement on the call for projects included:

- a community leaders' forum for feedback on the results

- Metro Councilor briefings to business and neighborhood groups
- an online survey with more than 2,900 participants.

The analysis was also summarized in a larger discussion guide for decision-makers that also relayed key issues and the results of the Call for Projects. A fourth and final Regional Leadership Forum was held in March 2018 to discuss findings and recommendations from the technical analysis and public engagement to inform finalizing the plan during Phase 5.

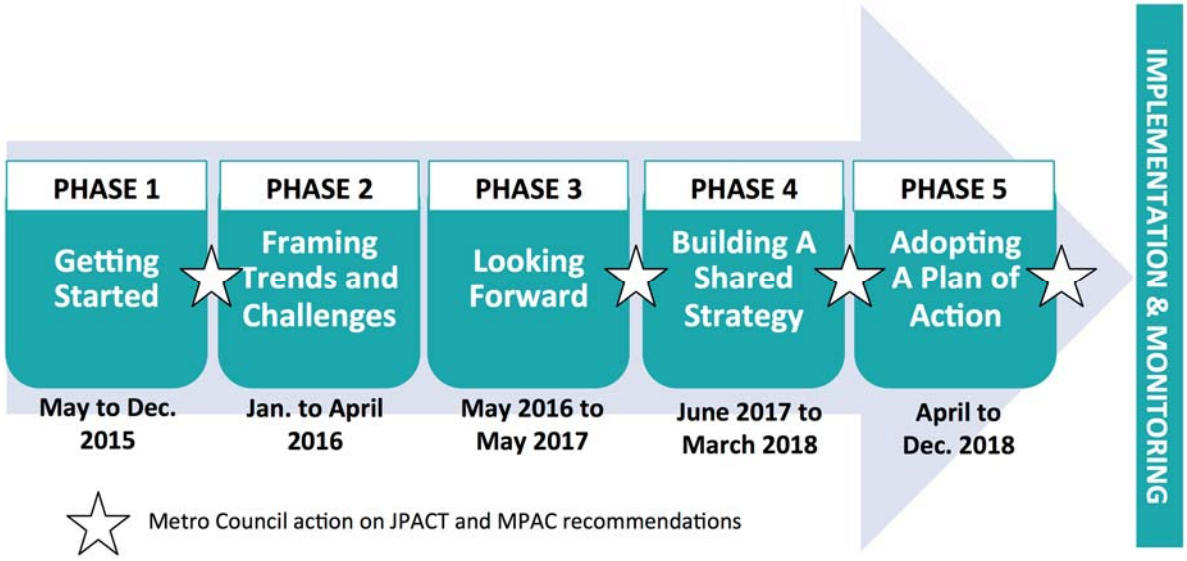
Phase 5: Adopting a plan of action The fifth and final phase of the process began in April 2018 and is focused on finalizing and adopting the region's investment priorities and strategies recommended through 2040. The 2018 Regional Transportation Plan will be available for public review in June 2018, with a formal comment period from June 29 through Aug. 13. For this comment period, engagement activities include:

- an online survey with a high level summary the plan
- an interactive map of projects, project lists and a briefing book that provides a more in-depth summary;
- draft documents, including the 2018 Regional Transportation Plan and safety, transit, freight and emerging technology strategies, available for review and comment.

The Metro Council will hold a hearing on August 2, 2018. All comments received during the comment period will be summarized in a public comment report. Recommended changes to the draft materials to respond to all substantive comments received during the comment period will be summarized in a public comment log that will be considered by MPAC, JPACT and the Metro Council during the adoption process.

JPACT and MPAC will make recommendations to the Metro Council in October 2018. Metro Council is scheduled to hold legislative hearings on November 8 and December 6. Metro Council will consider adoption of the final plan, project priorities and strategies for safety, transit, freight and emerging technology in December 2018. Figure 2 summarizes the process of developing the Regional Transportation Plan.

Figure 2: Summary of the Regional Transportation Plan development process



Developing the Emerging Technology Strategy

Metro conducted additional analysis and outreach to develop the Emerging Technology Strategy. Staff began by reviewing available research on the impacts of emerging technology, forecasts of when different technologies are expected to reach maturity, and technology plans and policies from peer agencies across the United States. Staff held one-on-one conversations with over 40 stakeholders across the region – including representatives of public agencies, technology companies and advocacy and community organizations – about their priorities for emerging technology. This research and these conversations formed the basis for a draft set of policies, which Metro staff refined based on feedback from Metro Council and Metro technical and policy committees; technology-related stakeholder groups including the University of Oregon Sustainable Cities Initiative, the Regional Smart City Action Planning group convened by Portland State University and the City of Portland and the Technology Association of Oregon; and an informal working group convened at Metro consisting of public agency staff that met four times as the strategy was being developed. Staff summarized the research and policies in a draft version of the Emerging Technology Strategy, and finalized the discussion draft based on feedback from Metro technical and policy committees.

Document Organization

The Emerging Technology Strategy consists of the following sections:

Executive Summary

Provides a short summary and key elements of the strategy.

Technology Today in the Greater Portland Region

Describes the how travelers are using the emerging technology that is currently available in the region.

The Next Five Years

Discusses the major developments that are likely to take place over the next five years and the opportunities and challenges that they pose for key issues facing the region.

The Next Four Decades

Gives an overview of the opportunities and challenges that emerging technology presents for each of the Regional Transportation Plan goals and evaluates potential approaches to working with different emerging technologies.

Emerging Technology Vision, Policies and Actions

Describes a vision for how technology can support the Regional Transportation Plan goals, as well as policies and potential implementation actions that Metro and our partners can take to achieve this vision.

Technical Appendices

The two technical appendices that accompany the plan provide more detailed information on how emerging technology is likely to develop over the next four decades and on the impacts that different technologies could have on our regional goals.

TECHNOLOGY TODAY IN THE GREATER PORTLAND REGION

Technology is already transforming our region's transportation system. In the city of Portland, ride-hailing services now carry more people than taxis do,[2] providing over ten million rides within the city in 2017.[3] Car share companies including Car2go, ReachNow and Zipcar operate over 1,000 vehicles in the Portland area.[4] Some of these companies have been around for a decade, but new models have sprung up, including free-floating car share, which allows people to pick up and drop off a car anywhere within a defined area, and peer-to-peer car share, which makes it easy for neighbors to borrow cars from each other. The City of Portland's bike share system, Biketown, launched in July 2016 and carried over 300,000 trips in its first year,[5] and people took over 676,000 trips on dockless electric scooters during a four-month pilot conducted in Portland in 2018.[6]

Meanwhile, smartphone apps have become the most popular way for people to get information on their travel choices, while the number of people who get information from other sources declined swiftly over the past three years. People increasingly rely on the real-time, multimodal information that apps provide to make on-the-go decisions when congestion or a change in circumstances means that they can't take the mode or route that they normally do.

New services like car sharing and ride-hailing are bringing more affordable and efficient options to the region, but some of them may also be competing with transit and increasing congestion. We have new ways to meet the transportation needs of underserved people, but many of these new options are not accessible to all. Surveys conducted by Metro find that a disproportionately large number of frequent ride-hailing users are wealthy and young, while a disproportionately small number are low-income people or people over 45.[7] The impacts are mixed and our information is limited, but it's clear that we're in an era of rapid change, and that public agencies need to act to make sure that emerging technology helps create more equitable and livable communities across the Portland region.

THE NEXT FIVE YEARS

Many companies are already testing automated vehicles,[8] and the first generation of street-ready automated vehicles will likely be available within the next five years. These vehicles will likely accelerate the already-growing use of new mobility services and smartphone apps when they arrive. Automated vehicles will cost more than regular vehicles, so most people probably won't be rushing out to buy them for personal use, and in the coming decade most of the vehicles on the road will continue to be human-driven. However, ride-hailing services and freight operators will be among the first to deploy automated vehicles, which will help them cut the cost of trips and serve new users.

As a result, ride-hailing services could become a more popular option for everyday travel and in smaller cities and suburban areas. Right now, people mainly use ride-hailing in larger cities and for occasional recreational trips or trips to the airport, but use of ride-hailing services is growing rapidly in cities outside of Portland. As the cost of ride-hailing trips falls thanks to automation, communities like Hillsboro, Oregon City and Gresham could see the same level of ride-hailing that Portland currently does. It likely won't just be Uber and Lyft serving these communities; many companies that are developing automated vehicles are planning to launch new transportation services as well.[9]

Will the future be shared—and is that a good thing?

Experts describe two potential future scenarios for automated vehicles, one in which they are operated in shared fleets and one in which they are individually owned. Shared automated vehicles would likely mean fewer vehicle miles traveled, less congestion, a richer variety of affordable travel options and more space for people instead of vehicles. The fact that automated vehicles will probably be available in shared fleets years ahead of when they become affordable for most people increases the likelihood of the shared scenario, but it may be hard to provide shared service in more suburban or rural areas where homes and destinations are farther apart, as well as to reverse 90 years of car ownership culture.

Even if shared mobility does prevail, it may not help us achieve our goals, because not all shared modes save people money and decrease traffic. If we want to see shared mobility benefit our region, we need to be specific about the type of sharing that we want to see—shared trips with more than one passenger in a vehicle, which provide people with more affordable options while reducing congestion and emissions—and take action to encourage it.

These developments will deepen the impacts that technology is already having and affect how some of the most pressing issues facing our region play out. The greater Portland region has inequitable access to safe, reliable, healthy and affordable ways to get around and is experiencing rapid population growth, rising housing costs and increasing congestion. Emerging technology has the potential to help us confront these challenges – or to exacerbate them.

Equity

Our region is undergoing a housing crisis. During the first half of this decade, average home prices in the region climbed by almost 90 percent[10] and average rental prices rose by 34 percent.[11] Communities where it is easy to walk, bike and take transit saw the greatest price increases, so

people of color and low-income households – who are the most likely to rely on these options because they are more affordable than driving – are being displaced to areas that lack good transit service and safe bicycling and walking facilities.

Emerging technology can help us better serve those who need it the most…

New modes like ride-hailing; car, bike and scooter share and microtransit (which describes a variety of new services that offer more flexible schedules or routes, use smaller vehicles, and/or involve a greater level of private sector involvement than conventional transit) can give people who can't afford to use a car the same flexibility and access to destinations that owning a car provides. Public agencies can use these modes to provide better transportation options to marginalized communities that are further from light rail lines or regional centers, at a lower cost than running new buses or trains. They can also help connect people who work a night shift when transit doesn't run or work in a large industrial area where transit doesn't provide door-to-door service with their jobs.

…if we remove barriers to accessing technology.

Half of low-income households lack a smartphone, while others cannot afford a data plan or the extra cost of new mobility services. While ride-hailing and car share are more affordable than owning a car, they are still expensive compared to transit. People in wheelchairs cannot rely on finding an accessible vehicle or a helping hand when using shared services. Many people lack the knowledge, English fluency, or access to a credit card that is necessary to use app-based services. Studies have found that people with African-American sounding names are more likely to have their ride-hailing requests canceled by drivers,[12] and that communities of color experience longer wait times.[13] The people who use new mobility services are more likely to be white, wealthy and young.[14] In order to make sure that everyone benefits from these services, we need to make digital access a universal right and work with community groups and new transportation services to bring better mobility to everyone, starting with those who need it most. We also need to continue to provide high-quality transit throughout the region, so that people can use new mobility services for short, affordable trips to transit stations and take transit the rest of the way.

Congestion

As our region grows, our transportation system is becoming more crowded. Measuring congestion is challenging, but recent studies have found that our region sees the type of congestion normally found in much larger metropolitan areas.[15] These patterns are largely due to where and how our region is growing. As new residents settle in places that are further from jobs and other destinations and harder to serve with transit, they are driving more and for longer distances.

Emerging technology can help manage congestion…

New mobility services can make it easier for people to share vehicles and rides, and when people share trips it helps to take cars off the road. Emerging technology can also be used to enhance transit service by making it easier for people to get a ride when and where they need it, improving safety, and reducing operating costs. Increased communication between vehicles and

infrastructure makes it possible to manage and price the congestion more efficiently and equitably. And once enough automated vehicles are on the road, it should significantly reduce the number of crashes and make it possible for cars to travel close together at high speeds so that everyone can travel more safely and efficiently.

...if technology supports transit, shared trips and active transportation.

Studies from multiple cities have found that ride-hailing, and in some cases car sharing as well, draws more people away from transit, walking, bicycling and carpooling than it reduces the amount that people drive alone.[16] Ride-hailing trips with one passenger contribute to congestion more than driving alone, because drivers travel extra miles to pick people up and tend to congregate in congested places while awaiting customers. Ride-hailing vehicles making pickups and drop-offs in inappropriate places can delay transit and create unsafe conditions for pedestrians, bicyclists and drivers. We need to continue to make transit, walking and bicycling, which are the modes that produce the least congestion, the most convenient ways to travel. We also need to use emerging technology to facilitate shared trips and connect people to transit while managing conflicts and competition among modes.

Are new mobility services good or bad for transit?

Both in the greater Portland region and across the United States, transit ridership is flat or declining while the economy is growing and we would normally expect ridership to increase. High housing costs in areas that are well served by transit help to explain why this is occurring, but many wonder whether new options are competing with transit—and if so, what that means for transit's future.

Most of the research to date has focused on ride-hailing, which is the most widely used new mobility service. One survey found that people usually hail rides late at night or on weekends when transit service is not as frequent, which suggests that the two modes compliment each other. However, a series of studies found that beween 14 and 42 percent of ride-hailing trips would otherwise be taken by transit. Any negative impacts that ride-hailing or other new mobility services have on transit in our region are likely small for now because people use these services infrequently, but there may be reason for concern as they continue to grow.

Transit is a critical option for those in need, the most efficient way to move people along crowded streets, and the backbone of many communities. It is difficult to imagine a positive future for the region without it. In order to make sure that transit thrives, we need to enhance service on high-ridership lines while experimenting with new ways to provide transit—like microtransit or using new mobility services to connect to stations—in communities that are challenging to serve with large buses traveling fixed routes.

Advancing the Public Interest

Metro and its public agency partners have a long tradition of working in collaboration with residents, businesses and community groups to create more livable communities. This tradition extends to our work on technology: Metro and our partners have led the way in using technology to provide better travel information and manage the transportation system. For example, TriMet developed the data format that is now used by transit agencies across the country to make schedule information available online. ODOT is one of the first state departments of transportation to test technology-enabled per-mile road pricing, and Metro has supported travel information and management programs across the region through our grant programs.

Public agencies can take an active role in shaping how technology impacts our region…

Private companies are now leading the way in developing and deploying transportation technology. This gives us a new set of partners who share our interest in a well-maintained, well-functioning transportation system, as well as in testing innovative new ways to move people and goods. It also means that public agencies need to take an active role in ensuring that new developments in technology help create great communities in our region and meet the needs of all residents, rather than only those who can access and afford them.

Early successes in creating a smarter region

The City of Portland, in collaboration with many other public agencies and private companies, was one of seven finalists selected for the $40 million USDOT Smart City Challenge, with a proposal to collect and share data to help residents make travel choices and aid the City city in making better planning decisions. Though the Portland team did not win, the City and its partners continue to collaborate to implement aspects of the plan. TriMet, long an innovator in providing better transit data to the public, won a federal grant to integrate information on ride-hailing into its transit planning app. A separate group of regional partners won another grant to provide real-time information to travelers along the I-84 corridor. And Portland has drafted a policy on automated vehicles and released a call for projects to test automated vehicles and related technology.

Meanwhile, Hillsboro was a finalist for the Bloomberg Mayors' Challenge with a proposal to integrate both existing and emerging modes of transportation at hubs throughout the city, and is currently working on developing a Smart City plan. Organizations such as the Technology Association of Oregon, Forth, University of Oregon's Sustainable Cities Institute and Portland State University provide local and national thought leadership on technology-related issues. And partners including the Westside Transportation Alliance, Oregon DOT and Ride Connection have developed new ways to provide travel information and collect data, often with support from Metro. These early successes lay the foundation for Metro and our partners to collaborate and lead the way in creating a smarter transportation system.

…if we're clear about our goals and we develop the tools that we need to reach them.

Most cities in our region haven't set policies or made plans regarding emerging technology. The differing needs, resources and cultures of public agencies and private companies can make it hard to find opportunities for collaboration. We need to establish a vision for how technology can meet our regional goals and develop tools to achieve that vision.

THE NEXT FOUR DECADES

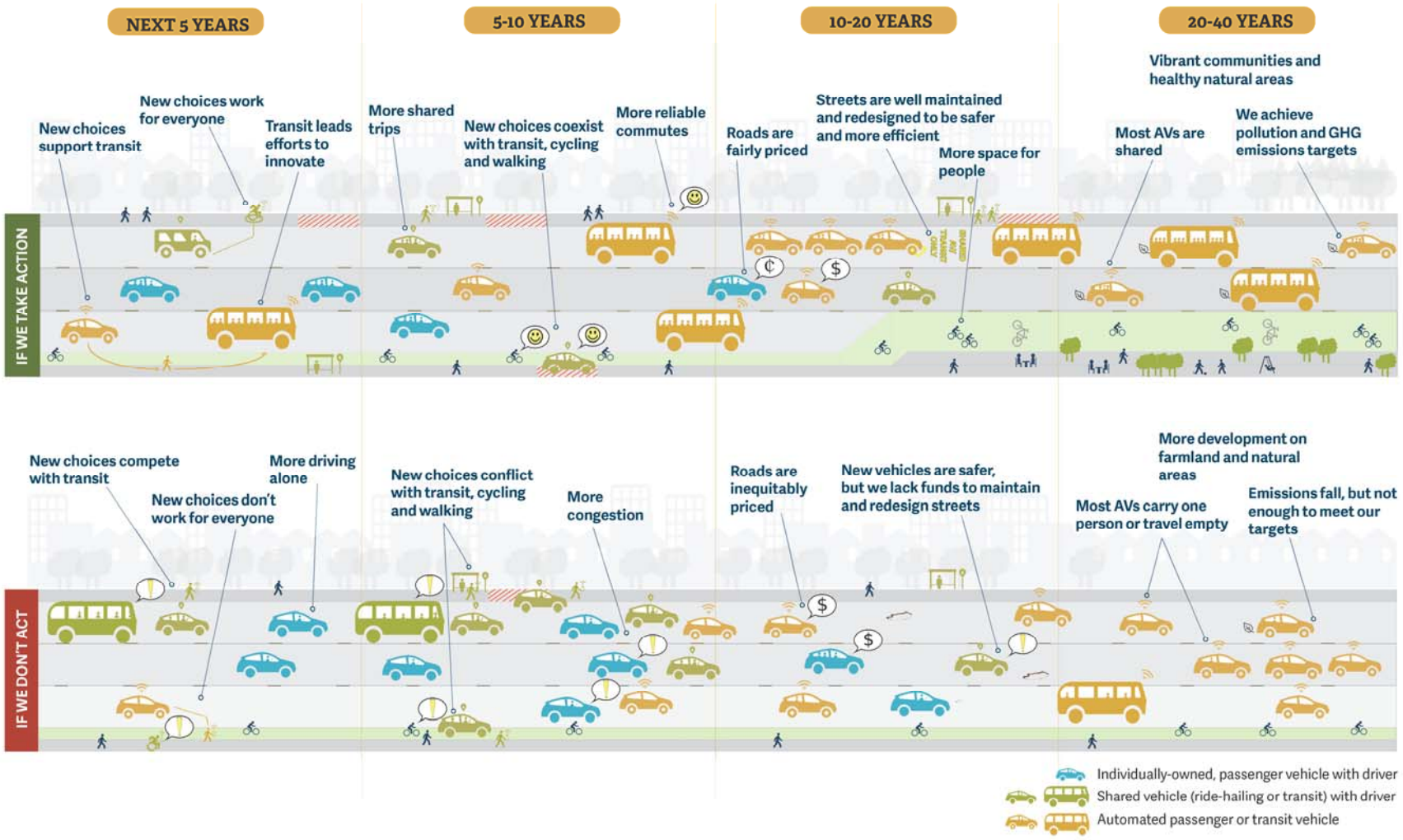
Over the longer term, we expect that technology will have broad and profound impacts on how people travel as vehicle technology continues to advance and more people use new mobility services to get around. Emerging technology stands to affect every one of our regional goals, both for better and worse, as summarized in Table 3. Our regional goals are summarized and consolidated below; the full text of the goals can be found in the 2018 Regional Transportation Plan.

Table 3. How emerging technology could impact our regional goals

Goal	Promise	Peril
Vibrant communities	We have more space for people instead of vehicles, particularly in regional centers, because vehicles no longer need parking and use less space on the road.	We prioritize moving vehicles efficiently over creating space for people. The increased convenience of driving creates less development in regional centers and more in communities outside of the metropolitan area.
Prosperity	New mobility companies bring new jobs to the region, and people are able to spend more time working or at home with friends and family instead of sitting in traffic.	Automation eliminates thousands of jobs, and productivity only increases for people who can do their work from a vehicle.
Choices	Transit becomes more efficient and new mobility services make carpooling the norm.	Driving alone becomes more convenient and new services draw riders away from transit, walking, and bicycling.
Reliability	Technology helps to reduce congestion as automated vehicles use roadway space more efficiently, carpooling becomes easier and transit becomes more efficient.	Technology increases congestion as driving becomes more convenient, vehicles travel more to move fewer people, there are more conflicts in high-demand areas, and delivery vehicles clog local streets.
Safety and security	Automated vehicles eliminate crashes due to human error.	More pickups and drop-offs create curbside conflicts, and the transportation system is vulnerable to cyberattacks.
Environment	Vehicles become cleaner and more efficient.	Vehicle miles traveled increase, offsetting the benefits of cleaner vehicles, and increased sprawl places development pressure on farmland and natural areas.
Health	Cleaner vehicles mean less pollution and better air quality, and bike share provides another active transportation option.	People live more sedentary lifestyles as driving becomes more convenient.
Equity	People who cannot or do not drive have more choices, and these choices become more affordable as technology advances.	New services focus on affluent customers, while others face barriers to accessing new technology and services.
Fiscal stewardship	Technology enables more cost-effective pricing, management and operation of the transportation system.	The gas tax and other sources of transportation revenue dwindle.
Transparency	Collecting transportation data becomes more efficient.	Private companies withhold data from public agencies and resist oversight.

At this point, we cannot predict whether technology will support our goals or make it harder to achieve them. What is clear is that Metro and its partners can begin to chart a course toward a positive future by taking action today to address the most pressing issues that technology presents. By addressing impacts that are already happening, we can develop the tools that we will need to influence how technology develops over the long term. If we make sure today that new mobility services work for everyone and support transit, shared trips, walking and bicycling, we lay the foundation to use technology to better manage congestion, protect the environment and create vibrant communities in the future. Figure 3 illustrates how taking action today can set us up for future success—as well as what might happen if we don't act.

Figure 3. What the region's future could look like if we take action on technology—and if we don't



How We Can Work with Different Emerging Technologies

The assessment above looks at the impact of emerging technology as a whole, which is helpful in identifying the general trends that we can expect to face. As we move forward with implementing the strategy, public agencies will be faced with decisions about how to respond to the unique opportunities and challenges presented by technologies like automated vehicles and dockless scooter sharing as they reach maturity or as companies launch new services in our region. This section looks at the impacts of different emerging technologies, and our influence over them, to help identify more specific approaches to implementation. We begin by revisiting how we define these technologies.

Automated vehicles (AVs) use sensors and advanced control systems to operate independently of any input from a human driver.

Connected vehicles (CVs) communicate with each other or with infrastructure like traffic signals and incident management systems.

Electric vehicles (EVs) use electric motors for propulsion instead of or in addition to gasoline motors.

Ride-hailing services (also known as transportation network companies, or TNCs) like Uber and Lyft use apps to connect passengers with drivers who provide rides in their personal vehicles.

What infrastructure will the vehicles of the future need?

The vehicles of the future are likely to be some combination of automated, connected, electric and shared. Many researchers and transportation agencies have been focusing on developing connected vehicle infrastructure, such as roadside sensors and communication devices. Now manufacturers are developing automated vehicles that sense their surroundings using cameras and detection systems, and it seems less likely that we will need a major investment in connected vehicle infrastructure.

Electric vehicle sales are expected to increase dramatically in the coming years due to falling manufacturing costs and rising demand, and nearly every model of automated vehicle currently being developed runs on electricity. We will likely need more electricity generation to power growing numbers of electric vehicles, but we may not need more public charging infrastructure since vehicles will likely be able to travel farther on a single charge. The first generation of automated vehicles are likely to be shared, and operators will need space to store, maintain and charge them.

Regardless of how technology develops, we clearly need to invest in keeping our current transportation infrastructure in a state of good repair. Whether automated, connected, electric or shared, all vehicles will need well-maintained streets—especially automated vehicles that rely on lane markings to navigate.

Microtransit describes a variety of new services, including Via, Chariot and Leap that offer more flexible schedules, use smaller vehicles and/or involve a greater level of private sector involvement than conventional transit. Some microtransit is **coordinated** with public transit, for example services that connect people to high-frequency transit or

operate in areas that are hard to serve with conventional transit, while **luxury** microtransit serves existing transit routes and offer more space or amenities than a public bus at a higher cost.

Car share services allow people to rent a nearby vehicle for short trips and pay only for the time that they use. Different car share service types include **stationary** car share (ZipCar, in some cases ReachNow), under which cars are kept at fixed stations, and users pick up cars from and return them to the same station; **free-floating** car share (Car2Go, ReachNow), which allows people to pick up and drop off cars anywhere within a defined service area; and **peer-to-peer** car share (Getaround, Turo), which enables people to rent cars from their neighbors on a short-term basis.

Bike and scooter share systems make fleets of bicycles, electric bicycles, or electric scooters available for short-term rental within a defined service area. **Conventional** bike share systems like Biketown in Portland typically use regular bikes and are operated through exclusive agreements between a private company and a public agency. In most cases users must pick up and leave bikes at designated stations, through Biketown and other modern systems also offer users a dockless option of locking a bike anywhere within the service area. Fully **dockless** systems operated by companies such as Ofo, Limebike and Spin allow users to pick up and leave bikes or electric scooters within a defined service area and require less coordination between the public and private sector.

Traveler information and payment refers to the numerous new ways in which technology enables people to learn about and pay for their travel options online, including moovel, Google Maps, TransitApp, Waze and TriMet's Tickets App.

Table 4 summarizes the impacts of the different technologies covered in this strategy on each of our regional goals. Appendix 2 contains more detailed information on the resarch summarized in the table.

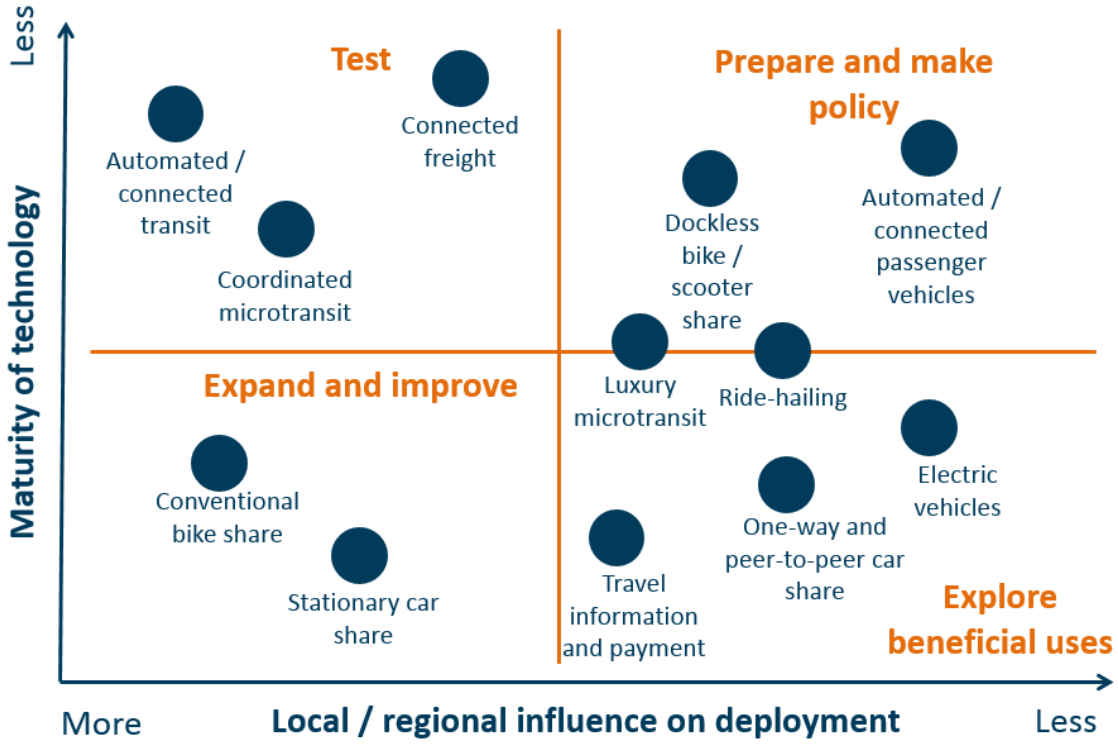
Table 4. How different emerging technologies are likely to impact our regional goals

Goal	Automated vehicles	Connected vehicles	Electric vehicles	Ridehailing	Coordinated microtransit	Luxury microtransit	Stationary / free-floating car share	Conventional bike share	Dockless bike and scooter share	Travel information and payment
Vibrant communities	+/-	+/-					+		+/-	
Economic prosperity	-			-				+		
Transportation choices	+/-	+/-		+/-	+/-	-	+	+	+	+/-
Reliability	+/-	+/-		+/-	+	+	+			
Safety and security	+	+		-						
Environment	-	-	+				+	+	+	
Health			+					+	+	
Equity	+/-	+/-	+/-	+/-	+	-	+/-	+/-	+/-	+/-
Transparency	-	+		+/-	+	-	+	+/-	-	-
Fiscal stewardship		+	-		+	-				

+: Generally positive impact
+/-: Mixed impact
-: Generally negative impact
(blank): Neutral / not enough information to assess impacts

It is important to consider not only what impacts technology will have, but also how public agencies can shape those outcomes. Some emerging technologies are already mature, and we have a clear idea of how they affect our region. Others have arrived but continue to grow and evolve, and many are still on the horizon, which limits public agencies' ability to take action. Public sector influence on emerging technology also varies; in some cases the public sector deploys technology directly or influences where and how new mobility services operate by issuing permits or allocating space, while in other cases technology involves very little oversight from local or regional agencies. These factors shape how public agencies can best respond to different emerging technologies, as shown in Figure 4.

Figure 4. How public agencies can respond to different technologies based on maturity and public influence

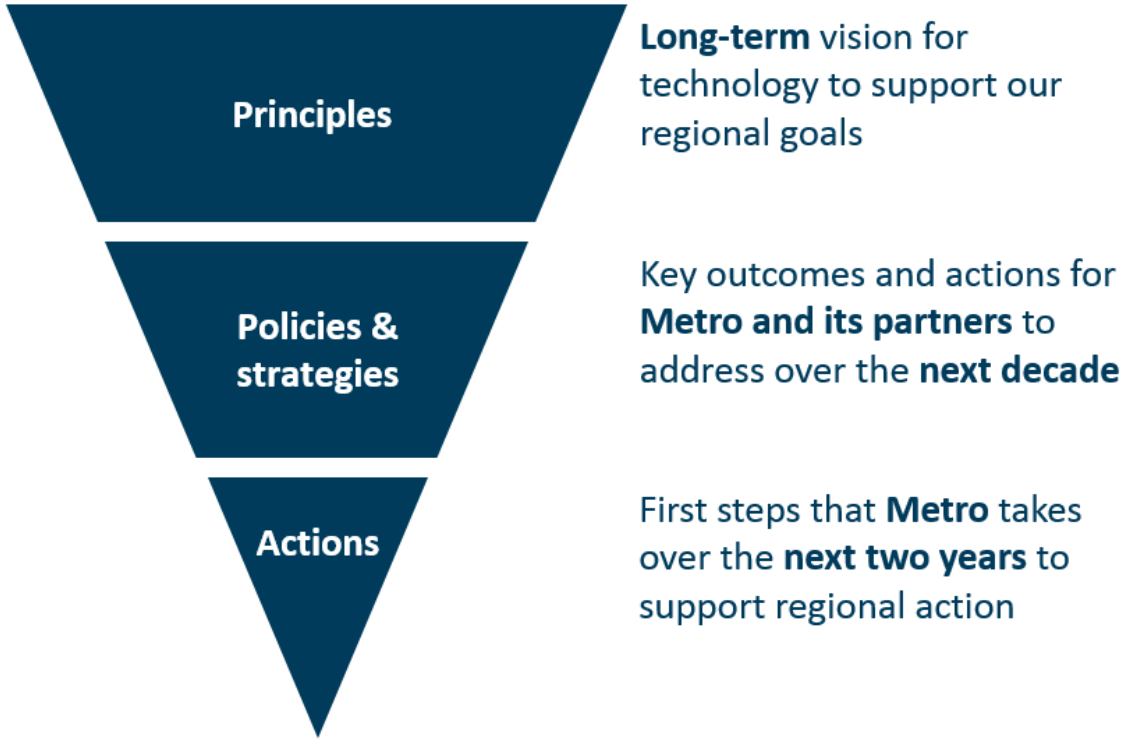


For mature technologies over which local and regional agencies have strong influence (conventional bike share, stationary car share), we have ample information on how they work and can look for strategic opportunities to expand these technologies to new communities or improve them—keeping in mind that traditional car and bike share models now face competition from free-floating car and dockless bike and scooter share. For technologies that are operating at scale without much public oversight (ride-hailing, electric vehicles, travel information and free-floating or peer-to-peer car share) we need to test the ways that we think that these technologies can benefit the region and see how they work. For example, we can try using these technologies to connect people to transit or meet the mobility needs of historically marginalized people. Public agencies should look for initial opportunities to deploy technologies that are still on the horizon and can help us better operate and manage the transportation system, particularly the transit system. Lastly, for technologies that are still maturing and largely in the hands of the private sector (automated vehicles, dockless bike and scooter share and ride-hailing services, which will continue to evolve as they integrate automated vehicles), Metro and its partners need to prepare by collecting information to inform policymaking, including advocating for federal and state policies that support local and regional goals.

EMERGING TECHNOLOGY VISION, POLICIES AND ACTIONS

The Emerging Technology Strategy begins with principles that outline a broad, long-term vision for how technology can support our regional goals and then focuses in on the critical steps we can take now to implement this vision. Policies and implementation actions describe how Metro and its public agency partners can tackle the most pressing technology-related issues and opportunities that are likely to arise over the next decade. Next steps highlight what Metro will do in the coming two years to support its partners in moving forward with policies and implementation actions.

Figure 5. Emerging technology policy framework



Principles

The principles below articulate a long-term vision for how technology should support the goals of the Regional Transportation Plan. These principles, summarized in Table 2, guide Metro and its partners in planning for and working with emerging technology as it continues to evolve, as well as in identifying companies that share common goals when developing partnerships and pilot projects.

Table 5: RTP goals and corresponding emerging technology principles

RTP goal	Emerging technology principle
Vibrant communities	Emerging technology should support our regional land use vision and enable communities to devote more space to places for people.
Prosperity	Workers whose jobs are impacted by automation should be able to find new opportunities, and emerging technology should create more efficient ways to meet the transportation needs of local businesses and workers.
Choices	Emerging technology should improve transit service or provide shared travel options and support transit, bicycling and walking.
Reliability	Emerging technology should help to manage congestion by promoting shared trips, decreasing vehicle miles traveled and minimizing conflicts between modes.
Safety and security	Emerging technology should reduce the risk of crashes for everyone and protect users from data breaches and cyberattacks.
Environment	New mobility services should use vehicles that run on clean or renewable energy.
Equity	New mobility services should be accessible, affordable and available for all and meet the transportation needs of communities of color and historically marginalized communities.
Fiscal stewardship	Emerging technology companies and users should contribute their fair share of the cost of operating, maintainingand building the transportation system, and new technology should make it possible to collect transportation revenues efficiently and equitably. Public agencies should test new ideas and technologies before commiting to them in order to get the best return on public investments.
Transparency	Companies and public agencies should collaborate and share data to help make the transportation system better for everyone.

Policies and Actions

The four policies below cover the issues that Metro and its public agency partners have identified as the most pressing to address over the next decade in order to stay on track to meet our regional goals as technology and mobility continue to evolve.

Figure 6. Technology strategy policies

Policy 1: Equity: Make emerging technology accessible, available and affordable to all, and use technology to create more equitable communities.

Policy 2: Choices: Use emerging technology to improve transit service, provide shared travel options throughout the region and support transit, bicycling and walking.

Policy 3: Information: Use the best data available to empower travelers to make travel choices and to plan and manage the transportation system.

Policy 4: Innovation: Advance the public interest by anticipating, learning from and adapting to new developments in technology.

These four policies are interrelated. In order to provide new and better transportation options throughout the region, we need to make sure that these options work for everyone. We need sound information and an innovative approach to identify, implement and evaluate the projects that work best for our region.

These policies are also critical to our longer-term success. We need to make transit and shared trips the easiest way to travel in a vehicle to make the most of emerging technology's potential to reduce congestion and pollution, improve safety and support our regional land use vision, and we need sound data and a nimble approach to stay on track to meet our regional goals as new innovations arrive. Table 6 below summarizes how the policies are related to the broader set of principles outlined above.

Table 6. Relationships between policy areas and principles

Policy area	Related principles
Equity	**Prosperity**: The transportation sector provides family-wage jobs for many people of color and low-income workers, and we need to help workers whose jobs are threatened transition to new opportunities. **Choices**: Historically marginalized communities are more likely to rely on transit and affordable, shared travel options, so these options will be more widely used if they are easy for marginalized communities to access.
Choices	**Vibrant communities**: Transit, shared trips and active transportation move people efficiently, freeing up space for people instead of cars. A thriving transit network is the backbone of our land use vision. **Prosperity**: Better choices mean less congestion and better access to jobs. **Reliability**: Transit, shared trips and active transportation all move people more efficiently than driving alone, reducing congestion. If automated vehicle trips aren't shared, the resulting increase in vehicle travel may outweigh the benefits of vehicles moving more efficiently. **Safety and security**: Minimizing conflicts between new mobility services and bicyclists and pedestrians protects vulnerable users from crashes. **Environment**: Shared vehicles and trips make it easier for everyone to access electric or clean energy vehicles. **Equity**: Improving transit service helps historically marginalized people, who are more likely to rely on transit, reach their destinations.
Information	**Choices**: Providing better travel information can help people who are used to driving alone find ways to take transit or share trips. **Reliability**: Public agencies need real-time transportation data to manage and price congestion as effectively as possible. **Safety and security**: We need sound information to know whether new mobility services are safe. As agencies collect increasing amounts of data, we need to protect people's personal information. **Fiscal stewardship**: Data is an increasingly valuable resource, and we need to be as careful in managing our data as we are in managing our infrastructure. **Transparency**: We need data on new mobility services to assess how they are impacting our goals.
Innovation	**Prosperity**: Pursuing partnerships with new mobility companies can help attract additional resources. **Reliability**: We need to anticipate the needs and characteristics of tomorrow's transportation system to effectively manage congestion. **Fiscal stewardship**: Pilot testing emerging technology can be a more cost-effective way of learning about it than funding research or planning projects.

Policy 1: Equity

Make emerging technology accessible, available and affordable to all, and use technology to create more equitable communities.

Metro and its partners are responsible for ensuring that the transportation system serves all people, particularly those in the greatest need. New mobility services have the potential to bring more flexible transportation options to historically marginalized communities, but not everyone can access these services. Communities of color face the threat of discrimination from drivers or companies, some older adults and people who speak limited English aren't able to use apps, many low-income people cannot afford costly data plans or lack access to bank accounts and people in wheelchairs often struggle to find accessible shared vehicles. If we can remove these barriers, we can bring better transportation choices to communities of color, night shift workers, people with disabilities, people living in areas that lack frequent transit service and others. We will use new mobility services to create a more just transportation system while helping transportation workers who see their jobs threatened transition to new roles.

What happens if we act	What happens if we don't
• It is easier for historically marginalized people to get where they need to go, especially when other options aren't available. • Transit, which is the most affordable and accessible way to travel, thrives. • Transportation workers find jobs in the new transportation system.	• There are more choices for those who can afford them. • Transit dwindles, especially in the communities that need it the most. • Historically marginalized communities are left behind as technology develops.

Implementation actions

1. Partner with historically marginalized communities to identify barriers to accessing emerging technology, understand the impact that new mobility services are having on displacement and transportation access, and develop solutions. (Metro, cities and counties, transit agencies)

2. Enable all people – regardless of race, age, language and culture, immigration status, banking status and digital access – to access new mobility services. (Metro, cities and counties, transit agencies)

3. Develop standards for wheelchair accessibility and service equity for new mobility services. (Metro, cities and counties, transit agencies)

4. Create affordable payment options to help low-income people access new mobility services that meet their transportation needs. (Metro, cities and counties, transit agencies)

5. Use new mobility services to connect historically marginalized communities to transit stations and to employment centers, community services and other

destinations that are not well-served by transit. (Cities and counties, transit agencies)

6. Use technology to improve paratransit and other special transportation services for people who have challenges driving or using conventional transit. (Transit agencies, special service transportation providers)

7. Develop programs to help transportation workers whose jobs are affected by automation find new opportunities. (Transit agencies, special service transportation providers)

Technology and the workforce

Close to 30,000 people, or 2.5 percent of workers in the region, drive vehicles for a living, and thousands more drive part-time for ride-hailing companies to supplement their incomes. These people could see their jobs threatened by automation. The transportation sector has long offered family-wage job opportunities to people who lack advanced educations, and driving for Uber or Lyft has become a way for people who do not have full time employment to make ends meet, so these job losses in transportation will mainly impact lower-income households. Meanwhile, advances in freight delivery are likely to benefit national businesses and online retailers, making it harder for local businesses to compete.

Technology also generates new job opportunities, but mostly for people with advanced educations, and these new opportunities don't seem likely to make up for the lost ones. Some envision a future where drivers are retrained to provide customer service or monitor safety on board automated vehicles, but those positions seem unlikely to offer the same security as driving for a living does. We need to start planning today to help prepare the region's workers for the changes that lie ahead.

Policy 2: Choices

Use emerging technology to improve transit service, provide shared travel options throughout the region and support transit, bicycling and walking.

Emerging technology has already given people in our region new ways to get around, whether by taking car or bike share, hailing a ride, or simply making it easier for people to learn about and pay for public transportation. However, new mobility services are concentrated in communities where it is already easy to take transit, walk and bike, which creates more congestion and pollution by attracting people away from more efficient modes and clogging streets with vehicles looking for passengers. In order to make the most of emerging technology's potential to reduce congestion and pollution, improve safety and support vibrant communities, we need to use technology to help people connect to transit, share trips with other travelers or leave their cars at home. We will prioritize and invest in the modes that move people most efficiently and continue to improve convenience and safety for transit riders, pedestrians and bicyclists. This is part of a broader effort, reflected throughout the Regional Transportation Plan, to improve transit service and create safer, better facilities for bicyclists and pedestrians.

What happens if we act	What happens if we don't
• New mobility services thrive side-by-side with transit, bicycling and walking. • We move more people in fewer vehicles. • Emerging technology helps to reduce congestion and emissions. • The entire region enjoys new ways to travel.	• New mobility services compete and create conflicts with transit, bicycling and walking. • Vehicles travel more miles to move fewer people. • Emerging technology increases congestion and emissions. • New options are concentrated in urban areas.

Implementation actions

1. Price, manage and design streets to reduce vehicle miles traveled and prioritize transit use and shared travel. (ODOT, Metro, cities and counties, transit agencies)

2. Design and manage the curbside to minimize conflicts between new mobility services and transit riders, bicyclists and pedestrians. (ODOT, Metro, cities and counties, transit agencies)

3. Support new mobility services that reduce vehicle miles traveled by connecting people to transit or providing shared trips, particularly in communities that currently lack options. (Metro, cities and counties, transit agencies)

4. Explore and pilot test new technology, such as automated vehicles and dynamic routing, to improve transit service. (Metro, transit agencies)

5. Work with travel information services to avoid routing drivers along neighborhood streets, through school zones and in other areas where bicyclists and pedestrians are vulnerable to safety risks from increased traffic. (ODOT, Metro, cities and counties)

Policy 3: Information

Use the best data available to empower people to make travel choices and to plan and manage the transportation system.

In today's transportation system, data is as important as infrastructure. Smartphones enable people to instantly book a transit trip or find a new route when they run into traffic, and new mobility companies use real-time data to balance supply and demand. Metro and our partners want high-quality information to be available on all transportation options in the region, and to be presented in a way that allows travelers to seamlessly plan and book trips. We will also develop the data that we need to plan the transportation system – including better data on transit, bicycling and walking as well as on new mobility options – and create systems that allow us to share data among public agencies and better manage and price travel. As we collect better data, we will also develop new policies around how we manage and use data so that we protect personal and competitive information and safeguard this increasingly valuable public resource.

What happens if we act	What happens if we don't
• People can easily compare travel options and pick the one that best meets their needs. • We know how emerging technology is changing transportation patterns. • We can manage congestion as it happens. • We get the best value out of public agency data.	• People rely only on the options that they know or that offer flashy apps. • We have limited insight into how our transportation system is changing. • We are slower to respond to collisions and incidents. • Public agencies waste resources on collecting and sharing data.

Implementation actions

1. Create or support services that allow people to compare and book travel options and multimodal trips seamlessly and competitively. (ODOT, Metro, cities and counties, transit agencies)

2. Modernize and share public agency data on transit service and bicycle/pedestrian infrastructure. (ODOT, Metro, cities and counties, transit agencies)

3. Conduct education and outreach to help travelers understand and use new mobility services that align with our principles. (ODOT, Metro, cities and counties)

4. Develop data policies that ensure access to and responsible usage of public agency data. (ODOT, Metro, cities and counties, transit agencies)

5. Collect data, conduct research and conduct education and outreach on usage and impacts of emerging technology. (Metro)

6. Increase capacity to send data to and collect data from the roadside. (ODOT, cities and counties)

7. Identify data that serves the public interest and share it in a way that protects confidentiality while supporting public decision-making. (Metro)

8. Develop new ways of pricing travel that address the impacts of emerging technology on travel behavior and transportation revenues while using technology to price travel more effectively and equitably. (ODOT, Metro)

Policy 4: Innovation

Advance the public interest by anticipating, learning from and adapting to new developments in technology.

Planning for a changing transportation system begins with changing how we plan. Our current planning process is designed around infrastructure projects designed to last for 50 years and an unchanging set of transportation services. It can take decades to plan and build a project, and once it is built there is little room for change. This time-intensive, risk-averse approach continues to make sense for major transportation investments, but in order to effectively plan for emerging technology we need to give ourselves opportunities to try new approaches, learn from our experience and adapt so that we can keep up with the pace at which technology is evolving. We will also actively engage new mobility companies alongside large employers, academics and community groups working in the technology arena, to identify opportunities to collaborate and test new ideas and turn our region into a hub for innovation.

What happens if we act	What happens if we don't
• We adapt to changes in technology. • We work together with all stakeholders to identify mutually beneficial policies and projects. • We try new ideas and learn from the results.	• We commit to processes, plans and projects that are increasingly out of date. • We confront big changes with limited resources and partnerships. • We sit on our hands because we feel like we don't know enough to act.

Implementation actions

1. Use Metro funds and leverage local dollars to support emerging technology projects that align with our principles, focusing on projects that advance equity and improve shared transportation options. (Metro, cities and counties)

2. Partner with new mobility companies, employers, researchers and community groups when developing and implementing pilot projects. (Metro, cities and counties, transit agencies)

3. Develop and test new data, tools, systems and models to plan, manage and price the transportation system. (ODOT, Metro, cities and counties, transit agencies)

Next Steps

Metro has identitied four next steps that it will take in the next two years to help the region implement the policies listed above. Table 7 summarizes these next steps as well as key milestones and ongoing work that will take place over the next two years.

Table 7: Next steps, six-month and one-year milestones, and ongoing work

Next step	Six-month milestones	One-year milestones	Ongoing work over the next two years
Fund technology pilot projects	Issue a call for projects for the new Partnerships and Innovative Learning Opportunities in Transportation (PILOT) program Update the RTO and TSMO program guidelines to better support emerging technology projects	Select and fund the first round of PILOT projects, as well as the next round of RTO and TSMO projects	
Convene stakeholders to establish consistent new mobility policies across the region	Share information on policy issues and approaches from other cities and identify next steps for regional coordination	Work with partners to support the development of new mobility policies	
Develop better data and tools to plan for emerging technology	Forecast the impacts of automated and shared mobility on our region Explore new data sources and data-sharing partnerships with new mobility companies	Identify strategies to refine data and models to better capture the impacts of emerging technology	Implement strategies to refine data and models to better capture the impacts of emerging technology
Advocate for state and federal technology policy that supports our regional goals	Participate in phase 1 of the Oregon Automated Vehicle Task Force	Participate in phase 2 of the Oregon Automated Vehicle Task Force	Participate in other state and federal policymaking efforts related to emerging technology

Fund technology pilot projects

Pilot projects are a cost-effective way to develop the information and partnerships that we need to make sure that emerging technology benefits our region. One benefit of the way that technology is developing is that it can lower the cost of trying new ideas in transportation. In the past, if we wanted to start a new shuttle service, we would have had to spend considerable time and money planning the service before it began operating. Now we can partner with shared mobility providers that are already operating in our communities to provide a similar service for a limited time using their vehicles and drivers, see how it works and decide whether it merits a long-term investment. This approach gives us better information on how people would really use the service, often at a lower cost than planning it out on paper.

Community EV and e-Bike Project

One of the first technology pilot projects in the region with an equity focus was the Community Electric Vehicle and e-Bike Project, a collaboration between Hacienda CDC and Forth. Over the course of a year, the project made three electric vehicles, as well as a fleet of electric bikes, available to residents of the Cully neighborhood, which has a large Latinx population and lacks high-frequency transit. Both the EVs and e-bikes were widely used by residents. The project also shed light on some of the challenges that marginalized communities face to using shared mobility. For example, usage of the EVs was limited by the online platform used to manage them, which only allowed day-long rentals during business hours. More flexible platforms are available in the region, but do not offer service in Cully.

Metro will develop a new funding program, Partnerships and Innovative Learning Opportunities in Transportation (PILOT), focused on testing how Metro and our partners can use technology to advance equity and provide better, more efficient travel options. The goals of this program are to collect information on how we can best implement the policies contained in this strategy and develop partnerships that enable long-term success. Even projects that fall short of their intended outcomes can foster valuable partnerships and yield information about how emerging technology can help create more equitable and livable communities.

The pilot projects that Metro is interested in exploring include:

- Developing services and conducting outreach and education to remove barriers that historically marginalized communities face to accessing new mobility services.
- Partnering with community groups to develop and implement shared mobility services or projects that meet the transportation needs of historically marginalized communities.

- Using new mobility services to connect people to transit stations when walking, bicycling or taking local transit service isn't an option.
- Providing shared rides for people who would otherwise drive alone.
- Using emerging technology to improve transit service.
- Testing new technologies or approaches for managing new mobility services and encouraging shared and active trips.

Metro will also support technology projects through two of our existing programs: the Regional Travel Options (RTO) program, which supports public agencies and community based organizations, to conduct outreach and education and build small-scale infrastructure that reduces drive-alone trips; and the Transportation System Management and Operations (TSMO) program, which supports transit and road operators in deploying new management technologies. Table 8 shows how the new PILOT program, RTO and TSMO could support the pilot projects listed above.

Table 8: Opportunities to implement emerging technology projects through Metro programs

	Travel information, apps and incentives	New mobility services	AV/CV/EV
PILOT	• Services to remove barriers to access for HMCs • Community partnerships that use new mobility to meet the needs of HMCs	• Services to remove barriers to access for HMCs • Community partnerships that use new mobility to meet the needs of HMCs • Shared mobility pilots that connect people to/from transit stations • Pilot testing technologies for occupancy-based pricing	• Shared EV, AV, or e-bike pilots in HMCs
RTO	• Improved public agency data on transportation options • Commute management and incentive apps • Services to remove barriers to access for HMCs	• Outreach, research and partnerships to help HMCs access services and develop projects • Services to remove barriers to access for HMCs	• Promotion of AV/CV/EV services the reduce single occupant vehicle trips
TSMO	• Systems to manage and share real-time transportation data • Incentives to reduce vehicle trips during peak periods	• Pilot testing technologies for occupancy-based pricing and curbside management	• CV, AV, or dynamically routed transit • Systems and standards for CV transit and passenger vehicles

Within the next six months, Metro will establish the program structure and evaluation criteria for the PILOT program and issue a call for projects. Metro will also update the RTO and TSMO program guidelines to better support emerging technology projects.

Within the next year, Metro will select and fund the first round of PILOT projects, as well as the next round of RTO and TSMO projects.

Convene stakeholders to establish consistent new mobility policies across the region

Ride-hailing, microtransit and car, bike and scooter share services are expanding rapidly, and have experienced some growing pains as the companies that operate these services mature from small startups into multimillion-dollar transportation services and public agencies struggle to address change. Companies have faced fines and settlements for violating insurance requirements,[17] defrauding customers,[18] failing to accommodate people in wheelchairs[19] and failing to investigate drivers who received complaints for driving under the influence.[20]

It can be challenging to develop policies for new technologies that aren't yet operating at scale. However, if we wait to take action until new services mature, we could risk endangering users' safety or disrupting options that people rely on. We need to ensure that new mobility services operate safely, equitably and transparently, while protecting competitive information for the companies that operate these services and allowing them the flexibility to innovate. To the extent possible, new mobility policies should be uniform throughout the region to give companies a consistent operating environment. There are plenty of examples from around the United States for us to draw on; for instance, counties and cities of all sizes in Washington have adopted ride-hailing ordinances, often in coordination with each other,[21] and a growing number of cities are trying new approaches to dockless bike and scooter sharing that allow companies to operate on a pilot basis before they are eligible for a permit.[22]

Within the next six months, Metro will share information through the Emerging Technology Working Group on policy issues and approaches from other cities and identify next steps for regional coordination.

Within the next year, Metro will work with partners to support the development of new mobility policies, potentially including regulatory, data-sharing or incentive-based approaches. Metro could support partners by developing model policy language, coordinating joint regulations or collecting and sharing data.

Develop better data and tools to plan for emerging technology

Based on the information available today – including Metro's surveys, a growing body of research and data from partners and peer agencies – we know generally that emerging technology is impacting our region and can identify the first steps we need to take toward our goals. As work progresses, Metro and its partners will need more detailed information to better understand how different emerging technologies are working in the diverse communities within our region. Pilot projects are one way to get that information, but we also need to explore other tools and data sources that can help anticipate and plan for the impacts of emerging technology, including:

- modeling the impacts of automated vehicles and increased use of new mobility services so that we can prepare for more sweeping impacts to land use, congestion and transportation revenues
- collecting more up-to-date data on travel behavior so that we can analyze the broader impacts of new services, technologies and projects on people's transportation choices
- sharing real-time data on transportation performance among public agencies so that we can better manage the transportation system and give travelers up-to-date information that they increasingly rely on to plan trips.
- collecting information on new mobility services so that we know how they are affecting travel patterns throughout the region. Public agencies are working to collect and house a growing amount of data on these services in a way that protects people's privacy and companies' trade secrets while maintaining access to the information needed to plan and manage the transportation system.

Within the next six months, Metro will use its travel and land use models to forecast the impacts of automated and shared mobility on our region, examining a variety of potential future scenarios. Metro will also explore new data sources and data-sharing partnerships with new mobility companies.

Within the next year, Metro will identify strategies to refine its data and models to better capture the impacts of emerging technology. These strategies could include revising the surveys that inform our travel model to better capture how people use shared modes, updating travel surveys more frequently so that the model is more responsive to the accelerating pace of technological change, and licensing private data sources that provide more detailed and comprehensive information on how we travel.

Over the next two years, Metro will implement strategies to refine its data and models to better capture the impacts of emerging technology

Advocate for state and federal technology policy that supports our regional goals

Many of the important policy decisions regarding emerging technology, particularly automated vehicles, currently rest with the state and federal government. It makes sense to address issues such as safety testing, liability and licensing and registration at the state and federal level for consistency's sake or because state and federal agencies already have the capacity to administer regulations. At the same time, local and regional agencies, both in the greater Portland region and across the United States, have a strong interest in getting emerging technology policy right. New mobility services and their customers – as well as their impacts, both for better and worse – are concentrated in metropolitan areas. Local and regional agencies also plan and manage the streets on which the majority of automated vehicle travel will take place. Metro will advocate alongside and on behalf of its partners for state and federal policy that supports our goals and maintains local and regional authority to manage the transportation system.

Within the next six months, Metro will will participate in the first phase of the Oregon Automated Vehicle Task Force, which focuses on developing legislation that addresses administrative issues related to automated vehicles, as well as other relevant state and fedreal policymaking efforts.

Within the next year, Metro will will participate in the second phase of the Oregon Automated Vehicle Task Force, which focuses on developing legislation that addresses the longer-term impacts of automated vehicles, as well as other relevant state and fedreal policymaking efforts.

Over the next two years, Metro will work with our partners to weigh in with a unified voice on other state and federal policymaking efforts related to emerging technology.

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TECHNICAL APPENDICES

2018 Regional Transportation Plan

Emerging Technology Strategy

A strategy for guiding innovation to support the greater Portland region's goals

December 6, 2018

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Regional Transportation Plan website: **oregonmetro.gov/rtp**

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APPENDIX 1: FORECASTING THE FUTURE

Below we describe in more detail how technology is likely to develop in the coming decades, as well as how it will affect our goals if we don't act and the actions that public agencies need to take in order to prepare for successive waves of change.

The next five years

How we expect technology to develop

In the next five years, the first AVs will likely hit our streets, and will be operated by ride-hailing companies, freight companies, and other private fleets. These first-generation AVs will be significantly more expensive than regular vehicles, but Uber and Lyft, as well as other companies that enter the ride-hailing market, will be happy to pay for them because they reduce the cost of driver labor, which can make up most of the cost of a ride-hailing trip. Initially, AVs will likely be deployed on a pilot basis, with a human operator ready to take over if something goes wrong.[1] However, several of these pilot deployments could be large enough in scale to serve entire cities.[2]

Most of the first AVs will be EVs. Almost all passenger AVs available today are EVs, because it is easier to automate control of an EV than a regular vehicle.[3]

Ride hailing companies will also continue to expand and improve service throughout our region, independent of automation, as they recruit new drivers and more people have the opportunity to try them. Other shared mobility services will also likely grow. BIKETOWN and car share companies plan to launch service in new communities in the coming years, and newer shared mobility models, such as dockless bike and electric scooter share, are also likely to grow their service in our region.

Transit agencies and freight companies will have new opportunities to innovate. Transit agencies across the country are already testing new approaches such as microtransit, AV shuttles, and subsidized ride-hailing trips to connect people to transit. In our region, TriMet is developing resources to help people plan transit trips—including bike share and ride-hailing connections to and from transit stations. These trends mean that people in the region are likely to enjoy new ways to seamlessly make and plan connections to transit. Freight companies and retailers will also continue to experiment with new ways to distribute goods, particularly the growing amount of purchases made online. Innovations such as ride-hailing-style delivery services, drone deliveries and package lockers could change how goods travel along our streets.

Apps will become the dominant way to access travel information. Whether you're a driver, cyclist, transit rider or pedestrian, apps are already the most widely-used way to get information on how to get around, and their popularity will continue to grow. Public agencies' success in managing the transportation system will depend increasingly on how well people can access information on public transportation options via smartphone—

particularly via third-party apps like Google Maps, moovel and Transit App, which are drawing a growing share of users while usage of many public agency apps and websites dwindles.

How it could impact our goals

Transportation choices: People in the region will have new ways to get around and plan trips. However, it is less clear whether emerging technologies will really improve our choices. New mobility services could compliment transit, bicyling and walking by focusing on trips that transit can't service and bringing better options to areas where driving is currently the only reliable and convenient way to travel. Or they could compete with walking, bicycling, transit and each other by focusing on serving those who already enjoy access to a variety of travel options.

Equity: As more people in the region turn to app-based transportation services and travel information, we risk leaving those who can't use or afford these services behind. Competition between new modes and transit could impact service that low-income people and communities of color disproportionately rely on.

Transparency: The public will have limited insight into how new technologies are affecting our communities. In most cases new mobility companies do not provide data on how people are using their services nor face requirements to provide safe and equitable service. Federal legislation may also prohibit state and local governments from requiring that AVs make vehicle data available.

Emerging technologies and transit

The rise of ride-hailing and microtransit has some people wondering whether transit will soon become a thing of the past—especially if AVs enable more affordable, flexible and convenient shared service. So why do we focus so much on transit in this strategy?

The first reason is because a future with transit looks so much brighter than a future without it. Even with shared AVs on the road, transit will remain the most efficient way to move people through congested areas. Transit is the mode that historically marginalized people most rely on for everyday trips, and the one that we can all rely on to keep our region moving in the event of a natural disaster. And the transit network is the backbone of our land use vision, anchoring vibrant communities across our region. New mobility services can reach people in places where transit isn't efficient, and they but it's difficult to imagine them providing all these other benefits.

The second reason is because transit provides great opportunities to innovate. TriMet is already a leader in making it easy for riders to plan and pay for trips online. We'll soon have the chance to pilot test new technologies like microtransit and automated transit vehicles.

How the region can prepare

- Develop policies to ensure that new mobility services—especially those that pilot test AVs—operate safely and equitably and provide the information that we need to plan for our changing system.
- Understand the barriers that people face to using emerging technologies, and work with affected communities to overcome these barriers.

- Pilot test new technologies to see whether they support our goals.
- Forecast how changes in technology will shape the future so that we can better plan for it.

Five to ten years

How we expect technology to develop

As AV technology matures, **ride-hailing and freight companies will likely begin to phase out human drivers.** This will enable ride-hailing companies to cut the cost of trips, potentially making ride-hailing a viable option for trips to work, the grocery store and other daily destinations – not only in Portland, but also in communities like Hillsboro, Oregon City and Gresham. And it likely won't just be Uber and Lyft serving these communities; many traditional automakers, AV technology firms and car share companies are planning to launch ride-hailing service when AVs arrive.[4] Autonomous transit vehicles should also become available, potentially lowering the cost of providing transit, particularly in areas that are challenging to serve with fixed routes.

We'll use the curbside differently. In addition to parking and bike lanes, the curbside will host increasing numbers of ride-hailing drop-offs, and potentially also more EV charging, microtransit boardings and new models of freight delivery.

How it could impact our goals

Reliability: In the nearer term, more ride-hailing likely means more congestion for the region. Researchers have found that ride-hailing services increase vehicle miles traveled because they travel additional empty miles to pick people up and shift trips away from transit, bicycling and walking, and because they focus on serving areas that are already congested. If AVs enable ride-hailing companies to more efficiently provide shared trips, it could help with congestion, and eventually, AVs should streamline traffic because they will be able to platoon and travel at higher speeds. However, the benefits of AVs on congestion will be muted as long as they are in mixed traffic with human drivers.

Prosperity: Close to 30,000 people, or 2.5 percent of workers in the region, drive vehicles for a living, and thousands more drive part-time for ride-hailing services to supplement their incomes. These people could see their jobs threatened by automation. The transportation sector has long offered family-wage job opportunities to people who lack advanced educations, and driving for Uber and Lyft has become a way for people who do not have full time employment to make ends meet, so these job losses will mainly impact lower-income households. Also, advances in freight delivery are likely to benefit national businesses and online retailers, making it harder for local businesses to compete. New mobility companies will bring some new jobs to the region, but mostly for skilled workers, and there are unlikely to be enough of these new opportunities to compensate for lost transportation jobs.

The impacts on **transportation choices**, **equity** and **transparency** discussed in the previous section will continue apace during this time frame, with some additional nuances. Autonomous transit could provide more flexible, efficient and affordable service, but if ride-hailing companies have a head start in deploying AVs it may be hard for transit to recapture riders. AVs could improve travel options for youth, older adults and others who cannot drive. And the reduced cost of automated ride-hailing trips could make ride-hailing a more viable option for low-income travelers. However, it seems likely that without significant effort to expand physical, financial, linguistic and digital access many people will continue to be unable to take advantage new mobility services.

How the region can prepare

- Create programs to help affected transportation workers transition to new jobs
- Continue to develop pilot projects and partnerships with new mobility companies.
- Redesign and manage curb space to reduce conflicts and congestion, prioritize shared trips and maintain safety, especially for bicyclists and pedestrians
- Price vehicle travel to manage congestion and encourage shared trips.

Ten to 20 years

How technology could develop

Sometime in the next two decades we could reach the point when **the majority of new vehicles sold—and a significant portion of all vehicles on the road—are automated and electric**. If vehicles use common communications protocols, it will open up new possibilities for using connected vehicle infrastructure to manage the transportation system. Groups of AVs traveling side-by-side will be able to platoon, taking up less space on the roadway.

Ride-hailing and freight could be entirely automated. We could see ride-hailing service peak as companies fully deploy AVs and prices drop to the point that **significant numbers of people start to buy AVs for personal use**. Driving will become much more convenient, because people will be able to work, shop or rest in their cars, and it may be possible to dispatch an empty vehicle to run errands, pick up family members or someone who wants to rent the vehicle or circle the streets instead of parking.

EVs will become as affordable as gasoline-powered vehicles as the cost of making the batteries that power EVs falls. We may need more publicly-available EV charging to accommodate this growth, but if the range that EVs can cover on a single charge increases most EV charging needs could be met at home, work or wherever shared fleets are headquartered.

Will AVs be shared or owned?

Experts describe two potential future scenarios for AVs, one in which they are operated in shared fleets and one in which they are individually owned. Shared AVs would likely mean fewer vehicle miles traveled, less congestion, a richer variety of travel options, and more space for people instead of vehicles. The fact that ride-hailing will probably start using AVs at scale years ahead of when they become affordable for most people increases the likelihood of the shared scenario, but it may be hard to provide shared service in more suburban or rural areas where homes and destinations are farther apart, as well as reverse 90 years of car ownership culture. The policies that we put in place over the next five years could make a significant different in setting us on a path toward a shared future that better supports our regional goals.

How it could impact our goals

Vibrant communities: In regional centers, where shared mobility services will likely be concentrated, we could see much less demand for parking. This could make it possible to redesign streets that have on-street parking, leaving more space for people, as well as create new opportunities for development on now-vacant parking lots. It could also spur new development by saving developers money on building parking spaces.

Reliability: It is unclear whether congestion will increase or decline during this phase. On one hand, having more AVs on the road will likely mean that traffic moves more efficiently. On the other, by making it more convenient to drive and making it possible for vehicles to travel without passengers, AVs are projected to increase vehicle miles traveled by anywhere from 3 to 68 percent,[5] further straining the capacity of the region's roads, many of which are already packed.

Environment: Transportation-related pollution and GHG emissions could go up or down during this phase. Vehicles will emit much less pollution per mile, but they will travel more. The significant increase in electricity demand due to electric vehicles—which could grow to 300 times what it is today globally[6]—may require the construction of new dams or the use of other, dirtier sources of energy.

Safety: Safety will likely improve once there are significant numbers of AVs on the road. Automation would eliminate human error in driving, which is responsible for the vast majority of crashes.[7]

Fiscal stewardship: Revenues from two major sources of transportation funding—the gas tax and parking fees—will fall dramatically during this period. Drivers of all-electric vehicles will pay no gas tax, and even those who drive the next generation of more efficient gasoline-powered vehicles will pay less. Meanwhile, if AVs are shared or if drivers are allowed to send their private AVs on a cruise instead of parking them, local governments might not collect any parking fees.

Prosperity: Any decrease in congestion would be a boon for productivity, since many workers will be able to spend more time working and less time in traffic. Even if there is more congestion, AVs will turn the commute into working time for people with office jobs.

However, those whose jobs require them to be at a specific location, such as construction workers, healthcare professionals and teachers, may not be able to work in their AVs, and their productivity may even suffer if congestion increases.

How the region can prepare

- Price travel and develop new revenue sources to fund construction and maintenance of the transportation system
- Develop policies, design communities and price travel to encourage shared travel and discourage vehicle ownership
- Reduce parking requirements and redesign streets in urban areas

20 to 40 years

How technology is likely to develop

Even according to the most conservative projections, the **majority of travel will be in AVs by 2050**, and **the majority of vehicles on the road will be AVs by 2060**. These changes could come much sooner, particularly if AVs are shared. Platooning and high-speed AV travel could become the norm on our streets, which could be transformed, with fewer, narrower lanes and no traffic signals. The need for parking spaces—already disappearing in urban areas—could also diminish in the suburbs.

How it could impact our goals

Vibrant communities: Since cars will need less space on the roadway, and may not need to park at all, we will have more space for people throughout the region that can be converted to housing, parks and trails, helping us create thriving centers and neighborhoods—assuming we can find new sources of transportation funding to help us retrofit our streets. However, many of the people who are now able to work while commuting could decide to live further out at the edges of the region, or even travel to Portland-area jobs from areas that are now rural. This could create more development pressure on farmland and natural areas and siphon growth away from now-vibrant communities.

Many of the impacts discussed in the above section will gain force during this period. **Safety** will likely improve for all, those who can work while commuting in their AVs will **prosper**, and **transportation revenues** will continue to dwindle. Advancing technology will help to increase **reliability** and benefit the **environment**, but it might not be enough to achieve our goals if AVs trigger sprawl on a scale we haven't seen before.

How the region can prepare

- Develop new land use policies to discourage sprawl and maintain vibrant communities in regional centers
- Reduce parking requirements and redesign streets throughout the region

APPENDIX 2: ASSESSING THE IMPACTS OF EMERGING TECHNOLOGIES

Automated and vehicles (AVs)

Automated vehicles use sensors and advanced control systems to operate independently of any input from a human driver. Transportation experts have developed a five-level system to distinguish between different levels of automation;[8] in this plan we focus on Level 4 or 5 AVs, which can operate independently under most or all conditions.

Status: AVs are not available for purchase yet, but they are being tested in a number of cities. The first consumer-ready models are expected to hit the streets within two years,[9] at a cost that is significantly higher than the cost of a conventional vehicle. Both the U.S. legislature and the State of Oregon are developing policies and regulations around the testing and deployment of AVs. The first generation of passenger AVs are likely to be operated in shared fleets by ride-hailing companies[10] because the money that these companies will save on driver labor will offset the additional cost of an AV. For similar reasons, freight companies will also likely be early deployers of AVs. The first AVs will mostly be electric vehicles; for engineering, economic and environmental reasons nearly every model of AV currently runs on electricity.[11] Sales of AVs will likely outpace sales of non-automated vehicles in 15 to 20 years, and the number of miles traveled in AVs will likely outnumber miles traveled in conventional vehicles within 30 to 40 years.[12]

Local and regional influence: Federal and state agencies intend to regulate the testing, safety and deployment of AVs, but it remains to be seen whether local and regional agencies will have enough oversight to ensure that AVs support policy goals. Draft federal AV legislation could pre-empt local governments from managing how AVs operate on their streets,[13] and few of the Portland region's public agencies have adopted policies regarding ride-hailing companies, which could affect how these companies deploy AVs.

Promise and peril: AVs will likely have sweeping impacts on the region—both for better and worse. It seems likely that they will create a safer transportation system, but also lead to much greater vehicle use and eliminate jobs. The impacts of AVs on land use, equity and the environment could be either positive or negative, and we need to start planning today to set the region on a positive course.

Goal	Promise	Peril
Vibrant communities	If shared, AVs could free up vehicle lanes and space currently devoted to parking to create space for people.	If AVs make driving more convenient, people are likely to move further from regional centers. If AVs are allowed to operate at higher speeds on local streets, it could create mini-highways bisecting communities.
Prosperity	Local companies are poised to play a role in deploying AVs.[14] Innovative approaches to AV technology could attract new companies and investment.	Many other metro areas are competing with the Portland Region as technology innovators, and automation will likely eliminate jobs in the transportation sector.
Choices	AVs create opportunities to expand the reach of transit and make carpooling convenient.	It seems likely that by making driving more convenient, AVs will reduce transit ridership,[15] which could in turn lead agencies to eliminate service.

Goal	Promise	Peril
Reliability	AVs will be able to safely follow other vehicles more closely and choose lanes more efficiently, cutting congestion and increasing travel speeds.[16] AVs could enable transit service in areas that are currently not cost-effective to serve.	AVs are likely to increase VMT by making driving more convenient, traveling empty miles to run errands or pick people up, and enabling people who don't drive to travel by car,[17] which could offset their operational benefits.
Safety	AVs could eliminate human error in driving, which is responsible for the vast majority of crashes.[18]	
Environment	The majority of AVs will likely be electric.	By increasing VMT, AVs could lead to growth in emissions even as cars become cleaner. AV-induced sprawl could increase development pressure on farmlands and natural areas.
Equity	AVs will likely improve transportation access for those who are unable to or choose not to drive.	Shared-fleet AVs will involve many of the same barriers to equitable access as other new mobility services currently do, and by expanding the reach of these services AVs could exacerbate inequity.
Transparency	AVs will collect rich data that can be used to monitor, manage and plan the system.	Federal legislation may prevent local and regional agencies from accessing AV data, and companies that operate shared AVs may want to avoid sharing data with public agencies in order to protect competitive information about their services.

Connected vehicles (CVs) and infrastructure

Connected vehicles (CVs) communicate with each other and with CV infrastructure to navigate the transportation system safely and efficiently. CV infrastructure can include traffic signals, incident management systems, sensors and monitoring systems, as well as the communications infrastructure needed to transmit increasing amounts of data to and from the roadside environment. Until recently, automated and connected vehicles were developing independently of each other, but it seems increasingly likely that vehicles in the near future will be automated and may include some connected elements as well.

Status: Some public agencies and automakers are already using or testing CVs and CV infrastructure, but most work in this area is still in the conceptual phase. For over a decade, several cities have used transit signal priority, an early form of CV infrastructure where traffic signals sense approaching buses and modify signal timing in order to move them quickly through intersections. One of the early commercially-available CV applications in passenger vehicles is in certain Audi models, which sense when a traffic light is red and display the number of seconds remaining until it turns green.[19] FHWA has also been piloting CV infrastructure in three different areas of the U.S. to improve safety and reduce congestion.[20] However, it is not clear whether or how the vehicles of the future will communicate with the roadside and with each other. The federal government recently withdrew a rulemaking process that would have required auto manufacturers to outfit all new models with similar communication equipment.[21]

Local and regional influence: Local and regional agencies have authority over many infrastructure decisions, including installations of CV infrastructure, but until there are consistent standards for how vehicles communicate it will be hard to identify worthwhile large-scale CV projects. Between now and then, there are still more limited ways that public agencies can prepare for CVs, such as increasing data connectivity to and from the roadside, developing policies on the use of CV infrastructure data to ensure that this data is used in a way that benefits the public, and piloting CV applications in transit vehicles, agency fleets, or in collaboration with private fleets.

Promise and peril: Public agencies will be able to manage the transportation system more efficiently, effectively and safely if we can communicate with vehicles and they communicate with each other. However, it can be challenging to make sure that CV infrastructure investments are worthwhile given the uncertainly around how technology is developing. We also need to make sure that these investments benefit everyone, not just CV drivers.

Goal	Promise	Peril
Choices	There are early opportunities to use CV technology to make transit more efficient and reliable.	Passenger CVs are likely to make driving more convenient, which could mean more competition with transit and other modes

Goal	Promise	Peril
Reliability	CV technology could allow public agencies to active manage the transportation system, rerouting traffic on the fly to avoid congestion and crashes.	
Safety	CVs, whether they have a human driver or are automated, are likely to be safer.[22]	
Transparency	CVs capture data that can be used to operate and monitor the performance of the transportation system more efficiently and thoroughly.	CVs might not provide us with the information that we need to know whether CV infrastructure is helping to meet our goals.

Electric vehicles (EVs)

Electric vehicles (EVs) use electric motors for propulsion instead of or in addition to gasoline motors.

Status: Automakers have been offering EVs for over a decade. In Oregon, as in the rest of the country, only a small share – roughly 100,000 of the 3.1 million passenger vehicles in the state – are EVs.[23] However, EV sales are expected to increase dramatically in the coming years due to falling manufacturing costs, rising global demand and state policies encouraging EV adoption.[24] According to more ambitious projections, EVs could cost the same as conventional vehicles by 2025 and outpace conventional vehicle sales by 2038.[25] If AVs take over the transportation system it could accelerate the growth in EV usage since almost all AVs available today are EVs.[26]

Local and regional influence: State agencies, including in Oregon, have actively worked to increase the number of EVs on the road. Oregon has adopted emission standards that are stricter than the national standards and require manufacturers to offer more efficient vehicles, potentially including EVs, as well as a zero emissions vehicle mandate that effectively requires that a certain percentage of all vehicles sold be EVs.[27] The state also offers a $2,500 rebate on EV purchases, with an additional $2,500 for low- and moderate-income drivers who trade in an older car when making their purchase.[28] However, local and regional agencies have typically focused on providing public charging, amending codes to require new developments to provide chargers or electrical capacity in parking areas and outreach. Given that these strategies don't address the primary reasons consumers don't buy EVs (their high cost or the lack of an electric model for many types of vehicles[29]), that most charging occurs at home and at work[30] and that the pace of new development is relatively slow, it is hard to argue that these actions have a significant impact over EV adoption.

Promise and peril: Electric vehicles are better for the environment and for public health, but since EVs consume less gas we will need to find another way to finance the transportation system besides the gas tax.

Goal	Promise	Peril
Environment	EVs produce fewer emissions than gasoline-powered vehicles.	
Health	EVs emit fewer health-damaging criteria air pollutants	
Equity	Long-term savings on gasoline and maintenance mean that many EVs cost less to own overall than comparable gasoline powered cars—especially given federal and state rebates.	The higher up-front costs of an EV, especially when compared to an affordable used conventional vehicle, make it hard for low-income people to realize these long-term savings.
Fiscal stewardship		EV owners buy less gas, and the gas tax is our main source of transportation revenue. It will be necessary to rethink how we fund transportation projects as vehicles get more efficient.

Ride-hailing

Ride-hailing services (also known as transportation network companies, or TNCs) use apps and websites to connect passengers with drivers who provide rides in their personal vehicles.

Status: Ride-hailing services are already changing the way that we travel in the Portland region. These services provided over ten million rides in the city of Portland in 2017,[31] carrying more people than taxis did,[32] and people in other areas of the region regularly use ride-hailing services for weekend trips and trips to the airport. Two companies, Uber and Lyft, dominate the ride-hailing market in the U.S. and are the only ride-hailing companies serving our region today. However, several other companies are poised to begin operating ride-hailing services in the near future.[33]

Local and regional influence: Ride-hailing companies have maintained that they are not transportation companies, but rather technology services, because they provide a platform that connects riders to drivers and do not operate vehicles. According to this line of thinking, ride-hailing services are not subject to the same local regulations as taxis and other transportation services, because they are not directly responsible for passengers' safety or mobility. However, several U.S. cities, counties and states have challenged this argument and adopted ride-hailing ordinances,[34] and courts in the European Union recently rejected it outright. Unlike neighboring states,[35] the State of Oregon does not currently have any laws in place regulating ride-hailing services, and in our region only the City and Port of Portland currently have ride-hailing regulations in place.[36]

Promise and peril: Ride-hailing have significant long-term potential to expand transportation choices in suburban areas, increase carpooling and reduce vehicle miles traveled and car ownership. However, most of the evidence to date finds that ride-hailing services are increasing vehicle travel, competing with public transportation and providing inequitable service.

Goal	Promise	Peril
Prosperity	Ride-hailing services provide flexible opportunities for drivers to earn extra money.	People who drive for ride-hailing companies lack benefits and job security. Ride-hailing companies have moved to cut drivers' pay,[37] and drivers' jobs will likely be eliminated as companies deploy AVs.
Choices	Ride-hailing services offer a new way to travel, and have launched carpooling services in the region.[38] Some transit agencies are subsidizing ride-hailing trips to transit stops in order to boost ridership.[39] Most ride-hailing trips take place during the evening and on weekends, when transit service is less frequent, which suggests that ride-hailing and transit are complimentary.[40]	Ride-hailing services generally focus on serving areas that already enjoy a variety of transportation choices, and attract riders away from transit.[41]

Goal	Promise	Peril
Reliability	Over time, ride-hailing services could help to reduce VMT by facilitating carpooling and allowing people to own fewer cars, reducing congestion.	Ride-hailing services increase VMT because they draw people away from transit, travel extra to pick riders up and enable people to take trips they wouldn't otherwise take[42]—particularly in areas that are already congested.[43] In San Francisco, ride-hailing services accounted for two thirds of congestion-related traffic violations downtown over a three-month period.[44]
Safety		In Portland and other cities, ride-hailing companies frequently violate safety requirements and traffic laws.[45] There have been instances of ride-hailing companies allowing drivers cited for DUIs to continue driving in spite of zero-tolerance policies.[46]
Equity	In the City of Portland, ride-hailning services face minimum requirements for service equity and disabled access. As AVs lower the cost of service, ride-hailing services could offer options in marginalized communities that are nearly as affordable as transit and much more efficient.	Ride-hailing companies appear to offer worse service to communities of color,[47] and lower-income people are less likely to use these services.[48] In spite of efforts to increase access, few ride-hailing vehicles are wheelchair accessible.[49] People who are unbanked, undocumented, limited English proficiency or lack access to the Internet also face barriers in accessing ride-hailing services.
Transparency		In many cases, ride-hailing services have actively worked to avoid regulation[50] or have failed to enforce regulations.[51]

Microtransit

Microtransit refers to privately-operated transit services that use smart phones to allow riders to book trips and collect data to tailor routes that meet riders' needs, and that typically serve these routes with vehicles that are smaller than conventional buses but larger than passenger vehicles.

Status: There are several microtransit services operating in major cities across the U.S., though none are currently serving our region. Some services, such as Chariot and Leap in San Francisco, essentially offer luxury alternatives to transit, operating along crowded bus lines charging higher fares for guaranteed seats, wi-fi and other amenities.[52] Others are more coordinated with public transportation and focus on serving areas or high-demand routes that are currently not well-served by transit, such as Via's pilot service in West Sacramento.[53] It remains to be seen whether microtransit is a viable business model, and a number of services have already failed.[54] Riders are satisfied, but microtransit faces competition from both transit and from ride-hailing services, and it is challenging to operate any transit service at a profit.[55]

Local and regional influence: Many cities and states regulate microtransit, licensing services, conducting safety inspections or requiring disabled access. Some agencies are also funding microtransit pilots in areas that are underserved by transit.[56]

Promise and peril: The benefits of microtransit depend on the service model. Services that offer luxury alternatives to conventional transit would do little to support our goals, but coordinated microtransit that provides first- and last-leg connections or serve areas that are hard to serve with conventional transit offers a promising new option.

Goal	Promise	Peril
Choices	Because microtransit offers more flexible service, it could bring new choices to areas that are hard to serve with transit, including providing connections to transit stations that boost ridership.	Microtransit services that operate as luxury alternatives to public buses likely attract users away from transit.
Reliability	Microtransit facilitates shared trips among people who would likely otherwise drive.	
Equity	Some microtransit pilots offer phone-based bookings for people that do not have access to apps or the internet.	Most microtransit serves high-income neighborhoods and employment areas at a premium. People who are unbanked, disabled, undocumented, limited English proficiency or lack access to the Internet also typically face barriers in accessing microtransit.
Fiscal stewardship	Microtransit could provide better service at lower cost in areas with underperforming transit.	Luxury microtransit attracts choice riders away from transit, diminishing revenues.

Goal	Promise	Peril
Transparency	There are many models for how to regulate microtransit, and some companies actively share data and collaborate with public agencies.	Many of the jurisdictions where microtransit could provide benefits do not have any regulations in place.

Car share

Car share services allow people to rent a nearby vehicle for short trips and pay only for the time that they use.

Status: Car share has been around for nearly two decades. Today, several different companies are active in the Portland region, operating over 1,000 vehicles and offering different service models.[57] These include:

- Stationary car share (ZipCar, in some cases ReachNow), under which cars are kept at fixed stations, and users typically pick up cars from and return them to the same station. Compared to other models, stationary sharing is better-suited for suburban areas, longer trips and errands since a wider variety of vehicle types are available. Stationary car share is currently available throughout Portland's central neighborhoods and Beaverton, Hillsboro, Clackamas Town Center, near the Gateway Transit Center and at the PCC Sylvania campus.[58]
- Free-floating car share (Car2Go, ReachNow), which allows people to pick up and drop off cars anywhere within a defined service area. Free-floating car share allows for more flexible travel than stationary car share, and typically offers only compact cars. It is used mainly for short one-way trips in urban areas, and within the region free-floating carsharing is currently only available in Portland's central neighborhoods.[59]
- Peer-to-peer car share (Getaround, Turo), which enables people to rent cars from their neighbors on a short-term basis through services that provide insurance, enable payment and manage booking and access. Peer-to-peer services are available in Portland, and used primarily for round trips and daily rentals.

Rapid change makes it hard to anticipate what car share will look like in ten years. Stationary car share, which a decade ago was the only type of car share available, is now facing strong competition from free-floating car share, and both of those models are threatened by the continued growth of ride-hailing services.

Local and regional influence: Public agencies have a fair amount of influence over most car share services. Stationary car share often requires space in the right of way or in public parking lots. Free-floating car share typically operates in areas where parking is at a premium, and relies on cities waiving parking fees or restrictions for shared vehicles.

Promise and peril: Research has found that car share users typically drive less and own fewer cars. However, since marginalized communities often lack access to car share not everyone shares in these benefits.

Goal	Promise	Peril
Vibrant communities	Car share members own fewer cars, potentially reducing the space needed for parking in areas where car share is available.[60]	
Choices	Car share provides residents with a new transportation choice.	

Goal	Promise	Peril
Congestion	Stationary car share users, and to a lesser extent, free-floating car share users, drive fewer miles overall.[61]	
Environment	Car share vehicles are more fuel efficient than the average vehicle.[62]	
Equity	Car share can offer an affordable alternative to car ownership.	Car share services are focused on central neighborhoods that tend to be whiter and higher-income.[63] People who are unbanked, disabled, undocumented, limited English proficiency or lack access to the Internet also face barriers in accessing car share.
Transparency	In many cases, car share services openly collaborate with public agencies in exchange for space or waived parking regulations.	

Bike and scooter share

Bike and scooter share systems make fleets of bicycles and scooters available for short-term rental within a defined service area.

Status: Over the past decade, cities around the world have created bike share systems. The City Portland launched its system, Biketown, in 2016. Biketown serves Portland's central neighborhoods[64] with a fleet of 1,000 bikes, and riders logged over 300,000 trips in its first year.[65] As with car share (see above), conventional bike share systems required users to pick up and leave bikes at designated stations, while modern systems are more likely offer users the flexibility to leave a bike anywhere within their service area. Biketown is a hybrid system; bikes are usually kept at stations but users can pay an extra fee to leave a bike at another location in the service area. Conventional station-based bike share sytsems are usually operated in close coordination with public agencies. More recently, a number of fully dockless systems operated by companies such as Ofo, Limebike and Spin allow users to pick up and leave bikes or scooters within a defined service area and require less coordination between the public and private sector. In many cases multiple dockless providers serve a single city.

Local and regional influence: In most conventional bike share systems, cities enter into exclusive agreements with private operators, and maintain oversight to plan and designate space for stations and make sure that systems are safe, equitable and meet community members' needs. However, dockless bike and scooter share companies have been threatening to undermine this sole provider model. Unless cities take active steps to regulate dockless companies, they p[erate independently of public oversight, which has led to complaints about illegal parking, safety and other issues.[66] Several cities have created program to permit dockless systems on a pilot basis in an attempt to address some of these concerns,[67] but cities could continue to face a choice between opening the market and making bike share more widely available versus maintaining control over the system.

Promise and peril: Bike share provides an active, environmentally-friendly alternative to driving, but since marginalized communities often lack access to bike share not everyone shares in these benefits.

Goal	Promise	Peril
Choices	Bike share provides people with a new travel option. Even though Biketown does not serve many residential neighborhoods, it provides people who work in central Portland another option for midday trips that they might otherwise need to drive for, and potentially enabling them to commute by transit instead of driving.	

Goal	Promise	Peril
Reliability	Bike share shifts trips away from driving.	
Environment	Bike share provides a low-emissions alternative to driving, particularly electric bikes, which allow people to take longer trips.	
Health	Bike share promotes active transportation.	
Equity	Programs like Biketown for All, which offer discounted memberships, rider training and easy enrollment for low-income people,[68] can overcome some of the barriers that disadvantaged people face in using bike share. Some systems are also offering or exploring adaptive bikes[69] for disabled riders or electric bikes[70] and scooters[71] that make it easier for people of all abilities to use them.	Bike share systems generally focus on serving central neighborhoods that tend to be higher-income. People who are unbanked, disabled, undocumented, limited English proficiency or lack access to the Internet also face barriers in accessing bike share.
Transparency	Traditional bike share systems are operated in partnership with public agencies.	Many dockless bike share companies are working to operate independently of public oversight.

Traveler information and payment

Technology is enabling a slew of new ways for people to learn about and pay for their travel options online.

Status: Traveler information and payment have been around for as long as maps and coins, but the rise of the Internet and smart phones have created an array of new ways for people to plan and pay for their trips. A growing and at times bewildering number of applications are available to help people compare different ways of getting around (moovel, Google Maps), get detailed information on their mode of choice (TransitApp, Ride Report, Waze), track and share their trips (Strava, MapMyWalk) and pay for trips (TriMet's Tickets app, Uber/Lyft). Some experts envision a future where all of these information streams are combined into a single app that enables people to seamlessly pick and pay for the best option for any trip, choosing from a variety of convenient shared and active options instead of relying on a personal vehicle. This concept, known as mobility as a service (MaaS), is being tested in Europe,[72] but it faces significant barriers to deployment in our region, including agencies that lack digital transit schedule or bike/ped network data and some new mobility companies' reticence to show comparative information on travel times and costs.

Local and regional influence: Initially, the challenge for public agencies was in making their data available online, and many agencies created their own travel information websites and apps. With the growing number of third-party websites and apps, including many that are more widely used than agency-owned options, the challenge now lies in making sure that the information available is presented in a way that supports positive outcomes. For example, some driver information apps direct drivers through school zones to avoid congested routes, and some transit apps display information alongside advertisements for ride-hailing or car share services, potentially diverting riders away from transit. At the same time, the popularity of third-party apps means that it is seldom worthwhile for public agencies to develop their own platforms for the sake of controlling how information is presented. Public agencies have had limited success influencing how third-party apps present information, and some are considering placing conditions on third-party usage of public data.

Promise and peril: Making more information available on transportation choices supports our regional goals—if that information is presented in the right way and made available to all.

Goal	Promise	Peril
Choices	Better travel information makes people more aware of their choices, and comprehensive information combined with competitive pricing could enable people to better identify the mode that works best for them.	Third-party sites may direct people toward privately-operated services that pay for advertising and away from transit and active transportation.

Goal	Promise	Peril
Equity	A MaaS-style system would enable public agencies to offer flexible subsidies to low-income and transit-dependent travelers that they could use to pick the mode that works best for them.	Marginalized people frequently lack access to apps, data plans and the Internet. Without additional investment in digital access, underserved communities will not benefit from enhanced travel information.
Transparency		Third-party apps sometimes use and present public data in ways that don't support our goals.

APPENDIX 3: EMERGING TECHNOLOGY WORKING GROUP MEMBERS

The Emerging Technology Working Group met monthly, beginning in 2018, to help refine the Emerging Technology Strategy and coordinate among public agencies in the greater Portland region on technology-related initiatives. Due to a late start in staffing and developing the Emerging Technology Strategy the working group is less formal than the other working groups involved in developing the 2018 Regional Transportation Plan. Agendas were not posted to the Metro website, and the group continues to add members and meet to discuss implementation of the Emerging Technology Strategy. Below is the list of all current and past working group members as of December 2018.

Member	Organization
Todd Juhasz	City of Beaverton
Katherine Kelly and Carly Rice	City of Gresham
Taylor Eidt and Peter Brandom	City of Hillsboro
Chris Damgen	City of Troutdale
Charlie Tso	City of Wilsonville
Eric Hesse, Jacob Sherman, Peter Hurley and Ingrid Fish	City of Portland
Chris Deffebach and Erin Wardell	Washington County
Jessica Berry	Multnomah County
Joe Marek and Steve Williams	Clackamas County
Jeff Owen	TriMet
Andrew Dick, Ali Lohman and Adam Argo	ODOT
Becky Steckler	University of Oregon
John MacArthur	Portland State University

ENDNOTES

[1] AV pilots have already resulted in fatalities and other safety issues; see https://www.nytimes.com/2018/03/23/technology/uber-self-driving-cars-arizona.html.

[2] The draft federal legislation governing AVs allows for each manufacturer to deploy 50,000 AVs that are exempt from safety standards in its first year of making AVs, rising to 100,000 AVs in the third year. https://www.congress.gov/bill/115th-congress/senate-bill/1885/text

[3] https://www.usatoday.com/story/money/cars/2016/09/19/why-most-self-driving-cars-electric/90614734/

[4] Ibid.

[5] http://www.fehrandpeers.com/autonomous-vehicle-research/

[6] https://www.bloomberg.com/news/articles/2017-07-06/the-electric-car-revolution-is-accelerating

[7] https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

[8] Ibid.

[9] https://www.wired.com/story/gm-cruise-self-driving-car-launch-2019/

[10] https://www.redchalk.com/industry/automotive/shifting-gear-future-scenarios-autonomous-vehicle-development/

[11] https://www.usatoday.com/story/money/cars/2016/09/19/why-most-self-driving-cars-electric/90614734/.

[12] http://library.rpa.org/pdf/RPA-New-Mobility-Autonomous-Vehicles-and-the-Region.pdf, p. 16-17; https://www.vtpi.org/avip.pdf, Table 7.

[13] https://nacto.org/2017/10/03/senate-fails-to-address-concerns-of-cities-in-av-bill/

[14] https://newsroom.intel.com/news/intel-mobileye-integration-plans-build-fleet-autonomous-test-cars/

[15] http://www.fehrandpeers.com/autonomous-vehicle-research/

[16] http://www.fehrandpeers.com/av-simulation-research/

[17] http://www.fehrandpeers.com/wp-content/uploads/2017/03/CNU-Article-Autonomous-Rapid-Transit.pdf

[18] https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

[19] https://www.theverge.com/2016/12/12/13923254/audi-v2i-las-vegas-test-drive-traffic-signals

[20] https://www.its.dot.gov/pilots/index.htm

[21] https://apnews.com/9a605019eeba4ad2934741091105de42

[22] https://www.its.dot.gov/cv_basics/cv_basics_20qs.htm

[23] http://www.oregon.gov/ODOT/DMV/Pages/News/factsstats.aspx; http://blog.caranddriver.com/oregon-adds-rebate-for-electric-vehicles-and-tax-on-bicycles/

[24] https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf, p. 98

[25] https://www.bloomberg.com/news/articles/2017-07-06/the-electric-car-revolution-is-accelerating

[26] https://www.usatoday.com/story/money/cars/2016/09/19/why-most-self-driving-cars-electric/90614734/

[27] http://www.autonews.com/article/20160627/OEM11/306279987/zev-mandates-get-harder-to-ignore

[28] https://forthmobility.org/news/HB2017

[29] https://www.nrel.gov/docs/fy16osti/65279.pdf

[30] http://www.seattle.gov/Documents/Departments/OSE/FINAL%20REPORT_Removing%20Barriers%20to%20EV%20Adoption_TO%20POST.pdf

[31] Conversations with Portland Bureau of Transportation staff.

[32] http://www.oregonlive.com/commuting/index.ssf/2015/10/uber_lyft_now_dominate_portlan.html

[33] These include car share companies such as ReachNow (operated by BMW; https://www.geekwire.com/2016/bmw-launch-uber-lyft-competitor-seattle-launches-reachnow-car-sharing-brooklyn/), autonomous vehicle manufacturers like Waymo (https://www.cnbc.com/2017/10/03/alphabet-waymo-self-driving-car-service-fall.html) and automakers, including General Motors (https://www.theverge.com/2016/1/21/10802240/gm-maven-car-sharing-service-price-launch-date-michigan). The rapid growth of new ride-hailing options that Austin, TX saw when Uber and Lyft stopped service (https://www.bizjournals.com/austin/news/2016/06/07/the-complete-field-guide-to-austins-ridesharing.html) also illustrates how quickly ride-hailing services can multiply.

[34] For examples from Washington State, see http://mrsc.org/Home/Stay-Informed/MRSC-Insight/September-2016/Regulating-Rideshare-Companies-Like-Uber-and-Lyft.aspx.

[35] Washington has insurance requirements for ride-hailing services (http://mrsc.org/Home/Stay-Informed/MRSC-Insight/September-2016/Regulating-Rideshare-Companies-Like-Uber-and-Lyft.aspx), and in California the Public Utilities Commission is responsible for licensing ride-hailing services, and has adopted rules and regulations related to drivers, vehicles, drug policy, insurance, data reporting, fares and wheelchair accessibility.

[36] See the Portland City Code beginning at §16.40.200 (https://www.portlandoregon.gov/citycode/?c=28593). The City of Portland's regulations cover permit applications and fees, vehicle and driver certification, company and vehicle operations, wheelchair accessibility and insurance; riders pay a 50 cent per ride fee that supports enforcement and accessible service. The Port's regulations are similar except that there is an additional $2.00 fee.

[37] http://www.sfexaminer.com/uber-cuts-passenger-fares-drivers-cry-foul/

[38] https://www.bizjournals.com/portland/news/2017/12/19/uber-follows-lyft-with-carpool-service-in-portland.html

[39] For examples, see https://nytransit.org/resources/transit-tncs/205-transit-tncs

[40] http://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf

[41] http://usa.streetsblog.org/wp-content/uploads/sites/5/2017/10/2017_UCD-ITS-RR-17-07.pdf

[42] Ibid. and http://www.schallerconsult.com/rideservices/unsustainable.pdf

[43] http://www.sfcta.org/tncstoday

[44] http://www.sfexaminer.com/sfpd-uber-lyft-account-two-thirds-congestion-related-traffic-violations-downtown/

[45] Ibid and https://www.portlandoregon.gov/saltzman/article/637492; according to data from the City of Portland 35% of ride-hailing audits revealed at least one violation, and the majority of violations were for safety-related issues, such as failing to carry adequate insurance or a hands-free device.

[46] http://www.cnbc.com/2017/04/13/uber-may-face-1-million-dollar-fine-over-california-drunken-driving-complaints.html.

[47] https://www.portlandoregon.gov/saltzman/article/637492 https://www.washingtonpost.com/news/wonk/wp/2016/03/10/uber-seems-to-offer-better-service-in-areas-with-more-white-people-that-raises-some-tough-questions/?utm_term=.2d881b8cfe5b

[48] http://www.trb.org/TCRP/Blurbs/174653.aspx.

[49] http://www.oregonlive.com/commuting/index.ssf/2015/10/uber_lyft_now_dominate_portlan.html / Greyball report

[50] https://www.nytimes.com/2017/03/03/technology/uber-greyball-program-evade-authorities.html

[51] http://www.cnbc.com/2017/04/13/uber-may-face-1-million-dollar-fine-over-california-drunken-driving-complaints.html

[52] https://www.citylab.com/transportation/2015/04/how-the-microtransit-movement-is-changing-urban-mobility/391565/

[53] http://www.sacbee.com/news/local/article183340381.html

[54] https://www.citylab.com/transportation/2017/11/dont-believe-the-microtransit-hype/545033/

[55] http://www.fehrandpeers.com/microtransit/

[56] http://www.arlington-tx.gov/residents/via/, http://www.sacbee.com/news/local/article183340381.html

[57] For a more detailed summary of car share business models, see https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/CIP-Automotive-Car-Sharing-in-Europe.pdf

[58] Service areas come from the ZipCar website (http://www.zipcar.com/portland) and conversations with ReachNow, and are current as of December 2018.

[59] Service areas come from the car2go (https://www.car2go.com/US/en/portland/where/) and ReachNow (https://reachnow.com/en/portland-or/drive/) websites, and are current as of December 2018.

[60] For an evaluation of the impacts of stationary car share, see http://trrjournalonline.trb.org/doi/pdf/10.3141/1992-09 and http://innovativemobility.org/wp-content/uploads/2015/07/Zipcar_Corporate_Final_v6.pdf. For an evaluation of free-floating car share, see http://innovativemobility.org/wp-content/uploads/2016/07/Impactsofcar2go_FiveCities_2016.pdf.

[61] Ibid.

[62] http://trrjournalonline.trb.org/doi/pdf/10.3141/1992-09.

[63] See service area maps for the different car share companies. Even peer-to-peer carsharing services, which do not provide any vehicles or physical infrastructure, sometimes redline disadvantaged communities; see http://www.opb.org/news/article/electric-car-sharing-low-income-housing/.

[64] https://www.biketownpdx.com/map

[65] https://content.govdelivery.com/accounts/ORPORTLAND/bulletins/1aaac54

[66] https://www.washingtonpost.com/news/dr-gridlock/wp/2017/10/05/abandoned-vandalized-and-illegally-parked-bike-share-bikes-now-a-d-c-problem/?utm_term=.90eaf6bf986a; https://nextcity.org/daily/entry/seattle-private-bike-share-experiment-stationless.

[67] Examples include Portland (https://www.portlandoregon.gov/transportation/77294), Seattle (http://www.seattle.gov/transportation/projects-and-programs/programs/bike-program/bike-share), San Francisco (https://www.sfmta.com/getting-around/bike/bike-share) and Washington D.C. (https://ddot.dc.gov/release/ddot-extends-dockless-demonstration-project).

[68] https://www.biketownpdx.com/pricing/biketown-for-all.

[69] Both Portland and Detroit are exploring offering adaptive bike share bikes (http://betterbikeshare.org/2017/05/10/two-cities-explore-adaptive-bike-rentals-people-disabilities/).

[70] JUMP Mobility, operated by the same company that supplies BIKETOWN bikes, is now operating in San Francisco and Washington, DC (https://jumpmobility.com/).

[71] Scoot operates in San Francisco (https://scoot.co/).

[72] http://maas.global/maas-as-a-concept/

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